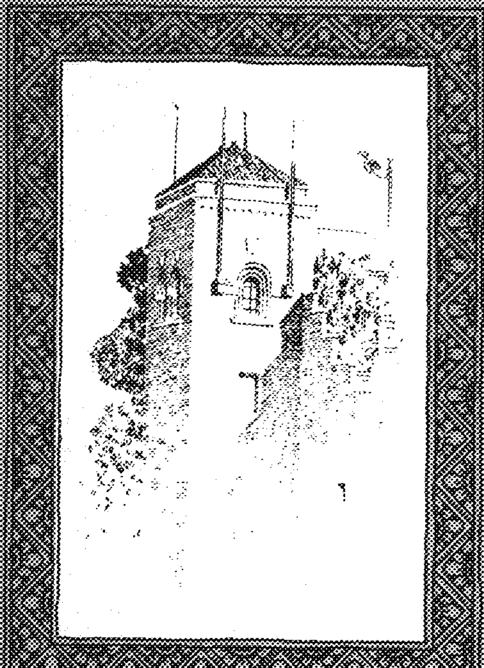
The MINNESOTA TECHNOLOG

Published Monthly by the TECHNICAL COLLEGES of the UNIVERSITY of MINNESOTA



OCTOBER

Volume VII. 1926 Number 1.

MEMBER ENGINEERING COLLEGE MAGAZINES Associated

The MINNESOTA TECHNO-LOG

University of Minnesota

October, 1226 Volume VII June, 1927

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THE MINNESOTA

TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

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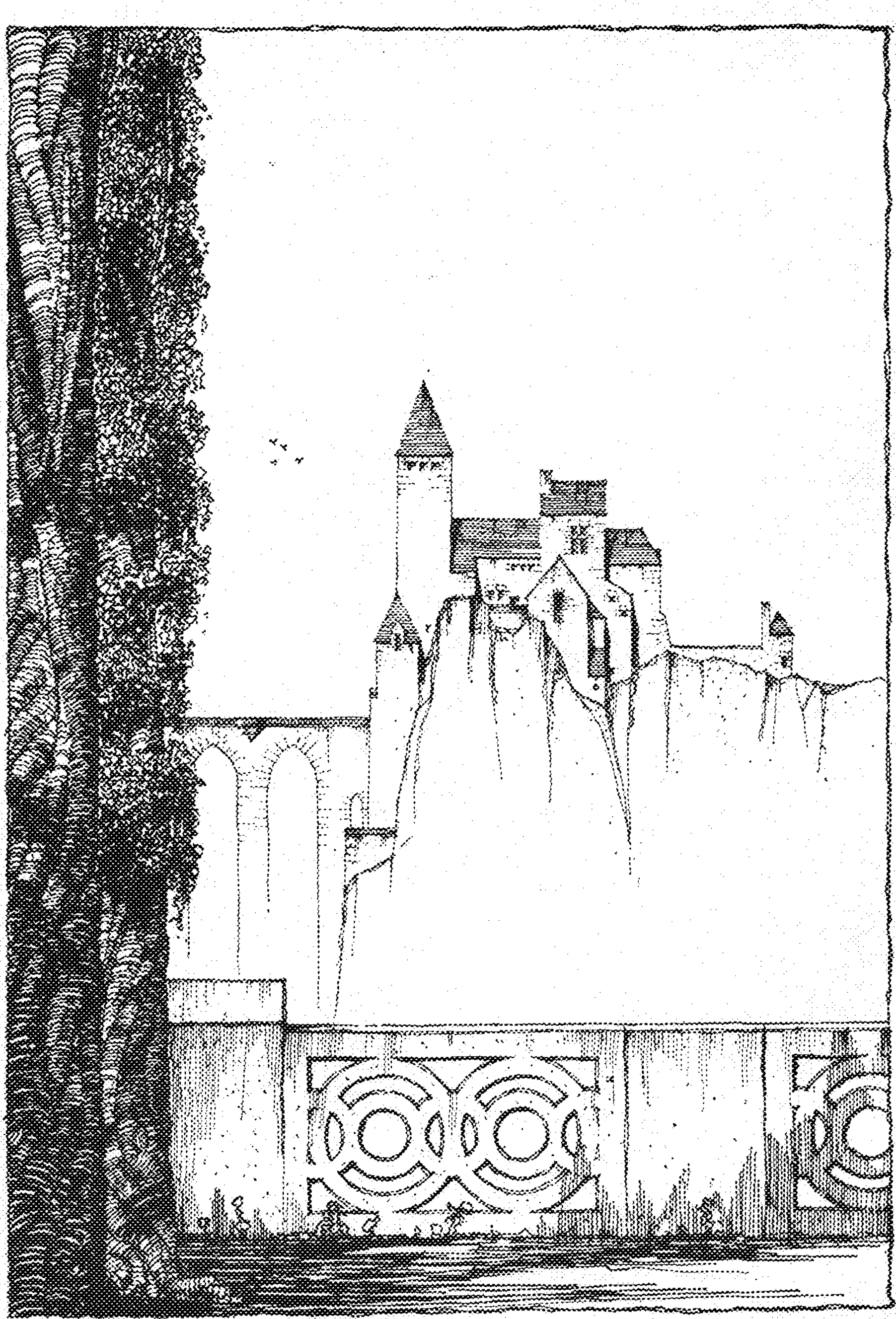


JOHN THOMAS GRISDALE

In Old England

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VII | OCTOBER 1926 | Number 1

The Wages of Engineering

By PAUL B. NELSON, E. '26

Associate Editor, The Electragist, New York City

HIS black eyes flashed as he said, "I don' call myself engineer. My countrymen they work in subway, lay brick, get sixteen, eighteen dollar a day. I go to university five year, work for New York Edison, get thirty dollar a week. Work hard in relay department, get raise; now get thirty-five. I not engineer. You bet not!"

We were seated in a Y. M. C. A. in New York. I had noticed the A. I. E. E. emblem proudly displayed on the coat lapel of this dark skinned youth. My brotherly spirit aroused at seeing a fellow engineer, I had started the conversation.

Italian? Yes. Member of the Institute? Yes sir. And then Anthony Morroni, an American for just 32 months, told me his story.

For five years he had attended the University of Turin, the best technical school in Italy. Had he studied calculus, I started? He ventured a question about relativity. I stopped.

Graduation and then—America, the place where engineers made history and a pot of gold at the same time. But the job—on the test floor of a large company at twenty-five dollars a week. And now testing relays in the training course of a metropolitan utility company. I saw tears in his eyes as he continued. Was this the land of wealth and opportunity?

"Do American engineers really make money?" he asked me.

"Yes," I quietly assured him, and explained that I knew of some very wealthy men in the profession.

And then I stopped to think. Had I been correct in telling my young Italian friend that those in the engineering business in this country really made money. My doubts were furthered a few days later when I noticed the following item, which appeared in POWER, a McGraw-Hill publication.

The contributor says:

"I quit engineering after eleven years practice to take charge of a business where engineering experience is valuable but not indispensable.

"After being out of college ten years, the secretary of our class—a large class, too—compiled statistics on earned income in a confidential manner, insuring privacy for the individual return. These statistics largely influenced me in changing from engineering to business. The list follows:

10 bankers and brokers	$11,040
36 manufacturers	8,524
18 physicians	7,944
7 architects	7,230
31 merchants	7,136
29 lawyers	5,905
41 salesmen	5,690
3 purchasing agents	5,600
4 advertising	5,476
5 newspaper	5,180
5 accounts and statistics	5,004
6 insurance	4,533
14 farmers	4,461
15 builders and contractors	4,287
7 veterinarians	3,921
83 ENGINEERS	3,724
33 teachers	3,137

"The actual incomes are not applicable today, as this table is several years old but the relative incomes of the different vocations are illuminating.

"On the basis, would one be wise in having a son study engineering, if that son had to earn his living in the profession in which he was trained?"

Judging from this, our noble profession would seem to approximate a Minneapolis baseball team as regards a cellar position. And perhaps, this tabulation substantiated a sign which appeared in the annual homecoming parade of a middle western college:

"Eighty of us graduated civil engineers. Seventy-five are now selling bonds."

But getting in a more serious vein, is it not startling that graduates of an engineering college should occupy the lowest position but one, in wage scale. We presume, of course, that the previous survey included graduates of the several colleges in his particular university. And if the insurance men, the farmers, the brokers all were engineering graduates, the facts are all the more significant.

It will be noticed that there were 83 engineering graduates listed with an average income of $3,724, making an aggregate of $307,092 for the group. Let us make a few presumptions. Of the 83, there are certain ones whose salaries are far in excess of the others. Patterning after the wage scale as compiled by a large eastern manufacturing company we arrive at the following distribution of wages: one, $17,500; two, $13,750; four, $7,500; eight, $4,500; ten, $4,100; twenty, $3,000; thirty-eight, $2,500.

At once, it can be clearly seen that the factor causing this low average is the *large* number of engineers receiving a *low* wage. As is the case with any profession, some are more proficient, or by some other quality or happenstance, more rapidly acquire a slice of the world's goods than do others. Therefore, when the statement is made that the profession is underpaid, it refers to the class, which in this survey numbers 58, with a salary of $2,500 to $3,000.

It would be interesting to know the number of these men who are with a large company and who are with a smaller concern, or are in business for themselves. We feel safe in asserting that those who have risen above mediocrity may be found in business for themselves, or as executives in a large manufacturing company. The sort of jobs that command only a nominal remuneration at the end of ten years' time, are those which require little special skill, no executive ability, place the engineer under no responsibility, and usually carry no threat of being fired. We believe that it is not to the discredit of a large concern that within its ranks, most of these positions may be found. In a large company, there must be jobs of all kinds, good and bad. There a graduate can work along, content with himself, the company and the world, and know as long as he doesn't commit burglary or arson, he can hold his job. There he may easily get into a rut, a very minor cog in the machinery of progress. And there he may show initiative, do more than is required of him, assume responsibility, and eventually become a big frog in a big pool.

Engineers and things engineering have not received the publicity that they deserve. Publicity, and by that we mean the constant bringing of your deeds before the eyes of the world, is an essential in business. When a large structure is completed, who receives all glory and credit? It is the financier who sat behind a mahogany table and juggled figures to insure its erection. The man

(*Continued on page 28*)

The Motor Bus in Minnesota

Auto transportation companies bring hitherto isolated portions of state into direct contact with more advanced districts

By Edgar F. Zelle, B. A. '13
President Jefferson Highway Transportation Company, Minneapolis, Minnesota.

THE motor bus in Minnesota today is operating on definite schedules between fixed termini on 5592 miles of highway. Outlining the routes from city to city one can almost trace the map of Minnesota by the scheduled bus movements. Beginning at the extreme northeastern point, Minnesota buses start their way from Port Arthur and Fort William bringing our Canadian neighbors along the north shore of Lake Superior on the boundary line furnished by Highway No. 1 to Duluth. From the Zenith City they radiate in all directions, furnishing the Iron Range country with a network of service that should be characteristic of that section of the state that pioneered bus operation. Scenic attractions vie with industrial necessities in their dependence upon the motor bus. Here was the first territory in the state where the demand of the public was expressed in a patronage that made it possible to link such communities as Duluth, Virginia, Hibbing and Grand Rapids into a compact system where frequent passenger transportation twelve months of the year has long since been established. From that strong nucleus the bus extended until it tied to itself the Northwest through Bemidji into Grand Forks and through Brainerd into Fargo. And then the bus brought this entire North Country into a correllated system with the southern development that in the meantime had been perfecting itself out of the Twin City territory by the establishment of six distinct north and south lines. From the eastern side of this fan shaped system there is one line from the Twin Cities that establishes communication with Duluth through Superior via Wisconsin Highway No. 35 and another that reaches Duluth via Minnesota Highway No. 1. Going slightly westward the North and South is tied more securely together by a line that connects at the north throug[h] Aitkin and Grand Rapids with Hib[-] bing. The next lateral support is [a] line from St. Cloud through Little Fall[s] that crosses the two east and west nort[h] lines at Brainerd and Bemidji, anothe[r] that goes northward from Sauk Centre through Wadena to Bemidji, an[d] another that joins the Duluth-Fargo lin[e] at Fargo itself, going by way of Alex[-] andria and Fergus Falls.

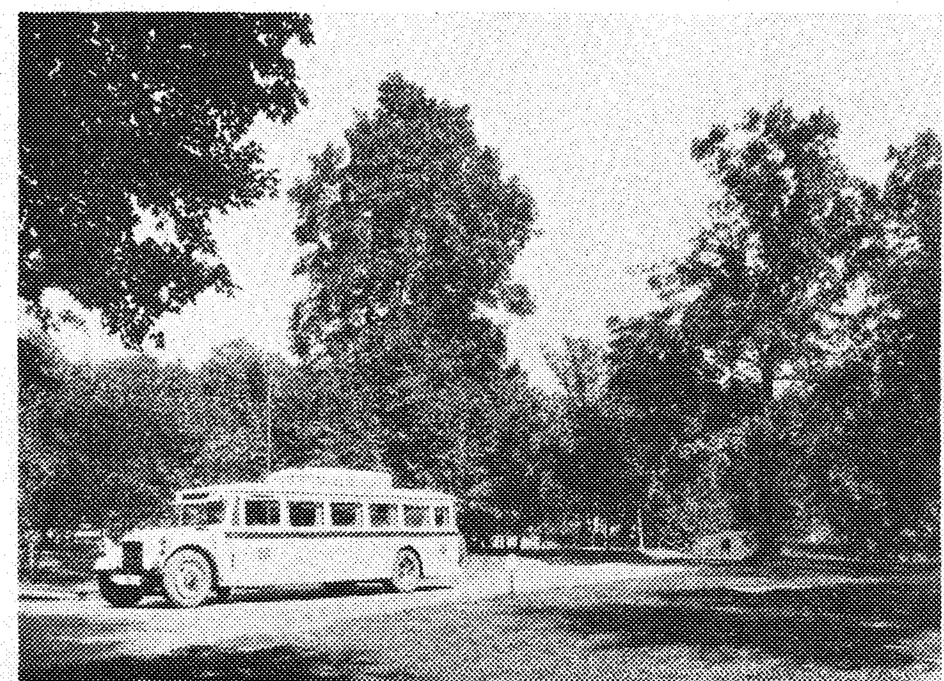
To the readers of the Minnesota Techno-Log *who may never have been fortunate enough to meet Edgar F. Zelle, we wish to introduce the president of the General Alumni Association, as loyal a Minnesotan as ever graduated from this institution.*

Mr. Zelle was very active during his undergraduate life. In his junior year he was business manager of the 1913 Gopher, and during his last year he was all-senior president and was honored by election to Phi Beta Kappa. In addition, he was a member of the Forum Literary society, and of Alpha Delta Phi, social fraternity, and Phi Delta Phi, legal fraternity.

Out of the Twin Cities extendin[g] into southern Minnesota there is a simi[-] lar network of lines as radiates out o[f] Duluth in the north. One line extend[s] southeast through Winona to La Crosse, another to the important medical cente[r] at Rochester. Still another line fol[-] lows Highway No. 1 from the Twi[n] Cities through Northfield, Faribault, Owatonna and Albert Lea to Maso[n] City. Another line operates to Man[-] kato through St. Peter and Belle Plaine. One line radiates from the Twin Citie[s] to New Ulm and on to Tracy, whil[e] another renders service west from Shak[-] opee through Glencoe, Olivia and Red[-] wood Falls to Marshall. Two mor[e] lines serve west from the Twin Cities, one through Litchfield to Willmar, an[d] another to Buffalo.

Almost all of these main arteries o[f] bus travel are joined by a coordinate[d] system of other bus lines that serve a[n] important adjacent territory from point[s] like St. Cloud, Willmar, Mankato, Owatonna, Albert Lea and Rochester.

Today there are 363 buses operatin[g] in Minnesota. For the most part the[y] represent the last word in modern bu[s] construction. During the last twelv[e] months there have been about seventy[-] five new buses put in service repre[-] senting an investment of about seve[n] hundred and fifty thousand dollars, o[r] an average of ten thousand dollars fo[r] each bus. The motor bus manufacture[r] has always worked closely with the oper[-] ators in Minnesota. The condition[s] brought on by the weather of th[e] changing seasons made the operator[s] keen in their demand for the very best i[n] motors, chasses tires and body con[-] struction refinements. The manufacture[r] who did not cooperate soon found him[-] self slipping in the vanguard. The for[-] mer makeshift of a reconstructed mot[or] truck was developed into the moder[n] low type of bus designed not only fo[r] the comfort of the passenger but al[so] for his safety. Such factors as wide tread design have been combined wi[th] long wheel base and low center of gra[v-] ity in such a way that the result mak[es]



THROUGH OWATONNA'S MUNICIPAL PARK SYSTEM

In southern Minnesota, the highways over which the various bus lines operate, pass through some of the richest agricultural districts of the Northwest.

CLEARING SNOW SOUTH OF ALBERT LEA
The heavy snowfall which occurs in Minnesota during the winter months compels the use of fleets of snowplows such as these to keep the highways open for bus transportation.

the present day bus the safest vehicle that operates on the highways. This has been more easily accomplished in designing the motor bus because all of the weight that is put into the construction of the vehicle itself to bring about these factors of safety do not need to be reduced to keep down the total weight. In the case of the motor bus the entire weight of a full load of the largest bus operating on our highways today does not average much over two tons.

Whenever weight is put into bus construction it is not for the purpose of conveying dead weight. It is to provide smooth and safe transportation for passengers where the weight of the load is but a minor consideration. The chassis provides the foundation for a low and long body that accommodates from twenty to thirty passengers with comfortable seats from which an excellent view may be had of the beauties of the countryside and the most interesting and attractive sections of the villages and cities through which the bus routes traverse.

Bus operations in Minnesota today are carried on by approximately fifteen companies. An interesting development has been the entrance of the Great Northern Railroad, through its subsidiary the Northland Transportation Co., in the field of highway transportation. Through purchase of lines that have been developed in its territory, this railroad has recognized the public demand for a frequency of service that could not be economically provided through its passenger coach facilities. In the local and suburban field the Twin City Rapid Transit Co. has also enlarged its scope by acquisition and development of lines initiated through independent means. One state is also served by about twelve other companies, some large and some small.

Passenger depot accommodations furnished by the bus companies vary with the size of the communities. The bus depot is placed where it provides the most convenient meeting place for the public. Where several lines operate from one city, as in St. Paul and Minneapolis, a Union Bus Depot is maintained. Here passengers may easily transfer from one line to another and continue their journey. The Minneapolis Union Bus Depot affords the unique situation of affording loading accommodations under one roof for as many as eighteen buses at one time. Patrons have a commodious waiting room that is equipped with information booths, restaurant, baggage checking room and every comfort for the thousands who daily pass through this down town depot, recognized as one of the most successfully constructed and operated bus depots in the country. In smaller communities the motor bus usually works out its depot arrangements with some centrally located place such as hotels and restaurants.

While the motor bus in Minnesota was established before state regulation, it is today operating under the jurisdiction of the Minnesota Railroad and Warehouse Commission. That body was given this power through a measure passed by the 1925 Session of the Minnesota Legislature, and was empowered to determine whether any of those who had been in operation on the first day of the legislative session were fulfilling requirements essential to their recognition as a public convenience and necessity. Hearings in the various parts of the state for more than a year were held by the Commission under the provisions of the law. Full recognition was given at the hearings to both proponents and opponents of the continued operation of established lines. The opposition in each case was developed and led

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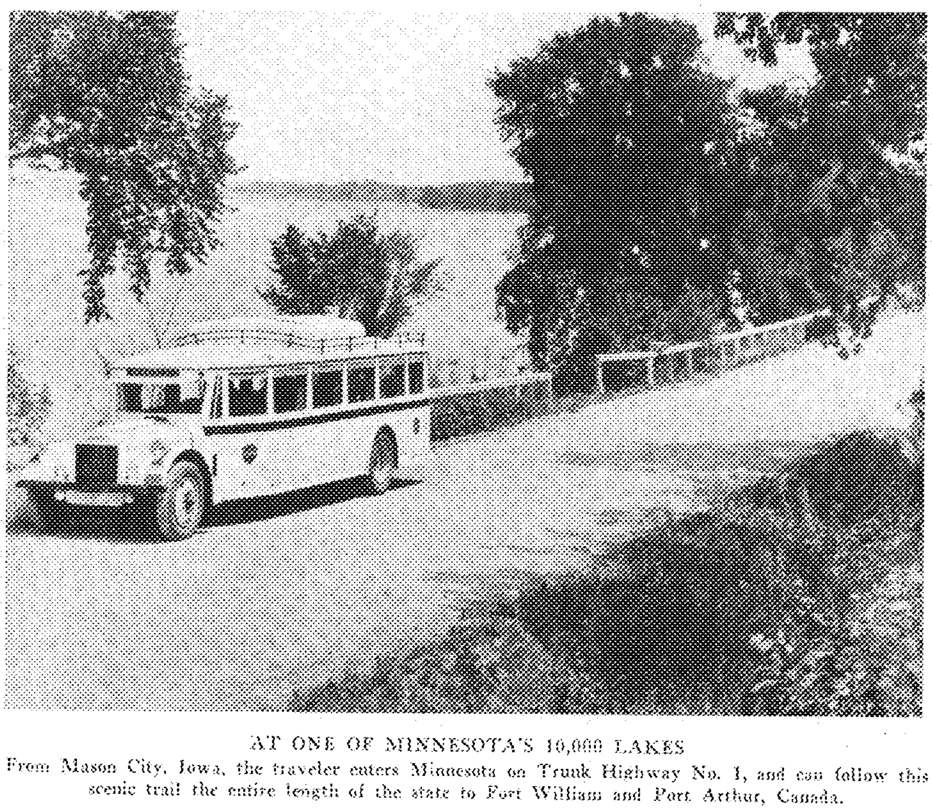
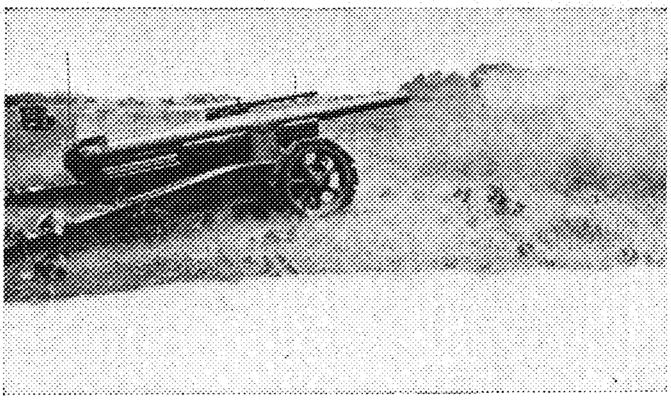
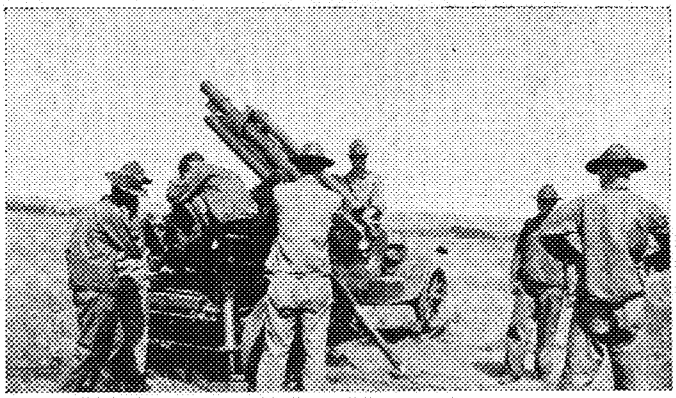


AT ONE OF MINNESOTA'S 10,000 LAKES
From Mason City, Iowa, the traveler enters Minnesota on Trunk Highway No. 1, and can follow this scenic trail the entire length of the state to Fort William and Port Arthur, Canada.



155 MM. FIELD GUN IN FULL RECOIL
A moving target was assumed and the course plotted. Results of fire were spotted in the field and then plotted, and corrections made.



GETTING THE LOWDOWN ON ARCHIE
A week was spent firing these 75 mm. anti-aircraft guns at sleeve targets towed by airplanes, and at the bursts of former shots.

"The Caissons Go Rolling Along"

Minnesota's coast defense men undergo six weeks of intensive training at the Field Artillery School, Fort Sill, Oklahoma

By ROY A. NYQUIST, Arch. Eng. '27

EDITOR'S NOTE: In the eyes of engineering students, the most important events that occur during undergraduate years are the various summer camps that are held by the different departments. These camps are looked forward to with high expectations, and when they have passed into history, are recalled with many fond memories. The TECHNO-LOG will feature these camps and trips in this and succeeding issues.

ONE hundred and twenty degrees in the shade and not a darn bit of shade—that was the vision we members of the Advanced Coast Artillery Corps saw before us when orders from the War Department changed our summer camp from Fortress Monroe, Virginia, to Fort Sill, Oklahoma. Instead of a summer spent on Chesapeake Bay, we were to spend six weeks in a land of flying sand, tarantulas and rattlers. No wonder that it was a rather disappointed group of future artillery officers who left for Fort Sill last June.

Nearly all of us drove down in autos, or rather in those antique relics so greatly prized by us "collich" boys. Through Iowa and Missouri in a cloudburst was the depressing ordeal that our group experienced and we certainly had a wonderful time crawling, sliding, and floundering through that internationally famous mud. Nevertheless, we pushed on steadily despite mud, rain, and "flats"; Rosing claims he lost count when the forty-ninth had occurred. Once in a while we rode like millionaires on smooth concrete and during those precious moments we gave a mental vote of thanks to the concrete-mixing civils.

Through St. Joe, Kansas City, and over the Ozark Trail through Kansas and Oklahoma we drove night and day as we were obliged to report at camp by June 16. We traveled through the famous zinc and lead mining districts of Missouri and Oklahoma, and the last night out we drove through the oil fields—a night never to be forgotten. Miles of derricks, their huge frames looming up against the black sky; now and then a geyser of flaming gas casting its ghostly flare over acres of weird structures; the tireless throb of the pumps—all seemed to tell us of the Romance of Oil,—oil to quicken the wheels of industry, oil to make our campus chariots chug more merrily.

We finally arrived in Fort Sill, some of us a day or two late. Our heroic tales of night driving against time, and of the oceans of mud we had been through, softened the hearts of our officers, and no punishment such as extra K. P. was meted out to us. Fort Sill was really an agreeable surprise to us. Located in the eastern end of the Wichita mountain range, it is admirably situated as an artillery school. Although the sun was hot and the thermometer hovered around the 100 mark, the heat was not so noticeable because of the high altitude and the relatively low humidity. Polo fields, baseball diamonds, a golf course, a modern theater, a fine Officers' Club, and two beautifully located swimming pools at Medicine Bluffs all tended to make Fort Sill an ideal place to spend the six weeks.

The first day we were assigned our bedding, rifles, and the "fatigues"—the famous "full dress" uniform of the army. We were assigned to barracks, the bunks alternating by schools so that no two men of the same school were bunkmates. During our spare moments before evening mess we worked on our rifles. Some job, too, as the army considers that vast amounts of cosmoline are necessary to keep one rifle in a fair state of preservation. When the bugler blew mess call at 6:05 P. M., there was a rush en masse to the "dining hall," and unbelievably huge quantities of good, wholesome army fodder vanished in record time. To a man the dictates of Emily Post were shelved.

The next day we drew and fired the 75 mm. guns, using shrapnel. Torrittin and Borrowman of Minnesota had problems to fire on this day, and the way those targets were wrecked betokened ill for any future enemy of Uncle Sam. After the physical exams, which we all feared and finally passed, we were issued the cotton and the O. D., the "tailor-mades" of the army.

Promptly at 8:30 A. M. on the first Saturday morning, after three hours of last minute preparation, the dreaded inspection came. Rifles which had glistened and shone while in our hands, and which we were confident would pass the most rigid inspection ever given by any "shavetail" fresh from West Point proved to be the dirtiest, oiliest, most disreputable pieces of armament ever placed in the hands of an inspecting officer. Imagine the feeling of relief when Captain Adams inspected a rifle and remarked at its cleanliness; then imagine the consternation when, as he handed the rifle back to its owner, he looked more closely and said, "Dirty screwhead. K. P. for you." But "Mac" fooled them all. He had volunteered for K. P. that Saturday before inspection.

During the second week of camp, w fired three problems with the big 15 mm. guns, using high explosive shells. Because of the fact that we were undc peacetime regulations and were usin

(Continued on page 24)

The Engineers' Bookstore

Dividends paid to members of this organization during the six years of its existence total over $27,300

By E. M. Peterson

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 six years the store has declared dividends to the amount of $27,301.97.

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 through the Co-op, thereby securing a discount of fifteen per cent. Under these systems is 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.

Howard C. Jacobson, who was then a senior in the engineering college, was appointed to manage the newly organized bookstore, and under his direction it rapidly grew from an experimental stage to its present well-founded status, as a study of the annual dividends listed below will readily show. In 1925, after five years of service, he resigned his position in order to devote all his energies to a manufacturing concern that his father had organized.

Harold D. Smith was then elected manager to succeed Mr. Jacobson, and he is the store manager at the present time.

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 financially successful and was closed in the spring of 1925.

THE ENGINEERS' BOOKSTORE
Balance Sheet
For Year Ending May 31, 1926

Assets

Current Assets:	
Cash on hand and in bank....$	948.06
Accounts receivable	479.64
Inventory	4,864.46
Total current assets	$ 6,292.16
Investments:	
U. S. L. L. Bonds General Funds	12,648.22
U. S. L. L. Bonds Cap and Gown Replacement Fund....	700.00
Cash and certificates of deposit—Students' Loan Fund	700.00
Total investments	$14,048.22
Fixed Assets:	
Store equipment	469.76
Store furniture	192.00
Cap and Gown Rental Costumes	1,354.68
	$ 2,016.44
Less depreciation charged off	$ 1,001.79
Total fixed assets	1,014.65
TOTAL ASSETS	21,355.03

Liabilities

Current liabilities:	
Vouchers payable	267.37
Deposits—Caps and Gowns....	265.00
Patronage Dividends Payable:	
1921	69.87
1922	92.59
1923	135.40
1924	153.73
1925	235.52
1926	5,859.99
Total current liabilities	$ 7,079.27
Students' Loan Fund	700.00
Memberships and surplus:	
Memberships	6,705.00
Surplus	6,870.76
Total memberships and surplus	$13,575.76
TOTAL LIABILITIES	$ 24,355.03

CONDENSED INCOME STATEMENT
For Year Ending May 31, 1926

Sales	$50,823.27
Cost of Goods Sold	37,693.86
Gross Profit on Sales	$13,129.41
Less Expense	5,996.97
Operating Profit	$ 7,132.44
Interest and Discount Received	596.96
Gross Income	$ 7,729.40
Deductions from Income	40.04
Net Income for Period	$ 7,689.36
Add: Surplus Balance May 23, 1925	5,082.21
Total	$12,771.57
Deduct: Patronage Dividends Declared	5,900.81
Surplus Balance, May 31, 1926	$ 6,870.76

The Engineers' Bookstore was organized for the benefit of the College of Engineering and Architecture, which includes the following departments:

Department of Architecture,
Department of Civil Engineering,
Department of Elec. Engineering,
Department of Mech. Engineering,
School of Chemistry.

The Engineers' Bookstore has proved so successful that students in other colleges have found it decidedly advantageous to become members and buy where a dollar not only does its duty, but five dollars do the duty of six dollars.

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
	$27,301.97

Membership in the Engineers' Bookstore is secured by making a five dollar deposit, which entitles the member to a dividend on the total amount of his purchases. This 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 the policies of the store, and are able to keep in close contact with the business and management through semi-monthly directors' meetings. The following men were elected to the Board for 1926-27:

Mr. John Hoving, Chairman, Department of Civil Engineering.

Mr. Clyde Webber, Secretary, Department of Electrical Engineering.

Mr. Kenneth Backstrom, Department of Architecture.

Mr. A. A. Cooper, Department of Mechanical Engineering.

Mr. Edgar Anderson, School of Chemistry.

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

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

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

Mr. Harold D. Smith, Manager.

Owing to the drowning of Mr. Cooper last summer and the non-return of Mr. Anderson, there were two vacancies on the board which have been filled this fall by Mr. Carl R. Barthelemy, new representative from the mechanical engineering department, and Mr. L. W. Cornell, who will represent the school of chemistry for the coming season.

The Engineers' Bookstore is doing unusual things: it is a strictly co-operative organization, it has established a dividend rate of one-sixth, and the accompanying income statement and balance sheet for the past year justify the maintenance of this rate.

Nela Park—A Human Organization

Embryo illuminating engineers find few dull moments during two weeks of lighting course at the National Lamp Works laboratory

By Stuart L. Bailey, E '27

ON the morning of August 23, six sleepy Electricals streched the kinks from their frames and cursed roundly the effrontery of the man who first called Mr. Pullman's rolling stock "sleepers". Dodging red-caps and other disciples of Jesse James, they made their way to the street, exclaiming with the engineer's innate originality, "So this is Cleveland". Thus began the two week's course in illumination presented by the National Lamp Works. Forty men, representing twelve colleges in the East and Midwest, assembled as guests of the aforementioned company and were introduced to Nela Park—University of Light. The course consisted of lectures and inspection trips conducted by men who are national authorities in each particular branch of the lighting field. The presentation of the principles of lighting and illumination design were accompanied by practical illustrations from cleverly designed models and exhibits which are a part of the furnishings of the Nela School of Lighting.

Contrary to the natural belief, the entire two weeks period was not devoted to the study of light—many illuminating hours were spent outside the classroom. You can well imagine the consternation among this group of meek and timid engineers when one of the first day's lectures mentioned that the greater per cent of employees at Nela Park were girls between the ages of eighteen and twenty-three. No one was trampled in the ensuing riot, but four men had to be hog-tied to keep them in the classroom! They got their chance with the rest, however, for each Thursday noon a synthetic jazz orchestra furnished music for the dancing in the cafeteria. Such "woiking goils"! A man was never sure whether he was dancing with the manager's secretary or an assistant glass bulb inspector as long as she refrained from talking. Just to keep in trim, some of the boys discovered Cleveland's own "Marigold" where Somebody's Virginians (consisting of six Hebrews from Gotham and a Greek from the corner fruit stand) wailed and twanged until the "wee sma' hours" while the management conducted a series of experiments on the effect of reduced intensity of illumination upon temperature. There was plenty of evidence that an inverse ratio existed between the variables.

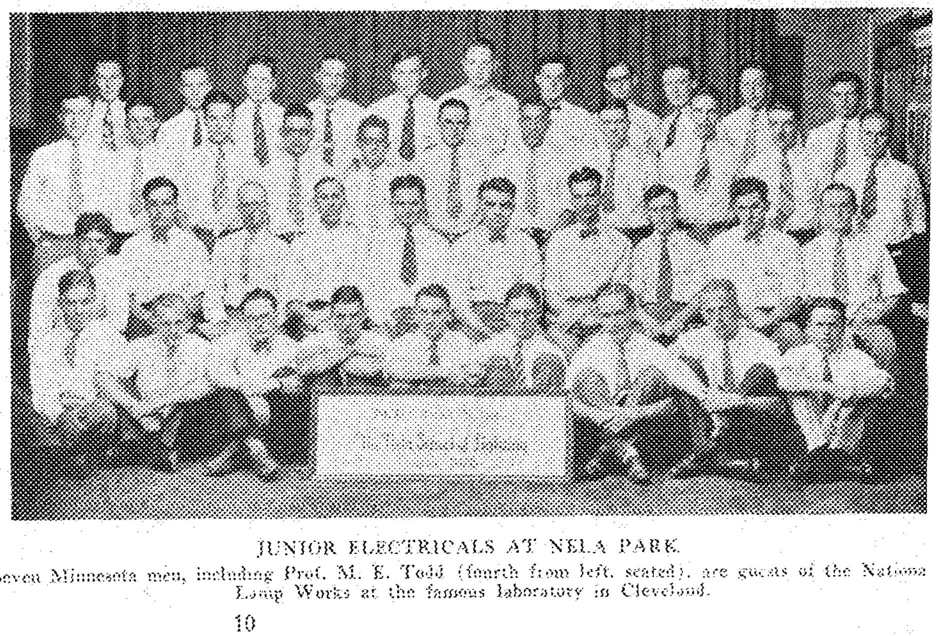
After the first week of such labor, the group was as well primed for a vacation. A beach party was planned for Saturday afternoon by the engineering department. The men of the Junior School were invited as guests and they turned out to a man. Such a party—swimming, athletic contests, a treasure hunt, a badger fight, and food! Clam chowder, baked clams, chicken, spuds, and roast corn, with an endless supply of pickles and olives served to relieve the immediate pangs of hunger, while watermelons and soft drinks were on hand to taper off the meal. Undaunted after a successful if somewhat mussy attack on this array of food, a few of the more fool-hardy members rushed off and took the boat for Buffalo, intent on viewing the wonders of Niagara Falls. Although the lake was smooth as glass, it was rumored that some of the men spent the greater part of the night in close proximity to the rail. After viewing Nature's wonder with the critical eye of an engineer, the concensus of opinion was that the Falls was "quite a mean drink of water". Some thought that the Falls were too small to warrant the publicity they have received, but agreed that experiments with barrels, tight wires, and other accessories to suicide should be left to the other fellow. The power houses came in for their share of attention, although it was difficult to convince the authorities that the men had no intention of stealing the generators or walking off with a turbine runner for a souvenir. After listening to three different guides tell three different sets of lies about the Falls, the party decided to call it a day well spent and returned to Cleveland in time for Monday's classes.

Each year the National Lamp Works of the General Electric Company invites a limited number of Junior Electricals to attend a two weeks course in illumination given at Nela Park, Cleveland, Ohio. The more serious functions of this organization were explained in the November 1925 issue of the TECHNO-LOG. The following article, in a lighter vein, attempts to show that a large business organization can plan a course of this kind without entirely forgetting the human interests of the undergraduate college student.—The Author.

The second week was similar to the first, the well planned series of lectures and inspection trips running off with clocklike precision. In addition, a generous number of banquets and evening demonstrations kept the classes well occupied, causing no small slump in the receipts of certain of the more convenient dance floors. One of these trips terminated in a visit to a well-known Euclid Avenue "eatery" where the class found their course manager togged up in a genuine bar-tender's apron serving soft drinks over a pre-war bar. Sandwiches, meats, salads, cake, ice cream and cigars were also available for the asking. From the noise and general hilarity, it was easy to conclude that this was one of the most popular courses in the study of lighting.

The grand finale came on the last Friday evening in the form of a banquet at the hotel. A picked orchestra

(*Continued on page 30*)



JUNIOR ELECTRICALS AT NELA PARK

Seven Minnesota men, including Prof. M. E. Todd (fourth from left, seated), are guests of the National Lamp Works at the famous laboratory in Cleveland.

The E. C. M. A. Convention

The Minnesota Techno-log will be host to the sixth annual convention of Engineering College Magazines Associated

THE Engineering College Magazines Associated will hold their sixth annual conference at Minneapolis on Oct. 22-23, with the MINNESOTA TECHNO-LOG acting as host. From 60 to 75 delegates are expected who will represent the 21 member technical college magazines that hail from all parts of the United States, and the discussions will cover all phases of business and editorial policy that in any way affect the various publications.

Too much emphasis cannot be placed upon the importance of the coming convention, for in the six years of its existence, it has really produced order out of chaos as far as the members are concerned. Standardization of size was one of the first achievements, and this was closely followed by the introduction of group advertising which is now very efficiently handled by Roy Barnhill, Inc. The national advertising policy of the association is now fixed on a basis that is unequaled by any other group of college magazines. Make-up and appearance have also commanded much attention with results that soon become evident when yearly files of the publications are compared.

A constitution drawn up by twelve of the present 21 members in February, 1921, at Chicago, Illinois, marked the modest beginning of the association which has since progressed so rapidly. The first convention was held at Ann Arbor, Michigan, in 1922, and subsequent conventions have been held annually at Urbana, Ill.; Ames, Iowa; Madison, Wis.; and Ithaca, New York.

The reason for, and purpose of E. C. M. A. is concisely summarized in the handbook of the organization as follows:

1. Adequate representation of widely scattered, but similar, publications in soliciting national advertising.
2. Elimination of multiple discounts on national advertising handled through miscellaneous agencies.
3. Saving to both publishers and advertisers through standard size type page in all member magazines.
4. Improvement in editorial quality.
5. Improvement in general make-up and appearance.

PROFESSOR LESLIE F. VAN HAGAN
Chairman of E. C. M. A.

The association welcomes new members in the field, but requires that any such newcomers be *established* magazines which conform to the Standards of Practice, publish at least four numbers a year, and have a paid circulation of at least 500.

This year's convention has been planned to include a full program of problems encountered by the staff of every college publication. Two of the most important issues to be stressed in the business sessions are advertising and circulation, both of them well-known bugbears in the amateur journalism field. Some of the points concerning the advertising question that will certainly come up for argument include the handling of cuts, copy, and proof so that the advertiser is satisfied, co-operating with the national representative, and interesting the local advertiser. On the circulation side there are problems on records and statements, service to subscribers, and many others of similar nature.

There are also the questions of business methods, editorial policy, the magazine's influence on the campus, and innumerable other points that invite discussion and argument. It is certain that the two days of the conference will be well spent, and that the various delegates will carry away many valuable suggestions.

Prof. Leslie F. Van Hagan, University of Wisconsin, is the present chairman of E. C. M. A. Eastern and western vice-chairmen are Prof. W. V. Merrihue, University of Pennsylvania, and Prof. W. O. Birk, University of Colorado. These men will alternate in presiding over the business sessions which will continue all day Friday and Saturday morning. The official banquet will take place Friday evening at the Leamington Hotel, and on Saturday afternoon the visitors will have the opportunity to witness "Doc" Spears' far-famed proteges perform against Wabash.

Program for E. C. M. A. Convention

FRIDAY, A. M.

9:00 a. m. Call to Order. (1) Roll Call, (2) Minutes, (3) Chairman's Report, (4) Barnhill's Report.

10:00 a. m. Advertising Problems. Led by Rodney Mayhew, Business Manager, Iowa Engineer.

11:00 a. m. Business Methods. Let by Millard J. Williams, Manager, Wisconsin Engineer.

12:00 m. Recess for Photo and Lunch.

FRIDAY P. M.

2:00 p. m. Announcement of Committees.

2:10 p. m. Circulation Problems. Led by Forest R. Hall, General Manager, Neb. Blue Print.

3:10 p. m. Editorial Problems. Led by K. M. White, Editor, Purdue Engineering Review. Magazine's Place on Campus. Led by W. W. Starke, Editor-in-Chief, Sibley Journal of Engineering.

4:10 p. m. Illustrating the Magazine. By Mr. Jack O'Shea, Bureau of Engraving, Minneapolis.

FRIDAY EVENING

7:00 p. m. Banquet.

9:30 p. m. Convention Dance.

SATURDAY A. M.

8:30 a. m. Call to Order.
Future Plans for E. C. M. A. Led by George B. Darling, Jr., Editor Tech Engineering News.

9:30 a. m. Rating Member Magazines. Led by Almon D. Thomas, Editor, Colorado Engineer.

10:30 a. m. Committee Reports.
Meeting Place for Next Convention.

11:00 a. m. Election of Officers.

12:00 m. Adjournment.

SATURDAY P. M.

12:15 p. m. Inspection of Washburn-Crosby Flour Mill.

1:15 p. m. Luncheon prepared for E. C. M. A. delegates by the Washburn-Crosby Company.

2:30 p. m. Football Game. Minnesota vs. Wabash, Indiana.

ENGINEERS IN ATHLETICS

Raymond Rasey, 1926 Conference Medal Winner

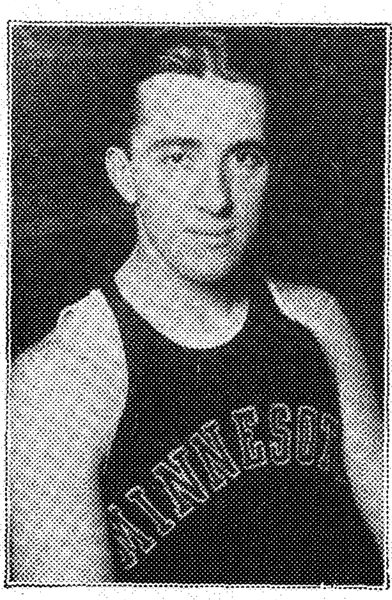
By Ralph Blyberg, *Mech. Eng. '29*

Another engineer brought honor to old St. Patrick, when Raymond Rasey, a senior architectural engineer, was awarded the conference medal for athletics and scholarship. Rasey, popularly known as "Black," was further honored in that he is the first non-football playing man to win the medal since the award was established.

The winner of the conference medal is selected by a committee of men from the school faculty and athletic department. The prize is given to the man who leads his class in scholarship and athletic prowess. There are ten medals awarded, one to each of the big ten schools.

The field at Minnesota narrowed down to three men: Ray Rasey, basketball and baseball, Harold Fischer, football and track, and Eldon Mason, football, basketball and baseball. As "Black" did not graduate with the June class of 1926 because of illness, there was much discussion at the meeting as to whether or not he was eligible for the award. However, the committee ruled that as he was to graduate in December, he would be graduating in the year of 1926 and therefore was eligible for the prize.

In case Rasey does not graduate in December, the award will either go to Harold Fischer or Eldon Mason. At the present time "Black" is working hard to get the necessary credits and is also working on a part time basis at the Y. M. C. A. As many of the courses offered in the spring quarter are not offered in the fall, Rasey is getting some special courses from his instructors. They give him outlines of the courses and he does the work in spare periods of the day.



RAYMOND RASEY

"I consider myself rather lucky to b
getting this award," Black said, "As th
medal is not usually given to a man wh
has not won his 'M' in football. I als
consider myself lucky to be getting speci
courses from my instructors as whether o
not I am allowed to keep the award de
pends upon my graduation."

Ray Rasey entered the University o
Minnesota from St. Paul Central wher
he won his letters in football, basketbal
and track. He made all the freshma
squads, but dropped football as it inter
fered too much with his scholastic work
He played varsity basketball and baseba
for three years and captained the 1925-2
quintet. In the game with Iowa las
season, he played the whole game with
broken hand.

His scholastic work has always bee
above par, and the coaches have never ha
to worry about whether or not he woul
be eligible. He has been an active Y. M
C. A. worker throughout the time he ha
been in school and is now working at th
"Y" on a part time basis.

"Black" became ill with the influenz
on the training trip last spring and di
not recover until two weeks before final
He was going to try to get his credits b
intensive studying but his doctors advise
him against doing so.

Technical College Intramural Sports

By Clarence Lande, *Civil Eng. '27*
Athletic Manager

Since the organization of the Technical College Athletic Board, which consists of the College Athletic Manager and the respective class managers including a manager from the School of Chemistry, more students have participated in college sports than ever before. This is a condition which has long been placed as an ideal by the directors of intra-mural athletics, and is due very much to the work done by the Athletic Board last year under the leadership of Kenneth Foster.

A review of the sports carried on last school year show that many students were interested in college athletics. Engineering sports are in an independent division. Teams in the engineering college play for the championship of the college, the winning team playing in the I-M play-off for the all-University championship. Last fall a touchball league consisting of four teams representing the seniors, juniors, sophomores, and freshmen was formed. Large numbers of students signed up for the tennis and golf tournaments. A basket ball tournament was held. The engineering college was represented by a hockey team which was a runner-up for the all-university championship. In the diamond ball league there were 14 teams which played in two divisions, the American and National. The frosh number one team captured the honors of the Nationals, while the junior civils won the American championship.

In the play-off the frosh bested the juniors thus becoming college champions, which gave them the right to represent the engineering college in the all-university diamond ball league. However, they were defeated by the Plant Pathology team from the agricultural campus, which reached the finals before going down to the Sigma Nu team, who were the all university champions.

The college baseball team was a runner-up for the all-university championship, but lost to the Psi Omega, dental fraternity, by 6 to 4 in one of the best played games of the I.-M. department.

In the spring tennis tournament, 75 signed up as contestants, and the tournament was won by "Mally" Gustafson in a hard fought match with George Schroepfer. About 40 men were entered in the golf tournament which was won by Hubert Tierney.

This year the Technical College Athletic Board is headed by Clarence Lande with Raymond Deegan and Lloyd Hoover, men that were on the Board last year, holding their positions till the new class managers are appointed after the clas
elections are held.

Even a greater season seems to prom
ise itself this year if fall sports are an
indication. There are 14 touchball team
entered in the touchball league, which
an increase of 10 teams over that of las
year. The fall tennis and golf tourna
ments are in full swing, and plans ar
made for the organization of basketbal
hockey and handball teams during the wi
ter. While in the spring diamond bal
baseball and horseshoe will very likely b
added to the list of sports.

Awards of sweaters with college lette
are made to the winner of any technic
college championship sponsored by th
T. C. A. B., and keys are awarded
men selected by the Athletic Board wi
have been outstanding in their work.

A few of the games scheduled for Oct
ber 12 in the engineers' golf and tenn
tournament have been played. In th
tennis matches, I. E. Anderson won h
meet from George Schroepler, and Ea
Wishnick took his sets from Charles Ma
golis, (6-1, 6-0). Clifford Brandt too
a somewhat tighter match from G. S. A
derson, the match going to three sets. Th
score was 5-7, 6-1, 6-1. The other gam
scheduled have not yet been played.

NEWS FROM THE TECHNICAL CAMPUS

Aviation Course is Installed in Engineering College

A two credit course in aviation has been added to the curricula of the mechanical engineering department at Minnesota, and hereafter all embryo young aviators can take their ground school instruction preliminary to actual flight training right here in the University. The Navy department is cooperating with the College of Engineering in putting over the course and the credit will be accepted as a prerequisite for flight and commission training in the United States Naval Reserve.

The course is under the supervision of Lt. Frank E. Weld, U. S. N. R., and Ronald M. Hazen, of the department of mechanical engineering, and the subjects covered during the three quarters of work include: history of aviation; types of planes, construction, alignment, and upkeep; instruments; aerology; theory of flight; aviation motors, types, designs, and maintenance; aerial navigation; aircraft communications; theory of control. Men selected from the class will be enrolled in the Naval Reserve and sent to Great Lakes, Ill., and Hampton Roads, Va., for 90 days' flight training during the summer of 1927. Upon the successful completion of the course, they will be commissioned as ensigns in the Fleet Naval Reserves and receive their designations as Naval Aviators.

Five men from the College of Engineering completed the entire course this summer and established an enviable record for Minnesota. Of 22 students who finished their flight training at Hampton Roads and took the professional examination for the rank of ensign this fall, Minnesota men captured first, third, fourth, seventh, and eleventh places, all of them being in the first half of the class. These men, in order of their rank, are Donald Stevens, Ross Mahachek, Lawrence Clousing, Lloyd Berkner, and Richard Hanson.

Shipley and Springer are New Department Heads

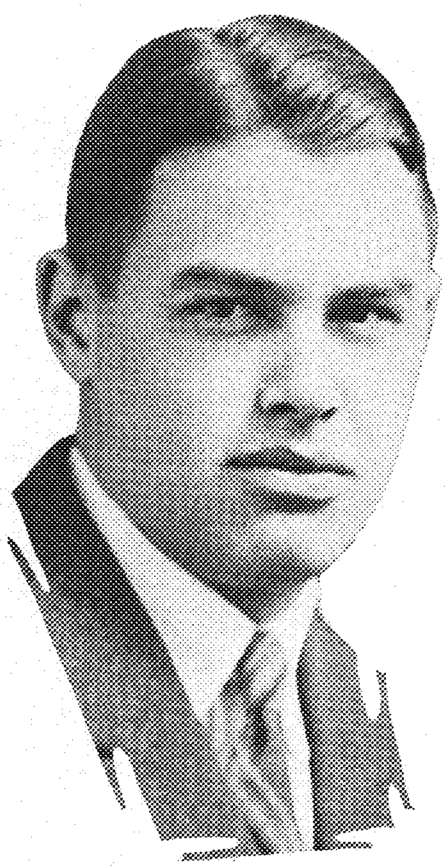
Professor S. C. Shipley of the mechanical engineering department, and Professor F. W. Springer of the electrical engineering department, have been appointed heads of their respective colleges to fill the vacancies left by the deaths last spring by Professor John J. Flather and Professor George D. Shepardson.

Professor Shipley came to Minnesota in 1907 as an instructor after seven years at the University of Cincinnati. During 1920-22 he taught at Robert College, Constantinople, while on leave of absence from Minnesota. On his return from abroad, he was appointed professor.

Professor Springer received his B. E. E. at Minnesota in 1893. Three years later he was appointed laboratory assistant. In 1898 he earned his E. E. degree, and in 1911 he was appointed professor, after a year's work in Berlin.

Professor Springer is the author of many articles appearing in the technical press. He is especially interested in engineering education methods and has written several articles regarding this phase of pedagogy.

Albert Cooper, Senior Engineer, Drowns During Vacation



ALBERT A. COOPER

The many friends and classmates of Albert A. Cooper, senior mechanical engineer, were greatly shocked to hear of his sudden death by drowning on August 15 while swimming in Lake Minnetonka. He was spending the weekend with his mother, Mrs. A. T. Cooper, at the home of Mr. and Mrs. W. M. Atkinson, Maplewood, Lake Minnetonka, when the accident occurred. He had gone in the lake for a dip, taking a boat with him, and his friends on shore suddenly heard him call for help, but before they could reach him, he had drowned. Members of the Wayzata fire department dived and dragged for the body four days before it was recovered 500 feet from shore in 35 feet of water.

Albert Cooper was born in Cedar Rapids, Iowa, and was 23 years old at the time of his death. He will be greatly missed by his many friends and by the organizations in which he was interested and took an active part. He was an excellent student, being a member of Pi Tau Sigma, honorary mechanical engineering fraternity, and corresponding secretary of Tau Beta Pi, honorary technical fraternity. In addition to these societies, he was a member of Theta Tau, professional engineering fraternity, Scabbard and Blade, and Mortar and Ball. He was vice-president of the junior engineering class last fall, and was elected the mechanical engineers' representative on the Board of Directors of the Engineers' Bookstore for the coming year.

Student Members of Techno-Log Board are Elected

In accordance with the Techno-Log Constitution, which was voted on and approved by the technical students of Minnesota on May 29, 1925, an election of student members of the Techno-Log Board was held on October 12. Strictly speaking, this election should have taken place last spring at the time of the All-University elections, but due to various circumstances, the election did not materialize as expected, and was therefore held this fall.

The constitution provides for six student members; three from the College of Engineering and Architecture, one from the School of Chemistry, one from the School of Mines, and one from All-College. The members elected were Lloyd Berkner, Paul Giessel, and Frederick Peterson, College of Engineering and Architecture, George Swenson, Chemistry, O. A. Aanes, Mines, and John Borrowman, All-College. Faculty members of the board are Dean O. M. Leland, Dean W. R. Appleby, and Prof. A. S. Cutler.

The purpose of the board is to act as a governing body which shall help determine the magazine's policy, and which shall be responsible for its proper management.

Minnesota Engineering Faculty Are Very Active in S. P. E. E. Work

The Society for the Promotion of Engineering Education held its annual convention at the University of Iowa in Iowa City early this summer and honored Dean O. M. Leland with the presidency for the coming year. Other officers elected were: H. W. Tyler, M. I. T., 1st vice pres.; W. S. Rodman, University of Virginia, 2nd vice pres.; F. L. Bishop, University of Pittsburg, secretary; W. O. Wiley, New York City, treasurer. Prof. W. E. Brooke, head of our department of Mathematics and Mechanics, is a member of the Council.

This society was founded at the World's Columbian Exposition in Chicago in 1893, having as its aim the promotion of engineering education, as its name indicates. The founders, seven in number, included Henry T. Eddy, former dean of the graduate school, and William R. Hoag, former professor in the Civil Engineering department of the University of Minnesota. Conventions held are annually at the various universities, the next being scheduled for the University of Maine and which will be held in June, 1927. The society has been financed by a grant from the Carnegie Corporation amounting to $8000, and for the last three years has been engaged on an extensive investigation of engineering education, reports of which are published periodically in the bulletin of the society.

The University of Minnesota claims a larger membership than any other school represented, and also supports a local section of the society here. The officers of the local S. P. E. E. are: Prof. J. V. Martenis, chairman; Prof. G. B. Heisig, secretary; Prof. J. H. Kuhlman, chairman of papers committee.

ALUMNI AND FACULTY PERSONAL NEWS

FACULTY

ARCHITECTURE

Several changes have been made in the faculty of the School of Architecture. Mr. Elmer Young has returned from New York where he has studied art for the past year. He will instruct in the art department.

Carl M. Wise is a new instructor in the School of Architecture. He is teaching architectural history and allied arts.

Prof. L. E. Arnal spent the past summer at his home in Marseilles, France, but it now back in Minnesota teaching design.

Miss Harwood, who was formerly in charge of the architectural library, has left for Los Angeles where she will study library training. Miss Gardner has been appointed to Miss Harwood's position, and she will be assisted by Miss Rhoda Cote, who is a member of the 1924 class in Interior Decoration.

CIVIL ENGINEERING

Prof. F. H. Bass spent part of the summer on city planning for Oakdale, Miss. He also completed designing the sewage disposal plant for Rochester, Minn., and acted as consulting engineer for the D. M. & N. R. R. Mr. Bass attended the annual S. P. E. E. convention at Iowa City in June, the national A. S. C. E. convention at Seattle in July, and the Mid-Continental Internatinal convention in Duluth and Hibbing. In addition to all these activities, he found time to visit the senior civils' surveying camp at Cass Lake early in September.

Prof. J. I. Parcel taught "stresses" in summer school during the first session, and then he and Mrs. Parcel drove to Portland, Oregon, and other points on the west coast.

Prof. A. S. Cutler attended the S. P. E. E. convention in June, and then remained in Minneapolis until the middle of August after which he instructed at the civil engineers' camp at Cass Lake, Minn.

Prof. O. S. Zelner and his family motored to South Dakota, where they witnessed the formal opening of the new Missouri River bridge at Pierre. He then returned to Minnesota to instruct the engineers at Cass Lake in the delicate niceties of current meter rating and Polaris shooting.

After designing forms and caissons for the Minneapolis Bridge Company during the first part of the summer, Prof. L. F. Boon accompanied the senior civils to their camp at Cass Lake, where he spent six intensive weeks drilling them in the mysteries of quadrilateral adjustment and bench level analysis.

Prof. G. A. Maney taught in summer school and was engaged in concrete building construction during the summer months. An interesting piece of construction upon which he and Professor Lagaard worked concerned a church in Le Seuer, whose tower, buttresses, and various other parts had failed.

Hibbert Hill, instructor in the civil engineering department, was in charge of hydro-electric power plant work for the N. S. P. Co. in Minneapolis.

Prof. F. C. Lang, who is also Engineer of Tests and Inspection for the Minnesota State Highway Department, spent the summer in Minneapolis and in various parts of the state where paving jobs were under way.

D. O. Nelson and F. E. Nichol, research fellows and instructors in structural engineering, took part of the summer to complete their thesis on "How to Predict the 28 Days' Strength of Portland Cement Concrete by Special Curing Methods." Mr. Nelson and his wife then made a tour of eastern U. S. and Canada, and is now District Engineer for the Truscan Steel Co. at Portland, Ore. Mr. Nichol spent his vacation at home and was engaged for a short time testing a new type of concrete for a Minneapolis engineering firm.

Charles Prichard, research fellow in highway engineering, was for a time in charge of asphalt paving for the city of Anoka. He also worked for the State Highway Department on bituminous paving and surface treating in the southern part of the state as well as doing research work on asphalt road construction and bituminous treatment of gravel roads.

James R. Johnson and Arne A. Jakkula, C. E. '26, have been appointed research fellows in structural engineering for the coming year. Mr. Johnson spent the summer as an oil inspector for the Highway Department, while Mr. Jakkula was a Student Engineer for the Bureau of Public Roads in Missouri and Texas.

ELECTRICAL ENGINEERING

Prof. F. W. Springer, new head of the department of electrical engineering, spent about half of the summer doing departmental work and arranging courses, and the remainder of the summer on patent and consulting work.

W. T. Ryan, professor of power engineering, spent the summer attending conventions and traveling. He attended the annual convention of the Society for the Promotion of Engineering Education at Iowa City and the convention of the Minnesota Federation of Architectural and Engineering Societies in Duluth. Professor Ryan made an auto trip through Iowa, Wisconsin, Minnesota, and Nebraska and visited various factories and power plants while enroute.

C. M. Jansky, Jr., assistant professor of radio engineering, spent an interesting summer in studying the field intensity of the signals radiated by the Gold Medal Station WCCO throughout the Northwest. During the summer Mr. Jansky took time out and made an extensive trip through the western, southeastern and the eastern parts of the United States visiting most of the larger radio stations. On this trip, while he was in New York, Mr. Jansky attended the third Annual World's Radio Fair and the Radio Industry's Banquet.

M. E. Todd, assistant professor of electric power engineering, also attended the S. P. E. E. convention at Iowa City and the national convention of the A. I. E. E. at White Sulphur Springs, W. Va., as delegate from the Minnesota branch of the society. In August Mr. Todd attended the Nela School of Lighting at Cleveland and was able to visit Niagara Falls, tak- ing a boat trip from Cleveland to Buffal

J. H. Kuhlman, assistant professor o electrical design, and E. W. Johnson, as sistant professor of electric power engi neering, attended the General Electri school this summer.

G. W. Swenson, assistant professor o telephone and telegraphic engineering, ha been working on a problem of loading line for the Northwestern Bell company.

Mr. R. E. Willey is a new instructo on the staff of the electrical engineerin department. He graduated from Purdu in 1925 and taught the following year a Georgia Tech. He has also done som graduate work at Wisconsin. Mr. Wille is a member of Sigma Mu Sigma, Et Kappa Nu, Scabbard and Blade, A. I. E E., and is a 2nd lieutenant in the Officer Reserve Corps. During the past summe he was in camp at Knox and Fort Harri son.

G. F. Corcoran, who was a teachin fellow last year, is now an instructor i electrical engineering. C. B. Feldman an M. E. Fiene are new teaching fellows.

MECHANICAL ENGINEERING

Prof. S. C. Shipley, the new head of th mechanical engineering department, suc ceeding Prof. J. J. Flather, who died lat last spring, spent the first part of the sum mer at his cottage in northern Wisconsi After returning to Minneapolis, he change his residence from East River Road t Prospect Park.

Prof. J. V. Martenis was engaged in re search work and doing special problems fo the Western Electric company during th summer months.

Mr. J. Flodin made an extensive tri through the eastern and southern part o the country.

Prof. F. B. Rowley, head of the experi mental engineering department, divided hi time between the experimental laboratorie and the enticing shores of Cass Lak where he owns a summer cottage.

Mr. F. A. Morris assisted Professo Rowley in the laboratory and installe equipment in the new highways buildin Later on in the summer, he made inspec tion trips through the engineering depart ments of Wisconsin, Illinois, and Purdu universities.

Ronald M. Hazen, instructor in mechan ical engineering, overhauled motors an conducted oil tests for the Twin City Br company for part of the summer. He als spent several weeks as a test pilot at Mc Cook Field, the Army Air Service exper mental field at Dayton, Ohio.

C. F. Shoop, professor of steam eng neering, employed the vacation months d signing a return system to use the wate from the heaters in the mechanical eng neering and power plant buildings for feed water in the power plant boiler. The sy tem will be in operation in a short time.

Minnesota welcomes several new in structors among the ranks of the mechan cal engineers this fall. P. M. Thornbur has succeeded L. F. Campbell as instructo in machine design. He graduated fro Purdue in 1924 and was employed by th Missouri Pacific railroad until he came Minnesota.

Mr. Nicholas comes to us from the Massachusetts Institute of Technology. He graduated from Lehigh University in 1915 and obtained his M. S. degree in mechanical engineering from M. I. T. last June. Mr. Nicholas wrote an article this summer in mechanical engineering dealing with his research work on gears.

Mr. Dawson is succeeding G. L. Tuve as an instructor in steam engineering. After graduating from Ohio State in 1921, he taught on the staff of the College of Engineering at Des Moines University until the present time.

Mr. Larson is assisting Mr. Shoop in steam engineering. During the latter part of the year he will work with Professor Robertson in gas engine laboratory.

MATHEMATICS AND MECHANICS

Several members of the department of mathematics and mechanics taught during summer school. Among those were: C. E. Herrick, W. F. Holman, J. O. Jones, R. W. Siler, H. A. Doeringsfeld, G. C. Priester, H. E. Hartig, H. B. Wilcox, F. E. Miller, and H. H. Dalaker.

Prof. C. E. Herrick spent part of the summer at Cass Lake.

Prof. W. F. Holman did reinforced concrete construction work for the firm of Shuett and Myer.

Mr. C. Boehnlein who sailed in July for Germany is now in Breslau, Germany. Mrs. Boehnlein accompanied him on his trip abroad.

Prof. R. R. Herrmann was with the Northern States Power company during the summer months.

Mr. H. L. Smith has left the department to assume a teaching position at the University of Louisiana. During the summer he taught at the University of Chicago.

Prof. G. C. Priester attended the convention on steel treating which was held in Chicago during the first part of September. He spent his week ends during the summer at his cottage on the shores of Cass Lake.

Mr. O. C. Lee has resigned from the department. He is now with the Electric Machinery company of Minneapolis.

Among the new members of the teaching staff in this department is Mr. E. D. Wells who comes to us from Hamline. He was formerly of the physics staff at Minnesota.

Another addition to the staff is Mr. L. W. Neubauer, a graduate of the civil department last June.

Professors W. E. Brooke, R. R. Herrmann, G. C. Priester, and H. H. Dalaker attended the convention of the S. P. E. E. at Iowa City in June.

Prof. W. W. McClintock did railroad signal work in St. Paul during the summer.

DRAW. AND DES. GEOM.

Prof. W. C. Kirchner spent part of the summer traveling in the East. He visited in Boston and Worcester, Mass., and also visited several colleges, manufacturing plants, and drafting rooms. The remainder of the summer he spent camping on the St. Croix river.

Professor H. C. Eggers and Professor Kirchner have been writing a descriptive geometry text.

Mr. O. W. Potter has just returned from the convention of the Foundrymen's Association.

I. W. Doseff, formerly an instructor in the School of Architecture, is now teaching drawing in the drawing and descriptive geometry department.

CHEMICAL ENGINEERING

Prof. C. A. Mann, chief of the division of chemical engineering, spent the first six weeks of the summer teaching in the chemical engineering department. He then went on an automobile trip through northern Minnesota, including Duluth, Superior, Itasca Park, and the Iron Range in his tour. In September, Dr. Mann went to Philadelphia where he attended the meeting of the American Chemical Society and the Sesqui-Centennial Exposition. At the meeting of the American Chemical Society, he read two papers; the first, "An Improved Method of Making Butyl Chloride," by C. A. Mann and J. Pagnucco, a graduate student at the University of Minnesota; the second, "Studies on the Dephlegmating Column," by R. E. Montonna, assistant professor of chemical engineering at the University of Minnesota, and L. A. Shirk, a graduate student at the University of Minnesota. Both of these papers were contributions of the chemical engineering division of the University. From Philadelphia, Dr. Mann went to Washington, where he attended the meeting of the Union of Pure and Applied Chemistry. While in Washington, he visited the Bureau of Standards, the Bureau of Chemistry, and the experimental work of the Bureau of Public Roads. On his return trip, he visited the Exposition of the American Society of Steel Treaters in Chicago.

Dr. L. A. Sarver spent the greater part of the summer in Maryland. He attended the Semicentennial meeting of the American Chemical Society in Philadelphia where he read a paper, "The Solubilities of Some Rare Earth Oxalates," which he prepared in collaboration with Prof. Paul H. M. P. Brinton. Mr. Sarver also published a new text-book in mimeographed form, "Quantitative Analysis for Pre-Medic Students."

Prof. R. E. Kirk is on sabbatical leave at Ithaca, New York. His address is 507 E. Buffalo St.

New assistants in the School of Chemistry are: Messrs. K. A. Kobe, J. H. Kugler, K. C. Lampert, F. A. Rohrman, E. F. Sverdrup, and R. B. Whitney, Miss Duschak, and Mrs. H. R. Freche.

Mr. G. B. Heisig spent the greater part of the summer in the city. During the last three weeks of the summer vacation, he took a trip to Texas. A revised edition of his "Laboratory Manual of Inorganic Chemistry" was published during July.

Mr. H. H. Barber was occupied during the summer with the task of superintending the rehabilitation of over 2,000 laboratory desks and the purchasing of $15,000 worth of supplies for the School of Chemistry.

Prof. P. H. Brinton taught during the first session of summer school. During the latter part of the summer he was in the West.

Mr. B. F. Ruth is an instructor in the chemical engineering department of the University of Minnesota. Mr. Ruth was at Michigan State College last year.

Mr. P. J. Riley has been appointed Curator in the School of Chemistry. He was engaged during the summer in working on a new system to be known as the service department, which will place all the apparatus in the School of Chemistry under the supervision of one man so that it may be used by all departments.

Mrs. K. E. Crowley, librarian, spent the summer in Minneapolis.

SCHOOL OF MINES

Dean William R. Appleby did not take a vacation this summer but remained at work in Minneapolis.

Prof. E. M. Lambert spent the summer at Hunky Dorry, Mille Lacs, recuperating from illness.

Mr. R. L. Dowdell and Mr. Webber have been engaged in research work, the former in Washington, D. C., and the latter operating in Buffalo, New York.

Prof. L. B. Pease and Prof. E. H. Comstock both remained in Minneapolis during the summer months.

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

Prof. W. H. Parker made an extensive auto trip through the Minnesota Iron Ranges, the Black Hills of South Dakota, thence to Butte, Montana, and through the Yellowstone.

Prof. O. E. Harder attended the Steel Treaters' convention and engaged in research.

Mr. E. H. Kerston instructed in the summer school sessions.

Prof. Frank F. Grout was engaged in Minnesota Geological survey during the vacation months.

Prof. J. W. Gruner is now on sabbatical leave in Germany.

Mr. A. M. Gow spent the summer in Minneapolis and the Minnesota Iron Ranges.

Prof. A. J. Carlson is now in California working for his Master Degree. He has been replaced by Mr. Strand.

Mr. R. W. Allard has been working for a consulting engineer, testing building materials, fuels, and oils.

ALUMNI

ARCHITECTS

The 1926 class of architects has spread its wings and departed far afield, but the world is too small to allow their activities to remain a secret from their friends back in Minnesota.

Gus Naslend and Herman Frenzel left for a tour of the East on October 10. It will be remembered that last year Gus won the Moorman Traveling Scholarship which provided for this trip. They are traveling via "Lizzie" Ford.

In opposition to Naslend and Frenzel is Oswald Stageberg who is following the

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The

MINNESOTA TECHNO-LOG

University of Minnesota

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THE MINNESOTA TECHNO-LOG enjoys the privilege of serving as host to the Engineering College Magazines Associated this month. Delegates, staff members, and faculty advisors of twenty-one member magazines as well as guests from non-members will be present to discuss various problems concerning circulation, advertising, make-up, policy, etcetera, that continually haunt the minds of those on the editorial and business staffs. From this conference, thoughts will arise that must surely help the publications to become more valuable to the students, faculty, and alumni for whom they are prepared.

It is the sincere wish of the TECHNO-LOG that its guests during the coming conference find their visit a pleasant and profitable one, and that they will return to their respective colleges with the feeling that their stay at Minnesota has been a source of inspiration to them.

Members and guests of E. C. M. A., Minnesota welcomes you.

A new year of school has taken a good start on the campus, and the beginning of the long grind on studies marks also the entrance of many extra-curricular activities which play such a large part in University life. Although we are here principally to absorb the knowledge disseminated so freely in the classroom, we must share in other college activities as well, if we are to obtain the full benefit of our undergraduate life.

Technical students pride themselves on the stiffness of the courses which they are required to take. Nevertheless, these same technical students, whose programs are filled so completely with such awe-inspiring subjects as Mineralography, Statically Indeterminate Structures, and Thermodynamics, find time for major positions on All-University functions, for athletics of all kinds, and for many more outside activities.

Now to get to the point of this rambling discourse. To you technical students who are interested in publications but have not as yet become connected with any of the student papers which appear on the University campus, the MINNESOTA TECHNO-LOG, which is *your* publication, has a place for you. If your ambitions lie along business channels, the business staff can use you in its advertising or circulation departments. If your talents are more in line with writing, the editoral staff welcomes you as a special writer or a department representative. Previous experience is not essential if you are ambitious and interested in the work and wish to work into a good position.

The TECHNO-LOG is not a publication for one school alone, but is meant for all of the technical colleges. In order to be of interest to all of those colleges, however, there must be men on the staff who represent those colleges and who will bring in news and articles pertaining to them, thus creating an interest shared by all technical men in the University.

We wish to call on the underclassmen particularly, for it is those men who will some day be responsible for the management of the MINNESOTA TECHNO-LOG and who will carry it on to successes far in advance of all previous attainments.

THE MINNESOTA TECHNO-LOG is entering its seventh year of active service on the technical campus. As we look back over the files of former years, we cannot help but experience a feeling of deep gratitude toward those pioneers who built up the magazine and shaped its course as it grew bigger and better year after year, and finally reached the high peak of perfection that it enjoyed during the past year.

We wish to take this opportunity to thank the staff members who worked so faithfully and consistently to make a Volume VI that would surpass all previous volumes in appearance and interest, and to hope that those who have not graduated will be with us during the coming year to uphold the present standards.

Especial recognition is due Paul B. Nelson and Alvah S. Bull, retiring managing editor and business manager, who were responsible for the publication's welfare during the past year and who handled it so creditably.

THE foremost requirement of a technical magazine is accuracy. Without this fundamental feature, the reader can have no faith in the statements printed and all reliability in the articles and news items is lost. The supposedly technical publication is then as valuable to the man for whom it is prepared as most of the Sunday supplement science which is dealt out so promiscuously and carelessly to the lay reader.

A great stride forward in the direction of accuracy has just been taken by the electrical engineering department. A committee of two, Professors C. M. Jansky and E. W. Johnson, has been appointed through which all news pertaining to that department will pass before being published.

The success of an arrangement of this type depends, of course, upon the attitude taken by both sides, but if the editorial staff remembers that accuracy makes for a successful publication, and the newly formed committee is willing to co-operate to the extent of lending their aid in obtaining adequate material that is interesting and beneficial to the reader, there is no reason to suppose that this plan will not work out with advantage to all concerned.

It is to be hoped that the other departments will take sufficient interest in the publication of reliable, first-hand information concerning their respective fields to follow the lead of the electrical school, for it is only by close co-operation between the TECHNO-LOG and the various departments that all the activities upon the technical campus can receive the accurate recognition that is due them.

The Motor Bus in Minnesota

(Continued from page 7)

by rail interests who had not recognized the bus as a new factor in transportation development. In the territory served by the Great Northern Railroad where applications for continued motor bus operation were heard, this railroad offered no such opposition. This railroad's view reflected by its president, Mr. Ralph Budd, in an address before the American Society of Civil Engineers at Kansas City, April 14, 1926, in answering the query "Why the Motor Bus," credited its greater frequency and flexibility of service in comparison with the railway trains. Mr. Budd said, "The ratio of cost of highway bus to steam train operation is about one to five, which means that for the cost of one train in each direction, say morning and evening, a bus can be run every two hours in each direction from 8:00 A. M. to 4:00 P. M., and this more frequent service better suits the needs of the average rural community. Owing to the extensive use of the private automobile there is scarcely enough travel even morning and evening on the average local run to justify a train, much less to justify several trains during the day; but the smaller and less expensive motor bus operating on the highway may pick up sufficient traffic to make it profitable. Besides greater frequency, there is the advantage of more convenient starting and stopping places. The motor bus is able to take on and discharge passengers at any street corner or at any house along the road. In other words, the motor bus is able to give a more flexible service than the train. People in the country can hardly use the railway for travel between neighboring stations, because, in proportion to the whole journey, the trips to and from the stations are so long. Not so with the bus. It gives continuous service all along the highway, while the railway gives it only at points four to six miles apart. Now, the amount of this strictly local business which railways cannot handle is considerable, and may be enough to insure the success of bus transportation."

In support of the bus operations before the Commission there appeared hundreds of representatives from all classes of the public, requesting the Commission not to deprive them of a bus service which had become an established institution in the every day life of each community. Bus operators presented passenger statistics showing the number of passengers carried by all railroads in the state of Minnesota from 1890 to 1924. These records indicated that the private automobile had brought about the railroad's loss of passenger traffic before the advent of the bus, and that as the number of private automobiles increased each year there was a corresponding loss of passengers by the rails. These figures were supplemented by records at stations where buses had operated where the railroad's loss was no greater than at stations where buses had never operated.

The Minnesota Commission went thoroughly into the merits of each application, and held numerous hearings before deciding its first case.

Among the Commission's final findings there is this interesting statement in the order granting a certificate to the Jefferson Highway Transportation Co. Hearings were conducted at Rochester, Owatonna and at St. Paul by Commissioner Ivan Bowen concerning one route from the Twin Cities to Rochester and another to Northfield, Faribault, Owatonna and Albert Lea. Five different railroads had appeared as objectors to the granting of a permit to this bus company that in its independent capacity had no connection with any rail interests. The Commission here said: "We have called attention to the development of motor vehicle transportation in the State of Minnesota in prior orders, and the exhibits of the Petitioner herein are further evidence of the demand for common carrier transportation upon the highways. Towns and villages and the rural communities which never had available convenient and frequent public transportation prior to the advent of operations by motor transportation companies were urgent in their desires for the retention of service on these routes.

"Another factor that must be taken into consideration in passing upon the question of convenience and necessity for the operation of an Auto Transportation Company is the impotency of regulatory authority by the State over railroads, due to the assumption thereof by the Federal government. Virtually all control by the state over passenger fares of steam carriers has passed into the hands of the Interstate Commerce Commission. The railroads themselves are not in a position to meet competition in the local passenger field, by reason of the standardization of their rates under the federal law. And their limitations at this time do not enable them to furnish the frequency and convenience of carriage to the passenger that is at the command of the Auto Transportation Company. This assumption of regulation within the state by the Federal Government would not necessarily enter into consideration of the question before us, were the regulation based upon intrastate operation, but the regulation exercised by the Federal Government is assumed only as the state operations of the steam carriers are a part of their operations in interstate commerce.

"In the carriers' briefs considerable space is devoted to the argument that a double cost for transportation is imposed upon the public when the Auto Transportation Company is permitted to operate. But, such argument fails to take into consideration the provisions of Section 15-A of the Federal Act to Regulate Commerce, and the fact that two classes of passengers are served—those whose principal interest is in the intrastate short haul and those whose interest is in the longer, or interstate haul. The State is interested primarily in the former class, while the carriers' obligation under the Federal Act is primarily to the latter class.

"The objectors' briefs further call attention to the fact that the greater percentage of both the petitioner's passengers and those of the steam carrier are carried between the larger communities, which have the most convenient rail service. And, although it is recognized that communities in between are furnished transportation, not otherwise immediately available, by the auto transportation company, it is contended the interests of such localities are outweighed by the consideration required to be given under the federal law to the interests of the rail carrier.

"It must be borne in mind that the carriers themselves give duplicated service between such larger communities, and under the terms of the Transportation Act are entitled to make charges upon the basis of cost of such duplicated operation, and in the fixing of charges the operation of the railroad as an interstate carrier is given first consideration.

"We do not call attention to this situation that exists under the act to regulate interstate commerce in a spirit of criticism, but merely in construing Chapter 185, Session Laws 1925. This Chapter regulates Auto Transportation Companies as common carriers in intrastate commerce, and in giving effect to the direction that reasonable consideration must be given to the transportation service being furnished by any railroad such direction refers to intrastate transportation.

"The representatives of the objectors' railroads presented exhibits purporting to show the effect of the operation of the Auto Transportation Company upon the passenger revenues of the rail carriers. This was done by a check showing com-

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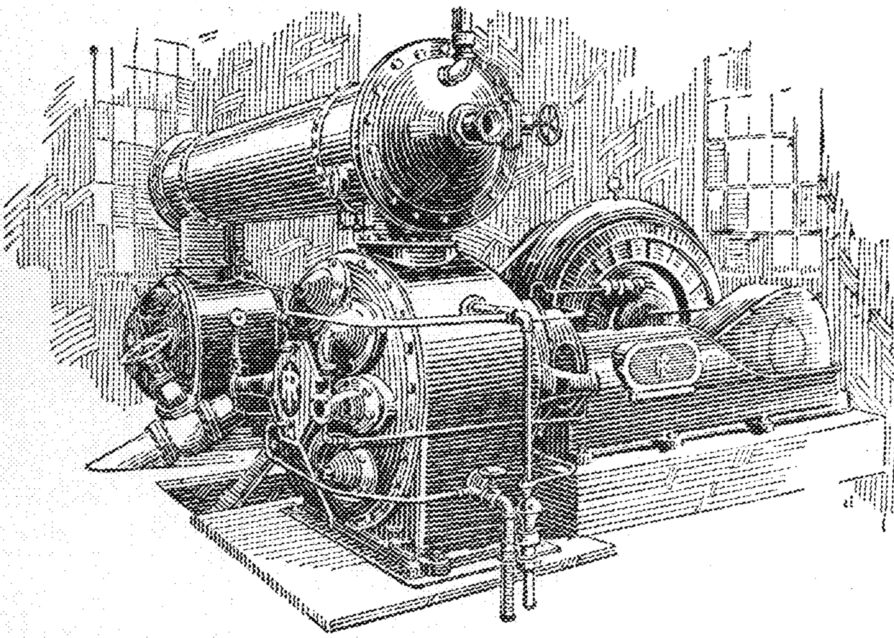

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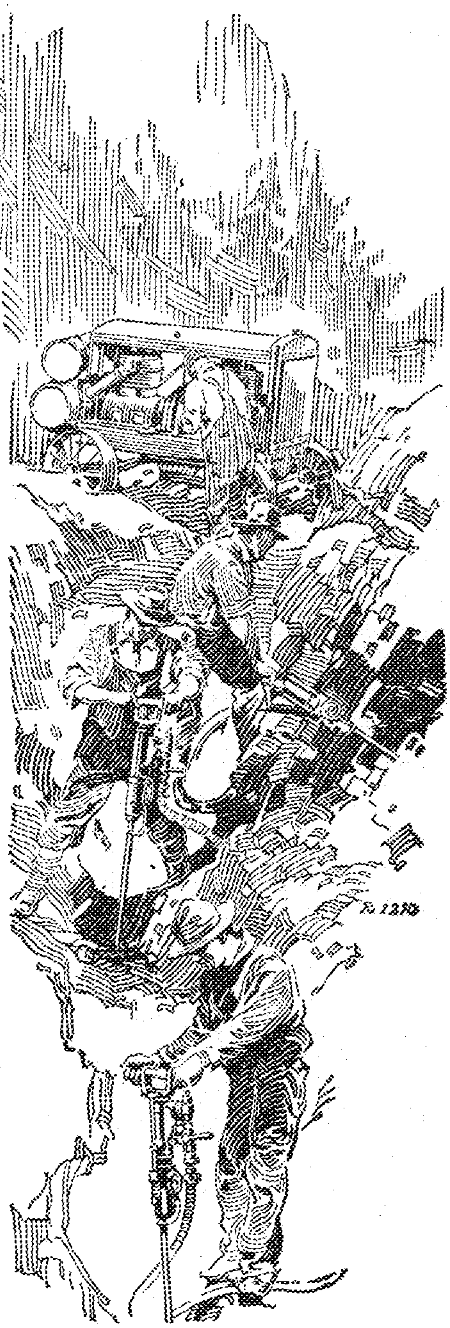

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WITH OUR ALUMNI

(Continued from page 15)

precepts of Horace Greeley and believes in the famous quotation, "Go West, young man, go West." He is now an instructor in the department of architecture of the University of Idaho, Moscow, Idaho.

"Bill" Towers has migrated to the sunny South and is an architect in Nashville, Tennessee.

Dewey Gerlach remained loyal to Minnesota and is now working with his brother, Henry Gerlach, who is an architect in Mankato.

Among those of the class who could not pull themselves away from the Twin Cities is Clyde Lighter who is with Colburn and Forsell, Architects, in Minneapolis.

Muriel Ehrenberg also remained in Minneapolis, and is practicing interior decorating with the William A. French company.

W. H. Edwards is working in the office of Ellerbe and Co., Architects, Saint Paul.

CIVILS

'18—Leon E. Battles with his wife and two daughters, aged 4 years and 2 months, have been in Minneapolis for a few days this month visiting friends. Mr. Battles is with the Oliver Iron Mining company, Coleraine, Minn., on open pit mine operations.

'19—R. T. Elstad is also with the Oliver Iron Mining company but is located at Chisholm. He was formerly at Coleraine.

'23—John J. Schlenk left in June of this year for travel abroad.

'24—N. Reeve Hankins is on subdivision work in the Park Rapids region. He was in Minneapolis for a few days looking for rodmen and chainmen.

'24—Walter Wilson is employed by the A. Nelson Contracting company, Duluth, and is on a paving job at International Falls.

Many recent graduates from the civil department were back to root for Minnesota at the Notre Dame game. Philip L. Berquist, '24, is assistant division roadmaster for the Great Northern Railway and has headquarters in St. Paul and Williston, Mont. E. T. Berquist, also of the class of 1924, is an engineer with the Minnesota State Highway Department.

Two of the 1925 graduates who were back for the game are *Horace W. Nutting*, who is inspecting paving for the highway department at Winona, and H. N. McAndrews, instrumentman for the C. M. & St. P. railway and located at Mason City, Iowa.

'25—Carl H. Gerdes was bitten by the wanderlust bug and is now in Venezuelas, South America, where he is on surveys for oil leases for the Standard Oil company.

The Minnesota civils in Chicago are a live crowd. They have established a Minnesota Engineers' Club, consisting mostly of 1925 graduates at present, and a meeting is held about once a month where they discuss news of Minnesota engineers and entertain any alumni who may happen along. Their organization is partly affiliated with the General Alumni Association and has held several picnics during the summer and made one excursion trip to Milwaukee. Two of the members are Arthur Kroll and "Baldy" Eilers, both '25 men and working on the Illinois Central. "Art" is a rodman in the building department while "Baldy" is with the maintenance of way.

'25—Neal Bartholemew is also with the Illinois Central but is located in Paducah, Ky., where he is working on the general building details of the new $6,000,000 division point of the Illinois Central. Neal is another graduate who has acquired undue independence since leaving Minnesota as he had the temerity to get married recently without the permission of Mr. Zelner.

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WITH OUR ALUMNI

(Continued from page 20)

'25—"Dinty" Olson is in Chicago designing reinforced concrete.

'25—Fred H. Larson is a rodman on maintenance of way for the A. T. & S. F. railway, and is located at Newton, Kansas.

'26—Clarence V. Lund is running lines and levels in the construction of the monstrous new state capital building at Lincoln, Nebraska. "Happy" requests that all and sundry of C. E. '26, plus or minus, write to him at 1681 Smith Street, Lincoln, Neb. Rumor has it that C. V. is getting homesick for Minnesota Indian summers.

ELECTRICALS

'23—C. M. Burril, who entered the students' engineering course of the General Electric company, Schenectady, New York, is one of a group of seven which constitutes the first graduating class in the three-year course in advanced electrical engineering. Leading engineers decide upon subjects that are essential to highly trained engineers and base the course upon their findings. The school is directed by R. E. Doherty, consulting engineer.

'24—Lawrence C. Warren is now in the International General Electric company at their main offices in Schenectady, New York, after spending two years in the test departments and engineering offices. He is preparing for foreign service with that branch of the General Electric and will in all probability go to South America.

'24—Fayette C. Anderson, who has been with the General Electric company in their engineering and test departments, will leave this fall, taking up work as an instructor in Lehigh University, Bethlehem, Pennsylvania. He will teach in their engineering department. In addition to his regular work at G. E., Anderson has taken one year of the advanced engineering course offered by that company under the tutelage of R. Doherty, chief engineer, who has taken the place of Dr. Steinmetz after the death of the latter.

'24—Harold Dahl has been transferred to the New York office of the Electric Machinery company. He spends most of his time traveling in the East, and can be addressed at 52 Vanderbilt Avenue, New York City. The company's headquarters and factory are located in Minneapolis.

'25—Philip Embry Richardson has finished his course in the Student Engineering Department of the General Electric company, Schenectady, and has been transferred to the Fort Wayne sales office of the same company.

'26—Win C. Hilgedick drove across country to Boston the latter part of July accompanied by friends. He sailed from Boston on a freighter as a radio operator for the Radio Corporation of America. Win intends to sail around the seven seas, returning to the U. S. in a year or so.

'26—Alvin Mann, Gus Haedecke, and Robert Hargreaves are now test men at the General Electric company at Schenectady, New York. They made the trip across country in an open Ford, the total cost being only about $20. They are staying together at No. 1 Willow Avenue, Schenectady, and are employed in the radio test division of the works.

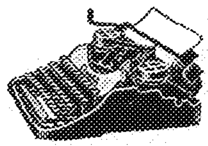
'26—Paul B. Nelson, managing editor of the Minnesota Techno-Log for the past year, is now Assistant Editor on the staff of the Electragist, the official journal of the Association of Electragists—International, with headquarters at New York City. He is back in Minnesota for two weeks to attend the annual conference of the Engineering College Magazines Associated which is being held at the University of Minnesota this year.

'26—Robert A. Beveridge is in the commercial department of the small motors division of the General Electric company and at present is located at Fort Wayne, Iowa. "Bob" writes that there are four other Minnesota men there; Hoyt Cass and Carl Ellis, '24, Philip Richardson, '25, and Paul Salstrom, '26.

MECHANICALS

'22—Floyd C. Olmstead, who is the technical advisor for the Association of Oil Burners of New York City, has just finished writing a manual on domestic oil burning for the Association, and is now compiling a handbook on industrial oil burning for the organization. Mr. Olmstead was married in August and returned West for this important ceremony.

(Continued on page 30)



"The Caissons Go Rolling Along"

(Continued from page 8)

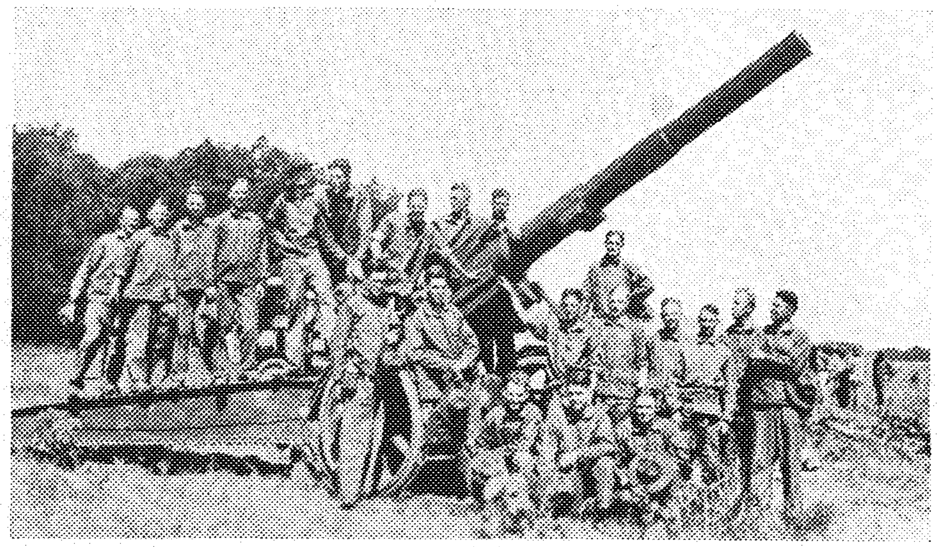
war-time ammunition with the ensuing danger of defective material, every man in the gun batteries had to "hit the concrete" before the gun was fired; consequently much of the glamour attached to heavy artillery firing was lost as we could not "ride the gun." In the 155 mm. firing, one of the disadvantages of training a Coast Artillery unit at Fort Sill became evident. As our natural target was a battleship at sea, we had to assimilate firing at a moving object by assuming a certain path of the target out in the field of fire, and by placing stakes at hundred yard intervals to indicate the changing positions.

The third week we fired the machine guns in anti-aircraft practice, using small balloons as targets. We drew the 75 mm. truck-mounted anti-aircraft guns and spent the week in intensive drill in their use, interspersed with hours of "Squads East." After the "hilarious fourth" we fired the 75 mm. A. A. guns. In this firing we used sleeve-targets towed by airplanes at an altitude of 2,000 feet, varying the single shots at times by shooting in bursts.

We also waged war on the bootleggers and had quite an interesting time. Three civilians in a big touring car rushed the guard and drove out into the field of fire. Ordering the firing to cease, two of our officers pursued the car, stopped it, and finding it loaded with liquor, proceeded to demolish the cargo by smashing the bottles on the fender, while 100 coast artillerymen almost died of thirst on top of Adams Hill.

The fifth week was a hot and heavy one as first call sounded at the unearthly hour of 4:45 A. M., and taps at 10:00 P. M. The long mornings were spent on the rifle range practicing and shooting for official record. Some of those mornings were so cold that the explosive language directed at the bugler often froze in midair.

The final week was Honor Week during which Honor officers were in command. Each school was entitled to a number of officers proportional to the number of men from that school. As a result, Minnesota, Kansas, and Washington universities each had one battery commander who held office for one week. Kansas State Agricultural College had two commanders as it was represented by the greatest number of men. The various platoon officers and noncommissioned officers were selected and announced each week. The two men selected from Minnesota were Nyquist, captain, and Behan, lieutenant, battery



MINNESOTA MEN AT FORT SILL

From left to right, standing on gun: Giessel, Robinson, Morris, Leegard, Pearson, Nyquist, Schaller, Christenson, Hanson, Gehring.
Standing on ground: Turrittin, L. Johnson, Barthelemy, Lundsten, Hoving, McDaniel, Barrie, Rosing.
Seated: Elston, Cooper, Behan. (Four men not in picture.)

commander and leader of the 1st platoon, respectively.

From the foregoing one would think that our camp was all work and no play, but that was not the case by a great deal. Every afternoon we participated in some form of athletics,—swimming, baseball, volleyball, tennis, golf, horseshoes, or track. Competition in these sports was held between individuals and between the three platoons. The members of the winning baseball team were given airplane rides which were regular thrillers, as Carter, of K. S. A. C., can testify. He inadvertently mentioned to one of the aviators that he had done some stunt flying and wanted the pilot to give him all there was. He got it, too, and came down green in the face and minus three meals.

Every Tuesday and Friday night we had a dance at the Officers' Club, with music furnished by the famous Foster's Frolicking Syncopators, an orchestra composed of camp talent. On other evenings we had song mixers at the Hostess House. There were movies every evening at the War Department theater and at the theaters in Lawton. Medicine Park, a beautifully situated resort in the foothills about eight miles from camp, attracted most of our engineering "sheiks." The boys from "The Land of Ten Thousand Lakes and Ten Million Swedes" certainly made a hit with those charming belles of the Southland. They were particularly interesting to us engineers as our college career is spent in the abstract field of triangles, curves, and contours. It will be a long time before we forget awakening at 3:00 A. M., July 5, to attend the Sunrise Dance at Medicine Park.

For those who did not dance, there were side excursions to Lawton, Wichita Falls, Texas, Craterville Park, Lost Lake, the Greenhouse—trips which were all full of interest. Many of us attempted to break speed records climbing Mt. Scott, and others explored the Wichita National Forest Reserve.

All in all, the camp was a great success. We enjoyed it immensely and most of us gained quite an insight into the duties of an artillery officer. Our officers were gentlemen who did their best to make our camp a happy, healthy, and educational one. We experienced all the phases of army life except serving in the guardhouse, and some of us even spent time in the hospital when the Surgeon-General exhausted his store of cures, the well-known remedy for one and every ailment.

On July 23, after checking in the last bit of equipment, we reported to the paymaster to wait for the eagle to scream. Most of us left camp that day, having performed the fond farewell stuff the night before. Some went south, others went home via the Mississippi valley, and still others went West. Our particular group toured through the Texas Panhandle and New Mexico, drove across Colorado, sang "Minnesota, Hail to Thee" on the top of Pike's Peak, wandered through Nebraska and over the Black Hills, and journeyed eastward until we finally reached Minneapolis. Upon our arrival, we dispersed, having agreed unanimously that our trip and camp had left nothing to be desired.

The Motor Bus in Minnesota

(Continued from page 18)

parative falling off of passengers at stations which were served by the petitioner and the objector carriers, and also stations which were served only by the objector carriers. A close analysis of these exhibits and figures demonstrates their unreliability for the purpose for which they were advanced. A conclusion drawn from them in one direction or the other will be upset by a change in the combination. The applicant contends that the fertile field for increasing his business is the private automobile owner and that his success depends principally upon his ability to convince such owner that the public motor vehicle is the economic mode of transportation. He contends he is able to do this by reason of his ability to operate at a less cost than the rail carrier.

"The objector railroads likewise contend that in the absence of the public motor vehicle this same field would be to their advantage. This is but a form of the argument that existance of railroad transportation negatives convenience and necessity for motor transport of passengers, and is weakened by the fact, of which we take notice, that one of the principal steam carriers in the state operates the largest Auto Transportation Company under a Certificate of the Commission issued upon proof of convenience and necessity, and which competes for passengers with its controlling railroad.

"We believe that proof of public convenience and necessity does not require absence of railroad passenger service, but must be deducted from the transportation needs and convenience of the public in the light of present day habits and methods of travel, and not under conditions which prevailed before the automobile became an economic factor in the everyday life of the nation."

That the sentiment of the railroads is changing is indicated not only by the entry of the Great Northern in the motor bus field, but also by the statement of President Gorman of the Chicago, Rock Island & Pacific Railroad Co. This railroad was one of the five that opposed the granting of Certificate to the Jefferson Highway Transportation Co. Mr. Gorman later, however, in addresses delivered in Faribault and at Hollandale, expressed the view that the motor bus had come to stay where it had won the patronage of the public, and that the railroad had to make its adjustments accordingly in matters of development.

The motor bus in the future must owe its success to its ability to serve a public that is more and more becoming motorized. The bus must serve efficiently and more economically than the private motor car if it is to continue to succeed. In Minnesota there is an automobile for every five persons. This ratio will, no doubt, continue to grow closer. The bus operator must serve intelligently according to the best interests of a public that is quick to show its independence of any transportation system by the use of its own private vehicles. But the public likewise is quick in its appreciation of service. The future possibilities along this line are probably best illustrated by a comparison of the passenger records of one of the representative motor bus companies. During the year ending July 31, 1925, this company carried on two of its lines a total of 240,377 passengers. In the following twelve months period ending July 31, 1926, this company carried 283,242 passengers, or 42,865 more passengers, an increase of approximately 18 per cent.

The public has accepted the motor bus in Minnesota as an established institution.

It is today entirely under the authority of the state as a regulated utility. Already there is a movement on foot to place all motor bus operations in the country under the federal jurisdiction of the Interstate Commerce Commission. Minnesota already has experienced her lack of control over rail operations because of federal legislation. It is not likely that she will favor any loss of authority over transportation on her own highways. The motor bus must serve the interests of the public. It has demonsrrated that it can do this in Minnesota under the regulatory authority of our own utility Commission.

The Wages of Engineering

(Continued from page 5)

who figured for long hours, pushed a slide rule endlessly, and thus made the building safe for use of human beings, is out of the picture.

But what would it avail if the engineer got front page stories, and perhaps his photo in the rotogravure section occasionally? Everything. Mr. Banker would think of his brother way down the list as the fellow who puts up his buildings, and constructed that railroad whose stock went up several points recently. The butcher, the baker and the rest of that famous crew would soon realize the importance of their fellow tradesman away down—. No, if this thing were true, Mr. Engineer would not be near the bottom; no he would be near the top and pushing the top-notchers hard.

The time has come when the engineering profession must stand on its hind legs, shake its fist, and rightfully demand recognition.

We have said that the average engineer is reticent. A large association of American manufacturers recently asked their employees what they would take if they had the opportunity to attend college again. The majority replied: English and Public Speaking. This would indicate that these men, long out of college, had found out that they lacked power of expression. Lack of forwardness is, then, perhaps due to proper method of "telling the world," and not because they have nothing to say.

The proper teaching of English in engineering colleges has been neglected to a great extent in the past. Recognizing this fact, the Society for the Promotion of Engineering Education has just finished conducting a special investigation, resulting in some beneficial discoveries.

Some propose a five-year course in order that a certain amount of electives may be taken. As the requirements that a technical graduate must fulfill increase, we predict a slow but certain change, and betterment of the undergraduate curricula.

What about those members who quit strict engineering and have gone into far different fields of endeavor? An engineering training is valuable though the graduate follow the profession of our upstairs neighbor, the veterinarian. A fundamental knowledge of natural phenomena is gained, powers of concentration are strengthened, an analytical mind is developed and real hard work is constantly experienced. Methods of solving problems are mastered. In many ways, the technical graduate is equipped to solve life's biggest problem, that of life itself.

Engineering has a multitude of phases each requiring a technical background, but yet requiring a specialization in some line of work quite removed from the realm of integrals and indeterminates. From a standpoint of economics, it is folly for an engineering graduate to wholly desert his profession. If a man has sales ability, if he has a legal trend of mind, if he would till the soil, or if he likes to write, there is a definite place in engineering for him. The term 'engineering,' like the minds of some American people today, is becoming more broad. A sales engineer is a salesman and an *engineer*. A patent attorney possesses knowledge both legal as well as scientific.

The profession is large enough and broad enough to absorb every graduate, whatever may be his peculiar likings. No doubt, if the tabulation given previ-

(Continued on page 30)

WITH OUR ALUMNI

(Continued from page 22)

'23—William J. Darmody is now doing experimental work with the U. S. Bureau of Standards in Washington, D. C.

'23—A. W. Luce is instructing in mechanical engineering at Lehigh University this year.

'24—Charles G. Simms, who was formerly with the Wisconsin Public Service Corporation, is now with the A. C. Spark Plug company at Flint, Michigan.

'26—Harold Rollin started work in the machine shops of Proctor and Gamble Company, Cincinnati, Ohio, upon graduation, but has since been promoted to the Crisco can plant.

'26—Clifford Comfort is also with Proctor and Gamble in the Crisco plant. He reports that prospects for advancement are excellent with this company.

'26—Donald E. Letson is now affiliated with the Timken Roller Bearing company.

'26—Larry O'Donnell is engaged in graduate work at the University of California this year where he received a Studebaker Fellowship.

'26—Leonard S. Kleinfeld has been spending the summer in the Graduate Students' Training Course of the Allis Chalmers Manufacturing company at West Allis, Milwaukee, Wis. He is now doing design work for that company.

CHEMISTS

'10—J. C. Tronson is a chemical engineer in the ore testing laboratory at the University of Minnesota.

'21—Meryl Seymour is doing graduate work in chemistry at Princeton.

'22—Mr. Darling and R. B. Ellestad have accepted positions at Harvard. Mr. Darling is an instructor and Mr. Ellestad is an assistant to Prof. Baxter, who is internationally recognized as an authority on atomic weights.

'23—J. W. Pagnucco and L. H. Shirk, '26, are now with the Proctor and Gamble company at Ivorydale, Ohio, in the capacity of chemical engineers.

'23—R. C. Ernst and A. S. Smith, 26, are now members of the faculty of the University of Louisville at Louisville, Ky. Mr. Ernst is the head of the department of chemical engineering and Mr. Smith is an assistant in that division.

'24—I. Lavine has returned to the University this fall and is now doing graduate work in chemical engineering toward his doctor's degree.

'24—Raymond C. Fuson, Ph. D. '24, has a national research fellowship at Harvard.

'25—E. B. Ayers received his master's degree last spring and is now chemical engineer for the Skelly Oil company at Eldorado, Kansas.

'25—A. A. Reiter is now an instructor in chemical engineering at the University of Wisconsin.

The following 1926 alumni are graduate students in Chemical Engineering at the University of Minnesota: K. A. Kobe, J. Kugler, R. C. Murray, W. H. Schlafge, L. L. Johnson, and E. Sverdrup.

'26—Henry Jerabek is at home managing his father's business this year. He expects to return to the University next fall.

'26—A. Lewenstein has accepted a position with the Appleton Coated Paper company at Appleton, Wisconsin.

'26—Marvin Rogers has a chemical engineering fellowship at the University of Michigan.

MINES

'26—Tom Andrews has left Minneapolis recently to sail for N'Changa, Rhodesia, where he will be employed by the Anglo-American Corporation as a geologist. H. E. La Tendresse, '23, is also in that region.

THE WAGES OF ENGINEERING

(Continued from page 28)

ously were rechecked and the salaries of sales engineers, legal engineers and like were counted with the rest, the results would place it far higher in the wage scale.

Many things point to a change in the profession; some are optimistic to believe that the engineer of tomorrow will cast aside his cloak of lethargy and with a voice, trained in the powers of expression, shout: "Listen, World."

What about our Italian friend we left back in New York? Poor Tony. He was only experiencing the "set the world afire" desires found in the heart of every ambitious recent graduate.

NELA PARK—A HUMAN ORGANIZATION

(Continued from page 10)

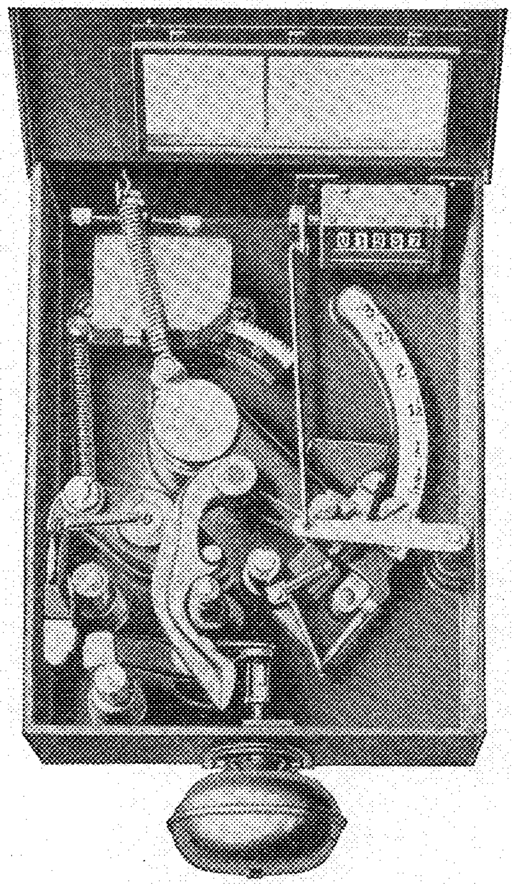
accompanied the soup overture and toned in with the celery crunching chorus. Spontaneous cheers and college songs kept the chandeliers swaying. Minnesota, having the largest delegation present, had no trouble in making herself heard, although some claimed an unfair advantage was gained by standing on the tables. Souvenirs and certificates were given to each of the men and prizes were awarded to the three men whose grades in the classroom problems were the highest. The Minnesota delegation was proud to learn that the first two prizes were won by two of its members. With the cheers for the organization and for the men who had so ably planned and conducted the course, the final banquet came to an end; and with it the 1926 Junior School of the Nela School of Lightning.

Standardized Concrete

KOEHRING HEAVY DUTY

This illustration of the Koehring escapement type batch meter shows the method by which the discharge chute is automatically locked as soon as the charge enters the drum. The discharge chute cannot be moved until the regulated mixing time has elapsed, when it automatically releases the discharge lever and signals the fact with a bell. The meter also registers each batch that enters the drum.

Patent Nos.
1,321,460; 1,282,558, 1,338,761.



THE Koehring Company long ago foresaw the *value* of standardizing concrete,—foresaw and provided for it before the tremendous volume used in constructing roads and permanent structures made standardized concrete a vital *necessity*.

One of the most important means of insuring a uniform strength and quality of concrete is the Koehring Batch Meter,—a positive means for timing each batch and measuring the thoroughness of mix. This device, upon being set for the specified mixing period, automatically locks the discharge chute as soon as the drum receives the materials; the discharge chute cannot then be operated until the full specified mixing time has elapsed.

Every state highway department requires, in its specifications for concrete highway construction, the use of batch meters. This Koehring development is an integral unit on practically every paving mixer today,—a Koehring contribution to the industry.

The Koehring mixer, with the Koehring batch meter, Koehring five action re-mixing principle, and the Koehring automatic water measuring tank, provides the most positive mechanical means yet developed for producing standardized concrete of unvarying uniformity.

KOEHRING COMPANY
PAVERS, MIXERS—GASOLINE SHOVELS, CRANES, DRAGLINES
MILWAUKEE, WISCONSIN

KOEHRING

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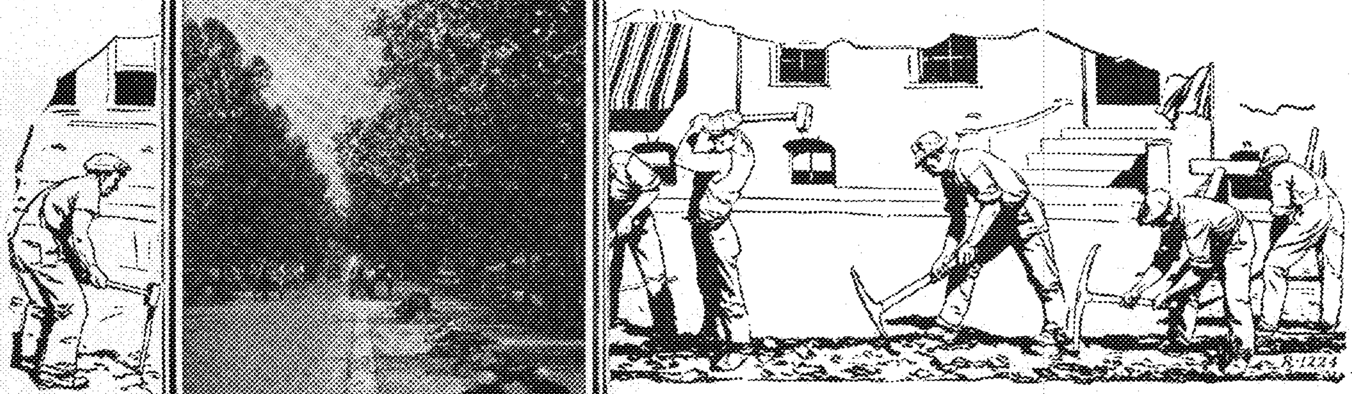

The pneumatic Paving Breaker does the work of 15 hand laborers.

Evolution of the Ditch-Digger

Some years ago, when little boys used to yell "Get a horse" at the hesitant and asthmatic vehicle which was the ancestor of the modern automobile, the term *ditch-digger* identified the man who had to perform the hardest labor imaginable. Squads of these workmen would be in the street with their crowbars and hammers, and there was always the sound of metal ringing on metal as the ponderous hammers descended. The passers-by would wonder that no hand was crushed in the process.

That was before the development of the Paving Breaker. Work that fifteen men took a day to perform is now accomplished by one man. Compressed Air has supplanted the uncertain human muscle, and the ditch-digger is no longer the man but the machine.

In this instance, as in a hundred others, Ingersoll-Rand Company has enlisted the aid of Compressed Air in the elimination of wasted time and effort.

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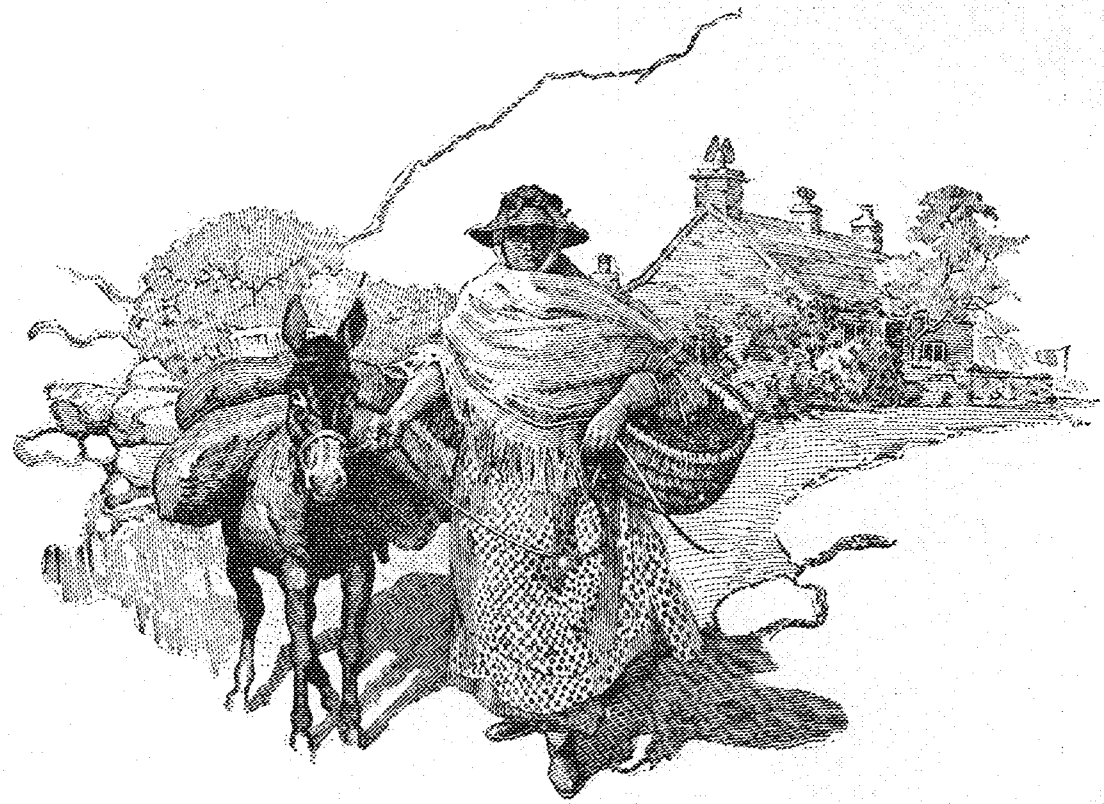

THE UNIVERSITY OF MINNESOTA

THE MINNESOTA TECHNO-LOG

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Villa Lante near Viterbo, Italy • • ~ • • The Upper Terrace

JOHN THOMAS GRISDALE

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VII NOVEMBER 1926 Number 2

Loading Telephone Lines

Many difficulties are encountered when new inductances are added to underground and serial cables.

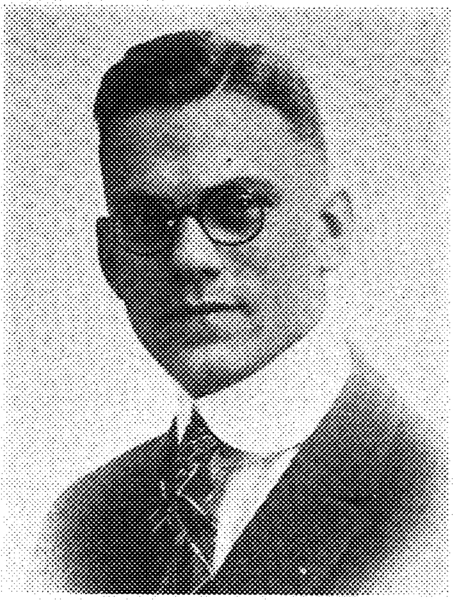
By GEORGE W. SWENSON, E. '21

Assistant Professor of Electrical Engineering, University of Minnesota.

IT is generally known among engineers that a circuit consisting of a pair of wires used for transmission of power has considerable electrostatic capacity and comparatively small self inductance. This holds true whether the conductors are aerial open wire or a cable pair. A cable pair, however, will have greater electrostatic capacity and smaller self inductance than open wire conductors due to closer spacing and higher dielectric constants. These effects are more noticeable and constitute a greater problem in medium and high frequency low power transmission, than in low frequency high power transmission. The former refers naturally to telephone frequencies, and the latter to 60 cycle power transmission.

In addition to the capacity and inductance of telephone lines, there are the resistance and leakage factors which affect the transmission of alternating currents. These factors are all uniformly distributed over the line, but can be approximately represented as concentrated for a small section of the line provided the line has many such sections.

The effect of the above factors on transmission is to cause the current to decrease in magnitude successively along the line and to transmit some frequencies more faithfully than others. The former effect is known as attenuation, which may be defined as the progressive loss along a telephone line due to the combined effect of resistance, inductance, capacity and leakage. The latter effect is known as distortion, and may be defined as the changing of the shape of the original wave form and affecting the quality of transmission. Attenuation may become so great on long lines as to reduce the volume at the receiving end to an inaudible quantity. The distortion may become bad enough to make the received sound unintelligible. It is obviously desirable to reduce both attenuation and distortion to a minimum. The better to analyze conditions, consider the equation which expresses at-



GEORGE W. SWENSON

tenuation in terms of the constants of the line:

$$\alpha = \sqrt{\tfrac{1}{2}\sqrt{(R^2+\omega^2L^2)(G^2+\omega C^2)}+\tfrac{1}{2}(GR-\omega^2LC)}$$

α = Attenuation per unit length
R = Resistance " " "
L = Inductance " " "
C = Capacitance " " "
G = Conductance " " "
$\omega = 2\pi \times$ frequency

This equation may be developed from the known constants of any line, whether it be aerial open wire or cable conductors. If cable conductors are considered, the leakage will be small on account of the large insulation resistances and it may be reasonably assumed that G=O. The above equation then reduces to:

$$\alpha = \sqrt{\frac{\omega C}{2}\left(\sqrt{R^2+\omega^2L^2}-\tfrac{1}{2}\omega L\right)}$$

A study of this equation shows that as L is increased, the attenuation constant will be decreased. However, the attenuation constant will vary with different frequencies, which means that the higher frequencies will not be transmitted as well as the lower frequencies due to the excessive capacity of the line.

In 1893, Oliver Heaviside proposed that inductance of telephone lines be increased by adding inductance in some form or other in order to counteract the mutual capacity of the lines. This suggestion was followed by Professor Pupin's patents in 1900 which proved mathematically that coil inductances could be inserted in the circuit at certain intervals and, if not too far apart, would very nearly stimulate uniformly distributed inductance. Professor Pupin proved that if more than 3.1416 coils per wave length are used in lumpy loading, the variation from a smooth line is now more than four per cent. This type of loading has been most generally adopted in commercial work. Cable may be uniformly loaded by winding spirally an insulated ribbon of magnetic material, usually permalloy, around the conductor. This method is expensive commercially, and impractical except for ocean cable where loading coils cannot easily be used.

The coils used for loading telephone lines are called loading coils. There are two coils on each core, one connected to each side of the line, for physical circuits. For phantom circuits, there are four coils on each core connected in such a way that they are inductive in the phantom circuit, and non-inductive to the side circuits.

The cores used in loading coils have had several stages of development. They are torroidal in form, and were first made with the stack of soft iron stamped rings insulated from each other. The next step was the use of soft iron wire cores. A later improvement was the use of powdered iron pressed cores. Practically all of the present cores are of this type. The eddycurrent loss is very low. In order to decrease the size and weight of load-

(Continued on page 52)

Illustrations and Their Manufacture

It is said that a picture is worth 10,000 words; if this is true, the engineer who can use one wisely has a great force at his disposal

By W. H. KIRCHNER *and* A. S. LEVENS
Dept. of Draw. and Desc. Geom.,
University of Minnesota

THE engineer often makes use of the art of printing. The scope of the work varies from the simple ticket or form to a report or survey of several volumes. The illustrations likewise cover the whole field from the mathematical diagram to the colored picture.

It is hoped that this brief description of the most common processes will assist the engineer in the preparation and selection of his materials and enable him to appreciate the possibilities of the many printing and engraving methods.

Line Engraving

Zinc etchings, frequently called line engravings, can be made by a photo-engraving process from a drawing that is made up of distinct lines, dots, or masses of black. Although drawings in strong red, dark green, or dark blue masses can be reproduced, the best results are obtained when the drawing is made on a white surface with black India ink.

In general, a satisfactory zinc etching cannot be made directly from a photograph, a colored specimen, or a wash drawing. Hence, it is necessary to make a drawing in black and white only.

After the copy has been prepared, the size of the required cut being known, a photograph is made. In the negative all of the black lines and masses on the copy show as clear glass while the white paper appears a dense black.

In the wet plate process, the negative is then stripped from its glass support, reversed so as to maintain the correct relationship of left and right, and placed in a printing frame in contact with a piece of polished zinc which has been coated with an emulsion that will harden when exposed to a powerful light. The light passes through the portions of the negative which show clear, hardens, and renders insoluble the sensitized coating on the zinc plate.

The plate and negative are removed from the frame, and an inked roller passed over the plate. The soluble parts of the emulsion are washed off. The plate is now dusted over with an etching powder that adheres to the inked lines. Fusion of the powder with the ink is brought about by heating the plate. In this manner a resistant to the acid which is used to eat away or etch the exposed or naked parts of the plate is formed. After the plate has been etched it is cleaned. It is next inspected by an engraver who trims and cleans out th lines that may have been partiall closed. The quality of the cut depend largely upon the amount of work per formed by the expert engraver at thi stage of the process.

The plate is then mounted on wooden block so as to make the plat and block type high. Proofs are struc off and the cut and proofs are ready fo delivery.

Half-Tone Engraving Process

The half-tone process is both photo graphic and chemical in nature. Half tones are made on copper when the illus tration is to be printed in the bette grade of books, magazines, and book lets. Zinc is used for stereotyping an printing in newspapers. Copper half tones will reproduce the more delicat gradations of light and shade.

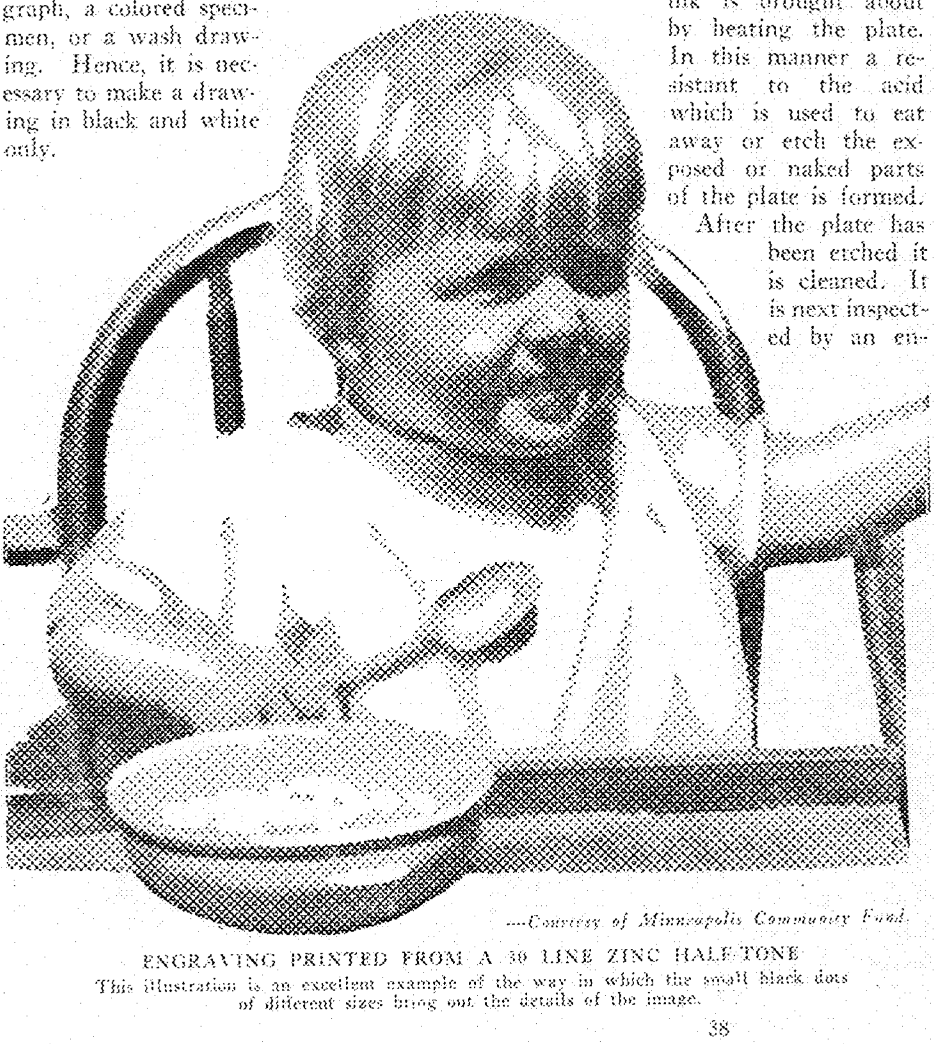
In making a copper half-tone of photograph, a negative is made as i the line engraving, except that the ligh passes through a screen before it fall upon the glass negative plate. Thi screen, known as a half-tone screen, con sists of two pieces of glass that are rule with parallel lines and joined togethe so that the lines of one glass run a right angles to the lines of the othe glass. The rulings on the variou screens run from 30 to 200 lines pe inch. The effect of the screen is t break the image into a large number o small areas. The composite resemble a very fine mosaic (See illustration).

If the illustration is observed closel it will be seen that the tones are no solid masses, but tiny squares or dot of different sizes, depending upon th strength of the tint. The texture pro duced by the screen is hardly noticeabl in the darker portions of the illustra tion, but in the lighter areas the squar dots may be seen easily, and in th brightest parts the dots are round an small.

The process of making the plate very much like that followed in th preparation of the line engraving.

After the plate has been heated an etched with an acid that eats the coppe between the dots, the plate consists a picture composed of dots in relief.

The half-tone can be made from great variety of originals. They ma possess any tint varying from pure whit to the darkest of grays. Half-tones ca be made from photographs, wash draw ings, water-color paintings, lithograph photogravures, steel engravings, or d rectly from the object itself. It is ev dent that in the translation of colo into black and white, the actinic valu



—*Courtesy of Minneapolis Community Fund.*

ENGRAVING PRINTED FROM A 30 LINE ZINC HALF-TONE
This illustration is an excellent example of the way in which the small black dots of different sizes bring out the details of the image.

of the different colors must be taken into consideration in order to obtain satisfactory results.

On news print and similar papers coarse screens are generally used. Zinc half-tones of 55, 65, 75, or 85 line screens are commonly employed for these purposes. If a better grade of paper is used and the printing is done directly from the half-tone, a 100 or 120 line screen could be used. For book and magazine work on the finer grades of paper, half-tones made in 120, 133, 150, or 175 line screens can be used, according to the quality and surface of the paper and the requisite definition of detail desired.

Rotary Photogravure

Photogravure sections of the metropolitan dailies are examples of one of the most perfect and unique processes that has been devised for reproducing copy in monotone.

The original process consisted of printing from an etched copper plate. This plate was made intaglio, that is, the engraving is not relief as in the line engraving and the half-tone engraving, but is sunk below the surface of the plate. The plate was inked by hand, wiped off, and placed in a hand press for printing. The ink was retained by the cavities, the paper forced into the plate, and thus a positive was obtained. Each impression necessitated re-inking, wiping, and printing. This process could not be employed for rapid cylindrical press work.

Only within recent years has this process been available for general newspaper and commercial uses.

The improvement is mainly in the method of printing, which is done on a rotary press from an etched copper cylinder.

A negative is first made of the object or picture to be reproduced. From the negative a positive is made. Then carbon tissue coated with gelatine and a pigment is sensitized with bichromate of potash and placed in a printing frame in contact with the positive and exposed to the light. The print is then exposed under a fine half-tone screen which differs from the ordinary half-tone screen in having white cross lines instead of black lines. The carbon tissue is now immersed in water for a short time and then placed in close contact with the copper cylinder. After the carbon tissue has set and dried, the paper backing is removed, leaving a developed gelatine film or coating on the cylinder. The cylinder is then etched. Practically everything essential to the production of an excellent rotogravure depends upon the skill and judgment of the etcher.

Printing is done from the etched cylinder which passes through a bath of thin ink. The surface of the cylinder is cleaned of the ink by means of a fine scraper, or "doctor" as it is commonly called, leaving the ink in the recesses. The print is made from the etched cylinder on special roto paper by means of a rubber roller. Some of the newspapers have now enlarged the field of rotogravure and are reproducing pictures in colors.

The Offset Process

This process is a method of surface printing. The theory of surface printing depends upon the lack of affinity between grease and water. The image which is to be reproduced is either drawn, transferred, or photographed onto a metal sheet which is either zinc or aluminum. The surface of the sheet is grained so as to retain moisture. The sheet is then treated with a solution of gum and acid to assist the blank parts to absorb moisture and to increase the adhesion of the inked copy to the metallic surface.

The press used in offset printing consists of three important parts, the plate (sheet) cylinder, the blanket cylinder, and the impression cylinder. These cylinders are of the same diameter. The zinc (or aluminum) plate is placed around the upper cylinder. In contact with it are two small rollers, one which keeps the plate moist, and the other for inking the design. After the plate cylinder has been moistened and inked by the small rollers, it prints the drawing on a rubber blanket which is around the blanket cylinder. The impression on the rubber is in reverse, since the original drawing on the metallic surface was positive.

The design in reverse is impressed on the paper, which passes around the third cylinder, thus producing a positive surface print.

The plates may be protected and stored for printing future editions. One of the advantages of this method of printing is the increased number of copies which can be made at one time, due to the fact that the original can be transferred as many times as the space permits.

The offset method is well suited for printing on hard papers, such as bond papers, note headings, check blanks, and similar work on which satisfactory results are obtained.

Special inks and suitable papers are of the utmost importance for obtaining the best results.

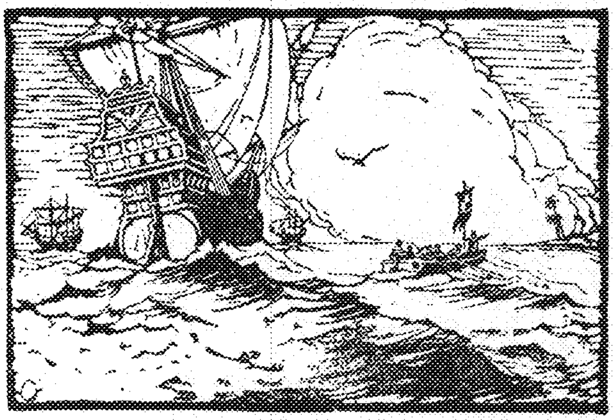
Lithographers are using the offset process quite extensively since it enables them to take advantage of the speed obtained by using a rotary press and to some extent is supplanting the use of the lithographic stone.

Electrotypes and Their Manufacture

Electrotyping is a process by which type forms or cuts are duplicated to produce a number of printing plates like the original.

The wax-mold method is used to duplicate type forms, line engravings, and some half-tones in the coarser screens. The original type matter or plate is impressed in wax which forms an exact mold, but in reverse to the original from which it was made. Since the original is in reverse like ordinary type, the mold is positive. The mold is

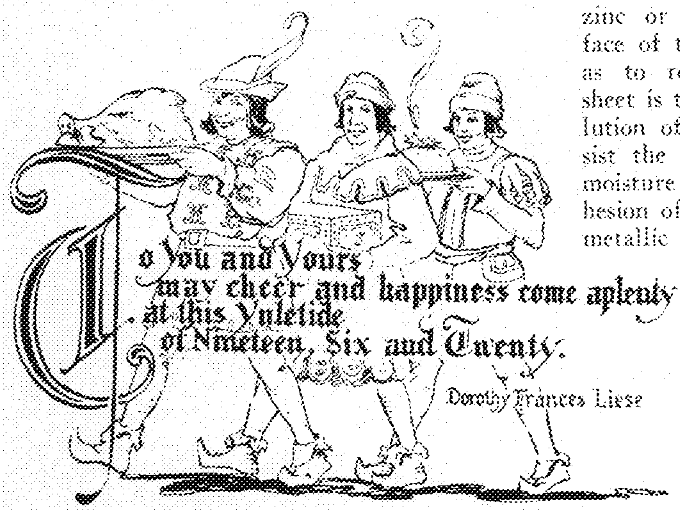
(Continued on page 58)



REPRODUCTION FROM A STEREOTYPE

This print was made from a zinc cut cast from a matrix. Compare with the line engraving below.

—Courtesy of Minneapolis Trust Company.



PRINTED FROM A ZINC ETCHING

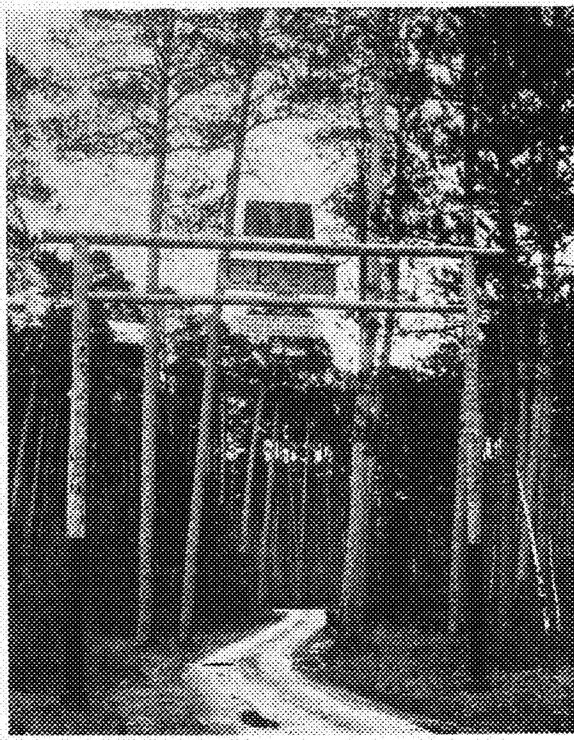
Black and white drawings lend themselves very readily to reproduction by line engraving. The above has been reduced one-half.

—Design by I. Doseff.

"CHAIN!"

"Some boys go to farming,
Others go to law,
Some boys take to bumming
And staying home with Paw;
But of all the lives I know of,
The life that is for mine
Is to eat like a hog and sleep like a log
On the gosh darn survey line."

By C. F. Luethi *and*
D. M. Campbell, C '27



THE ARCH OF C. E. '27
No more will new arrivals at future camps drive past withou
seeing the campsite. This arch is embedded in concrete
and has the name of each man in camp carved
upon its pillars.

TWO hundred and fifty miles north of Minneapolis on the sandy shores of Cass Lake is a spot that has become a sacred tradition to civil engineering students at Minnesota. This spot, guarded by towering Norway Pines, is the peaceful home of chipmunks and polecats during 46 weeks of the year; but during the remaining six weeks it is the scene of the annual surveying camp of the senior engineers, the event upon which freshmen and sophomores look with awe and hopeful expectancy, juniors with excited anticipation, seniors with pride of ownership, and alumni with reverence and fond memories. The fame of Norway Beach has spread beyond the bounds of the engineers alone, however, for each class that encamps for the short six weeks and then passes on, leaves a memorial in the form of a totem pole or other fitting monument to perpetuate its name; and many are the tourists that travel miles out of their way to see these structures and decipher the names carved upon them.

This year the camp opened officially on Friday, August 13, and the fatal jinx of this date evidently fixed itself upon the camp; for there was more rain and disagreeable weather during the period of encampment than ever before. Several of the men came two days early to help pitch the cook and dining tents, the office tent, and the computing tent, more affectionately known as the "workhouse." The forerunners of the outfit began straggling in on Thursday afternoon when two of the "Bummers' Club," namely, Campbell and Preus, pulled in having found many accommodating tourists along the way. The other two knights of the road, Wentz and Santelman, were not quite so fortunate and did not arrive until late at night, footsore and weary. The remainder of the class came wandering in by bus and train, by collegiate flivver and motorcycle, until by Friday afternoon the entire group of 43 were present.

Friday was taken up by pitching camp and getting everything shipshape for comfortable living. Floor platforms had to be patched, tents and flies erected, stoves set up in anticipation of cold nights to come, and benches, tables, and clothes racks built by those who believed in roughing it smoothly. The 1926 totem pole, reputed to be the highest in captivity, turned out to be quite valuable as a tent stake for Tent 3. "Public Works" details were appointed in the afternoon for the purpose of setting up instrument tents and unpacking instruments, building latrine and cess-pool, and making the cook tent fly-proof with many yards of mosquito netting and wire mesh.

Field work started the next day when the men received their first introduction to the "Swindle Sheet," the official bulletin board fastened to a huge Norway pine, on which all the parties and assignments to work were posted each evening. Parties were sent out on triangulation, bench levels, base line measurement, railroad surveying, and stadia topography, and two parties were also sent out to reset triangulation stations which had been dismantled the year be fore.

On this day also, an acquaintance wa made that was destined to fill an empty place in the life of each and every engineer present. This new friend wa none other than the famous basket lunch of Eric, mighty ruler of the cook tent Little knew they on this first day o field work, when the lowly rear flagman, rear chainman, axeman or rodman marched proudly in for the lunch for his party, that before many mor days, time would be measured by th contents of that basket. If, by chance at twelve o'clock (or ten-thirty, as th case might be) when the party took tim off for noon, four huge dill pickles wer discovered beneath a like number o peanut butter sandwiches, it was eithe Monday, Wednesday, or Friday; an the exact day was determined by th presence of doughnuts, cookies, or cake In the event of the above discovery, i was predicted with mathematical certainty that the next day would fin sweet pickles with jam sandwiches gracing the interior of the basket, and i was a rare occasion that this trus proved to be misplaced.

It was at the end of this day's fiel work, also, that the true depths of harmonious melody and power of expression that could repose in an ancient rusty, circular saw was first realized When Eric's delicate touch brough hammer and blade into gentle contact every engineer responded nobly to tha inner urge so joyously released by th melodious notes. Moreover, the musical tonic of the blade was so potent tha its effect did not abate until vast multitudes of calories had fulfilled their mission in life.

After the first Sunday, which was spent in a very literary manner by those whose thoughts wandered far from the material things of camp, the regular routine of work started. There were many field problems which required a continuity of effort, and the parties were so arranged that nearly every man had an opportunity to perform the duties relative to every job. The work subdivided itself naturally into railroad work under Mr. Cutler and topographic work under Mr. Zelner, combined with office work supervised by Mr. Boon under both main heads.

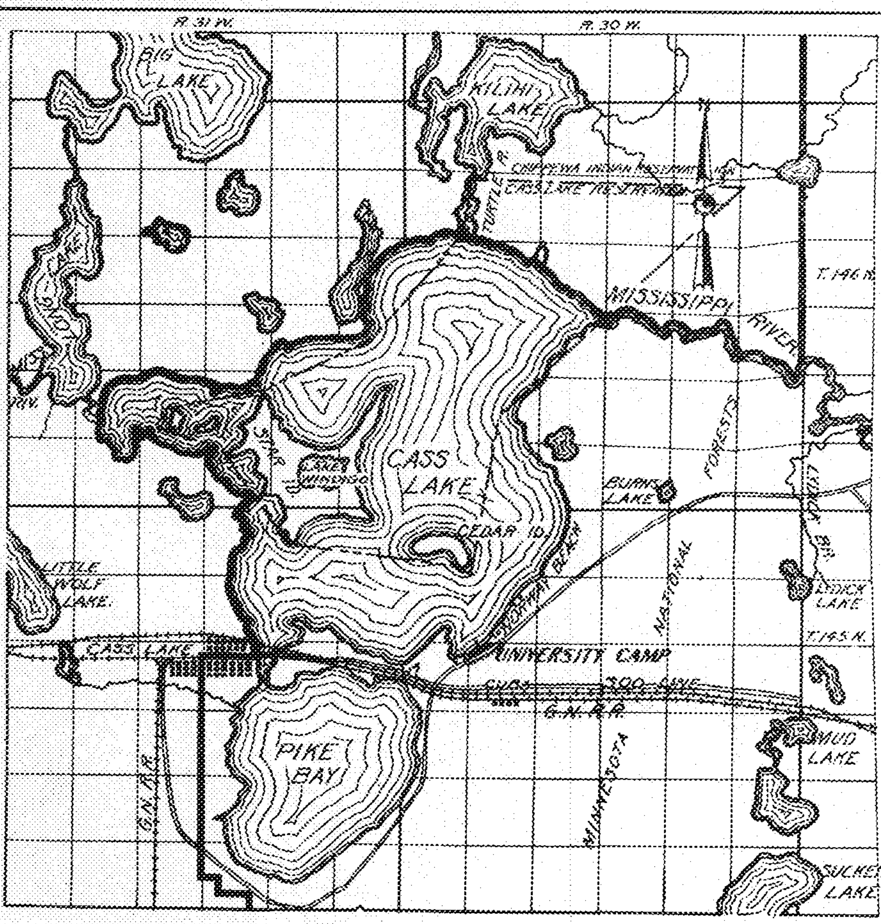
An attempt was made to allow each man to start work as rear rod, say, on a stadia topography party. He would serve one day in this capacity, and then work up through the successive stages of head rod, recorder, and instrumentman. He would then leave the party and spend a day computing his notes in the "workhouse," after which he would plot his results on a map which had been started by the first instrumentman working on the location in question. This would complete his initiation to stadia topography and he would then start at the most lowly position in another party, such as flagman on railroad survey.

In this manner, each man went through the actual labors that might be required of him in practice, and in most cases, the problems attempted were more difficult than those that might be expected in normal field work.

A great deal was done this year, as usual, on mapping of the territory about camp. Both stadia and plane table topography was carried on quite extensively on the timbered shores of Cass Lake, and in and about the town of Cass Lake, and duplicate maps were made of the areas by the two methods. A transit and tape survey was also made of the Soo Line and Great Northern tracks for several miles on each side of town. The intricate layout of the Great Northern yards in Cass Lake was plotted with such detail that many of the men swore that switch engines were pursuing them in their very bunks at night.

An interesting study in railroad location was worked out under the direction of Professor Cutler. The object of this particular problem was to throw out a branch line of the Great Northern from a point on the main line west of town, to work in a southernly direction,

TRIANGULATION STATION "TOWER"
The instrument is 18 feet above ground and allows sights to be taken for miles around. Ed Witt is seen testing the stresses in the framework.



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

going through all the various processes necessary for actual location up to the point of construction. During the first week a party went out to the territory in question and made a reconnaissance of the district to determine upon the best route for the proposed line. A transit and tape party then appeared on the scene and made a preliminary survey, setting stakes at all stations and intersection points of this so-called "P" line. A line of levels was next run over the line to establish elevations. The next party on the job was a hand level party which took topography for several hundred feet on each side of the tentative line and plotted the results as a contour map of the territory.

After this preliminary field work, a paper location was made of the proposed line by shifting it around on the topographical map until the most desirable position was found for a minimum rise and fall. A profile was also plotted and the line moved vertically upon this map until a proper location was found that would balance excavation and embankment as far as possible, and at the same time keep the gradient within the ruling grade.

The route was now established on paper, and the locating party was sent out to run in all curves, spirals, and tangents on this new "L" line. After the line was staked, the cross-section gang appeared to finish up the work preparatory to the theoretical construction. Their work consisted in setting center-line and slope stakes for cut and fill, and computing earthwork quantities.

Naturally 43 men could not participate in all the work of this location, but each man had the opportunity to serve in one or more of the various parties in the field, so that all obtained a fairly clear perspective of the problems that confront a locating engineer.

As usual, much attention was given to triangulation. An attempt is being made to tie all of Cass Lake and Pike Bay together with a rigid set of triangles; and inasmuch as scores of results are obtained over a number of years for the same sets of quadrilaterals, it is difficult to determine which results are correct. A least squares quadrilateral adjustment is being made each summer under the direction of Mr. Boon, however, and values are being computed from observed data which are as nearly correct as it is possible to obtain.

STREAM GAGING THE FATHER OF WATERS

The rate of flow in the Mississippi River where it emerged from Cass Lake was determined with a current meter as shown

Heretofore, one obstacle in the way of getting satisfactory triangles was several high ridges between Cass Lake and Pike Bay which effectively prevented sighting across. During this camp, however, the first attempt at building a triangulation tower was made on the highest of these ridges with the result that excellent shots were obtained connecting stations on Star Island with those on the shores of Pike Bay. This station consisted of a concrete post in the ground over which two towers were erected and firmly braced against swaying. The inner tower was solely to support the instrument while the outer tower was the observer's scaffold. The two towers were absolutely independent so that any movements of the observer could not affect the instrument.

Hydrographic surveying was confined almost entirely to stream measurement this year as poor weather rendered it practically impossible to read sounding signals by sextant during the last two weeks in camp when the schedule called for soundings. The problem in stream measurement consisted of determining the flow in the Mississippi River where it left Cass Lake. The current meter was first rated by moving it through still water at various rates of speed, and then it was held in the river at ten foot intervals of width. Th discharge was compute from the r. p. m. of th meter combined with th cross-section of the strea and was found to be ap proximately 100 sec. ft.

There were numero other problems to be do which have been work out by each class since th first camp on those m morable shores. Profe sor Cutler's famous cros over problem, for i stance, which has caus many a promising you engineer to tear his ha and gnash his teeth; mil of bench levels which pe sisted closing just outsi the 0.2 limit; the nightly target pra tice at the twinkling point in the sk Polaris; endless journeys up and dow the 3,500 foot triangulation baseli on the Soo Line track with steel an Invar tapes; all of these will rema long in the minds of those who vocabularies were so enriched whe their results fell so consistently outsi the allowable limits of error.

But there are other things whic went to make a successful camp besid the actual field practice, and some these are on the way to become trad tion with the civil engineering student One thing without which the cam would never be complete is the annu pajama parade in Bemidji. This eve

(*Continued on page 54*)

ROLL CALL OF THE 1926 SENIOR SURVEYING CAMP

Haakenson, Norman, Preus, Teske, Pohl, Krefting, Paulson, Turrittin, Youngquist, Zelner, Boon, Cutler.
Pajari, Marcroft, H. T. Pearson, Christenson, Clark, Luethi, Edlund, Kastner, Murray.
L. V. Johnson, Lundsten, Crowell, Rosing, Hagman, Burrowman, Bolnick, Sperling, How, Hoving, Campbell, Morris.
Peterson, Wentz, Witt, E. O. Pearson, Carlson, K. A. Johnson, Engler, Zuckman, Santelman, Gehring, McDaniel.
(Brattlof and Brobaugh not in picture.)

Convention Post-Mortems

Enthusiastic discussions feature E. M. C. A. conference recently held at Minnesota; many valuable ideas are presented

By LAWRENCE A. CLOUSING, E '28

IT came, lingered a seemingly few moments, and the sixth annual convention of Engineering College Magazines Associated had passed into history. Beginning with the calling of the meeting to order on Friday morning, Oct. 22, the sessions were a source of many ideas and much useful information to the editors and business manager of the publications represented. Many thoughts had a chance to find fertile ground, and all magazines represented took part in the discussions.

There are 21 member magazines in E. C. M. A., all of which were represented by one or more delegates. The largest delegation came from the Iowa Engineer of Ames, Iowa, which was represented by seven men. There was a total of 41 visiting delegates.

The first discussion of the convention after the opening formalities concerned advertising problems and was lead by Rodney Mayhew, business manager of the Iowa Engineer. Business methods were taken up next and this discussion was lead by Millard J. Williams of the Wisconsin Engineer. He described the business methods employed in Wisconsin and presented an exhibit which consisted of financial and operating statements, and of the various advertising and circulation forms which they use.

When Professor Zelner yelled "Hey" at our esteemed chairman who had just entered the main engineering building for the first time in many years, Professor Van Hagan thought for a moment that he was back in the hay fields of Wisconsin.

* * *

It is rumored that "Bill" Merrihue left his cigar butt on the doorstep of every sorority house at the U of M.

* * *

Too bad that the convention fell on October 23. Otto Birk, who hails from Wabash, lost all interest in the proceedings after the second quarter of the Minnesota-Wabash track meet.

* * *

Extra! Another amateur turned professional! "Gordy" Harris has been retained by Ohio State to supply dates for next year's convention dance.

In the afternoon, committees were appointed, and circulation and editorial problems were taken up in turn. Following the discussion, a talk on illustrating a magazine was given by C. V. Hodges, of the Minneapolis Bureau of Engraving.

The formal convention banquet was held on Friday evening at the Leamington Hotel. Prof. E. Marion Johnson, new head of the department of journalism, was the principal speaker and he gave a highly instructive talk on the field of technical journalism. Lighter entertainment was furnished by Cedric Adams and Carl Litzenburg, while "Pi" Thompson was present to do his tricks and lead the crowd in Minnesota yells in order that the delegates might carry away some of the Minnesota spirit. The formal dance was held at the Beta Theta Pi fraternity house after the banquet, and according to the visitors, it was a time well worth remembering.

In spite of the few hours of sleep the night before, all of the delegates were present on Saturday morning to renew the discussions of the convention. Rating of member magazines was decided upon as a good means of pointing out individual defects. A national committee was appointed to work out the details and to present the plan to the magazines

(Continued on page 62)

THE ENGINEER'S HOMECOMING

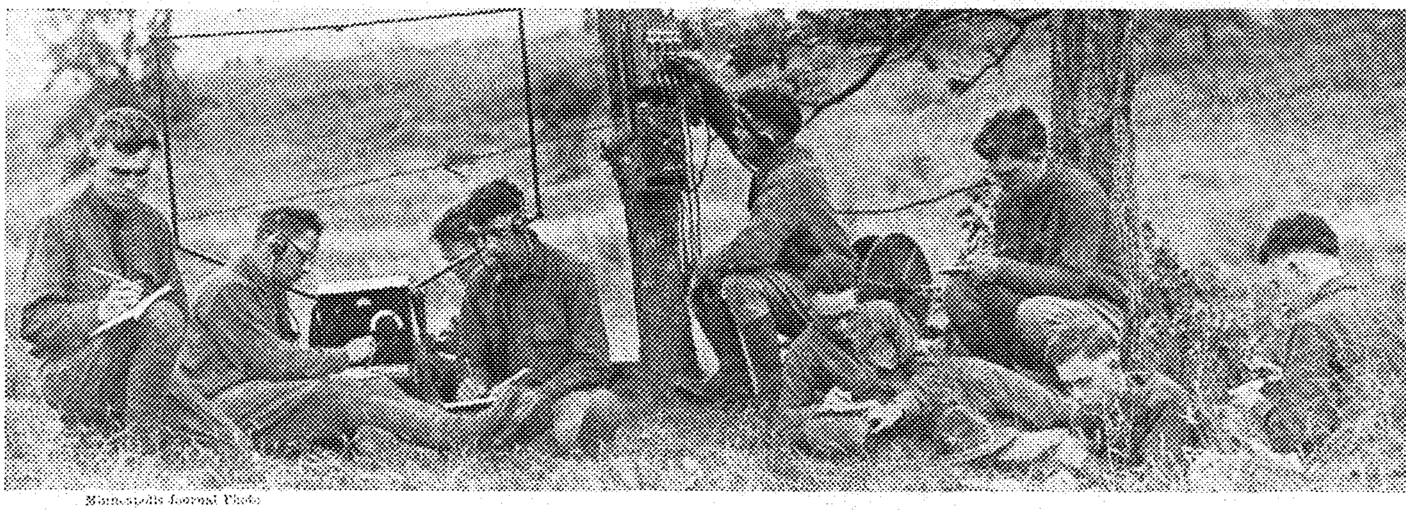
By PAUL B. NELSON, E '26

THE calculus problems will be erased from the board, the chalk carefully swept up, overstuffed furniture will replace the stiff-backed arm chairs, and a homelike atmosphere will prevail in Rooms 135 and 136, Main Engineering Building, University of Minnesota, when homecoming engineers from all parts of the country gather there on November 20 for the first official welcome ever planned for graduates of that college. This reception was conceived by Professor O. S. Zelner of the department of civil engineering, following suggestions made by several grads, and is to be put into execution by a joint committee from the Minnesota Techno-Log, the Engineers Bookstore and the Technical Commission. Mr. Jack R. Ginnaty (E '28), associate editor of the Techno-Log, is acting as chairman and has a large committee assisting him.

Although a great percentage of technical graduates revisit their campus each year at homecoming time, no plans had been ever made for an official headquarters where they might meet each other, leave their wives, check baggage, or greet their former professors. However, this year every visitor to the college will receive a warm welcome, and may sip tea together with his former schoolmates—and in the same room where a scant few years before he battled with problems in stresses and mechanics.

Under the direction of Mr. Carl Barthelemy (M '27), a committee will completely refurnish the room with lounges and easy chairs. Miss Kathleen Fleming (Arch. '30) is making preparations for the pouring of tea, which on this day of days will replace the customary cider and doughnuts, the usual refreshments of the engineer while an undergraduate. Mr. Al Flegal (Arch '27) is preparing posters announcing the event, and will place cards in various parts of the technical campus so that every grad may find his way to the gathering place. Engineers will have a special registration table at the Minnesota Union, which is in charge of Mr. Gordon Harris (E '28). The names of all men registering at this table will be then indexed and taken over to the engineering building so that each grad may find out the whereabouts of classmates. Assisting Mr. Ginnaty in the general arrangements are C. Evald Swanson (E '28) and J. Edwin Coates (M '27).

Headquarters will open at 8 o'clock in the morning and will not close until late in the evening. Facilities for checking packages will be provided and restrooms will be available. Many of the faculty members will be present during the day.



Minneapolis Journal Photo

OPERATION OF MESSAGE CENTER INCLUDING FIELD RADIO STATION AND TELEPHONE EXCHANGE

From left to right, the men are: C. Everett Swanson, chief signal officer, Ed Schultz, radio detail, Norman Ronning, telephone detail, Henry Tholstrup, radio detail, Clarence Pilger, telephone operator, Louis Kritzer and Andres Neilsen, telephone detail, C. Evald Swanson, message center chief, Jack Ginnaty, message center detail.

The Signal Corps at Fort Snelling

Eighteen budding electrical engineers practice modern wartime communication methods at summer military camp

By J. Robert Ginnaty, E. '28

JUNE fifteenth was the day our troubles began. After our "long and arduous" trip via the "Lowry taxicab," we arrived safely at Fort Snelling to spend six weeks in training to become officers.

Immediately upon arrival we were hustled to our assigned barracks. "Fatigues," the full dress of the army, were issued at once in addition to various other articles of equipment. Out of this miscellaneous material the complete equipment of the soldier finally appeared, and gradually the barracks took on a military appearance.

Let no one tell you that camp life is hum-drum. It is not. We who were there can testify to the contrary. A complete schedule of duties had been made out for us before our arrival, and it kept us "hopping" to keep up with it.

The following may give a slight idea of the average day:

Reveille	5:45 a. m.
Mess	6:25 a. m.
Drill	7:10 a. m.
Recall	11:50 a. m.
Mess	12:15 p. m.
Drill	1:30 p. m.
Recall	3:30 p. m.

Ceremonies were held on Monday, Tuesday, Thursday, and Friday at 4:55 p. m. These, of course, were looked forward to with much pleasure, and review took place to the tune of much miscellaneous muttering.

Wednesday and Saturday were half holidays. On these days we went off duty at 1:00 p. m. Sunday was a full holiday. The R. O. T. C. unit was given great leeway in the matter of hours off duty. As long as one appeared at reveille each morning no questions were asked as to his whereabouts during leave. This meant that from Saturday noon to Monday morning, appearance in camp was unnecessary. Needless to say, a great many of the men took full advantage of all these privileges.

Tuesday and Thursday nights were set aside as dance nights. Properly chaperoned dances under the direction of the morale officer gave the men a chance at the "light fantastic" with the young ladies from the various clubs in the city as guests. In addition to these dances, there was boxing, wrestling, and other sports that were enjoyed by a large number of the men.

The Signal Corps unit from Minnesota was the only one of its kind in camp. Due to lack of funds in the government purse, it was decided that our unit should not go to Camp Custer, Michigan, as in the past. When this news first came to our knowledge a great sigh went up. Events have proved, however, that the sigh was unnecessary.

Since the Signal Corps is a very special branch of the army, our training was, of necessity, a highly technical one. While the infantry, engineers, and others were out drilling and scouting, we were absorbing some of the fundamentals of supplying communication to as large a unit as the division.

Five complete and very comprehensive courses in radio, wire communication, message center maintenance, meteorology, and topography, or map making were very competently handled by Captain Persons, Signal Corps, Lt. Cassidy, C. A. C., and Master Sergeant Strider, Signal Corps. Much credit must be given to these men for the very able and interesting manner in which they presented the courses.

The course in radio completely covered the transportation, erection, and operation of all the latest army radio equipment. Code classes were held in which all the men gained some very valuable experience. Actual operating conditions in the field were imitated and our radio units functioned admirably in various tactical problems which were run off during camp.

The course in wire communication was designed to give us a complete knowledge of telephone and telegraph as the army uses it in the field. Networks were set up and operated under synthetic conditions of warfare. Wires were cut, telephones "jimmied," and various other defects placed in the apparatus to simulate wartime operation.

The course in message center organization and maintenance covered completely all message centers from division to company. Methods of registering, routing, and tracing messages were discussed at length.

The courses in meterology and map making were entirely theoretical and consisted of lectures and examinations. A complete course in pistol marksmanship was given under the direction of Lt. Cassidy, who acquitted himself nobly as was testified when fifty-five per cent of the men qualified in the grades of marksman and sharpshooter.

Field exercises in the form of high jump, bar vault, broad jump, hundre

(Continued on page 60)

ENGINEERS IN ATHLETICS

Technical Men Star in Varsity Football

By RALPH BLYBERG, *Mech. Eng. '29*

THE popular conception of an engineer is a man whose thoughts are always on the laws of sines, cosines, and strange formulas. He presumably never allows his thoughts to wander off the subject of engineering at any time, or under any circumstances.

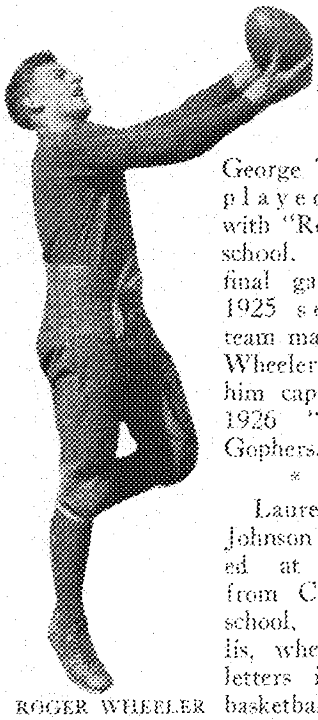
It is true that engineering is the main object of engineers, but when we look up the sport records we find that engineers have always been active in every line of sport and have served as regulars on the teams of each branch. It has been a tough grind for them to spend the afternoon and early evening hours practicing, without falling behind in their studies, but they have done it.

This year we find four technical students on the regular football squad. They are: Roger Wheeler, captain and star end; Laurence E. Johnson, tackle; Donald Riddell, halfback; and Fred Hovde, quarterback. Wheeler is a senior chemist, graduating in December, and Hovde is a sophomore chemist. Riddell is a junior electrical engineer and Johnson is a sophomore architectural engineer.


"DUKE" JOHNSON

Captain Wheeler is playing his last year of collegiate football as he graduates in December. "Rog" came to Minnesota from South high school, Minneapolis, where he won letters in football, baseball and basketball. He captained the championship 1922 South football aggregation and was the unanimous choice of the twin city sports writers for the all-city tackle position. Evan Williams, South high coach who developed George Tuttle, "Mally" Nydahl, and "Rog" Wheeler, in speaking of Wheeler said, "Wheeler was always one of those men who, when downed, would never stay downed. No matter how hard he was hit he always came back for more."

Captain Wheeler started on the university freshman squad as tackle, but soon was shifted to end, the berth he now holds on the varsity. He made his numerals with the frosh football squad and also made his basketball numerals. The next year, Coach Spaulding made him a regular end, and his running mate was George Tuttle who played at tackle with "Rog" in high school. After the final game of the 1925 season his team mates honored Wheeler by electing him captain of the 1926 "Fightin' Gophers."

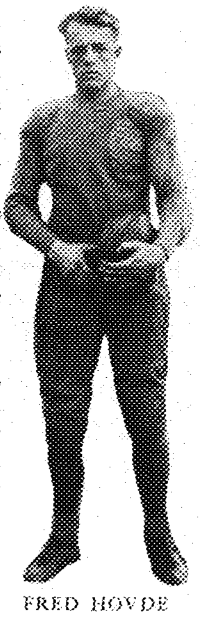

ROGER WHEELER

* * *

Laurence "Duke" Johnson matriculated at Minnesota from Central high school, Minneapolis, where he won letters in football, basketball and track. His size helped him a great deal as he was head and shoulder above all his opponents. He could nab passes out of the air when the man guarding him could not reach the ball. 1925 was his big season at track as he shattered two discus throwing records. In the city meet he hurled the plate 124.8 feet and in the state meet he threw it 122 feet, establishing records that still stand at this time.

Johnson played a consistently good game at tackle in football. His offensive work was always good. He made tackles that seemingly were impossible. In 1924 the sports writers of Minneapolis selected "Duke" to hold down the tackle position on the mythical all-city eleven.

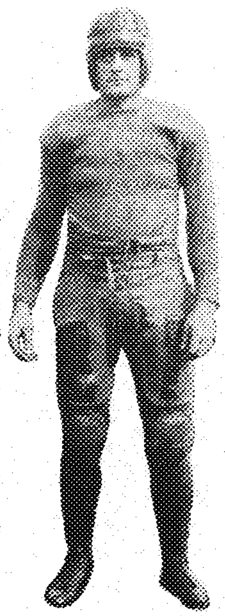
"Duke" won his numerals at tackle on the frosh squad, but did not go out for the basketball team, as he thought he could not spare the time. This year Coach Spears groomed Johnson for tackle and "Duke" has played in every game of the season. He played three quarters in the grueling battle with Notre Dame—a feat that shows the tremendous staying ability he possesses.


FRED HOVDE

In the late field day with Iowa, "Duke" made a most novel tackle, stopping "Cowboy" Kutsch from making a first down and possible touchdown. He eluded the Hawkeye interference and, reaching from behind the "Cowboy," caught him by the jersey and stopped him in midflight. Probably the star Iowa back was the most surprised man in the conference that day.

* * *

Devils Lake, North Dakota, is the town that boasts of producing Fred Hovde. Fred is one of the most promising of the first string sophomore quarterbacks. In his high school days Fred played football, basketball, and also made the track squad. He played quarterback on the Championship football team that did not lose a single game in the 1924 season, and played forward on the 1925 basketball aggregation that won the state title. The quintet went to Chicago to play in the national tournament, but was taken into camp early in the season. In his last year at high school the Fargo Tribune placed Hovde on their all-state team.


"FUZZY" RIDELL

Upon entering the university Fred Hovde tried out for the quarter position on the frosh squad and soon convinced the coaches of his ability to hold down a regular position. On the night of the "M" banquet he was awarded his numerals for frosh football.

This year he saw action in the Wabash game and the Iowa game. He was in the Wabash game for the last minutes of play and demonstrated that with a little more polish he will make a strong bid for the quarter position next season. He made some good gains in the Hawkeye game and showed good football sense in his selection of plays. He is looked upon to be one of Minnesota's best backfield men next fall.

(Continued on page 62)

NEWS FROM THE TECHNICAL CAMPUS

Chemistry School Undergoes Yearly Renovation

Spending $15,000 each summer to replenish the supplies of chemicals and apparatus in the School of Chemistry is the task that has been assigned to Mr. H. H. Barber, instructor in inorganic chemistry.

For the past eight years Mr. Barber has superintended the rehabilitation of the laboratories in the School of Chemistry. In this work he is assisted by twelve men who spend their entire summer in this work. With the growth of the school this work has increased until it has reached the stage where it requires the services of a corps of highly trained men.

Each summer all the desks, over 2,000 in number, are cleaned, painted, and repaired. Each desk, which has a value of about $15.00, must be thoroughly cleaned and all broken pieces replaced. All the metal apparatus is sand blasted and then enameled. While this forms the major portion of the work, a great deal of time must be spent in ordering chemicals to replace the large amounts used by the students during the year.

Although Mr. Barber handles this work very efficiently in the short space of a summer, it would be an almost impossible task for an inexperienced man.

Report on Finances of the 1926 Engineers' Day

Receipts.

Buttons, 774@35c	$270.90
Pipes, 366@10c	36.60
Costumes, 141@20c	28.20
Dance, 266@$2.00	532.00
Total	$867.70

Expenditures by Committees.

Decorations	$ 38.81
Open House	51.05
Brawl	117.00
Publicity	137.26
Parade	69.19
Alumni	25.75
Poster	27.33
Dansante	9.70
Senior Arrangements	89.32
Music	106.00
Green Tea	14.94
Finance	41.40
General	91.50
Total	$819.25

Receipts Less Expenditures.

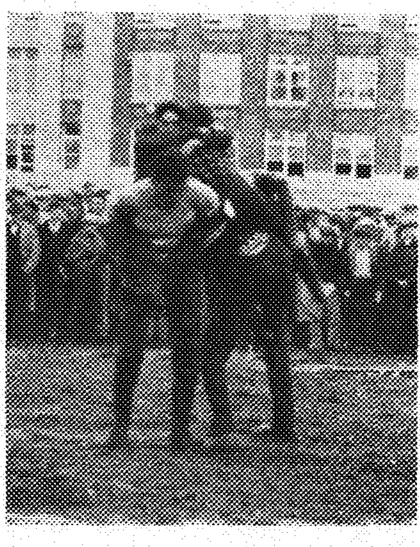
Receipts	$867.70
Expenditures	819.25
	$48.45

Amount turned over to the Technical Commission to be held in trust for the use of the Senior Class College of Engineering 1927. Total of $48.45.

Respectfully submitted,
JOHN E. HOVING,
1926 Engineers Day Treasurer.

Note: The expenditures for this year contain an item of $12.50 held over from the 1925 Engineers' Day.

Sophs and Frosh Battle for Supremacy



THE COWBOY FIGHT
This event was one of the few contests won by the Sophs.

That great fall classic, the Freshman-Sophomore scrap, ended in a score of 245 to 105 in favor of the first year men when the two famous opponents met on Oct. 16 in front of the engineering buildings. The freshmen had the edge in all but two events, but the sophomores gave them a hard fight in all the contests. The seniors, with memories of a battle in which green calsomine, rope, and bloody noses all played prominent parts, voted that the scrap had lost none of the old fight even though it is now fought under the rules of the All-University council.

The frosh began by taking the honors in the pushball contest but immediately lost their advantage in the cowboy contest. The freshmen came back strong, however, and won the bag rush by a score of 85 to 40. The struggle for the supremacy on the greased horizontal bar also went to the yearlings as did the tug of war.

In the evening after the scrap, all loyal engineers celebrated by attending en masse a justly famous theater that is patronized yearly by these knights of the slide rule, and after a long snake dance to show the natives that the engineers were still alive, the party adjourned for another year.

New Highway Laboratory Now in Operation on Engineering Campus

The new State Highway testing laboratory which has been built as an extension to the experimental engineering building is almost entirely completed now, and is in full operation this fall. The State Highway Department moved in on July 1, and since that time equipment has been placed in the section allotted to the university in anticipation of the fall classes which will conduct their experiments in the new building.

The laboratory is roughly divided into three parts. About a third of the space is used exclusively for the Highway Department laboratories and offices. Another third is for the use of the university for instructing embryo highway engineers while the remaining portion is common to both, having testing machines and apparatus for research work that will be used by both the state and university.

The basement floor of the new building contains a cement laboratory, storage rooms, receiving and equipment rooms. The first floor contains offices for both the state and university, and also holds the non-bituminous laboratories for both departments. On the second floor are located both bituminous laboratories, Highway department offices and chemical laboratory, and university balance room and class rooms. All three floors contain ample space for the large amount of research work that is continually being done.

New Text Adopted by School of Chemistry

"General Inorganic Chemistry" by M. Cannon Sneed, professor of inorganic chemistry, has been adopted as a standard text for freshmen in the School of Chemistry this year. The book, which was published in August by Ginn and Company, is being used in many of the large eastern universities. St. Thomas, Carleton, and several other colleges in this state are also using this text.

The "Journal of Chemical Education," a publication of the American Chemical Society, said, in reviewing Dr. Sneed's book, "The book possesses several very highly commendable features. Perhaps the main feature of the text is the great amount of information presented in 67 tables. The historical matter and the portraits of famous chemists make the text readable and interesting. The author has made an excellent and worthy addition to texts for college and university use."

Baily Is Appointed Cadet Colonel

The appointment of Stuart L. Baily to the position of cadet colonel in the R. O. T. C. last month brings this honor to the engineering school for the first time. In commenting on the appointment, Captain W. B. Persons, commander of the Signal Corps of which Baily is a member, said that the new colonel was one of the best men he had ever had under his command at the university.

Baily has been very active on the campus during the past three years. He was all-sophomore president; he is a member of Silver Spur, honorary junior fraternity; Scabbard and Blade, honorary military fraternity; Tau Beta Pi, honorary technical fraternity, Eta Kappa Nu, honorary electrical engineering fraternity, and Theta Tau, professional engineering fraternity. He is also alumni editor of the Minnesota Techno-Log, where he has served for the last two years.

The new cadet colonel will direct the regiment at the War Department inspection next spring, and will also lead the annual Military Ball.

A. S. C. E. Announces Student Prize

The first banquet and meeting of the student chapter of the American Society of Civil Engineers was held on October 21 at the Minnesota Union, Einar Pearson, the new president, presiding. Prof. F. H. Bass gave a short talk, in which he explained the aims and purposes of the society. He emphasized in particular that the American Society of Civil Engineers is the oldest engineering society in America, and that its rules for admission are the most stringent of any such society in America, consequently it commands much prestige and respect. Professor Bass also announced the details of the annual award for the best paper on some phase of civil engineering.

For the purpose of encouraging engineering students in investigation and creative work, the Northwestern section of the American Society of Civil Engineers has established two prizes of $25 and $15, respectively, accompanied by a certificate of award in each case, for the two best papers submitted, each year, by regularly matriculated civil engineering students in the University of Minnesota. The following rules govern the competition:

1. Papers may be prepared on subjects concerning the design, construction, or operation of engineering projects, or on subjects of broader interest, such as the financial, economic or social aspect of engineering problems.

2. Papers shall be judged from the standpoint of cogency, thoroughness, originality, orderly and logical arrangement, expression, conciseness, and appearance.

3. Papers to be eligible must have been produced by their respective authors without assistance, except for the impartial advice and suggestion of the Professor of Civil Engineering, who shall attach to each paper a certificate that said paper has been so prepared, referring to the paper and author by the identification number mentioned in paragraph 7.

4. Papers must not, either in whole or in part, have been previously published, or contributed to any other society.

5. No prize shall be awarded for a paper which in the opinion of the judges does not merit a prize. No prize will be awarded unless at least five papers are presented for competition.

6. Papers shall preferably not exceed 5,000 words, and shall be presented in typewritten form with text on one side only of a good grade of white letter size paper.

Sketches, drawings, or photographs, if any, unless inserted in the text, shall be on sheets of the same size as the text sheets or folded to conform thereto.

All sheets, composing a paper, inclusive of drawings and photographs, as far as practicable, shall be assembled in flexible covers and securely bound as a folio. The title page shall bear the title of the paper and the identification number. Detached sheets of drawings, photographs and other exhibits, if any, shall each bear the identification number and shall be enclosed in a large envelope or other suitable container correspondingly numbered.

7. Papers shall not be signed by their authors, but each paper shall bear an identification number and shall be accompanied by a sealed envelope, bearing on its back a corresponding number, and containing the title of the paper and the author's signature.

8. Students wishing to enter this competition shall present to the Dean prior to December 1 the title of their paper, together with a brief outline indicating the general plan to be followed, using the identification number as indicated in paragraph 7.

9. Papers shall be submitted to the Dean prior to April 1 of each year.

10. The Board of Directors of the Northwestern section of the American Society of Civil Engineers and the Dean of the College of Engineering and Architecture shall act as judges and shall announce the award of and present the prizes at the May meeting of the section, at which time the prize paper or papers shall be presented.

> *Notice to Structural Engineers—*
> *The center web members of a Pratt truss are necessary because they hold the truss together on account of the triangulation which is necessary over a plain rectangle.*
> *—From a stresses quiz.*

Huge Still Found on Engineering Campus

John Barleycorn has come into his own for higher education has at last taken steps to perpetuate his memory. A monument to commemorate his name was unveiled recently at the dedication of a giant two-pass still in the experimental engineering building.

Students became quite enthusiastic over future possibilities when they first viewed it, but Prof. C. F. Shoop soon blasted their hopes by announcing that the outfit was harmless and was only to be used for distilling pure water. He also saddened them by intimating that there would be some hard work in connection with the study of heat transfer in the "still," or "evaporator" as it is officially called. The apparatus is a valuable addition to the equipment of the experimental department and will be used in the study of thermodynamics.

Driscoll Addresses A. S. M. E.; Pi Tau Sigma Awards Prize

W. H. Driscoll, president of the American Society of Heating and Ventilating Engineers, addressed the student branch of the A. S. M. E. on Nov. 8 in the experimental engineering building. Mr. Driscoll is well known all over the United States for his work as he has supervised the installation of mechanical equipment in practically all the larger buildings in the East and Midwest. His talk was largely reminiscent of past experiences and was very interesting. The difficulties of providing elevator facilities in the metropolitan cities were dwelt upon and the remedies used to obviate these difficulties were clearly explained.

At this time, also, Pi Tau Sigma, honorary mechanical engineering fraternity, presented a prize to Elo C. Tanner, the highest standing sophomore in the mechanical department. The award, "Marks' Mechanical Engineer's Handbook," was presented by R. R. Trexler, president of the fraternity.

Prof. J. V. Martenis gave a short talk outlining the aims and benefits of the society after which the meeting came to a close with a decision to hold a joint banquet of the student and Twin City branches of the A. S. M. E. on Nov. 29.

Professor Lagaard Leaves Structural Engineering Department

Maurice B. Lagaard, assistant professor of structural engineering, announced his resignation late this summer, and has left to take charge of the Structural Materials Research Laboratory for the Portland Cement Association in Chicago. He will take the place of F. R. McMillan, a graduate of Minnesota in the class of 1905, who is now consulting engineer for the P. C. A.

Professor Lagaard has been with this university for 13 years, where he started as a laboratory assistant after graduation and worked up to his present position. During the war he was engaged in testing concrete ships for the Emergency Fleet Corporation with Professor McMillan. He will be greatly missed by his many friends and associates in this college, but he is to be congratulated on the excellent position for which he left Minnesota.

Electrical Instructors Attend Conference at Schenectady

June 28, 1926, marked the opening of another conference for engineering teachers at the Schenectady works of the General Electric company. The electrical engineering department of the University of Minnesota was represented by Professors E. W. Johnson and J. H. Kuhlman.

After spending Sunday, June 27, at Niagara Falls inspecting the large hydroelectric plants on both American and the Canadian side, they arrived at Schenectady on Monday morning June 28, the opening day of the Conference.

The first day was used to get located in the departments to which the various members of the conference were assigned. Professor Johnson spent the first part of the time in the Central Station engineering department and the later part in the railway engineering department. Professor Kuhlman, being interested in the design of electrical apparatus, spent the first two weeks in the Induction Motor Engineering department and the remainder of the five weeks period in the Direct Current Engineering department.

Numerous inspection trips were made through various departments of the works. Every Tuesday and Thursday the members of the conference were conducted through one of the various departments by engineers of that department. After each inspection trip the party gathered at a luncheon at the work's restaurant in Building 48. Trips were made through

(Continued on page 56)

The
MINNESOTA TECHNO-LOG
University of Minnesota

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THE convention of Engineering College Magazines Associated has passed into history, but the echoes of its passing can still be heard. Although much valuable information concerning technical college journalism was carried away by the visiting editors and business managers, there are other things which linger pleasantly in the minds of all who attended the conference. Many letters have been received from the delegates by the TECHNO-LOG, and all of them contain words of appreciation for the hospitality shown them by everyone with whom they came in contact.

The staff of this magazine, however, could not have been responsible for all this good feeling alone. It took the entire university campus and many Minneapolis organizations to make our visitors feel so thoroughly at home, and the MINNESOTA TECHNO-LOG wishes to take this opportunity to express its deep appreciation of the way in which its guests were treated during their short stay on our campus. The staff members themselves all did nobly, but especial recognition is due the faculty members who co-operated so fully in the proceedings, the Beta Theta Pi fraternity members who so generously opened their house for the convention dance, the officials of the Washburn-Crosby company who prepared so bounteous a luncheon for the visitors, the Minneapolis Civic and Commerce association whose officers were so willing to be of service, and the many other individuals too numerous to menton who were so largely responsible for the success of the convention.

THE Toledo News-Bee of Oct. 13 takes note of a commendable A. A. E. activity in the following editorial:

"Recently the American Association of Engineers began a movement to end the profitable business of certain unscrupulous correspondence schools which hold out the lure of little work and high salaries to the more credulous young of the land.

"An official cited a case where a school promised a salary higher than that of the chief engineer of the Chicago Telephone company on completion of a six months course of correspondence study.

"The gullible aren't all gone yet, and the power of the printed promise is great. The move of the engineers should be carried along by the other professions."

A movement such as this is certainly deserving of recognition, especially among students of an engineering school. Who is there, who has not seen those glaring ads which hold forth the promise of big engineering positions in return for an initial outlay in a correspondence course—with a drafting outfit thrown in?

Those who have gone through the training required for a well rounded-out engineer can easily appreciate the futility of becoming a high-class executive in the profession after six months of study. Students in prep schools, however, will often be tempted to enroll for such a course with high hopes of large returns in a short time.

The absurd promises of the more questionable schools not only take unfair advantage of the young and ambitious, but tend to bring discredit upon the engineering profession in general.

ONE of the joys of close connection with the TECHNO-LOG office is found in meeting the many grads who drop in, and hearing them tell of engineering alumni who have scattered far and wide.

L. H. Gadsby, of the electrical engineering class of 1909, found his way into our cubbyhole one day last month and told of the way in which his classmates keep up old friendships formed in college. The class was organized during the senior year and Herman Johnson was elected secretary. A small sum was levied on each man for the purpose of buying stamps, and after graduation each member of the class sent his address to the secretary. Mr. Johnson then started a class letter around by writing a personal message to his nearest classmate, and included the addresses of all members and the route that the letter should take. Each man, upon receipt of the class letter, added one of his own and continued it upon its way. When the entire circuit was completed, the first man extracted his previous letter and wrote a new one, after which he started the now large bundle of letters on its trip for a second round.

It takes about two years for the letters to complete the circuit, and in this way the class has remained intact for 17 years.

READERS of the MINNESOTA TECHNO-LOG have surely noticed the high class of art work which has appeared in the first two issues of the magazine this year, and the university is to be congratulated on the possession of an architectural department that can produce such work.

The new cover design which appeared last month is the design of Lawrence B. Anderson, art editor of the TECHNO-LOG, and the cover inserts are also his work. The design of the contents page is one of Anderson's productions of last year.

A new contributor from the art department is John Thomas Grisdale, who drew the sketch of the upper terrace of Villa Lante near Viterbo, Italy, which appears in the frontispiece of this issue, and who also designed the frontispiece last month.

In speaking of Minnesota art students last year, Dean Edgell of the School of Architecture at Harvard said, "The only recommendation we need is that you're from Minnesota." Harvard is one of the few U. S. schools which offers graduate work in Architecture.

Across the Editor's Desk

The American Chemical Society.

The average engineering student in college is usually pretty well wrapped up in the great amount of detail work that must be completed during the four years of undergraduate study. He does not rise above his chosen field and look over the territory, as it were, to see the broader aspects of the life that he has picked for himself. This is an unfortunate fact, but is true for the *average* student of engineering.

One available remedy for this condition is well established at Minnesota. This is the organization of student chapters of national societies such as the A. S. C. E., A. I. E. E., and A. S. M. E. The more thriving these local chapters are in the matter of keeping in touch with the national or regional societies, the more broadening is their effect to the individual members.

The engineering colleges, as mentioned above, have their organizations well established, and the Architects and Miners, while not affiliated with national societies, accomplish the same purpose with their Architectural Society and Mines Society, which are very strong in their respective departments.

There remains but one technical college which has no such student organization and that is the School of Chemistry. It is unfortunate that a school which ranks so high in the university as this one should have no such association through which the students could get an early acquaintance with the broader viewpoints of their field, and a little effort on the part of these students could easily overcome this seeming lethargy.

Portions of a letter written to the MINNESOTA TECHNO-LOG by Charles L. Parsons, secretary of the American Chemical Society should be of interest to students of chemistry.

"The great reason why students should join the American Chemical Society while still in college is that they may acquire at an early date an interest in their profession and a consciousness that they are a part thereof and can succeed only by contact and affiliation with others of like interests.

"The following is taken from a communication from the head of the chemical department in a university of a nearby state:

" 'Even a turtle can't get anywhere when he withdraws himself into his shell and you cannot afford to isolate yourself from your fellow chemists.

" 'An analysis made for one of our schools which has turned out a large number of chemists has given some interesting statistics. At least 90 per cent of the chemistry graduates who joined the American Chemical Society while they were seniors or shortly after graduation have been successful men. Of those who did not, at least 90 per cent have not been successful. We all want to be in that first 90 per cent!

" 'Had it not been for the American Chemical Society there would be fewer chemists employed today, chemical industries would not be in the solid position they now occupy and the people of our country would have but little knowledge, respect, or appreciation for our profession. You, yourself, are benefitting by the work which has been done by the American Chemical Society.

" 'If you knew anything about the glorious record of the American Chemical Society during the war you must have been tremendously impressed by it. No other organization responded more quickly or whole heartedly, and in these post-war days the American Chemical Society is doing its full share in bringing economic independence to America.

" 'The American Chemical Society does not function for profit (financial) but, composed as it is of the ablest men in chemistry in the United States, it tries to advance the profession, develop industry, and educate the people of America concerning the important role played by chemistry in medicine, in agriculture, in the industries, in the home, in everyday life, and in national defense.

" 'It isn't so much a question of being able to afford membership in the Society. The real question is 'Can you afford not to be?' If you expect to succeed in the chemical profession there is but one reply to the question. The answer is 'No'!"

There is a strong branch of the Society existing among the faculty of this school, and a few of the more far-sighted students join the chapter early in their college life, but nevertheless, a healthy student organization could easily be of great value to the men.

FACULTY SKETCHES

SAMUEL C. LIND

SAMUEL COLVILLE LIND, new director of the school of Chemistry, was born on June 15, 1879, at McMinnville, Tennessee. He received his early education in the public schools of McMinnville. Later he attended Washington and Lee University, where he obtained his A. B. degree in 1899. Three years afterward, he obtained his B.S degree at Massachusetts Institute of Technology and remained during the years 1902 and 1903 as an assistant in quantitative analysis.

After receiving his Ph.D. degree at the University of Leipzig in 1905, Dr. Lind went to the University of Michigan where he became instructor of general and physical chemistry. Later he was appointed assistant professor in that division, in which position he remained until 1913 when he left Michigan to accept a position with the United States Bureau of Mines.

For a time he filled the position of assistant chemist in radio activity with this organization and later he was appointed physical chemist, in which capacity he remained until 1915.

The year 1915 proved eventful for in that year he was married to Miss Marie Holladay of Denver, Colorado. He has one son, Thomas.

In 1916 Dr. Lind was appointed superintendent of the Rare Metals Experiment Station at Golden, Colorado. He left the station at Golden in 1920 to assume the superintendence of the Rare and Precious Metals Experiment Station at Reno, Nevada. After three years in this station, Dr. Lind was appointed Chief Chemist of the Bureau of Mines at Washington, D. C. In 1925 he resigned this position to become the associate director of the Fixed Nitrogen Research Laboratory.

During the past several years, Dr. Lind has been actively engaged in technical publication work. He has been associate editor of the "Journal of the American Chemical Society" since 1921, and editor of the section of Subatomic Phenomena of "Chemical Abstracts" since 1922. The latter is a bi-weekly publication of the American Chemical Society devoted to abstracts of articles and papers pertaining to chemistry which are published in the current issues of the various scientific journals. He has been the radioactivity editor of the International Critical Tables since 1924, and he is also vice chairman of the Division of Chemistry and Chemical Technology of the National Research Council.

Dr. Lind is internationally recognized as an authority on radium and radioactivity. He has several years of foreign study in these fields to his credit. During the years 1910 and 1911 he was at the University of Paris, where he did research work in the laboratory of Madame Curie. In the latter part of 1911 he attended the University of Vienna where he did research work in the Institute for Radium Research.

He has published between sixty and seventy scientific papers and addresses in various chemical and scientific periodicals, principally on the subjects of velocity of reaction, radium production and measurement, and especially on the chemical effects of radium rays. Among his other works are "The Chemical Effects of Alpha Particles and Electrons," one of a series of monographs published by the Chemical Catalog Company, and a chapter on radio-activity in a recent treatise on "Physical Chemistry" by H. S. Taylor, which was published in 1924.

He is especially interested in the influence of the various forms of radiant energy in bringing about chemical activation. A new division in photo and radio-chemistry will be established under his supervision in the School of Chemistry. This new division is designed chiefly for graduate students. Its work will principally be with the effects of light and radium rays in bringing about chemical reaction, and in a comparison of the two effects.

A number of scientific societies which claim him as a member are: Alpha Chi Sigma, Phi Lambda Upsilon, Sigma Xi, American Association for the Advancement of Science, American Chemical Society, American Electro-chemical Society, American Institute of Mining Engineers, and the Washington Academy of Sciences. He is a member of the Cosmos Club of Washington, D. C., and the Chemist's Club of New York City.

JUST A FEW SQUEAKS

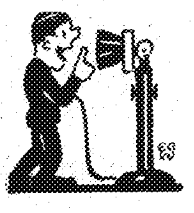
1st Co: "How do you study when your roommate is typewriting?"
2nd Ed: "Oh, that's all right, I read a chapter between clicks."—*Exchange*.

I'm getting a lot out of this course said the student, as he walked out of M. E. 14 with his pockets full of tools. —*The Rose Technic*.

The meanest man we know is the warden who put a tack in the electric chair.—*Arizona Kitty Kat*.

First Idiot: "Who was the smallest man in history?"
Second Idiot: "I'm ignorant, who?"
First Idiot: "The Roman Soldier who went to sleep on his watch."

Father(over long distance): "Hello son, what has been the matter with your grades?"
Son: "Can't hear you, father."



"I say, why weren't your grades better?"
"Really I can't hear a word you say."
"I say, do you need any money?"
"Oh yes, about $50, dad.

Bill (in a hurry): "Operator, give me Grand 22 double 2."
Operator: "Grand 2222?"
Bill: "Yes, and hurry. I'll play train with you some other time."—*Penn State Eng.*

Hopeful: "I wonder if it is true that the length of a boy's arm is equal to the circumference of a girl's waist?"
Hopeless: "Let's get a string and measure it."—*Dension Flamingo*.

Bandit: "Halt, if you move you are dead."

Professor (absent-mindedly): My man, you should be more careful of your English. If I should move, it would be a positive sign that I am alive."

Foreman: "Are you a mechanic?"
Pat: "No, sor, I'm a McCarthy."

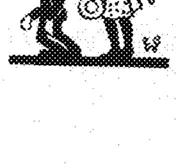
Adoring Aunt: "And what would you like for your birthday?"
Up-to-date: "Oh, I'd like a three step polyphase neutrodyne regulative unit, and a reflex inductive oscillatory tube for my radio.—*Juggler*.

"I hear the old bridge outside town has collapsed."
"I can't understand why; we just gave it three coats of paint and it looked like new."

College Student (at garage): "And while you are oiling and greasing the car, you can take out the promiscuous squeaks."
Dumb Mechanic: "Mister, they ain't no promiscuous on a Cadillac."

"And did the speaker electrify his audience?"
"Naw, gassed 'em."

Chemistry Prof:" "What is the best solvent for gold?"
Married Student: "Matrimony."



She tightly clings about him,
The dainty slender thing.
For he is just a wooden top
And she a long white string.
—*Nebraska Awgwan*.

Prof: "I believe you missed my class yesterday."
Student: "Why, no I didn't old man, not in the least."

Jack: "I am wondering whether to give you a book or a kiss."
Jill: "Oh, I have a book."

He: "What do you say to a tramp in the park?"
She: "Sir, I never speak to them."

Fond Father: "How did you get through calculus?"
A-want-to-be-engineer: "Don't know, Dad, went through at night and didn't see much of the place."

Have you ever heard of the stude who didn't know a Proverb from an adverb, and who thought farther away was a Catholic priest?

Tartar: "I hear the Kappas were lucky in pledging."
Sauce: "Yeah, they got a guy from Canada and one from Cuba and each of them goes home every vacation."—*South Owl*.

Visitor at Church (to friend, as collection plate nears): "Put that back in your pocket, Bill. This is on me." —*Collier's*.

AROUND THE WORLD WITH OUR ALUMNI

ARCHITECTS

'24 A—Wallace C. Bonsall is a recent convert to the old adage that two can live as cheaply as one. He was married last month to Miss Verna G. Smith, who is also a graduate of the University of Minnesota. Mr. Bonsall was a graduate student in the department of architecture last year where he received the Robinson-Nelson foreign travel scholarship. The couple sailed from New York on October 30 for Boulogne, France, and they will spend nine months in Europe in travel and study.

'25 AE—Emil Larson and Paul Wicklund are both structural designers and are located in Chicago.

'25 AE—Aubrey H. Grisson, who was in Minneapolis last month for a short vacation, is now an estimator on quantity survey for the general builders' association of Detroit A. G. C.

CIVILS

'11—Martin J. Orbeck is now assistant engineer for Holland, Ackerman, and Holland, consulting engineers on hydro-electric projects in Ann Arbor, Mich. Mr. Orbeck was an assistant professor of drawing and descriptive geometry at Minnesota from 1914 to 1923, with the exception of the war period during which time he served as an officer in the Engineer corps.

'25—Thorsten H. Berg has been a sales engineer for the Marion Steam Shovel company since graduation. He is working out of the Chicago office but his mailing address is the Maryland Hotel, Minneapolis.

'25—John W. Swanburg is still in the U. S. Engineer's office at Milwaukee. He took the examination for junior engineer about two months ago and passed with a grade of 90. He is now rated as a junior engineer.

'25—O. M. Skrukrud is also a junior engineer in the same office as Swanburg. He moved up from the position of inspector March 1, 1926.

'25—E. W. Nelson is on surveying and inspection for the U. S. Engineer's office, Grand Rapids, Mich.

'25—L. H. Carlbom has left the Illinois Central railroad and is now with the Minnesota Highway department on paving construction.

'26—F. J. Halbkat, associate editor of the MINNESOTA TECHNO-LOG last year, and C. E. Meyerdick are both working for the Elgin, Joliet, and Eastern railway, and are located in Joliet, Ill.

'26—T. P. Young, who was president of the student chapter of the A. S. C. E. last year is now in Richmond, Va., where he is employed as a draftsman in the bridge department of the Chicago and Omaha railway.

'26—Lawrence A. Sandvig is in Rogers City, Mich., working for the U. S. Gypsum company in their construction department. The main office is in Chicago but he is sent out with the foreman on various jobs with the view of handling them himself later. "Sandy" writes that the work is very interesting. Sheetrock is placed on a steel framework to serve as a support for the gypsum slab. The gypsum itself is reinforced with wire matting and is very similar to light concrete with the exception that it sets in about 15 minutes after being poured.

'26—C. E. Lorens is also employed by the U. S. Gypsum company but is located in Chicago.

'26—Keith Williams has migrated to Nashville, Tenn., where he is working for the Nashville Bridge company.

'26—A. A. Schultz is also in Nashville but he is employed by the Tennessee Highway department.

It seems that most of the 1926 Civils departed in pairs. Clifford Sandberg and "Jim" Breedon are both in Chicago. Sandberg is a designer in the bridge department of the Santa Fe railroad while "Jim" is in the bridge department of the Illinois Central.

CHEMISTS

Among the Minnesota Alumni who attended the semicentennial meeting of the American Chemical Society in Philadelphia were Dr. Francis C. Frary, Ph. D. 1912, J. D. Edwards, Ch. E. 1913, and Cyril S. Taylor, B. S. 1913, all of whom are now with the Aluminum company of America at New Kensington, Pa. Those who represented the Roessler Hasslacher Chemical company, of Perth Amboy, N. J., were Sterling Temple, Ph. D. 1915, Paul M. Paulson, '23, A. H. Kohlhase, Ph. D. 1924, and Frank J. Dobrovolny, Ph. D. 1925. Others who attended the meeting were Stephen F. Darling, '24, R. C. Fuson, Ph. D. 1924, both of whom are now at Harvard, and Gerhard Dietrichson, '10, who is now assistant professor of chemistry at the University of Illinois.

'20—Minerva Morse, Ph. D. 1925, is now assistant professor of chemistry at Smith College, Northampton, Massachusetts.

'23—Ernest B. Kester is now doing research work in pure organic chemistry at Northwestern University.

Dr. V. N. Morris, who received his Ph. D. in Physical Chemistry in June, 1926, has accepted the position of assistant chemist with the Fixed Nitrogen Research laboratory, at Washington, D. C.

'25—Harry W. Glenn, who is now works chemist for the Northwest Paper company, returned for the Minnesota-Notre Dame game.

Walton B. Sinclair, who received his M. S. at Minnesota in 1925, is now an instructor in the division of agricultural biochemistry. During 1925 and 1926 he was an assistant in biochemistry at the University of California.

'26—Waldo Johnson and George Dysterheft are doing analytical work at the Minnesota Dairy and Food laboratory at the old Capitol building, St. Paul, Minnesota.

'26—Harold Bunger has returned to the University this year and is engaged in research work in nitrocellulose lacquers.

ELECTRICALS

'09—L. H. Gadsby was a visitor in Minneapolis last month. He is municipal engineer for Visalia, Cal., and has served in that capacity since 1919. Mr. Gadsby boasts that his chief claim to distinction is the fact that he is one of the two remaining bachelors in the class.

'22—Glen B. Ransom is a transmission engineer for A. T. and T. and is in the long lines department in Chicago. He was in Minneapolis to supervise installation and balance lines for broadcasting the Notre Dame game from WGN by remote control.

'23—H. C. Forbes, who is chief engineer for the Zenith Radio corporation in Chicago, stopped at the university the latter part of October on a business trip to Minneapolis and Fargo.

'24—R. E. Mathes is photo radio engineer for the Radio Corporation of America in San Francisco, and is in charge of the transmission of pictures by radio between San Francisco and Honolulu.

'24—Clarence W. Teal, managing editor of the MINNESOTA TECHNO-LOG in 1923-24, was married recently to Miss Valentine Moline of Minneapolis.

'24—M. N. Lanpher is now a sales engineer for the Westinghouse Elec. and Mfg. Co. He moved from Pittsburgh last August to Chicago where his address is 111 West Washington street.

'25—Many of the 1925 boys are with the General Electric company at Schenectady, New York. Grant Nierling is still in the testing department engaged at present in the large turbine-generator sets department. Clem Tunell, who entered the testing department in February, 1925, is employed in the large motors and generator departments.

'26—Two of the 1926 class with the General Electric company are L. W. Anderson who is in the testing section of the industrial control apparatus department, and L. J. Hartley who is employed in the testing section of the railway and mill-type motor department.

MECHANICALS

'98—J. J. Garvey, who is with the Western Electric company, will be in Minnesota during homecoming week to interview seniors who are interested in the company, and incidentally to take part in the festivities which will center around the Michigan game.

'12—George Kottcamp, now a division engineer for the Great Western railroad, stopped off at Minneapolis recently on a trip east to visit his brother Will, also of the class of 1912. At present, Will is the city engineer for Gary, Indiana.

'12—James Markoe is now working for the Bauer Taxicab company of Chicago, but is located in St. Paul. His address is 1937 Selby Ave.

'24—Arthur L. Olson is affiliated with the Aluminum Goods Manufacturing company, and is engaged in research work.

(Continued on page 56)

Loading Telephone Lines

(Continued from page 37)

ing coils, it is likely that a permalloy core will shortly be developed.

The proper spacing of loading coils and the values of inductance to be used at each loading point have been subjects of much investigation and research in the past decade. There are many loading installations which were, some years ago, considered adequate, but which today are condemned in the light of new findings. For instance, it has been customary for some time to load long open wire circuits at a spacing of 7.88 miles. This practice has been discontinued in favor of using non-loading lines broken up into shorter sections with repeaters inserted between them, thus obtaining more satisfactory transmission as well as more economical installation and maintenance. For the above reasons, many cables are now being reloaded and open wire lines installed without loading. In some cases, present loading is being removed from open wire lines.

In the telephone industry, effort is continually put forth to give better service through improvement of facilities for giving such service. The most important point for improvement is in the quality of transmission. In other words, the ideal telephone system would reproduce sound at the receiving end exactly as it is transmitted at the sending end, the wave form containing all the initial variations with no additional harmonics. This perfect transmission system will probably never be commercially possible, but improvements toward this end are continually in evidence.

The writer was interested this past summer in loading a new section of toll cable on Superior Boulevard, and in reloading an existing underground portion. The section which was already loaded was about 5.5 miles long; the total length of new and old cable, 35 miles. Spacing of load points determined upon was 6,000 feet between load coils, and 3,000 feet from each cable termination to the first load point. This spacing resulted in 33 loading points for each wire where a coil was to be inserted. The 5.5 mile existing cable contained 114 pairs of wire, or 228 wires; most of the new cable consisted of 150 pairs, or 300 wires. This cable was to serve as a connection between the Minneapolis Toll office and the long open wire circuits to various points in western and southwestern Minnesota and adjoining states. In some cases, the circuits terminated at the ends of the cable, as for instance, the Minneapolis to Lake Point circuits. It was, therefore, necessary that the loading be made such as to provide the proper impedance for matching the line with which it was to work.

Three types of loading with respect to the amount of inductance inserted at each load point were used. Some of the circuits, such as the Ortonville, Marshall and Sioux Falls groups were loaded in the open wire, and therefore had a characteristic impedance of about 1,830 ohms. In order to match this impedance in the cable, it was necessary to load with inductances of 248 millihenries at each load point, a practice known as "heavy" loading.

Other open wire circuits which were not loaded had impedances of about 700 ohms, and in order to meet this impedance in the cable, inductances of 28 millihenries were used. This type of loading is called "extra light" loading.

Another group of circuits which terminated at two points of the cable and included no open wire, were loaded with 175 millihenries at each load point. This amount of inductance makes the characteristic impedance approximately 1,100 ohms, and the loading is called "medium" loading.

The coils are mounted on spindles and the spindles placed in a cast iron case. There may be only one spindle in some pots, where only a few coils are required, but generally there are three parallel spindles. Large iron washers are placed between the coils and each spindle is set in a compartment by itself. This is done to shield the coils individually in order to prevent cross-talk between circuits. After the connections to the coils are brought out in a lead covered group of wires, called the "stub" cable, the pots, some of which used on this project weighed as high as 3,000 lbs., are filled with compound and hermetically sealed.

The loading pots are placed in manholes for underground cable, and hung on poles for aerial cables. Where several pots are required at one loading point, an "H" fixture is arranged by setting two poles in line with the cable, about ten feet apart. Channel irons between the poles about 8 feet down from the cable, provide a platform upon which the loading pots are set.

Reloading the Existing Underground Cable

The existing underground cable from the Minneapolis Toll office to Falvey Ave. and Superior Blvd., was loaded with heavy and medium loading. The heavy loading was spaced at 4,500 feet with 248 millihenry coils at the load points. The medium loading was spaced at 9,000 feet with 175 millihenry coils used at the load points. From laboratory and field experience, it was determined that all spacings should be changed to 6,000 feet, and the same amount of inductance used as formerly. It will be seen that this meant shortening the medium spacing and lengthening the heavy spacing, which involved considerations as to where to locate the loading points in order to spare the expense of building new manholes. The maximum variation from 6,000 feet was set at 2 per cent, or 120 feet more or less than 6,000 feet. In spite of this limitation, the load points were so located that existing manholes could be rebuilt to make them sufficiently large to accommodate the proposed and future loading pots.

The existing cable was all in use, serving to connect important outlying toll points to the Minneapolis Toll office. With this in mind, it can readily be seen that it was no small task to remove the present loading and replace it with new, all without interrupting the service. This last requirement is vital, for a telephone company spares not time, energy or money to keep its toll lines always working and in good order.

After considerable "juggling" and shifting of circuits, it was possible to "clear" twenty of the 114 pairs in the cable and make them available as spares. This accomplished, the working circuits could be shifted around at will in the cable, and groups of wires made available for reloading. There were six complete operations necessary at each loading manhole and at the cable terminals in order to reload the entire cable.

Although it was thought that the season had been selected with due consideration for dry weather and low rainfall, no sooner had the sheath been opened at the splices, than there occurred the greatest cloudburst and flood Minneapolis had known for years. This was indeed cause for worry because the open splices were in the manholes beneath the pavement, and if the least bit of water should get into the exposed wires and insulation, the cable would become wet and be rendered useless for toll circuits. Only because the cable department had the foresight to plug up the manholes and seal them with beeswax, was this unforeseen storm successfully weathered.

The splices were left open for about two and a half weeks and, during this period, there were three or four cloud-

(Continued on page 66)

"Chain"

(Continued from page 42)

was held on the fourth Saturday night of camp, and the disclosures that resulted when 43 pajama-clad engineers appeared outside their tents were wonderful to behold. The various hues and designs that were exhibited ranged all the way from Teske's passionate sky-blue creation to the barber pole effects that emanated from Tent 6.

When all were assembled, the gaudy mob clambered aboard all the collegiate relics that were capable of locomotion, and with "Ted" Haakensen in the lead astride Pohl's "Leaping Lena," the cavalcade proceeded to Cass Lake where a practice exhibition was held featuring a roaring "Gesundheit" up and down the main street and through the Hotel Endion. The party then went on to Bemidji where the main demonstration took place as the wild-eyed crew snake-danced through hotels, theaters, and dancehalls.

For the benefit of any of the wandering 1926 class who may read this, it might be added that their faithful friend, Stechman, has left the force in favor of a more peaceful life in his own restaurant, and that he was royally entertained by the "Frightful Forty" with select musical numbers.

Another event of importance was the Chippewa Indian Pow-Wow that was held at Sah-Kay-Tay, near Cass Lake. The noble red men appeared in all their finery for their annual council, and many were the medicine dances that were given for the benefit of the romance-seeking white man. Much of the romance and nobility departed for these worldly-minded engineers when, on closer inspection, white shirts, collars, and ties were revealed under the leathern coats, and red flannel appeared at crucial points where buckskin left off.

During the solemn council one afternoon when all the chiefs were seated in a circle dressed in full native regalia of buckskin, beads, feathers, and paint, one old buck was seen squatting in the center of the circle. Dressed more fantastically than any of the others, if this was possible, he was quite evidently bored with the lengthy arguments that were carried on in the Chippewa tongue. Finally, with a guttural exclamation, he arose and stalked off into a nearby tepee. Ten minutes later he returned, sans buckskin and native ornaments, and—Shades of Sitting Bull—dressed in spotless blue overalls and a straw hat.

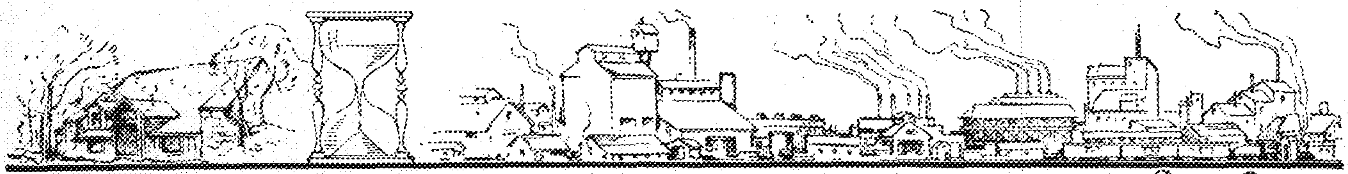
Other notable events occurred as well, for when a number of great and ingenious minds get together the outcome is natural; something big must come from the association in the shape of new and improved methods of engineering practice. For instance, Art Krefting was made famous by his complicated method of double-chaining to locate tracks in a round-house (not patented). Doug Campbell prepared a treatise on "The Loads Carried by a Spirit Thermometer," the conclusion being that any ordinary thermometer will not hold up a locomotive even though it is the smallest of passenger engines. Carlson's method of obtaining zero closure on triangulation without a plumb bob was surely a boon to the profession, and the Brown Derby in adjusting alidades was voted to Gus Brohaugh without a dissenting voice.

About a week before camp broke up, the Cass Lake high school coach challenged the engineers to a football game and a formidable team was at once assembled. The game was played one Saturday afternoon and was full of thrills and spectacular plays, the work of Larry Johnson and John Borrowman being outstanding in the backfield while "Nick" Preus and "Hank" Norman were feature attractions in the line. The team from camp held Cass Lake to the amazingly small score of 12 to 0, and the high school was spared a terrible drubbing when Larry Johnson suffered an injury to his favorite knee. Two extra quarters were played to give Cass Lake a chance to lose the game, but the Minnesota men would not be denied that honor.

During the last week of camp, all the spare time that was available was used for the purpose of erecting a fitting memorial to commemorate the class of '27. After several campfire counsels on the beach, it was decided that the totem pole idea had reached the limit as far as height was concerned, inasmuch as Foley Brothers were not present this year to contribute the use of their hoisting gear, and that the time had come when an entirely new design must be chosen.

The proposition of building an arch was presented, and immediately found favor with the result that action started at once. After the design was worked out, permission was gained from the forester to cut the necessary timber, and the trees were then cut and fitted. Each man in camp had a definite task in the construction which included carving his name in Roman letters in the pillars of the arch, and it was not until the last day that the completed arch stood imposingly over the winding road to tell the world that here was the location of the Senior Surveying Camp.

But all good things must end, and this camp was no exception. The last day of field work rolled around, and the Fates were kind enough to donate a dry day in which to strike the tents and pack all the equipment for shipment and storage. The gear was carted to town by truck and the grounds were policed and made shipshape for a long winter. The men then drove for the last time over the winding trail beneath the stately Norways, and headed south to the nine months of slide rules and drafting rooms that were necessary before they, too, would become alumni with warm places in their hearts reserved for memories of Norway Beach.



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Around the World with Our Alumni

(Continued from page 51)

'26—N. W. DuBois is coming along rapidly with the Minnesota Hydro-electric company at Pine River, Minn. He is the only technical man in the employ of the company, and increased the firm's business 10 per cent in his first three months. Plans for a new plant are now being advanced. Letters will reach him at Pine River, Box 71.

MINERS

'20—James D. Wheeler came clear from Columbia, South America, to see his brother Roger play football. He has been here for the entire season and will not leave until after the Michigan game. He is undecided as yet as to whether or not he will return to South America.

'24—John H. Nelmark left Minnesota for Oklahoma this summer. He remained there a short time and then continued south to Peru where he is being employed by the Cerro de Pasco Copper company.

'25—Hugo R. Kamb left the range last month for Tulsa, Oklahoma, where he began work for the Mid-Kansas Oil company. It will be remembered that he won the Sigma Xi undergraduate prize for research during his senior year. It is an interesting fact that this prize, which is offered each year to technical students, has been won for five straight years by mines students majoring in geology. Beginning with 1922, the winners have been T. S. Lovering, C. E. Erdmann, J. H. Nelmark, H. R. Kamb, and T. F. Andrews.

News From the Technical Campus

(Continued from page 47)

the Switchboard, D-C and A-C Machinery, Induction Motor, Steam Turbine, Industrial Control, Radio, General Engineering and Research departments.

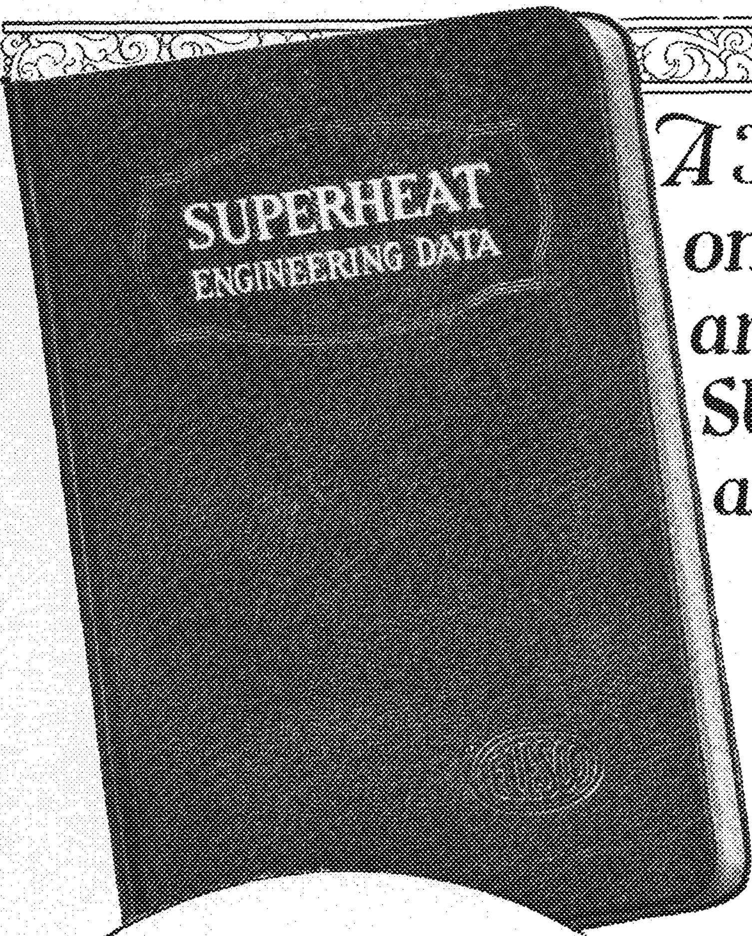
On Friday morning, July 9, the entire party was taken by bus to Pittsfield, Mass., to visit the Transformer works of the General Electric company. The day was spent inspecting the various departments of the Pittsfield works, which included Induction Regulator, Distribution and Power Transformer, Capacitor and the Single-Phase S. C. R. Motor departments.

During the course of the conference, several interesting lectures were given by Mr. A. C. Stevens, head of the educational department, Mr. R. E. Doherty, chief consulting engineer, Mr. Geo. Pfeif, head of the Industrial Relations department, and Mr. M. M. Boring of the same department.

During their stay at Schenectady, Professors Johnson and Kuhlman met a large number of Minnesota alumni. On Sunday, July 11, a Minnesota picnic was arranged by the Minnesota Alumni Association. The picnic was held at Mr. Allee's camp a few miles north of Schenectady. A fine picnic lunch had been prepared by the ladies and was enjoyed by all. Professors Johnson and Kuhlman held the honors in the horseshoe pitching contest. Those present were Mr. and Mrs. Allee and family, Mr. and Mrs. Dunham and family, Mr. and Mrs. Heineman and family, Mr. and Mrs. Grant, Dr. and Mrs. Newkirk, Mr. and Mrs. Morton, Mr. Bill, Mr. Warren and Mr. Burrill.

Week ends were spent in visiting some of the many beauty spots about Schenectady, such as the Adirondack Mountains with the beautiful Lake George, the Catskill Mountains, etc. On Sunday, July 25, Professors Johnson and Kuhlman were entertained by Mr. Warren and his friends at Balston Lake, a few miles from Schenectady.

In the opinion of the Minnesota representatives, the 1926 Conference was an extremely interesting and successful one. Every opportunity was offered to obtain any information desired on all types of electric apparatus and to study new and recent developments in the electrical industry. Professors Johnson and Kuhlman feel very much indebted to the General Electric Company for the privilege of attending this conference.



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Illustrations and Their Manufacture

(Continued from page 39)

now brushed over with graphite so that it will conduct electricity. The wax mold is suspended in a tank which contains a solution of copper sulphate. A sheet of copper which faces the mold is suspended in like manner. A current of electricity which is connected with the plates brings about an electrolytic action which causes the atoms of copper in the solution to deposit a thin film on the wax mold. The copper shell is usually very thin so that the type faces will not be enlarged excessively. The copper coating is then removed from the mold and a reinforcing layer of tin solder applied to the under surface so that the backing metal can be poured on.

After the electrotype has cooled, it is finished by leveling the surface. The back of the electro (the name usually given an electrotype) is then shaved smooth by a machine until the plate is one-eighth of an inch thick if it is to be mounted, or about one-sixth of an inch if unmounted. Usually, the plate is mounted on wood, plate and block being type high. The finished plate is then ready for the printer. Since the original or master plate is used for making the mold only, as many electros as required can be made without injury to the original.

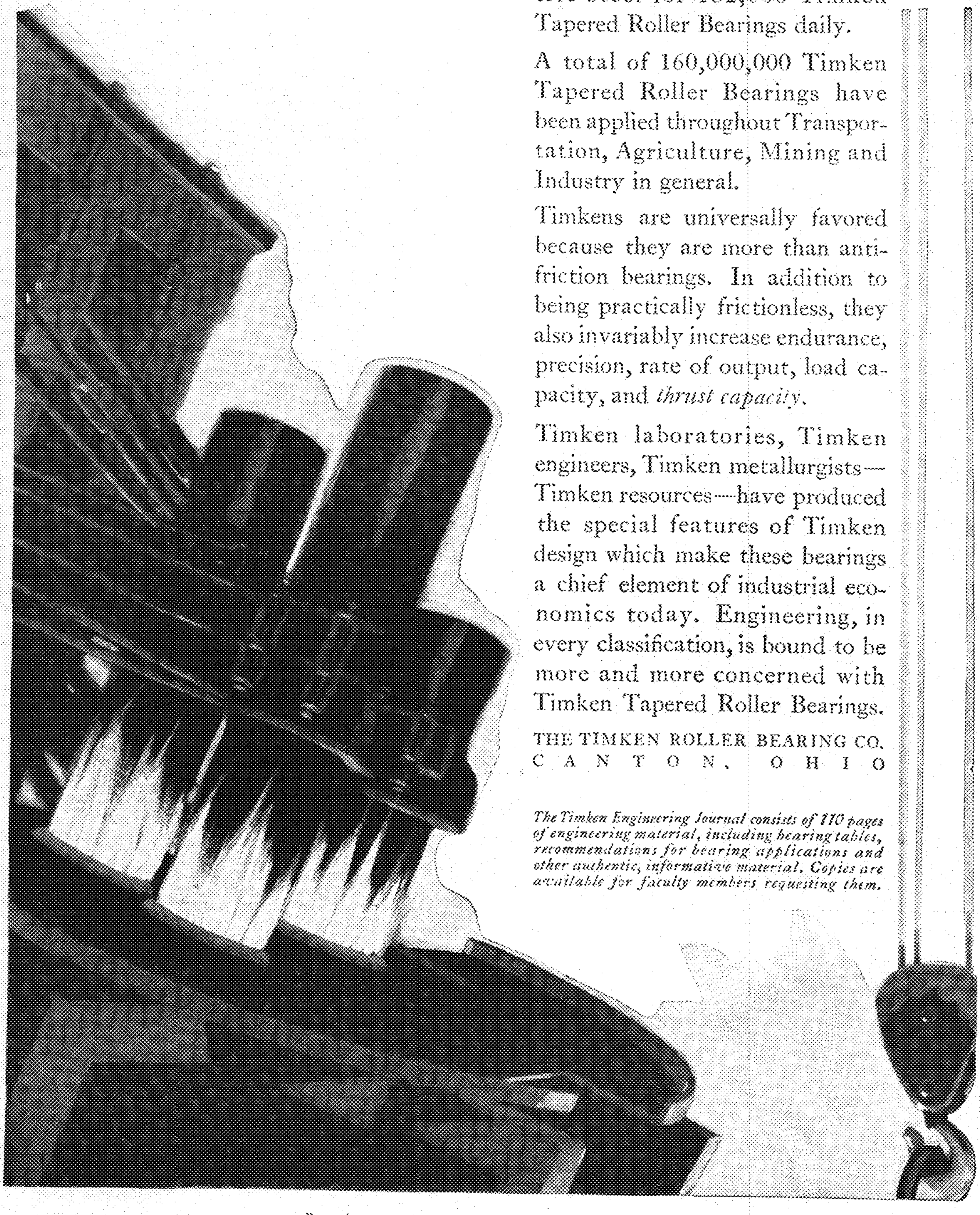
The method known as the Doctor Albert Lead-Mold process is best for electrotyping half-tone engravings. The main difference between this method and the wax-mold process is in the mold, which is formed by impressing the original engraving in sheet lead instead of in wax. The sheet lead mold is then brushed over with graphite, suspended in the tank and a film deposited as in the wax-mold process. Clean cut electros are made when the sheet-lead mold is used. Prints made from an electro of this kind can hardly be distinguished from those made from the original plate. Another advantage in using the lead mold is that the impression is not destroyed when the copper shell is removed from it, and therefore may be used for duplicate electros.

Very often it is not advisable to use the original plate. If an expensive master plate is injured accidentally, it may be necessary to replace it at the original cost, and in the meantime a delay in the progress of the work may be caused. The repeated use of the original for direct printing will cause the plate to show signs of wear, and in order to keep up to the standard, another original will have to be made. In printing large editions, a number of original duplicates could be made to facilitate the work. This plan increases the cost. However, many advertisers frequently use only original engravings for their most expensive work.

Stereotyping

This process consists of taking an impression from the flat type form on a thick pulpy sheet of specially prepared paper. The stereotyped sheet is known as a matrix, commonly called a "mat." The mat is flexible enough so that it can be enclosed in a cylindrical mold into which the hot type metal is poured. The cast curved plate is used for printing on a rotary press. Practically all of the larger newspapers use the stereotyping process for the making of these plates.

Stereotypes for books and similar work are made from the set up monotype or other type forms using wax molds and printing from the flat plates.



The Signal Corps at Fort Snelling

(Continued from page 44)

yard dash, etc., were participated in at the close of camp. It was with great satisfaction and with the heaving of many sighs that these were completed. They had been looked forward to with much dread among the members of the unit.

Little can be said in this short discussion of the activities of the other branches of the service in camp. The infantry, engineer corps, dents, vets, and medics all had their share of woe to be sure. Just what they went through we do not know. Although we had an hour of close order drill and physical exercise with them each day, this was hardly enough to give even a small idea of their activities.

On the morning of July 6, the regiment, consisting of A, B, C, D, E, and F companies, was assembled for the event of events, "the practice march." After marching a distance which varied from six to twelve miles, depending upon the person to whom you were talking, we finally reached the camp site. Tents were pitched immediately, after which gruelling ceremony mess call blew.

After mess a tactical problem was put on by A, B, C, and D companies. This problem lasted till twelve that night. The signal corps furnished communication for this problem, having two outposts at strategic points. Complete communication was carried on by wire and radio with the message centers functioning at their best. This tactical problem gave us a chance to apply in co-ordination all of the various branches of signal corps training in which we had received instruction. It is my personal opinion that we rolled out millions and miles of wire for that problem and then reeled it in again the next day. Perhaps you will not believe me, however, so you may ask any one of the eighteen men who were in camp. Some of them at least will bear me out, I am sure.

The next day, July 7, saw us wearily on our way back to camp amid the groans and oaths of the wounded. Companies E and F which had mounted guard over night and supplied medical aid to the corps, were really overworked for the only time during camp.

Near the end of camp we furnished communication for the regiment on a moving attack problem. My shoulders still ache when I think of the storage batteries I "toted" around that day.

One might think from the above that we did nothing but hard work. Such, however, was not the case for camp life had its humorous side as well. Many and varied were the tricks that were perpetrated upon some of us at intervals throughout camp. One night in particular, when Harris and Wehlitz went to Minneapolis, we tied a rifle under Harris' bed in such a manner that when he sat down, a blank cartridge in the rifle would be fired. We also tied Wehlitz's bunk up on the rafters. When the boys came home, the results were such to gratify our fondest hopes. However, revenge was sweet for the victims, for no one in our barracks was spared when the crash of overturning bunks resounded throughout the camp a few moments later.

But the good times could not continue forever. At the end of camp, honors were announced, and Cadet Hawkins was awarded the medal for the most efficient man in the Signal Corps. Cadet Hilgedick was awarded the medal for proficiency in pistol marksmanship.

Camp broke up on July 22, and it was with mixed feelings of relief and regret that we closed our association with Fort Snelling for the summer.

Convention Post-Mortems

(Continued from page 43)

for a vote. The publications will be rated on punctuality of appearance, editorial matter, makeup, and advertising, and the weight to be given to each will be determined upon by the national committee.

Future plans of E. C. M. A., committee reports, and election of officers took up the remainder of the morning session. The present officers were re-elected for the following year. They are: L. F. Van Hagan of Wisconsin, chairman; W. V. Merrihue of Pennsylvania, eastern vice-chairman; and W. O. Birk of Colorado, western vice-chairman. Ohio State University was selected for the 1927 convention and the Ohio State Engineer will act as host.

After adjournment, the delegates were the guests of the Washburn-Crosby company at a luncheon which followed an inspection tour of their flour mills. The party then traveled to the Memorial stadium to witness the Minnesota-Wabash football game which constituted the end of the 1926 convention.

Engineers in Athletics

(Continued from page 45)

Donald "Fuzzy" Riddel, varsity halfback, seems always to be pursued by hard luck. Injuries is his Nemesis. A shoulder injury has kept him out of the last three games, and it was thought that he would probably not be able to finish out the season.

"Fuzzy" Riddel played a stellar game of football at Virginia Tech, where he received his prep school training. He also played basketball and participated on the swimming team. His work on the swimming team was a great aid to him as it developed his wind and stamina so that he could stand the grind of collegiate football. In his prep days he was named on the majority of the All-Range teams made up by the coaches and sport writers of the range district.

He made the frosh squad quite easily and was given one of the halfback berths on the first string freshman team. He finished out the season with the frosh in good shape and was expected to make a very strong bid for one of the halfback berths this year.

At the beginning of the present season he showed that he could play a very versatile game and his line plunging was powerful. In the game with Notre Dame, Riddel played the last few minutes and proved that he could carry the ball well. In practice sessions after this game, "Fuzzy" injured his shoulder, but not seriously. Shortly after the Wabash game, he again injured the same shoulder, tearing the ligaments. This injury was serious enough to keep him off the lineup but it is now healing rapidly.

If his jinx does not overtake him again, Riddel is expected to play a good game next year.

So Trim Your Sails

By J. M. Hipple
Manager Motor Engineering Dept.,
Westinghouse Electric and Manufacturing Company

THERE are indications that our engineering colleges and universities are to a greater extent than ever before helping to guide their students into the kind of work for which their natural abilities best fit them. If this is true, they are performing a service of perhaps even greater value than in the engineering training given. It is not suggested that this should be carried to extremes, but that as natural talents are uncovered in the student, these be developed and the student encouraged to seek his life work along lines that will permit their greatest use. The degree of happiness and success achieved in business life will largely be affected by this help that may well be given during the malleable years at college.

One of the most easily recognized talents is that of construction. This is often exhibited at an early age when a child will show himself to be more than ordinarily interested in building toys, to the extent of preferring to build one after another rather than being interested in playing with the finished toy. If the true constructive instinct is present, it will continue to be in evidence and may readily be discovered through the interest shown in the laboratory and shop work of the college student. Any one having such unusual interest and facility in building should doubtless be guided toward construction work of some character. If, in addition, a considerable degree of ingenuity and originality is shown, there is every indication that there is the creative ability, which will find its best expression in the field of design.

It is not to be expected that the colleges will produce fully trained and equipped designers. The designer grows and matures with experience. The newly graduated engineer, potentially endowed though he may be with all the desirable qualifications enumerated, is not yet a designer. He has yet to become acquainted with the state of the art by a study of fundamental reasons governing present designs, he must acquire skill in calculation to be able to evaluate results and to develop his judgment, he must study manufacturing methods and limits; in short, he must as quickly as possible catch up with the procession and equip himself to contribute his share to the progress of the art. Nothing will do more to develop the designer than experience, and this experience must carry its share of responsibility. Almost anyone would make a fair sailor in calm seas, but when the storms come with their varying conditions the resourcefulness of the navigator is then truly tested. So it is with the designer; passing through one storm qualifies him to deal better with the next one, even though it is likely to be a gale from a different quarter.

It is to the men who are in school today that we must look for the designers of tomorrow. Electrical apparatus design is today almost wholly in the hands of men who have been trained in the technical schools. It is from our technical colleges and universities that the designers of the future must come, and these schools may well devote serious attention to the development of the individual talents of their students in guiding them toward the character of life work for which they are best fitted.

—By courtesy of the Electric Journal.

A SUGGESTION FOR YOUR THESIS OR FOR OTHER INDEPENDENT RESEARCH

Perhaps no branch of mining appeals to the imagination as much as blasting. The mere mention of dynamite will usually cause a thrill of interest. Courses that treat of this subject are always fascinating to the student.

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(Continued from page 52)

bursts and floods, any one of which would have been more than sufficient to ruin the cable had not the utmost care been taken to keep the water out of the manholes.

One afternoon, while the men working on the next to the last lap of the reloading, with very little warning, one of these heavy rains came up. The rain was coming down in torrents and the water flowing down the pavement threatened to run into the manholes before the men could get out of them and cover them up. Had the water started into the holes, it would have taken only a few seconds to fill it full. The day was saved, however, when the cablemen succeeded in jumping out, throwing a canvas and a pile of sand over the covers. In three or four minutes the water had risen a foot and a half over the tops of several of the manholes.

Numerous tests were required to make certain that all the work was properly done. The first test, after the old loading had been removed, was to rebalance the cable for the new 6,000 foot sections. In making this test, a comparison of capacities of the side and phantom circuits, it was sometimes necessary to adjust the capacity of one on both side circuits in order to reduce the unbalance to an amount within the predetermined limits.

The unbalance was taken in terms of micro-micro-farads; the upper limit for unbalance being set at 30 mmf. for side to side circuits unbalance, and 50 mmf. for phantom to side circuit unbalance.

After the new loading was installed, the correctness of loading was checked in order to discover any possible errors in connecting the loading coils to the cable. This was done by connecting two phantom groups in two arms of a bridge circuit and comparing the impedances. If any great unbalance was discovered by this test, further tests were made to find the cause, of which, there were many possible. One cause for impedance unbalance might be that a loading coil had been omitted at one of the loading points. Other causes might be that a coil had been split between two circuits; and unintentional B "grounds" or "shorts" had been made on the circuits. It was then necessary to find these faults and correct them before any further work could be done.

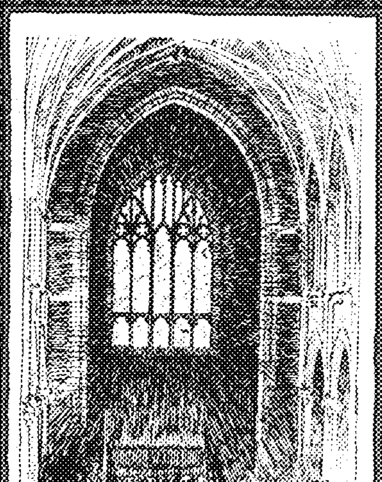
The final tests that were made before the circuits were placed in service were the impedance and cross-talk tests. An impedance run was made over the circuits used as "standards" in the correctness of loading tests to make sure that all of the circuits were not incorrectly loaded at some point. Should this be the case, the correctness of loading test would not detect the error because the impedances would still balance. The impedance run was the final check on the design of loading, as well as on the accuracy of doing the work. Any irregularity in the circuit could be quickly detected and located.

Cross-talk tests were made from both ends of the reloaded cable to determine the amount of cross-talk between circuits. Cross-talk results from defective shielding in the loading pots, unbalanced twist in the cable conductors, excessive leakage, due to wet insulation, or, partially grounded conductors.

When all of the above tests have good results, it could safely be assumed that the cable was satisfactorily loaded and ready to be placed in service. Considering the weather conditions, the amount of work involved in unloading and reloading the cable, and the number of tests required, it was quite remarkable that the project could be completed in two and a half weeks.

The MINNESOTA TECHNOLOG

Published Monthly by the TECHNICAL COLLEGES of the UNIVERSITY of MINNESOTA



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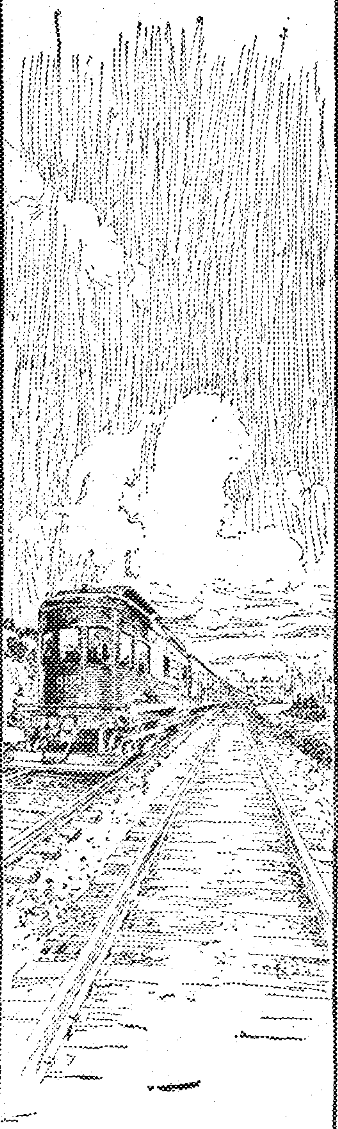

Transportation

SPEED of aeroplanes at McCook Field, or of motor boats at Detroit, or of automobiles at Daytona Beach, means little except as a phase of development. But the speed of milk trains, meat trains, coal trains, and passenger trains is quite a different thing—it is a necessity.

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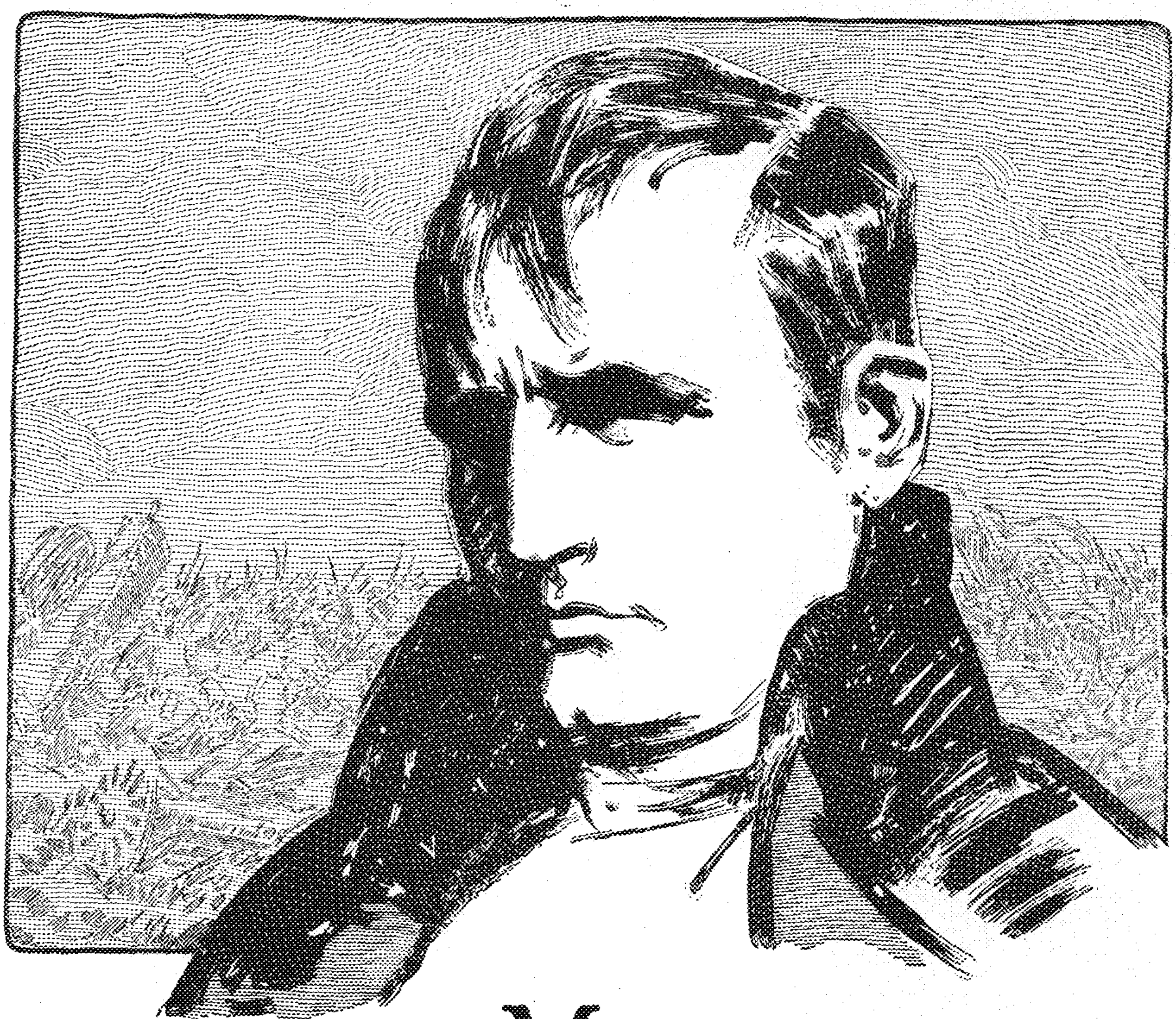

Man-power

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MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

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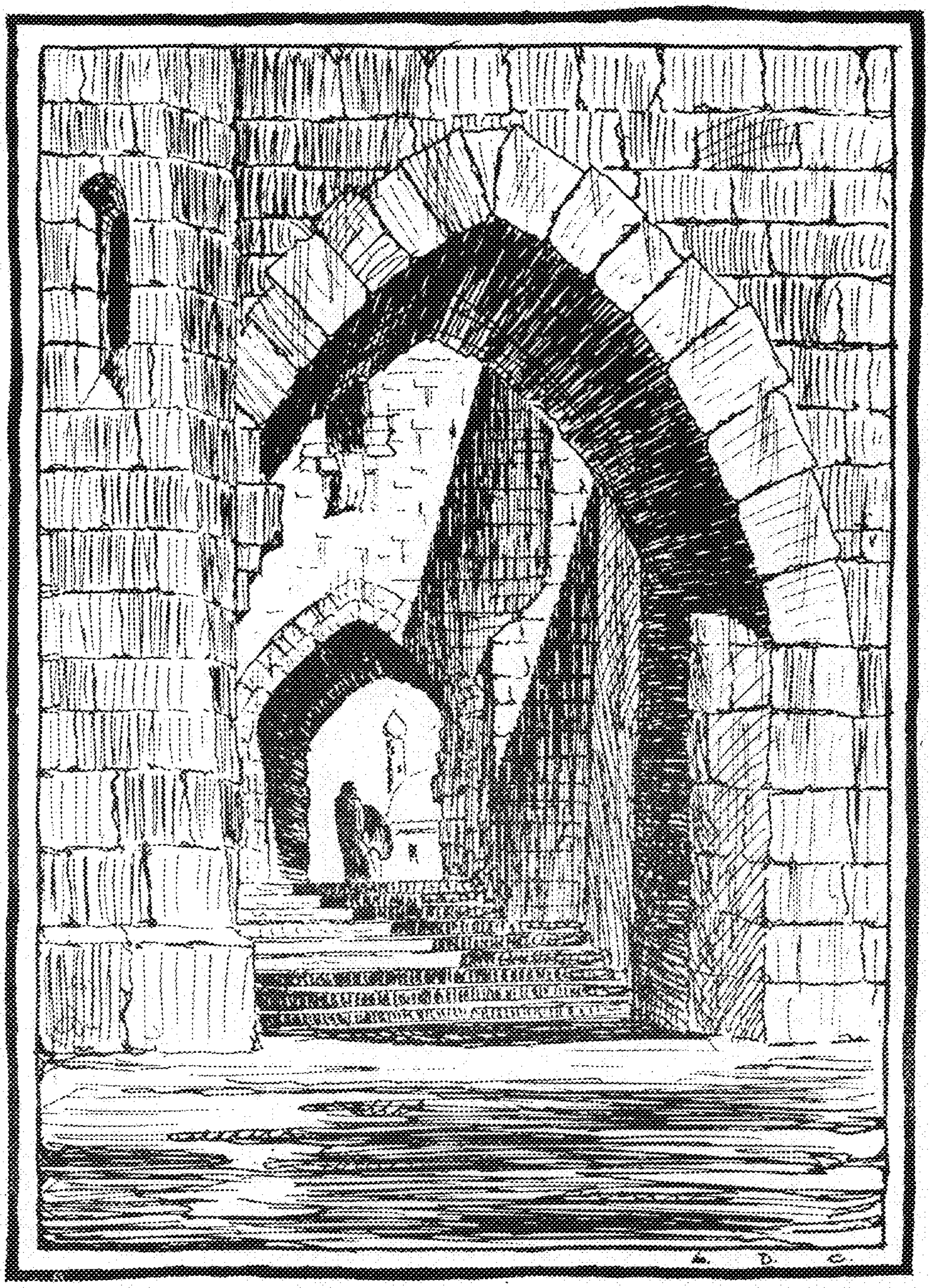


GEORGE D. CROSBY

Jerusalem: *An Old Street*

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VII | DECEMBER 1926 | Number 3

Of Castles and Bridges in Spain

By C. RALPH BENNETT

English Dept., School of Applied Arts
University of Cincinnati

FIRST I visited the scene itself, where men and machines labored. There was the bridge, and near it was the building. Each bank of that river seemed to have pushed out reaching arms from its sides. Gray masses of concrete crept toward a final clasping high above the muddy river waters. Threads of steel yearned upward toward the heavens, and fingered passing clouds. I heard the sound of steel on steel. The brown river frowned, and the gray arms lengthened. Two black girders twisted skyward at the end of strands of steel—I saw the painted white numbers on their sides grow small and blur and vanish. A derrick creaked. I craned my neck. A whistle blew. The sun was dropping toward the west.

A month ago I had passed this spot. A vacant, unscarred lot had flanked a slowly flowing river. Trucks rumbled noisily along a rutted road. I saw no rising plumes of steam then. I heard no rumbling concrete mixers. The men who build had not yet come, with blueprints and with visions.

The engineer and the architect are blood-brothers of the poet and the painter. All of these are dreamers of dreams, all of these are makers. Imagination gleams in all their eyes. They have laid their hands upon the earth and the air and the sea, and upon the thoughts of men. Mankind lives because they work.

It is strange that the world should ever have called the engineer materialistic. To be sure, he works with material things, but he is a creator, and materialists do not create. It is stranger still that engineers should ever have tried to make themselves believe they have no imagination. Unimaginative men do not become engineers. They sell stocks or bonds or clerk in banks.

I have always believed that nature gave man a universal heritage. It gifted men with vision. And man has used that vision well. But at the same time he has used it, he has been afraid of it. He has half believed that it made him less than a man, though he has known deep in his heart that it has made him more. He has feared that it might destroy his "practicality," whatever that might be. Back in his head all of the time he has understood that it is the mother of his "practicality." It is one of those things he does not like to admit. Perhaps he fears that the relationship is a bit scandalous.

When I first started to teach English to young engineers and architects, I noticed two characteristics of my students. I saw they had vivid imaginations. I saw, too, that they were youthfully positive that they hadn't. I embarked upon a campaign.

Every beginning college English course "offers" composition. Students do not like the offering, usually, and they have reason. For the common composition course, as it is taught in most of the colleges of this country, mainly in the Colleges of Liberal Arts, is a musty, dry-as-dust, lifeless gathering of masses of uninteresting details piled together in one grandly uninspired outlay of the mother tongue. The breath of life has never breathed upon it. The teacher has gained what he deserved, twenty-five stereotyped t r e a t i s e s on "How to Build a Fence" without an echo of an idea, without a scent of originality in the whole twenty-five groaning fences.

My students, coming from high-school, expected to assemble fences from the encyclopedia for me. They never made a single fence. Naturally, those students thought that I was "queer." I told them to let their imaginations gallop. Instead of detail ferreting and tracking down, I tried to let my students build me interesting, imaginative themes in their own way. I told them to try to make their themes interesting to themselves, because then they would be interesting to me. I drilled into them that I wanted them to "say something."

I realize that there were often whispers during the first weeks of school, and I know that when I said, "For next week you may use the theme title, 'Beyond,' or, 'Wheels,'" there was genuine sorrow among the boys—that another English teacher had gone crazy. But imaginations bubbled over—no bubbling, no theme—and "Beyond" rose full grown from the bubbling—and many "Beyond's." I wish you might see all of them.

I have always felt that theme writing may be made pleasure instead of drudgery; I have tried my best to make it so—and I believe I have sometimes succeeded. (I have even seen the time when my students, engineers and architects, all of them, to whom theme writing traditionally meant perspiration and exhaustion, came to like to write, and vied in the writing.) For there is born in each of us a desire to create, to make something of our own. Do not the wrecks of windmills on red barns, and the pathetically impossible home-made "machines" prove it? It makes little difference what we create. With our imaginations we give shape to our dreams. Some of us can never carry them to reality. What does it matter? The sport of it all, the joy of it, is in the building.

As I see it, the function of the teacher of English in a technical college is primarily to arouse that imagination which his students have so abundantly. He cannot create it—it is not necessary that he should try. He has merely to stir up what has been allowed to sleep. He must draw it out. He will give his students theme titles which in themselves mean nothing, the shorter the title, the more "outlandish" (on first glance) it seems, the better. He will, if he is wise, not explain his titles, for explanation means uniformity of product. His students will groan, and they will covertly curse him, and they will know that they cannot write any such theme. But each of them will summon what imagination he has, and he will surprise himself, and like it. I have seen those surprises.

By following such a method, I have received vastly interesting themes from my students. They have been interesting, they have been creative, they have been individual. Each has had something worthwhile in it, something "made." It has belonged to the student, just as that dam or that building or that machine will belong in the years to come

(Continued on page 96)

Producing Pig Iron in Northern Minnesota

The problem of competing with Pittsburg in the economic reduction of iron ore i the subject of much research at the Mines Experiment Station

By E. W. Davis, Supt.
School of Mines Experiment Station
University of Minnesota

AT the School of Mines Experiment Station at the University of Minnesota, our chief job is to increase the value and wealth of our iron mining industry. Indirectly this means increasing the wealth of the state but primarily any increase in wealth must first come to those interested financially in the industry. The work at the School of Mines Experiment Station is divided into two classes, service work and research. You are undoubtedly familiar with the fact that you have at your disposal the finest ore testing laboratory in the world for the study of your beneficiation problems. The state maintains this laboratory at a cost of about $25,000.00 per year so that the operators may send samples of their ores to us for investigation and test. Samples range in size from a few pounds to carload shipments. Equipment is available at the Experiment Station for testing iron ore according to all known methods and a staff of engineers, operators and mechanics is available the year around. This work is all done without charge provided the ore comes from Minnesota. The various railroads serving the iron mines transport ore for experimental purposes free of charge so the only cost to the operator is that of securing an accurate sample of the material he wishes studied. Last year nearly two thousand tons of ore were shipped to us for beneficiation treatment.

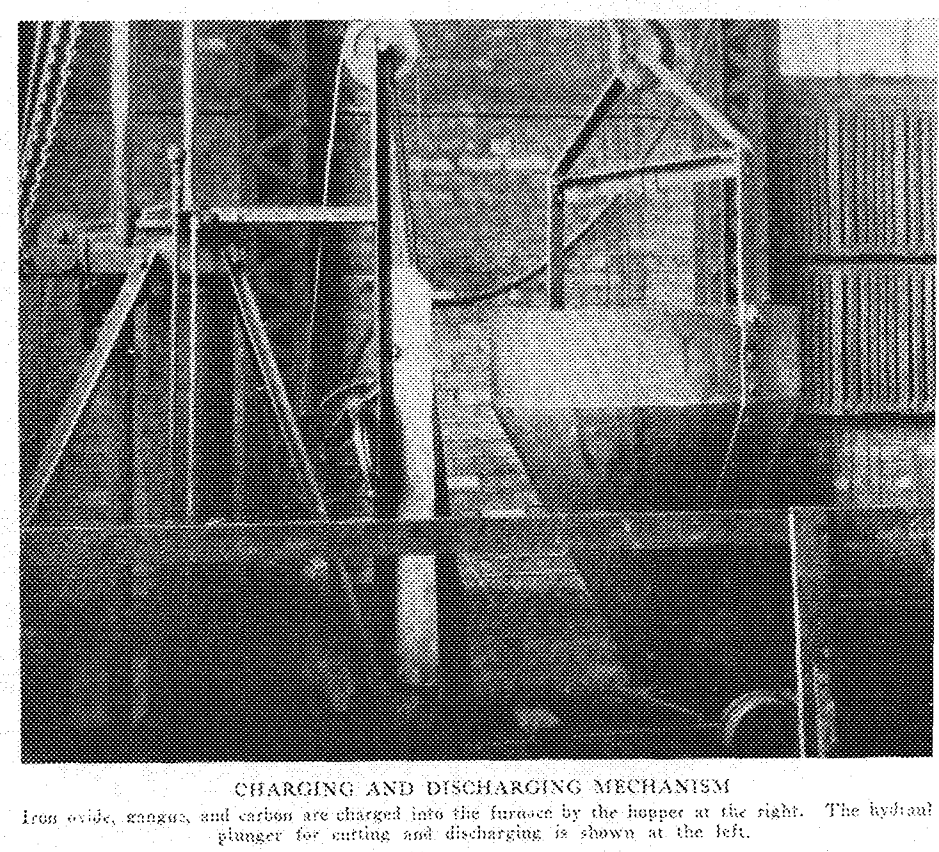
The research staff of the Experiment Station is a separate organization. This work can only go ahead as funds are available. Some years, considerable research work goes on and other years, practically nothing along this line can be undertaken. The service work has grown to such a point that practically all of our regular appropriation is required for maintaining the plant and staff and doing the ordinary testing work for the operators. The research work depends largely upon the generosity of the legislature in making special appropriations for particular lines of study. The legislature has been very considerate of this branch of our work in the past and there is every indication that this far-sighted policy will continue.

The last legislature appropriated sixty thousand dollars to be spent during two years in a study of the possibility of producing iron or steel near our iron mines. We ship annually thirty or forty million tons of ore out of the state. The average value of the ore in the docks is between three and four dollars per ton. If we could increase the value of our shipping product to ten or fifteen dollars per ton by spending eight or ten dollars on our crude ores near the mines, a very large new industry would be developed within our state. This would, of course, react to the benefit of the operators as well as the communities and the state itself.

This large tonnage of ore which we ship each year is all changed into pig iron, most of it at lower lake ports. The question arises as to the reason why this ore cannot be changed into pig iron before it is shipped. The Experiment Station staff has been at work on this problem for the last year and a half and while the answer is not yet available, some of the information secured may be of interest.

The production of pig iron is largely a question of freight, labor and raw materials. We have near our mining districts the best of railroad and water transportation. Labor can easily be provided since there is plenty of room in northern Minnesota, and at least one of the important raw materials is availabl in large quantities. Therefore accurat figures can be compiled which will cas light upon this question.

To make one ton of pig iron in th blast furnace, about two tons of iron or one ton of coke and one thousand pound of limestone are required. Conside first the cost of assembling these product in the Pittsburgh district. The freigh and handling charges on the two tons o ore shipped from the Mesabi Rang amount to about $5.95. The freight o the one ton of coke amounts to 50c The freight on the one thousand pound of limestone amounts to 30c. There fore, the total cost of assembling th raw materials at Pittsburgh amounts t $6.75 per ton of pig iron. Now con sider the costs if the pig iron were pro duced at Hibbing, for example. Th freight and handling charge on the tw tons of iron ore would be only fifteen o twenty cents. The cost of delivering th ton of coke would be about $3.50, an the cost of delivering the one thousan pounds of limestone would be about 90c This gives a total of $4.60 but it is nec essary to add to this the cost of shippin the one ton of pig iron to Pittsburgh No freight rates could be secured in thi connection but from the best informa tion available, it seems probable that th



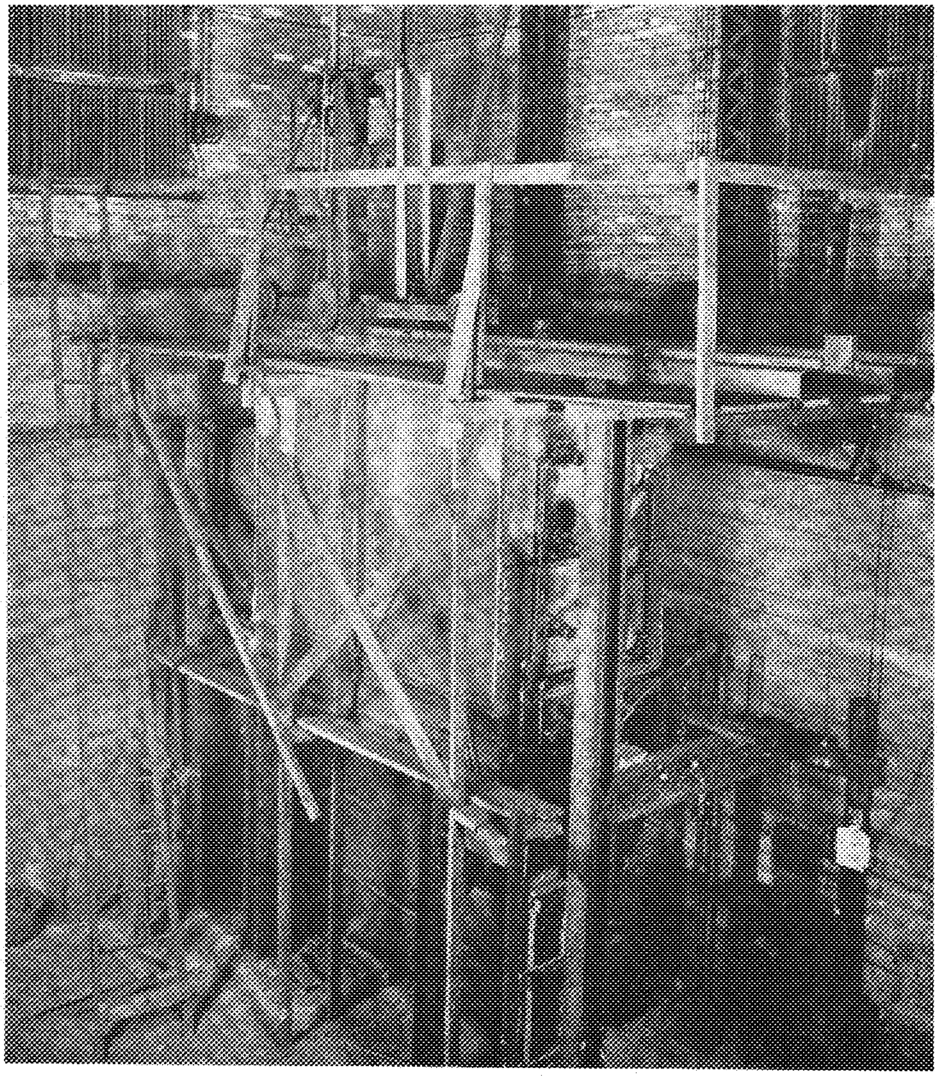
CHARGING AND DISCHARGING MECHANISM
Iron oxide, gangue, and carbon are charged into the furnace by the hopper at the right. The hydraul plunger for cutting and discharging is shown at the left.

EDITOR'S NOTE: This paper was read by Mr. Davis at a meeting of the Northern Minnesota Engineers' Club held at Chisholm, Minn., on Nov. 13, 1926.

rate would not be less than $4.00 per ton. This gives a total transportation charge for pig iron made at Hibbing and delivered to Pittsburgh ot $8.60 per ton. There is no reason to believe that a blast furnace can be operated more cheaply at Hibbing than at Pittsburgh and therefore Pittsburgh can furnish pig iron for its own market at least $1.85 per ton cheaper than Hibbing could deliver it to Pittsburgh. Similar figures to these have been made for pig iron manufacture at Duluth and Minneapolis but in all cases Pittsburgh has the distinct advantage. Of course if it were not necessary to ship the pig back to Pittsburgh, the advantage would be the other way. As conditions exist, however, this transportation charge must be added. Pittsburgh has the industrial development necessary to use the pig iron and Minnesota does not have it. Possibly at some future date, our northwest territory will develop to a point where another Minnesota steel plant can be constructed but at the present time, any considerable tonnage of pig iron produced near our iron mines must stand heavy transportation charges.

These figures are convincing evidence that we cannot hope to make pig iron near our mining districts at the present time, or even in the near future, unless means are secured for producing metal from iron ore more cheaply than by the standard processes now in general use. Therein lies the only hope of an iron and steel industry for Hibbing and also for the State of Minnesota. Metallurgists have been studying this problem for years and the patent office is full of patents on the metallizing, direct reduction and sponge iron processes. I will not attempt to describe or explain these processes here although one or two of them have been in commercial operation abroad and several more have been tried out commercially in this country.

The research staff at the Experiment Station has been studying all of these proposed methods for producing iron and steel without the use of blast furnaces and have collected from these schemes all of the ideas that have any bearing on the problem of producing iron or steel in Minnesota. Our problem is largely one of producing iron without the use of metallurgical coke and without the use of any large amount of electricity. Furthermore, we must compete with blast furnace operations. These three conditions which must be imposed upon any method for producing pig iron in Minnesota eliminate from further consideration most of the suggested processes. After careful study and much experimental work, we have decided that our best chance lies in retort reduction followed by reverberatory melting.



GENERAL VIEW OF THE SPONGE IRON FURNACE

The iron oxide is reduced to sponge iron in the upper portion of the furnace, and then discharged to the lower portion where it is allowed to cool.

Retorts may be characterized as those furnaces in which the heat must pass through a gas-tight wall before it reaches the material to be heated. In a sense, boilers can be considered as a type of retort furnace since the heat must pass through the metal of the boiler tubes before reaching the water. Retorts are generally considered, however, in connection with the type of furnaces characterized by the term "ovens." Coke ovens are, of course, the outstanding example of this type of furnace. Ordinary coke ovens are approximately 30 feet long, 10 feet high and 15 inches wide. These are the dimensions of the retort in which the coal is coked and which is separated by gas-tight walls from the fire boxes or combustion flues, which are the source of the heat. The combustion flues cover both sides of the retort but are separated from it by walls of firebrick 4 to 8 inches thick. The heat must be driven through these walls of firebrick before it reaches the coal in the retort. At first thought, this would seem to be a very inefficient method for heating coal to the high temperature required for coking since firebrick is ordinarily considered a good heat insulator. However, compared to coal, firebrick is a good conductor and there is no necessity for a good heat conductor in the walls of the retort when the material to be heated is such a poor conductor that it cannot absorb heat rapidly. If heat is supplied to any furnace faster than it can be absorbed, a temperature will soon be reached which will destroy the furnace.

In making coke, coal is charged into the retort which is then sealed up to prevent the access of air. Gas burning in the heating flues gradually raises the temperature of the coal, over a period of time ranging from ten to forty-eight hours, to a temperature of about 1000° Centigrade. By this time practically all of the volatile constituents of the coal have been driven off as gas and only the carbon or coke remains. This is pushed out of the oven and quenched to prevent oxidation. The volatile matter driven off during the coking operation is largely combustible gas. This gas is used to provide the heat necessary in the

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Studying a Nation's Highways

Bureau of Public Roads conducts valuable tests on the efficiency of concrete paving operations and the performance of roadbuilding equipment

By Arne A. Jakkula, C. '26
Research Fellow
University of Minnesota

When I was offered the opportunity of working for the Bureau of Public Roads last June in the capacity of student engineer, I accepted primarily because the job presented a chance to do a little traveling at some one else's expense. The promise of a per diem living allowance in addition to salary was another thing that did not detract from the job's allurement. Now that the summer is over, I realize that the traveling was just a minor item and that the job taught me many valuable things. Among other things it presented a new line of work in civil engineering that as yet has been little touched and that in the future will become of great importance.

Before I start on the more technical side of this article, I must tell of the traveling that attracted me at first. Three thousand miles by train and over a thousand miles by automobile was my share. It took me from Minneapolis to central Missouri, from central Missouri to eastern Texas, from there to western Texas, and from western Texas back to Minneapolis again. Six weeks were spent in Missouri, three weeks in eastern Texas, and three weeks in western Texas. Then I must not forget the pleasurable weekends spent in Kansas City and St. Louis. These were unofficial, however, and space restrains me from lingering over the details of these visits. Suffice it to say, if one combines an adventurous band, a strange town, sufficient money, and a tough constitution, events are apt to occur that are not easily forgotten, that one does not wish to forget.

The work was a combination of efficiency study on paving operations and research work on concrete. It was part of the bureau's endeavor to obtain facts and figures from actual road construction in the hope that they could show the contractor where his major time losses and consequently his major "money" losses occurred and their cause. With this object in view, the Division of Control employed twelve college men, mostly seniors, as student engineers to aid their permanent force of about a dozen men during the summer months.

It is apparent that since the main piece of equipment on any concrete construction is the mixer, its speed of operation and its delays affect all operations that may be going on simultaneously. Because of this fact, the mixer on any particular job in question was studied in detail, with the aid of a stop watch, for an hour each morning and afternoon. During the hour, the time of the following movements were recorded to the nearest second: (a) raising the loading skip from the ground to a vertical position, (b) mixing the batch, (c) the lag between the ringing of the bell announcing the complete mixing of one batch and the raising of the skip containing the materials for the next. This cycle was timed for every batch during the hour. All delays occurring during the hour were carefully noted both as to cause and length. Some of the common causes for delays were the following: shortage of material; inadequate truck supply; shortage of water; mixer trouble, both operative and mechanical; lack of subgrade; delay of finishing machine; delay in placing center strip and reinforcing steel.

Numerous other time studies were made on other parts of the mixer and on the pieces of equipment at the slab and at the material yard. These can be briefly summarized in the following manner:

A. At the mixer:

(1) Skip Operations

In this study, the time required to raise skip from ground to full elevation, the charging lag, or the time elapsing from the setting of the timer until all the material has entered the mixing drum, and the time elapsing from the instant the operator releases the lever until the skip reaches the ground, were all carefully noted. An effort was made to secure readings when the aggregates were wet as well as when they were dry to see if varying degrees of moisture had any effect upon the time required to empty skip.

(2) Discharge Operation

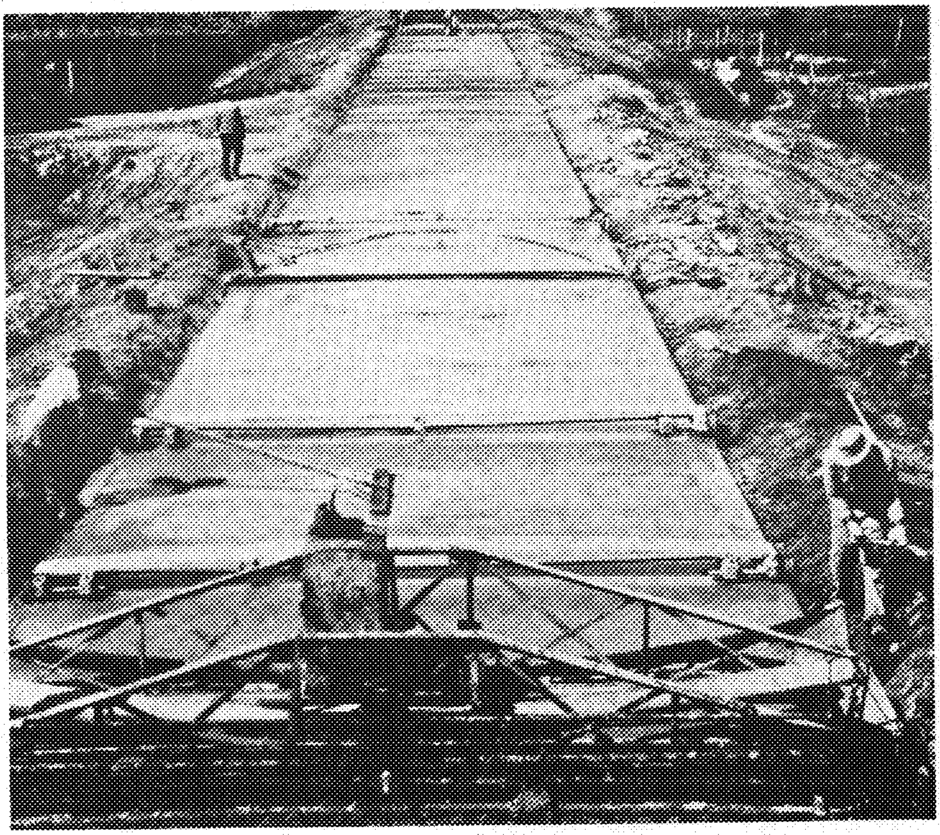
These studies were made to determine (a) the time elapsing between the sounding of the timer and the opening of the gate by the operator so that the concrete appeared in the chute, (b) time from opening discharge gate until batch is discharged into bucket, and (c) the time required to run out the bucket and dump it.

(3) Mixer Drum

Studies were made to determine the revolutions per minute of the mixer drum.

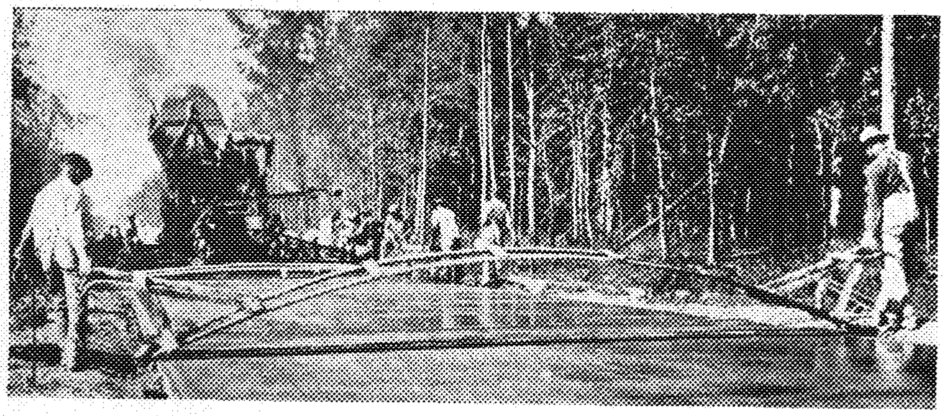
(4) Water Tank

Studies included (a) a careful observation as to whether or not there was any leakage into the mixer drum whe



SMOOTHING OPERATIONS ON A SOUTHERN HIGHWAY

The operations in order are: finishing with a Lakewood finisher, transverse floating, longitudinal floating, curing with wet burlap, and curing with a covering of wet earth.



MIXER OPERATIONS NEAR TEXARKANA
Efficiency studies were conducted on this job, located on the boundary line between Texas and Arkansas. The "longitudinal floating," or smoothing process, is shown in the foreground.

the valve was supposed to be closed and the amount of leakage if any occurred, (b) the actual amount of water furnished at the gauge setting, (c) the time to fill tank, (d) the time to empty tank, (e) determination as to whether or not water from the supply line flowed into the tank while it was emptying, and the extent of any such flow, and (f) observations as to whether or not the amount of water supplied to a batch was affected by the grade of the roadbed upon which the mixer was operated.

B. At the material yard.

(1) General

Studies were made to determine as nearly as possible under prevailing operating conditions (a) the output capacity of each major piece of equipment, (b) the output capacity of the plant as a whole, and (c) the efficiency rate at which operations were conducted. These details varied, of course, with the layout of the plant and the equipment used. Where some form of crane was used to handle the aggregates, studies were made to determine its operating characteristics and performing abilities as to (a) time required to handle a bucket of sand, stone, or gravel from car to bin, from car to stockpile, and from stockpile to bin, and (b) the average amount of material handled per bucket. During these studies all delays both as to magnitude and cause were noted.

(2) At the Batcher

Detailed studies were made of the performance at the batcher, and these included (a) the time to fill the batcher with each of the materials and (b) the time required to empty and return ready to fill. If mechanical loaders were used, their speeds and their capacities were studied.

(3) Hauling Equipment

Studies of the hauling equipment through the yard were made noting (a) time to load aggregates, (b) time to load cement, (c) time for turning if trucks were used and switching if industrial railroad was used, and (d) the length and cause of all delays.

The research work that was conducted in conjunction with these studies consisted of making cylinders to see if the length of mixing time had any effect upon the strength of the concrete. In all of these tests the water content was carefully measured because it was realized that variations in the water content could easily cause variations in the strength greater than could variations in the mixing time. This was done by measuring the water content in the sand and gravel used in the batch from which the cylinders were made. The water added at the mixer was measured by the gauge on the tank and corrections were made if the mixer was located on a grade.

The thickness of the slab and the accuracy of the finishing machine and subgraders was measured by placing blocks on the forms and stretching over them a piano wire upon which each foot was marked. The wire was held taut by a spring. The depth to the subgrade and to the finished slab was measured from this wire. These depths gave a measure of the uniformity of the subgrade and of the finish while the difference of the two readings gave the slab thickness.

Taken all in all, every phase of the paving operation was minutely studied. It gave one who was observant a chance to see where operations could be speeded and where delays could be eliminated. It gave one who was interested a chance to learn paving from start to finish. It is my belief that the Division of Control, Bureau of Public Roads, presents the best opportunity in the country to learn concrete paving. If one really wishes to learn paving, one could not do better than to work for this division for a year or two.

Personally, I visited seven different jobs, some of which were studied in detail and others only casually. Each job was different and presented for observation the ideas and opinions of the contractors, gained through experience, on how concrete roads should be layed. Thus one could see for oneself how things were done and by a comparison of different methods, learn which were more efficient.

In addition to paving, the Division of Control investigates the performance of all road building equipment. They have studied elevating graders, blade graders, steam shovels individually, and grading outfits of every type as a unit. Thus they have determined the proper number of wagons needed for every length of haul and the type of outfit that is best suited for any kind of soil.

One can readily see the vast amount of information to be obtained in this work, information that is there for the taking and that has never been thoroughly investigated. For example, I heard of a contractor who ran an elevating grader outfit. He had a new grader, dependable drivers, and the weather was ideal. In fact he had everything desirable for a profitable season and yet he lost money. On his short hauls his wagons were waiting for the grader and on long hauls the grader waited for the wagons. Thus in the first case, he paid salaries to drivers who only held the reins, and in the second case, he allowed valuable minutes to slip by when he was not moving any "pay dirt." When he learned how to figure the number of wagons needed for every quarter mile of haul, his profits began to show a healthy growth.

This type of work, namely, studying construction operations minutely with the object of noting delays and their causes so that they may be eliminated is the new field of engineering to which I have reference. It might well be termed "Production Engineering." At the present time the big cry is "Produce." The public wants its roads opened as soon as possible and the builder wants his construction done in the minimum length of time. The contractor, too, demands production for the health and growth of his pocket-book. The contractor knows in a rough way how long it takes to do a piece of work, but he does not always realize how a second's delay here and there counts up in the course of a day, week and month. It is these seconds during the working day that are vital and not so much the delays caused by weather conditions. In paving work, in which weather is the largest factor in stopping production, if a contractor, by getting a faster crane or by showing the mixer operator where he can save two or three seconds during each batch, can lay only ten feet more per hour, he is much interested, because ten feet an hour during the course of a day amounts to 100 feet. This might easily be the difference between profit and loss. Every day that can be utilized must be used to its maximum, for the next day it may rain and stop operations for an entire week.

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STUDENT AVIATORS, OFFICERS, AND INSTRUCTORS AT THE NAVAL AIR STATION, HAMPTON ROADS, VA.

Twenty-three embryo ensigns from Great Lakes, Ill., Squantum, Mass., and Rockaway Beach, New York, attended this advanced class. Counting fro left end, standing, the Minnesota men are: fifth, Lloyd Berkner; ninth, Lawrence Clousing; tenth, Donald Stevens, thirteenth, Richard Hanson; fourteenth, Ross Mahachek.

"All Clear!" "Contact!"—

—And away for a trip through the clouds when Minnesota engineers take flight training with the U. S. Navy

By LAWRENCE A. CLOUSING, E '28.

IT was a clear calm morning. The sun was glaring brightly down on the blue, cold water of Lake Michigan, which was whipped into small waves by a fair, north wind. Conditions were ideal for seaplane flying, and a group of aspiring aviators gathered on the beach for their first hop in a seaplane.

A month passed, and again the aviation students were assembled in a similar group on the beach, but this time it was an occasion of more than usual importance, because they were going to be checked that day to see if they could handle a plane well enough to fly it alone.

Two weeks more passed and the men had finished their preliminary flight training with the Naval Reserve.

That is the brief outline of the preliminary training we received as student aviators with the Naval Reserve during the past summer. To some, a month seems like a very short time in which to learn how to pilot a plane, but it really is a long time, when it is considered that in ten hours of flying time, a man should be able to pilot an airplane alone. Bad weather which came during the month and which is the bugbear of aviation training on the Great Lakes, was the cause of the unusual length of time before a solo flight was performed by any member of our class. The northeast wind that would whip across Lake Michigan carrying with it rain and rough weather, often held up flying for days at a time.

There were eleven men who finished their preliminary training in this class; five from Minnesota, Ross Mahachek, Lloyd Berkner, Donald Stevens, Dick Hanson, and myself; and six from Wisconsin, Indiana, and Ohio. Great Lakes, Ill., was the location of the Naval Reserve Aviation Unit where the U. S. Navy gave us our preliminary training for reserve commissions. On the successful completion of six weeks work which included thirty hours of solo flying, we were sent to the Naval Operating Base, Hampton Roads, Va., for more advanced training.

The aviation beach at Great Lakes, Ill., faces east and is down below a high bluff upon which is the Great Lakes Naval Training Station. A long breakwater stretches out into the lake for about a mile, enclosing a large area which makes the place excellent for the flying of seaplanes, because in rough weather landings and take-offs can be made inside of the breakwater. Two tall radio towers rise to great heights from the radio station atop of the bluff. The towers and breakwater were a great means for identifying the station from a distance. On hot days the warm air blown down over the bluff by off-shore winds is cooled by the water, and bumps and eddies fill the air near the beach, so that flying above the beach is like riding a speeding auto over a rough country road.

The first hop given to us was an indoctrination hop just to give us the feel of flying in an airplane, since very fe of us had ever been up in one befor and some had never even seen them a close range. On later hops we took th controls, of which there are thre ailerons, elevators, and rudder, and wer taught to make shallow turns, spiral take-offs, and landings, progressing fro the simpler and less dangerous maneu vers to the more difficult as the trainin progressed. Since the plane has du controls, it is possible for the student t handle the ship without danger, as th instructor, who sits in the forward cock pit, can always take the controls if th plane gets into an unpleasant situatio

After the first few hops it became a parent that it is always a wise poli to keep the nose of the plane down. other words nobody wants to have t plane stall, and go into a spin. . . u less of course, it is done as a stunt. lining up parts of the motor with t horizon the plane is kept level, and flyi speed is maintained, and since the s dent usually does not develop his flyi sense, or feel, for some time, he m be governed by these artificial means. the early days of our training, the adage of the aviator was instilled in us, and we learned to heed its wisd well:

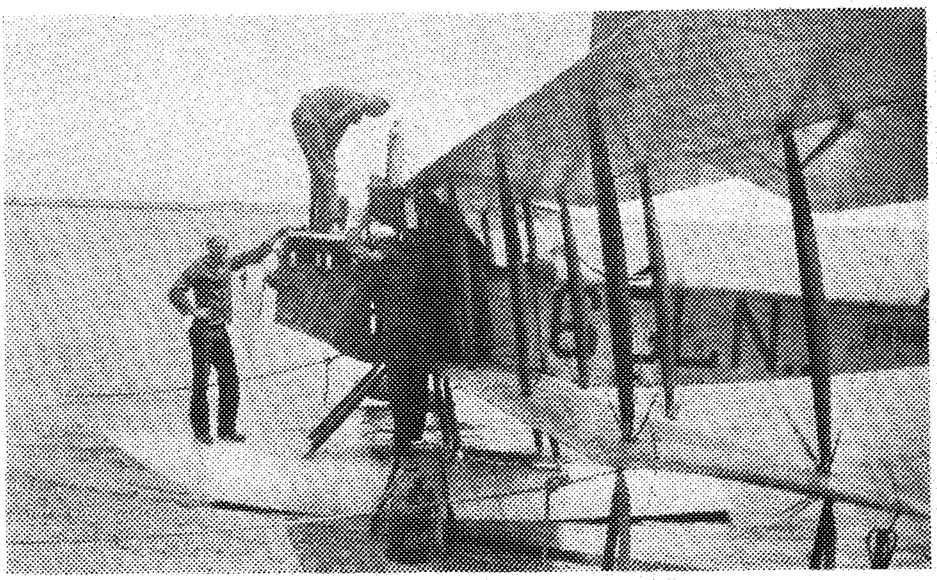
"When in danger or in doubt,
Nose her down and bring her out.

Before we soloed, the instructor p the planes into spins, and had us reco from them. He also performed w overs, flipper turns, and side slips, get us used to flying in unnatural positions.

While we were going through this period of instruction, Jack Green, one of the experienced pilots who gave us our instruction, informed us in this manner: "One man cracked up a plane while waving at his girl when flying over a bathing beach off Lake Forest, and another man who was thinking of a girl flew the plane like an egg crate, so I am telling you now, if you have any girl on your mind, forget her until you get done with your training. You aren't good enough at this stage of the game to do two things at once."

I guess the instructions were followed out because no one cracked up a plane, although the tail was broken off of one of them. That was the nearest thing to a crack up while we were there as students. Mahachek, and Ens. Priestman were up in a plane, and made a landing in very rough water. On the take-off when the plane was just about at the flying speed and ready to leave the water, it swerved slightly, and refused to take to the air. And as Mahachek relates it, neither pilot knew of the broken tail, until Priestman turned around and said, "Why, hell, the tail's broken." Evidently the strain of the landing on the rough water and the subsequent take-off proved too much for the plane.

Bad landings were the most embarrassing things for students, because there were usually some of the more experienced flyers on the beach watching the solo students perform, and the landing was usually made rather close to the station, so that everybody could count the bounces if it was bad. A good landing looks like the easiest thing in the world to make, with the plane gliding along, slowly approaching the water, but any small mismove at that time would prove quite awkward. In technical terms, the best landing is made if the plane just touches the water when the plane is completely stalled, which is the point at which the flying speed has so decreased that the plane will not be supported by the planing action of the wings. None of the landings were so bad as to crack a plane up, although some had bad bounces to them. That is where seaplane training is safer than landplane training, because if a bad landing is made in a land plane it is liable not to bounce, and may wreck the landing gear. Then, too, if anything should happen to the motor of the seaplane, it can usually land any place on the water, while in landplane practice there are many places where a plane cannot be landed. In landing a landplane properly a three point landing is made when the two wheels and the tail skid touch the ground at the same time. For irony, the navy men named a landing of "three graceful bounds" a three point landing.



SERVICING IN N-9 TRAINING PLANE

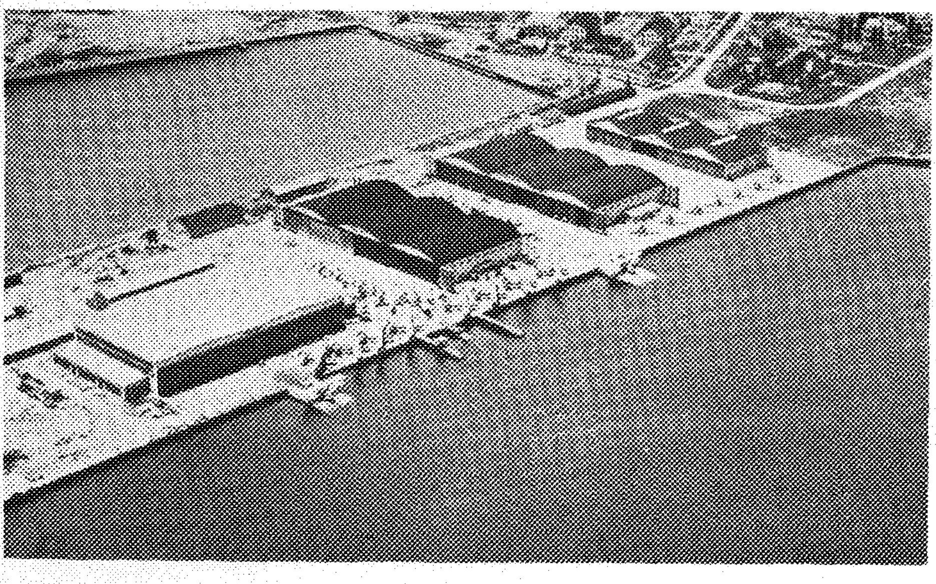
Every two hours the plane must receive its rations of twenty gallons of gas, one gallon of oil, and water in order to carry on with student piloting.

A full sea-bag of clothing, including the entire outfit of a full-fledged sailor, was issued to us upon our arrival at the station, but dungarees constituted the official uniform of the day as far as we were concerned. These were supplemented with sweaters and leather jackets when flying on cold days.

The daily program usually started about six. Sometimes when the weather was good it started earlier, and the planes were kept going till dark, or even after dark at times. There were a limited number of planes at the Great Lakes station, and in order to get flying time in for everybody the planes were kept running as much as possible. Then when the day was done the planes were placed on dollies which ran down a runway into the water, and the plane was pulled up the runway by a most useful thing about an air station, the Fordson tractor.

After being placed in the hangars the planes were serviced with about 20 gallons of gasoline, a gallon of oil, and water. Grease and oil was wiped off as much as possible and the planes were ready for another day.

However, a plane is a fickle thing, especially an old plane. The motor won't start, and if it does start, some of the cylinders are often missing, requiring the services of a mechanic. If the trouble isn't with the motor, the copper striping may be torn off the step of the pontoon, the pontoon may be leaking, or some wires may need adjusting. Much experience was gained in helping to remedy some of these things, and at times when the planes were being lined up, the students were expected to give a hand. These small ailments, that



AIR VIEW OF THE HANGARS AT HAMPTON ROADS

The seaplanes are lined up on the apron. Officers' quarters and barracks of the Naval Air Station are seen in the background.

always seemed to pop up just as we wished to take out a plane, proved to be most valuable to us in learning to maintain the ships in proper flying condition.

No altitude flights were made during our training, and the highest any of us got was about 10,000 feet in the air, which is the ceiling of the N-9 planes. However, it is much safer to be up that high than a few hundred feet off the water, but much more lonesome as well.

Cranking the planes was a task, and this was done by means of a crank geared to the engine by reducing gears, so that the engine could be turned over, which would be almost impossible if it were connected direct. After exercising for 20 minutes the motor usually started. When the plane came down with a dead motor, it was called a "dead stick," which was quite a pert way of saying the motor was dead.

But we weren't flying all of the time, and our time on the ground was taken up in many duties about the station, such as raking the large stones out of the beach, oiling and gasing the planes, and in helping riggers and mechanics. A schedule of duties was arranged which changed the work of each man every day. Two men were mess cooks for the day, another was Captain of the Head (the meaning of which can be learned from any gob), another was Junior Officer of the Day, two others were appointed the job of "boots," one other was flight clerk, and the rest of the men were on the beach to shove planes off, and wave them in. "Boots" were so called because they put on high boots which permitted them to wade in water up to their chest. They are big and clumsy, and were dispensed with in favor of a bathing suit as often as the weather permitted.

It was the duty of the flight clerk to keep an eye on all of the planes up in the air, and a record of the plane with its passengers, and time they were up. He also kept the "Bevo" sheet, which every pilot had to sign before going up certifying that he had partaken of no intoxicating liquor in the last 24 hours. Besides this, he saw to it that the individual inspection record of each plane was filled out each day before the plane went up, and he kept the instrument records, and the government waivers which all civilians who were taken up in flights were required to sign relieving the government of any responsibility in case of an accident. So it is seen that enough precautions were taken regarding each flight in a government airplane.

It wasn't long before we all knew each other well enough to call each other brothers. We all lived in one large room, sleeping in double-deck cots. The quarters were well equipped with showers, and were furnished with tables and chairs for studying the many books that were provided on aviation subjects. We didn't get much book learning at Great Lakes, because the preliminary training was mostly practical work, although on rainy days classes were conducted. Just at morning everyone was hopeful of rain, because it meant an opportunity to stay in bed for another hour. We messed together, having plenty of good healthful food, worked together, and did everything but fly together, although as students at Hampton Roads two of us always flew together, but in a different type of plane. Early in the training it seemed as though we would never be able to fly a plane, and when all were in bed after a hard day's work we used to sing:

"They told us we'd have a vacation,
They told us we'd fly like a bird.
They told us we'd soar like a sea gull,
But we stuck to the ground like a
worm."

A hangar dance was given for us the last week of our stay. The planes were all taken out of the hangars and set on the apron. The hangars were cleaned out as no doubt they had never been cleaned before. The concrete floor was covered with corn meal and powdered wax, and made an excellent dancing su face even though not conventional.

After a few more flights our prelim nary training was finished. We le Great Lakes with memories of the beau tiful scenes of Lake Forest from th air, scenes of a little toy country, wit little toy steamers on the lake. . . . sunsets with the light diffracted in co ors of red, purple, and pink, revealin tufts of clouds in many shades. . . . the calm lake surface reflecting the man colors broken up into perfect green wav forms by a plane that comes taxiing int the beach. It is this time of the da when the heat is passed and the air calm and balmy that flying is most won derfully beautiful.

After our 45 days at Great Lak were up, and our 30 hours of solo fligh in the N-9's were completed, we checke out for a two weeks' vacation at hom before going to the advanced flight trai ing course at the Naval Air Statio Hampton Roads, Va. Mahachek an Berkner, however, because of late arr val, had to stay at Great Lakes unt time for the class to call at Hampto Roads.

Life at Hampton Roads was leisu compared to that at Great Lakes. He there were regular beach crews to servi the aircraft and do all the necessa handling. We had only to fly the shi and attend ground school classes. O quarters were different in that we no had rooms in which two of us lived t gether, although we still had the co venience of double-deck bunks.

The class was a composite of 23 st dents from Rockaway Beach, N. Y Squantum, Mass., and Great Lakes, Il the three naval reserve air stations f preliminary training. We were divid into two sections, one of which was fl ing while the other was in the class roo The ground school work consisted of study of engines, radio, bombing, gu nery, navigation, and general inform tion, all of which was covered in t questions of the professional exami tion for the commission of ensign in t naval reserve, given on the satisfacto completion of the course.

The change from the N-9 to HS-2-L type of flying boat, which the plane in which training was gi at Hampton Roads, was not so gr as was the change made by the men fr the other stations who had been fly the U-O type of plane. Both the and H-boat are rather slow on the c trols, while the U-O, or Vought ob vation plane, is much faster and ha higher degree of maneuverability. HS-2-L is a large ship with a boat hull and a wing span of 72 feet, does not respond quickly to the cont It is not kindly disposed toward ma

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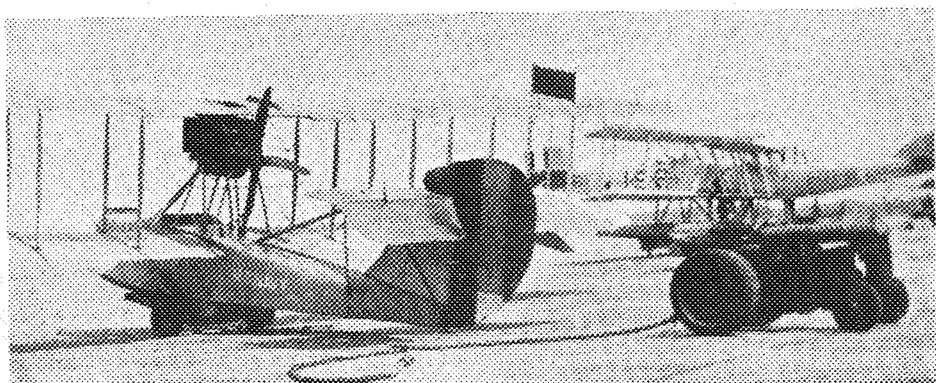

AN HS-2-L READY TO "GO OVER."
The Fordson tractor is an indispensable part of the equipment when moving the heavy ships about on their "dollies."

ENGINEERS IN ATHLETICS

Knights of the Slide Rule Take to the Water

By Ralph Blyberg, *Mech. Eng. '29*

THE swimming squad at Minnesota is drawing more and more technical men into its ranks each year. It is a good sport for engineers as it gives a lot of exercise and competition but does not entail the long hours of practice and the out of town trips which are so detrimental to studies.

This year we find two engineers on the varsity, and four, including the captain, on the frosh squad. Donald "Fuzzy" Riddell, and Dean Graham are the varsity men. Donald Bayer, Clarence Waidelich, Alfred Ericksen, and Roy Kinzie are the frosh swimmers. Don Bayer is captain of the freshman squad.

It is possible that Riddell will not do much swimming this season as the injuries he received while playing football this fall may tend to slow him up. Graham is a newcomer to the ranks, as he is a sophomore. Both Riddell and Graham are 440 men.

"Fuzzy" Riddell did his prep swimming on the Virginia Tech team. Swimming is a more or less major sport on the range so competition is quite intense. He made the frosh swimming squad in his first year here and became a member of the varsity squad in his sophomore year, doing most of his swimming in the 440.

COACH NEIL THORPE

The other technical man on the varsity, Dean Graham, first entered aquatic sports while attending Central high school, Duluth. The team was disbanded soon after Graham made it and most of his prep swimming was done on his own initiative. In 1924 and '25 he swam on Y. M. C. A. teams, swimming the 100 yard and 40 yard races, and the relay. Last year he swam with the frosh at Minnesota where he made good in the 440.

Coach Thorpe is expecting the technical men on the frosh squad to form the nucleus of next year's varsity. Some of the men are the equals of the varsity men at the present time. Donald Bayer, the frosh captain, holds the state record of 118 3-5 seconds for the hundred yards, which he made in the twin city high school meet at the Minneapolis athletic club in the winter of 1925. He broke the record of Sam Hill for this event at an earlier date, later breaking his own record. Bayer came to the university from the University high school where he was a member of the swimming squad for three years. This year he was elected captain of the frosh, and is specializing in the 200 yard back-

(Continued on page 94)

Fall Sports on Tech Campus Buck King Winter

By Clarence Lande, C '27
Athletic Manager

THE snow and cold weather that prevailed during the last week of November and that continued through December brought the athletic events of the fall quarter to an end in the technical colleges. The weather this fall has been anything but pleasing from a player's point of view. The tennis and golf tournaments were the greatest sufferers. Although we were unable to complete these tournaments, we had our schedules further advanced than other similar tournaments on the campus. The tennis tournament had reached the semi-finals, while Art and Don Burris were to vie for brotherly and championship honors in the golf tournament.

Touchball is the favorite fall sport on the engineering campus. The engineers have demonstrated for several years that the game is fast and entertaining. This fall, ten teams were entered in the engineers' touchball league, which was larger than any other similar league on the campus. In all of the games, the teams have shown real enthusiasm and fight, which is characteristic of all technical teams.

This year the teams were divided into two divisions. The senior civils and the sophomore electricals were tied for honors in the American division, while the architects and frosh engineers were tied for the National division leadership. The games to determine the championship of the engineering colleges could not be played this fall due to weather conditions, but there is a possibility of playing these games in the spring.

A few words about the touchball rules might be mentioned at this time. Former rules followed the football rules rather closely in that the team carrying the ball were allowed four tries to make ten yards, one forward pass being allowed beyond the line of scrimmage. However, this manner of playing had a tendency to result in more or less of a running game. In order to bring out the features of throwing and catching the ball with some running to make the game more deceptive and interesting, the rules have been revised in such a manner that the offensive team is now allowed four attempts to make the field for a touchdown, and the ball may be thrown any number of times as long as the play is not dead.

Plans for the winter athletic program, which will go into effect immediately after the Christmas holidays, are now well advanced. A basketball tournament will be organized that will be based somewhat along the same lines as the touchball tournament, with about fourteen teams entered from the various classes and schools. All games will be played on the university armory courts. The winner of our tournament will represent the engineering colleges in the play-off for the All-University I-M championship. Besides the basketball tournament, an all-college hockey team will be organized, and possibly handball and squashball tournaments.

(Continued on page 94)

NEWS FROM THE TECHNICAL CAMPUS

Honor Societies Elect Fall Initiates

TAU BETA PI

The 35th semi-annual initiation banquet of Minnesota Alpha of Tau Beta Pi, honorary technical fraternity, was held at the Leamington Hotel on Dec 8. Dr. S. C. Lind, new director of the School of Chemistry, gave a very interesting and instructive talk on "The Present Status of the Muscle Shoals Development."

The fall initiates were: junior, T. W. Thomas, C. E.; seniors, L. B. Anderson, Arch.; E. B. Berglund, E. E.; J. C. Brightfelt, E. E.; H. T. Caddy, Mines; L. W. Cornell, Ch. E.; G. F. Johnson, E. E.; P. R. Lee, E. E.; Tauno Pajari, C. E.; J. C. Smith, E. E.; S. L. Stolte, A. E.; C. Everett Swanson, E. E.; R. N. Thorshov, A. E. Twenty-six alumni members helped to make the banquet a huge success.

CHI EPSILON

Chi Epsilon, honorary civil engineering fraternity, honored its incoming members at a banquet at the Andrews Hotel on Dec. 10. The principal speaker of the evening was Mr. James Davies, assistant professor of German at Minnesota, and dramatic and music critic for the Minneapolis Tribune. His subject was "Kipling," and he favored his audience with three readings from the famous English poet.

The new members of the organization were: seniors, John K. Borrowman, John E. Hoving, C. A. Wentz; juniors, W. W. Dreveskracht, LeRoy Engstrom, R. P. Johnson, G. W. Schroepfer, T. W. Thomas.

ETA KAPPA NU

Six men were taken into Eta Kappa Nu, honorary electrical engineering fraternity, this fall. The men are: seniors: Harry Du Bois and Jerome Smith; juniors: Glendon Brown, Douglas Johnson, James Barnes, and Lawrence Clousing.

The formal initiation was held Tuesday, November 23, and following the initiation ceremony a banquet in honor of the new initiates was held at the Leamington Hotel. Professor Ryan was the main speaker of the evening, and gave the address of welcome, and also discussed the various relations of engineering. Other talks were given by the incoming men.

PI TAU SIGMA

Pi Tau Sigma, honorary mechanical engineering fraternity, held its fall initiation banquet Tuesday evening, December 7, at the Andrews Hotel. The formal initiation was held in the afternoon. The men taken in at this time were: Irvine Sinnott, Selmer Von Stocker, Wilton Lundquist, Joe Blackshaw, and Merle Elliott.

Graduate Engineers Conduct Research Work in Electrical Department

Mr. E. J. Albrecht, E '25, transmission engineer of the Tri State Telephone and Telegraph company, and Mr. R. B. Johnson, E '25, engineer in the generation department of the Northern States Power company, are attacking a problem on high frequency transmission in co-operation with Professor Swenson of the electrical department here. These men have made some special arrangements whereby they can take this work in addition to their regular work without neglecting the latter.

This work now being done in the graduate school proves conclusively how highly Minnesota's electrical department stands in the minds of engineers in this part of the country. Various research problems of all descriptions are in the process of solution at the present time concerning which more will be published in the near future.

Sophomore-Junior Mixer Planned For Early January

The engineering sophomores and juniors want to get acquainted with each other and so the evening of January 14th has been set for a smoker for these two groups. The features of the evening will be boxing matches and *real* music. There are twelve committees at work trying to make this get-together an overwhelming success, and general arrangements are directly under the supervision of Herbert Hathaway and Leon Mears, the presidents of the junior and sophomore classes.

Short snappy talks by faculty members and a prominent professional engineer will be given, and after refreshments, the crowd will finish up the evening by attending some down-town amusement center.

American Chemical Society Holds Double Meeting

The 134th and 135th meetings of the Minnesota section of the American Chemical Society were held November 8, 9, and 10 in the auditorium of the Chemistry building. Due to schedules which were inflexible, it was necessary to have both meetings in November instead of one each in October and November as is the usual custom.

Dr. William M. Guertler, an internationally known authority on metallurgy and metallography, gave three lectures. The first, "The Corrosion Resistance of Steels," was given on Monday evening. On Tuesday afternoon, Dr. Guertler gave his second talk on the subject, "The Hardness of Metals." His third lecture, "Systematic Procedure in Establishing the Limits of the Utilization of New Metal Combinations in Technical Practice," was given Tuesday evening.

Dr. Ernst Cohen was the principal speaker at the 135th Meeting which was held on Wednesday. Dr. Cohen, an eminent chemist, has done extensive research work in collaboration with his teacher, Van't Hoff, in dynamics, electro-chemistry, and piezochemistry. Dr. Cohen, whose research work has been published in over 250 technical publications, is a member of all the major scientific societies in Europe, the Royal Society of London, and the American Chemical Society. "Van't Hoff, His Life and Work," was the subject of Dr. Cohen's Wednesday evening lecture. On Friday, November 12, he gave a popular lecture, "Caricature in Science," in which he described the ridicule to which early scientists were exposed.

Following Dr. Cohen's lecture on Wednesday, a business meeting was held and officers for the coming year were elected. The new officers are: chairman, J. J. Willaman; vice-chairman, A. A. Schaal; secretary, G. H. Montillon; treasurer, W. M. Swanson; Councilors, M. C. Sneed and C. H. Bailey. The chairmen of committees are: program, C. O. Rost; social, W. M. Sandstrom; membership, O. E. Harder; publicity, M. W. Taylor; auditing, C. V. Pettibone; contributing editor, "Journal of Chemical Education," G. B. Heisig.

A. I. E. E. Holds Committee Meeting in Chicago

At a recent meeting of the Great Lake district No. 5 of the A. I. E. E., Minnesota, was represented by two prominen members of the Electrical college, Professor J. H. Kuhlman, faculty counselor, an Charles Burmeister, student chairman.

The purpose of this meeting was to organize a District Committee on studen activities as provided for by the Board o Directors of the A. I. E. E. recently.

In his report on student activities an the size of the local branch, Mr. Bur meister said that Minnesota had a mem bership of about 100 juniors and senior with an associate membership open t sophomores. He expressed an opinion th a student section in the journal would b of much value to the student.

Professor Kuhlman emphasized the n cessity of strengthening the relations the student and the institute. He urg that the committee provide suitable spea ers for the branch meetings includi A. I. E. E. officers, and speakers from t large electrical manufacturing compani

Many questions of vital interest to t student were taken up in detail and su gestions were made by the various stude chairmen as to means for the promotion better service to the student.

AROUND THE WORLD WITH OUR ALUMNI

ARCHITECTS

'21 G—Roy O. Papenthien is practicing architecture in Milwaukee. He is a member of the firm of Velguth and Papenthien, Architects.

CIVILS

'08—Leroy F. Borrowman is president of Borrowman and Jamesin Ltd., contracting firm of Winnipeg, Canada. Mr. Borrowman attended the Homecoming game.

'08—D. I. Okes was another Homecoming guest. He is partner in Hanlon & Okes Co., paving contractors, located at 1501 Merchants' Bank Bldg., St. Paul.

'09—S. R. Okes, also a partner in Hanlon & Okes Co., was here to give his support to the team.

'09—Edward S. Nelson is in architectural work with offices at 715 Capitol National Bank Bldg., St. Paul.

'11—S. H. Smith, city engineer of Mitchell, South Dakota, attended the Pioneer Homecoming.

'13—C. C. Pagenhart is engaged in general contracting at Rochester, Minnesota.

'13—Carl T. Nordstrom is in highway engineering, with office at 410 Hamm Bldg., St. Paul.

'14—H. N. Weigel is in the contracting business and can be found at 542 Builders' Exchange, Minneapolis. Mr. Weigel is engaged in structural steel designing and contracting.

'15—George T. Anderson is another civil in municipal work. Mr. Anderson is city engineer of Chisholm, Minn. He was here over Homecoming.

'15—W. K. Doolittle, who has been structural steel designer for the Minneapolis water works in the design of the Fridley Filter Plant, is now affiliated with the Wm. Bros Boiler and Manufacturing Co., of Minneapolis.

'20—Henry M. Lende has left his position with the Board of Park Commissioners to become garage manager at Granite Falls, Minnesota.

'20—Carl C. Hanke has been promoted from designer to assistant engineer of the sanitary district of Chicago. His business address is 910 So. Michigan Ave., Chicago, Illinois. Mr. Hanke saw the Minesota-Michigan game.

'21—Clarence E. Olson is bridge designer for the Minnesota Highway Department at St. Paul.

'22—R. E. Ost, formerly with the Northwest Paper Co., is now plant engineer for the Northwestern Cement Co., Mason City, Iowa.

'22—L. W. Newberry is in structural design work at Chicago, Ill.

'22—H. J. Burdon is field engineer with the Northern States Power company at Menomonie, Wis.

'22—John M. Reardon is assistant civil engineer on construction for the Department of Public Works, St. Paul.

'22—E. C. O. Erickson is designing engineer in the bridge department of the Soo Line railway at Minneapolis.

'23—W. E. Kotz and Nels Johnson are both with the Minnesota Highway Department. Mr. Kotz is in St. Paul, while Mr. Johnson is senior instrument man working out of Rush City, Minn.

The first engineers' homecoming at Minnesota was a huge success. Headquarters for returning technical students was established in room 135E by committees from the Minnesota Techno-Log, the Technical Commission, and the Engineers' Bookstore. The Bookstore provided the room with furniture to make the guests comfortable, and after the Michigan game coffee and doughnuts were served. About 125 alumni made use of this room, as well as wives, children, and other guests.

Plans are being made to establish this idea as a yearly custom in the engineering college and the success of this first venture gives great hopes for the future.

The alumni listed this month are those who registered as visitors to the Pioneer Homecoming.

'23—J. E. P. Darrel is also with the Highway Department as assistant engineer.

'23—Leo M. Buhr is in Bruce, Wisconsin, as engineer on hydro-electric surveys.

'23—Elmer J. Olson is mining engineer for the Oliver Iron Mining Co., Chisholm, Minn.

'25—Clarence R. Peterson is draftsman for the C. M. & St. P. Ry.

'25—Sam S. Galanter is in Chicago doing concrete design work.

'26—Barton Juell still believes in studying. He is a student with the Commonwealth Edison Co., Chicago.

CHEMISTS

'05—George Borrowman is a consulting chemist for the General Chemical Service. He is located at 9 South Clinton, Chicago.

'22—Reuben W. Cornell, who is now chemical engineer for the linseed oil division of the Pittsburgh Plate Glass company at Red Wing, Minnesota, was on the campus for Homecoming.

'26 Ch. E.—Marvin Rogers returned to the campus for Homecoming. Mr. Rogers is doing graduate work, and is a teaching assistant in chemical engineerinf at the University of Michigan.

ELECTRICALS

'04—Lloyd Downing is growing fruit in St. Charles, Minn.

'15—E. W. Johnson is assistant professor in the electrical engineering department here. He is on the news committee of the department.

'19—E. W. Christenson is located in Omaha, Neb., for the present. He is toll equipment engineer for the Northwestern Bell Telephone Co.

'20—N. W. Kingsley is employment supervisor for the Northwestern Bell Telephone Co. in Omaha, Neb.

'22—J. E. Sorenson is in the employ of the Western Electric Co. as telephone equipment engineer. He will stay in Chicago for the present.

'23—LeRoy A. Grettum is in the electrical engineering department of the Mississippi Valley Public Service Co., located at Winona, Minn.

'23—Clifford L. Sampson is now working for the Northwestern Bell Telephone Co., Minneapolis, Minn., in the capacity of interference engineer.

'24—F. R. Kapple is in the employ of the N. W. Bell Telephone Co. as interference engineer in Minneapolis.

'25—B. R. Lewis is division engineer for the Northern States Power Co., and is located in Minneapolis for the present.

MECHANICALS

'97—R. P. Blake of Livingston, Montana, made the long trip here to help Minnesota scalp Michigan. Mr. Blake is division master mechanic for the N. P. railway, with headquarters at Livingston.

'08—George T. Peterson was also here for Homecoming. He is supervisor of apprentices for the D. & I. Ry.

'15—H. J. Mayer is in construction work with headquarters here, at 900 Builders' Exchange.

'15—Clarence J. Snow is associated with the Commonwealth Electric Co., 417 Broadway St., St. Paul.

'17—John H. Murray whose business address is 312 Genesee Bank Building, Flint, Michigan, was here for the Michigan game. Mr. Murray is engineer for Mr. E. W. Atwood in property development work.

'22—A. J. Nordenson is experimental engineer for the Mahr Manufacturing Co., 1728 North 2nd St., Minneapolis.

'24—A. O. Sebo, service engineer for the Bailey Meter Co., has been engaged in installation and service work on steam power plant metering equipment.

'25—W. O. French, who was junior class president was here for Homecoming. He is in the engineering department of the Mississippi Valley Public Service Co., Winona, Minesota. Mr. French is doing design and testing work.

'26—George W. Mork has become affiliated with the Universal Portland Cement Co., Morgan Park, Duluth, Minn., as mill engineer. He was also here for the Michigan game.

MINERS

'04—S. V. Wood is president of the Minneapolis Electric Steel Castings Co. of 3800 5th St. N. E., Minneapolis.

'07—K. P. Swensen came all the way from New York to see the "Battle of the Brown Jug." Mr. Swenson is a mining engineer with headquarters at 110 W. 57th St., New York.

'15—Henry H. Wade is metallurgist in our own Mines Experimental Station.

'25—Bernard Carpenteur likes old Minnesota. He is technical assistant in the School of Mines. On the eve of the game he remarked that the weather was "deucedly cold," or words to that effect.

The
MINNESOTA TECHNO-LOG
University of Minnesota

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CHALK up another mark for the new era! A fresh blow has been dealt to the old fallacy that the "hard-boiled" engineer, with his boots and britches, works only with concrete and steel, and with the forces of Nature, leaving the subtleties of politics to those with more gifted tongues and more winning ways. The state engineer of Wyoming, Frank C. Emerson, has been elected governor of that state. As far as is known, this is the first instance that an accredited civil engineer has ever been governor of a state.

There is only one reason why an engineer should not be a capable governor, and that is his own point of view as evidenced by the majority of engineers in the past. On the other hand, there are many reasons why a man with a technical training should be the ideal man to lead the destinies of his commonwealth, and among them is the fact that the profession of engineering is continually expanding to embrace more and more the common problems of mankind.

The beauty of it all, however, lies in the fact that engineers in ever increasing numbers are beginning to wake up to the new possibilities open to them. A case in point concerning a member of our own rapidly increasing family at the University of Minnesota presents a good example. S. C. Chapin, a graduate of civil engineering in the class of 1924, resigned his position as city manager of La Crosse, Kansas, last September to take up post graduate work in the School of Public Affairs and Citizenship at Syracuse University, with the intention of continuing in manager work.

It is indicative of a healthful condition when the engineering profession, and more particularly the younger members of it, lose that "inferiority complex," or what have you, when trespassing outside of the field of pure engineering.

THE Mines Experiment Station of the University of Minnesota carries on its work in an obscure corner of the campus and most of us little realize what an invaluable work for the State of Minnesota it is doing. This laboratory is being maintained by the state for the benefit of the mine operators at a cost of $25,000 per year, and a great amount of testing is being done free of charge for these operators. In addition to this testing, research is carried on as funds are available.

We learn from the Minneapolis Journal of a few days ago that iron ore shipments from Minnesota in 1926 totaled 41,891,510 tons, and that this was the second highest record since the war period. What an added revenue for this state would be available if this huge amount of ore could only be converted into pig iron before being shipped to the steel industries in the East!

Mr. E. W. Davis, superintendent of the Mines Experiment Station, in his article on other pages of this issue, tells us how in time this dream may become a fact by virtue of the research done by the staff of these laboratories.

The work of this station in making commercially possible the transformation of hitherto worthless low-grade ore to valuable high-grade ore has already been of great benefit to the mining industry of the state.

IT is with great pleasure that we are enabled to print a contribution from the pen of a former member of the College of Engineering and Architecture, C. Ralph Bennett.

We well remember the long hours that were spent struggling over an obstinate theme on the subject of "It," or "When." "It!"—What a theme subject for an aspiring engineer! If we had been told to write on the subject of "Bevel Gears" or "Minnesota Highways," we might have been somewhat reconciled to the ordeal of enduring a year of English—that subject which we so fondly hoped to escape by taking engineering.—"It!"—How we shuddered over that assignment.

But that which was sought was evidently found, for imaginations began to develop. We not only learned to endure the English but actually began to find pleasure in it.

It was with genuine regret that we learned that Mr. Bennett left Minnesota this year to join the staff of the English department, School of Applied Arts, University of Cincinnati.

A REQUEST

THE New York Public Library has notified us that their files of the MINNESOTA TECHNO-LOG are incomplete and that they greatly desire certain issues to complete these files. Certain of these issues have been entirely exhausted in our own files, and if there are any among our readers who may have saved their copies and who would be willing to present them to the New York Public Library on the understanding that the file would be taken care of and preserved permanently, the MINNESOTA TECHNO-LOG would greatly appreciate it if they would send the copies to our office for forwarding.

The library needs the following:

Vol. I, all issues.
Vol. II, Nos. 1 and 7.
Vol. III, No. 1.

IN closing another quarter of work, the MINNESOTA TECHNO-LOG extends the season's greetings and a wish to a happy, prosperous New Year to all its many friends and co-workers.

Across the Editor's Desk

The Library of the College of Engineering and Architecture

Technical students at Minnesota are fortunate in the possession of a library which enjoys such a large and comprehensive collection of books. As we pass through its glass fronted doors and stand upon its threshold, what a wealth of knowledge is unfolded before us. The latest periodicals on all varieties of engineering to our left, the newest books on applied sciences to our right, reports of internationally famous scientific committees above our heads, and bound technical magazines for years back in the basement below; all invite us to hours of exploration in this new world to which we have given our futures.

Do we fully appreciate the possibilities offered? Perhaps a few words by the librarian, Miss Gertrude Veblen, will help us to a better realization of the pleasures and benefits to be obtained which are ours for the asking.

"The library of the College of Engineering and Architecture, located in the north wing of the main engineering building, is an integral part of the General University Library.

"The books, with the exception of special reserves, handbooks, and theses, are on open shelves where the reader may consult them at his convenience and browse around as much as he pleases.

"A working collection of books is kept in the architectural reading rooms on the third floor of the building, for convenient use by students studying design in the drafting rooms.

"The library has over twenty thousand books on engineering, architecture and related subjects. It is well equipped with reference books, including the Encyclopedia Americana, Encyclopedia Britannica, Funk and Wagnalls Encyclopedia, Machinery's Encyclopedia, the Century Dictionary and a Cram's Atlas of the World. It has copies of the 'American Men of Science,' 'Who's Who,' 'Who's Who in America,' and of special interest to engineers, 'Who's Who in Engineering.' Technical dictionaries are a feature. There are dictionaries in English, French, German, Dutch, Spanish, Italian, and Latin.

"Of unusual interest is the collection of handbooks on civil, electrical and mechanical engineering, on architecture, physics and chemistry, highway engineering, fire prevention, industrial management, and on many other subjects. These handbooks are a real mine of information.

"The Industrial Arts Index and the Engineering Index are guides to periodicals. They are similar to the Readers' Guide, but they index engineering and architectural periodicals, or periodicals dealing with related subjects.

"The library receives current periodicals from all parts of the United States and from Canada, South America, England, France, Italy, Germany, Austria, Holland, Japan, and China. It receives publications of all engineering experiment stations and from many engineering and other scientific societies and institutions. Periodicals, when bound, are kept in the basement reading room.

THE MINNESOTA TECHNO-LOG has placed copies of its exchanges from other engineering college magazines in the library, so that all students may enjoy them.

"Publications of learned societies are kept in the balcony. These contain some of the best and most useful information to be had. They contain results of work of members of these learned societies, which include the foremost men in all engineering lines. The library collection of publications of societies, while not complete, is one of the best to be found.

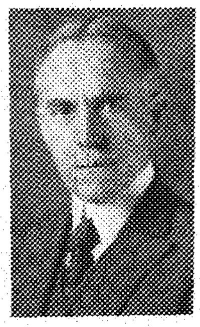
"The library uses the Dewey decimal system of classification, but instead of arranging the books by author, under the classification number, it uses 'Biscoe Numbers,' by which the books are arranged chronologically, by the copyright date. The letter "R" includes books published from 1910 to 1919, "S" 1920 to 1929. Any book with the marking, S6 will be recognized as a 1926 book. This brings the latest books on a given subject together.

"The library has a dictionary card catalog, in which books are listed by author, subject and title, all in one alphabet. Duplicates of these cards are filed in the card catalog of the Main University Library, so that a record is kept there, as well as in the Engineering Library.

"In 1918, the Engineers' Club of Minneapolis gave a large collection of books and magazines to this library

(Continued on page 92)

FACULTY SKETCHES



FREDERICK MAYNARD MANN

It was in the big, bold, bad city of New York, in the spring of 1868, that Frederick Maynard Mann first opened his eyes, and beheld the world. No doubt all the large buildings he saw in his urchin days set up a desire in his breast to sometime plan great structures, and he has since planned many of them.

After completing his high school education, he entered the University of Minnesota, and graduated with a B. C. E. degree in 1892. He then entered the Massachusetts Institute of Technology, where he took up the study of architecture, and in 1894 received a B. S. degree in architecture. As this did not satisfy him, he returned the next year and received an M. S. degree in the same subject. But he had not forgotten Minnesota, because in 1798, following work here at Minnesota, he graduated from civil engineering at this university. During his years in school, Professor Mann became a member of Tau Beta Pi and Sigma X, honorary technical and scientific fraternities.

His career has been one of practice, and yet he has always been closely connected with school work. He was an instructor of architecture at the University of Pennsylvania for four years. Following this he spent four years practicing architecture in Philadelphia. In 1902 he again took up teaching, this time as professor of architecture at Washington University, St. Louis, where he taught until 1910. The next year he took a position as head of the department of architecture at the University of Illinois.

In 1913, when the desire and need of a course in architecture and architectural engineering was felt at Minnesota, Professor Mann came from Illinois and took up the burden of organizing the courses. It is largely due to his effort that the department of architecture here at Minnesota has grown from such a small beginning thirteen years ago, to its present status, where it now is ranking with the best schools in the United States.

Professor Mann has been the architect for many well-known buildings. He was consulting architect for the St. Louis Public Library, the King's Highway Viaduct, and the Masonic Temple, all in St. Louis, Mo. He designed the Church of St. John the Evangelist in Philadelphia, the University Methodist Church at Austin, Texas, the biology building at the University of Pennsylvania, and the Acacia fraternity house at Champagne, Ill.

Buildings in Minneapolis that Professor Mann has designed are the Delta Tau Delta fraternity house, the Kappa Kappa Gamma sorority house, the University Y. M. C. A., and many houses about the city. He was also the designer of the Dental Building at Rochester, Minn. At present he is the consulting architect for the University of Minnesota.

Two medals, the first two offered by the society of Beaux Arts Architects, were won by Professor Mann. He also has the title of Fellow of the American Institute of Architects, and is a member of Tau Sigma Delta, honorary art fraternity, the College Art Association, the Minneapolis Engineering Club, and Psi Upsilon and Alpha Rho Chi fraternities.

JUST A FEW SQUEAKS

"I admire a man who says the right thing at the right time."

"So do I—particularly when I'm thirsty."—*Le Rire.*

He (after a little quarrel)—"I think our lips are parallel, don't you?"

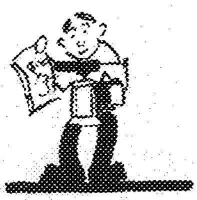
She—"I don't know. Why?"

He—"Because they never meet."

Freshman: "May I kiss your hands?"

She: "Yes, but why stoop so low."

Breathes there a man with soul so dead
Who never to himself has said,
As he cracked his dome on the upper bed
"$"&'()&'??!!!!!!



I'd like to be an artist
And with the artists stand.
Some wrinkles on my forehead,
Some charcoal in my hand,
Or with my 6B pencil
And skillful hand so light
I'd make the nicest sketches
And burn them every night.

"Where do you bathe?"

"In the spring."

"I didn't ask you when, I asked you where."

"Are you positive the defendent was drunk?"

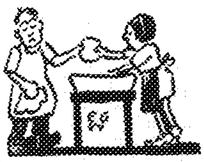
"Well, your honor, I saw him put a penny in a patrol box and then he looked up at the court house clock and roared, 'Gawd! I've lost 14 pounds.' "—*Yellow Jacket.*

Jimmie: "It's shaky business."

Hugh: "What is?"

"Playing with dice."

A Hard-Hearted-Hannah said to the Prince of Wales, "Go on home, kid, and come back when you're king."—*M-I-T Voo Doo.*



Newly-wed Engineer: How did you like the washing machine I sent out today.

His Better Half: Oh! It's terrible. Every time I tried to get in it to take my bath, the paddles hit me.

AN E. E. PROPOSES

"Mazda darling," he wrote, "be mine. Incandescent one! Watts life without you? Ohm is not ohm without the light of your presence. My heart is a transformer that steps up at every thought of you. I would lay my head alongside your switch; the touch of your hand is like a live wire. Marry me, and let us have a little meter in our home."

Horizontal—Bill's smoking Robinson Crusoe cigarettes now.

Vertical—What brand is that?

"Cast aways."—*Michigan Gargoyle.*

A reading of the smoking tobacco ads leads to the impression that gentlemen prefer blends.

"To think!" exclaimed the enthusiastic young husband, "that by the time we get all this furniture paid for we shall have genuine antiques."—*Life.*

Xenophone: "In my day when a girl wore a frat pin, it meant engagement."

Sophocles: "Well, today it only means necking privileges."—*Yellow Jacket.*

A man with rips in his coat and buttons torn off his coat should either get married or divorced.

Definition: "Concentration is a person's ability to keep his eyes on the cards in a game of strip poker."—*Widow*

1st Co-ed: Father is getting simply impossible!

2nd Co-ed: Why, darling?

1st Co-ed: He had the nerve to ask for the car this morning! Imagine!

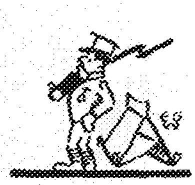
1st Kappa: "The Lord made us beautiful and dumb."

2nd "Gold Digger": "How's that?"

1st Kappa: "Beautiful so the men would love us, and dumb so that we would love them."

"What makes the world go round and round, pop?"

"Oscar, how many times must I tell you to stay out of the cellar?"—*Rugers Chanticleer.*



"Heavens. My boy has been robbed."

"What? The one in the army?"

"Yes—he says here the other guard came on at six and relieved him of his watch."—*Michigan Technic.*

"I'm not going to let him take my daughter to the Sophomore Frolic."

"Why not?"

"He just wrote us that he won a loving cup."—*Brown Jug.*

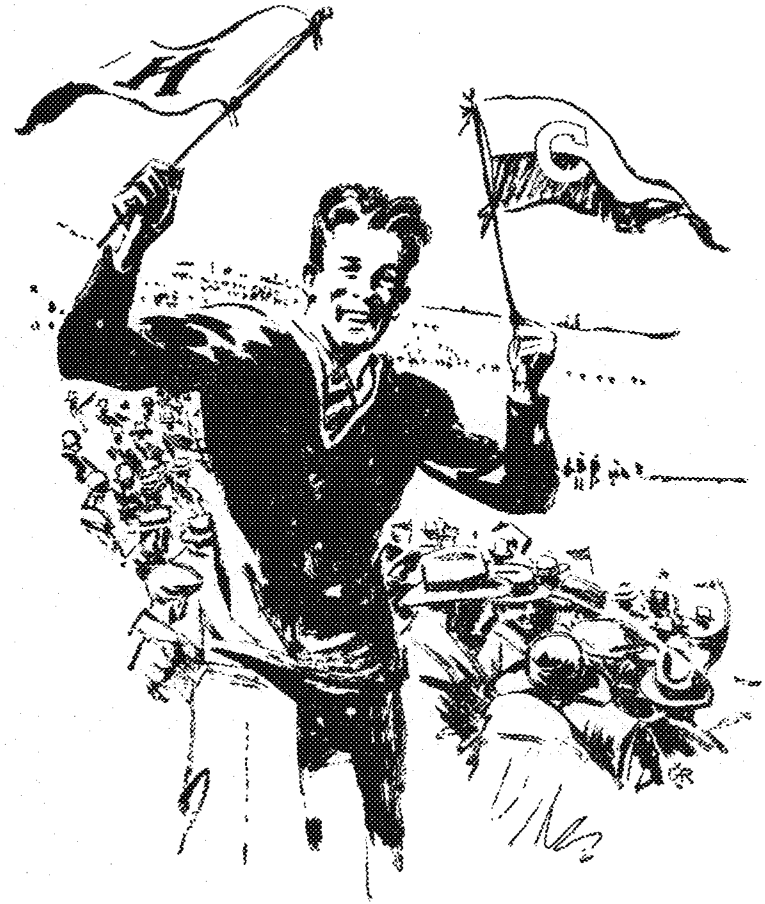
Consider the sad case of the professional theme-writer who spends half an hour selling a freshman a theme only to find he is talking to an English prof—*Yellow Jacket.*

Prof. Todd: "Is that your cigarette stub?"

Electrical—"Go ahead, you saw i first."

"Confound it! We've run out o gas!"

"Oh, Don! Do drive up beyond thos trees, the hotel folks are bound to see u here!"—*The Big "T."*



Producing Pig Iron in Northern Minnesota

(Continued from page 75)

heating flues of the oven. Standard coke oven designs have been perfected after many years of study and trial. There are thousands of these ovens in operation today producing millions of tons of coke each year. The maintenance expense of these ovens is very small as there are no moving parts to wear out or deteriorate. Many of these ovens have been in continuous operation for ten or more years. The operating expense is low as very few men are required to operate a plant having a battery of a hundred ovens or more. All of these facts lead to the conclusion that this type of furnace is admirably adapted to the pig iron industry provided efficient metallurgical operations can be secured without seriously changing the design.

The retort method for metallizing iron ore is carried out by first mixing the ore with the required amount of fine coal. This mixture is charged into the retort, from which air is excluded, and the temperature is raised to about 1000° Centigrade. The retort may then be discharged but, like coke, the product from this retort will oxidize rapidly in the air unless means are provided to prevent this reoxidation. The result of heating the mixture of ore and coal is to cause the oxygen in the ore to combine with the carbon in the coal, thus forming a large quantity of carbon monoxide gas. As in coking coals, this gas is available for heating the ovens. It is therefore evident that the coking of coal and the metallizing of iron ore require quite similar conditions and can be carried out with about the same type of furnace. The chemical reactions involved, however, are quite different.

When a mixture of carbon and iron oxide is heated to a temperature of about 900° Centigrade in a partially closed retort, two important chemical reactions take place. First of all the oxygen in the air that has remained in the retort is changed by contact with the hot carbon to carbon monoxide. This carbon monoxide attacks the iron oxide and combines with part of the oxygen to form carbon dioxide. Then this carbon dioxide immediately combines with the carbon in the charge to form carbon monoxide which again attacks the ore, removing more of the oxygen. This cyclic reaction will continue until all of the carbon or all of the oxygen in the ore is removed. Any excess carbon will remain in the retort as there is no oxygen available with which it can combine. It is therefore necessary to add only the theoretical amount of carbon to the ore in order to effect complete reduction of the iron oxide. As was previously stated, this figures out to be 32 per cent of the weight of the iron present in the ore in the form of hematite. Any excess over 32 per cent cannot be consumed in the retort and there is no necessity for any considerable excess over this theoretical requirement.

In the tests that have been conducted at the station, furnaces of various sizes and dimensions have been constructed. At the start, furnaces were built holding only a few pounds of ore but as more information was secured, the dimensions were expanded until we are now operating a coke oven furnace having a capacity of about 1,250 pounds per charge. This furnace, which has been in operation for several months, has a reducing chamber 6 feet long, 6 feet high and 6 inches wide. This chamber stands vertically and is closed by a hinged door on the bottom and a sliding door on the top. The walls of the retort are made of solica brick 4½ inches thick. Outside of these walls are the combustion chambers in which the gas is burned to produce the desired temperature. The whole furnace is what is known as a vertical discharge type oven having horizontal flues, that is, the burning gases pass horizontally through the length of the furnace in the bottom flue, turn and pass upward into the next flue and so on through the six horizontal flues before the gases escape into the stack. The furnace stands on steel columns about 8 feet from the floor of the furnace room. Between the bottom of the reducing chamber and the floor of the room is a steel cooling chamber which is attached to the bottom of the retort and is approximately air-tight. When the bottom door of the reducing chamber is opened, the charge can fall into the cooling chamber without coming into contact with the outside air.

The operation of this furnace is very simple. The mixture of ore and coal is fed into the retort through an opening in the top door. At the end of six hours, the charge has reached a temperature of about 800° Centigrade. At this temperature the reactions begin and as has been previously explained, these reactions are endothermic and absorb considerable heat. Therefore the temperature rises slowly from 800 to 900 degrees Centigrade, ordinarily requiring about seven hours. This slow increase in temperature continues until a temperature of 950° is reached, after which the temperature rises rapidly if the furnace is not discharged. This rapid increase of temperature beyond 950° Centigrade indicates that the reactions are practically complete and the charge should be removed. Ordinarily it requires about sixteen hours to reach a temperature of 1000° Centigrade, at which temperature, the bottom and top doors of the oven are opened and the charge poked out into the cooling chamber. The hot ore tends to hang up in the retort and a mechanical poking mechanism has been arranged to facilitate the discharge. As soon as the old charge has been removed from the furnace, the doors are closed again and the new charge put into the retort. The hot ore that has fallen into the cooling chamber is allowed to stand and cool for several hours before a small door at the bottom of the chamber is opened and the metallized ore removed. If the ore charged to the oven has assayed 55 per cent iron and 10 per cent silica, the reduced material removed from the cooling chamber will assay about 80 per cent iron and 14 per cent silica. Over 95 per cent of the iron will be in the metallic form. Iron silicates, which may be present in the ore, are not reduced.

For the reducing agent in this oven, fine soft coal is ordinarily used. The normal mixture with an ore assaying 60 per cent iron is 100 lbs. of ore and 20 lbs. of coal. With this mixture, the reduced ore usually contains about 5 per cent carbon after it has been removed from the cooling chamber. It is desirable to have this carbon present in the reduced ore for subsequent work, which will be explained later.

While the mixture of ore and coal is being heated in the retort, large quantities of gas are evolved which escape through a pipe in the top door of the furnace. This gas is a mixture of the volatile constituents of the coal and carbon monoxide gas. It contains practically no nitrogen or oxygen and is therefore a very high-grade gas, suitable for use in maintaining the temperature required in the flues. In this furnace, we have metallized about fifty tons of ore, both hematite and magnetite. The ore and coal are both ordinarily crushed to fine sizes although there is little advantage in reducing the size much below one-quarter inch.

The metallized ore, as removed from the furnace, is black or dark gray in color and very porous. The various particles of ore are ordinarily fused together slightly but are easily broken apart with the fingers. In this condition, the material has little value as it oxidizes so easily that charging it into a

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cupola, blast furnace or open hearth would produce an excess amount of iron oxide. In order to overcome this difficulty, the metallized ore is pressed into briquets. Since the iron is all in the form of metal, this material briquettes very readily without the use of any binder into a hard dark dense mass. At the station, the briquetting is done after the reduced ore is cold and quite a high pressure is required in order to form satisfactory briquets. This is done merely as a matter of convenience and in any commercial installation, this briquetting would be done with rolls working on the hot metallized ore as it is discharged from the oven. In this condition, the reduced ore is soft and spongy and the briquetting can be accomplished with a very slight pressure. The briquets which we are now making are four inches in diameter and four inches long. They weigh five pounds each and have a density of about three.

This is as far as the large scale operations have progressed at the station. The next step will be to melt these briquets so as to form pig iron in a reverberatory type furnace. A four-ton, tilting, oil-fired furnace has been installed but has not as yet been put into operation. Work is now under way investigating the proper kind of lining to put into this furnace. So far, we have been melting small briquets in small open hearth and electric reflection arc type furnaces. The procedure is to build up a molten bath of slag in the furnace and then drop the briquets into this slag. They immediately sink below the surface and melt out of contact with the oxidizing atmosphere of the furnace, thus preventing the reoxidation of the iron. If it were not for the fact that about 5 per cent carbon is left in the metallized ore when it is briquetted, it would be very difficult to melt these briquets. This carbon, however, combines with the iron as it melts and thus lowers is melting temperature. The resultant metal ordinarily contains between two and three per cent carbon and is quite fluid with the furnace at a temperature of 1500° Centigrade. The slag is poured from the furnace and the metal cast into molds.

To those of you who are familiar with western copper reverberatory practice, it may be said that we hope to melt down the briquets in much the same type of furnace as is used in connection with the copper ores. In these furnaces, which are 125 feet long and 30 feet wide, the slag volumes are large and little or no attempt is made to refine the bath in the furnace. These furnaces ordinarily operate at a temperature of about 1500° Centigrade, this temperature being maintained by blowing powdered coal through several burners at one end of the furnace. Waste heat boilers are placed at the lower end of the furnace and the waste gases pass through them before escaping. Preheated air is not necessary as in the ordinary open hearth type of furnace. These reverberatory furnaces require about 300 pounds of pulverized coal per ton of charge melted but the recovery of heat by the waste heat boilers reduces the amount of coal chargeable to melting the ore to less than 100 pounds per ton of charge melted. There is no reason to believe that this coal consumption will be materially increased when melting the metallized ore briquets.

In describing this method of making pig iron from iron ore without the use of coke, I have given you no indication of the many difficulties that have been encountered. The experimental work has progressed slowly and we are by no means finished with this development. New obstacles have been encountered at every advance step and many difficulties lie before us, any one of which may stop us temporarily or change the whole plan of the work. Sulphur removal, carbon absorption and slag losses are requiring much attention in the laboratory at the present time. Many mechanical difficulties must be overcome and detailed cost estimates must be made by people

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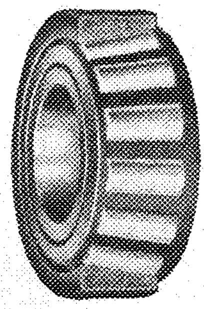

"All Clear!" "Contact!"—

(Continued from page 80)

vers requiring unnatural positions, and if the pilot wishes to be among those present, he will fly it in a safe and sane manner.

Zooming the fishermen, looking out for fish stakes on landings, and watching the freighters and steamships in Norfolk harbor provided most of the entertainment for us while we were up in the air. Fish stakes are poles about two inches thick which the fishermen put up so that they can place their nets on them, and since they were not large it was rather a hard task to see some of them when making a landing at the speed of 40 knots. When this did not provide enough entertainment, letter writing while up in an airplane became the favorite out-door sport of the season.

The Lewis air-cooled machine gun was used in gunnery practise, and firing from one plane at a sleeve towed behind another was carried on. No hits were recorded on the plane which towed the target, which was in accord with the desire of the pilot of the towing plane. The highest record scored was 176 hits out of 186 shots, two holes in the sleeve counting as one hit. Although the Lewis machine gun is classed as a relatively slow gun, firing only 400 shots a minute, it was fast enough for us.

Bombing practice, too, was great sport. A bombing sight was provided which took into account the direction of the wind, the height of the plane, and the heading of the plane, so that all that was necessary was the adjusting of the bomb sight. A target about six feet square was provided at which sub-caliber bombs were dropped from an altitude of about 1000 feet. The target itself was hit only once out of about 250 trys, which however, is not indicative of bombing in general, but just of us as beginners. Anything within a 100-foot radius of the target counted as a hit, and most of the bombs lit that close to the target. With more practice we could have become much better, for with the training received, we just became somewhat proficient in one thing when the training was changed to another.

The bomb in its downward flight seems to have wings as it follows directly below the plane, and seems to grow smaller and smaller until it hits the water, the concussion exploding a blank shotgun shell which is placed in the nose of the dummy bomb. The explosion helps to mark the place where the bomb hit the water.

One officer thinks we are poor bombers. One of the gobs picked up a bomb and threw it in the water right in front of the hangars while a plane was passing overhead on a bombing trip and headed for the target. When the bomb exploded he said, "If that target were much closer we'd be getting bombs on our head any minute while those students are trying to hit the target." Since we always had Saturday afternoons off, and all day Sunday to ourselves, as well as every night in the week, we saw plenty of Norfolk and the surrounding cities. Several trips were mad to the army flying unit at Lanley Fiel and often dirigibles from the field fle over the Naval Base. The Los Angel went over the station once, too, and a the air station at Hampton Roads ha many types of planes, there was muc to be seen about the station.

A lot was learned during the summe and the training was most enjoyabl The officers were human, and helped t make our training interesting, and memo ries of those three months will remai for a long time, and we all look forwar to the next summer when two weeks o flying will be on the program for u The Minnesota men finished first, third fourth, seventh, and eleventh in the clas which speaks well for Minnesota, sinc the other men were from Harvard M. I. T., and other eastern colleges.

There were station examinations, an the bureau examination for our commis sions taken before our work at Hampto Roads was complete. And then after th final physical examination was taken, an all pay had been received and the flyin suits and other gear had been turned in we were ready to check out for home.

Across the Editor's Desk

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and in 1919, Dr. Henry T. Eddy gave his fine collection of scientific books and pamphlets. Through these two outstanding gifts and from many smaller gifts, we have secured books which could be had, only by much search. Some, it would be impossible to duplicate, as they are out of print and very rare.

"The library is open, not only to the student public, but to the engineers of the city and state. It is open from 8 A. M. to 10 P. M. daily, except on some holidays and during the hour of university convocations. It is closed o Sundays.

"The library is strengthened by it affiliation with the Main Universit Library and its great collection, rapidl approaching a half a million, includin books on sociology, economics, chemistry and other subjects, which furnish background for all engineering subjects

"A recent accession to the library 'English Applied in Technical Writing, by C. W. Park, contains a very valuabl chapter on 'The Use of the Library.'

Fall Sports on Tech Campus Buck King Winter

(Continued from page 81)

The Technical Colleges Athletic Board has been officially organized for the '26-'27 school year. The present members of the board are as follows:

Senior Representative—Harry Du Bois.

Junior Representative—Lloyd Hoover.

Sophomore Representative — Lloyd Russ.

Freshman Representative — "Tiny" Stafford.

Chemistry Representative—Fremont Parkin.

Athletic Manager — Clarence C. Lande.

The officers of the board are:
President—Clarence C. Lande.
Vice-president—Lloyd Hoover.
Treasurer—Lloyd Russ.
Secretary—"Tiny" Stafford.

Knights of the Slide Rule Take to the Water

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stroke. Alfred Ericksen is another frosh technical man who is making his mark swimming the breast stroke.

Roy Kinzie and Clarence Waidelich are two members using the crawl. Kinzie came here from Winona where he got his start swimming at the Y. M. C. A. meets. Swimming was not a major sport at the high school and the tankmen had to get along as best they could without a coach. In the last yearly meet held by the Y. M. C. A., Kinzie outpointed his opponents in all around swimming and diving. In the summer of 1924 he was appointed life guard at the Winona public beach, and in the contest between the guards he won all the events in which he entered.

Clarence Waidelich graduated from the Technical high school, Omaha where he captained a team in 1925 that did not lose a meet in the season. He was a member of the tank squad for two years. In his first year, he swam the 50 and 100 yards free style, 100 yard backstroke, and the relay. He broke the existing record for the 100 yard free style. In his second year he made a specialty of the crawl stroke. This last season was his most successful as he broke his own 100 yard record, and tied the 50 yard record. He also was a member of the relay team that broke the record for the 200 yard event. In his last year of high school competition he was the highest point winner on any of the prep school teams in Nebraska. This year he is specializing in the crawl, and is giving Sam Hill, varsity man, a hot run in the races in which they compete.

Out of these men Coach Neil Thorpe is expecting to develop stars for the varsity of 1927. They are nearly the equals of the varsity men at the present time, and with a little more polish they will give any man on the present team a hard race.

Producing Pig Iron in Northern Minnesota

(Continued from page 90)

competent to use our test data and translate it into the dollars and cents of operating and maintenance costs. Adverse freight rates must be reviewed and proper loading and unloading facilities must be provided. There are many problems, technical and commercial, that must be solved before we will be in a position to make detailed cost estimates which will be sufficiently convincing to warrant the enormous investment necessary to carry out this work. The question of taxation is of vital importance.

Before concluding, it is interesting to speculate a little upon the relative merits of producing pig iron at Pittsburgh and at Hibbing in the light of this new development in the reduction of iron ore. Going back to the figures on assembly costs of raw materials, we now find that Hibbing is in a better position. In the new process, 660 lbs. of soft coal are required to produce a ton of metallic iron and about 100 lbs. more are necessary for melting the briquets into pig iron. This indicates a total coal consumption of 760 lbs. per ton of pig. The freight on this coal per ton of pig iron will be about $1.14, on the ore 20c, and on the limestone 90c, giving a total assembly cost at Hibbing of $2.24. To this must be added the freight to Pittsburgh on the pig iron. This gives the total freight charges for making pig iron at Hibbing and delivering it to Pittsburgh of $6.24 per ton. For standard blast furnace practice at Pittsburgh, we have seen that the total assembly charge of raw materials is $6.75. However, if the new process is successful at Hibbing, it can be used at Pittsburgh, so a new set of assembly figures must be made at Pittsburgh contemplating the use of the new process there. The freight on the 760 lbs. of coal to Pittsburgh will be about 19c, on the limestone 30c, and on the ore $5.90. This gives a total assembly charge on raw materials at Pittsburgh for the new process of $6.39. This shows Hibbing to still have a slight advantage over Pittsburgh on the assembly costs based on the new process in operation at both localities.

It must be remembered that these figures are only rough estimates of a part of the costs and do not tell the whole story. No information is as yet available on the operating cost of this new process and until these figures are available, it is impossible to tell what the total costs of making pig iron will be. The figures do show, however, that Hibbing has a much better chance of competing on the basis of this new process than it has with standard blast furnace smelting. These facts offer sufficient encouragement to justify the State of Minnesota in spending considerable money in making a detailed investigation of the whole proposition. There is however, no cause as yet for any great amount of enthusiasm. I can assure you however, that everything possible is being done with the funds available to work out this problem at the School of Mines Experiment Station of the University of Minnesota.

Of Castles and Bridges in Spain

(Continued from page 73)

—grown out of the same soil, bound by the same roots.

Those students who have been in my classes know that I have read much to them, and they know that especially dear to me are those writers who look at this common world about us and see the strangeness and the beauty and the wonder of it. For I believe that such men belong to youth. They bring it what it needs; they bring it broadening horizons. They help to crystallize its dreams and to translate them into facts—it is the dream become a fact that lifts men high.

I am glad that "technical English" is passing from our college of engineering. I see a time when it will no more be given to the freshmen engineers and architects. It has a place, but its place is not in that first course. It should come later, after the teacher of English has stirred up that imagination which strains and pulls and fears to go. It is the details, and details follow the broad foundation.

As I have said, I have been amused by this tradition that engineers and architects are unimaginative. I wonder if they have ever looked at their work. I realize that they have liked to think themselves "hard-boiled" (quaint fallacy!), and have thought that to be imaginative is to be effeminate. They are changing.

How I have delighted when that youngster who has told me that he could not write a theme using my title has labored and toiled and consigned me to perdition, and has brought me that story, or that picture, or that phantasy, or that poetry—for I have received poetry from engineers, and good poetry, too. On his next attempt he has found that he has labored less, and finally he has reveled through a theme. Probably he was surprised to know that he had an imagination; perhaps he didn't believe in "the darned thing." If he is wise, he will let that imagination grow. Some day it will create for him.

Naturally, in the year of English which the technical college now gives its students, it is not possible for the English teacher to do much. He will just begin. If he is fortunate enough, as I have been, to have his students write many themes with him, and to discuss with those students the literature of the world from its beginnings—and a course in world literature is the only English course which should be given in that first year of engineering and architecture— he has, however, accomplished a little. Everything he has done has been a vision builder. He may know that his students will keep those reading lists which he gave them, and that they will explore by themselves. A former student has just written me that he has recently completed "Gil Blas"!

From the teacher's point of view, it is much more delightful to teach English to technical students than to those in College of Arts and Sciences. For the young engineer is used to work. He has interest. He does not profess to be tired with himself. He does not suffer from that terrific "intellectuality" which is so prevalent among academic students, and so humorous. He has ambition. And thank God, he is not blasé.

All of this has sounded idealistic. I has intimated that an English course may be an actual pleasure, that even theme writing may be interesting.

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has meant to show that the work should be stimulating and creative. I, for one, have had sport doing it. I hope I have contributed a bit toward the making of some good engineers and architects. I feel that some of my students have gained a glimpse of yesterday and today, and the beauty and the terror and the glory of the world. Perhaps that will help them to work in the world about them.

Once a student talked with me. He told me that while in high school a friend and he used to walk into the night of summer. On a hilltop both boys would lie on their backs and look up at the stars and talk and wonder. The blue-black heavens seemed pinned with glistening light points. Those boys wove their dreams then, and their fancies carried far. Poetic? Yes. The boy who told me is studying engineering.

And that same boy wrote this theme for me. It is the spirit of youth:

TOWERS

Of imagination, of wonder, of the future are the towers I dream. When I dream of what I'll do, when I ponder, as on some still night under that sparkling void of imagination called the sky, when I wonder, towers of the future rise and fade away in a mighty, wondrous, never-ending procession.

Some day my creations will be real, some day I'll build them. The way is more wonderful than the towers of this future. It holds a magic and a mystery.

Have you ever, on some still, starry night, lain on the grass and gazed at the Milky Way, and the dark setting in which those sparkling eyes are set, and wondered where the end was? You think, you imagine yourself going on and on and still farther on; you try to imagine the end; but when you get there, it's not there. It frightens you; you are small; you are smaller than nothing, in your own world of imagination.

Wait, there's hope. You think of the piece of steel in your hand. It is not a solid mass—it is a group of little universes like our own, separated by immense distances. Maybe people live on those worlds; maybe our own world is just an atom of a piece of steel of another and greater universe. And to think that we ourselves are made up of these great universes or infinitesimal particles, and these strange particles in some strange, unaccountable way give us the power of trying to realize ourselves!

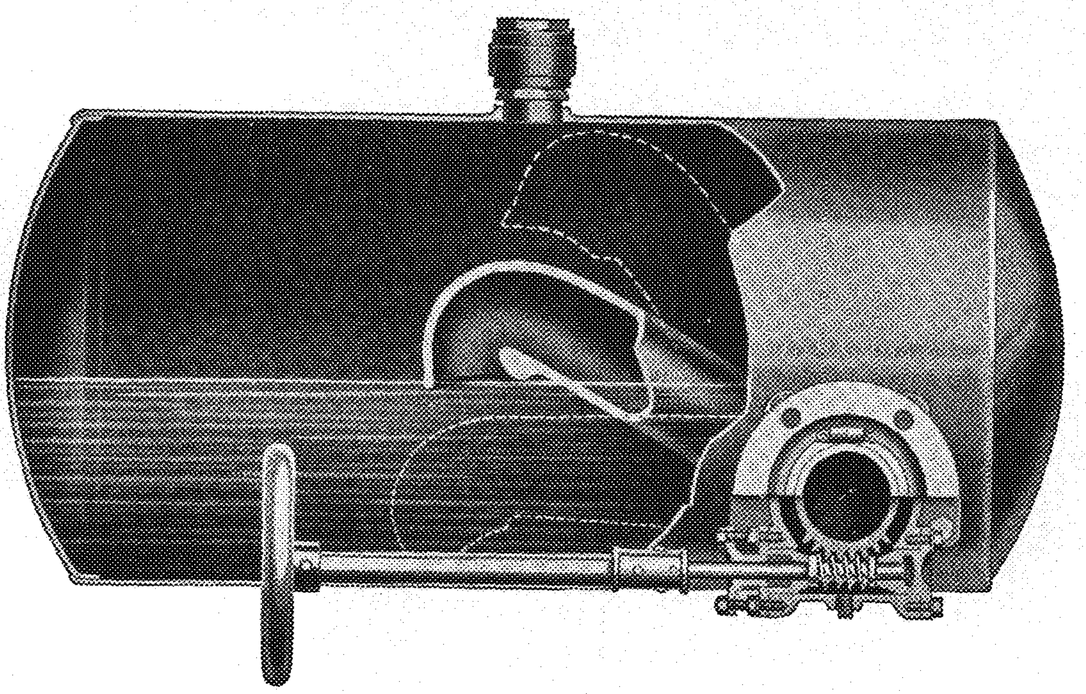
After such thoughts, I see my towers of the future clear and distinct in the haze of the great unknown.

The English teacher has, you see, the possibilities for the most interesting course in the whole university. It is his duty to help toward making his students better engineers and better architects by discovering with them that "there are more things in heaven and earth than are dreamt of" when men shut their eyes.

Studying a Nation's Highways

(Continued from page 77)

I believe that in the future "Production Engineers" will become vitally necessary and that they will be in great demand by contractors and others interested in getting things done as efficiently as possible. Thus far it is a branch of civil engineering that has been neglected, or at least not utilized to its fullest extent. In closing, I hope that this article presents the possibilities in the Bureau of Public Roads, and the potentialities in production engineering.



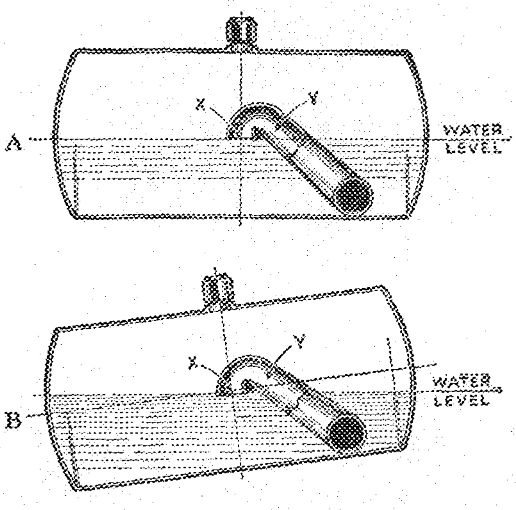
—another reason why Koehring Pavers Produce Dominant Strength Concrete

VITALLY important to the resultant strength and durability of concrete is the admittance of an accurate amount of water into the mixing drum at exactly the right instant. Long ago the Koehring Company recognized this fundamental requirement and set to work to devise an automatic water measuring system.

Today, the system is as nearly exact and accurate as human ingenuity has been able to design. A balanced three-way valve is automatically opened at a certain point, by the charging skip as it is raised, admitting the water into the mixing drum at exactly the right instant. The regulating hand wheel governs to a minute accuracy the amount of water which is to be used per batch.

All dribble is eliminated by the syphon-gravity principle which draws the water through a straight 3½ inch pipe into the mixing drum. Straight flow from the tank to drum secures a fast, clean discharge.

This is another pioneering development by Koehring engineers which with the Koehring batch meter, Koehring boom and bucket, and Koehring five action re-mixing principle produces standardized, dominant strength concrete of unvarying uniformity.



A and B illustrate clearly why changes of grade do not materially affect the accuracy of water measuring when using the Koehring system. X represents the volumetric center of the tank and Y the measuring arm.

"Concrete—Its Manufacture and Use" is a 210 page treatise on the uses of concrete, including 26 pages of tables of quantities of materials required in concrete paving work. To engineering students, faculty members and others interested we shall gladly send a copy on request.

KOEHRING COMPANY
MILWAUKEE WISCONSIN

MANUFACTURERS OF PAVERS, MIXERS—GASOLINE SHOVELS, CRANES AND DRAGLINES

The MINNESOTA TECHNOLOG

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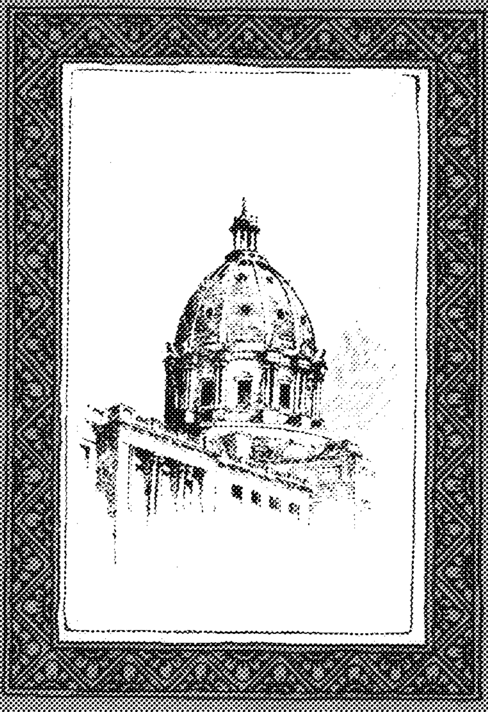

JANUARY

Volume VII. 1927 Number 4.

MEMBER ENGINEERING COLLEGE MAGAZINES Associated

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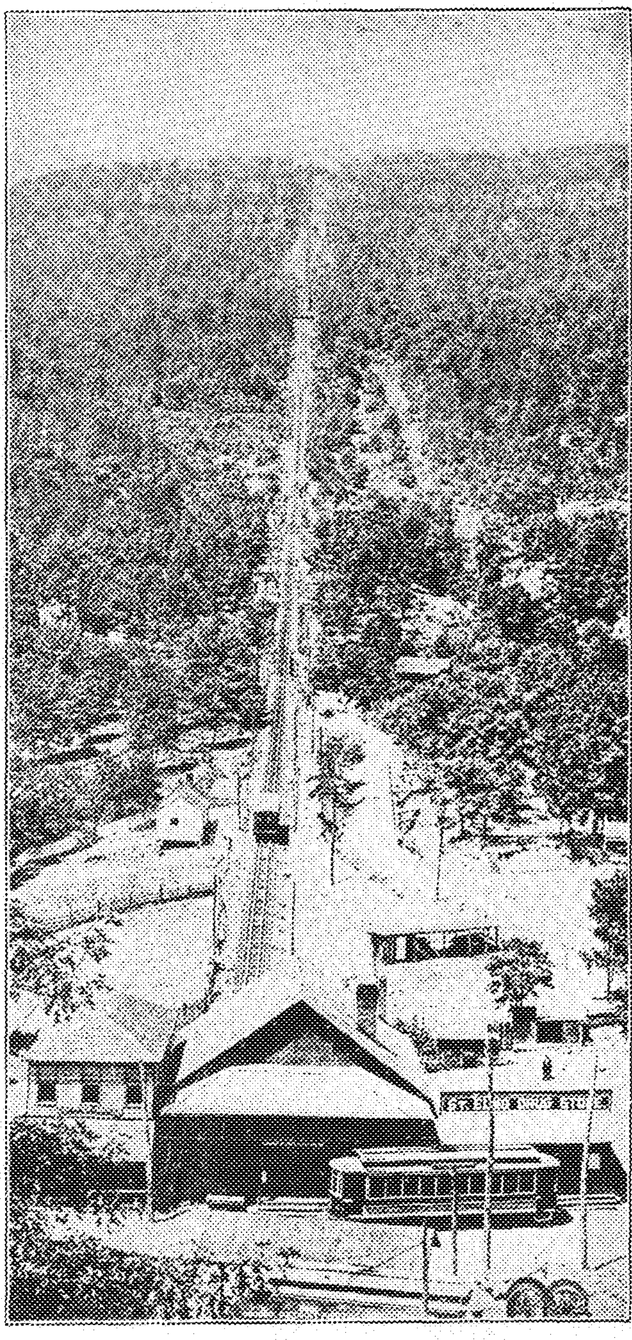

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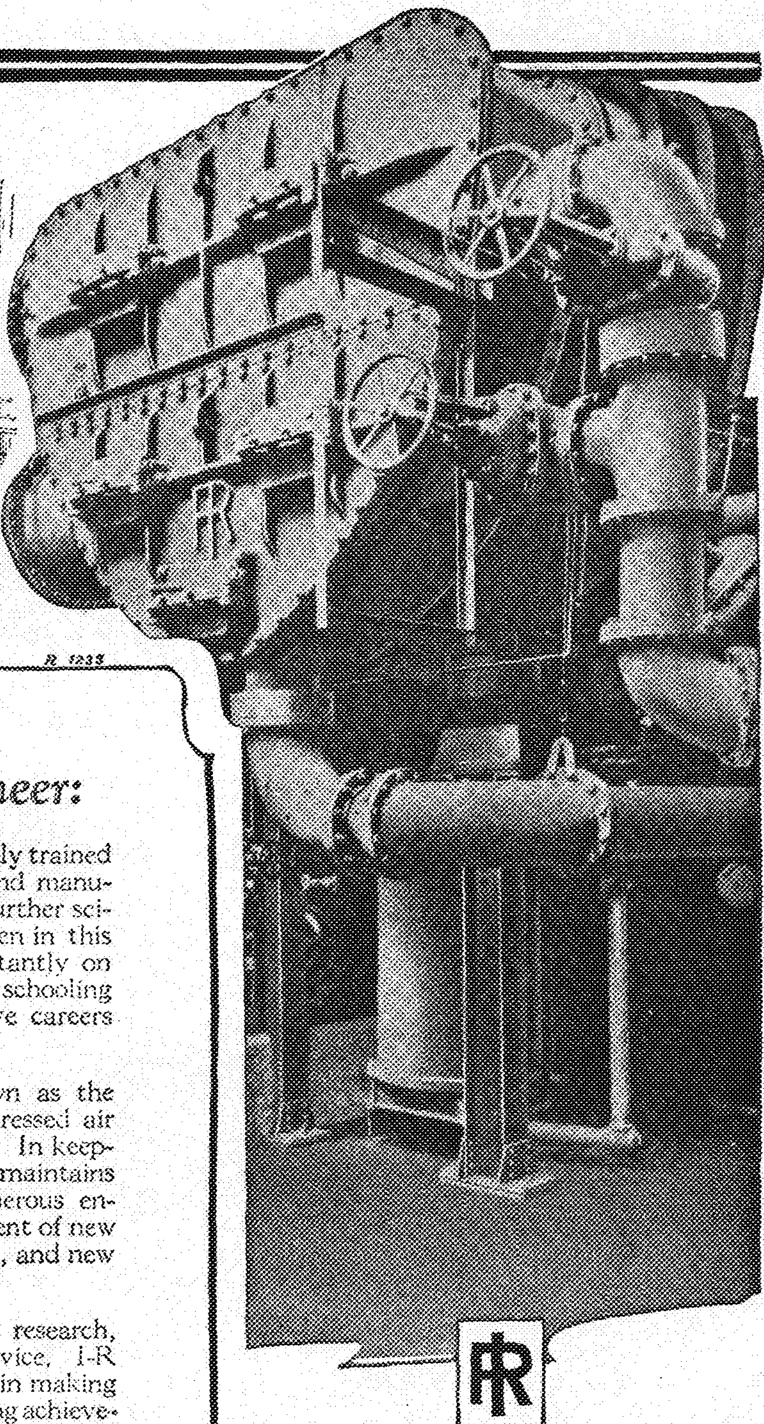

THE MINNESOTA

TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

VOLUME VII. MINNEAPOLIS, MINN., JANUARY, 1927 NUMBER 4

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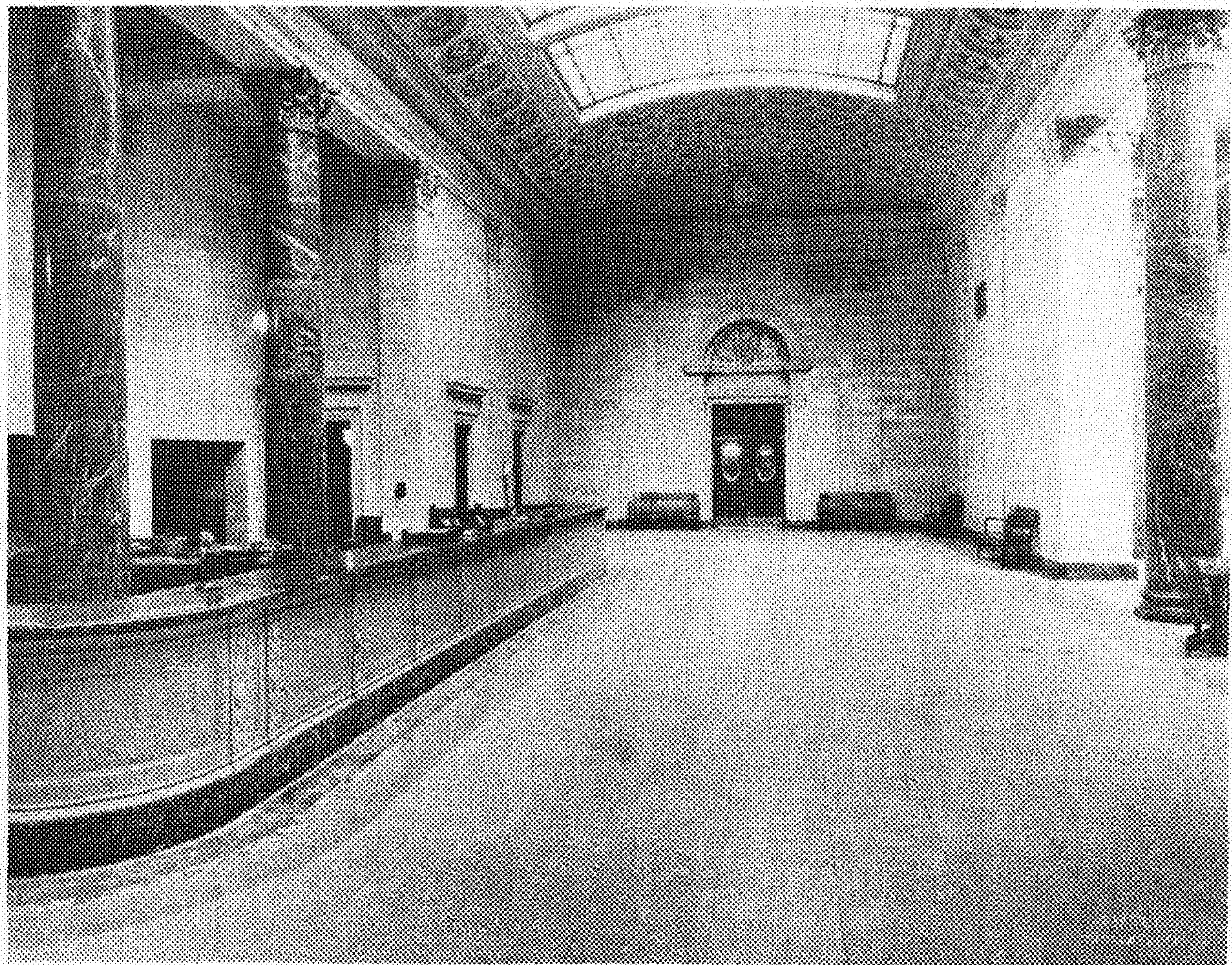

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The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VII — JANUARY 1927 — Number 4

"The Religion of an Electrical Engineer"

By PROFESSOR GEO. D. SHEPARDSON.

Reviewed by

JOHN V. MARTENIS

Associate Professor of Machine Design, University of Minnesota.

EDITOR'S NOTE: *The following is a review of "The Religion of An Electrical Engineer," written by Professor George D. Shepardson, former head of the Electrical Engineering Department at the University of Minnesota. Shortly after completing the manuscript of this volume, Professor Shepardson died suddenly in Florence, Italy, on his homeward journey of a trip around the entire world. The book is published by Fleming H. Revell company, New York.*

OWING to the diversity of opinions expressed relative to the apparent conflict between science and religion, which is fundamentally based upon a rational interpretation of the Holy Bible, many of the present generation and especially youth, evidence an uncertainty in the quality of the foundation. The evolution through which religion has passed tends to raise pertinent questions in the thinking mind relative to the harmony of certain basic truths. The average religionist is, at times, prone to be dogmatic and unyielding in his views when asked to interpret his religion satisfactorily to the present generation.

Unfortunately, the controversy usually hinges upon some statement contained in the Scripture rather than upon the attitude of the human heart and the result of human experience. In our present educational program, much is taught relative to science, but there is little or none concerning religious experience except in the home or in the Church—and all too often but little there.

Professor Shepardson happily possessed a tolerant belief in his religious faith and after long years of experience, which had those periods of doubt so common to most of us, he reasoned his way through to a personally satisfactory conclusion. His host of friends will agree that his life exemplified in a fine way the high ideals toward which we should strive.

The engineer, in order to succeed in his chosen profession, must put his thought and energy into his job. In proportion to this, will his success be measured. As a corollary to this statement, if one does not put any thought or energy into his religious nature, he will not develop along these lines.

In the opening chapters of the book, we find these words:

"It is often said that man is incurably religious, and that few, if any peoples have ever been found who did not have some sort of religion, however crude. Every religion is based on a belief in the existence of a god or of a number of gods.

"We face at once the fact that during long ages, students have found intellectual difficulties in reasoning about God. The philosopher affirms that it is impossible for finite to comprehend infinity, for finite mind to understand Infinite God.

"As an example of comprehending something of infinity, we believe that space is practically infinite. Our knowledge of space is increasing. The astronomers now confidently resolve what have seemed to be mere patches of dim light in the sky, into vast universes so distant that light requires hundreds of millions of years to reach this earth from those distant bodies. Since we know considerable about nearly infinite space, we should not feel hopeless in seeking to acquire an adequate and confident knowledge of the Creator and Ruler of infinite space and all that is therein."

The engineer, in his quest after knowledge, is not discouraged if he finds the commonly accepted avenues beset with apparent difficulties, but naturally seeks other means or routes by which either directly or indirectly, he may achieve the desired result.

"There is suggested a reasoning from effects back to cause, and reasoning by analogy from the known to the previously unknown. One might try going beyond strictly logical processes, to gain knowledge by intuition or 'hunch' or some mental process not yet classified or analyzed by philosophy, recognizing that some forces and some facts seem to lie outside the scope of our present organized sciences.

"Much of the knowledge we have of forces and their effects, shows clearly that the mind of man can appreciate and deduce facts concerning those forces. It appears logical that as we delve deeper into nature's storehouse, we should stop to consider from whence it all came. To the thinking mind, the facts discovered in nature is a challenge to discover the causes which underlie her manifestations. It seems highly improbable that any rational person would attribute the creation of all the materials and forces of nature to a chance happening. The facts discovered by scientists clearly show that all events are the result of a definite plan laid down by one who has infinite power and control over the things he has created."

In his discussion of the Bible, the author states, "It contains history, prophecy and its fulfillment, biography, principles of conduct for individuals and laws for the government of a nation, directions for public worship and aids to private devotions, advice for the conduct of business and for maintaining satisfactory relations with one's neighbors, chants of triumph and cries of penitence, moralizing over the past and hopeful outlook toward the future, tragedy and comedy, poems and prose. Every phase of life is mirrored, every mood depicted, and through all, there is a stimulus for the present and a hope for a better future."

The author is not at all dismayed by the accounts of the then called miracles, because in modern science we have so many times accomplished the impossible. New discoveries are calmly accepted as a matter of course, yet our grandfather would have said that these things are miraculous.

"No one can doubt that Jesus Christ lived, walked among men and exemplified a type of living which so far transcends any moral code known to man that we must concede to Him a divine

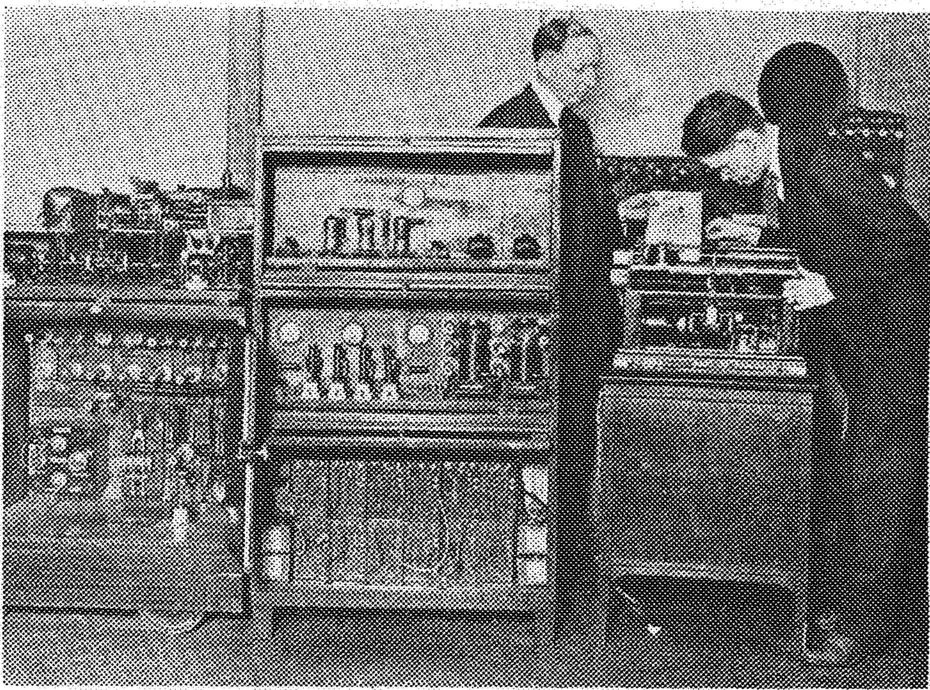
(Continued on page 130)

Pictures by Radio—Another Seventh Wonder

Flashing pictures across the ocean through the air is the latest miracle that science has placed at the disposal of man

By R. E. Mathes, E '24
Photoradio Engineer, Pacific Division,
Radio Corporation of America

"ZIP, and the New York banker will have in his hands a copy of that morning's London Times!!" So said Mr. Owen D. Young, chairman of the Board of Directors of both the Radio Corporation of America and the General Electric company, in predicting the development of radio pictures during a talk before an interdepartmental meeting of the Radio Corporation of America. He further said, "I am not an engineer so I do not know how this will be accomplished; it is a problem for you engineers to solve." This prediction was made in January, 1923. On the morning of May 6, 1926, a little more than three years later, that very thing was first accomplished when a New York paper published a facsimile copy of the May 5th issue of the London Times, containing the latest news of the great British general strike. This was transmitted by radio from London to New York via RCA, utilizing its system known as the Photoradio Service.



GENERAL VIEW OF THE SAN FRANCISCO PHOTORADIO INSTALLATION

From left to right, the apparatus includes the transmitter, the photocell and amplifier, and the receiver. Mr. G. H. Porter, manager of R. C. A., Pacific division, left, and Mr. R. E. Mathes are watching an incoming picture.

There are at present two photoradio circuits open for commercial business. One is from San Francisco to Honolulu and return and the other is from New York to London and return. Some extremely interesting uses have been made of this service on the Pacific circuit. News pictures of the volcano in the Hawaiian Islands last April were transmitted and published in papers throughout the country. A photo of President Coolidge opening the Sesquicentennial Exposition was transmitted to San Francisco by the telephoto system and from there to Honolulu by the photo-radio system.

More recently, a check for five hundred dollars was written in Honolulu and a facsimile copy transmitted to San Francisco and cashed by the payee. The original check was cancelled in Honolulu by the photoradio operator who wrote across the face of it the words "Void, transmitted by Photoradio." This then, made the facsimile copy at San Francisco the only existing unvoided check. It is impossible to obtain a photoradio copy at the transmitting end of the circuit which could be used to draw the money on illegitimately, due to the saving grace of our old friend "Static." It is also impossible to obtain more than one copy per transmission at the receiving end of the circuit. This then, safeguards the recipient of the facsimile copy against having more than the one unvoided check in circulation. A vice-president of a San Francisco bank has given it as his opinion that such procedure should make the received copy sufficiently legal to pass any court in the land.

Another very interesting use of the service occurred just lately. Robert W. Shingle, a resident of Hawaii, was on the mainland at the time of filing nomination papers for election to the Hawaiian Territorial Senate. He had made out his papers in due form and mailed them to Hawaii from New York City. Something unforseen occurred so that the papers were not in Honolulu on the last day for filing of nominations. Mr. Shingle's backers radioed very hurriedly for him to do something to get his application on file by the close of nom inations at midnight that night. In re sponse to this he radioed back authoriza tion for them to proceed as his attorney in-fact to sign fresh papers. This au thorization, however, was not acceptabl to the government. Finally, as a las resort, Mr. Shingle approached RCA with a request that we send his signa ture in facsimile. Mr. Shingle was re quested to draw up, in his own hand writing, a statement: "I herewith se my signature to my nomination papers short term Hawaiian Senate.

Robert W. Shingle.
Witnessed:
Chas. K. Johnson,
September 2, 1926."

This statement was transmitted to Honolulu, attached to the nomination papers, and accepted for filing four hours before the expiration of the filing time allowance.

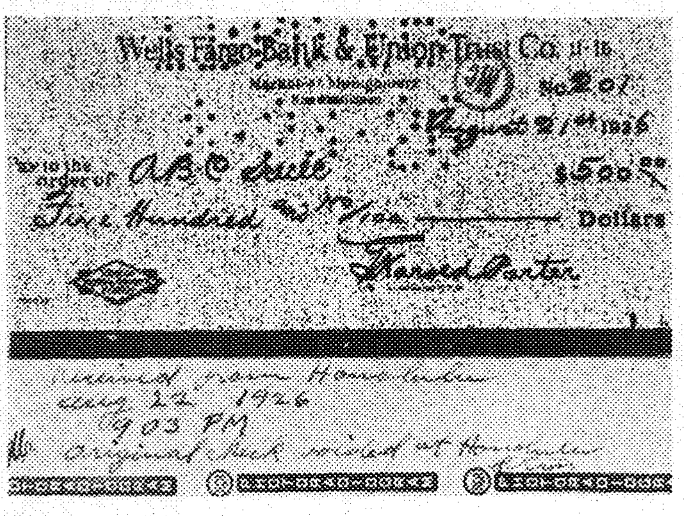
Other uses have been made of this circuit for the transmission of news photos, drafts, letters of credit, identification cards, Bertillion records of criminals, and the like.

During the British strike great use was made of the service to supply photos of the latest developments, t American newspapers. Since then a con siderable demand has been developed fo pictures and sketches of the latest crea tions of the Parisian fashion dictators As a result of this service many larg fashion centers of the Atlantic coast ar supplying regularly, models of these crea tions to their clientele from twenty-fou to forty-eight hours after conception o the idea in Paris. At the time of th Dempsey-Tunney fight, action picture of the bout were in London within thre hours of the finish of the fight in Phil delphia. Pictures of the Miami tornad and of the tragic mishap to the Fon trans-Atlantic plane were received an published in London in record time.

Other types of transmissions have bee handled with success. Excellent resul have been obtained in the transmissi of Japanese and Chinese writing.

one time it was desirable to have the Hawaiian end of the photoradio circuit install an improvement in the apparatus. A drawing of the part was made and transmitted to Hawaii and the part was readily constructed and installed from that drawing. It was not even dimensioned but was drawn to scale. Other drawings, wiring diagrams, charts or graphs, and maps have been handled from time to time.

The apparatus employed to effect the transmission of pictures is quite complicated, as might be expected when it is realized that one must deal with thousandths of a second in their relation with one another. The method of accomplishment will be described in as brief a manner as possible.

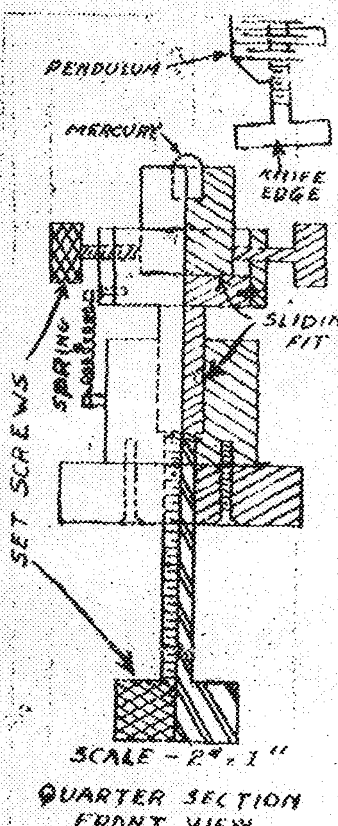


MONEY FROM THE AIR

This is a copy of a check actually transmitted from Honolulu to San Francisco and cashed there by the payee.

The picture, printed matter, or whatever is to be sent, is first photographed on an ordinary camera film. This is developed in the usual manner and then placed on a glass cylinder, being firmly held in place by metal clips. The picture is now ready to be transmitted.

At one end of this glass cylinder is mounted a small but intense arc lamp known as a Point-O-Lite because the light is concentrated into a very small luminous ball about an eighth of an inch in diameter. The light from this arc is focused through a set of lenses and thrown onto a mirror inside of the cylinder. The mirror in turn, reflects the light beam, now concentrated into a small point, through the cylinder and film and into a camera box located in front of it. Now the mirror and camera box are mounted on a mechanism which moves them back and forth along the axis of the glass cylinder and at the end of every stroke of the mechanism the cylinder is caused to rotate 1/128th of an inch. By this means the surface of the film, which is carried on the cylinder, is, in due course, completely covered by the light spot reflected from the mirror. As the light and dark portions of the picture are traversed, the intensity of the ray is varied in accordance with the shading on the film at that particular spot. This ever changing beam of light, after having passed through the film and camera box, is again focused through another lense and reflected into another box and onto the sensitive element of a photo-electric cell, a recent development of the General Electric company, which transforms the light rays into electrical impulses which can be transmitted by radio much the same as the regular telegraphic message.



PHOTORADIO FOR A RUSH JOB

This drawing and a side view were sent to Honolulu where the part was constructed with no other specifications.

This photo-electric cell, commonly spoken of in the laboratory as the "electric eye" of the transmitter, is a glass bulb coated on the inside with a special chemical compound. The coating has the unusual property of ionizing to a more or less extent depending upon the amount of light shining on it, when a fairly high D. C. voltage is applied between it and an electrode mounted in the center of the bulb and insulated from the coating. This property is known as the photo-electric phenomenon and is present only in certain compounds. In other words, the action of the "photocell," so-called, is that of an ordinary three element vacuum tube except that the light replaces the grid voltage in controlling the plate current. Being an ionic device the photocell functions practically instantaneously. In fact, experiments have been made in cutting off the light at the rate of 10,000 times per second and the photocell has followed with no apparent lag.

The photocell is, therefore, responsible for reproducing an infinite number of different electric current values which correspond to the light or dark areas of the picture being transmitted.

The varying intensity D. C. of the photocell is passed through two stages of direct coupled amplification and then caused to modulate a special fifty cycle oscillator, the output from which is passed through a magnetic relay and then fed to the control line to the radio telegraph transmitter some fifty or more miles distant. The modulation of the oscillator is so devised as to cause the radio transmitter to "space" for the parts of the picture which should be pure white. For light grays the transmitter makes very brief dots widely spaced and as the picture becomes darker these dots occur closer and closer to-

(Continued on page 128)

PROVING A RECORD CATCH BY RADIO

Pictorial matter such as this is easily transmitted between San Francisco and Honolulu through the air.

The Automobile Headlight Problem

The solution of the driving light question as applied to the average car owner is now being studied by prominent engineers

By Gordon C. Harris, E '28

IT is well known that the situation in regard to the use of automobile headlights is in very bad shape. "The Engineering News Record" for January 6th, 1927, says, "Road safety has become a major issue during the past year. There is extensive and glaring abuse of headlights, and it creates the greatest single danger of the road today."

Any night one may drive on any highway in the nation, and he will find many flagrant abuses of the law. Everyone knows the evils of the glaring headlight. No one who has ever driven a car has escaped meeting many cars on the road whose lights have blinded him temporarily. Whether he slips by unharmed or not is merely a matter of chance. When the glare from these blinding lights strikes a driver's eyes he is totally helpless. Some drivers try to keep their eyes on the curb or the edge of the road in order to avoid the glare. Sometimes this may work very well, but in wet weather it is rather a danger than a safeguard, since to come too close to the edge of the road is sometimes fatal.

Some states have laws requiring approaching cars to dim their driving lights. This is usually worse than useless since the dimming of driving lights below the glaring point always results in having too little light on the road. This case is just as bad as if both cars had used full driving lights.

Some cars are equipped with a special low power bulb whose rays are of such strength that a person may be easily distinguished at a distance of seventy-five feet without the accompanying glare. These lights are usually a failure since it is very hard to get this combination.

In addition to the above it is always a nuisance for a driver to be continually switching lights on and off. This trick is also a source of danger to both drivers on account of too little light. There is no reason why we cannot have lights properly adjusted and of such strength as will eliminate all danger.

Professor F. W. Springer, acting head of the electrical engineering department at the University of Minnesota, and chairman of the Headlight Committee of the Governor's traffic conference organization has for a long time suggested as one of the remedies of bad lighting the education of the driving public. At his suggestion a brief outline of the characteristics of safe lights is given for the benefit of the automobile driver.

(1) *Properly adjusted head lamps* in good order, equipped with 21 spherical candle power bulbs, or with a maximum of 32 spherical candle power bulbs, will provide sufficient light to enable a driver to see a person (or some part of him) at a distance of 200 feet from the automobile.

(2) Head lamps and auxiliary driving lamps should be so adjusted that the top of the beams of light from the lamps shall *slant downwards* away from the car, and not be over 42 inches above the ground at a distance of 75 feet in front of the car.

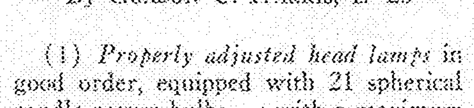


Fig. 1. Bulb at Focal Point

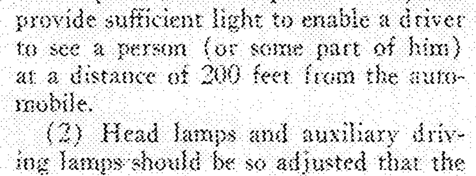


Fig. 2 Bulb Behind Focal Point

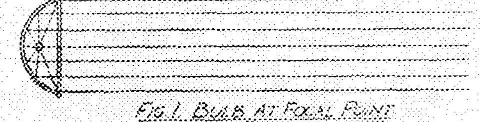


Fig. 3 Bulb Ahead of Focal Point

(3) These beams of light may readily be observed by the owner, traffic officer, or others, as made visible by dust, smoke, fog, mist, rain or snow.

(4) If the *"top of the beam slants upwards"* (on a level road) the lights are glaring or dazzling and are a menace to safety.

(5) All vehicle lamps are glaring or dazzling when they materially or considerably impair the vision of an approaching pedestrian or the vision of an automobile driver who is looking through an open windshield or through a windshield which is free from dirt, dust, moisture drops, or snow.

Such matters as the above should be given immediate attention by the automobile driver if for no other reason than his own safety.

Following are suggestions to automobile drivers as given in some remarks made by Professor Springer before the Board of the Minnesota Federation of Architectural and Engineering Societies, on October 16, 1926.

Directions for Headlights

1. Every person who drives an automobile at night needs no assistance, nor advice, nor instrument to determine whether or not the headlights or spotlights of an on-coming car interfere with his view of the road. We all recognize with gratitude the driver having safe lights such that we pass with unimpaired vision of the road—and what we think of the other is unprintable.

2. All realize that the beam of light from headlights or spotlights, of tens of thousands candlepower intensity, will, *if* it strikes the eye, cause pain and temporary and partial blindness. Also, such a beam will carry with glaring and blinding intensity many hundreds of feet from its source.

3. The place for such light is on the road and is, for driving purposes, a total loss to the driver.

4. The problem is to keep driving lights directed below the horizontal and on the road instead of into the eyes of pedestrians, and drivers of on-coming cars.

5. All recognize that glaring, blinding headlights not only do not give their best driving illumination, but also may constitute a basis for a charge of criminal liability for their owners.

Testing Headlights

Inasmuch as everyone is competent to judge the headlights of passing cars as to their safety to himself, so also it is possible for each owner to test his own car, as follows:

1. Stop the car on a level road at one side of the road, when sufficiently dark, leaving the headlights on with the engine running fast enough so that the generator and battery will give full lighting power. Stand on one side and a little ahead of the car and note the path of the beams of light as they may be made visible by fog, smoke, rain, snow or dust. If the beams of light rise above the horizontal, they are dangerous to others. They should be adjusted. See also Test 2, and Adjustment 2. (See Fig. 4.)

2. Leave the headlights on as above, and walk ahead of your car several hundred feet and then turn and approach your own car along the path which would be taken by passing vehicles. Your eyes will be ap-

proximately on a level with the eyes of a driver. Stoop occasionally so that your eye may be brought to a level with your own headlights. If you are blinded or inconvenienced by your lights at points above the waist-line in this test, your headlights should be adjusted before subjecting any one else to their discomforts and dangers.

3. If still in doubt, repeat the above by driving in another car past your car. Ask your friends whether your lights cause discomfort or not.

4. All drivers should keep their windshields clean and free from dust, snow, and raindrops. The windshield should preferably be inclined to the vertical 15 to 30 degrees. These precautions avoid catching stray light on the windshield and obscuring your view. It is not fair to judge the other fellow's headlights through a dirty windshield and thus confuse mild diffused light with glare.

Adjusting Headlights

With the majority of headlights now in service, proper adjustment is all that is necessary to obtain greatly improved road illumination and to avoid the dangerous glare to others.

1. The light bulb may be moved forward or back so that the rays of light may be made parallel or spread. (See Figs. 1, 2, 3, and 5.) A slight spreading is desirable. The adjustments may be tested on a target fifteen to thirty feet distant, such as the back wall of a garage. These adjustments should be tested with the front lens closed as in use. There are lenses and reflectors on the market so constructed as to flatten the beam and to spread it sideways in order to illuminate the sides of the road and ditches.

2. After the lights have been properly focused, then tilt the top edge of each headlight forward until the beam from each headlight is such that *the angle between a horizontal line and the top of the light beam is enough so that small bumps on the road, a heavy load in the rear of the car, or soft rear tires and hard front tires, will not raise the upper edge of the beam above the horizontal.* The lens must be in place in this adjustment. Any beam that rises above the horizontal may strike someone in the eyes at some point ahead of your car. This is the most important adjustment.

3. Turn the headlights to the right or left until the beams will properly illuminate the ditches and the road.

4. Recheck the above adjustments.

5. A little light above the waist-line of pedestrians may be desirable but must be strictly limited to that which is not a glare, such as is caused by a concentrated beam of light.

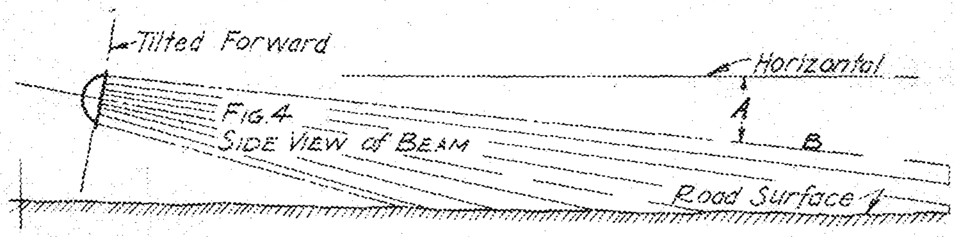


FIG. 4 SIDE VIEW of BEAM

It would seem that anyone who is competent to drive a car is also competent to inspect his own headlights and then either to adjust them himself, as explained above, or to have the work done in a service station.

It is assumed that the greatest number of those driving with glaring lights are ignorant of the fact and also of the law. In order to remedy this state of affairs it has been suggested that the state issue a pamphlet with each license, and in this pamphlet set forth the regulations in plain English, thus putting the responsibility directly on the driver.

It is also suggested that official testing stations be established at numerous easily accessible points to which automobile drivers could go to have their lights properly adjusted. This propaganda would educate the driving public to the use of proper lights, and many accidents would be eliminated as well as assuring pleasant driving conditions on our highways at night.

While the suggestions used for determining the safety of driving lights as given above are of use to the automobile driver, a real engineering test may be applied to determine whether or not the headlight device meets the manufacturing requirements for safe lights. Exact data as to the intensity of the beam in all directions cannot be obtained without the use of a photometer and specially constructed photometric range.

Research work on the best means by which to accomplish this end is being conducted in the electrical engineering building at the University of Minnesota at the present time.

Mr. H. P. Warner and Mr. F. M. Cook, of the electrical department, are conducting tests under the direction of Mr. E. W. Johnson, assistant professor of electrical engineering.

The measurement of the intensity of the light beam will be made at distances of 60, 75, 100, and 150 feet from the source. The beam of light is thrown upon a screen in the center of which is a small opening for the photometer. The screen is protected from stray light by a system of screens in which the openings are only directly in front of the test screen. The head lamps to be tested are mounted upon a frame which can be rotated about both a horizontal and vertical axis, so that any part of the beam may be thrown upon the photometer, thus enabling the easy measurement of the intensity of that part of the beam, and also saving the necessity of moving the photometer.

A telescope is mounted at the intersection of the median planes to allow of accurate direction of the beam upon any part of the screen, which is graduated in degree lines.

The manufacturers of headlight devices have already reached a very high degree of perfection in the manufacture of their product. There are, however, many improvements which could be incorporated in the mechanism if the defects were brought to the notice of the particular manufacturer. It is to this end that many exhaustive tests will be applied to various headlight devices which may be submitted for test to the research department. It was thought at first that a regular photometric gallery could be erected at every official testing station.

By means of these tests the efficiency as well as the safety of the headlight beams can easily be measured.

This research work in the department is to stimulate interest, and to train students in an accurate knowledge of the principles of safe head lighting.

It is to be hoped that the legislature will pass the proposed "Uniform Vehicle Code" laws for the solution of the problem of *"Safe Driving Lights for the Public."*

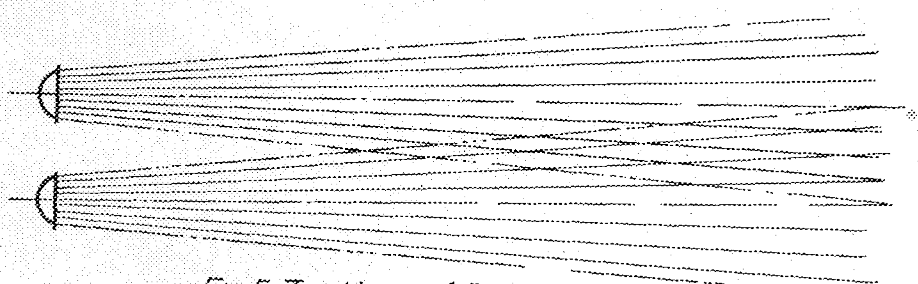


FIG. 5 TOP VIEW of BEAMS

Architectural History in Minnesota

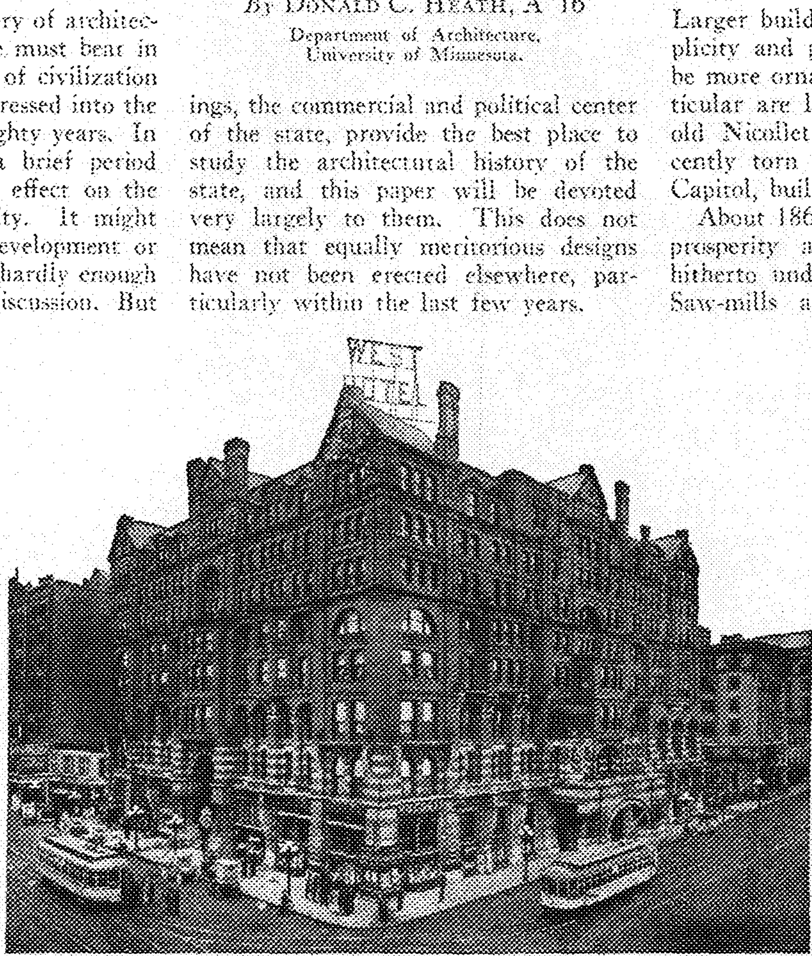
Great changes in design have featured the growth of architecture in this state during the past four decades

By Donald C. Heath, A '16
Department of Architecture,
University of Minnesota.

In considering the history of architecture in Minnesota, we must bear in mind that the history of civilization in the state has been compressed into the brief space of less than eighty years. In any previous age, such a brief period would hardly have any effect on the architecture of any locality. It might have produced a slight development or refinement, of detail, but hardly enough to warrant very lengthy discussion. But in Minnesota, the development of civilization has been so rapid that architecture in general has undergone several sweeping changes. Most of the old buildings and many of the later ones have disappeared before the rising tide of commerce. The structure which can claim fifty years is a rarity.

In this respect, as in practically all others, the history of architecture in Minnesota parallels that of all the other Mid-Western states. At the time of their development, the nation was so closely interlocked, and communication so intimate, that new ideas brought out in one place were immediately copied everywhere else. Thus local conditions and materials played a smaller part than might otherwise have been expected. Materials did play some part, however. In practically virgin forests, lumber, both pine and hardwood were cheap. Wood being always a pliant and grateful material as well, very much of the earlier work, even in quite large structures, was of wood. Where wood was considered too perishable or undignified, there was an abundance of local stone, ranging from sandstone, through several grades and colors of limestone, to granite, the latter also found in a great variety of forms. The Minnesota limestone is, however, of such a soft and brittle texture, as to preclude the possibility of delicate work, while the granite is so hard as to make the cutting and working of it extremely expensive. This has accounted for the comparatively slight effect of local materials on the development of architecture in the state.

The Twin Cities and their surroundings, the commercial and political center of the state, provide the best place to study the architectural history of the state, and this paper will be devoted very largely to them. This does not mean that equally meritorious designs have not been erected elsewhere, particularly within the last few years.



A FAMOUS CLASSICAL DESIGN IN MINNEAPOLIS
The West Hotel, built in 1884, is an example of the Queen Anne style of architecture with Byzantine and Romanesque.

The architectural history of the state practically begins with the opening of the territory to homesteaders in the late forties. Settlers began to erect farm houses and farm buildings. Most of the early settlers were from New England, and the influence of the New England colonial is apparent in the few remaining houses of this period. The same simplicity and refinement and air of fitness with their environment is noticed. This is perfectly natural, as climatic and commercial conditions, and characteristics of the pioneers themselves were similar in both cases. Very few of these old residences, and practically none of the more important buildings such as churches and schools, survive. The Godfrey and Stevens houses, in Minneapolis, and an old limestone house in Mendota, are preserved as historical relics, while in Shakopee, a few old houses show by the delicacy and grace of their details that they belong to this "colonial" period, as it might well be called.

Larger buildings began to lose the simplicity and grace as they attempted to be more ornate. Brick buildings in particular are less pleasing, as seen in the old Nicollet hotel in Minneapolis, recently torn down, and the old State Capitol, built in 1854.

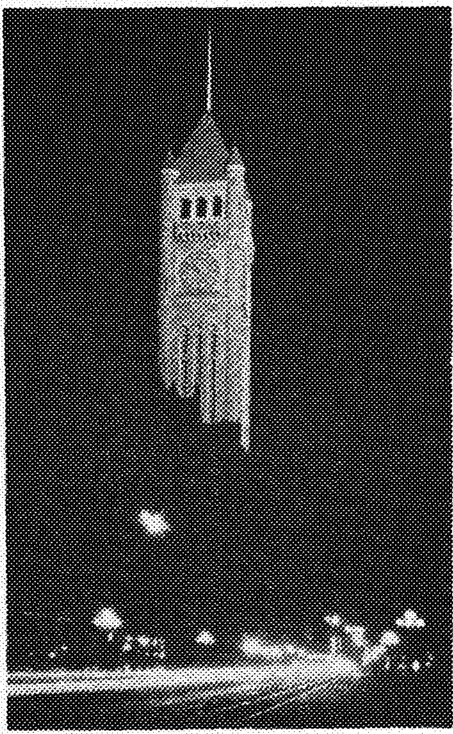
About 1860 the state began an era of prosperity and commercial expansion hitherto undreamed of in any locality. Saw-mills and flour-mills sprang up everywhere, railroads were built, and a great amount of building of all sorts was begun. It was unfortunate for the aesthetic possibilities of the time that this period of expansion coincided with one of the darkest eras of American architecture; the so-called Victorian era, sometimes alluded to as the "Dark Ages" of American Architecture. Many large and imposing structures were erected, using rough surfaced blue limestone. These buildings were designed by untrained men and often had elaborate attempts at richness of ornament with very little thought of design and proportion. They were unskilled attempts to copy the so-called Victorian Gothic, which was then the fashion in the east. Occasionally, where the designer forgot that he was designing an ornamental building and simply built something to house a factory, a building attained some dignity due to its size and simplicity, as for example, in some of the older flour mills at Minneapolis, built in the late seventies. Other remaining structures of this time are the old business buildings on East Third Street in St. Paul, and in the Gateway district of Minneapolis. The old city hall was one of the most imposing of these latter.

Large residences were plentiful, most of them of wood, though a few of the more pretentious were of stone. The wooden ones imitated their more pompous brethren, even to the extent of having the wooden siding marked off to imitate stone jointing. Builders tried to outdo each other in elaborateness, which led to the grotesque jig-saw decoration so unpleasantly familiar to most of u and which still exists in large quantities.

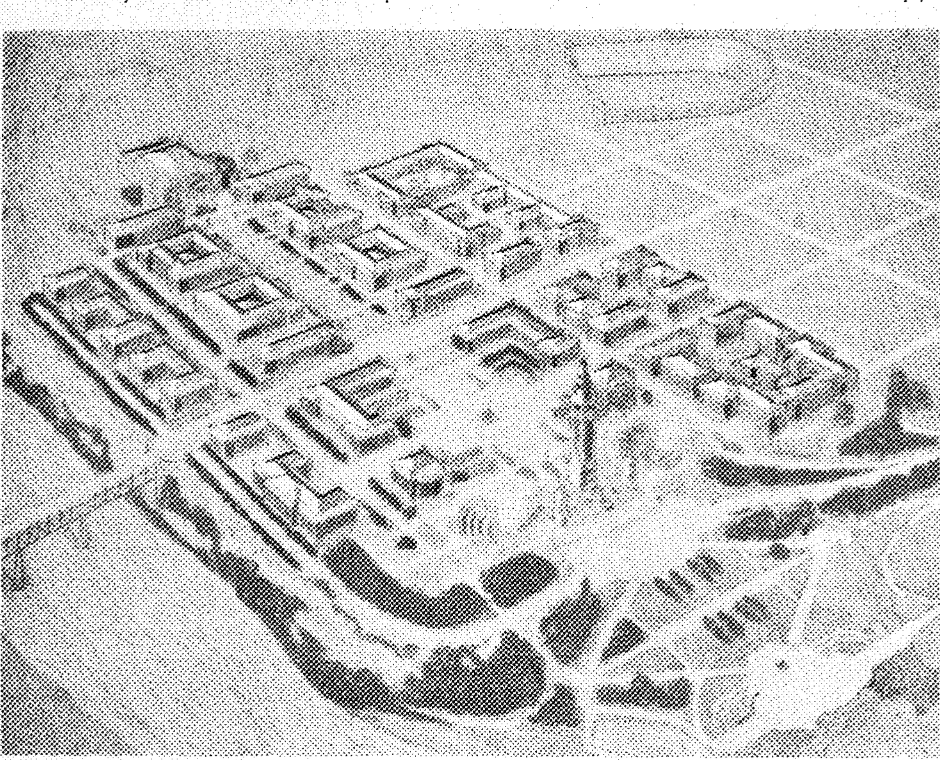
About 1880 a new style originated in England, which immediately sprang into great popularity in the Eastern United States. This was the famous Queen Anne style, which was supposed to draw its inspiration from the English work of the period of Good Queen Anne, 1702-1714. The latter was a period of decadence from the pure classical renaissance work of Sir Christopher Wren, and in its modern revival, came to mean an indiscriminate use of classical detail, with very little regard for its fitness. The utmost freedom of treatment was encouraged, and picturesque designs were sought. In the hands of unskilled designers, some rather weird effects were obtained, giving rise to the ancient jest about the house with a "Queen Anne front and a Mary Ann behind." This style was readily taken up by the local architects, but with greater restraint than in many other localities, and consequently with better success. Many dignified examples are still to be seen in many parts of the state, among them, the old Federal Building at Third and Marquette, Minneapolis, and the famous West Hotel. The first is of limestone, using a great variety of classic columns and pediments, the whole forming an effective, if somewhat restless, design. The West Hotel, designed by L. S. Buffington, when built in 1884, was the largest west of Chicago. It is of brick with stone trim, and is a very free design, using not only classic detail, but also Byzantine and Romanesque. In spite of this, it is an effective and harmonious design, although somewhat restless and lacking in dignity, like most of the buildings of that time. The old State Capitol, built in 1885, is also of this period, but is a rather crude and uninteresting structure of red brick. Many large residences were also built at at this time, and still remain, although many of them have suffered the ravages of progress and are now cheap boarding houses.

This particular phase was short-lived, and was superseded about 1885 by a new craze. This was the Romanesque, or "Richardsonesque," as it was nicknamed after its founder, H. H. Richardson. The latter, a New York architect, was trained in the Ecole des Beaux Arts in Paris, and had traveled and studied extensively in Europe. There he had become enamoured of the 11th Century Romanesque churches of southern France, and saw in its inspiration, the hope of a characteristic new American style. Richardson was a genius, and he designed some of the noblest monuments in American architecture, most famous of which is doubtless Trinity Church, Boston. His success with the new style inspired a host of imitators, and the country became dotted with Romanesque buildings of every type. However, the style, so flexible in the master's hands, became intractable in those of his less able imitators, and after a few years was practically abandoned. Minnesota has its share of this style, but was fortunate in possessing, at the height of the craze, some very able architects. Long and Kees, L. S. Buffington, Harry W. Jones, A. H. Stem, Cass Gilbert, Hayes, and others were just beginning to give the state some real architecture. These men, working with sympathy and understanding of the Romanesque, produced some excellent and monumental buildings which are still a credit to the state. The most outstanding example is perhaps the Court House and City Hall at Minneapolis. In a competition held in 1887, Long and Kees were appointed architects, and the building was begun the following year, and was completed in 1906. It occupies a full city square, with an open court in the center, and is of rough red granite, with a red tile roof. The tower, rising to a height of 345 feet, still dominates the skyline of the city, and over thirty years after it was designed, the building still houses the vastly increased machinery of the city and county governments. Other examples of this style are: Pillsbury Hall at the University; the Minneapolis Public Library, L. S. Buffington, Architect; the Bank of Commerce, now the Minnesota Loan and Trust, Harry Jones, Architect; the St. Paul Postoffice; the Guaranty Loan, now the Metropolitan Life Building, and the Lumber Exchange, Minneapolis. The two last are among the state's pioneer skyscrapers, and show how unsuited the Romanesque with its massive blocks of stone is to the problem of the modern office building. In construction, they are entirely different from the modern office building. The mas-

(Continued on page 122)



THE CITY HALL TOWER AT NIGHT
This stately landmark is of Romanesque design, so very popular in its day.



THE FUTURE UNIVERSITY OF MINNESOTA
This sketch shows the Cass Gilbert design of the Greater University, modified to fit present plans.

ENGINEERS IN ATHLETICS

Engineering Puck Chasers Help Defend Hockey Title

By Ralph Blyberg, *Mech. Eng. '29*

TECHNICAL men have done very well in demonstrating to Coach Emil Iverson that they are as proficient with hockey sticks as they are with "slip sticks." There are nine engineers in all upon the varsity hockey squad. Of these men four are veterans who have earned the "M's" in previous seasons.

These four veterans form an important part of Coach Iverson's hockey sextet. They are Kenneth Bros., center; "Mally" Gustafson, left wing; Wilfred Lowther, left defense; Carl Wilcken, goal guard. Kenneth Bros and Wilfred Lowther are both seniors, while Gustafson and Carl Wilcken have one more year to play.

"Mally" Gustafson is fast proving himself to be one of the fastest and most dependable men on the squad. He plays a speedy passing game, and his goal shots are very accurate. His defence work is excellent as he checks many of his opponents in mid-ice and wrestles the elusive puck from them. The manner in which he takes the puck down the ice and maneuvers into position for a shot at the goal is beautiful to see. In the first game of the season with the Fort Snelling sextet, Gustafson led the Gopher pucksters, halting the Soldier attack time and again and skating down the ice on solo offensives.

Much of Minnesota's advantage on the ice has been gained by Kenneth Bros playing the center position. Bros has a knack of getting the puck on the face off and passing it across to the wings. He is fast, and is capable of getting into position in very short order. Bros will leave a gap that will be hard to fill when he graduates in June.

A good share of the credit for the Gopher wins must go to Carl Wilcke goal guard. He seems to be able t spread himself out to cover the whol front of the cage. Wilcken follows th puck assiduously and is always in posi tion to block the opposing goal trie Few shots get by him to score for th Gopher opponents.

Wilfred Lowther, another of las year's veterans, is starting a little slov this season but is fast rounding int shape. His regular position is left de fense. Lowther's forte is checking ad verse rushes, and taking the rubber int enemy territory. It is expected that h will bear the brunt of the Gopher's de fense when he hits his stride.

Coach Iverson has a wealth of re serve power in the other technical me on the squad. Kalmer Klammer an Lloyd Russ are goal guards. Both o these men are giving the regulars a goo run to hold their positions. Frankli Seeger and William Tilton are wing and Loyd Westin is a defense man Kalmer and Seeger have had the mos experience of these men as they hav been playing with the frosh one year an on the varsity squad for one year. West in, Tilton and Russ are newcomer from the freshman ranks.

The hockey squad should have a goo season this year as most of the men nov playing have played on the champion ship sextet of last year.

> **BASKETBALL SCHEDULE**
>
> *The five teams entered in the engineering basketball tournament have been matched according to the following schedule. All games are to be played on Monday nights at 5:30 p. m., beginning Jan. 24.*
>
> January 24
> *Seniors vs. Juniors*
> *Sophs vs. Frosh No. 1*
>
> January 31
> *Seniors vs. Frosh No. 2*
> *Juniors vs. Sophs*
>
> February 7
> *Seniors vs. Frosh No. 1*
> *Juniors vs. Frosh No. 2*
>
> February 14
> *Frosh No. 1 vs. Frosh No. 2*
> *Seniors vs. Sophs*
>
> February 21
> *Juniors vs. Frosh No. 1*
> *Sophs vs. Frosh No. 2*

Winter Prospects in Engineering Athletics

By Clarence C. Lande, C '27
Athletic Manager

THE Technical Colleges Athletic Board has decided to hold its annual dance the latter part of February. This will be the third dance sponsored by the athletic board. It is the aim of the board to establish this dance second only to the Engineers' Brawl as an all-engineering social event. The dance is given for a worthy purpose and should have the support of all the technical students. All profits from the dance are used for the promotion of inter-college and inter-class athletics and make possible the presenting of awards such as watch charms, sweaters, etc., to teams and individuals who have won championships in the various sports sponsored by the T. C. A. B.

The technical colleges, comprising the College of Engineering, the School of Architecture, and the School of Chemistry, have established a worthy reputation for having a student body with a real college spirit, as manifested by their athletic activities. About 40 per cent of the technical students participate in some form of athletics sponsored by the I-M department and the T. C. A. B., and this percentage is increasing each season.

Some of the sports that are well represented each year in the form of tournaments are touchball, basketball, hockey, baseball, kittenball, tennis, golf, and handball. Something new in engineering athletics is to appear this spring when the T. C. A. B. is to organize an all-engineering field track meet between the various classes and technical colleges. One can readily see that the engineers are well represented in I-M sports as well as varsity sports.

In regard to the present season, the basketball tournament will start Mor day, Jan. 24, with the following tean entered: Senior Engineers, Junior E gineers, Soph Engineers, Frosh No. and Frosh No. 2. The tournament wi last five weeks. Teams are to play ea other once. The winning team will re resent the engineering college in the I-l elimination contest for the all-universi championship.

The engineers are represented in t independent hockey division in the I- tournament. The schedule will sta the first part of February. Parker, s wing, and Lande, defense, are the or veterans back from the team that w runner-up for the all-university cha pionship last year. Equally good resu are expected this year. The followi men are on the squad: Parker, F. Seeger, R. H. Seeger, R. A. Anders Hanlon, Lidman, Eidsvold, Thour and Lande.

NEWS FROM THE TECHNICAL CAMPUS

"To Be, or Not to Be; That Is the Question"

Speculation has been rife as to the outcome of a conference held some time ago between the M. E. faculty and the building and grounds committee. The subject was placement of the Auditorium and new quarters for the M. E. department.

After much pondering and deliberation, several brilliant plans were suggested. Since one corner of the Auditorium must occupy the space where the foundry and forge shops now repose, a proposal was made to eliminate the present power plant and to place in its stead the foundry and forge shops, interlocked in a sort of checker board fashion, so that the students may sit on the anvils while pouring molds.

This plan was successfully opposed by the faculty, so the committee immediately brought forth a bigger and better suggestion. A plan was formulated whereby the foundry would take the place of the forest reserve which is now between the M. E. building and the Power Plant.

Pending the adoption or rejection of this plan, the committee has had the Power Plant building redecorated. Great patches of fresh paint now adorn the battle scarred walls, and it is estimated that the mechanicals will retain their present quarters for another twenty years.

New Pelton Wheel Installed in Hydraulics Laboratory

The experimental engineering department has recently bloomed forth with a new impulse water wheel. It has been installed in one of the basement rooms vacated by the highway department when it moved into its new location, and will be used by Prof. Jones with his class in experimental motors and pumps. The wheel is built by the Pelton Water Wheel company of San Francisco. It has a 21-inch wheel and a 1½-inch nozzle and will develop about 20 h. p. at 550 r. p. m. under a 200-ft. head.

Minnesota's water wheel is one of the largest now used in the laboratories of the country and is a counterpart of the bigger commercial wheels. The largest commercial wheels are the 22,500 h. p. wheels recently installed in the Big Creek plant of the Southern California Edison company.

Professor Boehnlein, on Leave, Studying in Europe

Charles Boehnlein, professor of mechanical engineering at Minnesota, is in Germany on sabbatical leave where he is studying advanced aerodynamics under Professor Prandel, of the University of Goettingen, an international authority on this subject. His address is Rosdorferweg 7, Goettingen, Germany.

The University of Goettingen seems to be favored by our engineering professors. Professor Brooke, head of the department of mathematics, studied there and Professor Holman received his Doctor of Philosophy degree there.

A Flux Meter

By Franklin W. Springer

THIS device may be used for measuring the field strength at any point in air, such as magnetic fields, resulting from currents in bus bars or leakage flux from dynamo machines.

Dismantle any suitable small moving coil type of d-c ammeter or voltmeter, removing all magnets and magnetic material, and remount the jewel frame with non-magnetic material. More sensitive springs may be used if desired.

Place the instrument at any point in the field to be tested, setting the instrument so that the axis of the moving coil will be at right angles to the flux. The plane of the coil must be kept parallel to the flux lines while readings are taken. The direction of the flux may be obtained by a suitable compass needle. A measured current should be sent through the moving coil.

It is evident that the readings of such an instrument will vary directly as the strength of the field in which it is placed. If this instrument is calibrated while placed in a field of known strength, it may be made a direct reading flux meter.

A standardized field may be obtained by sending current (I), abamperes, through a relatively small conductor and calculating the field strength (B) at a definite distance (p) from the conductor by the well known formula—

$$B = \frac{2I}{p}$$

An instrument of this type has been in use several years in the electrical laboratory in connection with bus bar force experiments. Under certain conditions, it can be used for exploring a-c magnetic fields as well as those from direct current and permanent magnet sources.

Mr. Levens Investigates Concrete Shrinkage Due to Calcium Chloride

Mr. A. S. Levens, instructor in the department of drawing and descriptive geometry, is doing extensive research work on the effects of calcium chloride when incorporated into a concrete mixture.

Until quite recently, the use of calcium chloride in curing concrete pavements was limited almost exclusively to surface application, as it has the property of absorbing moisture from the air and thus keeps the concrete moist until it is sufficiently cured. Now, however, it is being added to the mix in solution form and has proved of great benefit as it hastens the curing process and the road can be opened to traffic sooner. This benefit depends entirely upon the judicious use of the calcium chloride, as any amount in excess of 3 per cent based on the weight of cement causes a great deal of shrinkage and loss of strength.

The use of calcium chloride is not limited to concrete roads by any means, but is also used in building construction. Mr. Levens is much opposed to its use in beams as the shrinkage is usually sufficient to cause large cracks and make the beams dangerous. An excess also causes considerable scaling of the concrete. Quantities not greater than 2 per cent or 2½ per cent increase both the tensile and compressive strengths, the greatest increase coming in the first four or five days of curing. Calcium chloride tends to fill the voids and produces a concrete with a much more uniform texture than would be obtained without its use. It is often used to hasten curing in cold weather construction, but it must be added wisely or the resulting shrinkage will be sufficient to render the structure unsafe.

At the present time, Mr. Levens is investigating shrinkage caused by calcium chloride in detail, and is studying its effect on the tensile and compressive strength of the concrete in dry, wet, and moist conditions.

Professor Lang Attends Highway Meeting in Washington

F. C. Lang, professor of highways and pavements, attended the annual meeting of the Highway Research Board of the National Research council at Washington, D. C., the first part of December. This board is composed of 24 organizations, technical and otherwise, all of whom bring reports of highway problems to this joint meeting. The committee on the character and use of road materials, of which Mr. Lang is a member, held its meeting on Dec. 1, and the general meeting was held on Dec. 2 and 3.

Research Fellow Conducts Tests on the Heat of Setting Concrete

Arne A. Jakkula, instructor and research fellow in the civil engineering department, is investigating the temperatures developed by concrete during setting at various air temperatures. At present he is comparing the heat developed in setting by Atlas Lumnite and Portland cement concrete. By the use of a specially constructed cabinet, he can obtain given conditions of temperature and can determine the heat of setting by thermo-couple readings at fifteen minute intervals.

Mr. Jakkula has been given permission to make tests on the new tenth avenue bridge by Mr. Paul, superintendent of construction, and conducted tests during the holidays.

Using neat cement mixtures in the laboratory, the heat of setting was developed inside of 12 hours, but in the bridge, where a 1-3-6 mix was used, it took 48 hours for the heat to develop. Inert substances such as rock and reinforcing steel kept the temperatures down, but the general trend was as found in the laboratory.

(Continued on page 126)

AROUND THE WORLD WITH OUR ALUMNI

CHEMISTS

Dr. Paul Sharp, a former student of agricultural biochemistry, is now full professor of dairy chemistry at Cornell University.

'21—Arthur N. Parrett is now a chemist for the Dupont Dye works at Wilmington, Delaware.

'22—Walter Hartung, after having taken his advanced degree at the University of Wisconsin, is now employed as chemist by Sharpe and Dohne, of Baltimore, Maryland.

'24—Karl F. Paul is now with the Hercules Powder Company of Wilmington, Delaware. He was formerly with the Empire Refineries, Inc., at Okmulgee, Oklahoma.

MECHANICALS

'25—Folmar Bjerre has been with the Mathews Conveyor Co., Ellwood City, Pennsylvania, since graduation. He is now chief engineer and has secured patents on several very successful conveyor systems which he devised.

'25—Russell Backstrom is carrying on research work in our own experimental laboratory.

'26—Vernon Lundquist is doing test work for the Northern Fire Apparatus Co., of Minneapolis.

'26—Wesley Anderson is with the Westinghouse Air Brake Co. at Wilmerding, Pa.

'26—Earnest C. Cole, more familiarly known as "Sky," is now in the marine Diesel engine sales division of the Fairbanks Morse company in New York City. He can be reached at 318 West 57th Street, New York City.

'26—Russel Grant is telephone engineer with headquarters in Chicago.

George W. Foltz, a former member of the M. E. '23 class, who left school in 1922 to go to Annapolis, graduated from the Naval Academy in June, 1926. He was included in the list of midshipmen who were slated for aviation training following graduation. George will be remembered as one of the first book passers in the Engineers Bookstore.

ELECTRICALS

'08—Alfred B. King is eastern sales manager of the Electric Machinery Manufacturing Co., builders of synchronous motors used extensively in artificial ice plants. Mr. King's home is in White Plains, New York.

'09—Arch Robison, in a letter to Dean Leland, enclosed a photograph of a 25,000 k. w. power development at Inglis, Florida, on which he was engineer. The plant was in commercial operation eight and one-third months after the first pick was driven in the ground.

'16—Harry T. Thompson is also with the Electric Machinery Manufacturing company.

'24—Alfred B. Greene, who has been in the Glen Lake Sanatorium ever since his graduation, celebrated Homecoming by attending the game in a closed and heated car. The University Senate voted Al the privilege of parking the car inside the stadium for the big game, since this was his first visit to Minneapolis since he entered the Glen Lake Sanitarium.

Al will be remembered as one of the outstanding men in the class of '24, being all senior president, president of the senior engineers, varsity football manager, member of Silver Spur, member of Grey Friars, and active in the Arabs, Y. M. C. A. and on the MINNESOTA TECHNO-LOG, as well as being instrumental in organizing the senior advisory system in the engineering college.

'25—T. B. Caswell, who was first employed in the General Electric Company as a student engineer in the testing department, is now a member of the Industrial Engineering Department. He is a member of a group of men who have recently completed the sales training course given by the company.

'26—E. L. Slaggie is in the Winona offices of the Gate City Insurance and Investment Co.

'26—R. A. Beveridge is working for the General Electric Co. in their small motors department at Fort Wayne, Ind. At present he is on sales engineering work in the office, but expects to be on the road in a few months.

A. W. Wilson and J. O. Hummell, both of the class of 1926, and N. W. Hussey of the class of 1925, have recently completed a two weeks' salesmanship course in the commercial school of the Westinghouse Electric company.

'26—Lowell Anderson is taking the G. E. training course at Schenectady, New York.

CIVILS

'09—Eli Torrance of the firm of Thorpe Brothers, realtors, was recently elected president of the Minneapolis Real Estate board. Mr. Torrance was formerly vice-president and has served as chairman of the board's industrial committee.

'14—W. E. Koepke recently spent two weeks visiting in Minneapolis. While here he was initiated into the Theta Xi fraternity, having been a member of the old local, Alpha Kappa Sigma. Mr. Koepke is an estimator with the Kalman Steel Co. in New York City.

'15—Lester M. Mitchell, who is now chief engineer for a marine contractor in Duluth was in Minneapolis over Homecoming. Mr. Mitchell, along with Prof. Priester, was instrumental in starting the St. Patrick's Day celebration at Minneapolis.

'21—Richard T. Daly is also working with the Kalman Steel Co. in New York City.

'26—Carl Liese is in Marian, Ohio, with the Marian Steam Shovel Co. He says he is learning the work from the "ground up."

'26—Leslie D. Croswell and Clifford Anderson are taking up graduate work in business administration at the Leland Stanford University. According to their claims they are really working hard for once.

'22—Ellsworth Johnson has signed a contract to go to Colombia, South America, on a big paving contract with an American concern. He sailed December 8th on the United Fruit Co. S. S. "Sixaola."

A portion of a recent letter to Professor Boon should appeal to his many friends:

"It might interest you to know that they have air mail service from Baranquilla to Medellin and the charge is thirty cents but it cuts the time down to 11 days whereas otherwise it is problematical when mail is received due to the fact that the service is dependent upon whether or not the river is dry. If such is the case I think they must carry it over on foot. However, I hope not. My address will be easy; care of R. W. Hebard and Co., Medellin, Republic of Colombia, South America.

"It snowed here in New York last night and it makes me appreciate my departure from here all the more.

"The first stop the boat makes is at Kingston, Jamaica. From there we go to Cristobal in the Canal zone and then to Puerto Colombia and by rail to Baranquilla and then by river steamer to Puerto Barrios, then by rail again over the mountains to Medellin. I think it will be nearly New Year's day when I finally get there."

'23—John J. Schlenk is a junior engineer in the U. S. Engineer's office at Milwaukee, Wis., and has been working on soundings and on surveys and inspection for construction. He left this position last June for travel in Europe. He reports that Switzerland is an engineers' paradise with its interesting engineering projects in highways, railways, and electrification.

1926 CIVIL CIRCULAR

24 '23 Civils Attend Annual Dinner and Story Hour

Mitchell and Nelson in Fine Form

Bullis Handicapped by Lack of White Sweater, War Bag

Curtis Hotel, December 27, 1926.—Nearly a half of the Civil Class of 1923 is present at the Third Annual Dinner being held in room 226, Curtis Hotel, this evening. The banquet room is so crowded by the 24 members that the arrival of Cliff Stephens with a gallon jug made it necessary for Elmer Nelson to crawl under the table to make room for the jug. However, in a few minutes Elmer and the jug changed places, so no one was greatly inconvenienced. MacGowan was only a half hour late. He explained that the cork came out on the way down and he had to make another trip. It's too bad that oysters on the half shell formed the first course. Many of the boys didn't like them. If they had been served after the steak the boys wouldn't have known them from flapjacks.

With the steak the discussion changed to Summer Camp. Mitchell paid a tribute to training received there, pointing out how he was later aided, by his Camp experience, in the design and construction of sewage disposal plants. On a motion by Walt Maiser it was voted to issue a warning to future classes against too frequent visits to Star Island. Walt admitted that the rowing was beneficial as an exercise, but he cited the example of Ray Spencer who acquired a wife as well as the exercise. Mike, after considerable argument, a g r e e d that no skunks should be shot in the vicintiy of a tent without consulting the occupants of that tent. At this point it was noticed that Ev Bullis was weeping. On inquiry it was found that he wanted to go to Cass Lake but couldn't find his white sweater. Convinced that that course was hopeless, he wanted to go to bed, and his grief increased when he found there was no warbag to sleep in. Ev was finally comforted when an old potato sack was obtained. He crawled in head first, unassisted, and slept peacefully the rest of the evening.

After the desert a lack of cigars was felt. Schaller blushingly volunteered to buy them in view of the recent announcement of his engagement. He then left, but not before he paid for the cigars.

The dinner over, the story telling hour commenced. Everyone was invited to contribute to the entertainment. Whenever an awkward pause occurred, Mike or Elmer stepped in and with a gracefully told tale set the company again at ease. It was heart warming to see the rapt attention, the eager, shining eyes, the innocent enjoyment evoked by the tales of these two! Many others contributed notably and at the end of the hour I am sure everyone wished that some magic could project them into December, 1927, so that they could immediately enjoy another such session.

Two minutes of business served to appoint Hib Hill to care for arrangements at the next dinner, to be held between Christmas and New Year, 1927.

The annual reunion was over. The boys left, some walking unassisted, to return to the humdrum affairs of life until another year has passed. Ah, me!

* * *

As an aftermath, some dozen of the boys repaired to Swan Peter Berg's apartment (his wife being in Texas), and an evening and morning of cards indulged in. Ye scribe is thus able to defray the cost of this publication.

* * *

Statistics of the Reunion

Total Present	24
Married	9
Engaged	5
About to be	8
Hopeless	2

Paul Swanson calculated that the combined annual salaries of the group, if converted into dollar bills, would pave Nicollet Avenue between Washington Avenue and Third Street, provided dollar bills were big as bed sheets.

Automobiles owned:	
Packard	0
Cadillac	0
Buick (1914 model)	½
Overland	2
Chevrolet	1
Ford (17 units)	3⅔
Combined Age	Legal
Preferences:	
Bourbon	1
Scotch	3
Alki	2
Red Dog	5
Indifferent	13
Blonds	6
Brunettes	3
Indifferent	15
Employed by Minnesota Hiway Department	8
Teaching	1
Earning a living	15

Hib Hill, *Editor.*

'14—T. H. Granfield is located at Omaha, Nebraska, and is an engineer of costs for the Northwest Bell Telephone company.

'24—Herbert W. Liese, who has been office engineer since October, 1924, for Foley Bros., contractors in St. Paul, recently returned from Forsyth, Montana, where the firm had a large coal stripping contract. Herb is fast becoming a "recreational engineer," having built a nine-hole golf course while in Montana. Previous to that he designed and laid out an outdoor swimming pool at the home of Mr. Foley on Manitou Island, White Bear.

'24—Phil Berquist has moved from the position as assistant roadmaster at Willmar for the Great Northern, to that of traveling car service agent for the same road. Upon graduation, Mr. Berquist started work as a switchman for the Great Northern, to that of traveling car service agent for the same road. Upon graduation, Mr. Berquist started work as a switchman for the Great Northern as a special appointee of Mr. Budd, with the aim of working through the various departments to an executive position.

'25—Norman R. Moore, formerly assistant on the engineer corps of the Chicago Terminal Division of the Pennsylvania Railroad, has been transferred to the Baltimore division as assistant supervisor with headquarters at Parkton, Maryland.

'25—Clarence W. Blue is in Minneapolis as construction superintendent for W. D. Lovell. He has lately been engaged on post office construction work.

'25—Carl Gerdes is on geological surveys for the Standard Oil company of Venezuela, South America. He writes: "Have changed my location as well as my department in the last few months. Am now working out of the Maracaibo office on geological surveys. In the first place, we are in camp for a greater length of time than heretofore and so feel that we can spend the time in getting the camp fixed up. In fact, we have been living in close to nature houses for the last month, quite a luxury for field work, as the usual thing is to put a tarpaulin over a framework and call it a camp. I thought when I left eastern Venezuela that I would be getting out of the rainy district, but there is about an hour in the afternoon when there is a regular tropical deluge, from two to three inches of rain nearly every day. We are situated close to the Caribbean Sea, about an hour's ride, and consequently can go bathing and fishing occasionally."

'26—Edward Gould was a recent visitor here. Eddie is in the structural steel shops of the McClintock Marshall Co. of Chicago. Ray Johnson is in the same shop. Tom Comfort detailing for McClintock Marshall.

'26—Clifford S. Nyvall is affiliated with the P. V. Nyvall & Son, Standard Sidewalk Co., concrete contractors.

'26—Ray C. Deegan is inspecting for the Minnesota Highway Department at Pine City, Minn.

'26—George E. Kaercher is now market supervisor for the U. S. Gypsum company at Fort Dodge, Iowa.

WHEN a university has grown until its registration exceeds the 10,000 mark, and its student population is divided among some fifteen schools, each of these schools or colleges must develop a real college spirit in addition to its university spirit if it is to assert itself on the campus as a definite force. An insipid college spirit will certainly not be instrumental in building up pride of school and university.

The engineering colleges have been accused of many sins of omission and commission, but they can never be truthfully charged with a lack of spirit when they have common interests at heart. If anyone takes exception to this statement let him come within sight or hearing of an Engineers' Day or class scrap day celebration, or venture into the loop district of Minneapolis after the annual Gayety party has been staged.

There is still much room for improvement, nevertheless, in the development of a true spirit of teamwork on the technical campus. An element has been injected into the student body that will cure any unhealthiness of spirit if anything will, however, and that is the very necessary element of athletic participation. The strong athletic organization that has grown up in this school in the past two years gives great promise of bonding the technical students together into a firmer unit than ever before.

The Technical Colleges Athletic Board, officially organized in the spring of 1925, was fortunate in carrying on its first year of recognized existence under the capable leadership of Kenneth Foster, and during that year intramural sports in the technical schools was established on a firm foundation. The athletic department co-operated heartily with the furnishing of equipment, and much credit must be given to the Engineers Bookstore, which was very liberal in supplying footballs, diamond balls, and other athletic equipment. The bookstore also established an incentive to produce championship teams by offering individual keys, sketches of which appear at the top of the page, "Engineers in Athletics," to players on those teams.

Clarence C. Lande, senior civil engineer, is carrying on the work of last year in a very able manner, and more engineers are participating in intramural sports this year than ever before.

There is no reason to believe that the interest shown at present will die down, and the progress of athletics in the engineering colleges must surely be followed by a stronger feeling of kinship among the technical students, which, in turn, must result in a more ideal college spirit.

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 state. 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 rigid "monkey laws" 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 1844, 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 telephoto 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 miracle of photoradio transmission by which a picture can be flashed through the ether to the ends of the world in a few seconds.

What lies ahead in the next century 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.

WE can again be justly proud of our prominent engineering interest center, the Engineers' Bookstore; this time as a result of the gift of $1,000 to the university for the use of a loan fund, primarily for engineering students.

The Engineers Bookstore has always been a source of tremendous service to the engineering students in the supplying of books and school supplies at a discount to members. Besides the ordinary routine service, the Bookstore has helped in the financing of intramural athletics, awards, and the engineers' homecoming, and has proved to be almost indispensable to technical students. This spirit of service is again reflected in the establishment of the loan fund, and the technical colleges can commend the action of the directors of the Bookstore

Through Campus and College

Architecture, Its Awakening in the United States

Tau Beta Pi Essay

BY ROY N. THORSHOV, A '27

ARCHITECTURE is a mirror of the manners, customs, and temperaments of the people. It is their expression of their life. An age of intellectual effort and achievement such as the "Golden Age of Pericles" leaves an inheritance of monuments, which are an inspiration to strive strongly for that which is beautiful and expressive.

Generations have passed since Athens produced the Parthenon. Civilizations have come and gone. Today in America a great experiment for a new social order exists. Can it produce a great and expressive architecture? I believe it is doing so.

Much of our architecture of the past has been crude and ugly. It is only necessary to look at the older portion of a city to realize this. The adaptations which have been made of many motives are humorous and their use is monotonous. But we must remember that this was the architecture of a pioneer period, a period of expansion and exploration. Towns were not founded as centers of culture but as centers of trade. People were primarily interested in barter. To them a building was nothing more than a shelter in which to conduct their business. Yet some people were sensible to that craving of something more beautiful and expressive.

This period was a period of experimentation for the architect. Construction methods were being revolutionized. The problem became one of properly clothing a skeleton of concrete or of steel. There was no precedent. Architects for a time crudely and illogically copied the architectural motives of the past. There seemed to be no attempt to co-ordinate the elements of design with those of construction. The American architect, however, was a student. He studied the great monuments of the past, and learned how to apply correctly their underlying principles.

During this period of experimentation, the social order had become stabilized, so that the hard struggle for the stern necessities of life had become minimized. The people began the pursuit of the cultural as they and the nation became wealthy. As in the Italian Renaissance, much of the wealth was devoted to the encouragement of art. People now demand that their buildings be built beautifully.

Architecture has become expressive. It is vibrant with life. The office buildings of New York are dominant, expressing the vigor of American commerce and trade. Schools no longer carry the musty look of tradition, but convey the characteristics of a growing, vigorous, and inspiring spirit. Their very designs spell purpose and efficiency. They breathe the life of the age.

The United States is embarking upon a great Renaissance, or rather Awakening, for it is not a re-birth but rather a maturing. The pioneer architecture was its youth. Now it enters upon manhood. Tradition no longer sways. Architecture as well as religion no longer expresses itself with the voice of the past but with its own voice. Its lines strive upwards; its proportions reach toward beauty, for it realizes there is a truth to be attained in all things. Unless a catastrophe should take place so that this country would revert to the Dark Ages of dogma and land-locked thought, architecture will go forward hand in hand with the onward march of culture and thought toward truth and beauty, and it will reach a perfection not hitherto attained.

FACULTY SKETCHES

JOHN IRA PARCEL

JOHN IRA PARCEL, professor in structural engineering, was born in the town of Westfield, Ill., in 1878. He received all his early education in Westfield, finishing high school in 1896, and graduating from Westfield College, a small denominational school, in 1903.

In the latter school he got a general academic education, receiving his A. B. degree, but his ambitions turned to the technical side of life, and he entered the engineering school at the University of Illinois in 1904. He graduated from there with a B. S. in C. E. in 1909, having worked two years in the meantime. One year he spent in detailing for the American Bridge Co. at Ambridge, Pa., and the other as detailer and designer in the Bridge Department of the C. M. and St. P. railroad, and following graduation he returned to the C. M. and St. P. for a few months.

In the fall of 1909 Mr. Parcel came to Minnesota as instructor in structural engineering, and remained here four years. In 1913 he returned to Illinois as assistant professor in charge of structural engineering work, but in the fall of 1914 he came back to Minnesota as associate professor in structural engineering. He has remained here ever since, becoming professor in charge of structural engineering in 1919.

Professor Parcel has done considerable research work, and has served in the capacity of consulting engineer for various architects in Minneapolis. In 1917, he and Professor Maney, also of the civil engineering department, investigated the secondary stresses in the Norfolk and Western railway bridge over the Ohio River at Kenova, W. Va., the report of which is published in university bulletins. This bridge was at that time the longest single span steel truss bridge in the world. In the summer of 1918 he was engaged with the Emergency Fleet Corporation in a special investigation of concrete ship frames, of which project Professor Maney was in charge. The year of 1921-22 he spent on leave in Europe, traveling and spending much time in advanced study, chiefly at the University of London. At various times in the last few years he has acted as consulting engineer to Professor Mann of the Architectural department, including work on the Rochester dental building, the Minnesota stadium, and several less notable structures. His work on the stadium consisted of a complete report on all of the principal features of the design. For the last two years he has been consulting engineer in charge of structural design for Croft & Boerner, architects on the Minneapolis auditorium.

In August, 1915, Mr. Parcel was married to Florence M. Kirkup of Portland, Oregon.

Mr. Parcel has contributed many articles and discussions to the engineering press and the Engineering Society Proceedings, and he and Professor Maney are co-authors of a text on "Statically Indeterminate Structures," which was published last spring.

Mr. Parcel is a member of Chi Epsilon, honorary civil engineering fraternity, Sigma XI, honorary scientific fraternity, and Zeta Psi, academic fraternity.

Our Latest Acquisition

THE Engineering College will be forced into the back yard of the University with the erection of the new $250,000 physics building on the plot just south of the administration building. The building is planned by Professor Mann of the department of architecture, and will conform to the general Cass Gilbert plan for the Greater University.

Professor Henry Erikson, head of the department of physics, stated that the new building will be built as a general utility building. However, it will have several distinctive features.

One novel feature is the three lecture rooms, the largest seating 450, and the two smaller ones seating 175 and 150 each. All rooms face on the general apparatus storeroom, making it easy to use apparatus for demonstration in any

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Optimum Sized Classes *and* Laboratory Sections *in* Electrical Engineering

By FRANKLIN W. SPRINGER
Acting Head, Electrical Engineering Dept., University of Minnesota

AFTER experimenting for more than fifteen years in classes up to eighty-five and laboratory sections as large as twenty-five, I have reached the following conclusions:

Satisfactory educational results should be obtained by experienced instructors, using proper methods, in case of electrical engineering sophomores, juniors, and seniors, in *classes* up to something greater than 100 per section, *depending upon the class room conditions and arrangements* (ventilation, acoustics, temperature, illumination, vision, tablet chair comfort, and humidity).

In the regular electrical *laboratory* work, experience indicates a maximum of 10 to 12 per section for sophomores, 14 to 18 for juniors, and 16 to 24 for seniors. In the case of each course, the smaller number applies to the first quarter of the year's work, and particularly to the first half of the first quarter. It is found that in the latter part of the year, students have become more self-directive in each of their courses and this is true not only from quarter to quarter of one year, but from year to year. A fair average would be *10 sophomores, 16 juniors, and 20 seniors* per laboratory section which numbers should not be exceeded, particularly, in the beginning quarter of a year course.

These, however, are not all; there are many other, possibly controlling factors, as follows:

(1) The larger percentage of engineering educators seem to favor small class and laboratory sections for various reasons. It is not, at present, a popular thing to advocate or to practice handling large classes in engineering.

(2) There is much other work to be done in a department besides the teaching itself. Large sections tend to reduce the numerical strength of a department and this reduces its influence in so far as numbers count. The range of specialties, as affecting research and public service, is also influenced, generally reduced.

(3) Large sections with fewer instructors is not likely to have a good effect on research work unless the discrepancy is deliberately offset in some other way.

(4) Credit in w o r k is generally thought to be rated in terms of credit-hours per week, irrespective of the size of classes. It is a heavier load to carry large classes than small ones, and instructors do not wish to be penalized themselves or to have their respective departments placed at a relative disadvantage in obtaining needed help.

(5) Program difficulties are likely to arise in the upper years, owing to the likelihood of some of the students being cut out of certain electives by having only one class section as in electrical engineering. No doubt, these difficulties could be minimized by the Program Committee.

(6) A general policy of large classes would immediately require re-arranged and re-designed class rooms and laboratories in many cases (a large order).

(7) There are advantages and disadvantages of large and small classes. The large class stimulates the instructor more than a small one, also, just as no one would care to see a theatrical performance or hear a sermon alone, there is a certain amount of driving force and stimulation felt by the individuals of a large class as a result of numbers.

(8) No advocate of large classes would likely content that a teacher could do better work in general with 100 per section than with only 25 per section, disregarding cost; but most teachers would admit that, for the same cost, better educational results would be obtained by an experienced teacher having 100 students in a class section, than by four inexperienced teachers with 25 per section.

(9) Until the problem is solved to the point where administrations can deliberately support and encourage large classes, it would not seem to be advisable for a particular department to attempt it on a complete scale.

Illustrative Comments

Consider one experienced teacher receiving $6,000 handling a section of 100 students, assisted by a part-time teaching fellow receiving $800 for correcting papers, in comparison with the same 100 students taught in sections of 25 by four instructors receiving $1,700 each. Note further that, if good instructors could be obtained for $1,700, they would be immediate candidates for substantial increases.

In the case of addresses, lectures, demonstrations, written recitations and examinations, the limit in number of students is probably much higher than many engineering teachers suspect. At a recent convocation, the president spoke to an audience of several thousand. In order that all might hear perfectly, a public address system for sound amplification was used. Clearly in such a case, being able to see the speaker would set the limit to the maximum number. No one would likely believe that such an address or lecture would be more effective if delivered in sections of 25.

It is just possible that engineering teachers, habituated to small classes and small laboratory sections owing to the natural limitations resulting from small registration and divisions into specialties, have failed to note some of the advantages of large classes such as may be found in other colleges. No doubt, there are courses and parts of courses in engineering which could be handled with satisfactory educational results in large sections.

Undoubtedly, each course will have to be studied by itself and the optimum sized classes and laboratory sections decided upon by the needs of each case. The range in size may be one to 100,000. Unseen audiences, by radio, may be millions in number. Shop work, ordinary engineering laboratory and research work, oral foreign language practice, music, and other *supervised practice sections* should, of course, be limited to that number such that proper individual attention may be given to students, but it would seem that no such limitaions need apply to lectures, written recitations, examinations, or demonstrations.

EDITOR'S NOTE: Discussion read at the meeting of the Minnesota Section of the Society for the Promotion of Engineering Education, November 9, 1926.

The Sophomore-Junior Smoker

On the evening of January 14th, a new experiment was tried in the Engineering College. The Sophomores and Juniors have always complained that they were not well enough acquainted, and so the smoke was put on to find out whether the fellows really did want to get acquainted. Judging by the turnout of about 200, the rumors must have been well based.

The entertainment of the evening was put on almost exclusively by engineering talent. The group started off the evening by singing popular songs and seeing which one could yell the loudest. Mr. Nelson played the marimba for this singing and was accompanied by Henry Roberts on the piano and Mr. Hanson on the banjo.

"Doc" Holman took care of the serious side for the evening and gave a short talk on what an engineer should try to do after leaving school. He stressed the point that an engineer should meet all the people he could and should try to

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JUST A FEW SQUEAKS

A great hush descended upon the multitude as Mussolini took his place at bat, and with one mighty swing opened a can of soup. "I'm innocent!" cried Coolidge, and he slid home on a wave of popularity, just in time to avoid colliding with a street car. Then Jack chased him into a corner singing boisterously, "Beautiful, my Beautiful." But Doug would have none of it, shouting, "All for Italy." And after a moment's thought decided to go home before it started to rain.

"I like spinach," said the little boy as he ran eagerly to school. But it was useless; whole cities disappeared in the wake of the storm, and Jones was just about to open the morning mail when his wife woke him up.

"What is it?" she cried, shaking him roughly. "Civilization," he retorted briskly. And going to the phonograph, he put on "The Vulgar Boatman"; then requested the nurse to get the morning paper and read him to sleep again.

Dean: "Do you know who I am?"

Stude—"No, sir, but if you can remember your address, I'll take you home."—*Brown Jug.*

Man in elevator: "Sixth floor, please."

Operator: "Here you are, son."

Man: "How dare you call me son? You're not my father."

Operator: "Well, I brought you up, didn't I?"

Professor: Well, sir, have you any good reason why I shouldn't flunk you in chemistry?

Student: Yes, sir—just take a snort of this gin that I made last night.

"Say it with flowers," his friend said to him.

"All right—what kind of flowers say, 'I can't call on you again, I've got a new girl.'"—*The Kodak.*

He—"You live in the next house, don't you?"

She—"Yes."

He—"I haven't seen much of you."

She—"No; I live on the other side of the house."—*Big T.*

A St. Paul woman was called out of bed at 5 one morning to answer the telephone, and the following dialogue ensued:

"Hello."

"Hello."

"How are you this morning?"

"All right."

"Well, then, I guess I must have the wrong number."—*The Northwestern Bell.*

Geography teacher: "James, please tell me about the poles. Does life exist there?"

James: "Sure—I mean yes, ma'am. Because my dad's a lineman, and puts wires that are alive up on the poles every day."

The teacher was holding a lesson on modern inventions and had just explained how the telephone was invented a half century ago.

"Now, James," said the instructor, "Can you tell me one thing of importance that did not exist fifty years ago?"

"Me," replied the lad.

All the world loves a lover except the folks waiting to use the phone.

"Here's where I cut a good figure," said the chorus girl as she sat upon the broken glass.

Doc Cooke: What do you expect to be when you get out of college?

Frosh: An old man.

DEFINED

Kiss is a noun, often declined, never singular, more common than proper.

Prof: "What's the occupation of your father, John?"

John: "Fireman."

Prof: "Where is he working?"

John: "He's dead."

JUST A FEW SQUEAKS

Mother: Poor Jimmy is so unfortunate.

Caller: How's that?

Mother: During the track meet he broke one of the best records that they had at college.

Prof. to Freshie: Did you take Math at High School?

Freshie: Yes, sir.

Prof., smiling: Well, then, tell us how many sides has a circle.

Freshie: Two.

Prof., laughing: What are they?

Freshie: Inside and outside.

She: If you tell a man anything it goes in one ear and out the other.

He: If you tell a woman it goes in both ears and out her mouth.

He: Are you fond of indoor sports?

She: Yes, if they know when to go home.

Frank: I'm only a pebble in her life.

Cliff: Well, why don't you try to be a little boulder?

How is your boy getting along at school?

Oh! He's halfback on the football team, and all the way back in his studies.

May: Jack said that I was the only girl he ever loved.

June: Doesn't he say it wonderfully.

What part of speech is woman?

She is not a part of speech; she is all of it.

She: I consider sheep the stupidest o[f] animals.

He (absentmindedly): Yes, my lamb

A college education teaches you s[o] many things. You could not begin t[o] mention them—not in polite society.—*The Tech Flash.*

I felt the beat of her heart
So close was hers to mine,
We could not wrench ourselves apar[t]
Her presence was like wine.
But still the girl I couldn't win,
So near and yet so far,
For that's the way with strangers in
A crowded tramway car.

—*Goblin.*

Architectural History in Minnesota

(Continued from page 111)

sive stone walls, many feet thick at the base, actually carry the entire weight of the floors above, while the modern building is supported by steel columns, the walls being merely an enclosing shell. While considering this matter, it is worthy of note that it is generally accepted that a Minnesota architect is the inventor of the steel frame building. L. S. Buffington worked out a design for a 28-story building using steel columns and girders several years before such a building was ever built. The design, in advance of its time, was never carried out, and the first structure actually to employ such a construction was built in Chicago by other architects, so that Buffington failed to get the credit that was rightly due him as the first to conceive the practical possibility of the modern skyscraper.

The passing of the Romanesque was hastened by an event which had a widespread effect over the entire United States. This was the Columbian Exposition or World's Fair at Chicago in 1893. It was a revelation to the nation at large, of the beauty of pure classic design, adapted to modern requirements. It really marked the birth of a new renaissance in American architecture, and the allied arts, and began a period which has continued with ever-increasing success up to the present. The work of a few brilliant eastern architects, such as Charles F. McKim, Stanford White, Carrere, and others, also helped to start the movement. It has been marked by a constantly growing knowledge and sympathetic understanding of all the historic styles; while the feeling is well established that no style is worthier for every purpose than any other styles, but that each is only good when it is the one best fitted to the requirements of the problem in question.

There has been so much excellent work executed in the last twenty years that it is almost impossible to attempt to list it, but a few outstanding projects may be mentioned.

One of the most prominent structures, both in design and magnitude, is very properly the State Capitol at St. Paul. After a competition, participated in by many of the foremost architectural firms of the company, the job was awarded to Cass Gilbert of New York, but formerly of St. Paul, later noted as the designer of the Woolworth building. The Capitol is of white marble, located on a lofty hill overlooking the city, and is surmounted by a great marble dome. When built, this was the largest marble dome in the world, although by no means the largest dome. It is almost an exact copy of the famous dome of St. Peters cathedral at Rome, at about two-thirds scale. The dome with the two projecting wings forms an almost perfect composition, and the interior, enriched with a rich variety of marble, is equally good. The two great stairways leading to the two legislative chambers are especially fine. Altogether, it is one of the finest structures in the country.

Another competition which attracted great attention was that for the Minneapolis Insitute of Fine Arts, in 1907. This was won by the firm of McKim, Meade and White of New York, over a large field of competitors. The complete plans call for a quadrangular building covering two city blocks, although only one side of the quadrangle has been completed. It is of Minnesota granite, and purely classic in design. The St. Paul Public Library, by Electus Litchfield of New York, is another splendid public building.

Some of the finest buildings in the state are the churches which occur in profusion in all the large cities. Most important of these are the Catholic Cathedral and Pro-Cathedral in St. Paul and Minneapolis, designed by the late E. L. Masqueray; the House of Hope Presbyterian in St. Paul and St. Paul's Episcopal in Duluth, both by Cram, Goodhue and Ferguson of Boston.

Hewitt and Brown of Minneapolis have become famous for their beautiful churches, the most important of which are St. Mark's Episcopal and Hennepin Avenue Methodist, Minneapolis. Other noteworthy ecclesiastical structures are the great Catholic monastery at Lake Johanna, by McGinnis and Walsch; the little Lakewood Cemetery Chapel at Minneapolis by Harry Jones, and the beautiful chapel at St. Catherine's Academy, St. Paul, by H. A. Sullwood.

On no class of buildings has so much money been spent of late years as on educational buildings. At the head of these, naturally, are the new buildings of the University of Minnesota. In 1909, Cass Gilbert was commissioned to draw up a general plan for at greater university, and all buildings since then have been erected in accordance with this design. A free adaptation of the Italian Renaissance was adopted as the style of the new campus, and the buildings have been designed by the State Architect, C. H. Johnston, of St. Paul. By far the best of the newer buildings is the Library, opened in 1924. The exterior, of brick and Bedford stone, harmonizes with the surrounding buildings. The interior is finished in marble and Minnesota Travertine, while the massive oak-beamed ceilings of the reading-room are beautifully picked out with color. Every detail—bronze grilles, lights, furniture,—is in keeping. It is without doubt one of the finest college buildings in America. The late Professor J. H. Forsythe of the Department of Architecture, was consulting archi-

tect for the University. The new Memorial Stadium, designed by Professor F. M. Mann, is a model of its kind.

Next to the university buildings are the high schools of the state. Hardly a town is so small but that one of the principal show places is the high school. And nearly always it is good; large, airy, well-suited for its purpose, which, after all, is one of the chief ends of architecture. The Central High School, Minneapolis, was designed by William B. Ittner, of St. Louis, in 1912, and has served as a model for many of the high schools built since then. For the last ten years the school board of Minneapolis has maintained its own architectural office.

Of late years there has been a tendency in large and important work, to employ architects from Chicago and the East. This has aroused some sentiment since the work of local practitioners is fully equal to that outside.

Nowhere has the improvement in architecture been so apparent as in domestic architecture. The work of young unknown architects shows a grace and charm that was lacking in the work of the masters of twenty years ago. There is better understanding of detail, a freer and at the same time more sympathetic use of historic precedents.

A large part of this improvement in the last decade is due to the greatly increased number of trained young designers who graduate from the architectural schools of the country. In no field of creative work is the designer so dependent on his assistants as in architecture. The work is so complex that no one man, however brilliant, could attend to all points of design, so that in most large offices the architect entrusts most of the work to subordinates, and acts only in the capacity of a critic or overseer. In fact, in some cases, he is more of a business administrator, most of his time being consumed in consultation with clients and builders. It is only natural, therefore, that the better trained and more cultured the draftsmen, the better is the work produced. This better training and culture is due to the establishment of Architectural Schools at the large universities of the country.

The Department of Architecture at Minnesota in its present form is of comparatively recent date, being only about 14 years old. There had been several attempts to start a school of architecture before that time, the earliest one over thirty years ago, with Mr. Harry W. Jones, a prominent Minneapolis architect, as instructor. All these attempts were short lived and never reached the dignity of anything more than an elective in the civil engineering course. In 1913, however, a separate department was organized, and Professor F. M. Mann, a former Minnesotan, was induced to come here from the University of Illinois, to take charge, with Mr. Lewis B. Walton as assistant. The first year there were thirty-two freshmen and twelve sophomores, the latter composed of engineering and academic students who had been studying architecture as far as they were able. The department flourished at a surprising rate and in 1916 the first class to graduate received their diplomas, four in number. Since then the progress of the department has been slow but steady, and now has a faculty of eight, with nearly 150 students enrolled. Since its inception over 100 men have been graduated, while a far greater number have had two or three years' instruction, and it is to its influence, more than to any other one thing that the notable improvements in architecture in the last decade is due.

"Uncivilized"

An ancient ape, once on a time
Disliked exceedingly to climb,
And so he picked him out a tree
And said, "Now this belongs to me,
I have a hunch that monks are mutts,
And I can make them gather nuts
And bring the bulk of them to me
By claiming title to this tree."

He took a green leaf and a reed,
And wrote himself a title deed,
Proclaiming, pompously and slow;
"All monkeys by these presents know."
Next morning, when the monkeys came
To gather nuts, he made his claim;
"All monkeys climbing on this tree,
Must bring their gathered nuts to me,
Cracking the same on equal shares,
The meats are mine, the shells are theirs."

"By what right?" they cried amazed,
Thinking the ape was surely crazed.
"By this," he answered, "if you'll read
You'll find it is a title deed,
Made in precise and formal shape
And sworn before a fellow ape
Exactly on the legal plan
Used by the wondrous creature, man,
In London, Tokio, New York,
Glengarry, Kalamazoo and Cork.
Unless my deed is recognized,
It proves you quite uncivilized."

"But," said one monkey, "you'll agree
It was not you who made this tree."
"Nor," said the ape, serene and bland
"Does any owner make his land,
Yet it, and all of its hereditaments
Are his, and figure in the rents."

The puzzled monkeys sat about,
They could not make the question out.
Plainly, by precedent and law
The ape's procedure showed no flaw;
And yet, no matter what he said,
The stomach still denied the head.

Up spoke one sprightly monkey then,
"Monkeys are monkeys, men are men.
The ape should try his legal capers
On man, who may respect his papers.
We don't know deeds, we do know nuts,
And spite of 'ands' and 'ifs' and 'buts'
We know who gathers, and unmeats 'em
By monkey practice also eats 'em.

"So tell the ape and all his flunkeys
No man tricks can be played on monkeys."
Thus apes still climb to get their food
Since monkey minds are crass and crude
And monkeys, all so ill-advised,
Still eat their nuts uncivilized.

—EDMUND VANCE COOKE.

Our Latest Acquisition

(Continued from page 117)

lecture room. Each auditorium has an individual ventilating system.

Another feature, the only one like it in the country, is the switchboard control. This board will allow for a variable voltage from zero up to a maximum on any of the four circuits. One circuit is a 220 volt-20 ampere storage battery circuit; another is a 6,000 volt high tension storage battery circuit. Then there are 110 volt A. C. and 110 Volt D. C. circuits supplied by motor generators.

Each of the 30 research rooms will be equipped with a standard pier and two six-gang outlets, each containing six taps; one for high tension circuits, one for low tension, one for 110 volt alternating current, one for 110 volt direct current, compressed air, and gas.

Another feature will be a 6x8 foot shaft extending from the sub-basement to the roof which will be used in performing experiments requiring a great height.

The north end of the building will rest on the filled in area formerly occupied by the Northern Pacific tracks. The footings for the north end will be carried down about 24 feet to reach solid earth at the bottom of the old railroad cut. This will provide firm bearing and prevent an unequal settling of that part of the building.

Professor Erikson stated that as soon as enough money is available, two wings will be added to the building. These wings will house the department of astronomy. Each wing will support a revolving dome under which will be mounted the astronomical telescopes used for observing the stars.

NEWS FROM THE TECHNICAL CAMPUS

(Continued from page 113)

A. I. E. E. Awards Prize For Student Paper

In a recent competition, Henry R. Reed and G. F. Corcoran, both of the electrical engineering department, were awarded the A. I. E. E. student prize for their paper on "Oscillographic Analysis of Current Flow in Squirrel Cage Windings." This prize was the only one available in this competition which speaks well for the excellence of the paper.

The American Institute of Electrical Engineers awards four prizes each year as follows:

1. The Best Paper Prize
2. First Paper Prize
3. Best Regional Paper Prize
4. Best Branch Paper Prize

(a) The "Best Paper Prize" shall be awarded the author or authors of the best original paper presented at any meeting of the Institute.

(b) The "First Paper Prize" shall be awarded the author or authors of the most worthy paper presented at any meeting of the Institute, provided the author or authors have never previously presented a paper before the Institute.

(c) The "Best Regional Paper Prize" shall be awarded the author or authors of the best paper presented at any regional or sectional meeting of the Institute.

(d) The "Best Branch Paper Prize" shall be awarded the student author or authors of the best paper presented at a branch or other student meeting of the Institute.

The fundamental consideration in the award of the national prizes is the quality of the contribution made for the advancement of Electrical Engineering.

All papers submitted for prizes must be written by members of the Institute, or at least one of the authors shall be a member of the Institute.

The author of the "Best Paper" shall receive a gold medal and $100 in cash, also a certificate of merit; the author of each of the other papers shall receive a cash prize of $100 and a certificate of award; at the discretion of the committee on award of the Institute prizes, any prize awarded may be omitted in any year in which at least three papers are not submitted in competition for the prize. Also at the discretion of this committee, a single paper may be awarded more than one of the prizes available and honorable mention may be made of papers which do not receive awards.

A paper taking first prize in a district organization may be submitted to the national headquarters and entered for competition for one of the national prizes.

Jansky Goes on Leave; Sweet Takes Over Radio Work

Mr. C. M. Jansky, assistant professor of electrical engineering at the University of Minnesota, has been granted sabattical leave for the winter quarter of 1927.

His radio class work has been taken over by Mr. R. R. Sweet, Chief Engineer of W C C O, the Gold Medal broadcasting station located at Anoka.

Mr. Sweet is a graduate of Minnesota, class of 1921. He was with the General Electric company at the time this company built station W G Y, and was very active in the construction of this station.

Mr. Sweet planned and supervised the installation of station W L A G, which was the first large broadcasting station in the Northwest. When this station was torn down to make way for W C C O he planned and supervised the construction and opening of this station.

Mr. Sweet's ability in radio matters is well known and there is no doubt that the work in the radio department will run as smoothly under his guidance as it has done under that of Professor Jansky.

Engineers' Bookstore Gives $1,000 Loan Fund to University

For the benefit of engineering students who are in need of money to put them through school, the Engineers' Bookstore has established a loan fund which will be administered to the students under the direction of Edward E. Nicholson, dean of student affairs, although students of other colleges may make use of the fund if circumstances permit.

The fund which amounts to $1,000 is the result of the action taken by the Board of Directors of the Engineers' Bookstore, and the manager, Harold Smith. The proposition was offered to the University at the meeting of the Board of Regents on Dec. 14, and was accepted by them. The loan fund is an outgrowth of a trust fund of $700 which was placed aside in 1923, and which was later made into a loan fund for engineering students. The loan fund under this arrangement, however, was directly in the hands of the Bookstore, and since they had no means of qualifying students, it was decided to increase the fund and place it in the hands of the University authorities.

Pictures by Radio

(*Continued from page 107*)

gether until at gray the length of dots and spaces between them are equal. As the picture goes more and more toward the dark the dots become dashes of longer and longer duration until finally, at black, the transmitter is making one long solid dash. As the photoradio mechanism traverses back and forth across the film these variations will act to produce at the receiver a faithful reproduction of the original picture, which will have very much the same appearance as the usual half-tone prints produced in newspapers and magazines.

The electrical interpretation of the picture is then transmitted over land wires from the RCA offices at 28 Geary Street, San Francisco, to the highpower radio telegraph transmitting station located at Bolinas, California. Here the picture pulses operate small relays which in turn control the 200 KW Alexanderson high-frequency alternator energy fed to the antenna. The signals are received at Kokohead, on the Island of Oahu in the Hawaiian archipelago, and sent at audio frequency over telephone lines twenty miles to the RCA city office at 923 Fort Street, Honolulu, where they operate the photoradio receiver. The photoradio system has purposely been developed to operate in connection with the established radio transmitting stations, now engaged in sending radiograms daily between the United States and other continents. Thus the new device does not require the preparation of any special radio circuits for efficient operation.

The audio frequency signal as received at the Honolulu city office from Kokohead is fed through an audio frequency amplifier and rectifier and thence to a special vacuum tube push-pull device which controls a very sensitive highspeed magnetic relay. The armature of this relay is supplied with plus 220-v to neutral for the time when the transmitter is signalling, and is supplied with minus 220-v to neutral when the transmitter is spacing. This armature is then connected through a limiting circuit to the moving coil on the photoradio receiver. This coil is mounted in a very strong D. C. field and the changing polarity of current through the coil, as supplied from the relay, causes it to move up or down in this field. The action is similar to the reproducing element of a Radiola No. 104 Loudspeaker.

The moving coil is mechanically con- nected to one end of a very light leve arm, the other end of which carries a small pen point fashioned like a drafts man's pen. This pen, through the move ments of the coil, is caused to draw a line on a roll of paper when the trans mitter is signalling, and leave a space when the transmitter is not signalling The pen instead of using ink, as would be expected, uses parafine wax colored a deep red. This wax is fed from a well, where it is kept molten by a smal heater coil, to the pen point, by a wick so that the wax is very hot right to the tip of the pen. When it touches the paper, the cold surface hardens it im mediately, so that it has no chance either to clog and not write, or to blot, as does ordinary ink.

The coil, heater and pen are all mounted on a mechanism quite similar to that on the photoradio transmitter. This mechanism moves the pen system back and forth across the surface of the roll of paper at exactly the same time and exactly the same speed as the movement at the transmitter. It is this move

ment, or rather the synchronizing of this receiver movement with that of the transmitter, which is the problem most difficult of accomplishment. The solution now in use is comparatively simple.

The mechanism mentioned is driven by a fractional horsepower D. C. motor, the shaft of which carries a special commutator. The commutator works in conjunction with contacts mounted on an electrically driven tuning fork, in such a manner that the field current of the motor is increased or decreased depending upon whether the motor is tending to run faster or slower than the tuning fork. This keeps the motor at exactly the same speed as the fork which is constant in speed to within one-half of 1 per cent. But even this accuracy in speed is nowhere near enough, so a very accurate master clock is caused, through a vacuum tube relay device, to correct the speed of the fork every second so that the fork will vibrate at thirty-five cycles per second. Each of the photoradio installations has one of these clocks to regulte the speed of all the equipment in that installation. The clocks throughout the system are checked daily by the standard naval time signals and the rates of all the clocks in the system are within a quarter second daily. This insures that the speed of all the driving motors in the entire sytem will be accurate to within 1/1000 of 1 per cent.

The effect of keeping the speeds the same is, that as the pen travels back and forth across the paper it will always put the same shading in the same part of the picture whether the pen travels in one direction or the other. If this were not the case the shading would be staggered in pen strokes in opposite directions, and if the staggering were too great the picture would become blurred beyond recognition.

The art of sending pictures and facsimile copies from one continent to another across great oceans has taken a long leap since that banquet in January 1923, when Mr. Young first predicted photoradio. From past accomplishment then, it is safe to predict—nay, even to promise—that within a similar span of time photoradiograms will have made for themselves just as important a place in the business of foreign commerce as the radiogram holds today. Even now enough commercial photoradio work has been done to prove to many business men the real need that such system fills for them in a very satisfactory manner.

"The Religion of an Electrical Engineer"

(Continued from page 105)

attribute which is further confirmed by his works and acts. The germination and growth of plants after the burial and partial decay of the seeds, the renewal of vegetable life every spring after the apparent cessation of activity in the fall, the revival of many forms of animal life after a winter of hibernation, the renewal of mental and vital activities after a night of sound sleep, all these familiar cycles in nature point toward a revival after the more profound sleep of death. Again, the apparent indestructibility of matter and of energy points toward a similar indestructibility of the human mind and character."

As previously stated, the believer in a Supreme Architect of the universe, whom we consider our Heavenly Father, must have some means by which intercommunication can be accomplished. The present known medium is prayer, which has been used with satisfaction from the earliest Biblical times. Analogous to prayer, radio communication may be cited. In both cases, there must be a power station as well as a receiving station, and in order to get results, a proper 'tuning in' is necessary. In the radio we have a receiver, in prayer—our conscience. A lack of harmony in any case renders our efforts futile.

In the appeal of religion to the masses, all sorts of conditions of human life and thought must be satisfied if it is to form a sound basis for Christian living and some extracts from Professor Shepardson's volume will furnish food for thought along these lines.

"In a sense, every open-minded student is an agnostic, recognizing like Newton that he has been playing along the shore, interested in a few stones or shell, while the great ocean of truth lay before him mostly unknown. If he becomes overwhelmed with partial realization of the vastness of what is still unknown, and humbly recognizes his own relative impotence, he may, like many before him, experience the truth of the adage that 'man's extremity is God's opportunity,' and may begin to acquire personal knowledge of Divine help. The honest and persistent seeker for God and for truth will find help coming in ways he may not expect or fully understand. There is hope for the agnostic who is sincere and open-minded. None are so blind as those who will not see, and one convinced against his will is of the same opinion still."

In his summation, the author says: "Religion appeals to the man of science and to the engineer; by challenging his incomplete knowledge, by widening his vision; by adding a personality to the otherwise purposeless nature about him; by adding and by pointing out his part in the great system of the universe; by offering him guidance to higher activities and greater usefulness; by adding meaning and dignity to human life; by giving him something that satisfies his innermost self; by opening visions of a larger life beyond the grave, free from the limitations of this part of life; by offering him conscious sonship and even partnership with the Infinite Ruler of the universe."

Thus ended the book, and thus was a great life ended, for the author passed into the Great Beyond shortly after the completion of this manuscript. What finis would have been more appropriate, more heroic, more fitting?

The volume makes a strong appeal to all classes of people in its direct yet simple presentation of en engineer's religion. To the student, the book is especially valuable, since it gives him food for deep thought. Read it, therefore with an open mind and get from it what you can.

The Sophomore-Junior Smoker

(Continued from page 118)

develop his social side as well as his technical leanings.

Shaut, the former Northwest Amateur Lightweight Champion, and Dodge, the University R. O. T. C. welterweight champion, gave a good demonstration of real boxing.

After the usual refreshments had been served, the most novel part of the evening began. It was announced that the person who could give the best impromptu entertainment would receive two pounds of candy. Everybody took a hand in this part of the program an Joe Blackshaw finally brought down th house with one of those good ol "Scotch" stories. From then on every body wanted to tell his favorite jok The contest ended in time, but th judges could come to no decision so th candy was passed out to the crowd.

The arrangements for the smok were taken care of by the respecti class presidents, Leon Mears of t sophomore class, and Herbert Hathaw of the Junior class.

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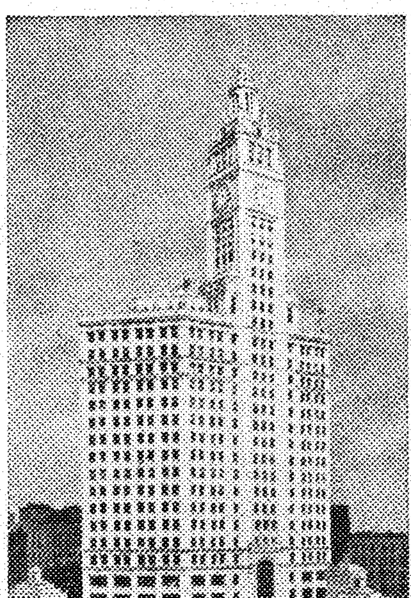

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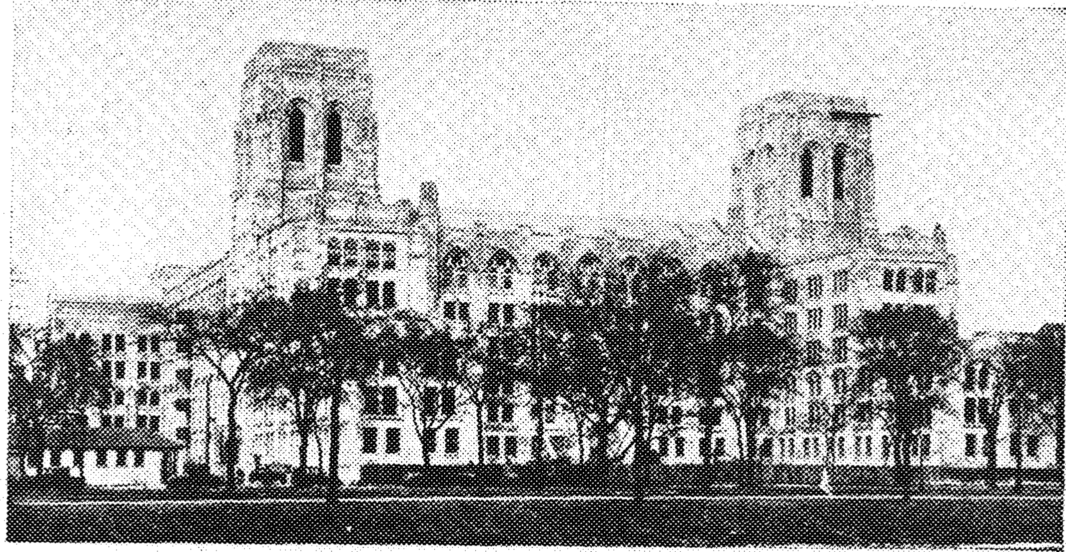

Saving Lives and Sparing Lives in Modern Hospitals

MEDICAL SCIENCE not only aims to save lives, but to institute economies in hospital operation whereby lives are spared for more vital work than running an elevator.

Nothing could be more ghastly than to have a patient, on his way to the operating room, stuck in an elevator between floors. Modern hospital authorities are particular in selecting elevator equipment of the safest and most trustworthy manufacture.

The latest development of Otis Collective Automatic Control permits of the use of automatic push button elevators in the highest class and size of hospitals, where heretofore the automatic type was limited to low buildings where the elevator service was infrequent.

Collective Control is so arranged that the elevator automatically answers all the calls in the direction in which it is traveling, and does not require any operator. It also stops on any trip at all floors for which a button in the car has been pressed, the older system of control necessitating the elevator answering only one call at a time.

It is significant that the Medical Buildings of the University of Chicago, pictured above, as well as the St. Luke's Hospitals in Chicago and Cleveland are installing Otis Collective Control Push Button Elevators, representing the last word in hospital elevator operation.

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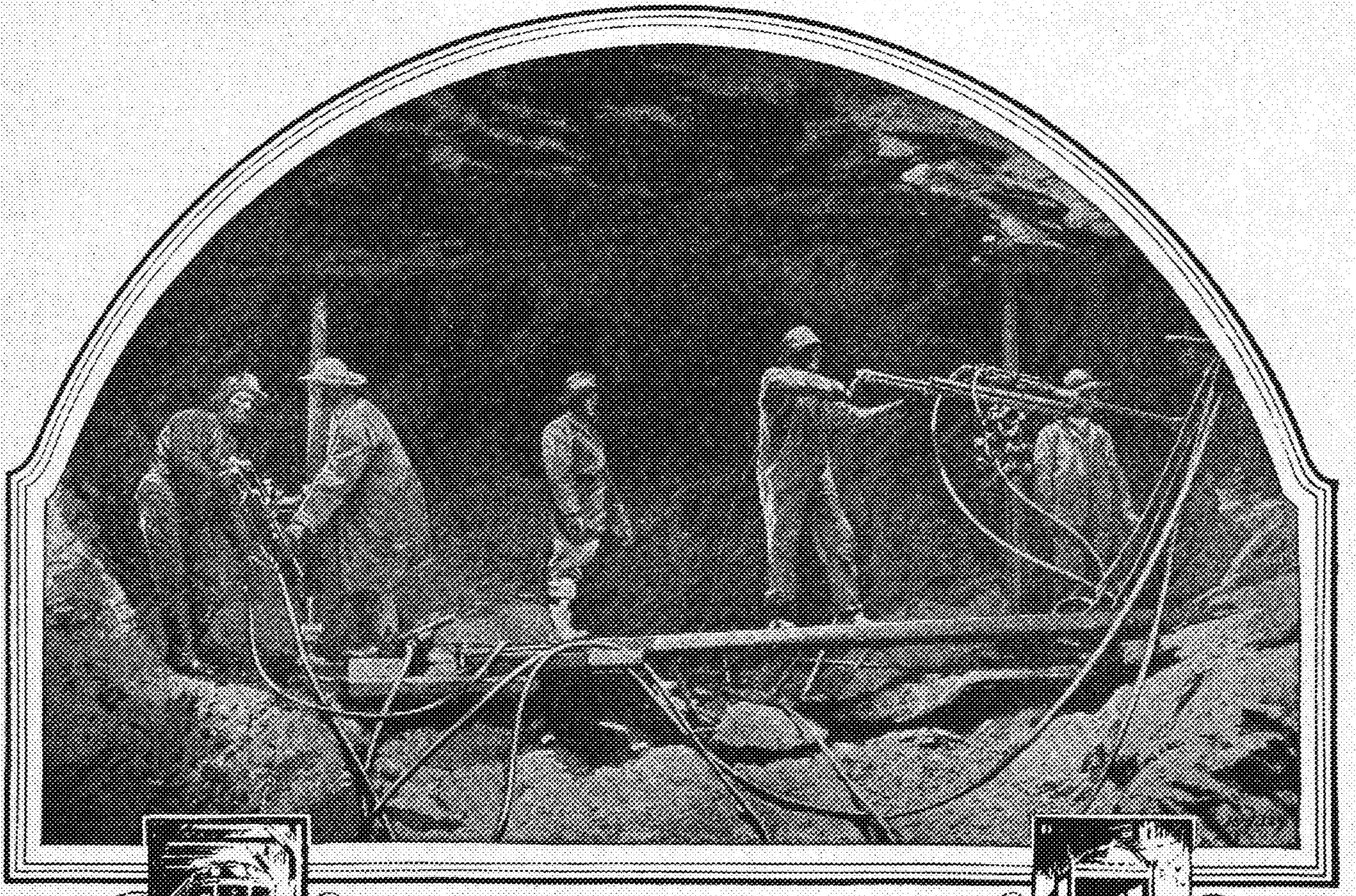

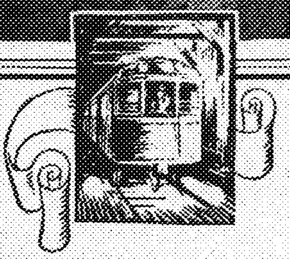

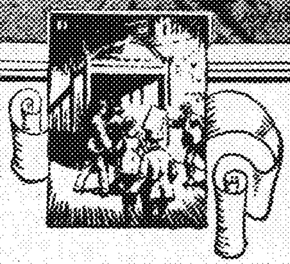

Ingersoll-Rand Rock Drills are used extensively in the New York subway work

New York~

The World's Greatest Mining Camp

ENGINEERING construction work has made New York City a great mining camp in which thousands of workers are busy tunnelling or excavating its rocky base. Miles of new subway tunnels and hundreds of foundation excavations, often to a depth of five or six stories, involve the removal of vast quantities of solid rock. In these great engineering developments Ingersoll-Rand compressed air machinery has played a most significant part. In fact, the cost of many famous projects would have been prohibitive without the use of air-operated devices.

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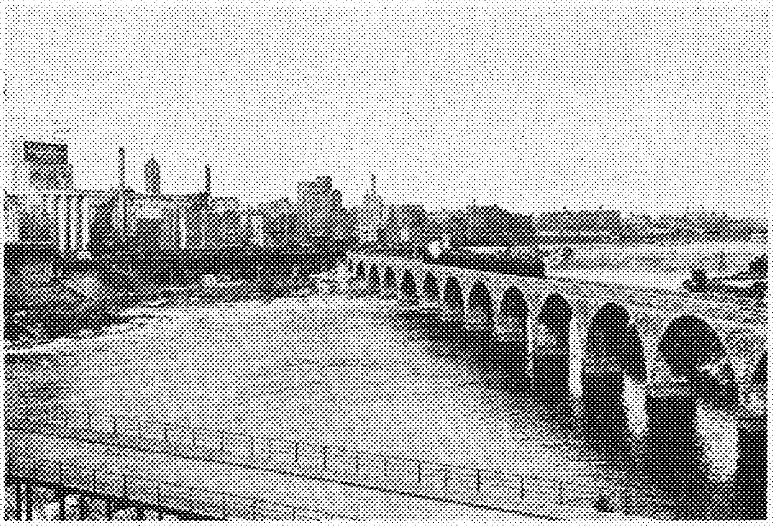

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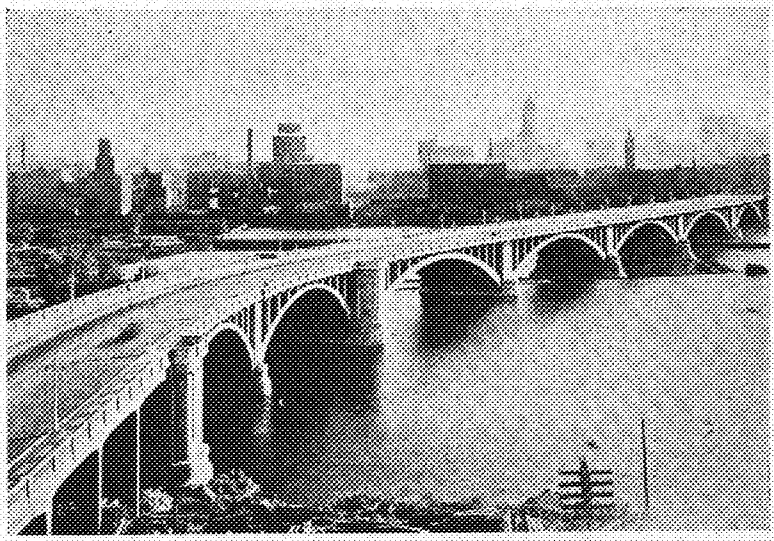

THIRD AVENUE BRIDGE, MINNEAPOLIS

The MINNESOTA TECHNO-LOG

University of Minnesota

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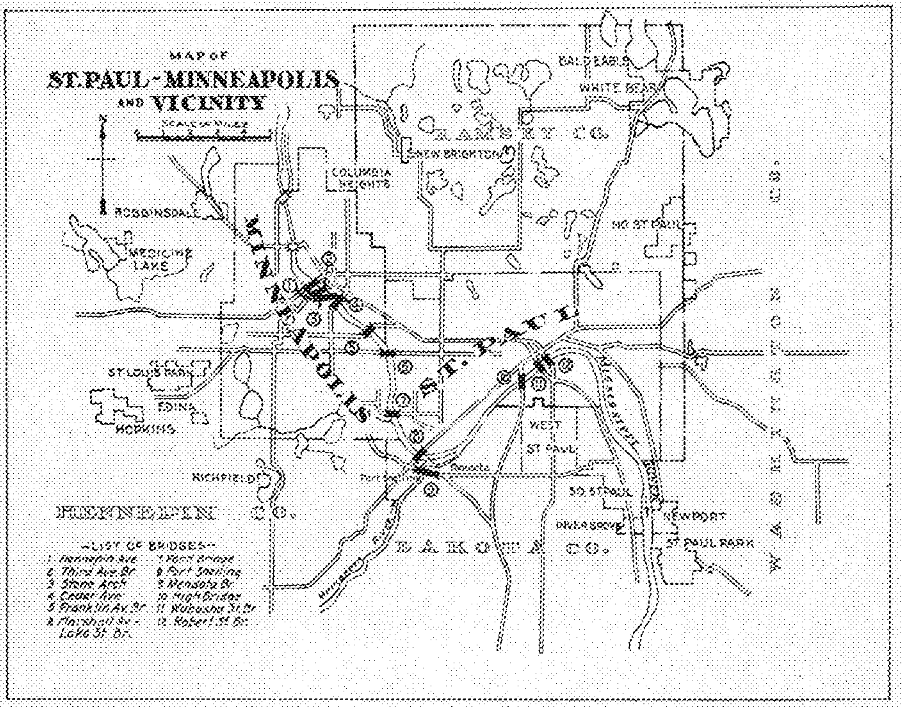
Twin City Bridge Construction

No other area of like size approaches Minneapolis and St. Paul in variety of design of reinforced concrete spans

By GEORGE M. SHEPARD, C '09
City Engineer,
St. Paul, Minnesota

THE history of bridge construction in St. Paul and Minneapolis and vicinity gives in a striking manner the various steps in the development of the art of bridge design and construction. With the saw mills at St. Anthony Falls and the Mississippi River forming the outlet for the lumbering activities of the state it is not surprising that the earlier bridges were constructed largely of wood. The earliest means of transportation across the river was by ferry. Following this we have the early type of wood truss and suspension bridge with wooden towers. Then came the wrought iron truss, some examples of light cantilever construction, and the steel truss and arch. At the present time reinforced concrete is used almost entirely for the highway bridges on account of its adaptability to pleasing design and low maintenance costs. Nature has perhaps nowhere provided a more beautiful setting for an arch bridge than in the Mississippi River valley between Fort Snelling and St. Anthony Falls.



The location of these two cities adjacent to each other and traversed by the Mississippi River from the northern boundary of Minneapolis to the southern boundary of St. Paul made necessary the construction of many bridges. The Marshall Avenue-Lake Street bridge was the first inter-city bridge to be constructed, this being financed jointly by the two cities. These original bridges accommodated team and vehicle traffic, together with street car traffic in some cases, all of which was very light as compared with present day standards.

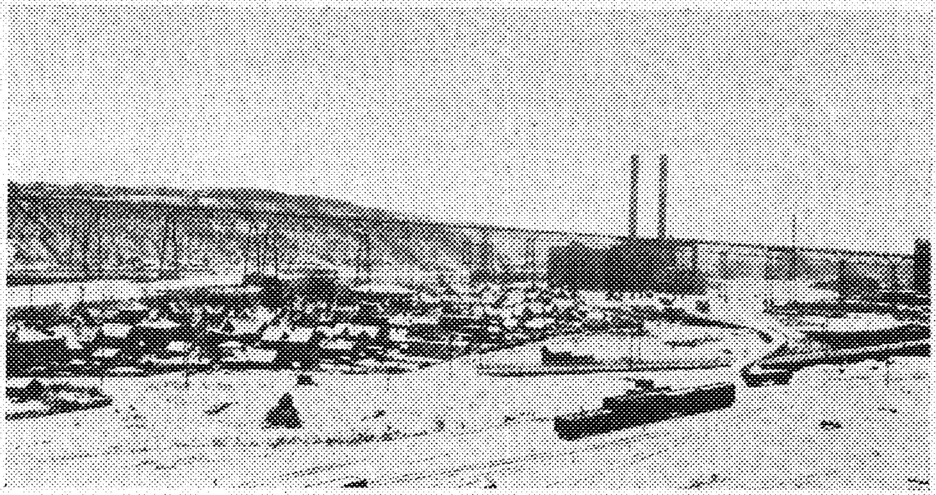
The coming of the automobile and truck has revolutionized the requirements of bridge design. Bridges must now be designed for greater concentrated loading together with a greater width to take care of the traffic. Many of the important state highways converge into these cities, placing a burden of incoming and outgoing traffic upon the bridges which was not dreamed of twenty-five years ago. The strictly technical features of the design and construction of the more recent bridges has been thoroughly covered in technical articles in the current engineering magazines and consequently I will not attempt to touch on these items. On account of the limited scope of this paper no attempt will be made to describe the various railway bridges in this vicinity, except for a few words about one of the historic railway bridges of the Northwest.

In going over the records of early bridge construction one is impressed with the construction activity during the decade between 1880 and 1890. During this period the first Fort Snelling bridge, the first Robert Street, the Hennepin Avenue steel arch, Stone Arch, Washington Avenue and Marshall Avenue-Lake Street bridges, together with the High Bridge and reconstruction of the Wabasha Street bridge were completed. For construction activity this period compares well with the present period beginning in 1920 in which the Cappelen, Robert Street, Mendota, Ford and Cedar Avenue bridges have been or will be completed.

Wabasha Street Bridge

In 1850, a year after the organization of the territorial government of Minnesota and incorporation of St. Paul as a town, the Ramsey County Board of Commissioners gave authority for the operation of a ferry across the Mississippi River at the lower landing between Robert Street and Jackson Street. The population of St. Paul at this time was 2,197 and that of the entire territory of Minnesota was 4,780. The first bridge across the Upper Mississippi was constructed at what is now Wabasha Street slightly above the location of the ferry. This bridge, known as the St. Paul bridge, was built in 1857-58, being erected and financed by a private concern, the St. Paul Bridge company, the structure being authorized by the legislature under an act passed March 4, 1854. The bridge was operated as a toll bridge by the bridge company until 1867 when it was taken over by the municipality who continued the toll system until 1874, this system being discontinued and the bridge made free at that time.

This bridge consisted of one 100 foot span, one 240 foot span, seven 140 foot spans and one 50 foot span and about 320 feet of pile trestle, all of the spans being Howe trusses of wooden construction except for the 240 foot channel span which was a combination of timber and iron. This structure has since been rebuilt as it stands today with a 280 foot cantilever steel span across the main river channel. The bridge is now 1204 feet long, and is constructed on a 5 per cent grade with a roadway width of 33 feet, carrying double track street railway.



HIGH BRIDGE, ST. PAUL

Hennepin Avenue Bridge

The first bridge across the river on East Hennepin Avenue from the west shore to Nicollet Island was constructed in about 1860 as a suspension bridge with wooden towers. On account of the weakness of these wooden towers the bridge was rebuilt in 1878 using stone towers. At the same time as this reconstruction work, a stone arch bridge of five spans was built from Nicollet Island to the east side, this bridge still being in use. The second suspension bridge was replaced in 1888-1890 by the present steel arch bridge. This bridge was designed by the late Mr. F. W. Cappelen, then bridge engineer for the City of Minneapolis, and Mr. Andrew Rinker, city engineer. The total length of this bridge is 544 feet with two steel arch spans 258 feet in length. The roadway is 56 feet in width with 12 foot sidewalks on each side. Each of the arch spans have six ribs, three of which are three hinged and three two hinged. The pavement of the bridge is creosote blocks on concrete supported by a buckle plate floor. The total cost was $266,375.00.

Stone Arch Bridge

The stone arch bridge crossing the Mississippi River just below St. Anthony Falls was constructed by the Minneapolis Union Railway company, now a portion of the Great Northern Railway company, in 1882-1883, under the direction of Colonel C. C. Smith, chief engineer at that time. The bridge crosses the river on a tangent with a curve at each end. This structure is to the best of my knowledge the only all masonry bridge crossing the Mississippi River at any point on its entire length and is now and will be increasingly so in the future one of the historic bridges in this vicinity. It is 2100 feet long and has 16 semi-circular arches of 80 foot span and 7 segmental arches of from 40 to 98 foot spans. It was built throughout of masonry with granite for the piers and limestone for the arches and spandrel walls. The approximate original cost was $750,000.00. The entire bridge was reinforced and water-proofed in 1907 and 1908 at which time the spandrel walls were tied together with long steel rods. This work was done during traffic with one track out of commission. The arches are all regular barrel arches, the distance from side to side of parapet walls being 27 feet. The distance center to center of tracks is the same as when the bridge was originally constructed, that is, 12 feet, this distance being slightly increased in the curves.

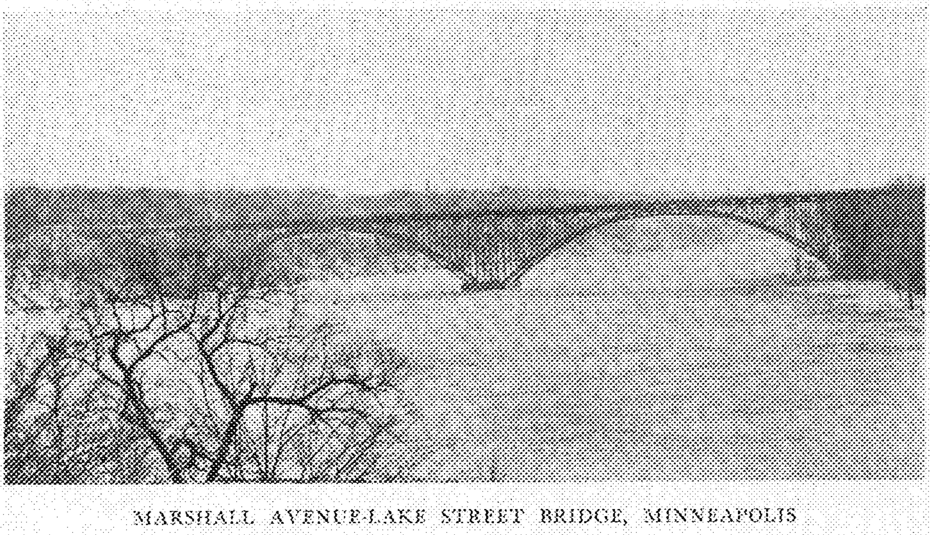
Fort Snelling Bridge

The original bridge across the Mississippi River between Fort Snelling and St. Paul was constructed in 1880. There were considerably greater military activities in this vicinity in those days than there are now, the headquarters of the Northwestern department being in St. Paul and a garrison of considerable proportions being at Fort Snelling. This bridge was constructed by the United States government for the purpose of facilitating traffic between the Fort and the city. On account of the light construction and the narrow roadway of the old bridge, it was replaced in 1909 in a location a short distance below that of the old bridge and just above the mouth of the Minnesota River by a new bridge with two steel arches of 364 foot spans each, which was financed and constructed jointly by the United States government, the City of St. Paul and the Street Railway Company. The roadway is 35 feet wide and is 100 feet above water level. The present bridge was designed by W. S. Hewett and constructed by Hewett and Bayne of Minneapolis.

Marshall Avenue-Lake Street Bridge

The Marshall Avenue-Lake Street bridge was built jointly by the City of St. Paul and City of Minneapolis in 1888 and consisted of two braced steel arch spans each 456 feet in length. For the purpose of carrying a street car line this bridge was reinforced and widened in 1906 by the addition of a third center arch located half way between the two old ribs. By this method the 18 foot roadway was increased to 33 feet and two outside sidewalks made possible. The new design was worked out largely by Professor F. H. Constant, then professor of struc-

(*Continued on page 160*)



MARSHALL AVENUE-LAKE STREET BRIDGE, MINNEAPOLIS

Gasoline and Oil-Electric Transportation

Many advantages of the electrically operated engine over the steam locomotive are proven by service; buses are also well adapted to gas-electric drive

By GEORGE B. CUMMING
Assistant Manager, Minneapolis Office, General Electric Company.

THE scope of my subject is limited to the use of electric power and the attendant apparatus, as a substitution for mechanical transmission or direct drive on various types of transportation equipment. In every case this equipment includes its own prime mover and is, therefore, independent of any external generating station.

Transportation equipment now in common use, using electric drive rather than direct drive or mechanical transmission between the prime mover and the load, comprises the following:

- Gasoline-electric buses
- Gasoline-electric rail cars
- Oil-electric rail cars
- Oil-electric locomotives
- Gasoline-electric locomotives
- Oil-electric tug and towboats, and
- Steam-turbine-electric boats of various description from ferry boats to boats of the size of the United States battleships.

Historical

The first use of gas-electric drive in this country was in 1904 when a single deck bus was built for experimental use on Fifth Avenue. The use of the electric drive was advocated in England as early as 1903 and today there are in England approximately 1300 electric-driven buses, of which 460 operate on the streets of London.

About 1905 the first gasoline-electric cars in this country were manufactured. Typical of this design are those cars which continue to operate out of Minneapolis on the Minneapolis, Northfield and Southern Railroad and the Minnesota Western Railroad. About two years ago a car weighing 35 tons of greatly improved design was put on the market and the railroads running out of the Twin Cities have purchased a number of these units.

More recently the Canadian National Railway has placed in operation several passenger cars having electric drive and using an oil-engine originally designed for airplane service. In the meantime various adaptations of the gasoline-electric equipment for use in locomotives have been tried. During the past two years, a number of locomotives, primarily for switching service and weighing either 60 or 100 tons, using oil-electric drive, have been placed in service on the various railroads in this country.

With the development of the smaller-powered, higher speed Diesel engines for marine use, electric drive has been used successfully on tugboats, ferry boats and even freighters, having oil engines as prime movers. Possibly some of you have seen the oil-electric freighters of the Minnesota Atlantic Transportation company, which ply out of the port of Duluth.

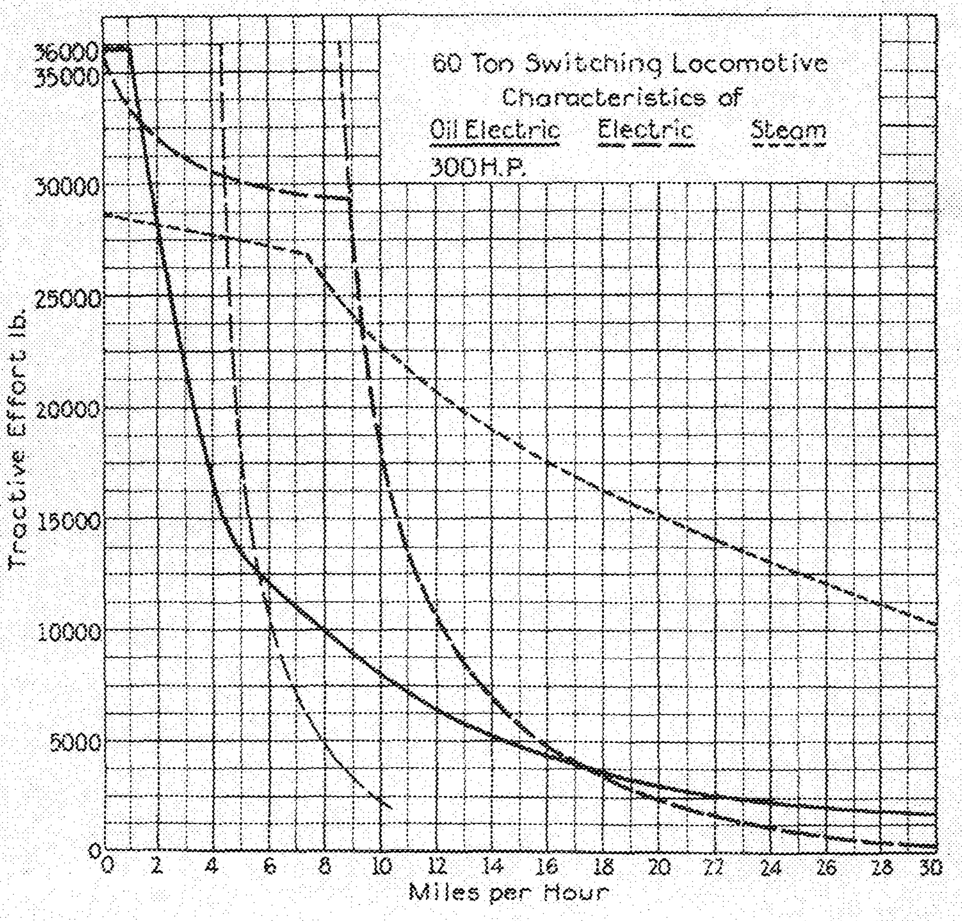
Gasoline-Electric Rail Cars

The development of a light-weight, high-speed efficient rail car which does not require a full train crew, as a substitute for the branch line and short run steam trains requiring a full train crew and all appurtenances, is the result of the needs of the steam railroad to meet various types of competition. The first equipment offered to meet this competition consisted of a combination passenger and baggage coach, having mounted directly on the front truck a gas-engine with mechanical transmission of the power to the truck. Reverse movement and change of speed was obtained by a gear shift.

The advantages of the rail car over a local train drawn by a steam locomotive are that it does not require a full crew to operate it; it can operate over a much longer schedule and during a greater proportion of the time than a steam locomotive, with very little inspection and with no drawing of fires. It is not necessary to provide expensive facilities such as water tanks, coal bunkers or ash pits with their attendant equipment.

The advantages of the gas-electric car as against the gasoline car with mechanical drive are primarily flexibility, efficiency and low maintenance. The flexibility of control is a characteristic feature of electric drive. The engine does not require a reverse gear, reverse movement being accomplished by reversing the electrical connections. The gas engine may be designed for the most economical maximum speed since the speed of the car is independent of the engine speed. The torque characteristics of electric motors are such that there is no appreciable shock to the engine equipment during starting and accelerating. This is important with cars of the weight required for this service.

The maintenance of the mechanical transmission on cars of this weight has been much higher than the maintenance on gas-electric cars. Because of the fact that the engine in the gas-electric car



EDITOR'S NOTE: *This paper was read before the St. Paul Engineers' Club on January 31, 1927.*

GREAT NORTHERN RAILWAY 100-TON OIL-ELECTRIC LOCOMOTIVE
The power plant comprises two 300 h. p. engines with General Electric generators as shown below. Four motors are geared to the driving axles.

operates within a very limited speed range, it is possible to attain very high economy on the engine. This, of course, is not the case with any rail car using a mechanical transmission, where for each gear ratio the speed of the engine varies directly with the speed of the car.

The equipment on the first gas-electric cars gave the operator complete control of practically every operation of the power plant and motive power equipment, and it was so arranged that the operator had to control the various functions. This necessitated the training of skilled operators usually recruited from the steam engine men assigned to the division.

In comparison the cars now being produced are designed to simplify the work of the operator in every possible way. The engine is started from a battery like the ordinary automobile engine. The advancement and retardation of the spark is taken care of automatically. The voltage and current control of the generator are inherent in its design and that of its exciter, and the engineer's duties are confined to the manipulation of the controller and starting switch at starting or to change from the series to the parallel connection, and the operation of the throttle. He must also handle the usual standard air brakes.

A brief description of the equipment and electrical circuits of a typical gas-electric car may be of interest.

The generating unit consits of a gas engine with a direct-current generator and exciter mounted on the same shaft. The exciter is separately excited from a 32-volt storage battery. The exciter field circuit is automatically closed by a switch which closes when the gasoline throttle is moved from the "off" position. The voltage is, therefore, applied automatically to the exciter and through it to the main generator. Voltage is thus applied and removed from the main generator at the will of the operator by manipulation of the gas throttle, but without any attention from him.

The function of the exciter thus includes:

1. Furnishing current to the field of the main generator.
2. Charging the storage battery.

The generator is equipped with a commutating field and the exciter with a differential series field which gives a drooping characteristic suitable for the duties of this type of equipment. The air compressor is connected directly across the terminals of the main generator and its operation is governed by the usual type of air compressor governor.

To start the car the engineer first moves the main controller handle to the first running position. He then opens the throttle, thus applying voltage to the main generator and raising the engine from idling to operating speed. When the car has accelerated to approximately 10 miles per hour with this motor connection, the engineer then moves the controller to the parallel or second running position and if a higher speed is required, to the reduced field or third running position on the controller. When he wishes to stop the car he simply returns the throttle to its "off" position. The controller handle can be returned to its "off" position at any time the operator desires before again starting the car. Should it be desired to charge the air tanks the main controller handle can be moved back of the "off" position, thus providing generator voltage for the compressor without applying it to the traction motors. In addition to these operating positions the controller has also a reverse cylinder which controls the direction of movement of the car.

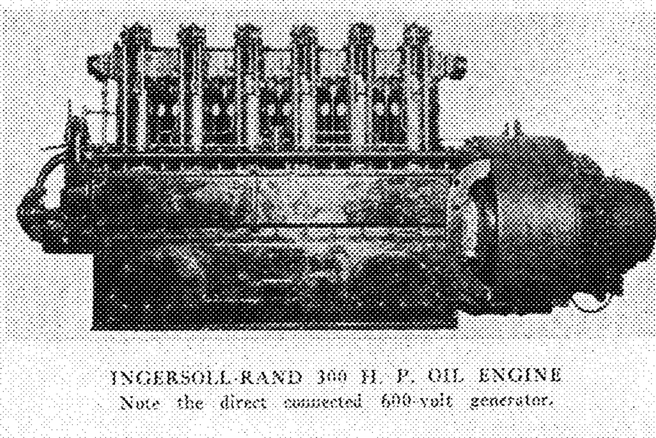
The engine which is being most commonly used on these cars at present is of a special design for this work and its characteristics particularly suited to use on the gas-electric car. By use of a special carburetor equipment this engine is being adapted to the use of distillate, a grade of fuel oil which can be purchased for approximately one-third the price of gasoline.

The modern gas-electric cars are being built in several sizes, the one in most common use being the 40-ton car with a 200-h. p. engine generator set and two 100-h. p. motors. Another equipment has also been designed with an engine of approximately 275-h. p. for heavier cars. A third design is obtained by using two of the standard gas-engine sets with four motors. The variety of equipment is such, therefore, that with suitable combinations of the standard units, cars can be built to operate on grade sections or for handling one or more trailers as may be required. This gas-electric equipment has been used to some extent on locomotives, but so far only a few units are in operation.

Maintenance and Inspection of Gas-Electric Cars

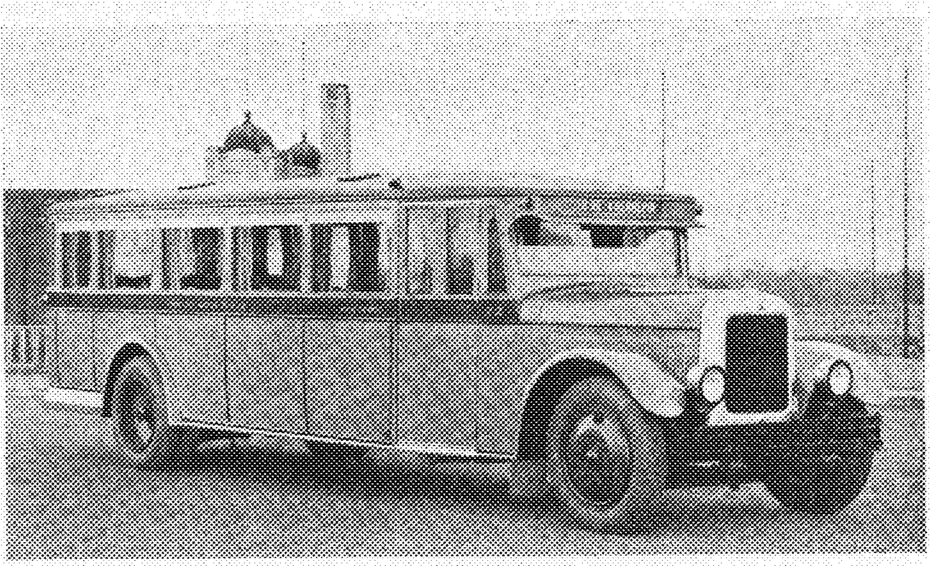
The gas-electric car is so radically different from the steam locomotive that different methods of maintenance and inspection must be employed. There are very few electrical men available for maintenance work on these cars and so far this work is being done by railroad mechanics such as shop machinists or roundhouse men. On a few roads this problem has been carefully studied and a system of inspection and maintenance worked out to insure proper care of the equipment. There is no question but that the service records of these cars will be dependent, to a large extent, on proper maintenance.

A number of these cars have now been



INGERSOLL-RAND 300 H. P. OIL ENGINE
Note the direct connected 600-volt generator.

in service for quite an appreciable period and figures available on the cost of operation approximate from 32 to 43 cents per train-mile. These figures include fuel, train crew, maintenance and an allowance for interest and depreciation. This figure compares with a general average for steam operation with locomotive and trailing coaches from approximately \$0.80 to \$1.20 per train-mile. A short time ago figures were compiled showing that 41 of these gas-electric cars are making an average mileage in daily service of more than 6,000 miles per month per car. More than half these cars are operating on main line runs. Twenty-seven of them are hauling standard coaches weighing as high as 42 tons. The average runs are making as high as 25 to 40 miles per hour, schedule speed. As far as availability for service is concerned, experience over a long period of years has definitely shown that the gas-electric car is far superior to any other type of motive power.



A GASOLINE-ELECTRIC BUS OPERATING IN MINNEAPOLIS
This is one of the eight buses now in service on the Nicollet Avenue line. It uses a 90 h. p., 6-cylinder engine with a 25 kw. generator.

Oil Electric Locomotives

Since October, 1925, the General Electric company has supplied nine 60-ton oil-electric locomotives and two 100-ton units using similar equipment. All of these are now operating in switching service so that no operating experience is available as to their adaptability to main line work. There are now under construction two locomotives, one a 750-h. p. unit for freight service and the other an 880-h. p. unit for passenger service, both to be used on the Putnam division of the New York Central Railroad.

This type of locomotive has several advantages over the steam locomotive, particularly for switching and industrial service. Points of advantage which may briefly be enumerated are as follows:

1. Saving in fuel variously estimated from 5 to 1 upwards based on present experience in switching service.
2. Greatly increased availability.
3. An appreciable reduction in maintenance.

In addition to these major points the oil-electric locomotive is also preferable on account of the elimination of smoke and the large reduction in facilities required.

Economies

When coal is burned to produce steam in a locomotive, approximately 6 per cent of the heat is recovered. The same percentage is recovered when oil is burned to produce steam, but when oil is used to operate an internal combustion engine as in the oil-electric locomotive, about 25 per cent of its heat is recovered. This represents an increase of more than 300 per cent in fuel efficiency. Coupled with this increase of efficiency is the smaller quantity of fuel required. A 60-ton oil-electric locomotive uses an average of approximately .43 of one pound of fuel oil per brake horsepower hour. The average fuel, lubrication and water bill for this locomotive is 38 cents per locomotive hour. The fuel cost with locomotives of previous type and similar size is from three to six times as high. The same proportion holds true with locomotives of 100 tons or any other size.

We feel on the average, therefore, that it is safe to say that the oil-electric locomotives can divide the power cost by four; in other words, produce a saving of 75 per cent of the money paid out for fuel.

Since 1900, locomotive shop equipment has multiplied many times in cost. New equipment for the maintenance of locomotives is constantly required in order that maintenance may be efficient. It is estimated that the average road with about 3000 miles of track must spend in the neighborhood of approximately \$100,000 yearly to provide this equipment.

The use of an oil-electric locomotive greatly simplifies the work of maintenance because there are few parts to repair, and the parts are much smaller and less expensive to handle. With 80 per cent availability, one oil-electric locomotive can usually replace two steam locomotives for the same class of service. Certain figures would indicate that it costs approximately \$4000 to \$12,000 a year to maintain a steam locomotive, while a 60-ton oil-electric locomotive can be and has been maintained at a yearly expense of less than \$3000.

One of the first oil-electric locomotices to be tried out in the Middle West was that supplied early this year the Chicago & Northwestern Railway for their Chicago yards. After a careful trial it was found that this 60-ton unit could replace two steam switching locomotives. The railway company, therefore, placed an order for a duplicate unit to supplant the other two steam locomotives operating in the same district. This application is of particular importance on account of the agitation in Chicago for the elimination of smoke and cinders from steam locomotives. The exhaust from the oil engine is no more objectionable than that of the automobile truck.

The use of a 100-ton oil-electric locomotive by the Red River Lumber company brings out the fact that in heavily timbered regions it is possible to eliminate the hazard from fires caused by locomotive sparks. Incidentally, this company found a remarkable saving in fuel upon making a very careful test between the steam and the oil-electric locomotives. The fuel consumption records showed that for a similar duty cycle the oil burning steam engine used 1370 gallons of oil fuel, while the oil-electric required only 180 gallons of the same fuel. Another feature of the design of the oil-electric is the absence of reciprocating parts which tends to reduce the expense of upkeep on the roadbed and in this respect the oil-electric has practically the same characteristics as the straight electric locomotive.

From the characteristic curve of the oil-electric locomotive, it will be seen that at starting and low speeds this type of motive power resembles the straight electric locomotive in that it is able to slip the wheels or at least to produce a tractive effort equivalent to 30 per cent coefficient of adhesion. Due to the fact that the horsepower of the locomotive is limited by that of the engine, the tractive effort must necessarily diminish with an increase in speed.

Engine

The oil engine most commonly used

(*Continued on page 152*)

A Survey of the Spectrum of Radiant Energy

Photochemistry, the science dealing with effects of absorbed radiation, reveals wonders of electronic bombardment throughout entire range of the spectral region.

By BERNARD LEWIS, Ph. D.
National Research Fellow,
University of Minnesota.

FEW people stop to consider the great part played by radiation, not only in the lives of human beings, animals, and plants, but also in the very things that are about us at all times. Our early progenitors were sun-worshipers at some period or other in their development. Scientific investigation has shown and is showing that these instincts of sun-worshiping were well founded. In fact, that the sun is the source of all our material wealth, our power, and our life, has been very slow in penetrating our consciousness.

Whatever has been the urge which prompted the explorer into lands unknown, the chemist and physicist to seek out the materials of which matter is made, and the biologist to attempt to understand the nature of living things, it has resulted in a better and more precise knowledge of the world we inhabit. One thing we have learned is that the exercise of foresight pays, and that the scientist is able to view the present on the basis of the past, and is ever gaining in the power of prediction.

It is the physicist who in recent times has made great strides in studies concerning the constitution of the atom. He has pointed out that the atom can no longer be considered an elementary substance; that the electron and proton are elementary and are the basis of all matter. Successful achievements have resulted from his endeavors and today we stand on the threshold of a remarkable world. If we but stop to reflect, we will find that nearly all the benefits which contribute toward a more varied life are direct results of scientific discovery of the last fifty years. The physicist has stirred the chemist, the biologist, and scientists in all other branches. Every engineer is coming to realize more and more how much a knowledge of the atom, and an understanding of the effects produced by atoms, means to the future of engineering.

There is a group of scientists who are attempting to bridge the gap between radiation and its effect on matter. These photochemists, as they are generally called, are endeavoring to apply recently discovered physical phenomena to studies with chemical substances. For instance, it is one thing to know that electrons exist, that they may be obtained in several different ways, and that they are accelerated by electric fields and deflected by magnetic fields. It is still another thing to know what interaction, if any, occurs between two appropriately selected chemical substances if one of them is submitted to electronic bombardment. Very remarkable changes may occur.

Bernard Lewis, Ph. D. (Cantab.), took his undergraduate work at the Massachusetts Institute of Technology. After obtaining his degree, he did graduate work at Harvard and Cambridge Universities. Dr. Lewis spent two years in the laboratories of Cambridge University, after which he devoted some time to visiting physical and chemical laboratories in several European countries where he had the good fortune to be able to discuss many problems in connection with his investigations with several well-known scientists.

Dr. Lewis holds a national Research Fellowship and is at present conducting investigations in photochemistry at the University of Minnesota.

Witness the beautiful effects produced not only on chemical substances but also on organic matter by impacts with high speed electrons in the recently developed Coolidge tube; quartz, lime, and other materials when placed in the path of the electron stream glow with a bright visual fluorescence for hours afterwards. We have a good picture of what is happening.

Every system has a central core or nucleus about which electrons revolve. The number of these electrons depends more or less upon the material. If one of these outer electrons should receive a shock sufficient to force it out of its normal position with respect to the nucleus, it will take up some new position of greater energy content corresponding to the magnitude of the shock it has received. (Assume that the latter has been insufficient to remove the electron completely from the material to which it belongs.) This new position is abnormal and unstable and so in the course of time, if the material has not encountered other matter with which it can react as a result of being so highly energized, this electron will return to its normal position. In doing so it must rid itself of this extra energy. This it does by emitting monochromatic light of a characteristic color and frequency, the latter depending upon how far the electron moves from the abnormal to its normal position.

This is exactly what does happen when certain substances are placed in the path of high speed electrons issuing from a Coolidge tube, the shock being supplied by the electrons. To show how precise is our conception of what is happening, very interesting experiments can be carried out which serve to confirm the theory. The fluorescent substance may be cooled to a very low temperature by means of liquid air. The electron in the abnormal position or orbit is now frozen out and is thus unable to return. Fluorescence is arrested or nearly so, but reappears when the substance is allowed to warm up to room temperature.

These high speed electrons may effect a variety of phenomena, such as to disintegrate organic matter, and render substances highly reactive which are ordinarily quite inert. Such phenomena are not confined to electrons alone, for alpha particles, which are charged helium atoms and are emitted by radio-active elements, produce similar and other effects. Furthermore radiation, that which we ordinarily distinguish as light, and also that which is invisible both in the ultra-violet and infra-red, is capable of rendering systems very reactive, stimulated by its presence, so to speak. Photochemists, taking the lead offered by the quantum theory, which conceives radiation as consisting of small bundles of energy or quanta, are engaged in unraveling the mysterious influence which quanta have on chemical substances and subsequent reactions which proceed only as a result of this stimulation. Not only is he concerned with the final effect of radiation on matter but he also wishes to analyze and determine if possible the process or mechanism whereby the change from the initial to the final state takes place.

The first requisite which radiation must possess in order to have any effect on chemical substances is that the latter must absorb the former. In order to determine what wave length of radiation to employ in his studies he must know what part of the spectral region is absorbed by the substance in which he is interested. This having been ascertained, frequently he desires to know the quantity of radiation which is absorbed by a given amount of substance. He has at his command methods for measuring what fraction of the incident radiation is finally transmitted and what is retained and from this is afforded a means, with a knowledge of the absolute quantity of energy contained in the spectral region employed, of knowing how effective an absorbed quantum of radiation is in causing chemical change. He need only measure, finally, the extent of the reaction being studied.

It is of importance to be familiar with the approximate wave length limits of the several spectral regions of radiant energy. This is given below in the order of increasing wave lengths. Wave lengths are expressed in milli-microns or 1/1,000,000 of a millimeter, and microns, or 1/1000 of a millimeter.

	Wave Length Milli-Microns
Ultra-violet radiation	0 to 390
Extreme region	0 to 200
These include gamma rays, Röntgen rays, etc.	
Middle region	200 to 300
Near region	300 to 390
Visible Radiation	390 to 770
Violet	390 to 430
Blue	430 to 470
Blue-green	470 to 500
Green	500 to 530
Yellow-green	530 to 560
Yellow	560 to 590
Orange	590 to 620
Red	620 to 770
	Microns
Infra-red radiation	0.77 to infinity
Near region	0.77 to 20
Infra-red photography up to	1
Fluorite prism to	10
Rock salt prism to	20
Intermediate region	20 to 500
Selective reflection from rock salt to	50
Selective reflection from KCl to	61
"Reststrahlen" method up to	354
Electric oscillator method up to	500
Extreme region	500 to infinity

Electric waves such as that radiant energy studied by Hertz, that used in wireless electric circuits, that resulting from high frequency currents, and that due to ordinary alternating currents complete a long range of wave lengths to beyond 12 kilometers in wave length.

In order to obtain some idea of the magnitude of a quantum let us select a portion of the visible spectrum, say the red. One of the elementary red quanta contains an average of 2.8×10^{-12} ergs of energy or very nearly three trillionths the amount of energy associated with a force of one dyne acting through one centimeter. The dyne is a force, which, acting for one second on a gram weight, produces a velocity of one centimeter per second in the gram weight. Furthermore this same red light has a frequency of vibration of about 3×10^{14} per second. Again, if sufficient quanta are absorbed corresponding to the number of molecules in a gram molecular weight of substance, about 40,000 calories of energy enrich the absorbing medium.

The practical lower and upper limits of the visible spectrum from the standpoint of the eye are 400 and 700 millimicrons. It must be remembered that the eye is not analytical but synthetic. A blue may appear blue but actually a spectroscope may show it to have a red band. Yellow may not be yellow but may consist only of red and green.

On considering the spectrum of radiant energy as a whole and the various properties of the radiation of various spectral ranges it is seen that visible radiation is merely that of a certain range of wave-lengths or frequencies. Silver chloride is affected by a certain range of frequencies corresponding to ultra-violet and violet. Each of the various photographic emulsions "sees" a certain range of wave-lengths. One chemical process responds to certain waves and others to different ones. Thus viewed as a whole, a great many "eyes" exist varying in sensibility to radiant energy of different ranges of wavelength.

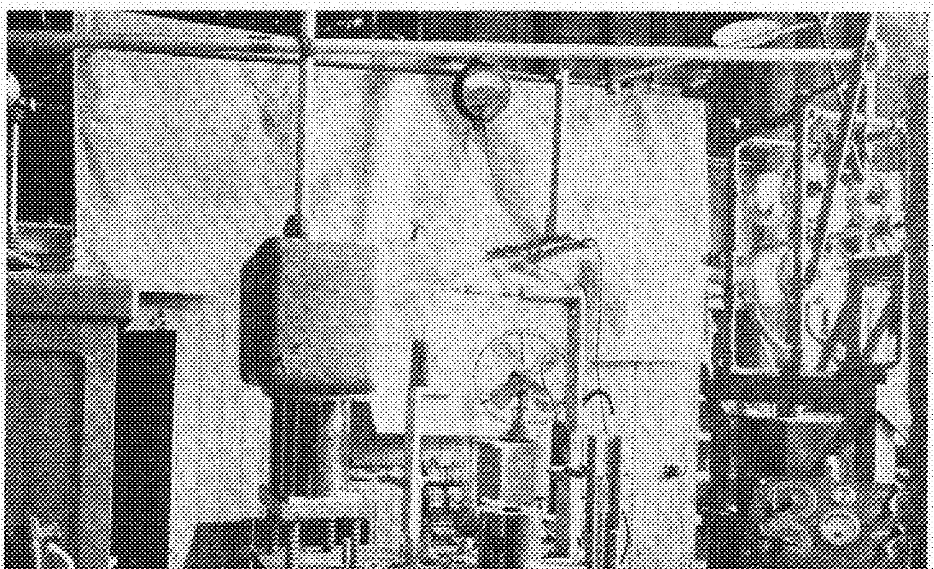
It is not the aim to present a detailed and chronological account of the development of the science of photochemistry. In order that the reader may better appraise the status of our knowledge at the present time, one or two facts may be noted. Ten years after Newton described his decomposition of sunlight into its component colors by means of the prism and discovered the variation of refrangibility with the hue, Römer, the Danish astronomer, discovered that light travelled at a finite velocity. It is remarkable that his determination of this velocity differed only by about three per cent from the value generally accepted today. Huygens enunciated the wave theory of light in 1678. In 1777 Scheele noted the effect of violet rays on silver chloride, namely the release of chlorine and the precipitation of metallic silver. The ultra-violet region escaped his attention. Both this region and the infrared were discovered simultaneously. W. Herschel found the latter in 1801 and Ritter the former in his studies on the decomposition of silver chloride.

In the years immediately following, several discoveries were made pertaining to the effect of visible, invisible, and ultra-violet radiation upon silver salts. Cruickshank in 1801 noted the effects of light on chlorine and hydrogen. Such phenomena as the bleaching of dyes and the decomposition of water by chlorine in sunlight had already become known. A few years later Grotthus enunciated his photochemical absorption law; namely, that only the rays absorbed are effective in producing chemical change.

Discoveries of a photochemical nature followed very rapidly in the early part of the nineteenth century, such as those which Chevreul described in 1873 on the bleaching of vegetable colors. Scheele, Ritter, and others were pioneers in the development of photography, though it remained for Niepce and Daguerre to produce the first practicable process about 1830. Many researches were conducted by E. Becquerel on the effect of various wave-lengths on silver salts. Thousands of researches have developed photography to such a point where it is today perhaps the best tool in all spectrographic work.

Maxwell in about 1868 enunciated the electromagnetic theory of radiation and predicted the existence of electric waves which Hertz verified in 1888. An un-

(Continued on page 162)

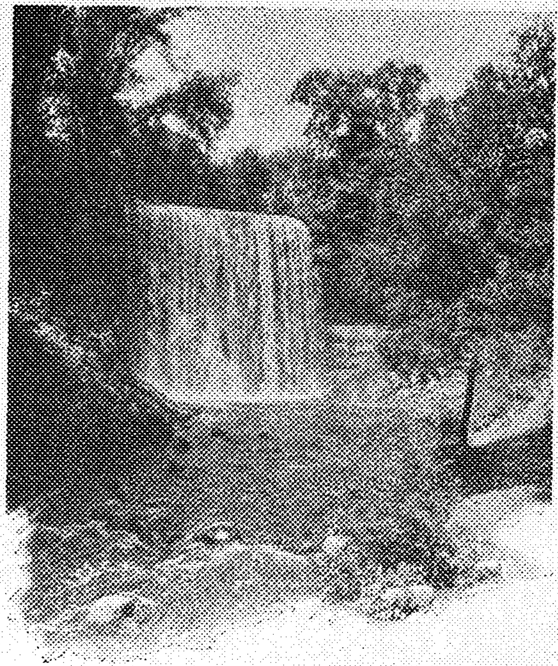


—*Courtesy Science Service, Inc.*

THE NEW COOLIDGE CATHODE RAY TUBE

The tube is in the center with electrical setup at the sides. The cathode is at the left of the tube and stream of electrons are shot out at the right.

Thus departed Hiawatha
To the land of the Dakotahs,
To the land of handsome women;
Striding over moor and meadow,
Through interminable forest,
Through uninterrupted silence.
With his moccasins of magic,
At each stride a mile he measured:



Yet the way seemed long before him,
And his heart outran his footsteps,
And he journeyed without resting,
Till he heard the cataract's thunder,
Heard the Falls of Minnehaha,
Calling to him through the silence.
"Pleasant is the sound!" he murmured,
"Pleasant is the voice that calls me!"

Engineers *and* Mother Nature *Join Hands*

By Paul B. Nelson, E '26
Department of Journalism,
University of Minnesota

MINNESOTA, state of the North Star, is proud of its gophers, ten thousand lakes and abundant iron ore. It prides itself in such personages as Andrew Volstead of Granite Falls, the Mayos of Rochester, and Sinclair Lewis from Sauk Center, home of the original Main Street.

Equally famous is a small waterfalls, Minnehaha by name, which flows from Lake Minnetonka into the Mississippi, Father of Waters, near the City of Minneapolis.

From the earliest times, it has been the attraction of the countryside. This it was "whose roar Father Hennpein heard from the distance." It is not known when the name "Minnehaha" was given, for the Indians called all of their falls "hahas" or laughing water. At one time, it was Little Falls and later Brown's Falls in honor of Joseph Renshaw Brown, who has the distinction of being called Minnesota's pioneer. In 1840, Mrs. Mary Eastman used the name "Minnehaha" in her book, "Life and Legends of the Sioux." However, it was Longfellow, in 1855, who made it and Minnesota famous by his poem, "Hiawatha" which was inspired by a daguerrotype of the falls given him by his friend, George Sumner.

As time went on, the springs that fed the Falls gradually dried up and the stream, like the redmen who named it, grew less and less. The laughter of the waters sank lower and lower for they had no heart for merriment. On the bank, the statue of Hiawatha, carrying his bride across the torrent — Hiawatha whose story had been made classic by Longfellow—stood waiting for the return of the lost brook.

"Ah," cried the city fathers recently, "our Falls must not dry up. We must preserve its beauty for posterity."

As is usual in the case of serious problems, the officials called upon the city engineer. The park board engineering staff made preliminary surveys and soon a solution was ready to present.

An artificial lake was to be created. A powerful pump, driven by an electric motor, would fill this reservoir, drawing the water from a deep well. And then, from this lake, would flow the stream to hurl itself over the rocky ledge below.

The council had several overtime sessions. Certain members could see no use in spending money to pump water, only to let it flow away again. Then it was pointed out that the rejuvenated waterfalls would pay for itself by the increase in tourist trade. There's some sense about this proposition now, said the contrary members, and suitable appropriation was made.

Plans called for a well, 731 ft. deep, 400 ft. of which was drilled through solid rock. This well, 12 in. in diameter, was lined with casing for 261 ft. where it went through a porous rock ledge near the surface. A pump house was built at the outlet of the well at an elevation of 5 ft. above the old creek bed. This contains a screw pump, driven by a 30 h. p. electric motor. Water is pumped at a rate of 1000 gallons per minute.

A concrete dam is to be built above the falls, thus forming a 4,000,000-gal. reservoir which will be constantly filled. The output of the pump may be turned into this reservoir at night and enough water stored up to keep a normal stream flowing during the day. Or, in times of drought, the reservoir's surplus from the rainy season can be turned into the channel, thus maintaining the stream and the waterfall. It is planned to use the resevoir as a skating rink in winter time.

The cost of the entire installation was nearly $12,000. Drilling of the well cost $7.50 a lineal foot. The cost of operation for a seven-month period is $1800.00 on the basis of 12 hours pumping per day.

Many Minnesota engineers, employed in the engineering department of the City of Minneapolis, played a prominent part in this project. R. Louis Bevan, '24C, and Leslie L. Halladay, '21C, are both with the Board of Park Commissioners. Others in the Engineering Department are Verne F. Curtis, '22M, Julian Garzon, '24C, John A. Jensen, '05C, Melvin S. Olsen, '08C, Frederick T. Paul, '09 C. Nels W. Elsberg, '09C, is the city engineer. Theodore Wirth is superintendent of the Park Board and B. L. Kingsley is president. C. F. Goslen designed the dam.

Early last year, men started digging on the spot where years before stood tepees of the Dakotahs.

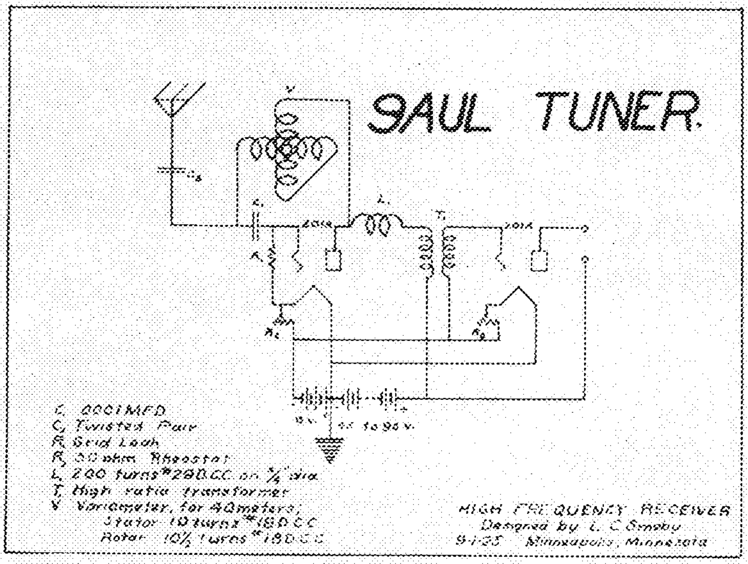
Last November, while the council members watched, the president of the Park Board pushed an electric switch in the red brick pump house. The motor started. Soon, a steady flow of water accompanied the steady beat of the pump. The thirsty stream quickened and became a miniature torrent. Down the shale bed it rushed. Then, from below came the sound of splashing water.

(Continued on page 158)

An Efficient High Frenquency Receiver

By Lynne C. Smeby, E' 28

THE short wave tuner at *Radio* 9 A U L was developed with two definite purposes in mind. First, the set must be of such construction that the cost would be within the means of everyone who might care to build it. The set, including a one step amplifier, can be built for about four dollars ($4.00). Second, the set must be simple as to circuit so that it can easily be understood by a novice in the art. A glance at the schematic diagram will convince the reader at once as to the simplicity of the electric circuit.



Of course the set would be useless unless it worked efficiently, and brought in at least a fair percentage of the stations brought in by the larger sets. It seems that this purpose has been successfully accomplished. This simple piece of apparatus has successfully brought in many foreign stations both from across the Atlantic and from South America. Perhaps the most interesting piece of reception accomplished with this set was the interception of both sides of a conversation between a French and a New Zealand amateur.

The construction of the set is very simple and requires little explanation since the photographs show the details very clearly. All parts of the set except a good mica grid condenser and a metallized filament grid leak can be purchased at the five and ten cent store.

The set is built on a wooden frame. The base board is 9½ by 11¾ by ⅝ inches in size, the long dimension being the length across the front. The rear support for the variometer is 3 by 6½ by ⅝ inches in size. The size of the front support is 6 by 9 by ⅝ inches. All wood about the set must be given a good coat of shellac to prevent absorption of moisture which would interfere with the efficient operation of the set. In this case three coats were applied to insure proper results.

A space wound variometer is used as a tuning element. Two strips of bakelite 3/16 by ¾ by 3⅜ inches are used as the support for the stator. The strips are bolted together, and holes for 8/32 bolts are drilled and tapped in each end. Hard wood will do very well as the material for the shaft. The bearings are old switches which may be purchased for a few cents if there are none lying around in the junk box. In selecting these switches be sure that there is very little clearance between the bolts and the bearings.

The stator coil is wound on a 3⅝-inch form, each coil having five turns of number eighteen double cotton covered wire. The rotor coil is wound on a three inch form. First wind on five turns, leave a ⅜-inch space and then wind on five more turns. The wire is the same size as that used in the stator. These coils must all be wound in the same direction. All coils are supported by strips of celluloid held in place by collodion. In winding the coils a cardboard tube of the proper diameter is cut lengthwise in three pieces; the three pieces are then pasted together with a piece of paper on the inside. The proper number of turns should now be wound on this form, after which four small strips of celluloid cut from an old automobile window curtain are slipped under the winding. Collodion is now applied to the winding at the points of support. After the collodion is dry the cardboard form can easily be collapsed and the coil removed in completed form.

This type of coil construction leaves a minimum amount of dielectric in the magnetic field of the coil, thus improving the efficiency of the coil. Coils of the kind described will tune to the American band of forty meters and will also include the fringes of the foreign bands on either side.

L_1 in the diagram is a radio frequency choke made by winding 200 turns of number 29 D. D. C. wire on a piece of broomstick. Touching the end of the choke farthest from the tube produces no noticeable effect, thus showing that the choke is effective.

C_1 is a good mica condenser of .0001 mfd. capacity. Its accompanying grid leak can be from one to three megohms. Do not solder on to the leak or condenser. The grid leak should preferably be of the metallized filament type.

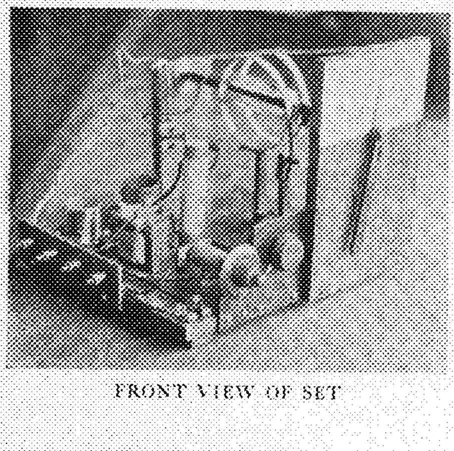
C_2 is the antenna condenser and is formed by a twisted pair of insulated wires as is clearly shown, in the rear of the set, by the photographs. This twisted pair should be at least twelve inches long.

T_1 is a high ratio transformer. These transformers are useless for broadcast reception but are very efficient for the reception of high frequency code signals. Poor transformers have a high peak where the signal is attenuated the least. The best note can be adjusted to this peak and thus better signals can be obtained than by taking a note at random.

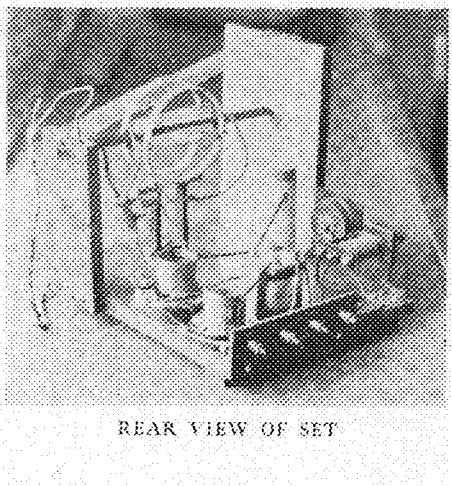
A glance at the front view of the panel shows the tuning control. The handle may be either of wood or bakelite of convenient dimensions. The pointer is a strip of aluminum. The scale is drawn on a strip of paper which is pasted on the front of the panel.

The celluloid strip running across the top of the coils and the two uprights are for the purpose of steadying the coils. The bottom of the stator coils are held in position by means of binding posts mounted on bakelite strips. The connections to the rotor are of flexible wire.

(*Continued on page 158*)



FRONT VIEW OF SET



REAR VIEW OF SET

NEWS FROM THE TECHNICAL CAMPUS

Shepard Speaks to Student Chapter of A. S. C. E.

George M. Shepard, City Engineer of St. Paul and a graduate of Minnesota in the class of 1909, presented some interesting problems in sanitary engineering to the student branch of the A. S. C. E. at their February dinner meeting held in the Minnesota Union on February 3.

The problem that Mr. Shepard presented was that of securing some sort of a sewerage disposal plant to satisfy the ever-growing needs of the Twin Cities. He pointed our the fact that not enough water is flowing in the Mississippi River to take care of the sewerage that is being dumped into it by both cities. By comparing the river flow during the past few years with the flow of previous years he arrived at the conclusion that we are now experiencing a period of low stage which will very likely end within a few years but which is also very like to recure periodically. This low stage, together with the location of the high dam in the heart of the cities, has produced a septic condition just above the dam which is fast becoming a nuisance. To complete a disposal system would require about twelve years, Mr. Shepard pointed out, and by that time the population of the two cities will have increased to such a point that the river will positively not care for all the sewerage.

The method most likely to be adopted will be that of constructing a trunk sewer parallel to the river, which will collect all the sewerage now flowing into the river. This trunk sewer will lead to the disposal plant, located just below St. Paul at some convenient point.

After Mr. Shepard had completed his talk, the meeting was turned open to discussion.

These meetings are a great benefit to the students, especially to the juniors and seniors who are starting to interest themselves in these engineering problems. About fifty men attended this meeting.

Former Chemistry Instructor Conducts Research at California

Dr. Paul W. Sharp, a former student and instructor of biochemistry at the University of Minnesota, is now engaged in research on the rare blood ingredient oocytin, at the University of California. Dr. Sharp and Dr. Guy W. Clark, his collaborator, have announced experiments with oocytin, a complex organic substance which has the property of starting the development of unfertilized eggs. Oocytin was discovered by the late Dr. Jacques Loeb, a noted biochemist, in 1909.

In a paper published in the "Journal of Biological Chemistry," Dr. Sharp states that in their experiments they have actually produced living specimens of sea urchins by treating unfertilized eggs with a solution of one part of oocytin in 500,000 parts of sea water. While the process has been found successful with other organisms than the sea urchin, Dr. Sharp says that further experiments along that line will not be undertaken, but that efforts will be made to analyze the substance and to determine its exact composition.

Dinner and Smoker Given by Chemistry Group

Over 70 members of the Minnesota section of the American Chemical Society were present at a dinner and smoker given at the Campus Club on January 20. The meeting, which was the first meeting held by the local section for purely social purposes for the past several years, was characterized by the absence of scientific discussion. Music, humorous talks, and a skit given by members of the Biochemistry Club of the Farm Campus were the main features of the evening's program. It is the plan of the section to continue these social meetings in the future as long as the attendance warrants.

Austrian Scientist Addresses American Chemical Society

Dr. Fritz Paneth, professor of inorganic chemistry at the University of Berlin, gave two lectures under the auspices of the School of Chemistry and the Minnesota section of the American Chemical Society.

Dr. Paneth is an Austrian scientist of international note, and has the distinction of being the youngest man ever appointed a full professor of chemistry at the Berlin University. He has become distinguished as a specialist in the field of radio activity and has held many positions of importance in that branch of science.

Dr. Paneth's first lecture, *"The Use of the Radio Elements as Indicators"* was given at the 137th meeting of the Minnesota section of the American Chemical Society on February 9. He gave his second lecture, *"The Volatile Hydrides of the Chemical Elements,"* in the Chemistry Auditorium on Thursday afternoon, February 10, under the auspices of the School of Chemistry.

Engineering Students Attend Power Plant Symposium

After being driven to the High Bridge Station of the Northern States Power Company in automobiles and served with dinner by an outside caterer, accompanied with the music of the Northern States Orchestra, and banjo players, engineers were in fine mettle to take in the program offered by the Northern States Power Company at the power symposium which was given under the auspices of the American Society of Mechanical Engineers. The members of the American Institute of Electrical Engineers were especially invited, and all other students interested.

Following the banquet, a talk was given by Mr. J. A. Colvin, superintendent of generation of the Northern States Power Company, on the transmission of power about the Twin Cities through the loop of transmission lines. It was explained that the High Bridge Plant was a supplement to the other generating stations of the system, and that the hydroelectric plants bear the greater part of the load while the steam plants supply the necessary additional power, although they can carry a larger part of the full load in case of failure.

Professor C. F. Shoop, of the university, read a paper on the use of high temperatures and pressures in our modern stations. Steam stations now use 40,000 to 50,000 kw. in each machine and use temperatures up to 700 degrees Fahrenheit, while steam pressures run up to as much as 1200 pounds per square inch, he informed those present.

The tour of inspection which followed the speeches centered its interest on the huge turbine generators. The power plant contains an initial installation of 60,000 kw. According to the Northern States Power Company, simplicity, convenience of operation, and economy were the guiding factors in the design of the plant. Underfeed stokers, and evaporators to purify the water were used. Two 30,000 kw. units are used at present and a final generating capacity of 240,000 kw. is expected.

Harry Du Bois Elected Manager of 1927 Electrical Show

At a meeting of the senior class of electrical engineers, held Tuesday, February 1, Harry Du Bois was elected manager of the electrical show of 1927. The show is given every two years, and junior and sophomore assistants are elected to help with the work.

Glendon Brown was elected junior assistant manager of the electrical show at the junior class elections held Feb-

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AROUND THE WORLD WITH OUR ALUMNI

ARCHITECTS

'23—Olaf Fjelde is studying at Harvard for a Master's degree.

'24—Oswald Stageberg is instructor of architecture at Idaho University.

'25—Ted Prichard is assisting in architecture at Idaho University.

'26 AE—"Black" Rasey is now working for the Winston Brothers Company which has a contract to rebuild part of the Missouri Pacific Railway. According to a recent letter to Professor Zelner, he looks forward to a long and interesting job.

"I landed here in Gasconade, Missouri, about a week ago. I spent some time at Jefferson City and looked at what I believe is the finest state capitol I've ever seen.

"I'm down here now on the banks of the Missouri River and we are going to move our camp to Gasconade where there is about a year's work in excavating, filling, and grading to be done. We're rebuilding and relining the Missouri Pacific line between Jefferson City and St. Louis. I think there is about five years of work ahead of us altogether. The old line was built in 1864 and follows and winds in and out around the bluffs along the river and naturally needs relining, etc."

CHEMISTS

'05—Francis C. Frary is director of research of the Aluminum Corporation of America at New Kensington, Pa. J. D. Edwards, '12, is assistant director and Cyril Taylor, '13, is on the research division of the same company.

'05—Geo. L. Borrowman, consulting and analytical chemist at Chicago, recently won a decision against the Permutite Company of New York concerning priority in the use of green sand for water softening.

'07—J. O. Halvorson is head of nutrition investigation at the North Carolina Agriculture Experiment Station.

'15—G. Sterling Temple is with Roessler, Hasslacher Chemistry Company at Perth Amboy, N. J.

'20 CH. E.—Donald F. Mitchell recently severed his connection with the Pure Oil Company in order to accept a position in the control laboratories of the Northern States Power Company in Minneapolis.

'21—R. Fuson is an instructor while Stephen Darling, '22, is an assistant in Chemistry at Harvard.

'26—J. C. Tronson has been appointed assistant in the general inorganic division of the School of Chemistry. He was formerly a chemical engineer in the School of Mines.

CIVILS

'11—I. Kvitrud manages to keep busy these cold days. He is secretary and treasurer of the Reese Metal Weather Strip Company, Minneapolis.

'13—Ben Wilk is manager of the Standard Building Products Company of Detroit.

'14—Leonard E. Ott is superintendent with A. Guthrie and Company, contractors on construction of a 6,900 foot tunnel on the Illinois Central line at Ozark, Ill.

'21—E. H. Grochau is now superintendent of construction with the Hollodvy Company of Nashville, Tennessee.

'21—E. J. McCubrey is on a Minnesota highway project at Luverne, Minn.

'26—Lawrence Sandvig is doing some mighty interesting work with the U. S. Gypsum Company supervising the construction of poured Pyrofill and Structolite roofs. He just finished up two jobs in Cincinnati, Ohio, and is now going to Detroit, Mich., where he will be on a 400,000 sq. ft. job for the Dodge Motor Company.

'26—Homer Wanamaker evidently did not believe all that he heard about the Florida hurricane and went down to see for himself. He is now working for the Florida State Road Department and is living at Rockledge. We hope "Wanny" will forgive us for taking the liberty of passing on parts of a very welcome letter.

"I am now in a state crew of seven men and am rated as instrument man, a very humble position but a good place to begin. It is at least one good jump ahead of an inspector's job, both in salary and in work. The work is interesting and enjoyable and not nearly as hard as going to school even on our most strenuous days. I miss, however, the men at school, and only hope that I run into many of them as we all journey along the 'survey line.'

"So far I like Florida fine. It is like Minnesota in the summer right now,—plenty of mosquitos, loads of snakes, and all sorts of pests of various kinds, including 'Fords.' That is all the S. R. D. furnishes us to ride in, and I have an especially exasperating machine that makes me long for the good old broken-down 'Chevrolet' that Carl Liese, Ed Young, and I dragged around the Cass Lake camp.

"Tell the civils that they need not worry about work. There is loads of work going on everywhere. Hope some of you sign up in the South. They are doing mighty things in Oklahoma, Texas, and Alabama right now.

"Give my best to '27 and all in the civil department."

ELECTRICALS

'92—Edward P. Burch, consulting engineer, has been appointed receiver for the Minneapolis, Anoka and Cuyuna Range R. R. Co. and is now rehabilitating the road and developing its freight business.

'03—Barry Dibble left the United States Reclamation Bureau where he had charge of engineering work in November, 1924. Since then he has been living in Redlands, Cal., as consulting engineer. Mr. Dibble recently made an investigation of power development at Twin Falls, Idaho.

'03—L. A. Rosok for several years manager of the Bisbee Improvement Company, Bisbee, Ariz., reports that this company was recently sold to the General Power and Light Co. of Chicago. This company has bought several utilities in Arizona which have been incorporated into the Arizona Edison Co., a subsidiary of the parent company. Mr. Rosok was appointed manager of the Arizona Edison Co. in Bisbee, serving the community with electricity, gas and ice.

'07—A. R. Fairchild is district central station engineer at Huntington, W. Va., for the Westinghouse Electric Company.

'08—Alfred Bachrach has shown that not all engineers are "rolling stones." He is beginning his 19th year with the General Electric Company. Mr. Bachrach lives in Los Angeles.

'26—Paul B. Nelson, who was in New York during the summer and early fall as associate editor of THE ELECTRAGIST, an electrical trade paper, is now an assistant in the department of journalism at the University of Minnesota. Paul is busier now than he ever was as editor of the TECHNO-LOG, for in addition to his work in the school of journalism he is northwest representative for several trade and industrial publications, and is also manager of the University band. He is assistant editor of the SCHOLASTIC EDITOR, a publication devoted to the interests of school papers and magazines, and holds down the editorial chair of the ELECTRON, quarterly publication of Kappa Eta Kappa, professional electrical engineering fraternity.

MECHANICALS

'06—B. W. Loye is acting superintendent of the Detroit Insulated Wire Company, Detroit, Mich.

'17—F. W. Hvoslef is chief heating engineer for the Timken Detroit Company, Detroit, Mich.

'19—Archie J. Dowd has been transferred to the new factory of the Western Electric Company at Kearny, N. J.

IN the last few years, colleges and universities have been subject to much criticism because graduates have not made good. In former years the college graduate was looked upon as a man of affairs, and a review of the number of men mentioned in "Who's Who" proves that college educations form the foundations for the majority of successful men. In face of such information, colleges and universities cannot be said to be fundamentally wrong.

With the increasing popularity of a university education, and with the tremendous increase in the enrollments of institutions of higher learning, it is not to be doubted that the standard of the average graduate has fallen. This should not indicate, however, that universities are of no value, as Mr. Wells would persuade us to think in an article published in the Literary Digest. An excerpt from the article reads as follows:

"H. G. Wells looks forward to a time 'when Oxford and Cambridge, Yale and Harvard, will signify no more in the current intellectual life of the world than the Monastery of Mount Athos or the lamaseries of Tibet do now.' In fact, intimates Mr. Wells, the chief present use of our large colleges is to give the modern youth a chance to waste his time. People 'send their boys trustfully and hopefully to these overrated centers,' where the young men 'find themselves confronted with pleasant, easy-going, evasive young men up to nothing in particular, and schooled out of faith, passion or ambition.' He comments:

"'I think we must be prepared to cut out this three- or four-year holiday at Oxford or Cambridge, and their American compeers, from the lives of the young men we hope to see playing leading parts in the affairs of the world. It is too grave a loss of time at a crucial period; it establishes the defensive attitude too firmly in the face of the forcible needs of life.'"

His criticism nevertheless is not untrue. Many students of engineering come to school and seem to be "schooled out of faith, passion and ambition." A rather false pride is established, and when work in grime and dirt presents itself the college graduate is inclined to leave it to some one else. Mr. Thomas Street, writing for Power, says:

"During the past years of my work in the power-plant field I have from time to time had graduates in mechanical engineering assigned to me for a sort of post-graduate course, and I can recall only one that was willing to mix his technical knowledge with the dirt and grime of the engine room; all the others were averse to crawling into a boiler, getting down into a pump pit or doing any work that might soil their hands. It might have been that they thought it would lower their dignity a bit, and the one that did get dirty, I am glad to say, is making good, while the others have fallen by the wayside.

"I know that technical knowledge is valuable, but I maintain that it has to be thoroughly mixed with practical experience, and pretty well mixed, too. In my opinion the young man that wants to make good in engineering should get a job in some large power plant and work through it from A to Z, and at the same time study during his spare hours and keep his mouth shut, and eyes and ears open. If he will do this, any 'old timer' will be glad to show him and give him points on just what books and technical papers to get. If he does this, he will, in my opinion, be better equipped in three years than the college man is in four, or even eight."

Looking about the laboratories of the university, we find this attitude to be true. When men are running tests on motors in the electrical laboratory, or are testing engines in the experimental building, or perhaps are pounding iron in the forge shop, especially noticeable is the fact that some make no change to clothing which would permit a man really to get in, mess up his hands and clothes, and learn the subject without regarding his clothes too closely. A man can't get vitally interested in his subject unless he can wade into the work, and he can't wade in with a tailor-made suit, especially if his pocket book is thin.

A university man has long had the nickname of "white collar," and the egoism of some cannot be taken as sufficient reason for the overthrow of universities. The fundamentals of engineering are necessary to good engineering practice, and if one attempts to teach himself while working, he is not apt to grasp the broad fundamental principles of the subject in hand, but will rather delve into particulars, which will not give him understanding, even though he will gain details of operation. The particular arguments of Mr. Wells cannot be directed against the teaching of engineering, because engineering deals with specific details, and fundamentals which must be learned if a man is to be a successful engineer.

Learning the fundamentals before going into practical work saves a good deal of time, and provides the worker with an understanding of the underlying principles of machinery, which he would not otherwise have if he started work blindly as Mr. Street suggests. His mind is developed, and he is better equipped to tackle any problem.

One thing that graduates forget, however, is that the practical work is necessary. With a college education a man can can advance more rapidly, and that is its main value.

Through Campus and College

A Tribute to a Former Dean

AN editorial from the Yale Alumni Weekly of Oct. 8, 1926, shows with what high esteem Dean Frederick S. Jones, former dean of the College of Engineering and the Mechanic Arts at Minnesota, was held at that school.

Oldtimers from this institution will remember his remarkable work in building up this school when he served as dean from 1902 to 1909. He was very much interested in the promotion of athletics, also, and was instrumental in organizing the first football team at Minnesota.

Dean Jones is on sabbatical leave at present, following an operation for a cataract, and will retire from active service at the end of the period.

The editorial follows in full:

Few men have stepped out of their office at Yale, for that period of retirement that comes to all Yale leaders in time, with a greater warmth of personal regard and well wishing than followed Dean Frederick S. Jones, '84, who closed his active college deanship last Commencement. He was the first Dean of Yale College to be elected to the post and to enter upon this work as a life occupation. Up to the time when Dean Wright took over the office, its work had been done by various faculty members with clerical assistance, and the President had actually filled the position presiding at faculty meetings and, as did President Dwight, haling wayward under-graduates before him in his office in the old Treasury Building, for the kindly and wise and often whimsical discipline that made him so well beloved of undergraduates.

Dean Wright was not elected to the office, but assumed its work as the most capable member of the Faculty of the Nineties to do it. Dean Jones was deliberately chosen by a faculty committee, and came to Yale from the University of Minnesota, the best-equipped Yale graduate of his time, to take up the office under modern conditions.

It might be a bit awkward for Dean Jones, if we were to speak here of the place he has won in Yale hearts since then. It is one thing to be a successful business man in a post of that sort, and Dean Jones was that; it is quite another to handle the personal problems that come to any college so incessantly and so grievously at times, and to make the record of wise guidance and stern but fair discipline that Dean Jones made. College youths are not yet men, and they live in a world of their own that has its own standards and goals. They are of as many types and backgrounds and personal characteristics as there are individualities among them. Not all of them are law-abiding and now and then a bad apple is found in the barrel. The good influence of Dean Jones in many a young Yale man's life under such circumstances cannot be estimated in mere words. His record is in the men themselves. Dean Jones leaves the College with the affection and best wishes of his host of friends, and with the knowledge that he has done a good work.

The Return of the Arabs

THE technical colleges will welcome the return of the Arabs, the engineering men's dramatic society, when they give their burlesque musical comedy this spring. They have been inactive for a year due to the playing of several ineligible men two years ago. The new organization, headed by Robert Gustafson, president, Edward Erck, treasurer, and John Kirchmaum, secretary, intends to eclipse anything ever attempted before.

The history of the club is interesting. Five years ago, a group of engineering and architectural students became dramatically inclined but felt the lack of opportunity to enter the ordinary fields of dramatics on the campus. They organized the Arabs Club, therefore, as they saw a chance to stage a musical comedy quite different from other campus productions. The membership was made up entirely of men students, and each year after its inception one review was produced. The novel feature was the fact that the entire production, from overture to finis, originated in the minds of the members themselves. They wrote their own plays, designed their own scenery and costumes, and composed their own music.

The last four plays presented were "The Caliph of Kolynos," "The Blue God," "Riquiqui," and "Mona Lizzie." The first was the most hilarious, and the song "I've Been a Fool," which was written for the play, received national recognition.

Paul B. Nelson and Lawrence B. Anderson have nearly completed the writing of the burlesque offering which will be presented early in the spring, and it is with great expectation that the campus awaits the latest production of the Arabs.

FACULTY SKETCHES

M. CANNON SNEED

M. CANNON SNEED, Professor of Chemistry and Chief of the Division of Inorganic Chemistry, was born on January 2, 1886, at Nashville, Tennessee. He completed his public school education in 1905. After finishing high school, he taught in a grammar school for a period of two years. At the expiration of that time Dr. Sneed entered Peabody College, where he received his A. B. degree in 1911. At the end of his first year at Peabody he was given an assistantship in biology which he held during the rest of his college course. In 1909 and 1912 he attended summer school at the University of Chicago.

After receiving his A. B. degree, he became teacher of chemistry at Newport High School in Newport, Kentucky, where he remained for three years. During these years Dr. Sneed studied at the University of Cincinnati and obtained his M. A. degree from that institution.

He was married to Miss Edna Dyer of Opelika, Alabama, in 1912. He has one son, William, and three daughters, Thelma, Mildred, and Catherine.

In the year 1914 Dr. Sneed held the position of Head of the Department of Biology at West Tennessee State Normal School. He gave up this position in 1915 to accept an assistantship in chemistry at the University of Cincinnati in order to complete his work for the doctorate. Before the year was over, Dr. Sneed was made instructor of chemistry at Cincinnati. He was granted the Ph. D. degree at the end of the year, and was also promoted to the rank of assistant professor.

In 1918 Dr. Sneed came to the University of Minnesota as associate professor and was placed in charge of the Division of Inorganic Chemistry. About two years ago he was promoted to his present position.

Dr. Sneed has published several scientific papers. He has written two books: one, "Qualitative Chemical Analysis," and the other, "General Inorganic Chemistry." He has another book now in press.

Dr. Sneed is a member of several scientific societies: Alpha Chi Sigma, Phi Lambda Upsilon, Sigma Xi, American Association for the Advancement of Science, American Chemical Society, and the National Geographic Society. He is a thirty-second degree Mason and a member of the Campus Club. In addition to being interested in all the activities of the University, Dr. Sneed is an enthusiastic hunter and fisherman and is vitally interested in the preservation and propagation of wild life.

JUST A FEW SQUEAKS

LEON MEARS, *Feature Editor* FRANK WING, *Cartoonist*

He: Do you believe kissing is unhealthy?
She: I couldn't say—I've never—
He: You've never been kissed?
She: I've never been sick.—*Life.*

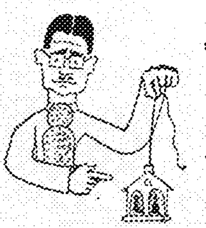
The person who coined the word "chicken-feed" certainly never took a co-ed out to supper.

It is rumored that the inventor of the steam-shovel got the idea from observation at the Minnesota Union Cafeteria at noon hour.

Protrude (playing saxophone): They tell me you love music?
Intrude: Yes, but never mind; keep on playing.—*The Sydney Bulletin.*

He: Sweetheart, you are the dearest little girl that ever breathed the pure air of this wonderful earth. Your little finger is worth more to me than all the other women in the world put together. You are as sweet and precious to me as a letter from my old mother. Will you marry me?
She: Hell, no!

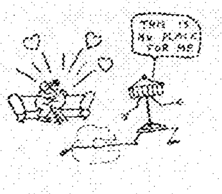
A freshman received a paper with the following upon it: "D— poor paper!"
He took it back and asked, "Please, professor, what is the mark?"



Prof. (in a Mechanics Lecture): How would you tell the height of a tower by means of a barometer?
Engineer: I would lower the barometer from the top of the tower, then I would measure the rope.

If all the shoe leather used up at dances on Friday nights were made up into one pair of shoes, they would be large enough for "Duke" Johnson.

"Can you play all night long in A flat and B natural?"
"I can play all night in any flat if I have the right key."



In the parlor there
were three,
She, the parlor lamp,
and he,
Two is company,
there's no doubt,
So the little lamp
went out.

She's very photographic.
Really?
Yes, sits in a dark room and awaits developments.

Year 1624: Indians sell Manhattan Island for a case of whiskey.
Year 1924: Citizens offer to swap back.

Libby: Tom's new mustache makes me laugh.
Marion: Yes, it tickles me too.

Seth: I gave Lucille a box of rouge for Xmas.
George: Quite a flossy present, wasn't it?
Seth: Yes, but I got it all back when she thanked me for it.

Sam: What are you doing nowadays?
Bill: I'm running a Bessemer converter at the steel works.
Sam: Well, drop in some day.—*Yale Record.*

He didn't know just how to begin. The taxi was moving fast with the meter keeping time. He was losing precious and possibly blissful minutes. At last he hit upon an idea.
"Er—are you—er—interested in politics?" he asked.
She looked at him in half-veiled disgust.
"Of course not!" she sniffed.
"Well, I was just wondering whether you were a conservative or a liberalist?"

She: "Don't you love driving on a night like this?"
He: "Yeah, but I thought I'd wait 'till we got further out in the country."—*Sub-Base Ballast.*

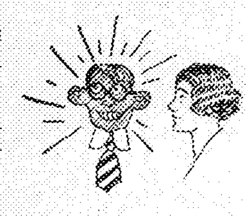
"Will you marry me?"
"Yes, but I must tell you, I'm a somnambulist."
"Oh, that's all right. You can go to your church and I can go to mine."—*Florida 'Gator.*

There's to be a big dance at the Union Station tonight.
(Excitedly): Oh, let's go, who's giving it?
Two trains are going to Charleston.

Harold: "What will it cost to send a telegram?"
Telegraph Clerk: "Where to?"
Harold (softly): "Ruth."—*Great Lakes Bulletin.*

English Prof.: Did you read Poe's 'Raven'?
Freshman (in great amazement): "I didn't know that. What's the matter with him?

It was prom time at college. *Fifty* couples were dancing to the strains of mad music.
It began to rain. *A hundred and fifty* couples were dancing.



She: Do you think you could learn to love me?
Bashful: I might, I passed calculus.

First Co-ed: "Whew! my laundry bill last week was $15.99."
Second Ditto: "Gracious, that's five times as much as mine."
First Co-ed: "Yes, but you don't go with an engineer."—*Rose Technic.*

Gasoline and Oil-Electric Transportation

(Continued from page 141)

on these locomotives is of the vertical, six-cylinder, four-cycle, single-acting, variable speed type, having direct fuel injection. The cylinders, cylinder heads and combustion chambers are completely waterjacketed. Fuel oil injection is accomplished by means of two opposed spray nozzles in each combustion chamber to which the oil is delivered under pressure by an injection pump driven from the main shaft. No compressed air is used for the fuel injection. Ignition is produced by the heat of compression only.

One fuel injection pump serves all cylinders. The fuel oil distribution is obtained by a distributor timed to admit oil to the spray nozzles of each cylinder in their proper firing order. Fuel oil for such an engine is commercially designated as Diesel oil. The lubricating system is entirely enclosed, and of the forced feed type. The lubricating oil is pumped to the moving parts of the engine by gear-driven pump in the crank case. Oil in contact with the cylinder walls is passed through a filter and returned to the crank case oil reservoir.

A closed cooling water system is used on the engine. The water is circulated by a centrifugal pump, driven from the crank shaft, and the temperature of the water in the engine jackets is regulated by a thermostatic valve, which controls the circulation of the cooling water from the engine to the radiators on the locomotive roof. To start the engine, compressed air at approximately 200 pounds pressure is admitted to each cylinder in succession, through mechanically operated starting valves. While in operation the engine drives a small air compressor which maintains the pressure continuously in the starting reservoir.

The generator is a 600-volt, direct-current, compound-wound, commutating pole unit, separately excited. The generator, together with its exciter, is specially designed for the service and is direct connected to the oil engine. Combined characteristics of generator and exciter are such as to produce a machine of practically constant output. The voltage of the generator is regulated by the current demand of the traction motors so that, making due allowance for the generator losses, the produce of the current and the voltage is equal to the engine power. The kilowatt output of the generator varies with the output of the engine, and at any position of the throttle, it is constant throughout the whole working range of the power plant. A 60-volt exciter is mounted on the same shaft as the main generator and serves to excite the field windings of the main generator. A 32-volt storage battery is charged by this exciter through one of the field windings in series. The exciter and the storage battery circuit are controlled automatically by the switch on the main throttle of the locomotive.

The control system on the locomotive is similar to that just described for gasoline-electric cars. The locomotive is equipped with four motors mounted on trucks and geared to the driving axles.

Application

In general it may be said that the oil-electric locomotive can be most readily adapted to locations where the traffic is not sufficient to warrant the expenditure for electrification. Under these conditions it is usually possible to effect a large saving over steam operation without the expense of installing overhead line and power supply. Particularly in switching yards where there are a large number of tracks, spurs and sidings, complete electrification would require a large expenditure for overhead trolley structures or third rail supply.

An interesting combination is being made by using an oil engine and generator on a 120-ton locomotive with a storage battery of sufficient capacity to furnish a heavy tractive effort for short periods. It is expected that the peak loads in this service will be of such short duration that the oil engine generator set will be able to keep the battery charged without outside charging.

This unit is similar in general to the gasoline-electric storage-battery locomotive now being tried out in the yards of the Chicago & Northwestern Railway. The following published extract is based upon information compiled by one of the Northwestern Company's officers, based on experience with the oil-electric locomotives in the Chicago yards.

"Before the oil-electric was purchased the Northwestern used four steam locomotives in the area. The new device has eliminated two of them. When the newly ordered oil-electric is delivered, it will replace the remaining two steam locomotives.

"George Hand, assistant to President Fred Sargent, said carefully compiled data had been reckoned on the first month of operating the oil-electric.

"'A steam locomotive cannot be operated 24 hours a day,' he explained as a preliminary. 'After 16 hours it must be taken to the shop to have its flues cleaned, its fires pulled and other cares bestowed upon it. We are operating the oil-electric 24 hours a day, changing crews every eight hours.

"'The wage cost of the oil-electric is $36.23 a day, while the same service with steam locomotives costs $45.42. The substantial saving is in fuel. For fuel oil the average has been $6.62 a day with an average of three cents a day for gasoline. That is a total of $6.65 a day as compared with $20.47 a day for a steam locomotive. On the basis of 300 days a year the fuel bill of the oil-electric would be $1,995 as contrasted with $6,141 for steam locomotive service.

"Projecting the figures over a year including roundhouse expense and lubrication, we now estimate the oil-electric operation will cost $13,200 and the steam locomotive $24,696.'

"The road now buys the oil at 9 cents a gallon, 200 gallons at a time; by buying oil commercially known as fuel oil in carload lots of 8000 gallons at a time and storing it for use later the road could buy it around 6 cents a gallon."

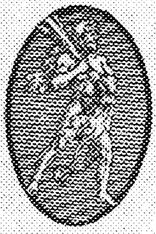
Gas-Electric Buses

The gas-electric bus is fundamentally the same as the ordinary gas bus except that the mechanical transmission is replaced by an electric transmission. With this scheme the engine drives a generator which supplies power to the motors which are geared to the rear axle. On some buses, of which a number have recently been sold, the motor is mounted on the drive shaft; i. e., longitudinally on the bus chassis and drives through the customary differential.

The majority of the equipments have so far used two motors with dual drive axles, the power being separately applied to each rear wheel. The larger single deck buses today and nearly all modern double deck buses use 6-cylinder engines rating about 90 h. p. with a generator having a nominal rating of 25 kw., but capable of transmitting loads 100 per cent or more above this rating. In these buses the two motors are rated about 15 h. p. each.

The generator is separately excited and is built as a unit with the exciter. The two armatures are mounted on the same shaft and the generator and exciter frames are made integral. These armatures are carried on a common quill and are driven by a propeller shaft connected to the flywheel through a suitable flexible coupling. In order to relieve the engine crank shaft of stresses which would be caused by direct connection of the generator mounted in a flexible chassis, a long couple has been secured by making the generator shaft hollow and passing the propeller shaft through it with a second flexible coupling at the

THE EXPLOSIVES ENGINEER— FORERUNNER OF PROGRESS



The title of this advertisement is also the title of a motion picture film that illustrates the part played by men who move materials with explosives in the great industrial undertakings of our times. It shows how engineering methods have transformed blasting from an uncertain, hit-or-miss operation into a science based on mathematical calculations. It illustrates the opportunities in this newest branch of the engineering profession.

More than this: it takes you behind the scenes in the great testing laboratories maintained by the United States Bureau of Mines and by one of the largest manufacturers of explosives, and shows you the exacting care with which explosives are tested in order that the tools of the explosives engineer may be as dependable as his figures.

"The Explosives Engineer—Forerunner of Progress" is contributed to the cause of industrial education. Together with another new Hercules film it will provide an evening of dramatic and instructive entertainment.

The other new film dispels the mystery that has heretofore surrounded the manufacture of electric blasting caps. This film clearly shows the manufacture and features of the Hercules Electric Blasting Cap. It illustrates the marked advantages of the larger diameter cap shell, adequate water-proofing, and platinum bridge.

Upon request, either or both of these films will be loaned without charge. Please let us know the date on which you wish to make your showing and we shall forward one or both, prepaid. Kindly use the coupon.

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(INCORPORATED)

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☐ "The Explosives Engineer—Forerunner of Progress."
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rear. This also permits a certain amount of torsional flexure in the driving shaft, thereby reducing wear and tear on the engine parts, particularly the bearing adjacent to the generator.

The exciter has two fields, a shunt field and a teaser field. The teaser field is excited from the 12-volt lighting battery and the shunt field from the exciter armature. The main generator field takes its current from this exciter. The terminals of the generators are connected directly to the motors and the characteristics of the generator are such that the proper current and voltage are applied to insure against overloading the engine and to give proper speed characteristics to the driving motors.

The traction motors are self-ventilated and have a relatively long frame of small diameter to facilitate assembly under the body where the road clearance is limited. The motors are designed with low magnetic density at normal load which gives a high torque per ampere on overload. In case of the single motor buses, the motor has a larger diameter and greater length than the motors used with the dual drive, but in both cases the torque characteristic is very steep.

The controller is a simple drum type switch having, in case of the two-motor buses, two forward positions (series and parallel connection of motors), one reverse point, one electric braking position and an "off" position in which the motors are disconnected from the generator. For the single motor drive the controller has one forward position, one braking, reverse and neutral. The electric braking in either case is obtained by reversing the motors with a limiting resistance in series. Practically any graduation in braking effort can be obtained by opening the engine throttle.

The electric transmission is naturally somewhat heavier than the mechanical transmission for the same size power plant. There are, however, a number of compensating advantages which need to be taken into account before making a decision as to the type of equipment best suited for any particular service. The principal advantages of the electric drive for buses are as follows:

1. Increased passenger comfort.
2. Greater safety and convenience.
3. Improved control and operation.
4. Reduced maintenance and depreciation.

The smooth accelerating characteristic of an electrically driven bus is sure to attract passengers in contrast to the usual gear drive. This is particularly the case where buses are frequently loaded so that passengers have to stand in the aisles. With the electric transmission there is no clashing of gears or racing of the engine. Faster schedules can be maintained since the time-loss of gear shifting at each acceleration is eliminated.

The speed of the bus is controlled by a single accelerator pedal operating the engine throttle which permits the driver to use his hands on the steering wheel except when applying the emergency brakes. This advantage is of great importance in heavy traffic. A given acceleration can be obtained with a lower maximum engine speed or a higher rate of acceleration can be obtained with the same top engine speed than with any other type of transmission. This acceleration is entirely automatic, being governed by the design characteristics of the generator and motors. It is impossible to stall the engine nor can it be raced as it is governed by electrical characteristics inherent in the apparatus. The parallel connection of the two-motor drive gives the same effect as the locked differential, reducing the possibility of skidding.

The torque characteristic of the series motor is particularly adapted to traction work as is evidenced by its practically universal use on the ordinary street car. An additional feature accompanying electric drive is the electric braking on long grades which effects a big saving in brake linings. This brake may also be used for emergency application.

A reduction in the cost of maintenance can also be obtained due to the fact that the operator cannot race the engine as can be done in intermediate gear positions and the maintenance of the clutch and transmission gears is eliminated. The engine runs at a more constant and a considerably lower speed than a similar bus with mechanical drive, giving longer life and a maintenance of higher efficiency. The number of engine revolutions for a given distance of travel is from ten to twenty per cent less with the gas-electric drive. This percentage, of course, depends upon the number of stops, increasing with the number of stops per mile. A bus with mechanical drive, for instance, running 180 miles per day on a 10-stop schedule, requires 5400 gear shifts on the basis of three shifts. With electric drive no gear shifts are required and the number of accelerations is only 1800, one for each start.

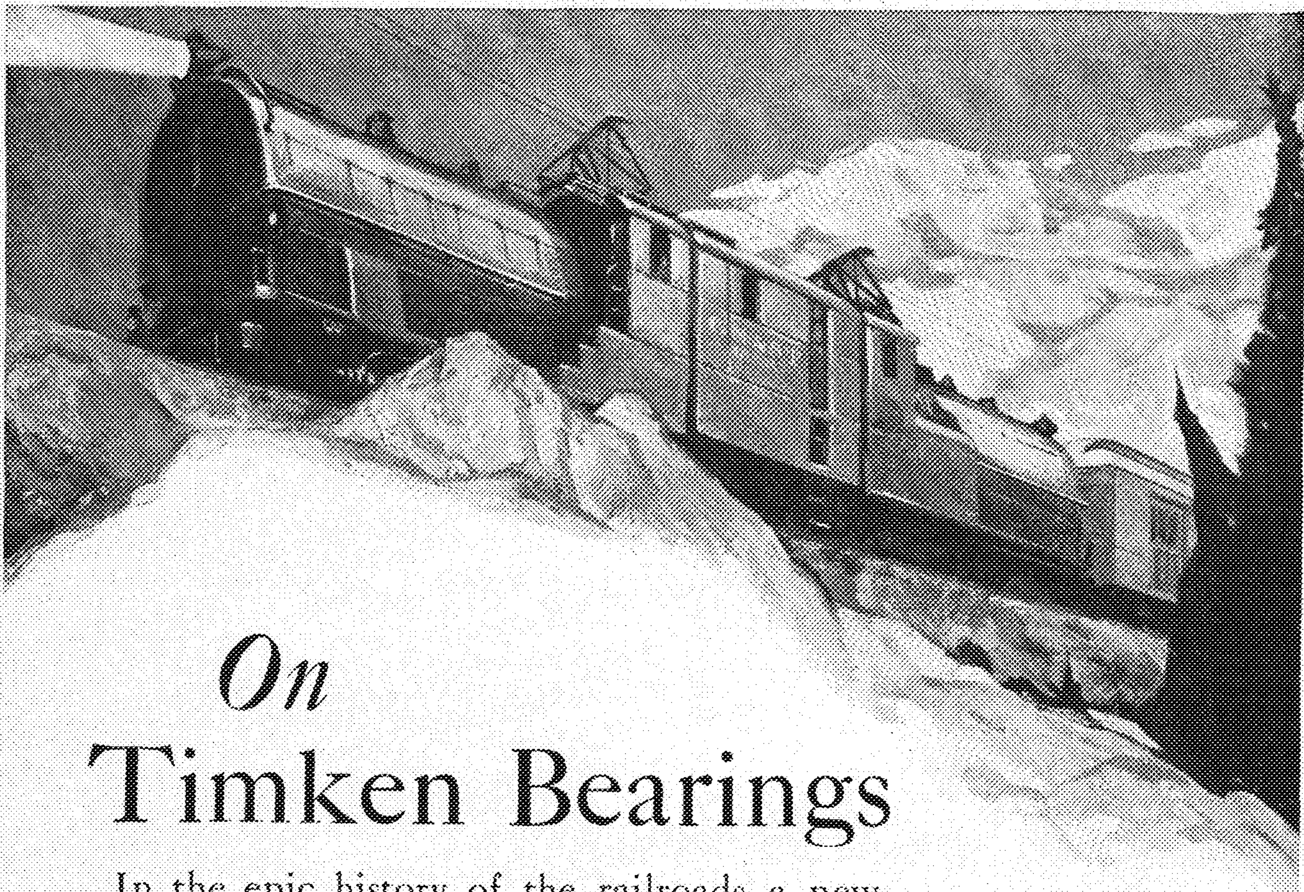
Due to the smooth, even application of power with the electric drive, the body and chassis of the bus will stand up much longer due to the reduction in the number of jolts and strains on the driving mechanism. The engine can be more readily tested by attaching the generator to a water rheostat and taking readings of its power output at various speeds.

In closing, I might remark that of the eight or nine hundred gasoline-electric drive buses now in service, there are eight in service on the Nicollet Avenue line in Minneapolis.

THE ETERNAL PROBLEM

Jimmy, aged thirteen, finding his girl a problem, was puzzled. "You see," said Jimmy, "I've walked to school with her three times and carried her books; bought her ice cream once, and a ice cream sody twice. Now do you think I oughta kiss her?" His chum was thoughtful. "Nah," he decided, "you don't need ta. You've done enough for that girl."

Indignation is useless unless it is accompanied with a stick of sufficient size to command respect.



NEWS FROM THE TECHNICAL CAMPUS

(Continued from page 146)

ruary 7, and John Newhouse was elected sophomore assistant at the sophomore class election held on the following day.

With the elections over, work on what is to be one of the most novel and spectacular electrical shows in the history of the University of Minnesota has started, and new ideas for features and stunts are being borrowed from books, magazines, other colleges in the country, and industrial concerns of the city. Interesting and instructive features for the general public who come are to make up a large part of the display. A dance, known as the senior party, will be held after the show.

The electrical show was first given in 1913, and has been given every other year since that time. It was first started as an open house for the personal friends of the students of electrical engineering, but has since developed an interest in the university as a whole.

The electrical show will likely be held on Engineers' day. The Dakota Division convention of the American Radio Relay League will also be held on that day, so it is likely that the two will be combined.

Electrical Students Attend Lecture on Lighting of the Sesquicentennial

Mr. D. A. Atwater, illuminating engineer of the Westinghouse Electric Company, gave a talk at last month's meeting of the A. I. E. E. on the subject of the lighting of the Sesquicentennial Exposition recently held in Philadelphia.

The lecture was illustrated with colored slides, and a general review of the cost and methods of special lighting at the exposition were of main interest. The immense liberty bell which was covered with so many lamps that it took ten men three days to screw them all into their sockets seems a gross exaggeration, but it is true.

Another strange lighting effect obtained at the exposition was the throwing of William Penn's picture on the clouds. Since there was rain nearly all the time, the peculiar weather conditions permitted this to be done, and manufacturers have since swamped the Westinghouse Electric Company with requests for such sky lighting.

William B. Stout Speaks at Special Convocation; Visits Technical Campus

William B. Stout, former student of the College of Engineering, was a visitor to the University of Minnesota on Thursday, February 3. In the afternoon he spoke on the development of the airplane to an audience in the Old Library. He was introduced by Dean Leland.

He also spoke informally to members of the engineering faculty at a luncheon held in the Minnesota Union. Following the luncheon, he was shown through the buildings on the technical campus by Dean Leland.

Mr. Stout gained prominence in the Twin Cities as a writer, and later gained national distinction through his activities in the fields of mechanical engineering and airplane development, as can be seen from the review of his life published last year in the February issue of the Minnesota TECHNO-LOG.

He is at present president of the Stout Metal Airplane Company, and his interest in the commercial development of aviation is a reason for his appearance in the city. In his talk he said that in commercial passenger service the use of helmet and goggles is obsolete, due to the introduction of cabin planes; that 20,000 miles are covered daily by airplanes; and that 9,000 miles of this is flown by commercial planes. Metal planes are coming into general use since they are more durable than those of wood and fabric. Duralumin is the metal most commonly used in the structure of all metal planes. The Ford Motor company, using Stout planes, is at present conducting airlines between several cities, and is contemplating the establishment of others.

Following his visit to Minneapolis Mr. Stout went to Duluth, where he also spoke on the development of aviation.

Sophomore Miners Hold Annual Shindig

Miners make the Shindig the one grand party of the year for their school and open the dance to the university as a whole. The dance is sponsored by the sophomore class of the School of Mines. This year William Spain, president of the class, was in charge of the Shindig. Members of the general arrangements committee were Walter Gulleson, who was in charge of tickets and publicity, Ingolf Serigstad, who was in charge of the entertainment and refreshments, and James Laidlaw, who had charge of decorations.

The atmosphere of the mine prevailed at the dance, and the guests were forewarned to bring their flashlights when they came on February 11th, for fear there might be a cave-in. Shindig Mines, Ltd., however, is very careful of the workers and the mines rescue crew was on hand to resuscitate all who might be overcome.

Since the dance was also a meeting of the stockholders of Shindig Mines, only those who held shares of stock were admitted. A dividend of 300 per cent fun was declared.

Father: "How is it, young man, that I find you kissing my daughter? How is it, young man?"

Lizard: "Great! Great!"—*Witt.*

Him: "Hey, that was a boulevard stop!"

Her: "Well, I ain't no boulevard!" —*Colorado Lookout.*

With Our Alumni

MECHANICALS

'17—Arthur Gerlach is with the Bureau of Chemistry, U. S. Department of Agriculture at Landisburg, Pa., where he has been experimenting in the prevention of dust explosions in industrial plants.

'26—Walter Pierce, who graduated this winter quarter, has accepted a position as engineer with the American Laundrymen's Association. He will travel around the country visiting the various laundries with a view to helping them out in engineering problems that come up in the operation of the plants.

CIVILS

'15—John West was a recent visitor here. During his undergraduate days Mr. West was on the gymnastic team winning the conference all around championship in his senior year. Mr. West is now engaged in highway and railroad contracting at St. James, Minn.

Minnesota Federation of Architectural and Engineering Societies Meets

The faculty of the college of Engineering and Architecture was well represented at the sixth national convention of the Minnesota Federation of Architectural and Engineering Societies held in Duluth on February 4th and 5th.

Professors F. M. Mann and R. C. Jones of the architectural department, S. C. Shipley and F. B. Rowley of the mechanical department, and F. W. Springer and W. T. Ryan of the electrical department attended the convention and brought back a very interesting outline of the proceedings.

Mr. W. B. Stout, of the Stout Airplane Company, and a Minnesota graduate, gave a very interesting talk on the development and possibilities of the commercial airplane. In connection with his talk he related a little personal item which added interest and also showed with what respect he holds the airplane as a safe method of transportation. He said that whenever he went anywhere by automobile he always telephoned or telegraphed his wife as to his safe arrival, but when he went anywhere by airplane he never had to bother to let her know, as she was never worried about his safety.

Mr. Frank McMillan, a former professor of civil engineering at the University of Minnesota, gave a very interesting talk on the water cement ratio in concrete work.

Mr. Reed Taft Bayne, president of the Duluth News Tribune, gave a very interesting talk on "*The Romance of the American Newspaper.*" In his talk he mentioned a very humorous episode concerning a cub reporter sent out to cover a church wedding. He said the reporter came back with the report that he had no story because the bridegroom did not turn up, and there was no wedding!

After several speech and business sessions, the convention broke up with an informal banquet and dance.

The Twin Cities were very well represented at the convention, there being about twenty-five present from Saint Paul and Minneapolis.

An Efficient High Frequency Receiver

(Continued from page 145)

If any difficulty in connection with body capacity effects is noticed, tinfoil should be pasted on the inside of the panel and grounded. This operation will remedy the situation.

The size of the antenna is immaterial. Any length from 20 feet up will be satisfactory.

In tuning the set the detector rheostat is used as a throttle and it should be run as low as possible for efficient operation.

Since the regeneration of this set is not under perfect control, phone reception is not all that could be desired. This imperfect control of regeneration is not detrimental to the reception of C. W. signals although it makes difficult the perfect reception of voice.

If the above directions are followed, a very cheap but efficient little set should be the result of your efforts.

ELECTRICALS

'08—A. W. Scholpf is with the Monongahela West Pennsylvania Public Service Co. at Fairmount, W. Va.

'25—R. V. Ludlum is making the world brighter in his work as illuminating engineer with the Edison Lamp Works of the General Electric Co. at Harrison, N. J. Mr. Ludlum has decided in favor of married blessedness. He was recently married to Miss Lucille Doeblin of St. Louis, Mo.

Engineers *and* Mother Nature *Join Hands*

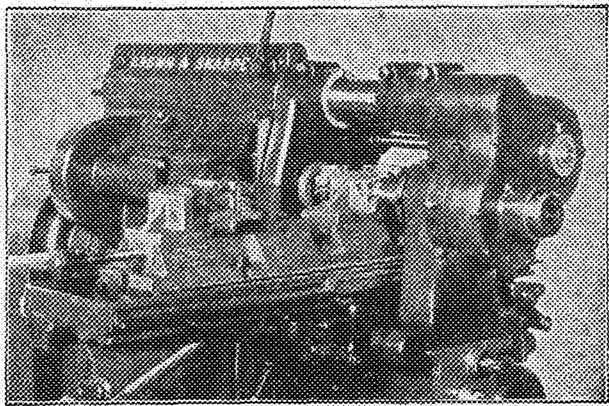
(Continued from page 144)

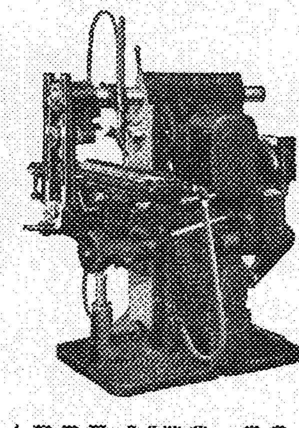
It grew louder. . . louder. . . Minnehaha was laughing once more.

Tourists storm the park and scatter peanut shells about. Hawkers sell picture postcards and plaster paris miniatures.

And now as the electric pumps purr contentedly, the taxi-cab drivers smile, the city council is pleased and the whole state rejoices.

The engineer is happy also, for he was the one who solved the problem.





Twin City Bridge Construction

(Continued from page 138)

tural engineering at the University of Minnesota, and the erection and construction of the third rib was done by the Minneapolis Steel and Machinery Company. This was a difficult problem on account of the interference with the existing laterals and sway bracing. It was cleverly accomplished by reducing the rise of the new rib as may be noticed in the accompanying photograph, thereby allowing the new rib to cross the plane of the old ones leaving the pins in the crown and spring line at different elevations from the old pin centers. With the construction of the high dam by the United States government and the consequent rising of the water, it became necessary to build protection walls around the old piers in order to prevent damage due to drift and ice. These protection walls are shown on the cut, the one at the west pier forming a dry box around the steel, the water being pumped out from inside of the wall periodically. At the east and center pier the steel ribs below the water level are surrounded with a water-proofing compound. The original cost of this bridge was $150,000.00, the widening being accomplished at a cost of $119,000.00. The height above the water is approximately 90 feet.

High Bridge

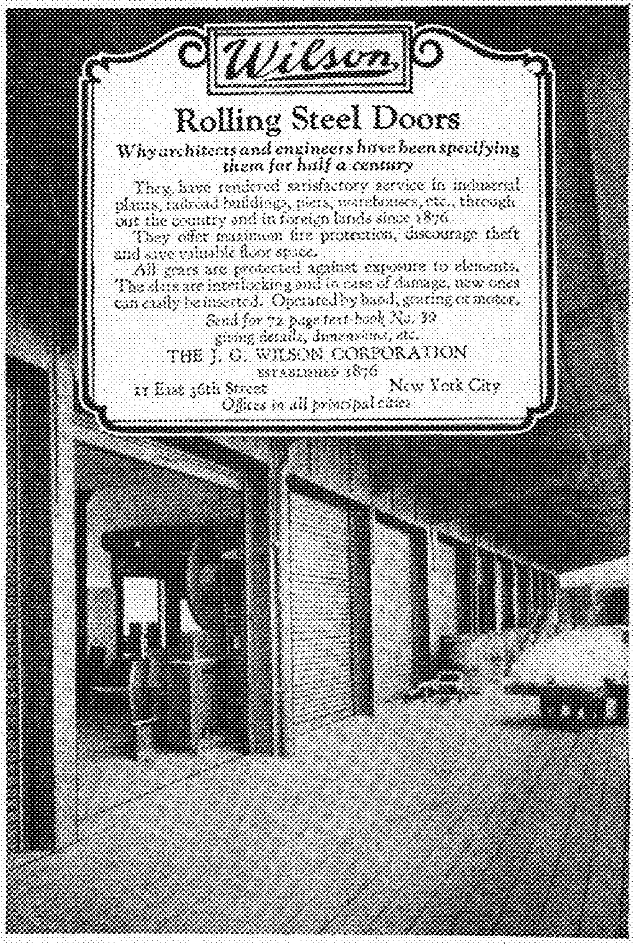
The High Bridge or Smith Avenue bridge in St. Paul was constructed in 1888-89 under the direction of the late L. W. Rundlett, then city engineer. Its height with the maximum of 200 feet above water level together with its light construction, renders it somewhat of a unique structure when compared to other existing bridges. It is 2,774 feet long, has a 24 foot roadway, two 9 foot sidewalks and is built on a 4 per cent grade throughout. It is designed as a series of bents and towers with short and long deck spans. The river is crossed by four 250 foot spans resting on high steel towers and rocker bents. The foundation is masonry piers on timber grillage and piling. In August, 1904, several spans at the south end or high end of the bridge were blown down by a cyclone which also severely damaged several portions of the city. The bridge, however, was reconstructed during the following year. The total cost of the bridge was $479,000.00 made up of $139,000.00 for substructure and $340,000.00 for superstructure.

Third Avenue Bridge

The Third Avenue South bridge in Minneapolis was built in 1914-18. It was the first long bridge constructed under the day labor system, the total cost being approximately $862,000.00. Competitive designs were furnished for the bridge and the Concrete Steel Engineering Company of New York made the detailed plans under its original commission of 1912. These plans were made for a bridge built on a tangent, but it was found necessary due to foundation conditions, to change the location and construct the bridge with reverse curves at the ends. The structure was redesigned to fit the new location by F. W. Cappelen, then city engineer.

Of special interest are the geological formations which effected the foundation work and which accounted for the relocation. The formation of the river bed at the bridge site consists of limestone about 15 feet thick which is practically bare in the west channel and covered only by a few feet of silt and sand

(Continued on page 162)



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Twin City Bridge Construction

(Continued from page 160)

in the east channel. This limestone strata lies generally above the St. Peter sandrock, which is about 600 feet in depth. The limestone ledge extends up-stream about 500 feet from the bridge and down-stream about 700 feet to the crest of St. Anthony Falls. In the early construction for utilization of power at St. Anthony Falls a peculiar advantage was afforded power development by the excavation of tail race tunnels in the soft sandrock underneath the lime stone. These tunnels had broken through at various times finally requiring the United States Government to make extensive repairs to close the breaks in order to insure continuance of water power and restore the original condition as far as possible. The location of these breaks determined the curved ends of the adopted design. The bridge is 2,223 feet long and has a 56 foot roadway with two 12 foot sidewalks. The main spans consist of five 211 foot and two 130 foot reinforced concrete arches. Construction was carried on by a double cable way of 2,020 foot span with a timber tower of 165 feet in height. N. W. Elsberg, present city engineer, was in charge of the construction.

[A continuation of this article dealing with more recent bridge construction in the Twin Cities will appear in the March issue of the MINNESOTA TECHNO-LOG.]

A Survey of Radiant Energy

(Continued from page 143)

explored gap in the long wave-length region has gradually been shortened in recent years until it can be said that this region is practically entirely known.

With the discovery of the X-ray by Röntgen in 1895, an unexplored gap was left between them and the shortest known ultra-violet rays. This, however, has been closed in recent years. Since the optical limit of glass is about 340 milli-microns, the known spectrum could not be extended beyond the near ultra-violet. The use of quartz crystals transparent down to 185 milli-microns greatly extended the known ultra-violet and by the use of fluorite, Schumann was able to extend it down to 120 milli-microns. The use of reflection-grating spectrographs, which eliminated the necessity of employing transparent media, and subsequently the introduction of the vacuum spectrograph became valuable accessories in this work. Lyman soon extended the known spectrum to 50 milli-microns by means of a spark placed in the spectrograph chamber. Recently it appears that Millikan has completely spanned the gap between 50 milli-microns and X-rays by means of high potential sparks which he recorded by means of special Schumann photographic plates. The recent discovery by Kolhörster and Hess of the existence of powerful rays called cosmic rays which have an extremely high penetrating power promises interesting results.

It will be observed that it is increasingly difficult to deal with ultra-violet radiation as the wave-length decreases. To conquer the ultra-violet it was necessary for the combined efforts of innumerable workers to be fused into one whole. Thus, while the credit for having discovered a particular region is given to one, it must be borne in mind that without the painful trials experienced by others to guide him, he could not of himself have accomplished what he set out to do. Thus we are consoled by the thought that however insignificant the investigation, it may some day serve to help link together many other phenomena in the explanation of one physical, chemical, or natural law. Views may be modified from time to time, but the work of the pioneers and the thousands of others who follow, remains. Science is ever in a state of flux and it is not expected that theories of today will still be unmodified tomorrow. It is the interpretations and explanations which suffer, but experimental facts are never altered.

A Changing Viewpoint

Joe Elder was an expert mechanic. He worked in the largest garage in town and was considered the best workman in the shop. But occasionally Joe had a grouch. "I get mad," he muttered, as one day he examined the engine of a high powered limousine, "every time 'old man' Thomas brings this boat in here. What did he ever do to entitle him to all he's got? He inherited a dinky glass factory thirty years ago and now look at him. He's the richest guy in town. He didn't make it, other men made it for him." Joe concluded, as he adjusted a loose nut.

A year later Joe was greatly surprised to learn that he had been left a thousand dollars through the death of an almost forgotten uncle.

"Now is my chance to buy that garage over on Exchange street," said Joe, the day he received the check. "I'll hustle over and close the deal."

From the very beginning Joe's venture was a success. His reputation as a mechanic was well known and Joe soon had more than he could do. He hired a helper, then another mechanic, and still two more, until at the end of his first year nine men were working for him, and to provide room for his growing business, he was compelled to enlarge his shop.

Another year and Joe was on the road to prosperity. A new home, a bigger and finer automobile, a growing bank account were all evidences of his success. Even an occasional pleasure trip was enjoyed by the family without the necessity of counting the cost so closely. And as the business grew and his income became larger, his resentment toward "old man" Thomas, who now brought his cars to Joe's place, seemed to decrease steadily. On occasion the two men indulged in short chats. Joe even termed the old gentleman a keen business man.

And as the business grew, with the consequent employment of more men, Joe saw no reason why, with the payment of good wages to his men, he should not profit by their labor.

Then came the big opportunity. Joe invented and patented a new type of wind-shield that would, he felt, be universally used. He talked it over with Mr. Thomas, owner of the glass factory, who at once saw the possibilities. A partnership was arranged. Joe sold his garage so he might devote all his energies to the new project.

Today, Joe Elder's limousine stands beside that of "old man" Thomas. The two men are recognized as business leaders. And Joe—well, he often smiles when his thoughts go back a few years to the time when he worked on his partner's machine in the garage and had queer ideas about things. He sometimes smiles as if to say, "It's different when it happens to you."—WORTH READING BULLETIN.

The MINNESOTA TECHNOLOG

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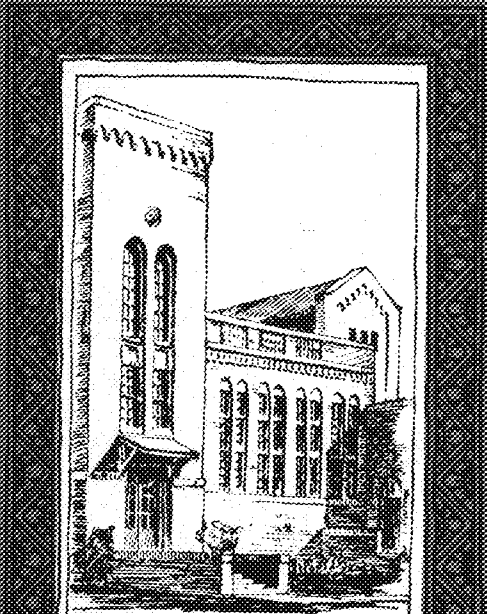
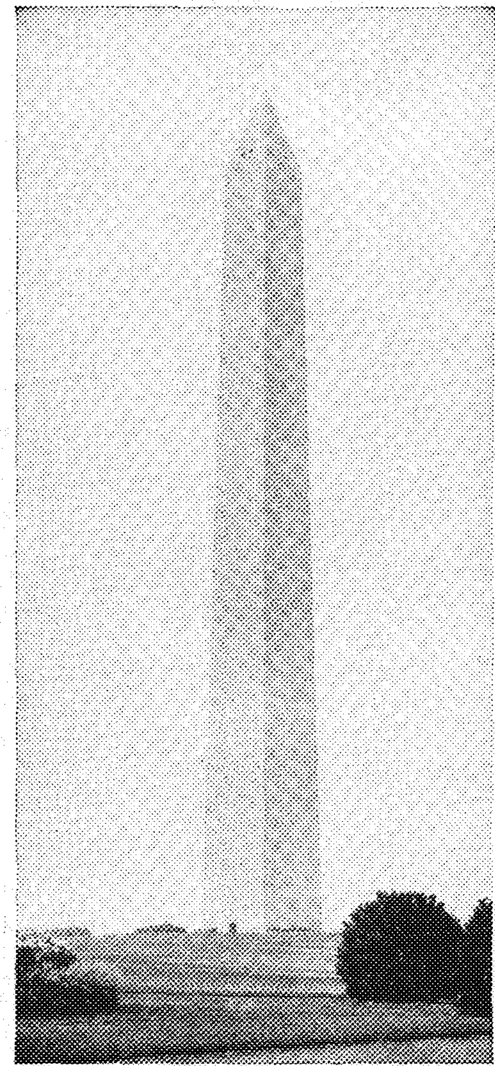


MARCH

Volume VII. 1927 Number 6.

MEMBER ENGINEERING COLLEGE MAGAZINES Associated

Uplift Applied To Monuments By Otis Elevators


© Harris & Ewing

THE Englishman confessed to his American friend whom he was conducting through the London Tower that never before had he visited that most historic building of his native city. It was always there; he could go any time. So he never did, until the insistent American prodded him into action.

Is it for a similar reason that so few college students in and around Boston visit the Bunker Hill Monument? Hardly: because they come from all parts of the country. Is it then another instance of indifference of college men? Not that either. College men in Washington generally ascend the Washington Monument.

No expert is needed to solve this puzzle. The ascent of the Bunker Hill Monument must be made on foot. It's a long, hard climb. But visitors to the Washington Monument are speedily and comfortably borne to the top in an Otis elevator.

AMERICAN HISTORY

1799—December—Congress passed Resolution for erection of marble monument in memory of George Washington.

1833—Corner Stone laid—

1839—Work stopped—

1880—Work resumed—

1884—100 oz, pure aluminum cap stone set.

1884-1926 Over 5,000,000 people ascended to top of Monument.

ELEVATOR CHRONOLOGY

1879—Otis Steam Elevator, installed for use in construction work.

1884—This elevator converted to passenger use. Round trip 17 minutes. Passengers carried to the top of the monument during the life of the elevator, 1,279,719.

1901—Electric Elevator installed, having a round trip time of 10 minutes. Passengers carried up during its lifetime, 3,750,000.

1926—Otis Micro-Drive Gearless Traction Elevator installed, with a round trip time of 2 minutes. Will carry to the top of the monument an estimated number of 12,000,000 passengers in the same time as the life of its predecessor.

THE WORLD'S WORD FOR ELEVATOR SAFETY — Otis

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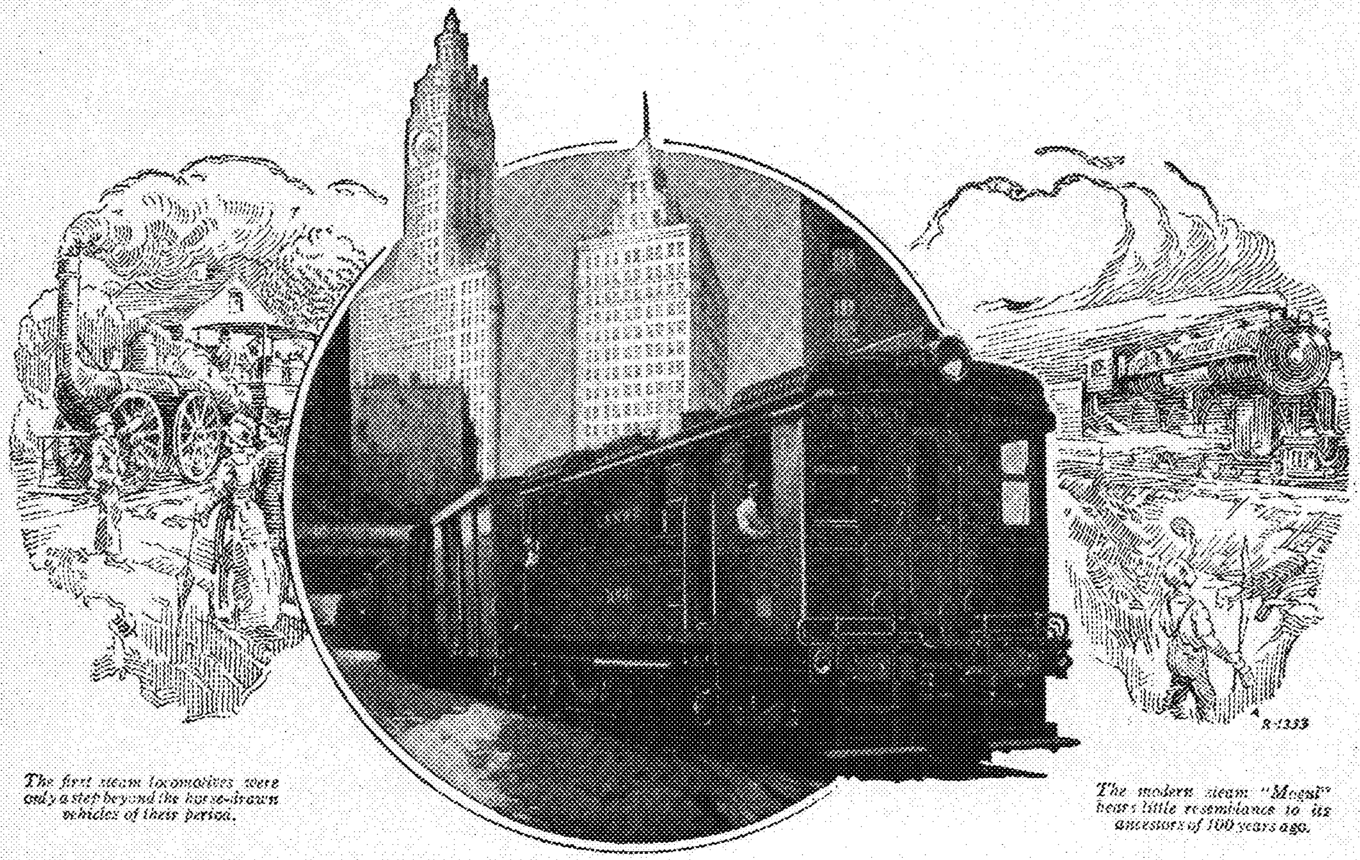

The first steam locomotives were only a step beyond the horse-drawn vehicles of their period.

The modern steam "Mogul" bears little resemblance to its ancestors of 100 years ago.

An Industrial Pace-Maker

THE last century has witnessed American transportation grow from a modest stripling into a full-fledged giant with more than his share of responsibilities. Regarded with skepticism a hundred years ago, this unpromising infant has gradually welded the country into an industrial unit that has no peer the world over. And he is only just beginning!

As a matter of history, the interval between the earliest and the most recent developments in railroading is not so great. To be sure, there is a vast mechanical difference between the "Tom Thumb" of 1830 and the massive locomotives of our own inventive age. But the "Puffing Billies," the "Tom Thumbs," the "Stourbridge Lions" were, in their day, advance agents of steam locomotion—ancestors of the modern engines that now haul some two-score cars with perfect ease. They were ancestors, too, of the powerful oil-electric, with its low-cost fuel, quiet operation, and unrivalled flexibility under varying loads.

Briefly, the oil-electric locomotive is one in which an Ingersoll-Rand engine operates a high-capacity generator, the latter furnishing power to several electric motors. By the adaptation of its oil engines to railroad uses, Ingersoll-Rand Co. has again contributed to industry, and has sponsored an idea which is as sound in principle and application as the I-R developments of other years.

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THE MINNESOTA

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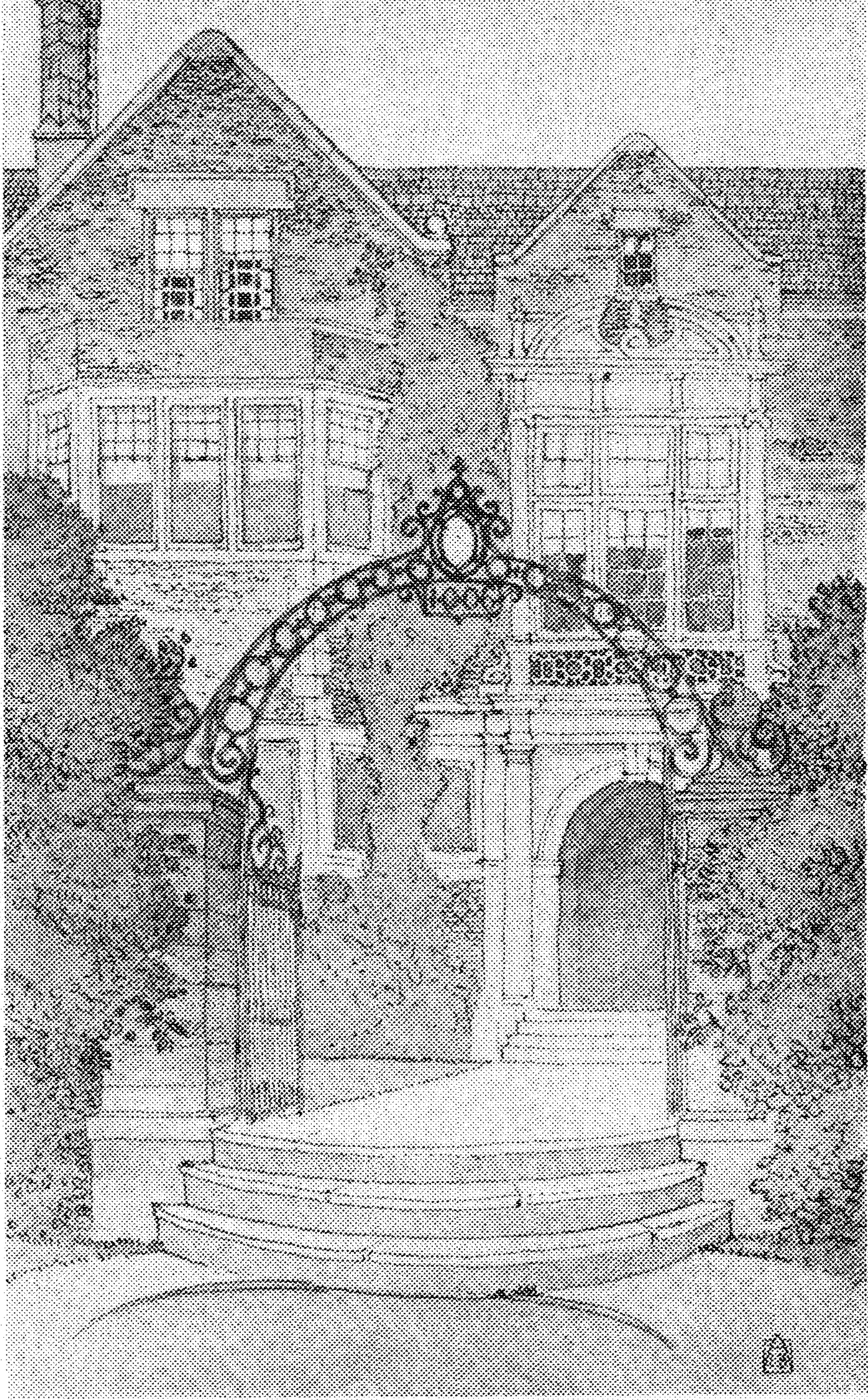


Lawrence B. Anderson

A Home on Summit Avenue

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VII | MARCH 1927 | Number 6

Under the Surface

Graduate and undergraduate engineers carry out interesting research problems in the department of electrical engineering

By Gordon C. Harris, E '28

FEW of us who are connected with the engineering field in the University of Minnesota, whether graduates or undergraduates, realize the importance of the large number of experiments which are carried to completion unheralded and unseen. Seldom even do we hear of the results of these numerous experiments which are going on under our very noses. We go about our daily work, and are so absorbed in it that we give little thought to the army of experimenters who are spending great amounts of time and energy to improve old mechanisms and to invent new ones for our convenience.

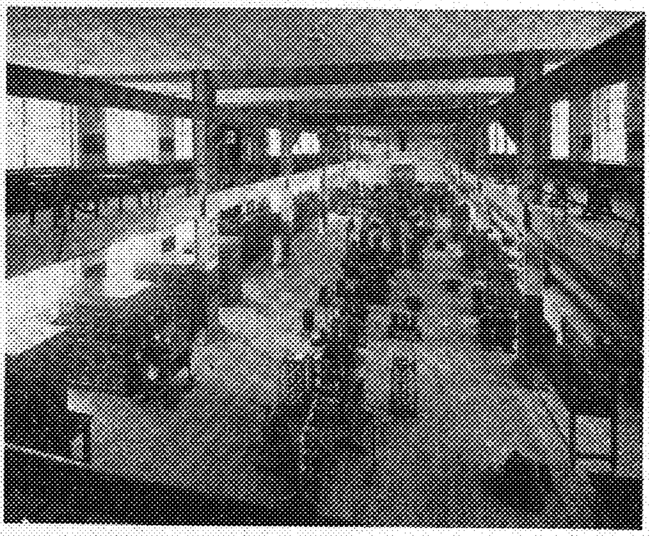
We always hear of those inventions which lighten our labors or contribute to our entertainment. We never give a thought to the hundreds, nay thousands, of hours of tireless research which have been spent by scientists and engineers on these problems. All that we can see is the result. Often an investigator will spend many hours on a problem to no apparent purpose. If his problem is a failure, we never hear of it. If it is a success we may never hear of it, and yet it may have contributed much to the progress of science in many ways.

At the present time we have, in our own electrical engineering department, many problems under investigation. These problems involve more than the field of electrical engineering alone, though in the main they concern this field to the greatest extent.

Photometry

We have in our laboratories one of the few large spherical photometers in the United States. The uses of this photometer are manifold, and its installation will greatly facilitate experiments in light and illumination. In this connection it may be stated that it is indirectly by the use of this photometer that the intensity of automobile headlight beams can be measured, as was mentioned in the article on automobile headlights which appeared in the January issue of the Techno-Log.

Professors E. W. Johnson and G. W. Swenson of the department of electrical engineering are investigating photo-electric cells for use in television. Equipment is being built up so that the properties of the cells may be studied under different forms and changes. This equipment will also be available for use in the investigation of the electric properties of various materials and the properties of vacuum tubes.



THE ELECTRICAL ENGINEERING LABORATORY

Mr. Harry Du Bois and Mr. H. A. Norberg are making a study of the development of the methods of visual demonstration of the principles of light and illumination. The principles of illumination lend themselves very well to the process of visual demonstration.

In connection with a research project relating to the flow of fluids, begun in April, 1926, and carried on in the experimental building by Professors H. E. Hartig and H. B. Wilcox, of the department of mathematics and mechanics, it was found necessary to develop a photo-electric detector and chronographic recorder of the variations of light intensity. A major part of the problem concerned itself with the design and construction of a suitable five stage resistance coupled amplifier for the magnification of the extremely feeble current of the photo-electric cell.

Another phase of the problem related to the development and construction of a filter, and a delicate amplifier of feeble sound intensities of definite frequencies. In connection with this part of the problem, a Western Electric oscillator, situated in the telephone and radio laboratory, was found indispensable as a source of high frequency sound waves.

Some of the results obtained are discussed in the Physical Review of March, 1927.

The layout of the new electrical engineering building was found admirably adapted to the convenient prosecution of work of this character, allowing, as it does, the use in the research room of any source of current in the building.

Communication

Mr. L. S. Nergaard and Mr. L. A. Weom, senior electrical engineers, are engaged in a study of intermediate and radio frequency amplifiers. A series resonance hook-up of the plate circuit for the production of high voltage amplification is being developed. A means for measuring the voltage ratios is almost completed, and the first tests will be made at audio frequencies.

Mr. C. B. Feldman, teaching fellow in the electrical department, and Jerome C. Smith, senior electrical, are making a study of electron tube plate resistance and its measurement, together with a study of the phase relations between grid voltage and plate current. This work is being done as an investigation of the possibilities and limitations of using the electron tube as a phase angle, or power factor meter in communication engineering. No definite results have as yet been obtained.

A low power A. C. electron tube volt-

(Continued on page 188)

Engineering in the Flour Mills

The miller and the engineer work hand in hand in solving the problems of the industry that made Minneapolis famous

By MAURICE D. BELL, *Mech. Eng. '07*
Assistant General Superintendent,
Washburn-Crosby Company,
Minneapolis, Minn.

THE flour mills of Minneapolis are familiar to all students of the University of Minnesota. The gray limestone buildings loom up against the horizon, on both sides of the Mississippi River below St. Anthony Falls, and are visible to those crossing over any of the bridges in the center of the city. At night, the illuminated signs make the leading brands of flour conspicuous against the sky.

The question arises in the minds of engineering students as to what part engineering has in the big industry that has made the name of Minneapolis known in all parts of the world. Milling is associated with wheat, which is thought of as the chief product of northwestern farms. In the form of flour it is identified with every household. What connection has engineering with wheat or flour?

The mills at Minneapolis represent a modern development of a very old industry. Milling, or the process of preparing grain for human food, began when man first showed signs of approaching civilization.

Within the last sixty years, milling has grown into the class of "Big Business," a highly organized industry making use of many of the sciences and branches of engineering.

Conditions at Minneapolis were favorable to a remarkable development. The northwest was adapted to wheat raising near the most important source of water power in the middle west. Favorable freight rates were established, partly through the building of railroads by the millers themselves, and the wheat was ground in transit on its way from northwestern farms to the east. These factors combined to make Minneapolis the biggest milling center in the world.

This concentration of milling capacity was accompanied by new and pressing problems in the field of engineering. A mechanical problem that would have been a simple matter in a small plant, when multiplied ten or one hundred times became a problem for most careful study and demanded the attentions of men with special training.

The purpose of this article is to consider engineering rather than the engineer, the work rather than the individual performing it.

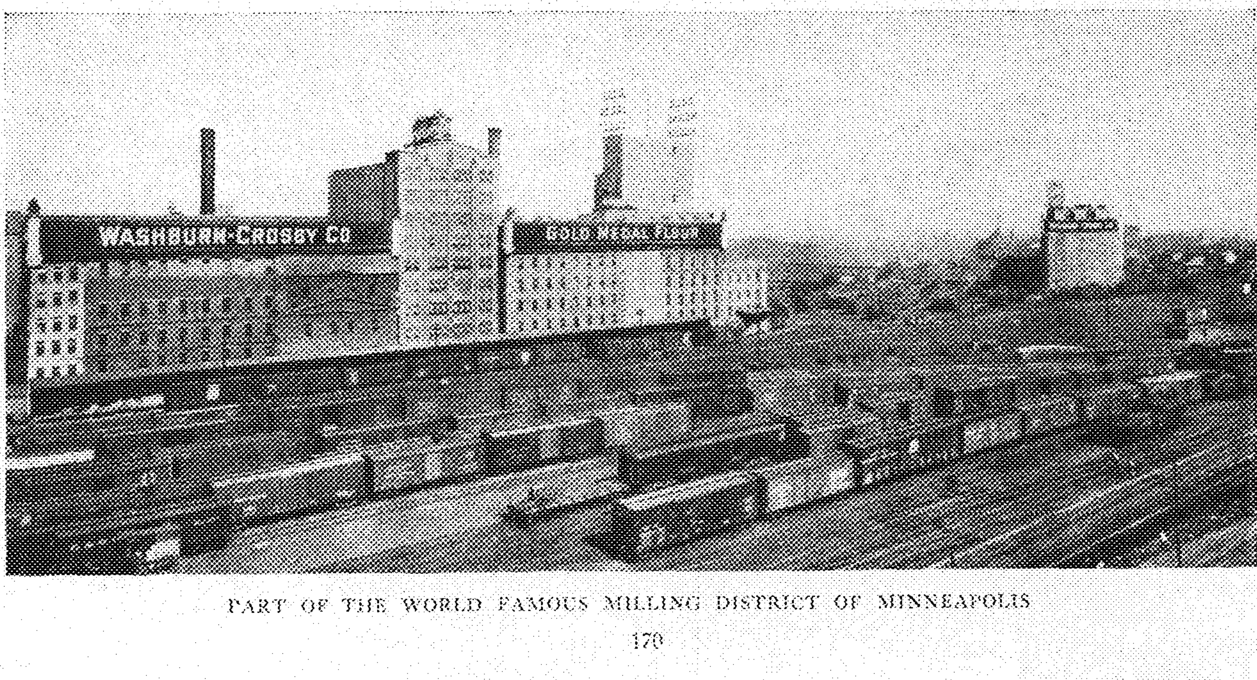
Engineering work in the early days was done by mechanics or by mill operators, frequently by the owner himself, without special technical training, but with a large fund of practical experience and common sense. Much credit should be given these early men who pioneered, and did work that commands respect today, without the fund of information and training available to graduates of engineering colleges. In the larger plants engineers are now being employed on many phases of this work, but in the smaller plants engineering work is being successfully handled as part of the duties of practical operating millers.

Engineering service is available to smaller milling organizations through specialists now being generally employed by companies selling milling equipment, or performing services for millers, in a wide range of activities corresponding to the special departments which a big milling company has within its own organization.

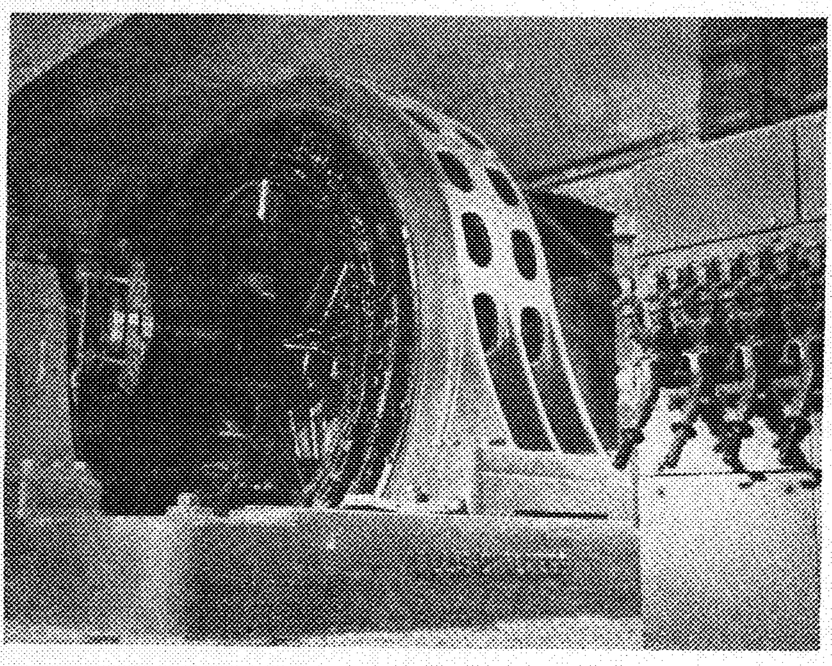
The drafting room has an important place in flour mill work. Here the young engineer is first given an opportunity to earn his way by making plans under the direction of others, on problems of maintenance, construction of buildings, design or installation of individual machines, power, or milling processes. The largest mill organizations employ specialists in flour mill design, elevator construction, electric power, water power, and machine shop practice. The drafting rooms are equipped with the most modern conveniences with adequate equipment for blue printing and files for preserving calculations, records, and drawings for extended periods. The tendency to larger organizations, with branch plants removed from the home office, gives added value to adequate records, drawings, and data in the engineering department.

Power was one of the first fields in which engineering served the milling industry. The primitive use of manual labor or animal power and the limited use of wind mills was hardly associated with engineering, but water power early became of first importance.

Power was easily developed by small streams with even very limited head, with primitive wheels that were sufficiently reliable to turn the machinery of small mills. As mills grew larger, they soon exhausted the possibility of the old equipment and engineering came to show how wheels could be built and installed that were more efficient, develop-



PART OF THE WORLD FAMOUS MILLING DISTRICT OF MINNEAPOLIS



ONE OF THE HUGE MOTORS THAT OPERATE A MODERN MILL

Alternating current motors of over 1,000 h. p. are required in up-to-date mills today. This one is of a low speed type and has 270 double coils.

ing more power from the same water, and insuring more continuous operation under all sorts of weather conditions.

The under-shot and over-shot wheels have been displaced by modern turbines, tending toward larger units until now there are numerous installations where the power of one wheel will exceed 1,000 h. p.

St. Anthony Falls was first developed for saw mills but with the settlement of the farming lands and the growth of agricultural life, this power was soon needed for flour mill use. The water power development at Minneapolis is a complete story in itself, full of interest and sound engineering that remains in use today.

The natural formation, a ledge of limestone varying from 15 to 25 feet in thickness overlaying a sandstone formation, lent itself readily to development. Water is conveyed to the individual mills in open canals blasted out of the limestone rock, thence conveyed to vertical water wheels in most cases.

The wheels discharge into tail race tunnels cut in the sand rock, which connect with the main tail race below the falls. The original water wheels were geared to the mill with huge mortise bevel gears, one gear in each pair having wooden inserted teeth.

Recent development has been largely influenced by the many small water power leases which still govern the use of water on St. Anthony Falls and it has been found economical in some cases to replace old wheels with wheels of modern type directly connected with alternating current generators and transmit the power electrically.

Building construction of the primitive small mill was a simple matter for the carpenter and stone-mason, but when mill buildings grew to eight stories or more in height, engineering problems were immediately presented.

Foundations required careful examination and special design to meet soil conditions. Design of floors, beams and columns required analysis of stresses and knowledge of materials, and experience in handling the loads of heavy machinery, storage of grain or bulk commodities, and vibration of power equipment.

The early construction at Minneapolis made use of the limestone that was freely available, with heavy timbering of the slow-burning mill type construction. Advancing prices for material and labor together with the necessity of fire prevention later turned attention to other material. Brick buildings with steel frames and plank floors have been used with or without column fire-proofing. In recent years, reinforced concrete has become a favorite material for frame and floors with brick or concrete exterior walls. The use of concrete has required a special design of building and in new construction the plans preferably provide holes for spouting and equipment.

The design of buildings involves many phases of engineering. Variations are due to local ordinances and conditions, particularly fire exposures, where savings in insurance rates will frequently justify increased expenditures for fire barriers and cut-offs. Modern designs are based upon close study of milling requirements and the new types of American mill buildings show increased advantages in reduced operating costs, maintenance, improved lighting, and sanitary conditions, improved safety and architectural appearance.

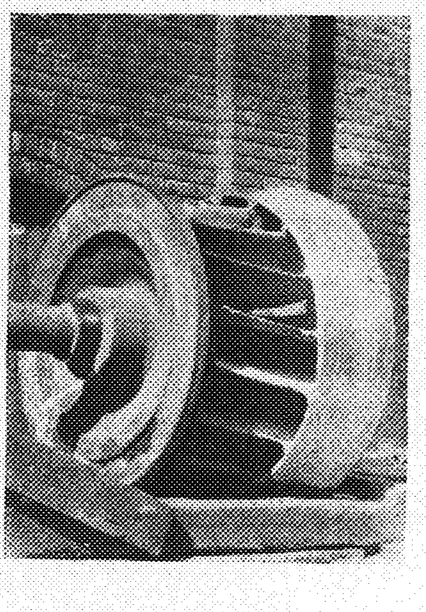
Insurance requirements are served by engineering appraisals based on surveys, lists and estimates of machinery, made at regular intervals and kept correct by current additions and deductions as machinery is changed or construction is modified. The calculation of values and depreciation or obsolescence is a special engineering field also serving tax requirements.

Closely related to building construction is planning of property, land and trackage, water supply, sewage disposal, fire prevention, and safety engineering.

Engineering study has resulted in modern fire protection equipment, sprinkler systems, pumps, water storage tanks, regular inspection of fire hazards incidental to operations, supervision, fire drills for employees, and a system of alarms, watchman's service, and electrical supervision of valves automatically giving alarms in case of water flow or tampering with equipment.

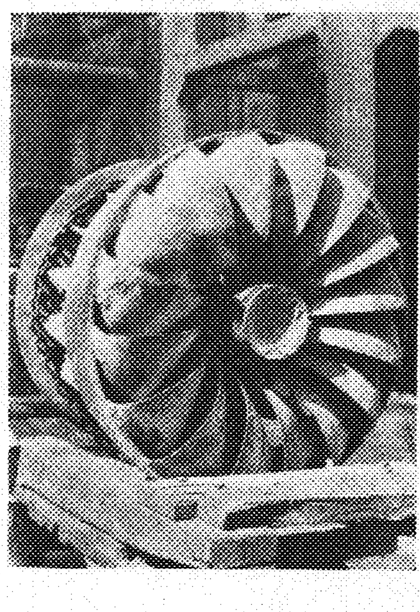
Safety engineering begins with the study of processes, and involves the design, manufacture, and installation of proper guards. It also extends to the

(*Continued on page 182*)



WHEN THE MODERN TURBINE DISPLACES THE OVERSHOT WHEEL OF THE PAST

This bronze waterwheel furnishes power to run an entire flour mill and is capable of developing over 1,000 h. p.



Bituminous Treatment of Minnesota Highways

The use of tar and asphaltic oils for surface application is fast growing in favor for roads where the traffic does not warrant the expense of paving

By H. G. Nicholson, *Ch. E. '21*
Minnesota Highway Department

MINNESOTA has a trunk highway system of approximately 7,000 miles of which there are about 850 miles of pavement and over 5,200 miles of gravel. In some localities gravel is scarce and expensive and its conservation is very important. Some of the gravel roads will probably soon be paved as they are carrying very heavy traffic. There still remains, however, a large mileage where the traffic is not heavy enough to justify paving, and yet the gravel surfacing is unsatisfactory both on account of the cost of the gravel and the dust nuisance to motorists and residents along the highway as well as the inability to maintain a smooth riding surface at all times.

In 1924 the Minnesota Highway Department started applying bituminous treatments to gravel roads in an experimental way. In 1925 and 1926 the mileage of this treatment was increased and the number of different kinds of oil and tar was also increased and from results obtained further development has been made as to the kind of road to treat and the character of the bituminous material to use.

The treatment of gravel or earth roads in this state endeavors to accomplish a multifold purpose.

(1) The cost of construction and maintenance is less over a period of years.

(2) A great conservation of the limited supply of gravel is made possible.

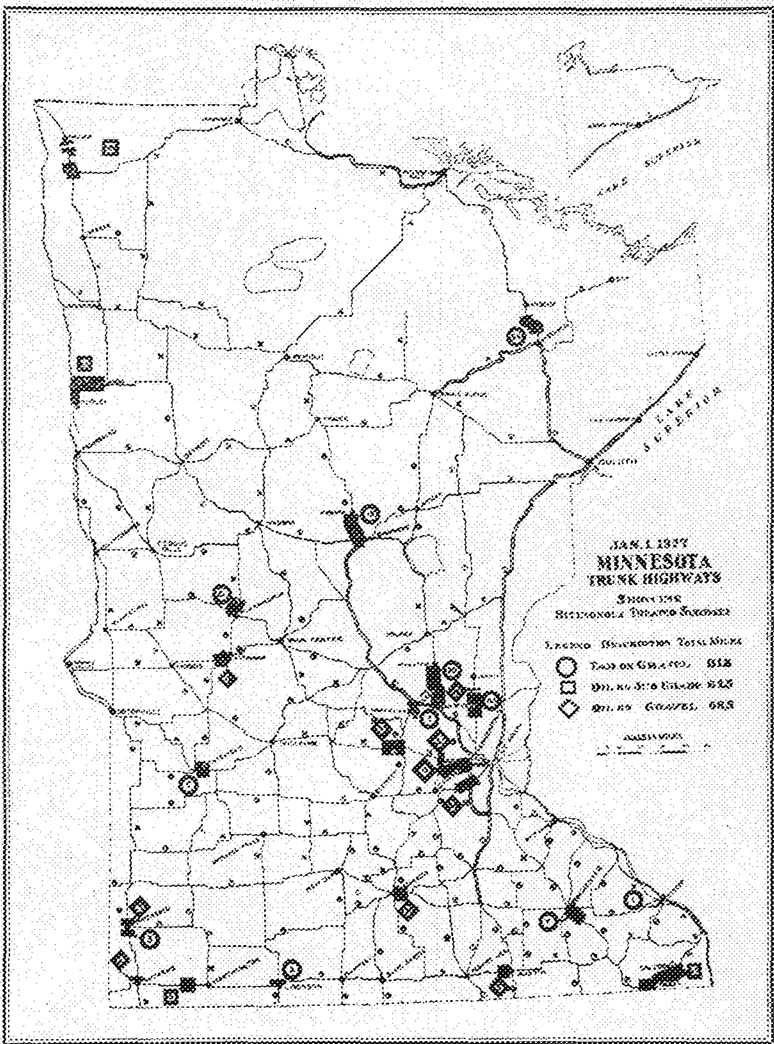
(3) Affords a better road for all kinds of weather, especially extremely dry or rainy weather.

(4) Acts as a dust palliative and preventative.

(5) More pleasing to the riding public and to the residents along the highways.

As the character of the roadways differs, throughout the state, as to subsoil and condition of the surface, the first problem that confronts the engineer is the choice of bituminous material for the particular project. At the present time several distinct treatments are used.

Probably the most common type is the treatment of a gravel road or a clay-gravel road where the top crust of the roadway is at least two (2) inches thick



of well compacted gravel. (By gravel in this work, we mean the ordinary surfacing material used in Minnesota.) These roads are capable of taking almost any one of the standard methods of treatment.

The next type of roadway to be considered is the dirt road where the surface has no gravel in the clay, gumbo, or other soil which constitutes the roadway. On this type of roadway tar treatment and cut-back asphaltic road oils are not advocated. Straight-run oils of the mid-continent fields, varying in asphaltic content from 45 to 65 per cent are employed. The lighter asphaltic content oils are used as a priming coat and followed up with the heavier asphaltic-content oils. This application covered with 200 to 300 cubic yards of gravel.

Another type of surface is the sand road where the surface consists of sand or sand and gravel which is not well compacted with clay or other binding material. Tar treatment or treatment with cut-back asphaltic road oil is advocated for this condition.

On all the roads treated, samples of the cover material, surface, and subsoil are taken before treatment is started, and sent to the laboratory for analysis. These analyses are used for future reference as to the history of the projects.

Method of Application of Tar

The "Minnesota Method" of tar application is the method most commonly practiced in State Highway work.

The roadway, which is smooth and true to cross section before any work is commenced, is first bladed free from loose gravel by means of a large motor patrol or a large blade pulled by a caterpillar tractor. The loose gravel is windrowed either along the shoulder of the road or just to the opposite side of the center line of the road on which side tar is to be applied.

The half of the roadway is then ready for the first application of tar. This is applied by means of power distributors taking widths varying in size from four (4) to twelve (12) feet. The most common width is a four (4) foot spray along the outside of shoulder of the road. This is then followed by an eight (8) foot spray adjacent to the four (4) foot spray. This makes it possible for the traffic to utilize one-half of the road and at the same time the distributor does not have to drive in any fresh tar. The amount of tar put on for this first application is between three-tenths (0.3) and four-tenths (0.4) of a gallon per square yard and is applied at a temperature of 140°-150° F.

This tar is then allowed to penetrate. On a warm day about two or three hours are required for setting before traffic is allowed on the fresh tar, and then traffic is encouraged on this section to bring out the weak spots or places where pockets or loose material existed. These weak spots are patched before the second application is put on.

After twelve or more hours, the second application of one-quarter (¼) to one-third (⅓) of a gallon is applied, starting at the center of the roadway with a four (4) foot strip and then following this with an eight (8) foot strip adjacent to said strip. The gravel is bladed over this second application immediately. The gravel is about one (1) inch thick over the top of the tar.

As soon as the cover of gravel is bladed uniformly over the half of the road which is tarred, this half of the road is ready to handle the traffic and the same process is gone through on the other side of the road.

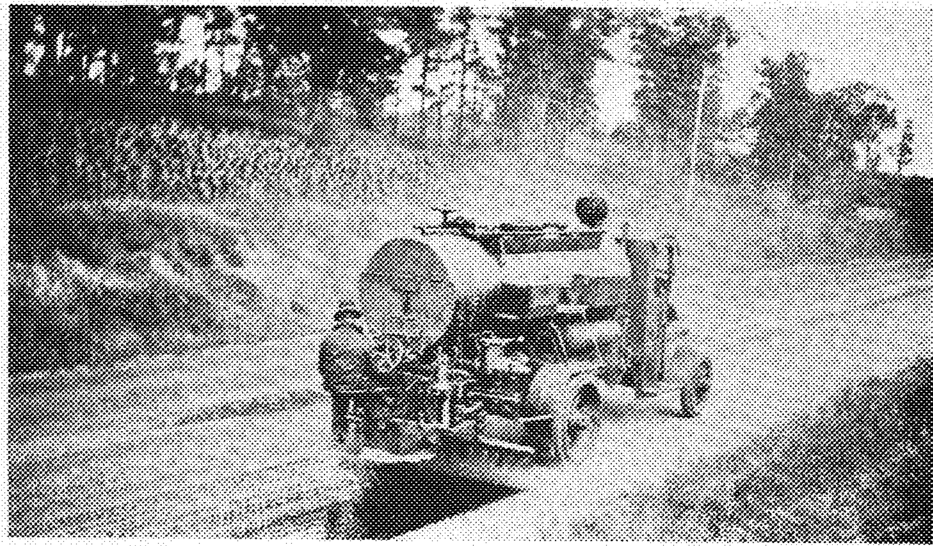
When the second half of the road has received this same treatment, the entire road is thrown open to traffic. Traffic pounds the gravel into the tar and also whips the gravel to the side but this is kept spread uniformly over the road by the use of a maintainer of some approved type. A blade with sensitive controls can be used or a motor driven maintainer that can be regulated so as not to gouge the surface, does very well. It is necessary to continue this dragging operation for about one week or until the roadway has "set up."

The roadway is then finished as far as construction is concerned, but maintenance should start immediately. As soon as a hole or rut develops it should be patched with a mixture of tar and gravel. About fifteen to twenty miles of this kind of treatment can be taken care of by one patrolman.

The above method can be used for the application of cut-back oils as well as for tar, and in each case about 300 to 400 cubic yards of gravel cover material are used per mile of road treated.

TAR TREATMENTS ON MINNESOTA TRUNK HIGHWAYS

T. H. No.	*Location*	*No. of Miles*	*Year of Initial Treatm't*
18	Elk River-Zimmerman	11	1925
18	Zimmerman-Princeton	9	1926
19	Brainerd-Nisswa	15	1926
6	Pipestone—So. from pavement	3	1926
4	Jackson—Through village	2	1926
29	AlexandriaNorth	5.1	1926
12	Montevideo-East	5	1926
5	Central Ave. N. from Pavement	11.3	1926
20	Rochester-South	7.0	1926
11	Britt	5.4	1926
25	Big Lake-Monticello	3	1924
7	Winona	1	1926
11	Sand Lake	4	1925
	Total	81.8	



SURFACE TREATMENT OF MINNESOTA GRAVEL ROADS
Power distributors such as these have transformed many dusty highways into clean, smooth-riding roads in the past three years.

Method of Treatment of Earth Roads or Subgrade Treatment

The earth road is first bladed or shaped true to cross section and grade, disturbing the top crust as little as possible. The road should have a six (6) inch crown for a thirty (30) foot roadway.

The loose material is then bladed to the side and wasted on the slope. As it is more convenient to haul the gravel for cover material before the oiling is started, a windrow of gravel containing 300 yards per mile is piled along the shoulder of the road on which side the oil is to be first applied.

Again it is to be remembered that traffic is to be carried on half of the road being treated, with the least inconvenience to the traveling public.

Starting at the shoulder or the edge of the gravel windrow, an eight (8) foot spray of oil is applied. As heavy an initial treatment as the soil will take is applied, varying between .35 of a gallon and .55 of a gallon per square yard. This is applied at a temperature of between 160 degrees Fahrenheit and 190 degrees Fahrenheit. This oil is allowed to penetrate and usually soaks into the surface in three to ten hours, depending on the time of the day applied and weather conditions. The penetration of the oil varies between one-quarter (¼) and three-quarters (¾) of an inch. A four foot spray is then applied adjacent to the eight (8) foot spray at the same rate per square yard. As soon as the one side of the road is dry or is in such a condition that traffic will not pick it up the other side of the road is treated in the same manner, while traffic is carried on the oiled section. Several miles of road can be treated in this manner and the cycle of first one side and then the other and then the first side with the seal coat and then the other side with the seal coat can be easily worked out to coincide with the equipment on the job.

A second coat of between .25 and .40 of a gallon per square yard is then applied and immediately covered by blading the gravel in from the windrow on the side. It is not necessary for the blade to pull the entire windrow in at one time as this will be too heavy a load and will cause a side push on the blade which is liable to be detrimental to the oiled surface.

This gravel is then kept spread uniformly over the surface by either motor patrols or horse patrols until the bituminous material has "set up."

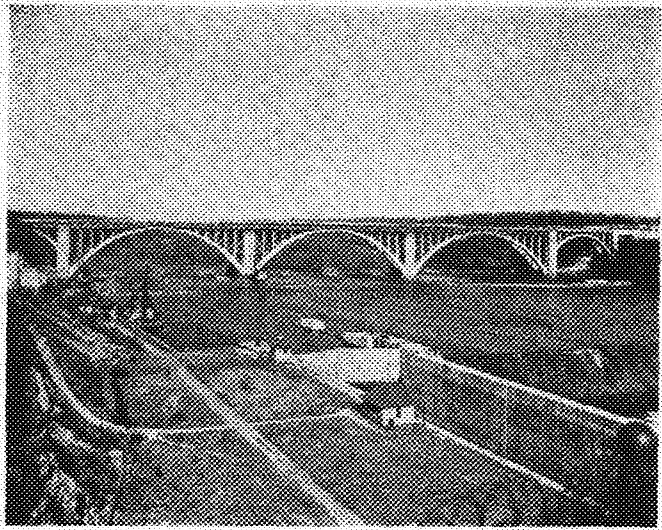
A very light coat of gravel is kept on the road throughout the year and very little "matting" takes place, although there should not be enough gravel to cause a dust to accumulate by the grinding of the gravel.

Below are bituminous treatments showing location, number of miles and year of initial treatment.

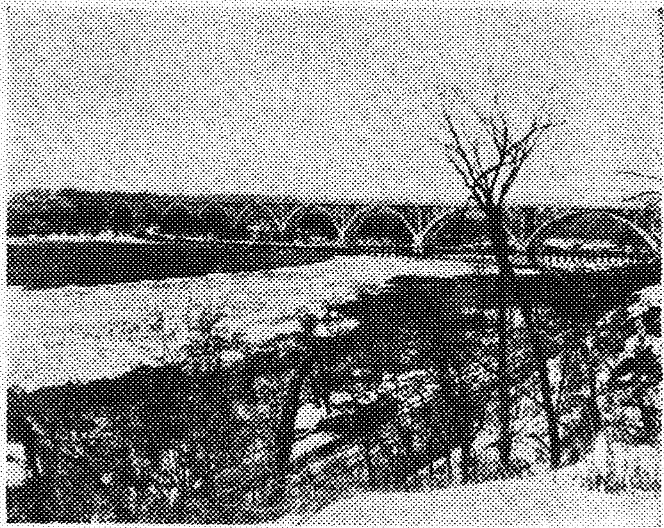
OIL TREATMENT ON MINNESOTA TRUNK HIGHWAYS

T. H. No.	*Location*	*No. of Miles*	*Year of Initial Treatm't*
6	Ada-Perley	25	1926
6	Hallock-South	10.5	1926
6	Pipestone N. of Pavement	3.0	1926
6	Luverne-North	2.0	1926
7	Mankato-Eagle Lake	7.4	1926
9	Worthington-Bet. Pavements	6.0	1926
10	Howard Lake-Montrose	9.2	1925*
12	Montevideo-East	5.0	1926
12	Minneapolis-Excelsior	15	1908
28	Glenwood-Starbuck	7.3	1926
44	Caledonia-Prosper	20.0	1926†
52	Lyndale-Cedar	2.4	1926
10	Wayzata-Long Lake	3.2	1908
5	Lyndale-Bloom. Bridge	6.0	1915
9	Austin-West	5.0	1926
5	Bethel Corner-North	1.0	1926
	Total	128.0	

* (1924 Waverly.)
† (Some in 1925.)



FORD BRIDGE, MINNEAPOLIS



MENDOTA BRIDGE

Twin City Bridge Construction

Editor's Note: This description of recent bridge construction over the Mississippi River is a continuation of Mr. Shepard's article which began in the February issue.

By George M. Shepard, C '09
City Engineer,
St. Paul, Minn.

Cappelen Memorial Bridge

THE Franklin Avenue or Cappelen Memorial Bridge was built by the City of Minneapolis in 1919-23 at a cost of approximately $1,000,000.00. It replaced an old steel truss bridge which was allowed to remain in place between the two arch ribs of the new bridge and was used for construction purposes. This structure was built by day labor by the city organization.

The center arch, with a 400 foot clear span, is the longest concrete arch span in America. There are a few spans in Europe of much smaller dimensions and lighter loading which exceed this span length slightly. The bridge piers in the river are carried down full size to the solid sand rock. The roadway carries double track street car tracks and has a 40 foot roadway with an 8 foot sidewalk on each side, the combined light and trolley poles being carried on the railing of the bridge. The reinforcement for the arches of this bridge, as well as that of the Third Avenue and Cedar Avenue bridges, consists of structural steel ribs.

The bridge was designed by the late F. W. Cappelen, then city engineer. N. W. Elsberg was in charge of its construction until his appointment as city engineer in 1922 following the death of Mr. Cappelen. He was succeeded as superintendent of construction by F. T. Paul. Since that time the bridge has been named the Cappelen Memorial Bridge in recognition of the long and faithful services of Mr. Cappelen to the City of Minneapolis.

Cedar Avenue Bridge

While the ferry still crossed the river at Hennepin Avenue in the earlier days of what is now Minneapolis, the first bridge across the river is said to have been constructed at Tenth Avenue South. This location is the same as that of the Cedar Avenue bridge now under construction. This new Cedar Avenue bridge when finished will be 2,921 feet long with a 40 foot roadway and two 8 foot sidewalks. It will be of reinforced concrete with two arch spans each 265.5 feet long across the river. It was designed by N. W. Elsberg, city engineer, and Mr. K. Oustad, city bridge engineer. It is being built by day labor at an estimated cost of $1,100,000.00.

Robert Street Bridge

The first bridge across the Mississippi River at Robert Street in St. Paul was built in 1885-86 at a total cost of $318,000.00, the substructure costing $127,000.00 and the superstructure, $191,000.00. The old bridge was constructed of iron and consisted of several pin connected trusses with girder approach spans, the main span over the river being 352 feet. The roadway was only 33 feet wide so that with double street car tracks, and extremely heavy vehicular traffic and an original basis of light loading, the necessity of a new bridge had been felt for some time. The new structure which was opened to traffic in August, 1926, was begun in June, 1924, and was part of a general plan of the City of St. Paul and Ramsey County to open and widen a thoroughfare by way of Robert and South Concord Streets from University Avenue through the business district to the great live stock market and packing center at South St. Paul. This highway will have a roadway width of 56 feet across the bridge and for a greater part of the distance, the bridge sidewalks being 10 feet in width. $3,800,000.00 has already been spent on the project including the cutting down of the hill in the rear of the Capitol, the widening of Robert Street and the bridge at a cost of approximately $1,700,000.00. The bridge proper was financed by Ramsey County which in 1922 engaged Toltz, King and Day, Inc., engineers and architects of St. Paul, to design and superintend the construction. The writer exercised general supervision over the work for the city.

The various fixed requirements, such as navigation clearance, railway clearance and street grades, were worked out so as to give a structure with easy grades and about twelve feet lower than the old bridge. On account of the traffic congestion at this point it was necessary to construct a temporary bridge at Jackson Street one block below for use during construction. This temporary bridge was a wooden trestle span with an 8(foot steel girder counterweight lift spar supported by wooden towers. Its cos with approaches was $70,000.00 and the cost of dismantling it $15,000.00.

The old Robert Street bridge wa completely removed and in this proces the old timber grillage upon which th masonry piers rested was found to be i such perfect condition after more tha forty years of service that the timber were used by the contractor for construc tion purposes. The foundations for th new bridge consist of concrete piers rest ing on piling driven practically to re fusal. The driving of piling at clos intervals in fine silt or sand of the rive bed was a difficult problem and require almost continuous jetting in connectio with the driving.

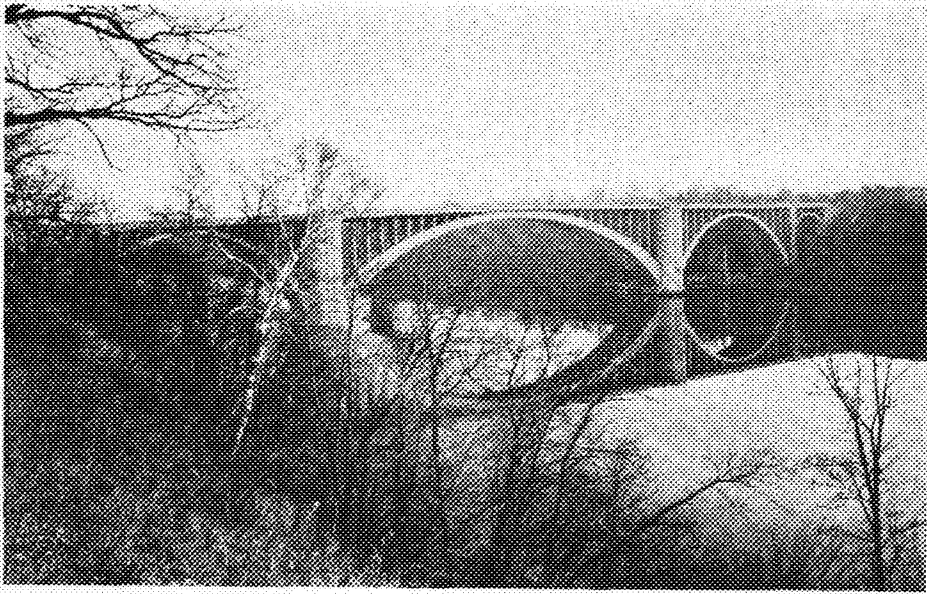
The navigation clearance requiremen

of 160 feet width and 47 feet height above ordinary high water determined the ruling grades on the bridge and lead to the decision of using the through arch for the main span in order to keep the approach grades as low as possible, being now one per cent on the north end and 3.3 per cent on the south end. This rendered the usual type of rib arch impossible, so in order to preserve the appearance of a concrete bridge the engineers cleverly worked out the final design with structural steel arches encased in concrete. Where the arches are above the bridge grade the floor is suspended by means of structural steel hangers encased in concrete. The floor system of this span is made up of 90 inch floor beams about 60 feet long and "I" beam stringers. All connections are riveted and all exposed steel work including bracing was covered with gunite reinforced by wire mesh. The total length of the bridge is 1,532 feet, the main arch over the river channel having a clear span of 265 feet. The roadway has double street car tracks between which the paving material is granite blocks, and between the tracks and curb 4-inch brick.

The construction was carried on from a timber trestle along the down-stream side of the bridge site, the central mixing plant and material yard being on the south side of the river. The Fegles Construction Company of Minneapolis were the contractors, John F. Green acting as superintendent for Ramsey County.

Mendota Bridge

While Ramsey County was carrying out its plan for a better highway artery through its business center to South St. Paul, Hennepin County also initiated a project to link Minneapolis with South St. Paul and to tap State Highway No. 1 by the construction of a bridge across the Minnesota River between Fort Snelling and Mendota.



CAPPELEN MEMORIAL BRIDGE, MINNEAPOLIS

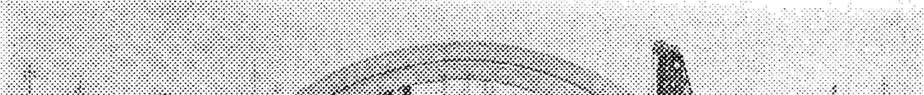
The Minnesota River widens out here into lowlands nearly a mile in width necessitating a bridge 4,119 feet long and 120 feet above water level. The bridge was designed by Walter H. Wheeler, consulting engineer, and the C. A. P. Turner Company, Associated, of Minneapolis. The total cost of the structure proper was approximately $2,000,000.00.

The bridge is a reinforced concrete arch viaduct with thirteen spans, twelve of which have a 285 foot clear width. Construction was carried on from a railway track trestle along the upper side of the bridge from which all cranes and the excavating buckets for sinking the caissons were operated. The steel centering for the arch spans was also moved along this trestle.

A 45 foot roadway is provided with two 6 foot sidewalks. Although the structure is designed to carry double street car tracks, they were omitted for the present and the entire roadway width paved with asphaltic concrete. The arches have two ribs spirally reinforced with the floor designed as a flat slab supported on single columns carrying the load to the arch ribs.

Due to the silt and glacial drift overlying the bedrock, sandrock in this case, to a depth of from sixty to eighty feet the foundation plan adopted consisted of four caissons sunk to sandrock for each pier. These caissons were hollow concrete cylinders formed by concreting successive sections at or near the surface of the ground as the caissons were sunk by excavating in the open the material from inside the cutting edge by a clam shell bucket operated from crane on the construction trestle previously mentioned. Above the ground the four caissons constituting one pier are tied together so as to form support for the arch ribs.

The contractor was the Koss Construction Company of Des Moines, Iowa. This bridge, requiring about two and one-half years for its completion, was opened to traffic in November, 1926. Of special note is the great length of the Mendota bridge and the low yardage of concrete per foot for a bridge of this height.



ROBERT STREET BRIDGE, ST. PAUL

Ford Bridge

Early in 1923 when negotiations for the location of the Ford Plant in St. Paul were completed, a bridge across the Mississippi in this vicinity to be financed jointly by the cities of St. Paul and Minneapolis was proposed and legislation passed authorizing the issuance of bonds and the construction of such a bridge. A joint bridge committee was designated in the enabling act to carry out the work of construction and design. The committee consists of C. M. Babcock, highway commissioner of Minnesota, chairman, Mayor L. C. Hodgson of St. Paul,

(Continued on page 192)

ENGINEERS IN ATHLETICS

Engineers Lose Hard Games in Intra-Mural Eliminations

By Ralph Blyberg, *Mech. Eng. '29*

THE winter season has been an active one in engineering athletics. Strong teams have been developed in basketball and hockey and the games have been hard and fast. In the playoffs for all-university championships, however, the engineers' teams have been unfortunate, losing in both branches of sport.

Basketball Standings

	Won	Lost	Pct.
Sophomore	4	0	1.000
Freshmen No. 1	3	1	.750
Junior	2	2	.500
Senior	1	3	.250
Freshmen No. 2	0	4	.000

Sophomores Defeat Freshmen

Shooting baskets from all parts of the floor the sophomore engineers on Thursday, February 24, defeated the freshmen, 22 to 15, to win the basketball championship of the engineering college. The sophomores took the lead early in the first half and never were headed again.

The entire game was marred by poor team work, and frequent fouling. The sophomores could have piled up a much greater score, if they had been more proficient in shooting free throws. Out of ten attempts the sophomores made four free throws good, while the frosh managed to cage but one out of seven.

The frosh had the edge on the sophs in the passing division of the game but the second year men were far superior in shooting. Morrison, sophomore center, managed to drop three long shots in the cage in spectacular style. He played a good game at the pivot position, but most of the advantage gained by his work was lost by poor passing and dribbling.

Centers seemed to be the stars of the game. Langenberg, center for the freshmen, led the first year attack, and garnered in six points, all on field goals. His dribbling was perhaps the best of any of the men on the floor, and his defense work did much in holding down the second year men's scoring.

Of the forwards, Shannon of the sophomores lead in scoring, getting three field goals and one free throw to his credit. His fight did much to bolster up the second year men's attack. Johnson, frosh forward, tallied five points.

The first half started in a slow fashion, most of the fouls being made in this half. The sophomores lead the frosh all through the half. The play was slow and baskets infrequent. The second year men lost many attempts to score via the free throw line, and the frosh also lost many points in the same way. The first half ended with the score 15 to 8 in favor of the sophs.

The freshmen started a rally at the beginning of the second half, but it was short lived. The second year scoring machine began to function in earnest, and they drew away to pile up a large lead on the frosh. The second frame was better than the first in that the play was much faster and penalties were infrequent. The end of the game found the sophomores on the long end of a 22 to 15 score.

The summary:

Sophomores (22)	FT	FG	PF
Shannon, R. F.	1	3	0
Christenson, L. F.	1	0	1
Morrison, C.	0	3	1
Cherne, R. G.	1	1	3
Weselik, L. G.	1	0	0
Mickey, R. F.	0	1	2
Kipp, L. F.	0	1	0
Meek, C.	0	0	0
Freshmen (15)			
Ellingson, L. G.	0	0	1
Harpal, R. G.	0	1	1
Langenberg, C.	0	3	2
Johnson, L. F.	1	2	2
Krema, R. F.	0	1	4
Rice, R. F.	0	0	0

Lawyers Down Sophomores

In the playoff series leading up to the all-university championship, the sophomore engineers were defeated in a hard-fought game on March 12, by the Lawyers, champions of the independent league, 18 to 16. The sophomores displayed the best basketball they have played this year in the game. Both teams did some good guarding and neither team slipped in for many baskets.

The play was fast throughout the game and the outcome was not certain until the final whistle blew. The second year men played as a well organized unit and got their passing game down well. The soph forwards, Shannon and Christenson, had their shooting eyes in good trim, and made the majority of the points. Christenson caged three pretty shots in the second half from well in the middle of the floor. Morrison did a good deal to bring up the soph's hopes with his work at center.

As the rounds in the intra-mural basketball race are elimination games the sophomores are through playing for the season. The men should make a good team next year as they played as freshmen last year and again this year. The lack of a coach has been the biggest drawback this season, and with proper coaching these men should be able to go a long way.

Engineers Lose in Hockey.

After winning their way into the finals, the engineering hockey team was defeated at the Arena Saturday, March 12, by the Chi Psi's for the all-university championship. The game ended 4 to 0 in favor of the Chi Psi's.

The engineers were clearly outplayed throughout the game, but they put up a game fight to hold the score down. Ed Tuohy, of the Chi Psi team, skated down the ice time after time for tries at the technical men's goal, only to be checked and lose the puck. The game was one of the best that either team had played.

The game started at a fast pace and it was soon evident that the engineers were to have a tough battle to keep the Chi Psi men from scoring. In the middle of the first period the Chi Psi wing slipped through the engineering defense and caged the first goal. The tempo of the game increased and the end of the period found both teams suffering from the furious pace.

All through the second period and the first part of the third frame the engineers held their own and kept the Chi Psi men from scoring. The game did not let down any in speed and the middle of the third period showed the engineers tiring. The Chi Psi's held their 1 to 0 lead until the last five minutes of play, when they rallied and slipped in three goals, all made by Ed Tuohy, Chi Psi center.

The Chi Psi's put up a good offensive game, and the technical men were more or less on the defensive throughout the periods. The engineer forwards threatened the Chi Psi goal on many occasions, however. The engineers entered the game somewhat at a disadvantage, not having played a game since about a month before, their schedule ending earlier than the academic's. The Chi Psi's, however, clearly demonstrated that they deserved the all-university title.

The line-ups are as follows:

Engineers	*Position*	*Chi Psi*
Parker	Center	Tuohy
Seeger	R. W.	Lutkin
Sider	L. W.	Ball
Thouren	R. D.	Carlson
Lande	L. D.	May
Halstead	Goal	McCaski

Spares: Chi Psi—Best and Fawcett.
Engineers—Eidsvold, Aske, Palmquist, Anderson.

NEWS FROM THE TECHNICAL CAMPUS

Senior Architects Win the Magney Tusler Prize

Paul Eaton and Lawrence Anderson, senior architectural students, were awarded first and second prizes respectively in the annual Magney and Tusler design competition, which this year had as a problem the design of an entrance to the rose garden at Lyndale Park, Minneapolis.

The prizes are $20 and $10. Honorable mention was given to Arthur Kastner, Al Flegal, and Paul Havens. Both seniors and juniors were eligible to the competition which started Thursday noon, and ended Saturday noon.

Subjects in previous years have been the following:

Floating Band Stand, '22
Gasoline Filling Station, '23
Temporary Stage for the Stadium, '24
Improvement on Stevens Park, '25
Monument for the Memorial Drive, '26

From 1923 till the present time the prize was won by L. W. Silverman. At present he is teaching at Harvard on a fellowship and he has recently distinguished himself as one of the five competitors who went through several preliminary stages in a national competition, which has as a prize a two year trip in Europe.

Memories of Camp Revived at Banquet of Senior Civils

The senior civil engineers grouped about the festive board in the engineering auditorium on the evening of March 1 for the last get-together of the class before it broke up at the end of the winter quarter when about a third of the class graduated. The banquet was to commemorate the civil camp at Cass Lake, Minnesota, which was held during the six weeks immediately preceding school last fall.

The engineers, dressed in the boots and breeches of camp days, started the program with the same roaring "Gesundheit" snake-dance with which they regaled the natives of Cass Lake and Bemidji on the night of their memorable pajama parade. This ceremony over, they turned enthusiastically to the stacks of meat, potatoes, and accessories which were placed before them, albeit with appetites that could not compare with those that greeted Eric, the cook, when he pounded the rusty circular saw under the pines of the north.

After the inner cravings were satisfied, lighter entertainment was furnished in the way of stunts by various members of the class, which were take-offs on humorous and ridiculous events which happened during the camp. During these acts many embarrassed young engineers furnished cause for amusement of the crowd, and even the professors were not spared in some of the stunts.

When the entertainment was over, the class presented Professor L. F. Boon with a pipe and Professors A. S. Cutler and O. S. Zelner with billfolds. A large photograph, tinted and framed, of the arch erected by the class at the campground was presented to the College of Engineering, and it will be hung in one of the corridors of the building.

Dr. Paul Leech Addresses American Chemical Society

The 138th meeting of the Minnesota Section of the American Chemical Society was held in the auditorium of the School of Chemistry on Thursday evening, March 3. The business meeting was preceded by a dinner at the Campus Club. At the conclusion of the dinner, the members adjourned to the chemistry auditorium, where they were addressed by Dr. Paul N. Leech, chairman of the Chicago Section of the American Chemical Society, on "Patent Remedies: Claims and Composition."

Dr. Leech in his talk, which was illustrated by lantern slides, gave a large amount of material which he has accumulated through his personal experience and research on the actual worth and harm of patent medicines.

Lloyd Hoover has been named chairman of Engineers' Day, and Porter Kilpatrick, a true son of the 'old sod, has been elected to the honor of St. Patrick.

The battle for the chairman of Engineers' Day ended in a 93 to 80 vote in which George Thwing was the opposing candidate. The seniors in their vote on St. Patrick were equally as close; Porter Kilpatrick, of crooning cowboy fame, won over Lawrence V. Johnson, the only other man in the race for the position, by a vote of 54 to 48.

Arabs to Give "Broadcast" as Musical Comedy

The Arabs have sprung into a concentrated, strenuous program of work on the next production, and the growth of the Arabs since the beginning of the quarter has been comparable with the program which they have taken upon themselves.

With the play "Broadcast" written, and music nearing completion, rehearsals of the parts, and the picking of the leading actors will soon take place. The play was written by Paul B. Nelson, former managing editor of the TECHNO-LOG, with the help of Lawrence Anderson, present art editor of the TECHNO-LOG and a senior architect. Paul Nelson has been named production manager of the show.

Since the appointment of Miss Mercedes Nelson as dancing instructor, engineers have layed aside their studies on Saturday afternoons, and have used their mathematical education by describing ellipses, and parabolas with their arms and legs on the dance floor.

Associate members of the club have been announced and the appointments of Avner Rakov as musical director, Henry Ogren as orchestra manager, Roy Irons as student chairman on singing, and Professor Otto Zelner as faculty chairman on singing have been made. The executive committee has been budgeting the play for this year, and work in preparation to making "Broadcast" rival any of the former productions has been going on steadily.

Inspection of Naval Reserve Aviation Unit Held

An informal inspection of the aviation unit of the United States Naval Reserve in Minneapolis was held in the Naval Reserve armory on February 17 by Captain Clyde W. Kelly, commanding officer of the Seventh Corps Area, Ninth Naval District, and Lt. Comdr. H. W. Scofield, commanding officer of the U. S. Naval Reserve Aviation Unit, Great Lakes, Ill.

This unit is designated as Division 2, Squadron VS-6, and will comprise part of a scouting squadron when mobilized in case of war. The division is composed largely of engineering students from the University of Minnesota. Lt. (jg) Frank E. Weld commands the division, and Ensign Earl D. McKay, C '15, is the executive officer.

At present about 15 students from the engineering college are attending ground school classes every Thursday evening in preparation for actual flight training which they will receive during the summer vacation. A like number of students are working in the mechanics division in an attempt to win mechanics' and radiomen's ratings in the U. S. Naval Reserve. They can then be detailed to Great Lakes, Ill., for 15 day periods for actual work on the ships with the privilege of receiving flights while on duty.

During the inspection Lt. Comdr. Scofield gave a short talk to the men outlining future prospects for this unit. He stated that the Navy Department was of the opinion that the Minneapolis division was the finest unoperating division in the United States, and that although there was little likelihood of the appropriations allowing an operating squadron to be located here this year, there was a very hopeful outlook for next year. In regard to the present training season at Great Lakes, he stated that there were five N-9 training planes, two N-Y training planes, and one U-O observation plane ready for the opening of the season.

Electrical Engineering Department Cooperates in Metermen's Short Course

Electric metermen will be instructed in the operation, theory, and care of electric meters at the metermen's short course, which is to be offered by the General Extension Division of the University of Minnesota in cooperation with the department of electrical engineering and the North Central Electric Association March 21 to 25. This is vacation week for students.

The course is especially offered for metermen employed in the meter departments of public service and municipal corporations, or in power and engineering work, and will consist of lectures, demonstrations, discussions, and laboratory test work.

Equipment is to be furnished partly by meter and service companies, and will be of many types. M. E. Todd, assistant professor of electrical power engineering, is in charge of the course, and is assisted by men from electric companies, and the electrical engineering department.

The
MINNESOTA TECHNO-LOG
University of Minnesota

THE technical colleges of this university occupy a unique position on the campus. In many ways they are considered as a single unit with similar purposes in view. In other ways they are entirely different in aims and outlooks and cannot be thought of as a single group. These colleges, whose student membership totals nearly 1,500 at the present time, include: The School of Mines; the School of Chemistry, whose enrollment is divided between the chemists and chemical engineers; and the College of Engineering and Architecture. The latter is further subdivided into the primary engineering groups, civil, electrical, and mechanical, and into the groups in the architectural department, architects, architectural engineers, and special groups such as interior decorators. There is also the more recent group of agricultural engineers.

All this motley throng of students, by reason of the technical training they receive, are considered by the campus at large as one group. Their buildings are located close together. They celebrate together on their annual Engineers' Day. They fight together on Class Scrap Day. All but the School of Mines are represented on the Engineers' Bookstore Board and on the Technical Colleges Athletic Board. And they are all served by one technical publication, the MINNESOTA TECHNO-LOG, and therein lies the difficulty and the reason for the above preamble.

Most of the work of putting out a publication like the TECHNO-LOG falls on the very few who are most intimately connected with it. These men are not usually distributed equally among the various colleges and if news and articles appearing in the magazine are to be truly representative of all the technical schools, there must be strong cooperation between the managers of the magazine and the students and faculty of these schools.

If numbers of active backers are indicative of cooperation, the TECHNO-LOG receives good support from two of the engineering departments and enjoys passive good wishes from the remainder.

A school with an enrollment of 1,500 should certainly have a strong means of self-expression, especially when that school is an integral part of a great university. The only such means available in the engineering colleges here is the TECHNO-LOG (except the Daily, whose purpose is different and whose news pertaining to engineering has been sadly lacking in accuracy), and its potential possibilities are decidedly not used to the maximum. Each department should have a page every month in which its activities and plans appear. The deans and heads of the various departments should all be able to keep direct contact with the student body through the medium of its columns.

To summarize, the MINNESOTA TECHNO-LOG, in order to fulfill its purpose, must have hearty support from *all* the technical colleges, and if every technical student were a subscriber, with all the interest that his name on the books implies, that support would certainly be forthcoming. It must be remembered that the TECHNO-LOG is always building for the future, and its membership in Engineering College Magazines Associated has stimulated this object more than the average student can possibly realize.

We greatly desire suggestions from readers of the magazine on how to build up along the line of true representation. Students, faculty, and alumni are strongly urged to write to this office, and more discussion of this subject will be held in later issues.

BY what process of reasoning does the editor of a technical or trade publication come to the conclusion that in order to be truly scientific, his magazine must be cold and distant? The pages must be stereotyped specimens of solid black type with but a few bold-faced cross lines appearing here and there to break the otherwise lifeless monotony. Even illustrations are the exception rather than the rule in some of the more extreme magazines. Covers are stamped-out products which stand aloof with an attitude of daring one to trespass within their austere depths.

The fact that a man is an engineer does not remove all human elements from his carcass. A technical profession does not necessarily set him apart from his fellow men in a world of integrals and logarithms. The engineer can open a journal that deals with his business and enjoy an attractive makeup as well as his artistic brothers in more delicate professions.

When each issue of a trade publication is opened with an expectancy that looks not only to the purely technical but also to the attractiveness of the magazine as a whole, that publication has surely accomplished a great deal that is denied to a less artistic paper. A very pleasing example of this is the Engineering News Record. The cover illustration itself, although invariably depicting some engineering activity, is always chosen with an eye to the beautiful or unusual. The interior of the magazine is always profusely illustrated with pictures and diagrams to make the technical articles more readable and more easily understood. Recently a series of articles entitled "The Civil Engineer in Industry" was illustrated solely with artists' sketches. One of the first issues of 1927 contained a pictorial survey of page after page of achievements in civil engineering that had occurred in 1926.

Such things help the engineer to remain a human being and yet absorb vast amounts of technical material from his trade journal without noticeable deformation of mind or body.

Through Campus and College

Engineering

By Charles Edward Lucke[1]

At the present time there are four major divisions of engineering that are fully recognized, and many others only partly accepted as proper divisions, and so of minor importance, either because of smallness of number of members or because of lack of real justification.

The four major divisions include mining and metallurgical engineering, civil engineering, mechanical engineering, and electrical engineering.

The engineering profession is a highly organized one, and the evidence of this, independent of its actual practice day by day, is found in the engineering societies, and in a most voluminous and fast-growing body of literature in the form of books and periodicals. Each of the four major divisions of engineering is represented by a national society in this country, with an aggregate membership of over fifty-five thousand, co-operation being secured through a central organization, which is in effect the national representative of the engineering profession. There are equivalent societies abroad, all maintaining contact and working together for the advance of engineering, without regard to language or national boundaries. In fact, engineering has developed a sort of international language of its own—its terms, its drawings, its methods, its materials, its appliances, and its products are understood by the engineers of all nations, regardless of their spoken language.

To enter the engineering profession a man must be trained, and a fair percentage must, in addition, be well educated to insure the vision and sympathetic contact with other men, especially non-engineers, that is so necessary to leadership of even the best-trained professional man. This training and education of engineers is also highly organized both in this country and abroad, and the very large number of students graduated each year by the engineering schools is immediately absorbed, with at least an equal number of men who succeed in rising from the ranks of the trades, and who, by study, qualify as professional engineers. In the engineering schools of the U. S. there are fifty-six thousand students.

As a rule, the engineering schools of Europe are independent of the old universities, and in this country there are many such independent schools. It is quite typical of the United States, however, that most of our best universities have established engineering schools on a par with the law school, the medical school, and with the non-professional departments of university scholarship. This is regarded as a great step forward, because of the resulting contact between the representatives of the different professions affecting professional standards, and, in addition, the contact of the professional-school professors and students with the great body of non-professional scholars making up the rest of the university.

There is no more promising career conceivable today than that which engineering offers a young man of the right type. Everywhere, in every walk of life, are young men with the will to work, especially at jobs that are interesting and free of monotony, young men with the creative instinct, an inborn desire to make something. This is the same feeling that prompts the artist, the sculptor, the musician, the writer, the carpenter and the machinist, the tailor or the builder, the true business man and banker with pride in the business and its usefulness, rather than the profits that may be squeezed out of it, and fortunately this is the case with most that succeed. Every young man who feels that he would like to really do things, and there are many who would if only they were told the story of things to be done, is a possible recruit for the engineering army, and for him engineering is a possible career. There must, of course, be sufficient mental capacity to stand the test of training, to grasp the laws of nature that must be learned as part of the training, and later on to learn to play the game of solving the problems that are engineering as a sport where the game is the thing; a most absorbing, clean, satisfying and unselfish game, the game of making nature work for man as man works for himself and his fellow-man, the finest and greatest game in the world—engineering.

[1] Head of the Mechanical Engineering Department, Columbia University, New York, N. Y.

The above reprint is an excerpt from a lecture by Mr. Lucke printed in *Mechanical Engineering*, November, 1926.

FACULTY SKETCHES

FRANKLIN W. SPRINGER

Franklin W. Springer, Professor of Electrical Engineering, and acting head of the department of electrical engineering, was born at Anoka, Minnesota, in 1870. After finishing his high school education he attended the University of Minnesota, where he received his B. E. E. degree in 1893. Five years later he received the E. E. degree from the same school. In 1900 he was made an assistant professor at the University of Minnesota. In 1908 he was raised to the rank of full professor, and was acting head of the department in 1912 and 1913. In 1925 and 1926, during the absence of Professor G. D. Shepardson, Mr. Springer again served for the head of the department, and in 1926, upon the death of Mr. Shepardson, Mr. Springer was made acting head of the department.

In 1900 and 1910-11, Mr. Springer made trips to Europe. He studied in Berlin and Paris and inspected a large number of schools and factories. As a result of these studies, several technical articles appeared in a number of foreign magazines.

A part of Mr. Springer's professional experience was gained while with the Twin City Rapid Transit Company. In 1898, as an employe of the company, he assisted in solving commutation problems and solved the bucking motors problem. He also devised a type of series-parallel street car controller, which was in use during the life of the four-wheel cars, and which saved about twenty percent of the power previously used by the cars, thus delaying the building of a new power station for several years.

A large number of improvements are the direct result of Mr. Springer's unceasing attempts to simplify the work in the electrical laboratory. To him is due the credit for the laboratory functional plans, the system of arrangement of power panels, the electrical distribution, and the transportation service system used in the new electrical building.

In addition to his professional engineering interests, Mr. Springer is vitally interested in educational systems and their allied problems, particularly as applied to the teaching of electrical engineering. He has made an extensive study of schools, both in this country and abroad, and as a result he has written a number of articles, several of which have been published in national periodicals. One of these, "The Spherical Want System," appeared in 1912 as a series of six articles in the Minnesota Alumni Weekly. It appeared as a complete article in the S. P. E. E. Bulletin in 1913. In 1924 it again appeared as a digested article in the S. P. E. E. Bulletin, and also in the Alumni Weekly of February 26, 1927.

Mr. Springer is a member of Tau Beta Pi, Sigma Xi, Kappa Alpha Sigma, Eta Kappa Nu, and Delta Upsilon fraternities. He has served two terms on the Board of the Minnesota F. A. E. S., and has acted on the instruments and measurements committee of the A. I. E. E. He has also served as local chairman and national vice-president of the A. I. E. E. He is a member of the S. P. E. E. and a fellow of the A. I. E. E.

AROUND THE WORLD WITH OUR ALUMNI

ARCHITECTS

'24 AE—All Minnesota men who drift down to Memphis, Tenn., must be sure to look up Lawrence A. Tvedt, who is working for the Gauger-Korsmo Construction Company of that city. He writes:

"Not many Minnesota engineers are in Memphis. Bob Kranzfelder (Arch. Eng. '26) is with us as 'cost man' on an eight story garage job here in Memphis, while 'yours truly' still functions, or tries to, as estimating engineer for the company. The two of us will gladly act as a welcoming committee for other Minnesota men coming to these parts.

"Pretty nearly forgot to mention another Minnesota engineering graduate who is located here, namely, Mary Slocumb (Int. Dec. '25). Had to add this to keep peace in the family as aforesaid person is now known as Mary Tvedt."

CHEMISTS

'25—John B. McKee has accepted a position as chemist in the laboratories of the Solvay Process Company at Syracuse, New York.

'25—Alvin M. Edmunds is now a chemist for the Dow Chemical Company at Midland, Michigan. Mr. Edmunds was formerly connected with the United Alloy Steel Corporation of Canton, Ohio.

Dr. A. W. Ganger, a former student at Minnesota, has recently been placed in charge of lignite investigations in the School of Mines at the University of North Dakota.

CIVILS

'12—Edward L. Haberle has been with the bridge department of the Great Northern Railway Company for several years, and at present is assistant engineer in that department.

'12—H. Seymour Swenson is with the Hustad Reinforcing Steel Company in Minneapolis.

'13—Donald W. Webster, who has been with the State Highway Department most of the time since his graduation, now holds the position of assistant construction engineer.

'17—George O. Fossen is an estimator for the J. & W. A. Elliott Company of Minneapolis.

'20—Irving B. Purdy recently sent us a letter with the letterhead, "Billman-Purdy, General Contractors, Lakeland, Fla." Mr. Purdy states that at present he is bucking post-boom conditions down there, but that the prospects for the future are promising.

'21—George M. Christilaw has been a resident engineer for the Minnesota Highway Department for the past three years. He is at present resident at Lake City, Minn., working on the pavement from there to Rochester.

George L. Brown, who left school in 1920 (C. E. '21), became City Engineer of Austin, Minn., in 1925. Before that he was in the Engineering Department for the city of Flint, Mich.

'23—George C. Schaller is in St. Louis, Mo., engaged on the construction of the large municipal stadium there.

'24—R. Louis Bevan is one of two junior engineers on the new Cedar Avenue bridge job, working under Mr. Paul, construction superintendent.

'24—"Any Minnesotans who want to work hard in a God-forsaken country are welcome in Australia," declares George Bestor. "There's money here but not much else. Would surely like to get some Yanks over here as it takes dynamite to make an Australian hustle.

"For the past few months we have had a bit of a Minnesota colony here. Martha Bartlett ('24) arrived here June 9 and was married to Kenneth E. Smith (Dartmouth, '25), secretary of the Southern Cross Service Company. Cedric S. Cady, who had one year in the Ag class of '17 at Minnesota was here for three months as superintendent of operation of the company. He is now in the United States but may return soon. My sister, Flora Bestor, was here three months and left recently to join the class of '28 at the University of Minnesota.

"Mr. Smith and I started a couple of service stations here early this year. A company was formed and there are now eight in our chain and we are the largest petrol (gasoline) seller in eastern Australia.

"Three or four other Minneapolitans live here in Melbourne, but I believe there are no Minnesota students."

ELECTRICALS

Herbert H. Wheeler, E. E. '17, Charles S. Lemarest, E. E. '11, and Arthur G. Chapman, E. E. '11, are all with the A. T. & T. in New York City. Mr. Wheeler is engaged in developing standardized construction work for the Western Union Telegraph Company.

'20—Walter J. Larson is now doing foreman training work at Ohio State University in connection with the Euclid Lamp Works of the General Electric Company.

'21—Alva W. Merritt left the Westinghouse Electric Company last year to accept a position as assistant division engineer for the Little Falls-Cuyuna division of the Minnesota Light and Power Company in Little Falls. Merritt was married on November 12th last to Lillian Elizabeth Eby of Duluth, Minn.

'21—Roy A. Palmer was transferred last year from the National Lamp Works (G. E. Co.) in Cleveland to the sales promotion and illuminating engineering department in Los Angeles, Calif.

MECHANICALS

'19—Ross M. Foltz is General Manager of the Obenberger Forge Company of Milwaukee, Wis., which position he has held since 1919.

'20—Glen Cerney has been working for the Standard Oil Company in India since graduation. He has now returned home and will join the sales force of Noble & Co., Southeast Real Estators.

'23—Rudolf Kuhlmann, former tennis star, is in Providence, R. I., in the Oil-O-Matic business. Rudie has been with the Williams Oil-O-Matic Company, but in November of last year went into business for himself, forming the Providence Oil-O-Matic Equipment Company.

George W. Foltz, who left the M. E. '23 class in 1922 to enter the U. S. Naval Academy at Annapolis, graduated last June. He has since been assigned to aviation training at Hampton Roads, Va., and Guantanamo Bay, Cuba, the assignments being interrupted by a few cruises on the U. S. S. Florida. Foltz was married on July 3, 1926, to June Evelyn Crane of Boston, Mass.

'24—Stanley B. Tuttle is now supervising test engineer with the Fairbanks Morse Company at Beloit, Wisconsin.

'24—Harley Langman is working for Proctor and Gamble. He has recently been made supervisor of production at their Kansas City plant.

'24—Arthur L. Olson is at present sales research engineer with the Aluminum Goods Manufacturing Company at Manitowoc, Wisconsin.

'24—Charles R. Blodgett is located in the production and scheduling department of the Federal Electric Company at Chicago.

'24—Paul M. Boyd has been in the engineering department of the Curtiss Aeroplane and Motor Company for some time. The plant is at Garden City, Long Island.

'24—Joe Anderson is with the A. C. Spark Plug Company in the inspection department of the plant at Flint, Mich.

'24—Kenneth Ross has been made sales engineer in the industrial department of General Electric at Chicago.

'26—Theodore R. Corbett, former associate editor of the MINNESOTA TECHNO-LOG, is working for the John Hancock Oil Company in Minneapolis

Engineering in the Flour Mills

(Continued from page 171)

training of employees in the use of safeguards, and by education reduces the number of accidents. This is a comparatively new field, but the larger corporations have done much to make their plants safe places in which to work. Millers also have the close engineering cooperation of the casualty insurance companies.

Grain elevator construction is a highly interesting field where modern engineering has quietly accomplished a complete revolution in materials and methods in less than twenty-five years.

Wooden cribbed bins for the storage of grain, are still used in small country elevators, but as terminal and flour mill grain handling operations grew rapidly, attention was turned to more satisfactory materials and tanks were constructed of steel, brick, and tile. The first reinforced concrete grain tanks in the United States are not yet twenty-five years old and today this type of construction is practically the only method used for big work on this continent.

The use of moving forms makes it possible to pour the tank walls practically monolithic from bottom to top, and the speed of construction is such that it is possible regularly to pour the tank walls from 100 to 115 feet in height, in 10 to 12 continuous 24-hour days, representing a storage capacity of as high as two million bushels in one group of tanks.

The mechanical engineer was early called in on problems connected with power transmission, shafting, gears, belting, bearings, and with installation and maintenance of equipment.

Steam power came into use when millers with vision stopped thinking that their business must be seasonal in character and that it was reasonable or necessary to shut down when water was no longer available. The small type of high speed slide valve engine first used in small units was soon displaced by the Corliss engine in units of from 1,000 to 2,500 horsepower. In recent years attention has been given to the Uniflow and Poppet valve engines, and in some cases combination installations have been made where the exhaust steam can be used for heating purposes in the winter, which is the low water period when steam power is normally required.

Steam turbines have been frequently installed for reserve power in connection with generators, or by means of reduction gears, connected with the mill shaft.

Combustion engineering affords a field for study in large milling power plants where several hundred tons of coal are burned daily. The increasing use of electric power tends to limit the size of mill steam plants, as electric power can be purchased from central stations where modern developments make it possible to generate and transmit power at a saving over the cost in individual plants.

Mechanical maintenance and construction of new equipment is a large field and many milling plants operate highly specialized shops or departments that compare favorably with outside shops doing commercial work. These shops include the machine shop, working on equipment and roll grinding and corrugating; belt shop; sheet metal shop; electrical repair shop, plumbing shop; carpenter and pattern shop; millwrights; steam and water piping shop, and others.

Invention has stimulated milling progress. The history of modern milling is a fascinating story of the development of new methods, new machines, one improvement following on another. Most of these inventions have been made by the practical men directly concerned in milling operations but they have been assisted and encouraged at times in their work by men of engineering training.

It has been said that the roller mill, and the "Patent Process," or gradual reduction system, was primarily responsbile for the development of milling in the northwest, because previously the flour made from northwestern hard wheat ground on the Buhr stone mills was dark in color, and compared unfavorably with the flour from eastern soft winter wheat.

The handling of materials in bulk by means of conveyors or elevating machinery is a typical American departure from previous practice in other countries. Modern grain handling is the result of much engineering study. Similarly in flour mill practice, continuous handling methods make a complicated mill, which requires innumerable machines operating together as one unit in a continuous process from the time the wheat leaves the bins until the finished flour is placed in the bins ready for packing.

Package handling similarly in recent years has responded to improved methods, using conveyors and special equipment. The automatic equipment for packing, weighing, and handling flour packages in sacks or cartons is a marvelous instance of engineering development.

Electrical engineering touched flour mill practice first in lighting, then in signalling, communication, supervisory service, and in power in recent years, with the development of alternating current motors.

The study of explosion hazards at an early date resulted in the adoption of electric lighting for flour mills, superseding the use of lanterns or gas jets with safety mantles. Some of the earliest industrial electric lighting installations were in the flour mills at Minneapolis.

Direct current was never used extensively for motors in flour mills because of the early satisfactory use of other power, but when the alternating current motor was developed, its advantages were quickly realized for installation in grain handling elevators where the squirrel-cage type of induction motors could be successfully used.

The slip-ring or wound rotor type of motor is used only in the larger sizes, frequently direct connected to the main

Reproduction of two-page Timken Advertisement in The Saturday Evening Post

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line shaft, where heavy starting torque is required. These for the most part are comparatively slow speed motors from 240 to 360 r. p. m.

Recent recognition of power factor correction and its advantage to both central power station and to the consumer has led to the use of synchronous motors in some installations, the load being taken care of either by magnetic clutch or direct connected with specially designed motors.

The advantages of electric power have been in convenience of installation, lower total investment than when a combined boiler and steam plant is required, flexibility in operation, and usually lower operating charges.

The control and distribution of electric power has required engineering study in adapting to milling requirements, developments by the manufacturers. Special equipment has frequently been furnished to meet conditions requiring dust proof installations. Practice has in recent years become standardized on three phase sixty cycle current, 440 volts for small units and 2,300 or 4,000 volts for larger units. In special fields like the district near Niagara Falls, 25 cycles remains because of the early development at this lower frequency.

Electrical maintenance, operation, and supervision, with particular study of clauses in purchased power contracts regarding demand charges, or power factor savings, fall under engineering supervision. Motor repairs, rewinding, or replacing of entire sections of laminations of motors of 1,000 or 1,500 h. p. have been successfully handled by milling electrical crews.

Other related activities, each involving a special phase of engineering of importance to the flour mills, in the design, installation, or supervision, are heating, ventilation, humidity control, refrigeration (for drinking water or cafeteria stores), freight and passenger elevators, and weighing equipment (a wide range of scales both manually operated and automatic).

Modern chemistry has contributed much to milling. Although not falling strictly within the field of chemical engineering, as milling processes involved are physical rather than chemical, nevertheless chemistry has given much valuable information to those directly concerned with the selection and purchase of the wheat, and those in charge of manufacturing it into flour. Within less than thirty years, our modern methods have been developed for testing flour and assisting the process of bread making, as well as testing the materials entering into the use of flour commercially by the baker. Chemical tests of other materials, such as coal, oil, fabrics, and many other items are a part of the service rendered by chemistry to engineering in flour mill work.

A knowledge of costs is vital to engineering in flour mill practice, as elsewhere. With the growth of operations, and changing conditions, large projects for new construction are frequently required. Estimates of costs based on careful design must be prepared so that decisions and appropriations can be made. Operating costs are vital and this knowledge may influence the design of new plants or govern the placing of business where a concern is operating several plants.

In contracting for large construction projects, engineering is called in to prepare plans and specifications, to supervise the letting of contracts and the performance of the work, together with approval of payments during construction. A knowledge of local ordinances and laws, together with the essentials of contract forms and practices is essential to engineers in this work.

Organization has been carried to a high degree of efficiency in modern flour mills. Requirements have been studied and the most efficient means of meeting them have been found and applied. Frequently this has meant separating func-

Error—In the February issue, the heading of the article on radiant energy was not written by the author, and is in error in that electronic bombardment has nothing to do with the science of photochemistry except in an analagous way.

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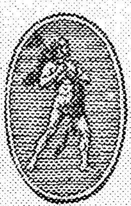

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Careful study of organization shows that the major considerations are human. The individuals of an organization are the channels through which ideas are put into operation. They require selection, training, cooperation, proper means for interchange of information, good will, the proper setting of standards, and rates of pay.

This phase of engineering has been characteristic of the larger mill organizations and in plant management has been accepted as fundamental long before the days of the "Efficiency Engineer."

In the field of management, engineering is finding recognition. Management is being governed more by facts and principles and less by guess or personal opinions. It is highly desirable that the engineer as an individual studies management, as it is the field that is filled by his employer. His understanding will ultimately determine what value his services are to the organization as a whole. His vision and effort alone will determine how far his training and experience will contribute to the success of the company, and how far he can fit himself to share in the responsibilities and the rewards of management.

Of the other phases of the milling business, the engineer is interested very directly in sales, purchasing, finance, and the whole field of economics. He may think of them as being in the background, and not directly the factors in engineering problems, but as they are always the determining factors which govern the business as a whole, they are of vital interest to him.

When next you cross the river at night and see the lights twinkling in those buildings that were built in the days of your grandfather, hear the rumble of the wheels, and see the reflection of the light in the moving water that turns them, you can analyze those impressions of magnitude and mystery, and see that you understand and are responsive to the forces that are there in operation.

With Our Alumni

'25—The 1925 civils have packed their slide rules and hand-books and departed far and wide. They are located all over the western hemisphere from Carl Gerdes in Maracaibo, South America to George Nelson in Juneau, Alaska, and from Fred Larson in Albuquerque, New Mexico, to Art Hanson in Philadelphia, Pa. Gerdes and Larson are both on plane table surveying, Nelson is on topographical surveying, and Art Hanson is a safety engineer for Hartford Accident and Indemnity Company.

According to a recent news letter of the class, they are divided as follows:

17 are working for various railroads.
8 are working for various Highway Departments.
7 are connected with contractors.
6 are with the Government.
4 are with steel companies.
3 are with public utility companies.
3 are in sales work.
2 are with insurance companies.
2 are connected with the University of Minnesota.
1 is with the Standard Oil Company.

With Our Alumni

ELECTRICALS

'11—Major R. E. McQuillin, who has been on duty at the Cavalry School, Fort Riley, Kansas, for the past few years as instructor in signal communication, is now serving with the Seventh U. S. Cavalry at Fort Bliss, Texas.

'19—Donald Marshall has been transferred to the Staten Island Factory of Proctor and Gamble Manufacturing Company, as assistant superintendent.

'24—Edgar M. Nelson, who completed the student course of the Ohio Bell Telephone Company, Cleveland, Ohio, was assigned to the division traffic engineer's office at Cleveland.

'25—Harry J. Winslow is instructor in mathematics at Evansville College, Evansville, Ind.

There is nothing that is deep, difficult, mysterious, or profound when it is fully understood.

Under the Surface

(Continued from page 169)

meter operating solely on one 45 volt "B" battery, and standardizable to calibration conditions by one adjustment, has been developed. The low range electron tube volt meter, in contrast with the low range dynamometer type and other electro-magnetic types, requires no measurable current or power to actuate it, and in this respect replaces the unsatisfactory electrostatic voltmeter. A further distinction is that the frequency (below very high frequencies) has no effect on the calibration.

Three former electrical engineering graduates have returned this year for work in communications subjects. Mr. C. L. Greene feels that he needs more work on vacuum tubes, and is back taking the radio course and is also investigating the properties of various tubes.

Mr. E. G. Albrecht and Mr. R. B. Johnson have been interested in carrier frequencies in cables. The object of the experiments is to determine the attenuation in No. 19 and No. 22 gage cables at frequencies from 100 to 50,000 cycles. In order to make the tests arrangements were made with the telephone company for cable pairs from the university to the Dinsmore exchange. An interesting phase of the problem is that coupling is secured by the capacity between one pair of wires in the core of the cable to all the other pairs. Favorable results along these lines will indicate that subscribers' lines may be simultaneously used for various purposes.

Mr. H. Tholstrup is making an investigation of the properties of oscillators and "B" battery eliminators. A study of the wave form in each of these units is being made for future use in the department.

It will be remembered that last year a system for automatic remote control of the broadcasting station from the Nicollet Hotel studio was invented and perfected by Mr. Hilliard, then doing research work in the department.

The only defect in this system was the fact that the operator in the Nicollet Hotel had to use a receiving set to monitor the station while it was on the air. As this station is the stand-by for WCCO, in case of trouble with the latter plant, a more efficient and convenient automatic monitoring system is desirable. Mr. L. H. Weeks is making an exhaustive study of the situation, and is well on the way to a solution of the problem. He is not quite ready to announce the detail till complete tests have been made, and the success of the invention assured.

Students in the department have developed a complete telephone exchange for use in the laboratory. This exchange is a model set-up embodying all the usual features of an exchange such as busy back, audible ringing, flashing recall, and jack for station party lines.

In connection with the oscillographic work in observation of alternating current phenomena, students studying transients are developing a synchronous motor switch by means of which it will be possible to cut in on any part of the voltage wave. This device insures accurate oscillograms.

Students studying telephone transmission characteristics are conducting experiments dealing with interference from power lines. An experimental power line, and telephone lines, are available for these investigations in the third floor hall. The power line is capable of carrying from 300 to 400 amperes for a short time. The current for this circuit is obtained from a welding transformer. The insulation of the line is such that 10,000 volts can be applied to it with

safety. Some very good quantitative results on electromagnetic and electrostatic induction are expected from this investigation.

A broadcasting station operating under the call letters W L B has been in operation at the university for nearly two years. Data taken from the operation of the station is used in research problems dealing with radio transmission. Material improvement of the station has taken place just lately. A new monitoring system has been installed. The remote control system invented last year has now been installed as a permanent piece of apparatus. A new antenna system has recently been erected, and it is hoped that under these improved conditions a much greater field will be covered, thus giving more ample data for the research problems being investigated.

A number of problems relative to short wave transmission and operation are under consideration by members of the staff of experimental station 9 X I. The station has been in continuous night operation since the opening of the fall quarter, and it is expected that many interesting facts may be deduced from the data compiled. It is interesting to note that out of over three hundred stations worked, over one hundred were foreign stations.

Power

Mr. H. R. Reed and I. C. Benson are studying leakage reactance of self-starting synchronous motors, and squirrel cage and wound rotor type induction motors. They have devised methods and set up formulas for calculating the leakage reactance of this type of machinery. In connection with this investigation, it was necessary to study the current flow in squirrel cage windings. To accomplish this, several special types of squirrel cage windings were constructed and the flow of the current in the different parts of the winding studied by the means of calibrated oscillographic elements.

Mr. Ikel C. Benson is making a study of the operation of synchronous motor fly-wheel requirements for such reciprocal loads as air and ammonia compressors. By cooperating with the Electric Machinery Manufacturing Company arrangements have been made whereby a very complete set of tests will be made on one or more motors in a local ice manufacturing plant. Fourier's series is being applied in a very interesting way to determine the periodical variation in the crank effort.

Mr. G. F. Corcoran and J. P. Barton are making a detailed oscillographic study of the starting currents in polyphase induction motors. Special attention is being given to the effect upon the starting transient of various types of squirrel cage rotors. The flux distribution in the air gap is also investigated by means of an oscillograph. There is available for this study an especially designed experimental motor with 13 rotors furnished by the General Electric Company. The operating characteristics of this same motor are being investigated by Mr. Earl Jacobson and Mr. A. C. Green, students in the Alternating Current Laboratory course of the General Extension Division.

Mr. Marcus Fiene is studying methods of commercial transformer design. In connection with this study, he will determine the type of design which will give minimum cost of transformer, also the type of design that should be used for any given transformer load to give the best operating characteristics. The investigation will further cover the cost of operating transformers of various types with various conditions of loading. The effect of the type of winding and the arrangement of the coils for disc type windings is being studied experimentally on a small core type transformer.

P. R. Lee, E. L. Bottemiller, C. H. Weber and P. B. Speer, senior electrical engineers, are designing and testing a device for the use of an electric dynamo-

(*Continued on page 194*)

Twin City Bridge Construction

(Continued from page 175)

O. J. Turner, president of the City Council of Minneapolis, Commissioner John H. McDonald, Department of Public Works, St. Paul, and N. W. Elsberg, city engineer, Minneapolis. In 1924 Mr. Elsberg and the writer were instructed by the committee to prepare the necessary plans and specifications. M. S. Grytbak, bridge engineer of St. Paul, was engaged as chief draftsman in charge of design and later as superintendent of construction.

After a discussion of various sites, that of Ford Avenue, St. Paul, extending across the river in a direct line was selected, the Minneapolis approach thence swinging to the north and west to meet 46th Avenue and 46th Street. A separation of grades for the River Boulevard is provided at the St. Paul approach and for Godfrey Road at the Minneapolis approach.

The bridge is located a short distance above the high dam which forms a pool approximately 1000 feet wide and 35 feet deep. With an additional 35 feet of sand and gravel above bedrock, the foundation problem presented the most difficult feature of the entire design. Thorough borings with core drill samples were taken across the site, these borings disclosing a sandrock strata underneath the gravel and approximately 70 feet below the water surface lying very nearly level entirely across the river.

The bridge is 1,522 feet long and has a maximum height above water of 100 feet. The three main arch spans each consist of two arch ribs with clear span of 300 feet each and the smaller end spans are 139 feet each. The roadway is 40 feet wide with two 9 foot walks. The bridge is designed for heavy traffic and for a double street railway track which will be installed this spring to provide still another inter-urban line. Combined light and trolley poles are provided at the curb line.

The construction was carried on by single cableway with 135 foot timber towers on each bank. The central mixing plant and yard was located on the Minneapolis bank. All steel centering, concrete buckets and practically every construction operation except the piling was handled from this cableway.

Of particular interest is the pier construction of this bridge, the piers being carried down to solid rock a depth of 70 feet below water level. With practically 35 feet of water above the gravel, coffe dam construction was extremely diffi cult. It was, however, successfully ca ried out by driving single steel sheet pi ing 50 feet long about each of the tw center piers. Forms for the four con crete caissons of 10 foot inside diamete were located in their proper position i side of the coffer dam of each pier. Th caisson shell was concreted in this pos tion and the cylinders sunk to rock with out accident or failure. The bottom be of the caisson cylinders was 19 feet diameter and the excavation inside wa made with clam shell and orange pe buckets, all four of the cylinders bein lowered equally. In order to sink th cutting edge entirely to rock, in sever cases it was necessary to put down a je and wash out boulders and gravel fro underneath. Following the sinking o the cylinders the interiors were fille with concrete and a 10 foot thick sla of concrete poured about the tops for th entire area of the pier. The water wa then pumped from the coffer dam an the pier construction carried above wate line.

Each of the arch spans consists of tw arch ribs. The 300 foot ribs are eac

5 feet thick and 12 feet wide at the crown and 9 feet 9 inches thick at the spring line. The arch ribs were constructed on steel centering which for the 300 foot spans was furnished by the Blaw-Knox Company. This centering was supported on wooden piling driven to refusal in the gravel bottom. The floor system is of beam and girder construction, the paving being brick on the bridge proper and sheet asphalt for the approaches. Construction has progressed rapidly since beginning in 1925 and the structure will be completed and open for traffic about July 1, 1927.

The cost of the bridge complete including the two approaches will be about $1,530,000.00. The James O. Heyworth Company of Chicago are the contractors.

Such a description of past and present bridge construction would not be complete without bringing to mind some of the important features affecting permanency and maintenance cost on a modern bridge. With the extremely high cost of bridges and bridge approaches, permanency of construction becomes more and more a necessity. Care during construction so as to obtain dense and impermeable concrete must be taken. When the fatigue of both steel and concrete over a long period of years are taken into consideration it is evident that the unit stresses should not be too high. With the severe winter climate existing here and the alternate spells of freezing and thawing which occur during the spring and fall, water proofing must be applied to portions of the bridge subjected to moisture if the proper service and life is to be obtained. The location and details of construction of expansion joints must be well studied. In the future as never before the engineer will be called upon to build for permanency.

Under the Surface

(Continued from page 190)

meter on motors and generators of varying types and sizes.

Mr. A. W. Shultz and Mr. H. A. Anderson are investigating and testing the power demands of the various types of farm machinery.

Mr. L. W. Lewis is making a study of electric controllers for different kinds of electric machinery.

The problems mentioned above give only a limited idea of the amount of research which is carried on in our own college of electrical engineering under our very eyes. The new building is very well adapted to research and thesis pro-
lems due to the very special design, a
now that we are nicely settled in
building it is expected that even th
amount of work will be increased.

In a limited article of this kind it
impossible to describe in detail all t
various problems in process of comp
tion in the engineering college at lar
or even to give complete information
the few which have been discussed.

To the undergraduate engineer
would say, "Look around you. See f
yourself what is going on in the ne
vicinity, and profit by your observatio
to the utmost of your ability."

WHAT HAPPENED TO LIL?

A note book was found on the alle
this week and the following notatio
were found listed under office expen

Oct. 3—Adv. for girl stenog. .$.
Oct. 6—Violets for new stenog .
Oct. 8—Salary for new stenog 15.
Oct. 11—Roses for new stenog. .. 3.
Oct. 15—Salary for new stenog 20.
Oct. 15—Candy for wife.. .. ..
Oct. 19—Lunch with Miss——— 10.
Oct. 22—Lillian's salary .. .. 25.
Oct. 25—Theatre and supper with stenog .. .. 22.
Oct. 26—Fur coat for wife.. .. 625.
Oct. 26—Adv. for male stenog. .. .

—*National Petroleum Ne*

The MINNESOTA TECHNOLOG

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APRIL

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MEMBER ENGINEERING COLLEGE MAGAZINES Associated

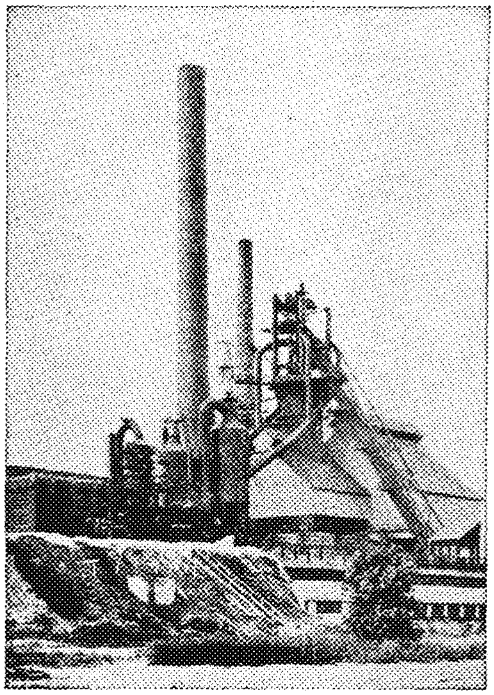
Devils for Rough Work—
Yet Delicate in Design

The steel industry demands and is using Otis Furnace and Bell Hoists for their modern blast furnaces. These may be in continuous operation night and day for periods of from three to seven years, depending upon business and life of furnace lining. Hence the Otis Hoist and Otis automatic controlling mechanism must be extremely reliable and constructed to withstand the severe strains and wear imposed by years of continuous service.

One of the most important features in connection with furnace hoists is the question of continuous operation. The machines must be entirely dependable, so that there will be no shutting down for repairs, as it is a very expensive matter to shut down a complete blast furnace, which would be necessary if the hoist were out of service.

The filling of the furnace itself is done by one man, all operations being so interlocked that the operators cannot deviate from the prescribed schedule. The furnace is filled by means of skips operated by Otis automatic electric hoisting machines. The materials used are ore, coke and limestone, each load of a kind being dumped into the skip from a car carrying material from the bins.

As the skip reaches the top of the furnace, it automatically delivers the material onto the upper valve or small bell of the furnace. As the skip starts down, an automatic device starts the small bell operating mechanism, allowing the small one to open and deposit the material on the lower valve or large bell. After a number of predetermined loads of the various materials have been deposited on the large bell, the automatic device starts this into motion, allowing the full load to slide off the bell into the furnace.

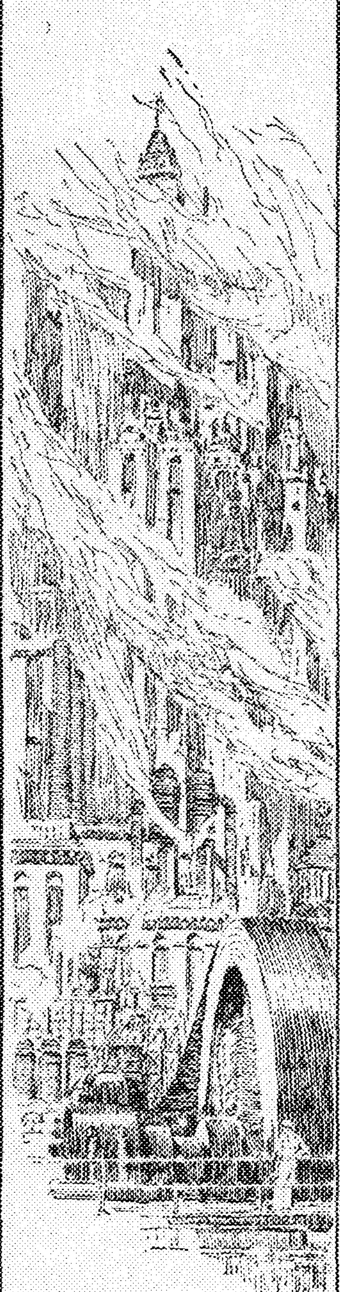


BLAST FURNACE WITH HOIST
Central Alloy Steel Corporation, Massillon, Ohio

THE WORLD'S WORD FOR ELEVATOR SAFETY — Otis

OTIS ELEVATOR COMPANY

Offices in All Principal Cities of the World



THE MINNESOTA

TECHNO-LOG

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VOLUME VII. MINNEAPOLIS, MINN., APRIL, 1927 NUMBER 7

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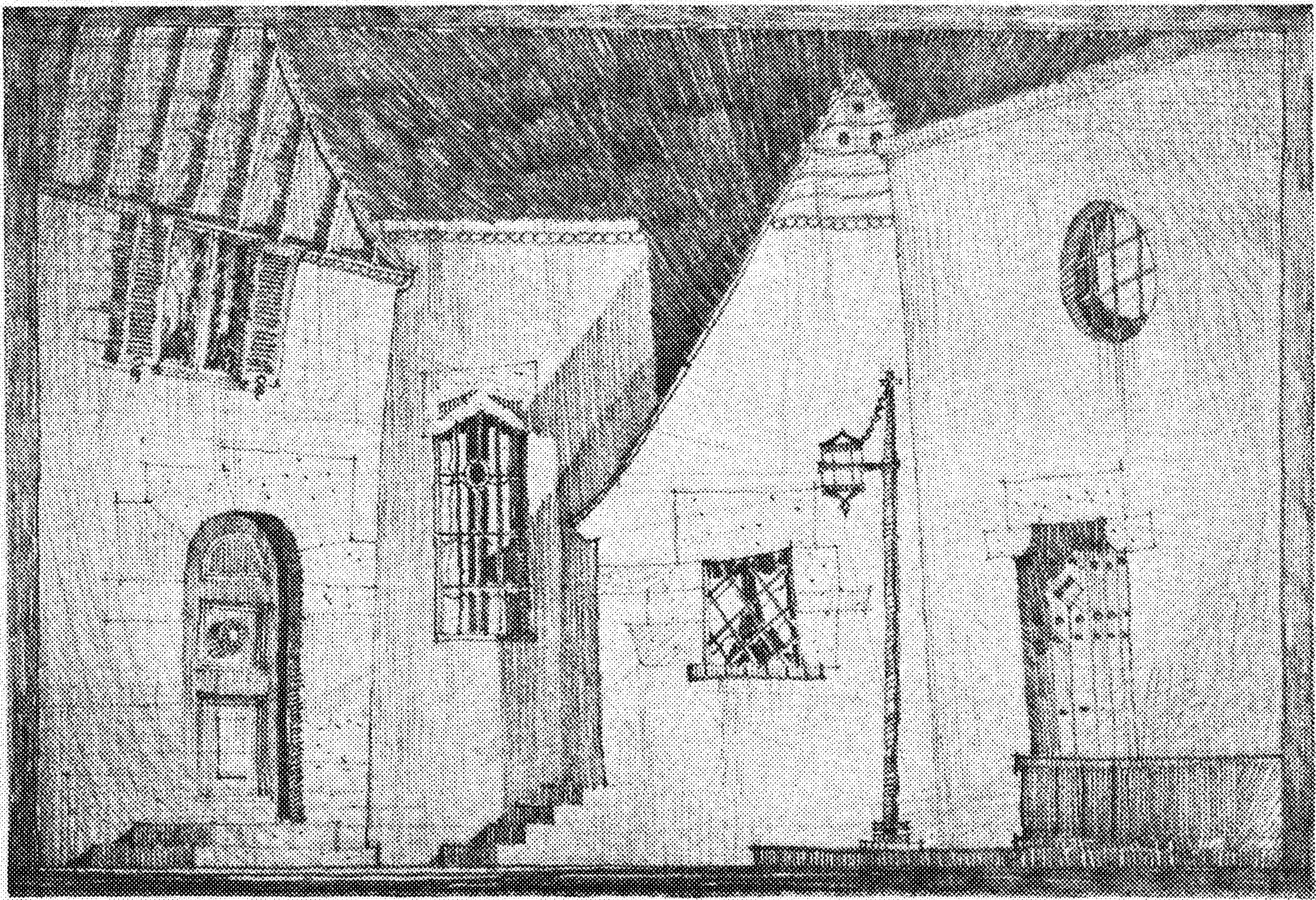

"Broadcast" Act I. John Thomas Grisdale

The MINNESOTA TECHNO-LOG

University of Minnesota

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Water Power Laws and Federal Policy

In the regulation of hydro-electric installation, the government has tried to protect public interest without restricting power development

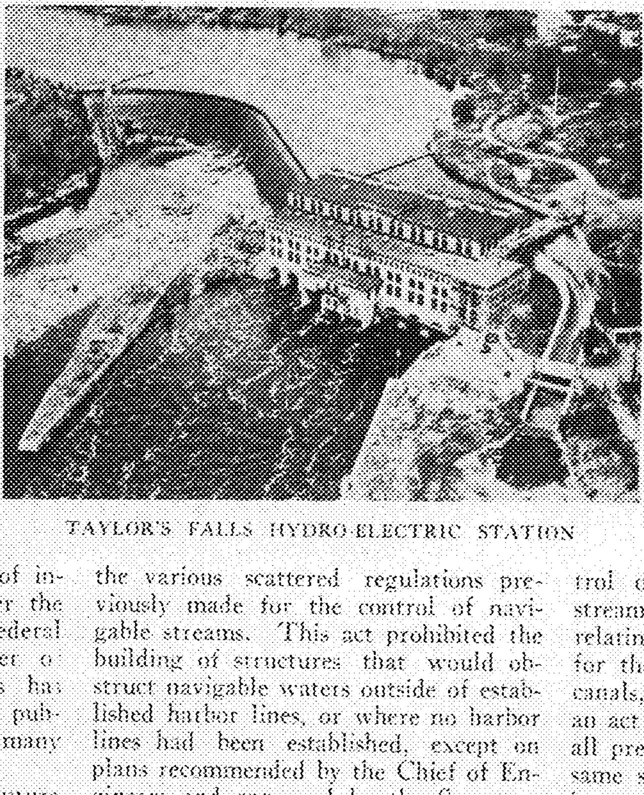
BY HIBBERT M. HILL, C '23
Instructor in Civil Engineering, University of Minnesota

ESTIMATES of the U. S. Geological Survey place the possible water power development of the United States at 55 million horsepower, available 50 percent of the time, or 35 million horsepower available 90 percent of the time. It is not at present feasible to develop all of this power, nor will it be so for many years to come. However, in 1926 hydro-electric stations produced 36.1 percent of the energy generated by central power stations in the United States, and this percentage ha been held essentially the same for several years past. Thus water power is a national resource of vast present and future value to the United States.

Of the developable water power the Federal Government controls approximately 85 percent. This control by Congress comes through three channels. First Congress, through its power to regulate interstate and foreign commerce, has the right to control the building of structures, or the manipulation o flow, in navigable streams. Second, boundary waters, whose development would be a matter of international agreement, come under the control of Congress, since the Federal Government, only, has the power o treaty-making. Finally, Congress ha under its power the disposal of the public lands, on which are situated many power sites.

The foundation upon which future Federal control of water power was to be laid was, quite naturally, Federal interest in navigable streams, and in canals. The early improvements to canals and rivers for navigation purposes were generally managed by the states or by state corporations. Federal participation was limited to encouraging legislation, mostly in the nature of subsidies, and the Federal Government acquiesced readily to any program of control presented by the states.

As the building of railroads developed it became necessary for Congress to authorize the construction of bridges across navigable streams. This Congress did by means of special acts, setting forth such conditions as were deemed necessary to protect navigation. The Act of March 3, 1899, brought together into one comprehensive statute



TAYLOR'S FALLS HYDRO-ELECTRIC STATION

the various scattered regulations previously made for the control of navigable streams. This act prohibited the building of structures that would obstruct navigable waters outside of established harbor lines, or where no harbor lines had been established, except on plans recommended by the Chief of Engineers and approved by the Secretary of War. The 1899 Act is still in effect.

During this whole period Congress made no general provision for the development of water power on navigable streams, but each development was made by virtue of a special act of Congress, granting the necessary rights in perpetuity and provided no restrictions except the possible repeal or amendment of the act making the grant. The first of these special grants was made in 1884 and there were in all something over 30 of them before 1906, when was enacted the first general legislation relating specifically to the development of water power on navigable streams.

The Act of 1906 made necessary the approval of the Chief of Engineers and that of the Secretary of War and gave these officers the right to specify as a necessary condition for approval that the grantee might be required at any time to construct, at his own expense, dams, locks, or other navigation facilities. This act was amended in 1910 to limit the duration of the grant to 50 years. The amended act reserved the right to revoke the grant at any time upon payment for the works constructed and further required that the United States be reimbursed for the costs of investigations, for headwater improvements, and for the cost of improvements for navigation purposes made necessary by the construction of the dam. The right was reserved to amend or repeal the act at any time with respect to any dam constructed under its provisions.

Coincident with the development of legislation for the control of water power on navigable streams, there was a growing code of law relating to the use of the public lands for the purpose of power house sites, canals, or transmission lines. In 1901 an act was passed designed to supersede all previous legislation dealing with the same subject. The act authorized the issuance of permits, expressly revocable, under general regulations. The value of the permits was further reduced by the fact that the lands to which they applied might be patented to others. Except for some scattered legislation this act of 1901 remained until 1920 the only authority under which rights to the use of public lands or reservations might be obtained for the purpose of power development.

It should be noted that, though the development of the water powers under Federal control was becoming increas-

(Continued on page 216)

Zeolite Water Softeners

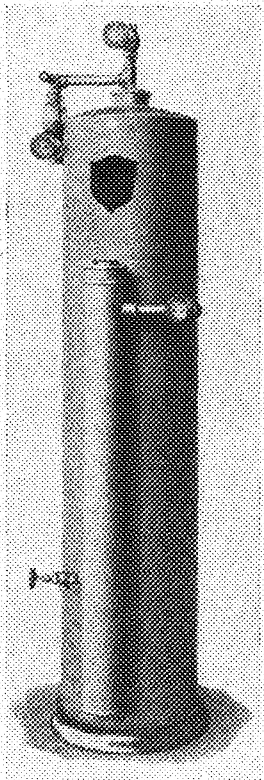
By means of these minerals, which can be regenerated, water may be obtained whic is of zero hardness and which contains no scale forming solids

By Ralph E. Montonna
Assistant Professor of Chemical Engineering, University of Minnesota.

THE importance of some sort of treatment of raw water for industrial use is too well appreciated by technical men to require any discussion of its necessity. Practically every engineer connected with an industry where water is used for steam-raising purposes has had, at some time, to consider the treatment of the available water supply to prevent corrosion and reduce scale formation in the boilers. Others connected with specialized industries have had like problems for reasons peculiar to the process in which water was employed. Most engineers are familiar with the causes of these undesirable qualities in raw water and with some of the methods for their removal, but there is a newer method which offers certain advantages that does not seem to have received the attention it merits, at least, from power engineers. This method of water treatment will form the subject of this discussion.

A brief review of the subject of water softening may not be amiss. For specialized industries, particular constituents of the water may be troublesome factors but, in general, treatment has to remove those factors causing trouble in boiler waters. These are the dissolved gases—principally carbon dioxide, oxygen and hydrogen sulfide—which cause corrosion and "encrustants" or scale-forming materials which impart hardness to the water. The latter are two kinds, those causing "temporary" hardness, i. e., hardness which may be removed by heating alone, and those causing "permanent" hardness. The bicarbonates of calcium and magnesium cause the former accentuated somewhat by salts of iron and aluminum and suspended matter, while the sulfates or chlorides of the same metals are the principal offenders in the latter case.

For the improvement of water, four kinds of treatment are, in general, available: (1) feed-water heaters, (2) boiler compounds, (3) chemical treatment, and (4) zeolite softening. The prime purpose of feed-water heaters of either the open or closed type is the improvement of thermal efficiency in boilers, but they also effect considerable improvement in the water by removing the greater part of the calcium and magnesium bicarbonates (temporary hardness), the aluminum and iron salts and part of the suspended and colloidal matter. The open type also removes most of the corroding gases. The permanent hardness is unaffected. Boiler compounds are substances added to the boiler to prevent the formation of hard scale. They have been likened by one authority on boiler waters to rat poison which kills the rodent, but leaves the dead body to decay *in situ*. Most engineers have learned in the sad school of experience that it is not good practice to use the boiler as a water softener. One chemical treatment consists of the addition of lime and soda ash (sodium carbonate), or, if the water is free from magnesium, of soda ash alone. The lime removes the dissolved gases, iron, and aluminum, causing purification but no softening because calcium replaces the metallic ions removed. The magnesium is removed down to five or six parts per million. Soda ash, which, when used alone, accomplishes all this except the removal of magnesium, then removes the calcium usually down to about twelve parts per million. Theoretically, removal to 5.2 parts per million of calcium may be accomplished but ordinarily the above figure represents good practice, and the calcium may remain as high as twenty parts per million. This is satisfactory for boiler purposes because a water containing less than one hundred parts per mil-



ZEOLITE SOFTENER
The water in this domestic-size tank passes through zeolite mineral on screens inside.

lion of encrusting and corroding sub stances is considered good. Suitable ap paratus of either an intermittent or con tinuous type for hot or cold treatment readily obtainable. The action is highl satisfactory, but this method requires ac curate chemical analysis of the water an careful control of temperature and tim of treatment. The fourth and newes type of water-softening devices, the zeo lite softeners, will now be compared t these methods.

The zeolites are a class of mineral consisting of hydrated double silicate of aluminum with the alkali (sodium potassium, ammonium, etc.) or alkalin earth (calcium, magnesium, etc) metal Artificial zeolites may be prepared b fusing substances containing the neces sary ingredients or by the formation c a jell from solutions containing them Their most interesting feature is thei ability to exchange one basic constituen for another. Thus if we have a sodiur zeolite of the composition $Na_2Al_2Si_2O$ in contact with a hard water, the fol lowing reactions occur:

$$Na_2Al_2Si_2O_8 + Ca(HCO_3)_2 \longrightarrow Ca\,Al_2Si_2O_8 + 2NaHCO$$

$$Na_2Al_2Si_2O_8 + MgSO_4 \longrightarrow Mg\,Al_2Si_2O_8 + Na_2SO$$

If, when the zeolite has exchanged al the sodium it possibly can for calcium or magnesium, i. e., will no longer softe water, it is placed in a fairly strong brin solution the reverse reactions take plac as follows:

$$Ca\,Al_2Si_2O_8 + 2NaCl \longrightarrow Na_2Al_2Si_2O_8 + CaCl_2,$$

etc. The calcium chloride, etc., may b washed out to the sewer and the zeolit is ready to remove more calcium or mag nesium from hard water. During bot these reactions no visible effect on th mineral is evident. It retains its phys cal structure unchanged, and the soften ing process, with the reversal or "regen eration" reactions, may take place r peatedly. It is thus evident that he is a substance which will soften wat without being consumed, needing on common salt to restore its efficiency.

The inception of the fundament chemistry on which these softeners a based dates back to the work of Thom Way, an English agricultural chemi who, in 1850, while studying the acti of potash salts as fertilizers in the s discovered that certain double silicat had the power of removing bases fr their solutions. This was followed the work of Eichorn, who demonstrat in 1858, the interchangeability of t alkali and alkaline earth bases in certain hydrated alumino-silicates (the zeolites). Further contributions to this subject were made by Harms, Mulder, Rautenberg, Peters and Ruempler; the latter employed certain of these natural silicates in the purification of molasses solutions. The masterful researches of Gans, a German chemist of the Royal Prussian Geological Institute, classified these double silicates or zeolites under two types: (1) those in which the bases are bound to silicic acid (which he called "double silicates of aluminum") which possess the power of exchange only to a limited extent and at a slow rate and (2) those in which the bases are combined with alumina (called "aluminate silicates" by Gans) which possess relatively great and rapid exchange power. Analcime ($Na_2Al_2Si_4O_{12}$. 2 H_2O) would be an example of the first class and chabasite ($Na_2Al_2Si_4O_{12}$. 6 H_2O) of the second. Gans showed that Ruempler's zeolites belonged to the first class.

He went further than this and produced an artificial zeolite of the second class, by fusing kaolin, sand and soda, which possessed even better exchange properties than chabasite. This zeolite had the approximate composition,

$$Al_2O_3 \ . \ 10\ SiO_2 \ . \ 10\ Na_2O$$

and was called by Gans "Permutit" from the Latin "permutare"—to exchange. Gans proposed the use of this material for the treatment of industrial water and the process was successfully commercialized about 1910. The zeolites were manufactured by fusing together feldspar, China clay and soda ash; the resulting glass was cooled, crushed and then hydrated. This is very similar to nature's own method for producing zeolites, but the hydration must be carefully controlled and stopped at the right stage. Many different ratios of the elements were employed, but the best results seem to be given by a material of approximately the following composition—

$$Al_2O_3 \ . \ 3\ SiO_2 \ . \ Na_2O.$$

Meanwhile many investigators had continued the study of the naturally occurring zeolites, most of which, e. g. analcime, chabasite, stilbite, etc., were too poor in exchange properties to prove useful for industrial purposes. Attempts were made to exploit one of the natural zeolites occurring in South Dakota, but they were not very successful commercially. Finally the work of Borrowman and others on glauconite or green sand showed that by suitable treatment a stable material of greater exchange capacity than the product manufactured by fusion could be obtained. This led to the introduction of the second type of water-softening minerals, the "natural" zeolites. In its natural state green-sand occurs mixed with earthly impurities in particles somewhat larger than ocean beach sand but considerably softer and of a grayish green color. Its exchange properties are greater and more rapid than the early synthetic zeolites but it has a great tendency to crumble and pack. Its treatment consists in, first, separating it from the earthy materials and finely divided silica by washing and flotation, second, heating to incipient fusion which imparts hardness to the grains without destroying their surface permeability and finally mechanical cleaning and sizing to uniform dimensions. By this treatment a clean, durable, uniform product is obtained which is hard enough to scratch glass, will not "slime" in water, and has greater and more rapid exchange powers.

The most recent work has been on the preparation of synthetic products of still greater capacity and rate of exchange by the formation of the alumino-silicate as a jell. By mixing dilute solutions of sodium silicate and sodium aluminate, a jell of sodium alumino-silicate is produced which can be dried to a hard, stable mass. The soluble salts are then washed out of this jell and the residue is a product which has great exchange capacity and an extremely rapid rate because the exchange is a surface reaction and the jell structure due to its porosity presents an extremely large surface to the water phase. These products are also much more stable than the earlier synthetic ones which tended to disintegrate in use. It is doubtful whether they should be called zeolites because, although they are essentially the same in composition, their physical structure is very different from that of any natural mineral and to this they owe their increased efficiency.

An ideal mineral (either natural or synthetic) for this type of water softening should fulfill the following conditions: (1) it should contain a large percentage of replaceable alkali, (2) it should be sufficiently hard and stable in structure to withstand long action without "sliming," packing or disintegrating, (3) it should present the largest possible surface of reaction, i. e., be of a porous structure, (4) it should be of the right specific gravity to allow it to be floated up during backwashing to remove channels in the bed without being floated away, and (5) it should be and remain a uniform sized particle. The earlier fused synthetic minerals possessed only small percentages of replaceable alkali and presented low surface of reaction. Some minerals prepared by precipitation at this time contained more replaceable alkali but disintegrated in use. The natural green-sands are intermediate in replaceable alkali and reacting surface and they are extremely durable but they are of high specific gravity. The recent precipitated minerals are very high in replaceable alkali, possess a large reacting surface and great stability and are very light. Thus a cubic foot of green-sand weighs 90 pounds and is capable of softening 270 gallons of water containing the equivalent of 10 grains of calcium carbonate per gallon while one of the newer synthetic products weighs 25 pounds per cubic foot and will soften 1,200 gallons of equally hard water.

For water-softening purposes it is sufficient to write the reaction as

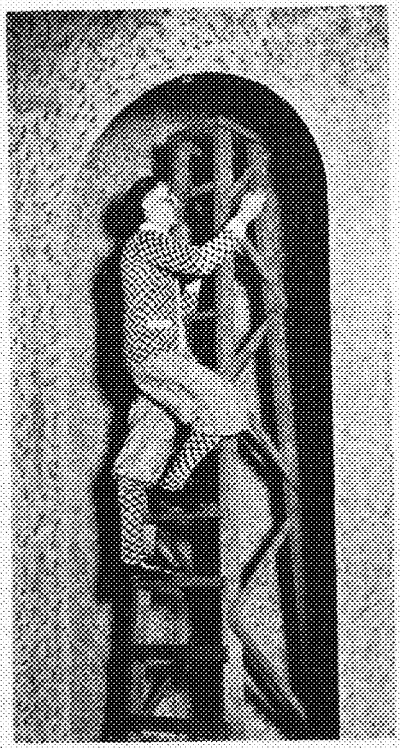
$$Na_2Ze + Ca^{++} \rightleftarrows Ca\ Ze + 2\ Na^+$$

where Ze represents the non-basic portion of the zeolite molecule and the bases may be any strong base (Na, K, NH_4, etc.) and any weakly basic element (Ca, Sr, Ba, Mg, Fe, Al, Mn, etc.). The reaction takes place at the surface of the mineral leaving its structure unimpaired, and represents a reversible system where the normal equilibrium is far on the right hand side. Thus if water containing the salts of weakly basic metals in solution is passed over the zeolite the ions of these weak bases replace the alkali of the Zeolite while the alkali bases pass into the water until equilibrium is attained, at least on the surface of the mineral. The mineral is then said to be "exhausted." If, however, a solution containing a fairly strong concentration of alkali ions, is now brought in contact with the zeolite, by the Law of Mass Action, the equilibrium is shifted to the left and the reverse action takes place until equilibrium is again attained at the surface. The ions of the weak bases pass into the salt solution, and may be washed out with it to the sewer when the zeolite is said to be "regenerated" or "revivified," i. e., is again ready to soften water. For this purpose a 5 to 10 per cent solution of common salt is used and this cycle may be repeated innumerable times until the structure of the zeolite is destroyed or its surface impaired by impurities. The speed of either reaction will depend largely on the relative surface offered by the mineral. It may be that reaction would go on until replacement had taken place to the equilibrium condition throughout the mass of the mineral but, especially in the case of the fused and natural minerals, so slowly after the surface reaction has taken place that it would be impracticable to wait for it. Generally, softening is done at some required rate until a soap test shows some hardness in the water. Regeneration takes from ten minutes to three or four hours (in case of the older type of minerals) depending on the surface structure. Some chemists

(Continued on page 224)

The Arabs Present—

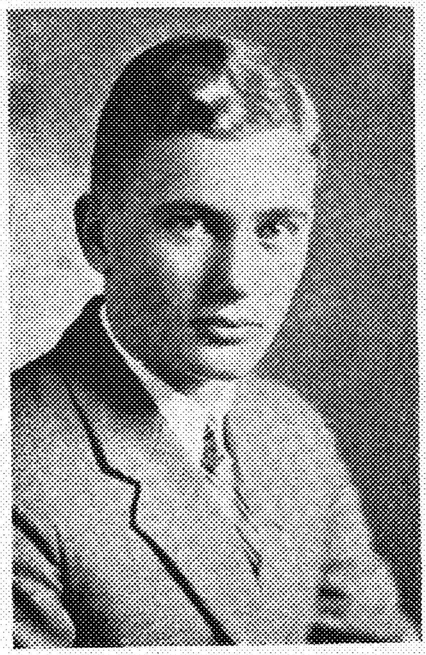
Gertie, the Gamma, the French-detesting leading lady, played by Merle C. Carlson, sophomore electrical engineer.



Roy C. Irons, senior mechanical engineer, in his role of John Engineer, the leading male part in "Broadcast."

Seven-Corner Sadie, a D. T. G. (down town girl), a vivacious vamp whose part is played by George L. Burch, sophomore architect.

Lawrence B. Anderson, senior architect, who conceived and designed all the staging in a clever futuristic setting.



Paul B. Nelson, former editor of the MINNESOTA TECHNO-LOG, *who is the author of the three-act musical comedy, "Broadcast."*

Carl Matthias Wise, department of architecture, the only remaining charter member of Arabs, who directed the production.

"Broadcast" to the Hereafter

The Arabs present for their fifth production a play dealing with student life in the year 1957 when earphones replace classrooms

NO University of Minnesota in the future! Just an elaborated radio station from which the various professors broadcast the daily lectures to students, who listen-in through their fraternity and sorority radio sets. . .

John, a collegiate, slip-stick sliding hero of 30 years hence who spies a most attractive girl through his surveyor's transit and later falls in love with her—Gertie, a French-detesting co-ed, a Gamma, and a vivacious brunette with and adventuresome complex; Professor Weinstein's discovery of the broadcasting of matter into the hereafter . . .

A moonlight love scene on fraternity and sorority row. Gertie's committing student suicide; John broadcasting himself into eternity in mad pursuit; Electron and Proton's polarity reversing trick. Happy reunion of our hero and heroine in the land beyond the thirty-mile limit. The saving of thousands of college professors and co-eds from eternal life in Hell . . .

That is "Broadcast," the fifth production of the Arabs, men's dramatic club of the three technical colleges, which will be presented April 22 and 23, at the Music Auditorium. In this musical comedy, the club, which has in past years scored hits with such productions as "Caliph of Colynos" in 1922, "The Blue God" in 1923, and "Riquiqui" in 1924, will show the attitude of the typical technical student to campus fads, foibles and characters, and life in general.

By setting the action 30 years ahead, into 1957, they will be able to burlesque an enlarged picture of present-day college life, with its student suicides, evolution disputations, morals, and even modes of dress. The many peculiar predicaments and humorous situations are made all the more comical because all actors are men. The cigarette smoking, painted, Seven Corner Sadie, who is the original D. T. G. (down town girl), has been practicing her cigarette smoking act in the atmosphere of the engineering college till she has rivaled the society women she intends to represent.

Paul B. Nelson, former managing editor of the MINNESOTA TECHNOLOG, as author of "Broadcast" has cleverly worked into this three-act comedy typical engineering color from the time of the civil engineering broadcast in Act One to John's successful piece of salesmanship in the closing scene when he sells Old Nick a complete set of oil burners for his fiery furnaces, thus relieving the grimy professorial shoveller gang. The local color in the play involves campus celebrities in unobtrusive, but interesting and peculiar ways.

The staging was designed by Lawrence B. Anderson. His imaginative mind caught the spirit of the situations and futuristic oblique settings will form the background for the play. Much of the scenery was made during the spring vacation by a group of architects. The remainder of the scenery was made during the study-filled school semester. In spite of the limited time for the planning of the whole play, and the designing and making of the scenery, the sets rival those on the professional stage in design, originality, and in mechanical construction.

(Continued on page 236)

EXECUTIVE STAFF OF ARABS

Officers

ROBERT F. GUSTAFSON	*President*
JOHN K. BORROWMAN	*Vice-President*
JOHN P. KRIECHBAUM	*Secretary*
EDWARD H. ERCK	*Treasurer*

Production Staff

CARL MATTHIAS WISE	*Director*
PAUL B. NELSON	*Production Manager*
AVNER RAKOV	*Musical Director*
LAWRENCE B. ANDERSON	*Scenic Director*
HAROLD ECKMAN	*Stage Manager*
CHARLES E. PETERSON	*Costumes*
HANS A. NORBERG	*Lighting*
PAUL E. DAHL	*Properties*
GORDON W. JONES	*Dancing*
LLOYD V. BERKNER	*Radio Director*

Dances were arranged by MISS MERCEDES NELSON.

All choral work was coached by PROF. O. S. ZELNER.

Business Staff

SHELDON F. JOHNSON, *Business Manager*

GORDON C. HARRIS	*Promotion Manager*
CURTISS E. CRIPPEN	*Programs*
JOHN T. GRISDALE	*Floor*
LAWRENCE A. CLOUSING	*Publicity Manager*
HARRY W. BOLNICK	*Ticket Manager*
WALTER J. HUCHTHAUSEN	*Posters*

THE CAST

John Engineer	ROY C. IRONS
Jim Engineer	LESLIE J. WESELIK
Bill Engineer	HERBERT F. HATHAWAY
Gertie, the Gamma	MERLE L. CARLSON
Seven-Corner Sadie	GEORGE L. BURCH
Sally	DAVE G. MCQUILLAN
Electron	OSBORN F. BILLINGS
Proton	KENNETH A. JOHNSON
Major Lance	CARL F. LUETHI
Professor of Foolosophy	PORTER KILPATRICK
Professor of Animal-Wifery	THOMAS C. FINNELL
Professor Weinstein	JOHN K. BORROWMAN
Old Nick	WILLIAM T. THOMPSON
Gate-Keeper (St. Peter)	HURLEY O. WARMING
Radio Announcer	PAUL Q. EDGREN
Dean	FRANK S. FREEMAN
Regent	HERBERT F. HATHAWAY

Men's Chorus

H. F. Hathaway, L. J. Weselik, S. D. Leach, E. H. Erck, E. H. Thoureen, Joseph Kotchevar, Herbert Spotts, C. T. Gustafson, L. F. Kernkamp, H. O. Warming.

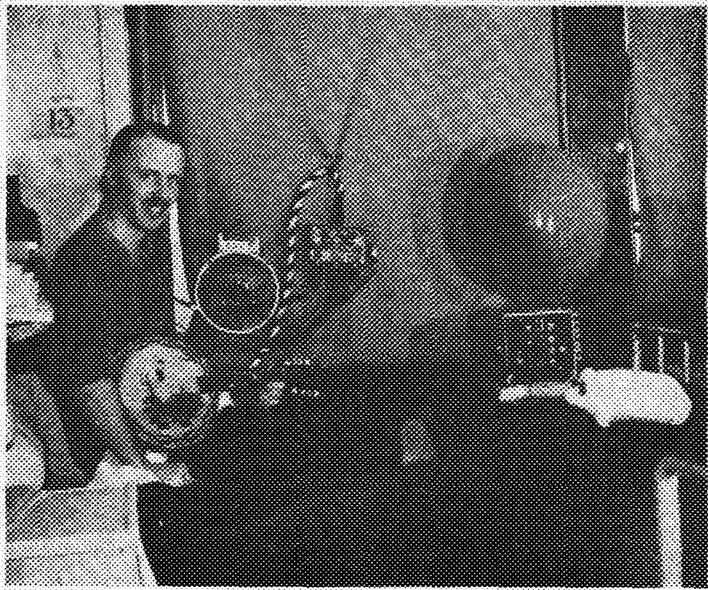
Girls' Chorus

K. H. Sommermeyer, Glynne Shifflet, D. C. Bayliss, M. L. Fergstad, R. C. Ramsdell, R. C. Freeman, Lewis Imm, John Miles, G. W. Jones, W. H. Jennings.

FOR THE LUVVA "MIKE"

By Alfred B. Greene, E '24
Glen Lake Sanatorium,
Oak Terrace, Minn.

*"Between the dark and the daylight,
When night is beginning to lower,
Comes a pause in the day's occupations
That is known as the Children's
Hour."*



STATION K-N-U-T,—AL GREENE, CHIEF OPERATOR

CHILDREN? Aye. Big children, little children, doctors, lawyers, housewives, flappers, students, children all shapes, sizes and colors, gazing out into the lengthening shadows of departing day, wondering.

Another day of the cure is gone; and out into the twilight quiet, out from behind the dark corners, creep countless little shadows of doubt, to dance about, bob up and make faces at you, chuckling with fiendish glee—"How much longer?" "Am I better?" "Wish I was home," "That pain back there, kidney, maybe," "Seemed to cough more today," "Can't eat, enteritis, I guess," "My arms look thinner," "Stingy with their shampoos," and so on they come, mingling with the pat, pat of footfalls down the hall—the demons of retrospection, those inhuman little pests of the lonesome hours.

What to do? What to do? Ah, yes. The radio! That audible panorama of orchestras and sopranos, ukuleles and bedtime stories, pipe organs and market reports. So at the listening post we listen.

The hands on our ticking watch creep round to six, and then the program from the outside world closes. In the ominous silence of the moment the leering imps of doubt pause and pale, shrink and quail, and look nervously for somewhere to hide. The stroke of a cowbell sounds clear through a thousand headphones, and a pleasant voice is heard to say:

"This is the Scandal Station, K-N-U-T, Oak Terrace, Minnesota, broadcasting our usual evening program from our radio on the roof of the Ocean View Hotel." There is a scramble of impish feet scampering for the exits. "The scandal station is owned by the 'Horizon Sunshine Company,'"—Lo! the fiends are gone!—"and is operated for service to the Reclining Public of Oak Terrace jointly with the cooperation of six hundred and fifty broad-minded listeners and six hundred forty-nine generous contributors (one fellow can't write.)" Now from out the shadows steal merry little feet. Bright little eyes seem to peek forth—mischievous laughing little eyes, full of fun and fellowship. "It is now six o'clock, rural standard time," (says the cowbell) and the fun begins.

> *Al Greene, E '24,—all senior president, president of senior engineers, football manager, member of Silver Spur and Grey Friars, and active in the Arabs, Y. M. C. A., and on the* Techno-Log *—has lost none of his good humor and enthusiasm since entering the Glen Lake Sanatorium immediately after his graduation. His broadcasting station, K-N-U-T, is on display as one of the exhibits at the Electrical Party.*—Editor.

The world is full of funny people doing funny things, but we go around most of the time with our mental earmuffs on, and when someone spills the conversational beans, about all we get is the echo of the broken dish. A person of insight set adrift a little poem:

"There was an old owl who lived in an oak;
The more he heard, the less he spoke,
And the less he spoke the more he heard.
Why aren't we more like that old bird?"

But it takes long ears to reach out of sanatorium rooms: and the walls are just thick enough to keep strangers to each other the makings of a nice, big, sanatorium family. Something had to be done about it. Imagine six hundred and fifty men, women and children going without their conversational beans! But that was all over a year ago.

In a little room in the deck house, upon the sun roof of Glen Lake Sanatorium, lay a bland heir with blond hair, who had spent the four or five years before coming there in tracking the elusive B. S., meaning Bachelor of Science. It did finally overtake him just as he stopped to rest; so he took time out for a few years to think the matter over. It was then that the bean question first came up—"Beans" which turned out to be "KNUTS."

Through the efforts of the Minneapolis Journal and the kindness of a host of generous citizens, Glen Lake Sanatorium had been equipped with radios. A head-set at each patient's bedside, all connected, as in many other sanatoria, to a central receiving set. For several years it had been common place to "broadcast" to the patients, from the auditorium, lectures and the efforts of visiting entertainers. By this means, the patients experienced a sort of contact with members of the staff, became acquainted with regulations, and received valuable information and instruction concerning their problems in adopting a new routine of living.

There is no doubt but what such a course is invaluable to a patient, relieving his mind of many queries, and impressing him with the nature and magnitude of the job before him. But in all of this, the rest of the family is silent.

The first inception of Station K-N-U-T, though then without a name, grew quietly in that little deck-house room and took the shape of a simple radio amplifier with a microphone attachment. Its first message was just a word of greeting to a friend across the way; and came unheralded in the quiet of the night just after lights were out and the radio operator had gone home for the night. But even so, it caused quite a whisper. Others happened to be listening, and passed the word around.

(Continued on page 224)

A Million Volt Party

Spectacular stunts and exhibits, and a special radio dance are to feature the biennial electrical engineering open house

By Harry Du Bois, E '27

THE Electrical Engineers Party has long since become one of the favorite traditions of the Electrical College. The party theme was adopted by the Electricals in 1913 and was introduced to provide a social function which would be strictly Electrical in theme and management. Although a large portion of the entertainment supplied by the students is of the show nature, it is customary to call the entertainment a party and for the students and faculty to issue invitations to their friends.

The numerous and varied effects of electrical phenomena are fundamentally spectacular, and since we are all most attracted by the spectacular, it is only reasonable that a large portion of our entertainment should be given to the demonstration of the uses and effects of electricity. This fact has led to the common error of calling the Electrical Party an electrical show. In the past, it has been impossible to introduce the "show" theme to any considerable extent due to the space limitations of the old building.

The dates selected for the 1927 party are April 21 and 22. These dates were chosen coincident with the convention of the Dakota Division of the American Radio Relay League. This convention will bring to the Minnesota campus a number of nationally known radio authorities as well as several hundred potential students for the technical colleges. The Electrical Party is a most desirable added attraction for the radio convention and serves admirably as a means of giving our radio friends a most hospitable reception during their visit to Minnesota.

The first day of the party will be primarily a social affair. Invitations have been sent out to the friends of the electricals and admission will be limited to these guests. The first part of the evening will be used for the demonstrations and exhibits in the laboratories while the latter part will be given over to dancing. On the second night, the party will be open to all the friends of the University and general invitations have been issued to all.

The problems involved in such an enterprise are serious and perplexing. The undertaking has always involved an immense amount of work by the students and can only achieve a maximum success through the perfect cooperation of the entire student body. Any rating of the success of the project is an equivalent rating of the degree of organization and the harmony promoted between the various committees. Financial success is assured by the simple expedient of subscribing the necessary funds several weeks before the time of the show. This is accomplished by the sale of invitations to the students.

The exhibits this year will incorporate many novel and interesting stunts. Every effort has been made to avoid the duplication of stunts used in previous years with the possible exception of those few standard exhibits which are always interesting. The student exhibit committees have done an immense amount of work in the development of new and unusual applications of electrical phenomena, while manufacturers' committees have endeavored to place exhibits which demonstrate recent developments in the electrical industry.

The greater portion of the exhibits will be the student exhibits which depend largely upon the ingenuity and application of the students. All the regular laboratory equipment will be put in service in the demonstration of the fundamentals of electricity. In addition to these, a large number of special exhibits have been built especially for the show. A radio group has devised a small car which will be controlled by means of radio transmitting apparatus. Equipment has been installed to demonstrate the transmission of pictures by radio. Another exceedingly interesting demonstration by the radio department will be the talking arc. An ordinary arc lamp is used as a radio loudspeaker through the use of power amplifiers.

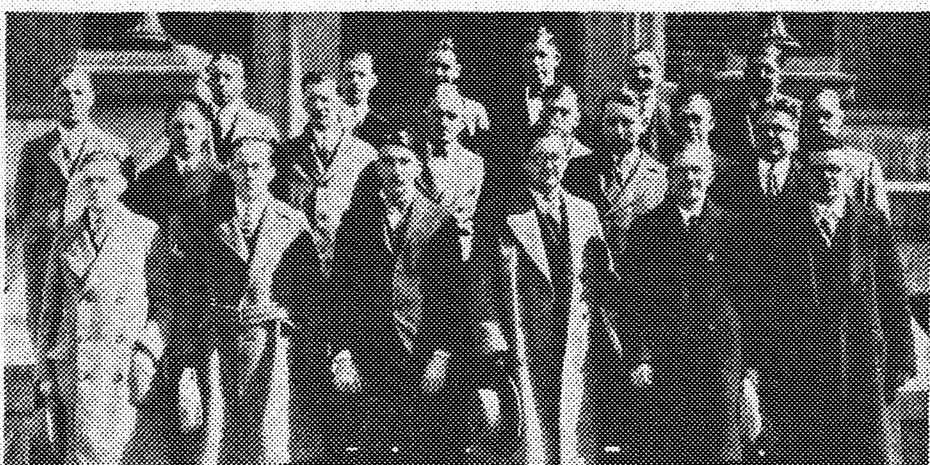
Friday will be the convention day at the exhibition and a special feature of this performance will be the radio dance. The orchestra program will be broadcast from the studio of WLB. This program will be picked up in the main engineering auditorium and used for the dance music. A great deal of work has been given to the development and placing of loudspeaking equipment in order to insure perfect reproduction and acoustics for this program.

To demonstrate the principles of power generation and transmission, a complete model sub-station has been installed in the laboratory and will be in operation. In contrast to this will also be shown some of Edison's first dynamos and the types of equipment used in these early ventures in the electrical industry.

There will be a miniature railway demonstration completely controlled by the modern electric block system which operates with unbelievable precision. The inner workings of the modern traffic control systems will also be open to the inquisitive. The illumination exhibit will prove exceptionally interesting and weird. The principles of lighting are peculiarly adaptable to visual demonstrations which will astonish the observer. These exhibits will include a study of the methods of lighting from the most ancient to the ultra-modern photo-electric cell which is so sensitive that it will register at the shadow of a hair.

One of the outstanding features of the evening will be the manufacturers' ex-

(Continued on page 220)



COMMITTEE HEADS OF THE ELECTRICAL PARTY

Joe Wald, A. C. Lee, John Newhouse, S. F. Johnson, J. Brightfelt, G. C. Brown, L. A. Clousing, R. Edgar, Hans Norberg, Lloyd Hoover, R. Gibson, J. H. DuBois, L. J. McKesson, Barret Rodgers, C. H. Burmeister, J. C. Smith, Paul Lee, W. Schultz, E. H. Scholz, H. F. Wehlitz, S. L. Bailey.

An Improved Stroboscopic Slip Meter

Added simplicity and convenience have resulted from the use of the neon gas lamp in measuring slip in induction motors.

By Carl C. Nelson, E. '25
Student Engineer,
Westinghouse Electric and Mfg. Co.

IN the testing of induction motors it is often desirable to determine the slip at different loads. Various means of measuring slip have been suggested and a number of these have been adopted in actual practice. In a great many cases, however, the devices employed have introduced intricate and expensive apparatus, and to some extent have been inaccurate. Therefore the stroboscopic method, using an alternating-current arc lamp and counting the apparent revolutions of a disk fastened to the shaft of the motor, has been, and is still in use to a great extent where accurate slip measurements are desired. This, however, entails the use of an arc lamp, which is of itself rather cumbersome. Carbons must be renewed now and then, and when in use adjustments must be made to secure a satisfactory arc.

Recently the neon gas lamp has been adapted to the stroboscopic method of measuring slip. The convenience and ease of application of this lamp have made its use worthy and deserving of further recognition than it has thus far received. In describing this improved means of measuring slip it is assumed that the reader is familiar with the arc lamp method.

The neon lamp is a gaseous conduction lamp. The theory of its operation has been taken up in various articles* so no attempt will be made to give a rigorous explanation here, except to show its use in connection with the measurement of slip. When an alternating-current potential is impressed upon the lamp, the voltage varies periodically. As the voltage increases, a glow discharge takes place at a certain value and continues until the voltage has passed the maximum point and approaches zero. The action of the lamp is such that there is a variation in the intensity of light corresponding to the frequency of the applied potential; this is somewhat similar to that of the alternating current arc lamp. Thus it is feasible to use the neon lamp in place of the arc lamp for the purposes of measuring slip.

A particular set of apparatus consists of a stand, lamp bracket, gear box, universal coupling and coupling socket. The lamp bracket and gear box are mounted on the stand so as to be adjustable to the desired height. The former is constructed in a manner similar to that shown in the sketch, Figure 1.

The neon lamp is mounted in an ordinary radio tube socket, being connected

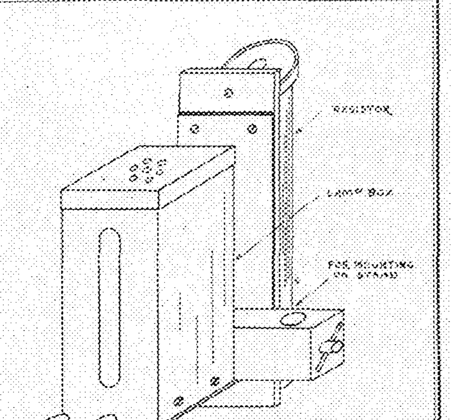


FIGURE 1

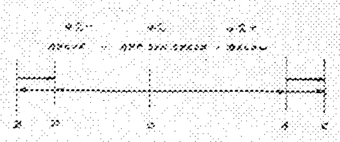


FIGURE 2

in series with a 3,000 ohm resistor, and used on a 220 volt circuit. It is inclosed and protected by a box, the front of which has a slot to allow the rays of light to shine upon the disk.

The use of the neon lamp is the same as that of the arc lamp in that the light is focused upon the disk fastened to the end of the shaft of the motor, and the apparent revolutions of the disk counted for a certain time interval. The slip in revolutions per minute and in per cent of synchronous speed can then easily be calculated.

When the slip is unusually high the gear box is used. This consists of a set of three meshed gears, the ratio of the common one to the other two being .96 and .92 respectively. The disk is fastened to the common gear and driven through one of the other gears, which in turn is driven by the coupling to the shaft of the motor. The coupling fits into a socket fastened to the end of the shaft. If the .96 gear ratio is used the disk will revolve faster than the motor and at exactly 4 per cent slip the disk will appear to be standing still. In using the gear box, the slip of the motor in per cent of the synchronous speed is expressed by

$$S = 100\,(1\text{-}R) \pm A\,(R/N)$$

where R = gear ratio (less than one),
A = apparent speed of disk in R. P. M.,
N = synchronous speed of motor in R. P. M.

The sign of A is determined by slightly increasing the load on the motor. If the apparent speed of the disk increases, the sign is plus, and if the apparent speed decreases, the sign is minus. This is explained as follows: Assuming that the .96 gear ratio is being used, an apparent synchronous speed is obtained at exactly 4 per cent slip. If the motor is running below the apparent synchronous speed, the slip can be represented by a vector OA, Figure 2. Similarly, when the motor is running above the apparent synchronous speed the slip can be represented by the vector OB, Figure 2. At a certain value of slip then it is not known whether the value is above or below the apparent synchronous speed point O. If the load is increased and the apparent speed of the disk increases, it is recognized that the motor was running below the apparent synchronous speed and the slip is 4 per cent + OA. The increase in apparent speed, in terms of slip, is represented by AC, Figure 2. If the apparent speed of the disk decreases when the load is increased it is recognized that the motor was running above the apparent synchronous speed and the slip is 4 per cent — OB. In this case the decrease in apparent speed of the disk, in terms of slip, is represented by BD, Figure 2. It of course must be kept in mind that the actual slip of the motor increases when the load is increased.

In any method of measuring slip such as this the accuracy of the result is dependent upon the ability of the tester to count the apparent revolutions of the disk satisfactorily. With a fairly competent tester results indicate that this factor becomes negligible when compared with the results of a number of other methods used. In addition, its simplicity and convenience have shown it to be a decided improvement over the arc lamp method.

* Some Electrical Properties and Optical Properties of Neon Glow Lamps, E. Karrer and A. Poritsky, Journ. of Optical Soc. of America, Vol. 9, No. 3, P. 323, Sept., 1924. Gaseous Conduction Light from Low Voltage Circuits, Moore, A. I. E. E. Trans. Vol. 39, P. 2021, 1920.

Rating E. C. M. A. Publications

Great improvement in technical college magazines should result from the system of judging recently adopted by the association

AT the annual convention of Engineering College Magazines Associated held at this school last fall, the question of a rating system of member magazines was presented. This proposal was directly in line with the policy of the association to show constant improvement in all phases of the publication of the various magazines. After some discussion, the convention referred the matter to the executive committee to work out a plan and submit it to the members of the association for criticisms and suggestions before putting it into effect.

That the Executive Committee, composed of Leslie F. Van Hagan, University of Wisconson, W. V. Merrihue, University of Pennsylvania, and W. O. Birk, University of Colorado, succeeded well in their efforts, is evident by the system of rating which they evolved. A proposed scheme was worked out and submitted to the member magazines last November. The criticisms and suggestions which resulted from this system were incorporated in a second tentative scheme. A vote was then taken and the final rating system was adopted last month on the basis of this vote. In addition, a scheme of awards was made to stimulate competition between the magazines.

The adopted plans will be put into effect as rapidly as possible. They are substantially as follows:

Basis for Rating Member Magazines

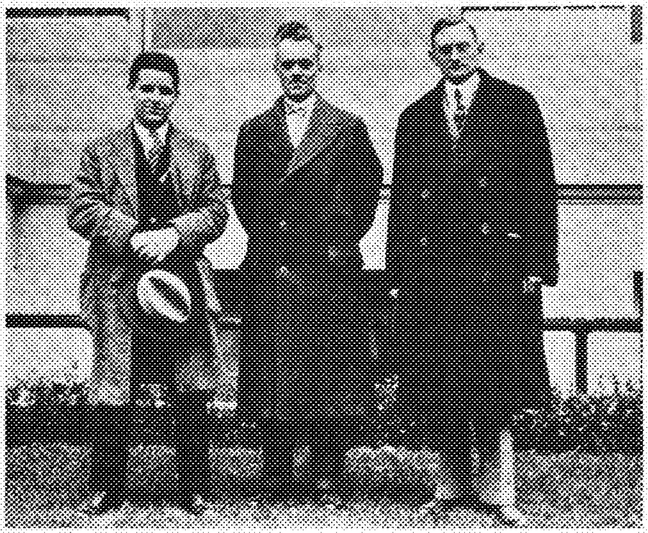
1. *General Explanations.* The rating of member magazines is one feature of a general scheme that is designed to bring about strict adherence to the Standards of Practice and to improve the general character of the publications. The scheme of rating that is outlined herewith has been developed in conformity with the following principles:

(a) The rating should be based upon items about which there can be no dispute. Matters of taste and matters about which there may well be difference of opinion should not be involved. This is the reason why editorial excellence or defect will have little effect upon the rating.

(b) The requirements should be reasonable and of sufficient importance to justify drastic action in case they are violated. Nearly all the requirements in the following scheme are taken from the Standards of Practice, which have been accepted by the members as reasonable.

(c) Failure to meet the requirements should be easily ascertained. There is nothing to be gained by making a requirement that cannot be enforced.

(d) Requirements should be far enough in advance of present practice to stimulate members to improvement, but not so far ahead that they discourage attempts at meeting them.



THE EXECUTIVE COMMITTEE OF E. C. M. A.
This picture, taken during the convention last fall, shows W. V. Merrihue, eastern vice-chairman, L. F. Van Hagan, chairman, and W. O. Birk, western vice-chairman.

NOTE: It is quite possible that, in the beginning, few or none of the magazines will qualify for an A rating; most of them will probably be in Class B until such time as they can remedy some of the defects in their present methods. It is also possible that some magazines will elect to remain in Class B rather than sacrifice some traditional policy, even though the policy be contrary to majority opinion in the group. That, of course, is the individual magazine's privilege, but it should not interfere with the operation of the rating scheme.

2. Ratings shall be made by the chairman and shall be published each month. The published ratings shall be accompanied by a statement of the specific reasons for failure of individual magazines to receive an A rating.

3. *Classes.* There shall be three classes, namely, A, B and C.

4. To rate Class A, a magazine shall meet the following requirements:

I. GENERAL APPEARANCE. It shall present a good appearance, present good proofreading, and there shall be no violations of paragraphs of the Standards of Practice dealing with appearance and makeup.

II. EDITORIAL. (a) There shall be no publicity material in violation of the Standards. (b) It shall print "Member of Engineering College Magazines Associated" on its cover and insert in its masthead, or on the title page, a list of member publications together with the name and address of the chairman, as specified in the Standards.

III. CIRCULATION. (a) It shall have a circulation of at least 500 paid subscribers. (b) It shall have as paid student subscribers at least 30 per cent of the students registered in the college or departments represented by the magazine. (c) It shall have as paid alumni subscribers at least five per cent of the graduates of the college or departments represented by the magazine. (d) The magazine shall be mailed before the 20th of the month of publication, as specified by the Standards. (e) There shall be no failures to mail the proper number of copies to the officers, Barnhill, or advertisers, as specified in the Standards.

IV. FINANCES. The "Assets and Liabilities" statement shall at all times show a cash surplus of at least $200, except that a magazine which is one of a group operated as a unit by a university press association shall be considered to be financially sound and shall be relieved of this requirement.

V. ADVERTISING. (a) There shall be no granting of commissions to other advertising agencies than Roy Barnhill, Inc., in violation of the Standards. (b) There shall be no complaints lodged against the magazine by national advertisers.

5. *Class B.* A magazine that fails to qualify for Class A shall be rated Class B, except in the case in which it falls into Class C.

6. *Class C.* Magazines shall be placed in Class C only in case of extreme delinquency, such as, (a) failure to publish a scheduled issue; (b) glaring violations of the Standards of Practice; or (c) financial failure. Members that fall into this class will be on probation, from which they can be removed only by the action of the Executive Committee. Nothing in this rating scheme shall be construed as interfering with the power of expulsion conferred upon the Executive Committee by the Constitution.

(Continued on page 222)

NEWS FROM THE TECHNICAL CAMPUS

Chemistry Group Holds Dinner: Heads Attend National Meeting

Dr. Arthur S. Loevenhart, professor of pharmacology and toxicology at the University of Wisconsin, was the speaker at the 139th meeting of the Minnesota Section of the American Chemical Society. The meeting, held on Wednesday evening, March 30, in the auditorium of the School of Chemistry, was preceded by a dinner at the Campus Club.

Dr. Loevenhart, who is a biochemist of note, was formerly associate professor of physiological chemistry and pharmacology at Johns Hopkins University. He has been head of the department of pharmacology at the University of Wisconsin for a number of years.

Dr. Loevenhart's lecture, "Relation of Biological Oxidation to Functional Activities in the Animal Body," was a presentation of various phases of his researches on the effects produced by changes in the rate of oxidation on the functional activity of the organism.

The University of Minnesota will be represented at the 73rd national meeting of the American Chemical Society, to be held at Richmond, Virginia, during the week of April 11, by S. C. Lind, M. C. Sneed, G. B. Heisig, and L. H. Reyerson.

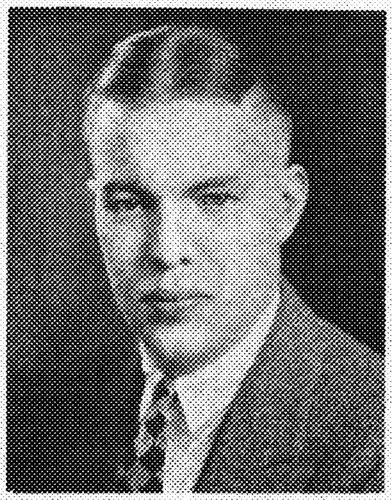
Mr. Sneed and Mr. Heisig will present a paper prepared in collaboration with George B. Trovatten, a graduate student in the School of Chemistry, on "Comparative Results Obtained by New and Old Methods of Analyzing Group III." Mr. Reyerson will present a paper on "Metallized Silica Gels as Catalysts for the Hydrogenation of Acetylene."

Mechanical Students Obtain New Shop Equipment

A general survey recently made of the mechanical engineering shops resulted in the acquisition of several much-needed pieces of equipment, including a drill press, a heat-treating furnace, a portable sander, a bench bandsaw and woodtrimmer, and scleroscope. The total expenditure amounted to fifteen hundred dollars and is expected to put all the shop departments up-to-date in every way.

The possibility of a new building for the department is still quite unlikely, but the erection of the auditorium will cause a change of quarters for the foundry although it will hardly move into a new building. It is hoped that in the course of a few years, room will be found in the budget to provide a new and better shelter for the department.

Radio Convention Shares Honors With Electrical Party



WALFRED W. SWANSON

What is expected to be one of the largest gatherings of technical radio men in the northwest will be held in the Electrical Engineering building, April 22 and 23. It is the Dakota Division Convention of the American Radio Relay League, to which about 250 men from the neighboring states and other parts of the country are coming.

The American Radio Relay league is a national organization of amateur radio operators and experimental men which has as its purpose the study of radio from a technical standpoint and the relaying of friendly messages through the stations of its various members.

Walfred W. Swanson, sophomore electrical student, is chairman of the general arrangements for the convention, having been appointed by Prof. C. M. Jansky, Jr., professor in radio engineering at Minnesota, and a member of the board of directors of the American Radio Relay League. Other electrical students who have been active in the arrangements of the convention are Lloyd V. Berkner and Richard Cotton.

Mr. John L. Reinartz, whom older men in the radio field will remember as the experimenter who developed the popular Reinartz receiving set, is the chief speaker and the honor guest of the convention. Mr. Reinartz accompanied Donald B. MacMillan on his last Arctic exploration trip. With this expedition he studied the Aurora Borealis and atmospherics with a view toward improving radio reception and communication in general.

In line with his radio experiences in the far North, Mr. Reinartz will present an illustrated lecture, "In the Land of the Midnight Sun," in the auditorium of the main engineering building on the afternoon of Saturday, April 23.

The convention has secured another attraction in Lieutenant Commander F. H. Schnell, U. S. Navy. Mr. Schnell was in charge of a recent cruise known as the NRLL, U. S. Navy cruise, into the tropics for the purpose of searching out various data on the dependability of radio communication at all times, and under adverse conditions in all parts of the world.

Mr. Schnell will lecture on his various findings and on the methods by which he formulated and actually carried out the tests. He will illustrate by moving pictures and slides the curves, values and general results obtained under a variety of conditions.

Ultra high frequency transmission is the latest development in the radio communication field. It is found that the wave length of a high frequency wave is so very short that it is subject to reflection by the strata of rarified air above the earth. As a result many seemingly freak transmissions occur, when the signal emitted from a sending station seems to disappear for a distance of several hundred miles and then appear again.

This phenomenon and others connected with high frequency transmission have been the subject of research by Mr. Schnell in cooperation with Mr. W. H. Hoffman in the Burgess laboratories at Madison, Wisconsin. They will present technical talks with actual demonstration of a high frequency transmitter and receiver in the auditorium of the Electrical Engineering building on the afternoon of Friday, April 22.

In radio transmission and in reception as well, the vacuum tube is the heart of the whole problem. The various actions of the tube, the reason for these actions and the underlying principals governing the vacuum tube will be the subject of a lecture by Prof. C. M. Jansky of the University of Minnesota. Mr. Jansky is a national authority on vacuum tubes and is a consulting radio engineer.

The University of Minnesota's experimental station 9XI employs the system of short-wave transmission and is in communication with stations all over the world. A staff of 26 operators with L. V. Berkner, senior electrical, as chief operator, keeps a constant schedule of operation every night of the week.

Engineering students are invited to attend the lecture of Mr. Reinartz on "In the Land of the Midnight Sun," which will be given at 1:30 Saturday afternoon, but in order to attend the other lectures of the convention payment of the registration fee of $5.00 will be required. This registration fee also includes the convention banquet.

AROUND THE WORLD WITH OUR ALUMNI

ARCHITECTS

'17—Floyd W. Brown is Associate Architect with A. R. Van Dyck in Minneapolis.

'18—Seeman Kaplan is also a Minneapolis architect. He is a member of the firm of Liebenberg and Kaplan.

'18—Harvey M. King holds the position of Architect-Secretary, Board of Church Extension, M. E. Church, So., of Louisville, Kentucky.

'22—Minneapolis' charms also holds L. H. Bakken, who is manager of the architectural department of the Northwestern Lumbermen's Association.

'23—Miss Eunice V. Nielson is a draftsman with Lang, Raugland, and Lewis, Minneapolis.

'26AE—Raymond "Black" Rasey is timekeeper for Winston-Hill Company. His present address is Camp No. 3, Gasconade, Missouri.

'26AE—R. Kenneth Redin is a structural draftsman for Schuett-Meier Company of Minneapolis.

CIVILS

George M. Cornell, C. E. '25, has recently been honored by the appointment to the Strathcona Memorial Fellowship at Yale University for the year 1927-28.

This fellowship was established in 1914 by the late Lord Strathcona of Canada and is awarded to a graduate student in civil or mechanical engineering, with special reference to fitting himself for work in the field of construction, equipment, or operation of transportation, preference being given to such persons or to the sons of such persons as shall have been for at least two years creditably connected with the railways of the Northwest.

Mr. Cornell maintained an extremely high average in his work at Minnesota, graduating with an average of better than 2.8 honor points. Since graduation he has been working in the bridge department of the Northern Pacific Railway at St. Paul.

This appointment is the third one that has gone to Minnesota graduates in recent years. Edmond S. McConnell, B. S. in E. E. 1924, is at Yale at the present time, having won the fellowship for the year 1926-27. Mr. McConnell had been working in the mechanical department of the C. M. and St. P. Ry. since graduation.

In 1922 Mr. Francis A. Dever, C. E. 1920, was awarded the fellowship and since the completion of his work at Yale has been in the engineering department of the Pennsylvania Railroad.

CHEMISTS

'08—Walter L. Badger, who is professor of Chemical Engineering at the University of Michigan, presented "The Growth of Crystals in Aqueous Solutions," a paper which was prepared in collaboration with Dr. G. H. Montillon of Minnesota, before the Richmond meeting of the American Chemical Society.

'25—Alfred A. Reiter is doing graduate work toward his doctor's degree at the University of Wisconsin, where he holds the position of instructor in the Department of Chemical Engineering.

'25—Homer A. Hamm is at present engaged in research on rayon. He is a chemist for the Bureau of Standards at Washington, D. C.

'25—Paul L. Covell is now employed by the Minneapolis Gas Light Company. He is doing engineering work on corrosion and incrustation of boilers.

'25—Norman P. Bekkedahl is now doing research work on carbohydrates for the Department of Agriculture. He is stationed at Washington, D. C.

'25—William J. Zeidlik has recently become attached to the Prohibition Enforcement Department of Texas in the capacity of chemist.

ELECTRICALS

'22—G. L. Oscarson has recently been transferred from the Chicago office to the St. Louis office in the sales department of the Electric Machinery Manufacturing Company.

'22—Henry C. Forbes has recently become associated with the Radio Division of the Westinghouse Electric and Manufacturing Company.

'23—Donald E. Thorne has gone from the New York office of the Western Union Company for a year's experience in Labrador. "Barney" is in the cable department of the Western Union and is making rapid progress.

'23—Walter F. Kannenberg is now living at 745 Ten Eyck Ave., Lyndhurst, New Jersey. He is a telephone engineer in the systems development department of the Bell Telephone laboratories, New York City.

'24—Joseph M. Juran is a statistician for the Western Electric Company, Hawthorne Station, Chicago.

'26—Lester LeVesconte is working for Westinghouse in Pittsburgh and is very enthusiastic about the course. He is evidently greatly enjoying himself, for: "Right now I'm in Engineering School with Nelson '25, Keller '25, Wentz '26, Joesting '26, and Bullard '26, and we surely learn a lot that we never knew before. Plenty of collegiate activities around here, too, so spare time goes at a premium."

MECHANICALS

'98—John E. O'Brien is located in Savannah, Ga. His position is Chief of Motive Power and Equipment for the Seaboard Airline Railway.

'99—Elias K. Wennerlund is with the General Motors Corporation and is located in Detroit, Michigan. He is head of the department of production engineering.

'10—J. B. Frear is an engineer in the container testing and designing laboratory of the Don L. Quinn Company. He is at present living in Buffalo, New York, but intends to move to a Chicago suburb soon.

'15—Albert L. Peterson is now a member of the firm of Peterson-Larson Electric Company of Fargo, N. Dak.

'23—C. F. Olmstead, who has been acting as New York alumni correspondent of the TECHNO-LOG, left his position as assistant secretary of the American Oil Burner Association the 16th of this month, and has become assistant sales manager of the Mahr Manufacturing Company. He is located in Minneapolis and made the trip west by automobile.

MINERS

'23—What is thought to be a new world's record for driving a single face prospect drift was recently accomplished in the North Lily mine of the Tintic Standard Mining Company, Utah, by a picked crew of 15 men headed by George W. Hezzlewood, a graduate of the School of Mines at Minnesota. This crew, between September 18 and January 4, drove 2,400 ft. of drift from the 700 level of the No. 2 Tintic Standard shaft, using a compressed air shovel and working three shifts a day. During the week of maximum progress, 250 ft. of heading was made in seven days.

A big factor in this record was the development of a new type of portable switch designed by Mr. Hezzlewood. This switch gives ample facilities for the handling of cars without widening of the drift, tearing up of track, or setting of ties. It consists of a double track switch 40 ft. long, giving room for ten cars, with two equilateral turnouts at each end. This movable siding fits over the top of the permanent track and can be loaded on trucks and hauled forward whenever necessary.

George Hezzlewood graduated in 1923 with a degree of Engineer of Mines and began work for the Tintic Standard Mining Company in August of that year. He is at present assistant engineer for the company and is located at Eureka, Utah.

The
MINNESOTA TECHNO-LOG
University of Minnesota

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COMPETITION! That has always been the keynote of progress. And when the stimulus of competition is applied to a group of student technical publications which represent the highest ranking engineering colleges in the United States, very fine results in the way of attractive makeup and well prepared articles and college news items must certainly follow. Again, the very natural and human satisfaction gained by being rated "Class A" among a group can hardly fail to inspire great efforts to attain that rating.

Read over the rating system and scheme of awards adopted by Engineering College Magazines Associated as outlined elsewhere in this issue, and then consider the possibilities involved when applied to the future of the TECHNO-LOG.

The University of Minnesota belongs to a group known as the "Big Ten," whose athletic activities rate with the best in the world. Minnesota's debating teams compete with the best of mid-western universities. And now the publication of our technical schools will be placed in competition with 20 other colleges from Massachusetts and Virginia on the east to Colorado on the west.

No greater urge should be necessary to create active interest in the MINNESOTA TECHNO-LOG among the technical students. The publication is the property of these students and it stands or falls with their interest and support. The coming year promises to be a big one in the history of this magazine, and the goal has been definitely set by the action of E. C. M. A. The fulfillment of this job is a goal for real engineers—the kind that Minnesota has always aimed to produce. With a few of these from each department all working toward the same end, the result must be obvious.

"AND your laboratory reports for the quarter will be written up as outlined on the instruction sheets which I will give you." How often the engineering student has heard these or similar words at the beginning of a term! And as he approaches the end of his course, those words raise the question in his mind, "What kind of a damfool layout will we have this time?"

The "long-suffering" student is both right and wrong in this attitude. He is wrong if he assumes that reports are "damfoolishness." They will always be part of his business when he graduates and it is very necessary that he know how to prepare them. Nevertheless, he certainly cannot be greatly blamed for refusing to take his reports seriously when he begins to note the utter lack of uniformity that is required of him during his report-writing career in college. In the majority of cases, the form of report that he is to follow depends upon the ideas of the instructor who happens to be teaching that particular course. Again, some instructors require a great amount of detailed explanation with diagrams and derivations of formulas, while others are content with little other than mere results.

Would it not be much wiser to pattern one general report form after the fashion of those used by industrial plants, making such minor changes as the various courses might require, and to standardize this form throughout the department? Some such scheme would at least eliminate the quarterly testing out of instructors by the students to determine the amount of detail necessary to "get by" with their reports.

COOPERATION and loyalty are features of engineering functions, which seem to come all at once in the spring of the year. No other college is said to possess the energy and ambition which engineers put forth in their events, and the famous engineering spirit will again be displayed with enthusiasm and vigor on Engineers' Day, the Electrical Party and the Arabs' show.

Outstanding among the organizations of the College of Engineering is the Arabs' dramatic club. Other schools of the country have men's dramatic clubs who put on plays in which men take feminine roles, but in no case is the membership limited entirely to engineering students, nor is the play produced entirely by engineers.

A dramatic production of the type which the Arabs are to give calls forth all the imagination, artistic talent, and ability that engineering students possess.

Engineers' Day is the outstanding event of the spring for the university as a whole as well as for the engineering students. It advertises engineers, and radiates with spirit. The work and preparations give opportunities for management which are but a step in development to the management of business and commercial interests in days following graduation.

The same is also quite true of the Electrical Party which is given by the department of electrical engineering to show people the interesting and peculiar tricks of electricity, and the modern adaptations of electricity to make life more interesting and comfortable. An open house party of this kind is a most enjoyable way of maintaining friendships between students of the various colleges of the university and friends of the department.

Much of the credit for the success of the Electrical Party goes to Harry DuBois, who is chairman of arrangements for the party, and who has been working strenuously on the event since his election during the winter quarter.

Through Campus and College

Paris Prize Competition

GRADUATE architectural students from schools all over the United States recently competed for the Paris Prize which is offered every year. This prize consists of a two year tour to Paris and amounts to about $3,000 in cash. Eastern schools were well represented in this competition. There were three different preliminaries which narrowed the field until but five men remained in competition for the final honors. These three men were allowed a period of about six months to complete their final plates for the prize competition. During this time the competitors finished their work under the direction of their respective supervisors.

The winning design of the Nineteenth Paris Competition was drawn and rendered by Carl C. Landefeld of the Carnegie Institute of Technology. His work was prepared under the direction of Professor Faelton of Yale University. The original plan can be seen in the architectural department here at Minnesota. The superior qualities of the work can readily be detected.

Donald S. Nelson of the Massachusetts Institute of Technology placed second. The straight forward presentation and solution of the problem won Mr. Nelson his place.

I. Woodner Silverman, a graduate of the 1924 class of architecture at the University of Minnesota and now studying at Harvard, was given third place. An admirable characteristic of harmony pervades his entire set of drawings. Mr. Silverman was under the supervision of Leon Arnal while at Minnesota.

Edward O. Holien, of the 1923 class of architecture at Minnesota and now studying at Massachusetts Institute of Technology, was another of the competitors. Although his work did not place he was allowed a First Medal with the three others who did place. The salient feature of his drawings is the brilliant Rendu. A second medal was awarded to A. F. Flint of Massachusetts Institute of Technology.

The success of these Minnesota trained men in competition with the best talent turned out by eastern universities certainly reflects back to our department of architecture, and must result in still further advancing the prestige which this school enjoys at the present time with eastern architectural schools.

An Engineer's Library

A GIFT of the 500 volume technical library of the late Professor George D. Shepardson, has been recently made by Mrs. Shepardson, widow of the former head of the department of electrical engineering. Professor Shepardson died of pneumonia in Florence, Italy, on May 26 of last year. In company with his wife and daughter, he had been taking a trip around the world during his sabbatical leave when his sudden death occurred. Approval of the gift has been given by the Board of Regents, and the books are now being listed, classified, and indexed preparatory to being placed on the shelves of the engineering library. A book plate containing a portrait of Professor Shepardson and a dedication to his memory will be placed in each book.

Mathematics, electrical engineering, general science and many bulletins comprise the majority of the books in the group. Advertising pamphlets and circulars of the electric manufacturing companies in their early history have been bound, and they provide an interesting comparison between present day practice in the electrical field and that found during the younger days of Professor Shepardson. An old photographic album, volumes on the review of street railways, bound volumes of bulletins of the Bureau of Standards, catalogs, copies of the Gopher of 1895 to 1897, volumes of the Engineer's Year Book, which was the publication of the engineering college, and copies of the magazine Popular Science as it appeared in 1879 show the diversity of his library.

Advance in the profession of electrical engineering is shown in a striking way to one who spends a few hours brousing through his volumes and magazines of 25 years ago. None of the books are particularly old or outstanding, but they do illustrate the advances made.

Professor Shepardson was a writer and his notes and writings are to be found among the books of the library. His last book was "The Religion of An Electrical Engineer," a review of which appeared in the January TECHNO-LOG He has written text books on phases of electrical engineering, and many technical papers, as well. The great care he spent in the maintenance of his private library is evidenced by the numerous bound volumes of bulletins and pamphlets.

FACULTY SKETCHES

S. CARL SHIPLEY

PROFESSOR S. CARL SHIPLEY, acting head of the mechanical engineering department, was born near Bethany, Mo., in 1873. All his grade and high school work was done there, and in 1895 he began attending the University of Missouri. His father objected to his taking engineering because of his youth, so he took the academic course, and in 1900 he received the degree. His real interests, however, were in engineering, and during the last two years of his arts work he was in charge of the mechanical shops at Missouri. He then went to the University of Cincinnati, where he received his B. S. in 1902 and his M. E. in 1903. He remained there for four years as superintendent of shops and instructor in the mechanical engineering department. At this time he was associated with Professor C. W. Marks.

In 1907 the University of Minnesota claimed his attention and he came here as an instructor in mechanical engineering. The next year he was promoted to assistant professor.

Cincinnati was still in his mind, however, and in 1909 he married Mary Fillmore of that city.

Much of the success of the mechanical shops at Minnesota is due to Professor Shipley, who eliminated student exercises and put the shops on a production basis. Exercises are used until the student becomes familiar with the machines and then production starts. A student sets up a machine and runs off a number of the same parts, while another student is making a quantity of some other piece. When all the pieces are finished, each one is given a complete set of them and a Gopher Outboard Motor is assembled. This is a complete rowboat motor and a worthy product of the shops.

In 1917, Professor Shipley took leave from the University to become chief engineer for the General Engineering Company, manufacturers of the No Kol Burner and the Doble Steam Car and Truck. These products were in their infancy at that time, and their development was largely due to his work. Designs and specifications for the steam car were on hand, but they were in no way complete enough to make a working model. It was necessary that he practically redesign the entire job. This was accomplished and the Doble Steam Car became a reality. A copy of the gasoline burner from the car was remodeled and experimented with until the No Kol Oil Burner was developed. Today it is one of the foremost on the market. Professor Shipley was in charge of all production there for a year and a half.

The world war was claiming many men at that time, so in 1918 he returned to the University of Minnesota, where he took charge of training auto mechanics for the army. He continued with this until the armistice was signed. In 1919 he was given the associate professorship in mechanical engineering.

In 1920 he went to Robert College, Constantinople, as head of the mechanical engineering department, and while there instructed many of the officers of Kemal Pasha's army. The training of the officers consisted chiefly of shop work for the production of army machinery.

Upon his return to the University in 1921 he was promoted to the full professorship, and in 1923, with the absence of Professor Flather, he became the acting head of the mechanical engineering department. Since the death of Professor Flather he has remained in that capacity.

Much of Professor Shipley's time has been spent in travel, and during the summers of 1921 and 1922 he traveled about Europe.

He is a member of Theta Xi, Pi Tau Sigma, Sigma Xi, and the Americal Society of Mechanical Engineers. He is also on the board of directors of the Minnesota Federation of Architects and Engineers.

Teacher: "Now, Danny, what are you doing, learning something?"

Danny: "No, Ma'am, I was just listenin' to you."

Motor Cycle Cop—"Here, you, pull over."

Eng. (in 1910 Ford): "Whasamatter?"

M. C.: "You were doing fifty."

Eng.: "Will you write that down and sign it so I can show it to my fraternity brothers?"

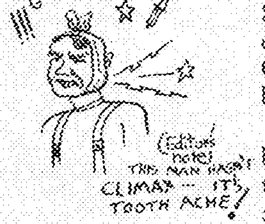
Young Knut—"I say, waitah, nevah bring me a steak like that again."

Waiter—"Why not, sir?"

Young Knut—"It simply isn't done, old thing!"

Stude (to Prof. Springer): What's that you wrote on my paper?

Prof: I told you to write plainer.



Sunday School Teacher: Is your pa Christian, Bobbie?

Little Bobbie: Naw. Not today. He's got a toothache.

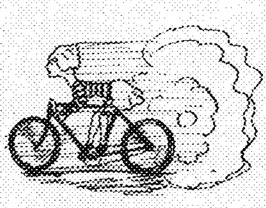
Wifie: "Herb, how is the car running?"

Hathaway: "Not so good. There was a little miss in it last night."

Wifie: "Yes, I found her gloves and handkerchief this morning."

"Dear Ruth," wrote a well known engineer, "pardon me, but I'm getting forgetful. I proposed to you last night, but I really forgot whether you said yes or no."

"Dear Carl," she replied by note, "So glad to hear from you. I knew I said 'no' to some one last night, but I had forgotten who it was."



Co: "They say Miss Peach is pretty fast."

Ed: "Yes, she has already covered five laps this evening."

"Say, Bob, can I borrow your pen?"

"Sure thing."

"Got a sheet of writing paper I can use?"

"Reckon so."

"Going past the mail box when you go out?"

"Uh-huh."

"Wait a minute till I finish this letter, will you?"

"All right."

"Want to lend me a stamp?"

"Yeh."

"Much obliged; say, what's your girl's address?"

Teacher—"Who organized the first geometry problem?"

Pupil—"Noah."

Teacher—"How's that?"

Pupil—"Didn't he construct the arc B. C.?"

1st—How was iron first discovered?

2nd—I heard Mr. Hughes say they smelt it.

1st Stude: "I hear Doc. Spears doesn't want Duke Johnson any longer for football."

2nd Stude: "Why not?"

1st Stude: "Because he's long enough already."

Our old cobbler has now a job in a restaurant shoeing flies.

I wonder what the people talk about in Iceland, where the weather never changes.

"I don't believe you love me any more," sobbed Catherine.

"Why do you say that, dearie?" asked Ray anxiously.

"Well, for the last week you've left every night before father threatened to throw you out."

ROOMMATES

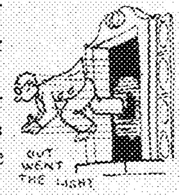
"Well, I see my friend gave you a black eye."

"Why, you never saw the person who gave me that black eye."

"That doesn't matter, he's a friend of mine, anyway."

"You are the light of my life, Frank," she said.

"I am sorry," said her father as he appeared in the doorway, "I'll have to put your light out."



Can you imagine it! Jack came over the other day and said that love is only a chemical reaction.

Yes, but don't you rather like the laboratory experiments?—The Michigan Technic.

Bailey was telling her about the members of the football team.

"Now," he said, "there's Joesting; in another year he'll be our best man."

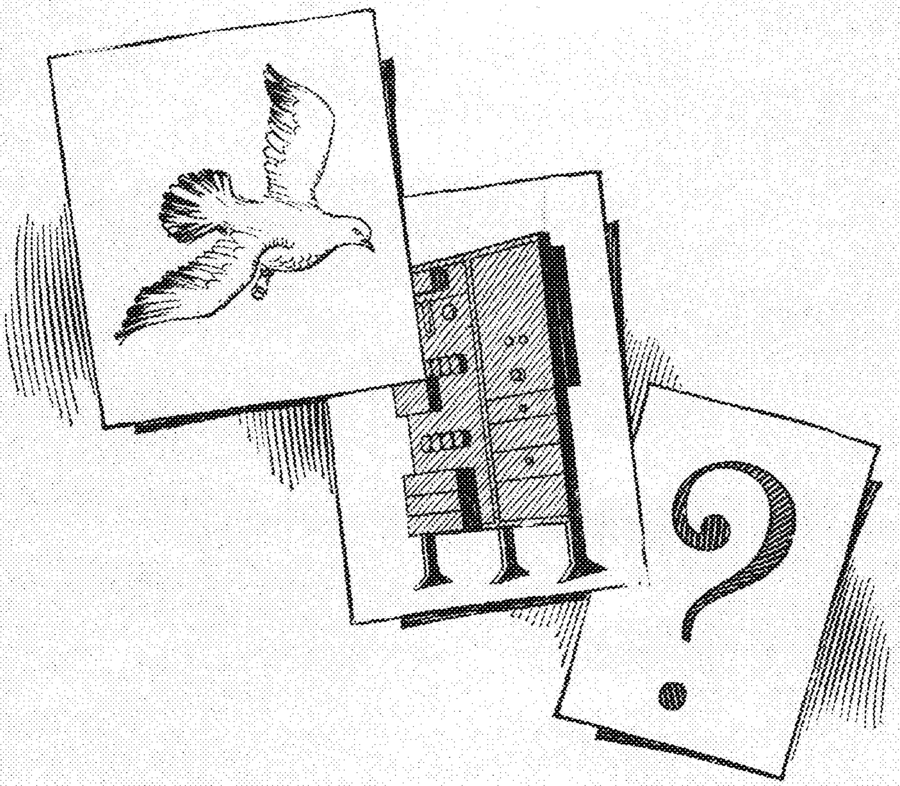
"Oh, Stuart," she gushed, "What a nice way to ask me."

Helen—Oh, George, think of coming to ask papa's consent in such shabby clothes.

Vye—That's all right. I had one suit ruined.

Sailor: The Captain? Oh, he's over on the starboard side, sitting on a hatch.

Sweet Young Thing: Gracious! Why don't you keep a hen?—*Alta Fixit.*

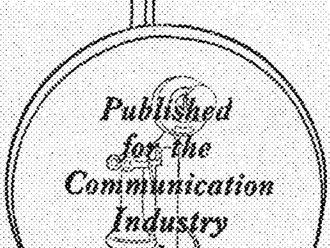


Carrier pigeon to carrier current

—and then some!

IN the field of communication great strides have been taken—and greater will be taken. And just as the carrier current in telephony is an infinitely better vehicle for communication than the carrier pigeon, so new and greater developments lie ahead.

Today, as never before, this field offers an opportunity for constructive work in design, purchasing, manufacture, finance, distribution and other phases. In short, a many-sided field of work in which the ultimate horizon still lies far beyond any present view.



Western Electric Company

Makers of the Nation's Telephones

Number 67 of a Series

Water Power Laws and Federal Policy

(Continued from page 201)

ingly important, the legislation in effect expressed no governmental policy encouraging such development; in fact the character of the legislation was such as, in most cases, definitely to discourage it. Revocable permits, or permits which might be altered in their terms so as to saddle the development with unforseen financial burdens were the best that could be obtained under the acts of 1906, 1910, and that of 1901 relating to the public lands. The administration of the acts relating to navigable streams was under the direction of the War Department, of those relating to the public lands under the direction of the Department of the Interior, and in 1905 the Department of Agriculture was brought into the melee by the transfer of the Forestry Bureau to that department. Thus by 1910 three separate sets of administrative officers were issuing permits for waterpower development, without the guidance of any definite policy and under statutes acceptable neither to those desiring to develop waterpower nor to the departments charged with the administration of the statutes.

In 1908 and again in 1909 President Roosevelt, and in 1912 President Taft, vetoed bills granting rights to power companies because they deemed the public interest was not sufficiently protected. These vetoes, coupled with the fact that the development of electrical transmission was making hydro-electric power of increasing importance, served to focus attention on waterpower legislation. The increasing desirability of developing waterpowers, the fact that Congress had granted, without restriction and in perpetuity, many valuable public rights to private concerns, the general hue and cry against "monopoly" and the "trusts" prevalent at that time, and the question of states' rights in the waterpower field, were all injected into the fight for a definite government policy and new and acceptable legislation on the subject of waterpower.

As an example of the agitation of the public mind at this time might be cited the stand taken by President Roosevelt in 1909. President Roosevelt took the position that Congress, in granting power rights, was giving in perpetuity and on very liberal terms, public property of enormous potential value to private persons and organizations without adequate protection of the public interest. He deemed that the public had a right to the increase in value that was bound to take place in the waterpowers under public control. In conformity with his stand on this question, and with his general "trust busting" policy, he refused to sanction the issuance of further waterpower permits which did not conform to the following conditions, as set forth in his message to the House of Representatives on January 15, 1909.

1. There should be a limited or carefully guarded grant in the nature of an option or opportunity afforded within reasonable time for development of plans and for execution of the project.
2. Such a grant or concession should be accompanied in the Act making the grant by a provision expressly making it the duty of a designated official to annul the grant if the work is not begun or plans are not carried out in accordance with the authority granted.
3. It should also be the duty of some designated official to see to it that in approving the plans the maximum development of navigation and power is assured, or at least that in making the plans these may not be developed as ultimately to interfere with the better utilization of the water, or complete development of the power.
4. There should be a license fee or charge which, though small or nominal at the outset, can in the future be adjusted so as to secure a control in the interest of the public.
5. Provision should be made for the termination of the grant or privilege at a definite time, leaving to future generations the power or authority to renew or extend the concession in accordance with the conditions which may prevail at that time.
6. The license should be forfeited upon proof that the licensee has joined in any conspiracy or unlawful combination in restraint of trade.

Roosevelt thought that Congress had the power to enforce such conditions, and he announced his firm intention of making every effort to see that the conditions were applied whenever a permit was granted.

After many futile attempts at legislation, Congress, in 1920, passed the Federal Water Power Act, which has in the main proved satisfactory to all parties concerned, and under which with slight amendment, Federal control of waterpower is now administered.

The Federal Water Power Act of 1920 establishes, for the administration of the terms of the Act, a Federal Power Commission consisting of the Secretaries of War, Interior, and Agriculture. This commission is empowered to appoint an executive secretary and to prescribe his duties and is further empowered to request that an officer of the United States Engineers be detailed as engineer to the Commission. No provision is made for a permanent engineering and clerical staff other than to grant permission to borrow the members of such a staff from the War, Interior, and Agricultural Departments. It is the duty of the commission to investigate all applications for license under the terms of the 1920 Act, and to issue permits for development when it is shown to the satisfaction of the commission that the terms of the Act have been complied with.

A license issued by the commission is a permit to develop, and to enjoy the fruits of a development, for a period of 50 years. The license is in the nature of a contract between the licensee and the government, setting forth conditions the licensee must fulfill. Once in effect the license may not be cancelled or modified by the Executive or Congress, but only by judicial action in event that the terms of the license have not been complied with. If a licensee does not start construction within a time specified in the permit, his license may be cancelled by administrative action. If, by judicial action, the properties are taken over before the expiration of the permit, the licensee is paid just compensation, as determined by the courts. At the expiration of the terms of the license (50 years) the property may be relicensed to the original licensee, may be taken over and operated by the government, or may be relicensed to another applicant. In event that either of the two latter courses are followed, the original licensee must be paid the "net investment" as determined by the terms of his license.

A license issued under the 1920 Act requires that the licensee develop the privileges granted so as not to interfere with the fullest utilization of the power available nor with the requirements of navigation or other uses to which the stream may be put. He is required to design and operate the works with a proper regard to efficiency and safety, and he is required to keep the works in good operating condition. The licensee is further required to establish adequate depreciation and other reserves, and to use earnings in excess of a reasonable rate to retire the investment, to keep accounts as prescribed by the commission and to make reports to the commission from time to time; these requirements being similar to those of the Interstate Commerce Commission with respect to the railroads. Capitalization for the purpose of rate making is prohibited, as

is the payment of unreasonable amounts for grants or franchises.

Where there is no state agency for the regulation of water power company rates and finances the commission is empowered to act in this respect until the establishment of such a state agency, after which the commission's regulatory powers cease.

An interesting provision of the Act is "that the licensee shall pay to the United States reasonable annual charges . . . . . for the purpose of reimbursing the United States for the costs of administration of this Act; for recompensing it for the use, occupancy, and enjoyment of its lands or other property." States and municipalities selling power at cost are exempt from this provision of the act, and the commission in its discretion may exempt other projects of less than one hundred horsepower.

The charges as levied under the regulations of the commission are divided into three parts. A charge to reimburse the United States for the cost of administration of the Act is based upon the power capacity of the project. An annual charge of two cents per horsepower of capacity is made from the issuance of the license until the 1st of January immediately following the date of operation of each unit. As each unit goes into operation the rate changes to five cents per horsepower for the first year, ten cents per horsepower for the second year, and twenty-five cents per horsepower annually thereafter. These rates may not be increased by the commission, but may be reduced. To recompense the United States for the use of public lands or reservations an annual charge of ten cents per horsepower is made effective on the 1st of January after each unit goes into operation. A charge of five dollars per year per mile strip 100 feet wide is made for the use of public lands used for transmission lines. All projects on Indian lands, and all projects involving the use of structures belonging to the United States must pay a reasonable annual charge as determined by the commission.

A provision of the Act that has caused adverse criticism requires that whenever a licensee under the Act is benefited by the construction of reservoirs or other headwater improvements built by another licensee or by the United States, the benefited licensee shall pay a proportion of the annual charges on the improvements in proportion to the benefits received, as determined by the commission. This is apparently the only provision of the Act tending to introduce unforseen factors into the financial operation of a plant licensed under the Act.

A person or corporation desiring to develop a water power under the jurisdiction of the Federal Power Commission must make application to the commission for a preliminary permit or license. A preliminary permit is issued for a period not exceeding three years for the purpose of maintaining priority while designing and investigating a project. An applicant must show that he is qualified under the Act legally to apply for a permit or license and as to ability to carry out the proposed development. He must show ability to finance the project, to dispose profitably of the power to be developed, and that his scheme of development will utilize the power possibilities of the site fully and in a manner not incompatible with the best use of the stream for other purposes of interest to the public, such as navigation and irrigation.

The Act has required interpretation and the establishment of a definite policy in its administration. A particular effort was made to establish a clear-cut and equitable administrative policy in drawing up the rules and regulations of the Power Commission. Committees of the National Electric Light Association and of the Engineering Foundation assisted with this work, and other organizations, corporations and individuals interested were heard before the regula-

tions were adopted. The policy expressed in the Act itself and as interpreted by the regulations is being gradually amplified by precedent as new situations arise upon which the Power Commission must rule.

The principal difficulties which have arisen in the administration of the Act come about through conflict with similar state authorities. Two points of contention have been encountered, the first in determining what projects come under the terms of the Act, and the second the determination of what part of the regulation of the activities of a licensee belongs to the state and what to the commission. The question of navigability as defined under the Act has given rise to the first question. The commission has endeavored to take a broad view of the matter, declaring its jurisdiction in doubtful cases only when such a course seemed best for the public interest. In the question of regulation the commission has left to the states all the powers that the states will assume not in direct conflict with the terms of the Act. The desire has been to delegate to the states some of the commission's powers rather than to assume powers properly exercised by the states.

It seems that the desired ends of the 1920 Act, namely the development of the waterpower resources of the United States as thoroughly and as rapidly as feasible, and the protection of the public interest in these resources, is being achieved under the terms of the Act. The public interest is protected in that the ownership and control of the power sites remains in the hands of the government. The terms of the Act protect the investing and consuming public from fraud and exorbitant prices, and specify that developments utilize fully the power possibilities of the nation. That the terms and administration of the act are, in the main, satisfactory to investors in waterpower is evidenced by the fact that applications have been filed with the commission for the development of some 22 million horsepower (1926). This is more than six times the applications for the development of power under Federal control in the past twenty years.

Acknowledgment: Much of the material for this article has been taken with slight modification from the published writings of Mr. O. C. Merrill, Executive Secretary of the Federal Power Commission, particularly from the First Annual Report of the Commission and from the Transactions of the American Society of Civil Engineers, Vol. 86, pages 749-57.

A Million Volt Party

(Continued from page 207)

hibits. Equipment has been obtained from many sources which illustrate new and unique applications of electricity in the service of man. A modern manual and automatic telephone demonstration will be set up in operation and experts will be on hand to explain in detail the minute operations involved in making a telephone call. The inner workings of the new electric phonograph will be shown which converts the mechanical vibration directly from the record into electrical energy which is then amplified and passed through a loudspeaker. Prominent among the other manufacturers' exhibits will be found the electric refrigeration machine, the electric typewriter, the electric clock and many other varied and interesting appliances.

The spectacular stunts will include the million volt transformer which generates lighting for the laboratories as well as for many of the well known high frequency stunts. A duel will be staged by men who will fight by hurling lightning bolts of high frequency currents at pressures of thousands of volts at each other.

Probably the most interesting and amusing features to be seen will be those

devoted to humorous applications of electrical equipment and the many and varied deceptions to which magnetic phenomena are peculiarly adapted. Weiners will be cooked by a new process which is certain to tickle the funny-bone as well as the palate. This process was discovered in our laboratory when one of the boys substituted a weiner for a fuse and received surprising results. A hokus frying pan which extracts heat from a block of ice will be shown to demonstrate the proverbial stunt of frying eggs on ice. These eggs and the dog fuses will be raffled off as sandwiches on a roulette wheel which is so crooked that the operator can wager the house against all comers without the slightest risk. You may have your fortune told by an ouija board which always lies.

It is generally conceded that the future success of the technical student requires considerable technical skill and a keen perception of what is required by circumstance. The prescribed scholastic program offers a convenient and effective means of laying a foundation for the future development of technical skill but offers no solution for making a finished product of the technical graduate. The problems involved in making a success of such an entertainment offer an excellent means of developing latent and desirable qualities which are stifled by the academic burden. This latter fact is one of the chief arguments in the favor of such an enterprise.

Rating E. C. M. A. Publications

(Continued from page 209)

Scheme of Awards

For the purpose of stimulating efforts to improve the quality of the editorial work in the member magazines, and for the further purpose of giving recognition to meritorious achievement, the Executive Committee of E. C. M. A., as an experiment, will undertake to make awards according to the scheme outlined below. The awards will be announced at the next convention, at which time *Certificates of Award* will be issued.

1. *Covers.* First, second and third places will be awarded to the magazines having the best covers throughout the year. Other things being equal originality will be given the most weight in making awards. The covers must, of course, be appropriate to an engineering college magazine and must not offend good taste in any way.

2. *Illustrations.* First, second and third places will be awarded to those magazines which, throughout the year, have been best illustrated. The basis of the award will be the amount, arrangement and effectiveness of the illustrations.

3. *Alumni Notes.* First, second and third places will be awarded those magazines having the best alumni notes. The basis of the award will be the amount and the attractiveness of the material. The desire is to develop alumni departments that will attract alumni subscribers.

4. *Student Articles.* First, second and third places will be awarded to those magazines whose student articles throughout the year have been best in amount and quality. Feature articles only will be considered. They may be by staff or non-staff writers. The desire is to develop and encourage the writing habit among engineering students, as that is one of the principal reasons for the existence of these magazines.

5. *Editorials.* First, second and third places will be awarded to those magazines whose editorials throughout the year have been the best. The editorials should be well written and convincing,—and there is merit in brevity. The desire is to develop editors who have breadth of vision and a familiarity with current matters of interest to engineers so that they can interpret those matters for their readers.

6. *Best Single Student Article.* One award will be made to the magazine having the best student feature article during the year.

7. *Best Single Editorial.* One award shall be made to the magazine having the best editorial written by an undergraduate during the year.

When a wise man gets the worst of it he makes the best of it.

Zeolite Water Softeners

(Continued from page 203)

have even gone so far as to claim that no real chemical action takes place but only an exchange of metallic ions adsorbed on the surface, i. e., held by forces other than those of chemical valence. At the present time, Mr. Irvin Lavine, du Pont Fellow in the School of Chemistry working under the direction of Dr. C. A. Mann, Chief of the Division of Chemical Engineering, is studying this exchange to find out, if possible, what the mechanism actually is.

The apparatus used in connection with these zeolites is of very simple construction consisting of a tank, either open for gravity feed or closed for pressure feed, partially filled with a layer of mineral on screens or perforated plates and a layer of gravel filtering material together with a smaller brine tank for regeneration. Considerable free space is always left above the mineral. The pressure type is almost universally used because soft water is then delivered at almost the full pressure of the mains. Two general types are the up-flow and down-flow. It is claimed that the latter has the advantage of preventing channeling and giving better contact by floating the mineral in the water. It has the disadvantage that unless the mineral is of the right size and specific gravity to correspond to the flow, some of it may be carried off with the soft water in rapid flow, and unless the water is prefiltered, any sediment will be distributed throughout the mineral instead of only on the top layers where it can be washed off by back-washing in the case of the down-flow type. Prefiltering is desirable to prevent clogging of the surface of the mineral if the water contains suspended solids, and may be provided for in the same tank, as is usually the case, or in a separate filter. Regeneration and back-washing is always done in the opposite direction to the regular flow. In case of the down-flow type this serves to stir up the mineral bed and remove channels. Depth of mineral is determined by the necessity of allowing sufficient time of contact to attain equilibrium at the maximum hardness of the water. Greater capacity is obtained by increasing the cross-sectional area.

The obvious advantages of the zeolite or exchange silicate system of water softening are:

1. Water of zero hardness is obtained.

2. The chemical composition of the water is unchanged except insofar as the calcium, magnesium, etc., are replaced by sodium.

3. The amount of total solids is approximately the same as in the raw water but they are non-scaleforming.

4. It may be used in conjunction with open feed-water heaters to remove dissolved gases or with a preliminary treatment of lime if it is desired to remove bicarbonates and so reduce the total solids.

5. If the mineral used is of proper stability, i. e., does not require frequent replacement, it is the cheapest effective method.

6. Only one simple chemical, salt, is required for regeneration.

7. No chemical or other control is necessary except a simple soap test for hardness which a child can easily perform.

8. It is practically "fool-proof" both as to equipment and mineral.

For these reasons this type of softener has come into popular favor, especially as a household softener. It has also found large application in hotels and hospitals and in many industries like laundries, paper-mills, bakeries, textile mills, etc. It has not, however, received the attention it perhaps deserves from engineers as a means of treating industrial waters for steam-raising purposes.

Three principal reasons have operated to cause this result: (1) fear of high maintenance cost, (2) apparently high first cost of installation, and (3) fear of excessive foaming in the boilers from the introduction of alkali metals. The first has been shown to be groundless if a properly prepared mineral is used since such a mineral will retain its structure unchanged and, if protected from suspended dirt, with activity unimpaired by years of active service. It is true that its installation cost is greater than feed-water heaters and the use of boiler compounds but, for any reasonable sized installation, it is not greater than that of a chemical softener system which is the only other satisfactory method of treatment. As to the third objection, it should be remembered that, in general, this applies equally to the chemical method where most of the scale forming elements removed are eventually replaced by sodium. In any normal water, the final concentration of alkali salts would not be great enough to cause excessive foaming in a well-designed boiler. Abnormal waters would have to be specially considered but it is probable that this method of treatment would be as satisfactory as any.

For the Luvva "MIKE"

(Continued from page 206)

The next night there were more listeners and additional greetings to be sent. Folks were beginning to find out who some of the other guests at the "Hotel" were. Buddies of old had been lying a few rooms apart for weeks and did not know it. Old schoolmates were discovered down the hall, and so the little realm of "fandom" grew.

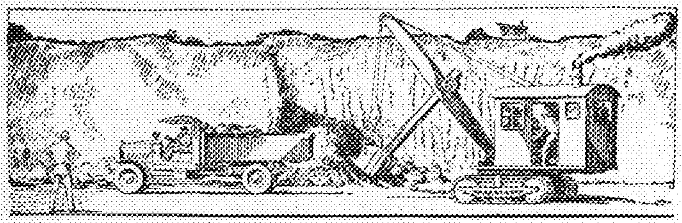
The "announcer," as he styled himself, lay "flat" in his "studio," jotting down in a little notebook the items of news as they were brought in by letter or messenger. He decided the station should have a name—any name that would imply the rollicking, fun-giving nature of the enterprise. Out of several submitted, the choice fell on K-N-U-T, because of its dignified phonetics and general, far-reaching application; and to further localize the dignity, the abode of its clientele was christened the "Ocean View Hotel," because of its marine location; overlooking as it does, a magnificent, rush-bordered frog-pond and a somewhat larger stretch of water, with doubtful shoreline, just beyond.

A few days later witnessed the birth of a more concrete fraternity—The Akorn Klub—peopled by loyal purveyors of the day's Royal News. At one's first communication with the scandal station he was dubbed a Kernel. If he wrote again, confirming his allegiance, no doubt he was a Knut, and after the Knuts in true natural consequence, came the skwirrels, and no mean honor either.

But just at this point in the meteoric rise of this new Sunshine Art something happened—the whispers grew too loud perhaps—at any rate K-N-U-T found itself the object of an official investigation. Sad but true, the staff had been left out in the cold.

Nine bells is nine bells; and "lights out" applies to radio announcers as well as radio denouncers, yea, even to members of the Akorn Klub. Thus began a week of silence. A pow-wow was scheduled at which all the big chiefs, medicine men and a few of the squawks were to be present and K-N-U-T put on the proverbial carpet.

Meanwhile the walls of "fandom" came pouring in by every mail—letters petitions and cards; by the time the pow wow had assembled, over three hundred



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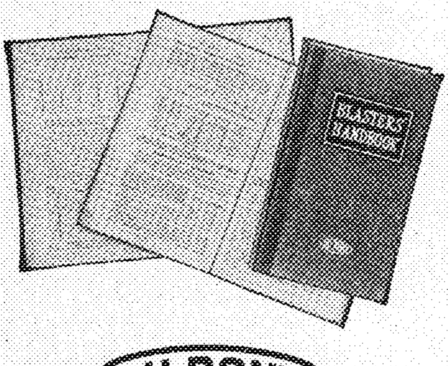

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You Don't Mind Reciting When You've Got the "Dope"

WE have that same feeling of security since we have installed the McClintock Burglar Alarm.

The system operates by the new Sound Wave method, which will defeat, without exception, any attempt to cut cables or wires, or to drill through our vault linings or doors.

Come in and let us show you what we have done to give your valuables 100% protection.

UNIVERSITY STATE BANK

Washington Ave. and Oak St. S. E.

and fifty names, with their attendant pleas, were ready for presentation. That night the cowbell again was heard and scandal station had resumed the uneven tenor of its way.

Many months have passed, and except for a few weeks "summer siesta" the station has waxed strong in quality and influence. As a disseminator of the Daily News it has a pulsing personality no printed scandal sheet could muster; and the elasticity afforded in the treatment of its subjects makes the commonplace a crime.

And the programs? They include everything. Twice a week the Scandal Bush blossoms and the tid-bits of local news are served up on the American plan, birthdays, troop movements, coups de amour and all the presentable comical occurrences constantly taking place everywhere if one has an open eye.

Friday nights come the special program. The amplifier "hook-up" and the shock-proof mounting have made possible the satisfactory "broadcasting" of almost any kind of music from the "Orthophonic" using only a telephone transmitter as a "mike"; so we have the Oak Terrace music hour, each number fondly dedicated in some "heart-touching" manner to a place or a personality in the local sphere. Ever and anon Prof. Block N. Tackle lectures to the intelligencia on such erudite subjects as "The Wampus," "The Whifflefish," "The Home Life of a Sardine," or "The Fourth Dementia," (copies on request).

At intervals K-N-U-T is linked in a grand "hook-up" with such stations as KOFF, Denver; HELP, Chicago; WET, Milwaukee; BLAH, Boston; PDQ, Reno; and broadcasts a nation-wide program of unsual merit from station WEAK, New York. New York, the home of "Moldy and Musty, who come to you through the courtesy of the Clicquot Company, manufacturers of Atwater Kent Heavy-Duty Tooth Paste." In all this, the announcer is the goat, playing all the parts, and directing the orchestra, lecturing, interlocuting or announcing as the case demands.

Saturday night is Home Talent Night, when the Oak Terrace Tennysons bid for the local laureate. Sweet shades of Shakespeare, what an output! Love lyrics, Odes, Free Verse and Sonnets; Kipling, Service or Sandburg reincarnate—and with quality beyond all expectation. There is even talk of a "K-N-U-T Book," after the manner of the Chicago Tribune's "Line Book," to preserve for posterity these masterpieces. Even so file copies are kept from which all may enrich their scrap books.

Extra programs are injected into other parts of the day in case of emergency or the presence of notables. A few weeks ago it was "Babe" Ruth and only the other day Gene Tunney who visited K-N-U-T and broadcasted greetings to the reclining public. Red letter days, to be sure, for K-N-U-T; and something new in broadcasting for the "Babe" and "Gene."

And so it goes—keeping up with the days news and trying not to miss any of the "evil" thereof; posting announcements, making friends and spreading good cheer, sort of a "Lincolnian" enterprise of, by and for the patients.

Why this little story? Not to explain a contrivance—it's no more than a new use for old ideas; not to exploit any one's ability—the project calls for no special qualifications, nor has the use of any; but just to tell of one way Glen Lake Sanatorium has found to furnish aid in solving the problems of morale. A new means of welcoming new patients and amalgamating the whole, finding friends for them and making everybody feel at home in the intricate processes of a new mode of life.

"The world is blue enough
 Without your feeling blue.
There's not half joy enough
 Unless you're happy, too.
The sun is always shining,
 There's always work to do.
This San. may not be heaven,
 But then, it's home to you."

—Edwin Osgood Glover.

"Broadcast" to the Hereafter

(Continued from page 205)

Because the Arabs design and make their own scenery, write their play, compose the songs, act both the feminine and masculine parts, dance, sing, and manage and direct their own orchestra they are distinctive, but since engineering students alone compose the organization, the Arabs are the only student dramatic club of their type in the world.

Each of the nine musical numbers was written by Avner Rakov. They include such carefree, catchy hits as "Sox Appeal," "You Can't Make a Monkey Out of Me," and "Red Hot Alma Mater Blues." Several of these selections have been sold to song publishers and will appear on the market in the fall. Avner Rakov has studied under some of the best musical instructors in the country, and his work on these songs shows what an engineer's mind can produce. The pieces are full of melody and spirit and when sung by the male voices they resound with enthusiasm.

The Electron and Proton dance with the chorus illuminated with tiny electric light bulbs will be a high light of the performance. Other novel stage tricks will also be introduced, and the entire broadcasting apparatus of WLB will be used in the play although it will not be on the stage. Voice currents from the stage will travel to the electrical building where they will be run through the speech amplifiers and back to the music hall to a loud speaker. In this part no voice will be heard direct from the stage, as the radio announcer on the stage will be enclosed in a sound proof booth.

Chorus singing under the direction of Professor O. S. Zelner, who is a trained musician, is expected to be the large success of the play. The songs are original and skillfully worked and are filled with clever phrases.

"Broadcast" is directed by Carl Matthias Wise, of the department of architecture. He is one of the original members of the club, having taken part in the first Arab production, "The Caliph of Colynos." "Broadcast" is expected to be a most successful production since the members of the club have been practicing faithfully on the play; the committees have taken care of the work in a business-like way; the cast is well fitted to their characters, and the music and staging is excellent.

With Our Alumni

CIVILS

'16—H. N. Bruce is general manager of the A. M. Chesher Printing Company of Minneapolis.

'23—Arthur C. Zimmerman, like so many other Minnesota engineers, believes in the romance of the sunny South. Mr. Zimmerman was married to Miss Mae Wenkstern on the first of January and it all took place at Miami, Florida.

'16—Harold L. Peterson, C. E. '16, is general manager of the Marmon Philadelphia Company in Philadelphia.

W. E. Koepke, C. E. '13, and Richard T. Daly, C. E. '21, are with the Kalman Steel Company in New York City. Norman E. Hendrickson, C. E. '16, Lewis M. Roth, C. E. '11, and Irvin S. Macgowan, C. E. '25, are with the same company in St. Paul.

The MINNESOTA TECHNOLOG

Published Monthly by the TECHNICAL COLLEGES of the UNIVERSITY of MINNESOTA

MAY

Volume VII. 1927 Number 8.

MEMBER ENGINEERING COLLEGE MAGAZINES Associated

THE MINNESOTA

TECHNO-LOG

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VOLUME VII. MINNEAPOLIS, MINN., MAY, 1927 NUMBER 8

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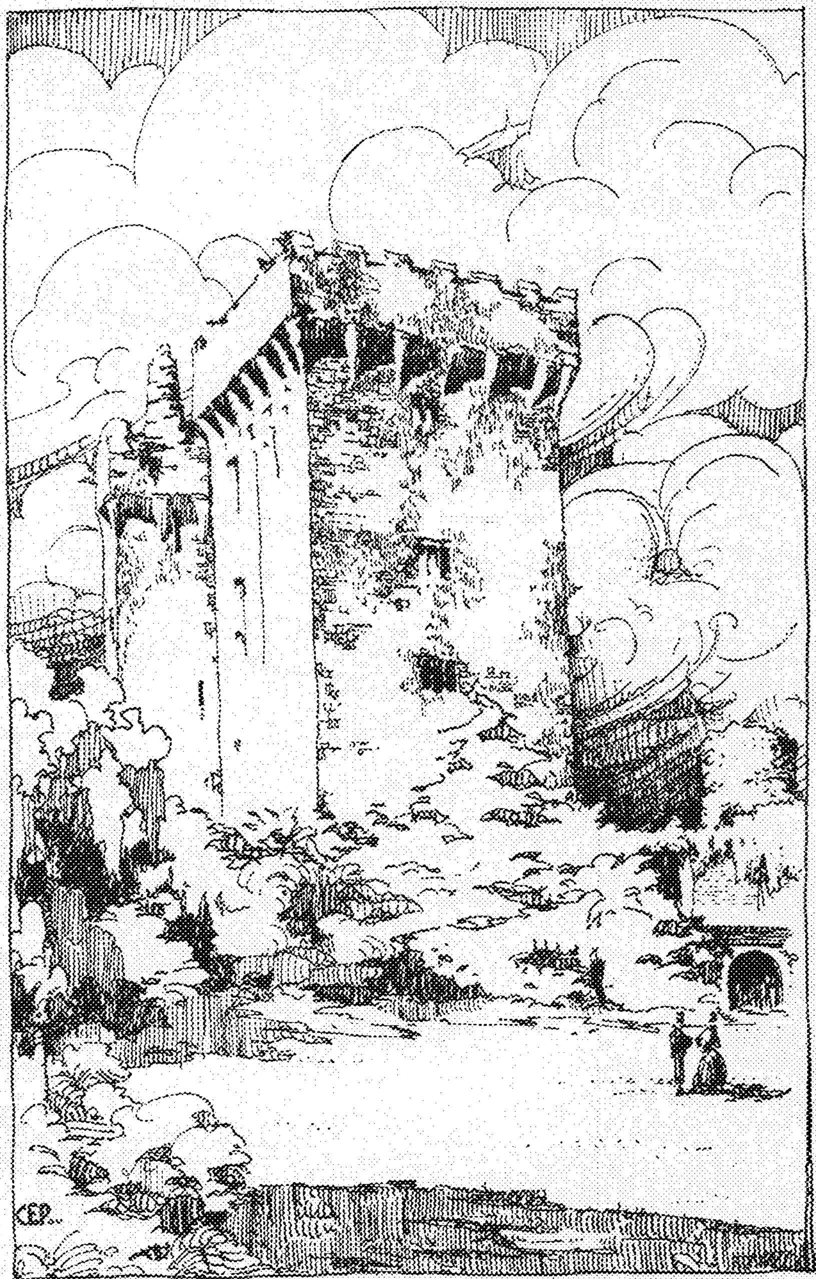


C. E. PETERSON

Blarney Castle

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume VII MAY 1927 Number 8

The Engineer as City Manager

This field of service is fast opening up to technical men, whose engineering education forms an excellent basis for graduate work in public administration

By S. C. Chapin, C '24

THERE is a marked tendency in both state and local government toward the use of the expert in administration. The downfall of the spoils system, with the introduction of civil service reform, has made it possible to develop an administrative technique in government which is rapidly becoming equal to that employed in modern business organizations. Municipal governments have lagged somewhat behind the national government in this development. As early as 1908 we find the installation of a more or less rudimentary form of city manager government in Staunton, Virginia.

Little attention was paid to the development of administrative methods and procedure in the early days of the city manager plan. The townspeople were occupied only with the more tangible things. In the city of a decade ago, as in the city of today, these were largely problems of public works such as water works, sewers, pavements and the like. The engineer was so distinctly connected in the minds of the people with public works problems that the inevitable result was the selection of engineers for the first city managers.

The average engineer is, of course, not necessarily an executive. There is a danger that he will become so engrossed in the technical phase of his work that he will neglect the administrative. With the further development and expansion of the city manager plan it was recognized that the manager should be more than an engineer and administrator. City government, in common with any popular government, is inseparably tied up with local politics. By this I do not mean that the city manager must be a politician. In fact, the City Manager's Association in its code of ethics specifically states that the city manager should not take an active part in politics. It is recognized by students of municipal government, however, that the city manager plan of government will rise or fall depending upon whether or not cognizance is taken of the fact that a political situation does exist, and that it must be recognized by the administration. In the mayor-council form of government the political leadership is assumed by the mayor and the council. In the council-manager form this leadership must be assumed by the council. The manager is an employe of the council and not a political leader.

> *"It has long been a belief of engineers that the problems of government are peculiarly susceptible to solution by the application of engineering principles and that if an engineer could be found with enough political sense to find his way through the mazes of officialdom and enough understanding to remember always that materials and methods do not dominate human behavior, he would be an ideal candidate for leadership in government."*
>
> —Engineering News-Record.

He must, however, have a working knowledge of practical politics and of political science, so that he can recognize the place of politics in the government.

What are some of the problems confronting the city manager? First, of course, is the problem of dealing with the public. The manager must have that type of personality that will enable him to meet the most irate citizen in the town and send him away smiling. To do this he must have tact, must know the business of administration, and must be conscious of the fact that his organization is working efficiently. As to strictly administrative problems the most important, perhaps, is personnel administration. The building up of an effective organization must be the first work undertaken by the city manager. He should know the principles of personnel administration. Above all he should be a good judge of men. In a large city much of the routine work of selection will be done by the personnel manager or by the civil service commission. This does not, however, relieve the manager of the responsibility of selecting his immediate subordinates and of checking up on the organization as built up by the personnel department.

Public safety, including the police and fire departments, and the courts, is a phase of administration that is coming rapidly into the foreground. Prevention of fire and of crime is becoming a watchword in the forward-looking cities. That the engineer must have special training to enable him to intelligently direct this branch of the work of municipal administration is evident. Health and education (the latter, in some cases, consumes half the yearly budget) are phases of administration entirely foreign to engineering. The same may be said in reference to municipal finance, including as it does budget making, debt administration, taxation and assessment.

On the other hand, the engineer comes into his own when public works and city planning are considered. And these are an important part of municipal administration. It is no doubt true that the importance of public works in municipal affairs diminishes as the size of the city increases. Personnel and finance administration are certainly not problems of the first magnitude in the city of five or ten thousand population. At the same time such items as water supply, sewage disposal, and street paving occupy an important place in the minds of the people. Where the manager is an engineer he may find it possible to take over the work of the city engineer, thus effecting an important saving in the municipal salary schedule.

An engineering education can be considered an excellent basis for one intending to enter the city manager profession. It should, however, be followed by a specialized course in public administration. Three universities in

(Continued on page 258)

The Voice of the Minnesota Campus

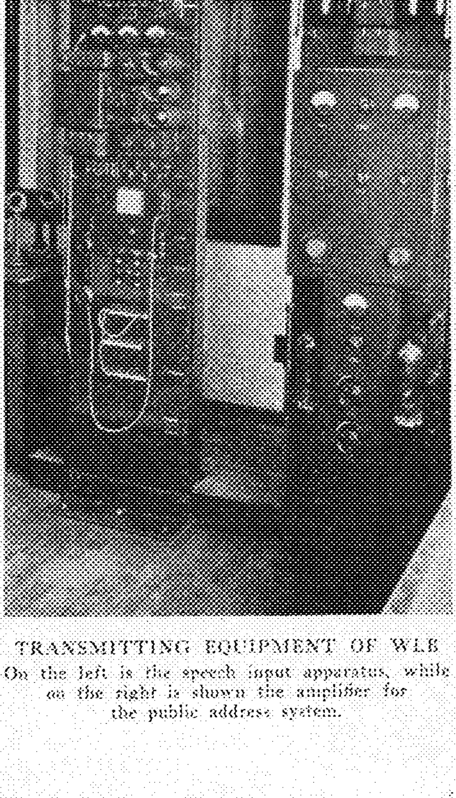
The university radio station, WLB, auxiliary to WCCO, embodies exclusive features of remote control

By Lloyd V. Berkner, E '27
Chief Operator, WLB,
University of Minnesota.

COMMERCIAL radio broadcasting, an enormous and indispensable industry, dates back only to about 1921 for its beginning. Before the war, development was slow and tedious. Stimulated by rapid advancement in radio communication during the war, and by the work of able experimenters and engineers immediately following that period, broadcasting has grown tremendously in its commercial aspects.

Leading in this rapid development the University of Minnesota in 1920 erected the first broadcasting station in the Northwest under the direction of Prof. C. M. Jansky, Jr. The history of this development has already been published.[1] In 1923 the new electrical engineering building was completed. A complete suite of rooms on the third floor of this building was arranged for radio broadcasting. At the same time the Washburn-Crosby Company of Minneapolis donated to the University a complete 500 watt Western Electric broadcast set. This had been in use at WLAG and WCCO previous to installation of the higher powered 5000 watt station at Anoka. The demand for a large University broadcasting station at that time was not sufficient to warrant any immediate development.

[1] Minnesota Techno-Log, April, 1926, "9XI-WLB," by Mr. Stuart L. Bailey.



TRANSMITTING EQUIPMENT OF WLB
On the left is the speech input apparatus, while on the right is shown the amplifier for the public address system.

In the past year the need for a modern broadcasting station called for the expansion which has taken place. This demand was based on two major features:

(1) The immense possibilities of presenting educational extension work and major University functions to the public in this most logical manner.

(2) The need for a powerful and efficient station as an auxiliary to existing commercial stations, to serve the people of the state, should emergency demand.

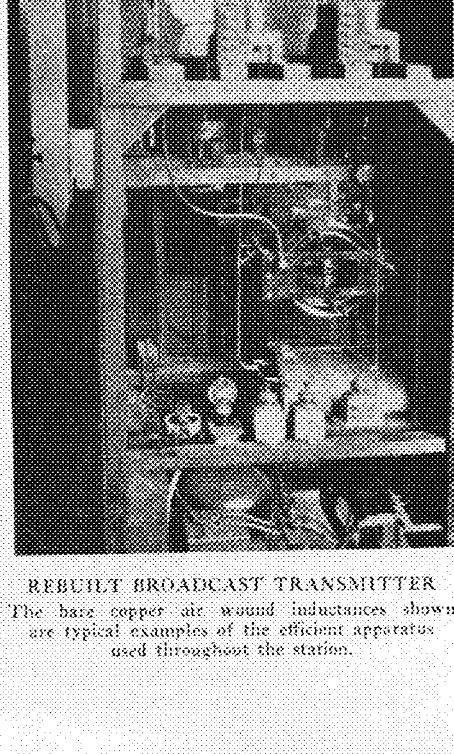
In the spring of 1926, President Coffman called together a group of University officials known as the "Committee on Radio Broadcasting" to consider these problems. Since that time a construction program has been authorized to bring the station to its present status. Now the University's programs are heard from coast to coast with regularity. The Administration Division of the station is supervised by the General Extension Division. This includes the business management and program arrangement. The Engineering Division supervises the design, construction, maintenance, operation and studio direction. This is directed by the communications faculty of the Department of Electrical Engineering.

A close laision between the University Station and the Gold Medal Station (supported by the Civic and Commerce Association and the Washburn-Crosby Company) has been maintained at all times. This was necessary and desirable for several reasons. First, the University could have the advantage of the extensive studio and wire service maintained outside the campus by the Gold Medal Station. Second, the programs from the University could be broadcast either from the equipment on the campus or from Anoka as desired. Third, the University Station could be used from the Gold Medal studios in case of emergency, as an auxiliary to broadcast the markets, weather and other services which are indispensable to the listeners of the Northwest. Fourth, the technical developments of each of the systems might be available for the most rapid advancement of both. An example of the advantage of this cooperation will be found in a later discussion of the automatic control apparatus now in use.

The broadcasting equipment is maintained in five rooms: the operating room, the battery room, the generation room, the studio, and the reception room. In the operating room are located the speech input equipment, the automatic control, and the broadcast set. Power is brought through wire ducts from the generation and battery rooms. The local speech input is brought in from the studio.

The speech input equipment consists of an incoming line terminal and a Western Electric 8A (three step) audio frequency amplifier with associated apparatus. The incoming lines include pairs of lines from the New Nicollet Hotel studio, from the local studio, from the music building, from the stadium, from the input and output of the 8A amplifier, from the broadcast transmitter, and from any other desirable external point. Special telephone lines are used for this purpose. These lines

(Continued on page 246)



REBUILT BROADCAST TRANSMITTER
The bare copper air wound inductances shown are typical examples of the efficient apparatus used throughout the station.

A Modern Protective Film

Nitrocellulose solutions, known as lacquers, are rapidly replacing varnishes and enamels in the decoration and protection of both metal and wood surfaces

By HAROLD BUNGER, CH. E. '26
Graduate Student,
University of Minnesota.

THE name lacquer is the descendant of the Hindustani word "lakh," which means "a hundred thousand." It refers to the many thousands of insects which secrete the clear waxy basis of shellac. The word may also refer to the exudation of an Asiatic tree, which is "Oriental Lacquer," and requires hundreds of coats for the beautiful, lustrous and enduring finish. There are two very excellent reasons why "Oriental Lacquers" are unfitted for Occidental usage. First, the undried lacquer is poisonous to those workers of our side of the globe and causes a painful skin eruption ending in death. Second, the cost of applying the required number of coatings to furnish the desired result would be so great that it would be prohibitive. To carry the derivation and application down to modern lacquers is not far fetched. They are finding a hundred thousand uses. This is borne out by the fact that the lacquer industry increased 108 per cent during the year 1926.

Gum shellac and its "poor relations," damar, copal and rosin, when dissolved in methyl alcohol, are the spirit varnishes or lacquers of older practice. When pigmented these spirit varnishes were the quick drying enamels, used where speed of drying was an essential factor in finishes. The protective films produced were subject to softening in warm weather and cracking in cold. Ultra violet light, abrasion and water were ruinous to the films.

When these products were enjoying favor in industry, solutions of cellulose nitrate in alcohol-ether found limited use in the fields of photography and medicine. The film produced whitened upon drying, due to the rapid evaporation of the low boiling solvents, and the accompanying condensation of atmospheric moisture.

Interest in the use of cotton (synonymous with cellulose nitrate in the industry) solutions as a protective film, was somewhat sidetracked by the discovery of the solvent and plasticizing qualities of camphor. The fabrication of a myriad of celluloid products followed.

In 1882, however, interest was revived, when Stevens patented the product produced by dissolving cotton in amyl acetate. It was impossible to dissolve more than six ounces of cotton in a gallon of solvent, and have a product which would be thin enough to spread on a surface. These heavy solutions found use as leather dopes for the manufacture of artificial leather and patent leather.

Amyl acetate made use of a waste product, fusel oil, in its manufacture. The ester was made from the by-product of alcohol manufacture. To supply the further demand made by the modern lacquer industry, other methods, both synthetic and by fermentation processes, are utilized. Many other solvents and nonsolvents have been produced for this new industry, which will be considered later.

> *Harold A. Bunger entered the University of Minnesota in 1921 and completed the work for the Bachelor of Science in Chemical Engineering in 1925. He was granted his degree in June, 1926, after spending the intervening year in experimental work with the Hercules Powder Company.*
>
> *His interest was attracted to nitrocellulose during this year, and he entered the Graduate School at Minnesota in September, 1926, to take up work leading to the Ph. D. in Chemical Engineering. He is now working on some of the fundamental problems connected with the properties of nitrocellulose lacquers.*—EDITOR.

The advance of the lacquer industry in the last five years is due to the advances in the fields of solvents and nitrocellulose manufacture. Cotton is now being made which can be dissolved in suitable solvents up to thirty-two ounces per gallon, along with sufficient plasticizers and gums to give a film of respectable thickness. The viscosity of the lacquer solution is approximately that of the product it is replacing, gum and spirit varnishes.

Cellulose nitrate, as the base of lacquers, has had an interesting career. The parent substance, cellulose, has not been chemically classified except in the general sense. More is known about the things that can be done with cellulose, than the why of it. Nitrocellulose has inherited all of the uncertain foundation of cellulose, with a whole group of new "doubts" all its own. Let it be stated here that the art of the manufacture of nitrocellulose is entirely empirical. Diametrically opposed is the fact that modern nitrocellulose is the handiwork of the chemical engineer. It follows, then, that the lacquer industry is also empirical. It is true that the development of nitrocellulose lacquers is scientifically sound, but lacking in fundamental facts, due to the lack of time for such research. It has been necessary for all available hands and minds to turn to the task of producing the newly demanded product.

It may be remarked here, that the chemical engineer and his methods have made possible the production of stable, low viscosity nitrocellulose. Upon being allowed to institute chemical control in a "rule of thumb" operation, where the workman felt and smelled the standards, he found that certain differences in the technique of nitration produced profound differences in the viscosity of the product. By intelligent research, he found that by careful control a product of any desired viscosity could be obtained. The chemical engineer was also responsible for the design and installation of equipment and plants, which made this very hazardous business one of comparative safety.

The ingredients of a lacquer may be divided into the following groups: cottons, solvents, nonsolvents, plasticizers, gums and pigments.

Cottons

The cottons used are chiefly the product obtained by treating scrubbed and bleached cotton linters with mixed nitric and sulfuric acids in a nitrating pot fitted with an agitator. At the proper time the acid is wrung out and the cotton drowned in vats of water. The cotton is then treated with a mild antiacid and water in an autoclave or digester until all acidity is removed. The cotton is then cooked or poached with water under pressure for a variable time up to sixteen hours. The cotton is then wrung in centrifuges and dehydrated by displacement of the water by ethyl alcohol, excess alcohol being removed by hydraulic pressing. The cotton is then broken up to individual fibers, graded and shipped to the trade wet with alcohol amounting to 30 per cent of the weight of the cotton, which is allowed to remain as a safety measure.

Cotton is classified according to the viscosity of a certain solution made in a prescribed manner. The cotton used in lacquer is that of lowest viscosity, so that the total solids of the finished lacquer will be as high as possible.

(Continued on page 248)

LLOYD HOOVER, *Chairman*

WINIFRED MOORE, *Queen*

PORTER KILPATRICK, *St. Pat*

Engineers' Day Committees

LLOYD HOOVER, *General Chairman*

IRVINE G. SINNOTT, *Assistant Chairman*

Parade
Frank Tebo, *Chairman*
LeRoy Engstrom
Frank Seeger
George Ferguson
Charles TenBrook
Glenn Youatt

Brawl
W. E. Petterson, *Chairman*
A. Osrowski
P. D. Silliman
C. E. Swanson
Melnor Rudser

Buttons
Elmer McIntire, *Chairman*
Joe Blackshaw

Open House
H. Hathaway, *Chairman*
Henry Roberts
Glendon Brown
Clifford Butler
Herbert Spotts
Walter Huchthausen
Leslie Hemenway

Knighting
G. C. Hawkins, *Chairman*
Hugo Gustafson
J. Marvin Cook

Finance
Geo. Thwing, Jr., *Chairman*
Harold Lockhart
Joe Armstrong

Decorations
Harold Ekman, *Chairman*
Rex Severson
Donald Schilken
Roy Thorsbov

Green Tea
Louise Belden, *Chairman*
Margaret Bradbury
Jane West
Grace Jones

Alumni
Homer Tatham, *Chairman*
Jack Crimmon
Winston Close
Vern Sievers

Posters
Gilman Holien, *Chairman*
Bruce Church
George Crosby
Edward Witt
Stowell Leach
Fred Grossman
Robert Dunning

Dansant
Wm. McGinnity, *Chairman*
Fritz Grossman
John Ramey

Publicity
L. A. Clousing, *Chairman*
Gordon Harris
Donald Bohrer

Program of the Day

MORNING

9:00-11:00—Open house for visitors will be conducted in every department, and engineering souvenirs will be given out.

11:00-12:00—The parade, composed of comic floats representing university life, will wind its way through the campus with the Blarney Stone in the lead.

12:00-12:45—St. Patrick, aided by his queen, will conduct the knighting ceremonies, where each senior will pledge allegiance to the royal order of St. Pat.

AFTERNOON

1:00-3:00—Open house in all departments will continue for visitors who missed the morning open house.

3:00-5:30—The Green Tea Dansant will be held in the Main Engineering auditorium, where all visitors may trip the light fantastic and sip the nectar of Erin.

9:00-12:30—At the Engineers' Brawl, in the Minnesota Union, all loyal engineers will climax the day's efforts to the syncopated strains of Robert Christine's orchestra.

Our First Engineer

A modern son of the auld sod tells of the greatest engineering feat of all times, the invention of the worm drive

By Porter Kilpatrick, *Arch. '27*

St. Pat. Engineers' Day, 1927.

B'YS, if the throb of ye're auld Oirish 'earts thrills to the sound o' me father's name, Oi'll be afther tellin' ye about the auld man. It's been many a long year since there lived in the country o' Oireland a wee lad a bearin' the name o' Patrick. Shure and it's glad Oi be that in later years this wee lad became me father.

Now it was that Dad 'ad been barn o' a great race o' Oirish foighters and while yet but a b'y 'e practiced the foine art o' gate crashin', and wrestlin', and the noble art o' self defense. 'Is father an' 'is mother predicted great things fer the b'y, and e'en thought that some day he moight be champ o' the woild. Oi 'ate to get off the track o' the story, but ye must admit that Dad picked some needy things to be practicin' on while young, because black eyes are certainly unbecomin' to any one, and are not 'ard to get begorrah, so Dad decided to take the best course and go in the window, Oi mane to practice early and become verra strong.

Well, Dad finally grew to manhood, as was the custom o' all the b'ys o' that day and age, and set out to make a name for 'imself in the big wide woild. 'E foirst 'ad a job as a 'od carrier on a 'ouse buildin' job, but 'e was afther gettin' dissatisfied with the woik an' took o'er the general manager's job. (Ye see the auld man is dead these many year so ye can make 'im great or small accordin' to y'ere desire.) To go on with the story, Dad be'aved verra nicely till 'e 'eard o' a great epidemic o' snakes which was a festin' our beloved Oireland. Shure and 'e kept up with 'is plumbing woik, fer Dad was a plumber, ye know, and all the toime 'e was a practicin' 'is profession 'e was devisin' wherein 'e could rid the country o' the snakes that was a makin' the land so miserable. 'E was a thinkin' o' this so much that begorrah 'e began to dream o' it, and went to formulatin' tremendous undertakin's whereby this pest would be woiped out with one swoip. Foinally, one night 'e 'it on a marvelous plan o' enticin' the entoire gang o' snakes into certain annihilation. 'Is plan was to go back to the tall timber and gather a fresh beef roast from where it was a growin' on the trees, to get a big 'ead o' cabbage from the cabbage bushes in the forest, and to pluck a mess o' fresh corn from its 'idin' place in the 'ills where it was a growin' in great masses o' tangled corn vines. Afther takin' these back 'ome, 'e put them all together and cooked them thoroughly, added pepper, salt, a little onion, and several big onions, fer ye see that Dad was all fer gettin' rid o' the pests that 'ad now multiplied to enormous numbers, and had grown to great size. Dad foinally 'ad 'is mixture ready and though 'e was afther eatin' the concoction 'imself, 'e put it in a pail

and started fer the center o' the city, and then, lo and behold all the snakes followed the aroma o' the corned beef and cabbage and bein' Oirish snakes, flocked afther Dad in great droves. Shure and the Oirish in the snakes was so strong that every reptile followed 'im so indiscreetly as not to be noticin' the path 'e was a takin' which led directly to the sea, tho 'e was aware that if the scheme failed 'e too would go to the bottom o' the sea with the snakes. Ye see Dad could not swim a stroke, and too (Oi'll be fer lettin' ye in on a little confidential gore) Dad ne'er did like water fer the single reason that prohibition at that toime was not bein' practiced, or e'en bein' contemplated, and, too, where'er there was water there was also soap. Well, Dad walked right into the sea still clingin' to the pail and the snakes were a followin' roight afther 'im and the pail with the Oirish dish in it.

To make a long story short Dad kept walkin' till all the snakes 'ad slid into the water and 'ad been drowned, only to find that at the next step 'e was in over 'is 'ead. 'E yelled fer 'elp and waved, but all the toime 'oldin' on to the pail, and then 'e noticed that 'e was a floatin' on top o' the water, and the pail was what was a seemin' to 'old 'im up. Foinally 'e reached the shore and 'e opened up 'is pail and there, begorrah, 'e saw the answer to 'is mysterious floatin' on the water. There in the pail were three big onions and a small one. Now you know, o' course, that Oirish onions float and these 'ad been strong enough to 'old poor Dad from drownin'.

Faith and when Dad went back 'ome to tell the news o' the destruction o' the snakes, 'e found that everyone bowed down and saluted 'im fer 'ad 'e not ridded the land o' snakes, and 'ad 'e not floated on the water when the entire population knew 'e couldn't swim a stroke?

So Dad became known as Saint Patrick, and is credited with being the first engineer since 'e invented the first worm drive, and bein' a good engineer 'e took it as best 'e knew 'ow, fer ye see 'e was not conceited and was not fer losin' any friends o'er a swelled head. Just to show all his countrymen what a good sport 'e could be, 'e invited the entoire populace to 'elp 'im celebrate.

Now then ye see juist why we engineers be celebratin' Saint Pat's day. Shure and it's glad Oi am to be 'is son fer they be sayin' 'e was the greatest engineer o' all toimes, fer didn't 'e engineer all the snakes out o' Oireland, and didn't 'e live up to the greatest desires o' all good engineers?

So now to all Loyal Plumbers and Sons o' Erin: Oi, son o' me Dad, Plumber-in-chief to the Free and Ancient State o' Erin, do hereby proclaim to me loyal followers and ad'erants that on the thoiteenth day o' May, Anno Domini, Nineteen Hundred an Twenty-seven, Oi will be afther bestowin' upon ye'er clear Oirish brows the 'onor o' the Order o' the Knights o' Saint Patrick, and on ye'er clean Oirish mugs the blessin' o' the e'erlastin' Blarney Stone. On this day, blessed alike by saint and sinner, shall the Green Shamrock bloom and lead ye not into temptation.

Three Cheers!

Three Cheers!

Engineers!!

By the Seal O' the Shamrock

Saint Patrick

(X)

His Mark

ENGINEERS IN ATHLETICS

Activity in Three Sports Features Spring Quarter

By Ralph Blyberg, *Mech. Eng. '29*

OVER 200 technical students are entered in the all-engineering tennis, golf, and diamondball tournaments which started on April 17. Of this number 120 men are playing on diamondball teams, 68 are entered in the tennis singles tournament, and 21 are competing for the golf title.

Aspirants to the golf championship have been handicapped in the past few weeks by cold and rainy weather. All of the public courses have been in a rather soggy condition making both the fairways and the greens slow. The men have succeeded in playing off several of the matches, however. Hans Wessel and Art Burris look the best of any of the men out.

Wessel was leading the technical golfers in the tournaments last fall, but the final matches could not be played because of the early snow falls. This year he is in as good condition as he was last fall and is furnishing strong competition to his opponents. Art Burris won the all-university golf championship last year and if his play at the present time is a criterion of what his game will be later on, he should go far in the tournaments this spring. The schedule calls for the finals to be played off on May 21, but because of the inclement weather it is doubtful whether they will take place until May 28.

For their choice of an individual sport, engineers are showing the most enthusiasm for tennis. The tennis matches were scheduled to start on April 17, but the inclement weather delayed the opening of the University courts to April 23. The number of men entered is so large it is hard to dope possible winners, and many of the men in this tournament are entering for the first time.

Gold medals will be awarded the winners of the all-engineering golf and tennis tournaments. The runners-up will be given silver medals.

There are four other tennis tournaments in the engineering college in addition to the all-engineering tournament. The architects have staged a singles and a mixed doubles tournament in which there are 60 entries. The senior civil class has also started a singles and a doubles tournament in which there are 38 men entered.

A gold medal will be awarded to the winner of the civils' singles tournament, with a silver award going to the runner-up. The victors in the doubles matches will be given silver medals. The awards will be donated by the University of Minnesota athletic department. When the tourney was being organized, it was at first decided to take up a collection from the class for the purpose of supplying the funds for suitable awards. However, Mr. Smith of the athletic department decided that as the civils constitute a graduating class, the medals could be given by the athletic department.

The diamondball league is already well under way having gotten off to an early start, beating the all-university tournament by a week. The engineering tourney has been divided into two divisions of six teams each, as follows:

Division A

- All-Stars
- Frosh Engineers No. 1
- Sophomore Chemists
- Architects
- Sophomore Engineers
- Junior Electricals

Division B

- Junior Mechanicals
- Frosh Architects
- Frosh Chemists
- J-S Chemists
- Junior Civils
- Frosh Engineers No. 2

The tournament will close June 1 with the respective division winners playing for the engineering championship.

Indications so far show the All-Stars and the Sophomore Engineers to have the edge over the rest of the field, both having won all their games so far this season. The Sophomores played together as freshmen last year and won the championship. They stand a very good chance of repeating this year as all of the veterans are back again.

A Year of Athletics

A report on engineering athletics, which was read before the Engineers Bookstore Board by Clarence C. Lande, athletic manager of the technical colleges, shows how very active the engineers have been in sports during the year 1926-1927, which began last spring quarter.

There were 14 teams entered in the diamondball league last spring. The championship of the engineering colleges was won by the Frosh Engineers No. 1, but this team was later defeated by the Plant Pathology team, winner of the Aggie tournament.

The engineers' baseball team was very strong and became runner-up for the all-university championship, losing to the Psi O's, 6 to 4, in the final game.

Seventy players entered in the engineering tennis tournament last spring. Mally Gustafson, sophomore civil, won the tournament by defeating George Schroepfer of the same class.

The engineers' touchball league, organized last fall, consisted of ten teams which were divided into two divisions. Division winners were the Senior Civils and the Frosh Engineers, but the play-off was impossible due to weather conditions.

During the winter season, basketball and hockey teams were organized. Five teams were entered in the former sport and the engineering championship was won by the Sophomores, who later lost to the lawyers in the all-university play-off. The engineering hockey team was runner-up for the all-university championship, losing to the strong Chi Psi team by a score of 4 to 0.

Mr. Lande's recommendations to the Board in regard to awards are as follows:

"With such an extensive athletic program, some system of athletic awards should be established. All of the engineering tournaments are of the highest quality. The engineers have the largest diamondball league in the university. In the fall, we have the largest touchball tournament. In tennis, the engineers' tournament ranks second only to the all-university tournament.

"Heretofore the Engineering Key awarded by the Engineers Bookstore

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NEWS FROM THE TECHNICAL CAMPUS

Architectural Prizes to be Awarded for Original Design Work

The spring quarter is a busy one for architectural students at the University of Minnesota who compete for the various prizes offered each year in that department. The Moorman prize, donated by Mr. A. Moorman, is a traveling fellowship consisting of a sum of money sufficient for a tour of the eastern states to study American architecture. This prize will be awarded at the Architects' Jubilee to be held on May 20. Junior and senior architects are working on a problem at the present time. Last year Mr. Gust Nastlund won the prize and inspected the departments of architecture at many large universities in the United States.

The senior class in architecture and architectural engineering is founding a fellowship prize which was originated in 1919 but which was since discontinued for lack of interest. Members of the class are subscribing towards the fellowships, and it his hoped that this fund will grow large enough so that the interest derived from the money will be enough to create a traveling fellowship.

The Scarab Fraternity, professional architectural fraternity, annually awards medals for the best original design of a special problem assigned at the beginning of the competition. Last year the prize was won by Lester Cameron '27, with Lawrence B. Anderson, president of the local chapter placing second. The problem for this year's design is a Presidential loge in a national stadium. The idea is an elaborated loge such that the president and his guests may be seated comfortably at large events which may take place in the stadium.

Active Interest Is Taken in Chemical Colloquim Meetings

Meeting semi-monthly, the Chemical Colloquim, which was established late last fall by Dr. S. C. Lind, director of the School of Chemistry, has become one of the most active organizations on the technical campus.

The Colloquim consists of a series of discussions dealing with various phases of research work being carried on in the School of Chemistry, at which one or more papers prepared by students or faculty members are presented. While the Colloquim is primarily intended for graduate students and instructors, any one interested may attend. The meetings are held in room 225 of the chemistry building once every two weeks, alternating between Monday and Tuesday so that some graduate students who are laboratory assistants and who otherwise would be unable to attend because of their duties, may hear at least a portion of the papers presented.

Among the papers which have been read so fare are "Halogenated Phenols" by Dr. Hunter, "Ring Method of Determining Surface Tension," by Dr. Mac Dougal, "Studies in Crystallization," by Dr. Montillon, "Addition Compounds of Chloral and Trimethyl Acetaldehyde," by Dr. Montanna, and "A New Method for Preparing Butyl Chloride," by Dr. Mann.

AH, YES

The situation regarding a certain railway accident is exceedingly clarified by a brakeman's report which was entered into the records of an Interstate Commerce Commission investigation.

We just pulled the drag off the main stem onto the two streaks of rust but she hung over. The hoghead was down on the ground greasin' the pin, and the tallowpot was up crackin' diamonds. The con was in the doghouse flippin' his tissues and the hind shack was cooling a red hub when he should a been out tryin' to put 15 sticks between him and the drag. I was up ahead bendin' the rails when the streak of varnish and plate glass come around the bend. The eagle eye seen us and throwed her in the big hole and give her two streams of seashore, but he'd been poundin' her on the back and they slid into us.

Steam Display at Electrical Show Causes False Alarms

Sirens sounded; fire engines clanged down Church Street and stopped in front of the electrical engineering building; the visitors at the show rushed out to see where the fire was, while firemen tried in vain to locate the reported fire.

But there was no fire.

The steam from the jets placed in front of the electrical engineering building hissed unceasingly, while the red, green and blue colored lights threw their varying light on the moving clouds of steam. From a distance, the display could easily be taken for a fire, and evidently at least two people were so firmly convinced that the electrical building was on fire that they called up the fire department on the spur of the moment.

Once at 10:00 p. m. the fire engines rushed out, and found the whole crowd of visitors there to greet them. Again at 2:00 when Robert Gibson, the arranger of the exhibit, was trying to take pictures with nothing but red light on the steam, the engines arrived on the scene with all equipment from the small engines to the hook and ladder trucks.

Mr. Hildebrandt of the buildings and grounds department of the university happened to come along just at this time and made the exhibitor shut off the display. Therefore the pictures were not obtained. The display is being experimented with, however, as a problem in the illumination class. Special apparatus and unique connections were used to obtain the undulating effect of the lights which played on the steam. A generator was set to furnish current at 59.5 cycles per second, and was connected in series with the 60 cycle alternating current of the city mains. Due to the slight difference in the frequencies of the two systems, the flood lights would brighten and diminish, giving an undulatory and flame-like effect.

Since the display is also a problem of electrical illumination, the experiments were to be continued after the show was over, if special permission could be obtained from the buildings and grounds department.

Weird Scenes and Costumes to Feature Architects' Jubilee

"A Trip to the Moon" is the theme of the Architects' Jubilee, annual costume ball which will take place May 20 in the engineering auditorium. This colorful fantasy of pleasure is patterned after the ball of the Ecolle Beaux Artes which is held in Paris every year.

An elaborate decorative treatment will grace the journey along the milky way to the palace of the moon. Costumes will be weird, fantastic, and futuristic, such as would only be worn by those taking such a trip.

To make this gala fete a success, the architects are devoting all of their energies and time. Members of Tau Sigma Delta, honorary architectural fraternity, are designing the decorations. The chairmen of the various committees as announced by the president of the Architectural society are as follows: Construction, Arthur Kastner; tickets, Porter Kilpatrick; publicity, A. S. Bull; finance, F. Grossmann; invitations and programs, John Grisdale; play, L. Cameron; music, Donald Gilfillan; exhibitions, Walter Hutchhausen; posters, Robert Gustafson; patrons and patronnesses, Margaret Bradbury.

(Continued on page 254)

AROUND THE WORLD WITH OUR ALUMNI

ARCHITECTS

'16—Jacob J. Liebenberg is a member of the firm of Liebenberg & Kaplan, Architects, Minneapolis.

'16—Louis W. Tannehill is with Holmes and Sanborn, Consulting Engineers of Los Angeles.

CHEMISTS

V. N. Morris, who obtained his doctor's degree in 1925, is now with the Fixed Nitrogen Research Laboratory in Washington, D. C. Dr. Morris presented several papers at the meeting of the American Chemical Society, which was held at Richmond, Virginia, recently.

'25—Ernest E. Jewett is a member of the technical staff of the Proctor and Gamble Company at Ivorydale, Ohio. He writes that he is very well pleased with his job, which is concerned with the solution of laundry problems.

CIVILS

'98—Edward Taylor is associate professor of mechanics at Pomona College, Claremont, Calif.

'00—Louis Yager, assistant chief engineer of the Northern Pacific Railroad, was recently honored by being elected as vice president of the American Railway Engineering Association at the recent convention held in Chicago. Mr. Yager has been engaged in railroad activities since his graduation, when he began working as rodman for the Northern Pacific. During the period of Federal railroad control, Mr. Yager was chief maintenance of way engineer, United States Railroad Administration.

'01—T. H. Strate is engineer of track elevation, C. M. & St. Paul Railway, Chicago, Ill.

'02—R. L. Beaulieu is manager of the American Pile Driving Company, Everett, Wash.

'03—Walter J. Bennett is assistant engineer in the Bridge department of the Great Northern Railway at Seattle, Wash.

'06—Elmer E. Adams is also with the Great Northern Railway as district engineer at Spokane, Wash.

'09—Fred W. Sheffield is vice president of the Fargo Bridge and Iron Company, Fargo, N. D.

'09—Frederick A. Hubbard is assistant engineer on the Union Pacific at Portland, Oregon.

'10—Carl F. Meyer is director of the Division of Sanitation, South Dakota Board of Health, Waubay, S. D.

'11—Sydney H. Smith is city engineer of Mitchell, S. Dak.

'14—Walter C. Brenchley recently left the Minneapolis Steel and Machinery Company and is now in Los Angeles, Calif., with the Union Iron Works.

'15—Thomas L. Croswell, former basketball star, is at the head of the Croswell Power Company in Twin Valley, Minn.

'15—Warren Withee is assistant engineer with the U. S. Geological Survey at Chattanooga, Tenn.

'15—Oscar F. Swenson is chief engineer of the Lackawanna Steel Construction corporation, Buffalo, N. Y.

'16—S. E. Nortner is captain, U. S. Corps of Engineers, St. Louis, Mo.

'17—Clarence M. Rader left his position as Petroleum Engineer with the Midwest Refining Company in Casper, Wyo., in 1925, and is now in Miami, Fla., with the Florida Power & Light Company.

'24—Martin E. Nelson has been given a fellowship by the Scandinavian-American Foundation to make a year's study of hydro-electric power developments in Scandinavian countries. Mr. Nelson has been connected with the Southern California Edison Company at Big Creek, Calif.

'25—Dwight T. Burns and A. W. Gobeli are both with the Santa Fe as inspectors on construction.

'26—Charles W. Bunnell and A. A. Schulz recently left the Tennessee Highway department to become connected with the firm of Kelker, Leuw and Co., Municipal Construction Engineers, Chicago, Ill.

'26—K. W. Williams also migrated from Tennessee in favor of Illinois. He is now with the Elgin, Joliet, and Eastern Railway at Joliet.

'26—"Bob" Drdla is busily designing with the Slefco Steel Company, Michigan City, Ind.

ELECTRICALS

'97—William L. Miller is vice president and general manager of the Union Fibre Company, Inc., at Winona, Minn.

'00—Joseph A. Thaler is professor of electrical engineering at Montana State College, Bozeman, Mont.

'00—Roy E. Thompson is purchasing agent for the San Diego Gas and Electric Company, San Diego, Calif.

'01—Chas. E. Tullar is attorney in the Patent Department of the General Electric Company.

'04—Edward J. Cheney has a consulting practice at 61 Broadway, New York City.

'05—Frank D. Coleman is district manager for the Montana Power Co., Billings, Mont.

'07—J. E. Smithson is president and general manager of the Oregon-Washington Telephone Company, Wood River, Oregon.

'07—Geo. W. Uzzell is assistant superintendent of the Lincoln Oil Refining Company, Robinson, Ill.

'08—Frank A. Anderson is manager of the National Appliance Company, Portland, Oregon.

'09—Walter C. Beckjord is vice president and engineer for the American Light and Traction Company, New York City.

'13—C. W. White is job engineer for the Southern California Edison Company, Los Angeles.

'16—Jesse L. Thompson is superintendent of Kerckhoff Power House, Auberry, Calif.

'17—Danforth K. Gannett is telephone research engineer with the American Telegraph & Telephone Company, New York City.

'17—Ben S. Willis is instructor in electrical engineering at Iowa State College, Ames, Iowa.

'23—Alfred Trask, recently with the Electric Steel Machinery Company of Minneapolis, is now in the rate research department of the Northern States Power Company.

'24—Arne Enger has returned to Westinghouse Company in Pittsburgh from the Northern States Power Company, where he was engaged in carrier current work in the generation department.

'25—Jeffery L. Lund, who has been taking the student engineering course of the General Electric Company since his graduation, has completed that course and is now employed in the Industrial Department of the company.

MECHANICALS

'90—M. H. Gerry, Jr., is a consulting engineer with offices in San Francisco, Calif.

'91—Baxter M. Aslakson is also in consulting work with headquarters in Chicago.

'92—James H. Gill is professor of machine construction at West Virginia University.

'98—Frank Zeleny is engineer of tests for the C. B. and Q. Ry. at Aurora, Ill.

'07—Oliver G. Tubby is engineer for the Foundation Company, San Francisco.

'07—Otto H. Wagner is engineer for the Decarie Incinerator Corporation, Long Island City, N. Y.

'10—Wallace H. Martin is professor of heat engineering at Oregon State College, Corvallis, Oregon.

'17—Duane L. Taylor is lieutenant U. S. Navy, Navy Yard, Brooklyn

'18—Hilder A. Anderson is at present chief engineer for the Johnston Manufacturing Company of Minneapolis, makers of various types of portable industrial oil burning equipment. Anderson has put much work and study on the combustion of oil and the design of oil-burning equipment. A paper that he had prepared on the subject of "The Correct Way of Burning Oil" was published in the "Iron Trade Review," the "Iron Age," the "Railway Mechanical Engineering," and the "Fuels and Furnaces" trade magazines.

He has helped to develop many small devices connected with the successful operation of oil burning equipment, and has invented a vacuum oil burner, which is used as a portable source of heat in industrial work. He formerly worked with the Mahr Manufacturing Company of Minneapolis as assistant engineer where he did much of the same sort of work.

'20—John E. Walfred is now equipment engineer for the Northwest Bell Telephone Company, Omaha, Neb.

'26—Lawrence O'Donnell is at the University of California as Erskine Fellow in Traffic Research.

'26—Ernest C. Cole is leaving the Marine Sales Department of the Fairbanks Morse Company at New York to enter the Field Service Department of the same company at Beloit, Wis.

MINERS

'28—Nathan Davies, who, during this last year has been in the employ of the California Company as an assistant geologist, finds he is gaining much experience that will be of use to him when he comes back to school next fall to finish up his course in mining engineering. He writes from his present place at Amarillo, Texas:

"I have had varied and sundry experiences since I left Minneapolis last spring and have had opportunities to see quite a bit of the good old United States. I really can't brag very much though about the part of the country I am in now as it is very monotonous appearing; no lakes; the elevation never varies more than a few hundred feet when you traverse large sections of the country. If this weather keeps up I am going to think of all the lakes around Minneapolis and wish that I could get a good swim just once. It was quite pretty around Thermopolis, Wyoming, though, and we spent a very pleasant five weeks there last fall.

"As an assistant geologist, it is my job to run the plane table whenever we do any detailing of structure in the field. When we are just doing reconnaissance work then it is my job to watch the speedometer on the car and be able to tell where we are any time on the map. I also sketch in roads, streams, etc., or whatever is necessary on the particular job we are doing.

"We travel all the way from twenty-five hundred to three thousand miles a month although we have been in Amarillo most of this month writing up a long report on the panhandle of Oklahoma and surrounding country."

(Continued on page 256)

"Broadcast," A Successful Production

THE Arabs, dramatic club of the technical colleges of the University of Minnesota, are again established as an organization without parallel. This organization is unique in that the membership is composed entirely of engineers registered at Minnesota. The members of the club write the play, the music, and the lyrics for the production; design and make all the scenery and costumes,—in short they do everything which has to be done in the production of a modern play. All these things go to show that we have in our college a really live organization.

Last month the Arabs produced the play, "Broadcast," a rollicking musical comedy of college life thirty years hence. In this production all feminine roles were played by members of the club. In fact the individual members of the feminine part of the cast imitated the weaker sex so successfully that when one of them appeared on the campus dressed as a co-ed, no one recognized "her" at all. The music for the play was written by Avner Rakov, an architectural student, and was exceptionally good. *Beautiful Night in June*, theme song of the play, was little short of entrancing.

The author of "Broadcast" has cleverly woven romance into the life of a technical student at Minnesota and with our campus as a setting, produced a fascinating and colorful play. Are engineers altogether lacking in sophistication? Are they unappreciative of the better things of life? "Broadcast" is the answer.

The scenery, designed by Lawrence B. Anderson, was composed of eight complete sets and carried out the futuristic atmosphere of the play very admirably.

The show took weeks of hard work by the members of the cast and the business staff, but the efforts were well rewarded when, on the nights of April 22 and 23, the play was finally presented to the public after many long and weary nights of rehearsal. The cast played to full houses on both evenings and to a large audience at the Saturday matinee. Such a sellout has never been accomplished by any other dramatic organization on the campus at any time. Broadcast played to a total of fourteen or fifteen hundred people in the three performances.

In the leading roles Roy Irons, Merle Carlson and George Burch acquitted themselves very nicely. Merle Carlson made a beautiful girl and looked very enticing in the white formal he wore in the love scene. George Burch in the role of a typical down town girl was the sensation of the evening with her brilliant repartee and her original dancing. Her talk to Saint Peter was especially well executed and drew a laugh in every line. Roy Irons' entrancing rendition of the various songs, especially *Beautiful Night in June*, was delightful. The four professors in the broadcasting scene called for many laughs when the waves got mixed and snatches of the different speeches were mixed up in excruciatingly funny sequence. The electron and proton dance in the second act was the feature dance of the play and called for encore after encore as the audience tried to fathom the weird disappearance of the members of the chorus from the stage.

Nearly seventy-five people were actively engaged in the production of the play and every one of them worked to full capacity giving his best that the final product should be a huge success.

The Arabs club worked this year under a big handicap left from two years ago in the shape of a two hundred dollar deficit caused in the production of Mona Lizzie, the fourth play written by the club. This deficit has been cleared off this year, and the Arabs are again solidly on the map at Minnesota. In recognition of the services of the members of the club who worked so hard, the organization enjoyed a dancing party on May 7. The dances were interlarded with short skits and entertainment, using the atmosphere of the stage with all its enchantment.

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University of Minnesota

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THE time has again arrived when the engineers in all their glory will favor the campus with the annual entertainment in the way of Engineers' Day. There is little that can be said editorially that has not been said many times before since the tradition of the day was first innovated. Nevertheless, the day is one which deserves much recognition as it marks the one time of the year when the engineering college is host to all who will enter and see for themselves what the engineers do in work and play. Friday, May 13, has been very appropriately chosen by the Technical Commission for the annual event. It is very late in comparison with other years, but the late date was made necessary by the many conflicting affairs in the spring.

The crowning event of the day is, of course, the knighting ceremony of the senior engineers admitting them into the royal order of St. Patrick. A true son of old Oirland in the person of Porter Kilpatrick, whose very name smells of the shamrock, will don the robes of state, while at his side as queen will be a real daughter of the hills, Winifred Moore.

As usual, each class has a definite part to play in the various events. The seniors display the exhibits and conduct the knighting, the juniors have charge of the general arrangements, and the freshman and sophomores plan the floats in the huge parade that advertises the day to the entire campus.

The final windup in the evening will be the big Engineers' Brawl in the Minnesota Union, the one yearly dance of the whole engineering group where all cares are forgotten in the enthusiasm of the celebration.

THERE is a phase of engineering which is not taught in universities under any certain course, and it is a phase which is little heard of by undergraduates. As a branch of engineering it receives little publicity because it represents a small branch of engineering, and its very ethics prevent self advertisement. Consequently few realize the advantages and prospects of this field. Although the field is restricted to men who have the native talent and adaptability for this type of work, there are many who would find themselves capable to advance far in this correlated field of engineering if they would but try.

It is the field of technical magazine writing.

Because only a limited number of men are interested in both writing and engineering, the field is not crowded. Yet we find that in those fields where engineering is interlocked with non-technical subjects, many of the best positions are to be found and prospects seem to be the greatest for advancement. It is not natural for engineers to be fluent writers, and this eliminates in a very natural way a large number of men from entering the field.

Not only is writing experience and aptitude necessary to a worker on the staff of a technical journal, but the worker must also have had a good engineering training, or much practical experience. This prohibits to a large extent untrained men from competing for positions on the staff of such a magazine. Although the general writing and newspaper field itself is largely overcrowded if any field is, the technical writing field is not, as no doubt can be shown by figures on graduates of the engineering college at the University of Minnesota. Every year an average of 185 students graduate, and yet less than one man out of two years' of graduates ever enters the technical writing field.

Nevertheless, there is a wealth of opportunity in the field. Technical magazines such as "Power," "Electrical World," "Iron Age," and "Engineering News-record," all of which can be found in the engineering library, are leaders of thought and action among those engaged in the various lines of engineering. The subscription list of these magazines is usually composed of executives, designers, and other men well up in their respective fields, who can well afford to pay the large subscription rate asked for by the technical publishers. The large amount of advertising which fills a technical journal is of interest to readers, and is a source of wealth to the magazine. So even though a technical magazine has a very limited circulation, it is usually a wealthy institution and can well afford to pay good salaries to staff members.

Advancement has been shown to be considerably more rapid here than in other fields, according to men who have lectured on this subject. The type of work is interesting, and is not routine. The work does not bind a man down to his job. Contacts are continually being made with new people and new ideas. Things that are to be published are known before the general public knows about them. Constant touch is maintained with the present world of engineering and with engineering plans for the future. There is no chance of going stale; the field is always moving and is vibrant with new ideas, and new engineering feats.

Work on a technical college publication, the learning of the fundamentals of writing and editing, and the acquired business experience brings one into a school activity which specifically and definitely fits a man for technical magazine work after leaving school. Work with organizations, clubs and events such as engineers' day are activities in school life which in a general way develop initiative and managerial qualities,

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Through Campus and College

The Technical Association

By George Vye, Mech. Eng. '27, *President*

PREVIOUS to 1923, the student organizations in the College of Engineering and Architecture and in the School of Chemistry were only loosely connected. The Association of Engineering Students, the student councils of engineering, architecture, and chemistry, and the various professional societies in these schools acted entirely independently of one another.

The students felt that these groups should be correlated, thereby bringing the students in the technical colleges into a general organization. In the spring of 1923 a committee headed by LeRoy Grettum, E '23, at that time president of the All-University Council, took up the task of devising a plan which would accomplish this purpose. As a result, on May 31 of that year, the students voted their approval of the organization as outlined by this committee and adopted the present constitution of the Technical Association. At this time the Technical Association took over the funds and property of the Association of Engineering Students, which ceased to exist.

The purpose of this new association was to provide a federation of departmental societies in the College of Engineering and Architecture and the School of Chemistry, and to enable the students of the various departments to act as a unit in all matters of general interest to these colleges and to the university. All members of the recognised professional departmental societies are active members of the association.

The government of this organization is the means whereby all the students in the various departments of the college are brought to act as a unit. The executive body is called the Technical Commission, and is composed of the presidents of the professional departmental societies and two faculty members who are appointed by the dean of the schools affected. The original societies of the association were:

The Architectural Society
The Chemists' Club
The American Society of Civil Engineers
The American Institute of Electrical Engineers
The American Society of Mechanical Engineers

At present the Chemists' Club is not functioning, but it is hoped that soon the chemists and chemical engineers will organize some society in order to be active with the rest of the association.

The commissioners have authority to act for their respective societies and in this way all member students are brought under one governing body. The commission selects from among its membership a president and a secretary-treasurer to manage the formalities of the meetings.

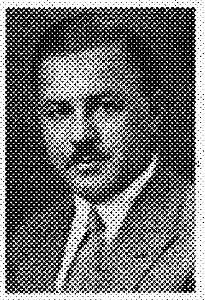
The duties of the commission are somewhat general in nature and cover considerable ground. The main obligation, however, is to act on matters of general interest to all members of the association and to foster student enterprises until such time as they are in a position to operate independently. The commission is also responsible for the supervision of Engineers' Day.

The finances of the association are contributed by the departmental societies on a basis proportionate to their membership.

The plan adopted by the students also has provisions for an Engineering Student Council, but this council and the Technical Commission are very closely related. The members of the Student Council are the same members that serve on the commission, namely, the presidents of the student societies. The chairman of the Engineering Student Council is the All-University Council representative from the College of Engineering and Architecture. This position for the coming year will be held by Joseph Armstrong, who was elected by the students in the spring election.

The Chemistry Student Council is organized by the students in the School of Chemistry and is independent of either the Technical Commission or the Technical Association. The reason for this is that all the professional societies that are functioning at present are in the College of Engineering and Architecture.

The duties of the Engineering Student Council are to conduct all student elections in the College of Engineering and Architecture and to regulate matters of student discipline.



FACULTY SKETCHES

ALEXANDER S. LEVENS

ALEXANDER S. LEVENS, the genial man to the right as you enter the office of the department of drawing and descriptive geometry, was born on February 12, 1900, in Minneapolis. Graduating from North High School, he entered the University, where he received, at the hand of Mr. O. S. Zelner, the mysterious letter "S" that has been a puzzle to many. Anyone knowing that old barbershop agonizer known as "Alexander" will have some idea of the application, when it is known that both Mr. Levens and Mr. Zelner are musically inclined. In 1922 Mr. Levens received his Bachelor of Science degree in Civil Engineering, and in '24 the University conferred upon him the degree of Master of Science in the same department. He is now completing work on his Civil Engineer's degree.

Mr. Levens started on his special field of concrete design at the end of his sophomore year when he spent the summer in the offices of the Minneapolis and St. Louis Railroad working on the construction of the Fifth Street bridge under the direct supervision of Mr. R. G. Kenly, chief engineer of the road. He was later assistant supervisor on the Seventh Street bridge, Minneapolis, and designed and supervised the construction of the M. & St. L. portion of the Laurel Avenue bridge. Following his graduation, he worked with the Truscon Steel Company on concrete building design. This he followed with work in the Hennepin County surveyor's office as deputy surveyor, where, among other projects, he designed and supervised the construction of the bridge over the Crow River between Dayton and Rogers.

In the fall of 1922 he became an instructor of drawing and descriptive geometry at the University, the position that he now holds. During these few years as instructor, Mr. Levens has done considerable research work in concrete, paying particular attention to the effect of calcium chloride in concrete mixtures. Part of his findings are to be found in papers published in the August 5 issue of the Engineering News Record, and in the January, 1927, issue of the Minnesota Techno-Log. That Mr. Levens has not limited himself entirely to concrete can be seen in a paper published in the November, 1926, issue of the Techno-log, "Illustrations and Their Manufacture." This paper was written with the collaboration of Professor William H. Kirchner, head of the department. He is also joint author with Mr. Howard D. Meyers, assistant professor of the same department, of a booklet on "Elements of Structural Drafting."

One of Mr. Levens' favorite hobbies is that yearly trip to the old C. E. summer camp at Cass Lake, Minnesota, where he endeavors to persuade the lurking pike to leave their native haunts, and journey with him to civilization. Faculty athletics also have their claim on his time, as he spends the few vacant hours outside of the experimental laboratory and classroom playing volleyball or tennis. Mr. Levens, as a collector of etchings and a disciple of Elman, also shows a deep interest in the Arts.

A Tau Beta Pi man and a Mason, Mr. Levens is also a registered civil engineer and land surveyor in the State of Minnesota.

Co-ed: Johnny, am I the only girl you ever kissed?
Johnny: Yes, dear.
Co-ed: I thought so.

John: Who can tell me of two famous men who were boys together?
Joe: I can. The Siamese Twins.

How many girls would it take to reach from here to Anoka?
Twenty. Because a Miss is as good as a mile.

George wanted to propose to a young lady, but he didn't know just how to go about it. He took her for a walk in the cemetery. Coming to a large tomb, he said: "Barbara, my dear, all my folks are buried here. Wouldn't you like to be buried here, too?"

The season's most popular bedtime story: Keep your feet off my back.

WANTED—A man with a wooden leg to mash potatoes in the Minnesota Union.

Fred Hovde (an aspiring chemist): I wonder if this waterproof ink has any effect on litmus paper?—Say, fellows, look! It turns it black.

A man is but a worm of the dust—he comes along, wiggles around awhile and finally some chicken gets him.—*Tech Flash.*

Some men seem to be rather underrated in their own homes. It was a cold winter's night. Little Johnny sat beside the radiator reading a book. Mother was about to retire upstairs. She called down to Johnny, "Johnny, bring up the bed warmer." Johnny, without leaving his cozy corner, hollered out to the kitchen, "Father, mother wants you."

Freshie—"How long can a person live without brains?"
Soph—"I don't know, how old are you?"

I have a car.
It never breaks down.
It never skids.
It never gets a puncture.
It never gives me bother up steep gradients.
It never gets overheated.
It has never got me into a collision or an accident of any kind since I got it.
I wish to goodness I could start it.—*Life.*

And in closing, brethren, let us pray, and I will ask Deacon Brown to lead us.
(Just coming out of a nap)—Er-r-r—but it's not my lead; I dealt.—*Tech. Flash.*

"This is a pretty snappy outfit," remarked the baby as he was put into his rubber panties.—*The Engineer's Bulletin.*

If Mark Twain was witty, was John Greenleaf Whittier?

He—Do you like candy?
She (eagerly)—Oh, yes.
He—Thanks, I'm getting statistics for Whitman's.—*The Technique.*

If Tom was unable to mow the lawn, could dynamo?

One person can dye his own hair, but it takes two to dialogue.

The sweet young thing was being shown through the locomotive department of the Minneapolis Steel and Machinery Company.
"What is that thing?" she asked, pointing with her dainty parasol.
"That," answered the guide, "is an engine boiler."
She was an up to date young lady and at once became interested. "And why do they boil engines?" she inquired again.
"To make the engine tender," politely replied the resourceful guide.

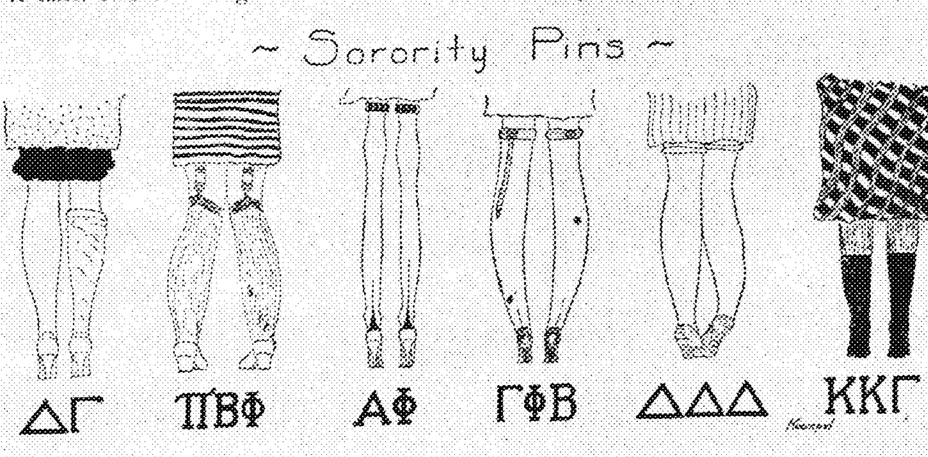
"I hear that your girl got married the other day."
"Yeah."
"Tough luck."
"Yeah."
"Who did she marry?"
"Me."

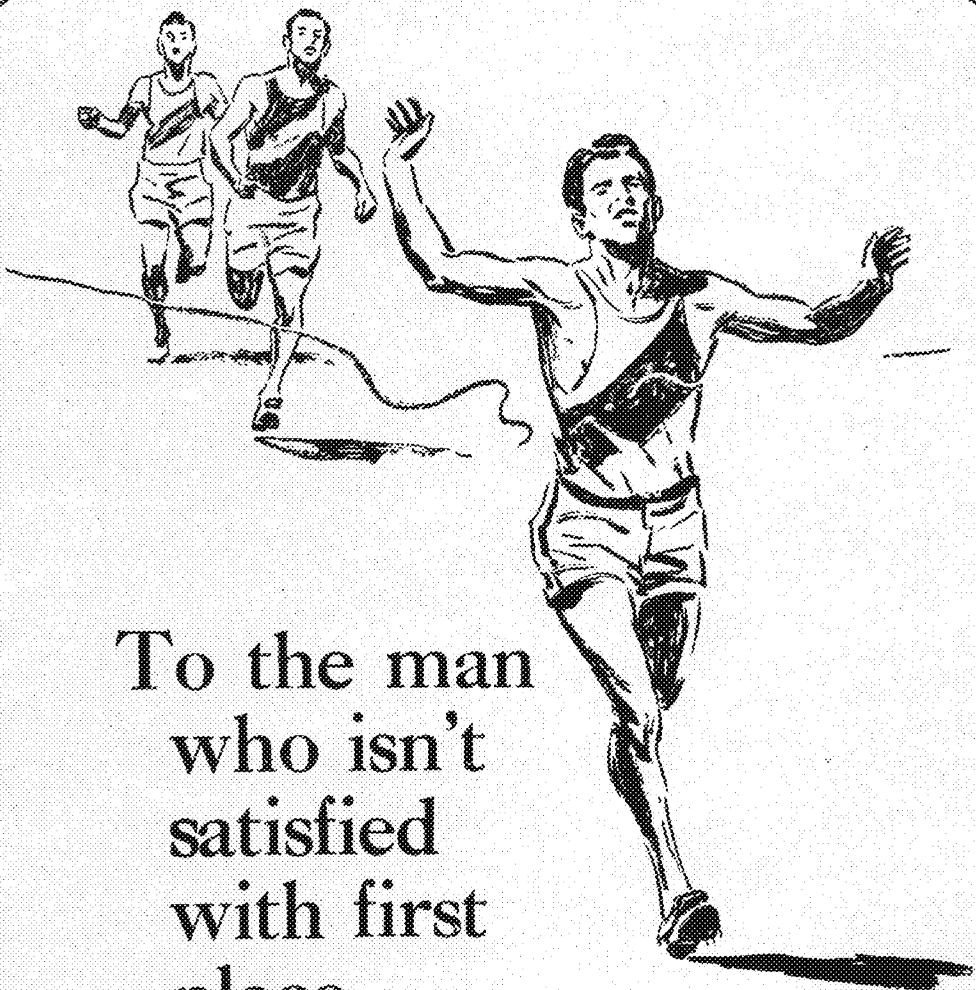
—*Exchange.*

Marion: Would you marry a girl if she were as pretty as a picture?
Bud: Yes, if she had a good frame.

Damma: I never kiss a new acquaintance for twenty-four hours.
Phino: Heavens! I never kiss anybody for more than twenty minutes.

He: "Is your husband a traveling man?"
She: "Yes, sir; but I don't go out with strangers, and besides I have a date for tonight."





The Voice of the Minnesota Campus

(Continued from page 234)

may be selected and connected in any manner whatsoever by means of the usual telephone patchcord system. Thus any input may be brought to the 8A amplifier and the output sent to any desired point, or any set of lines may be tied together as occasion requires.

The broadcast transmitter was originally a Western Electric 500 watt set. Certain factors of operation, however, made necessary a partial redesign and reconstruction. This was done with very pleasing results. The new design has featured more modern and lower loss construction. The transmitter uses the conventional Heising system of constant current modulation with a Meissner oscillator. For the 417 meter wavelength, the transmitter is connected directly to the antenna, but for the 278 meter wavelength it is coupled through two series antenna condensers.

The antenna which was erected under the new construction program is of the most modern type. A 75 foot, four inch vertical cage fans out at the upper end to terminate in a 60 foot inverted L flat top. The cage, which is entirely of copper, is of special non-breakable construction, while the flat top is made of phosphor-bronze for strength.

Power at a low voltage (12 volts) for filament lighting and relay switching on the transmitter, and at a high voltage (1600 volts) for the plate supply is brought from a double generator unit located in the generation room in the sub-basement. The two generators are driven through flexible couplings by a synchronous motor. Battery voltages of 52 volts for the automatic control, 12 and 140 volts for the speech input equipment, and 12 volts for the telephone monitoring circuits are brought from the battery room, where a complete duplicate set of batteries and the charging equipment are maintained. It has been found necessary to use metal-sheathed wire for all of these circuits because of the large radio and audio frequency currents induced from the power equipment.

The automatic control was designed in order that the station might be used as an auxiliary to the Gold Medal Station. It was developed by Mr. Lawrence Hafstad, E. E. '26. This control consists of a machine switching telephone connector operated by a common telephone dial. This connector is arranged to operate holding relays so that when certain numbers are dialed, corresponding relays will close the necessary circuits. For purposes of remote control, the university operators keep the transmitter adjusted to 417 meters at all times (the wavelength of the Gold Medal Station at Anoka) unless it is being operated as WLB on its regular 278 meter schedules. One line from the Nicollet Hotel studios is patched directly to the broadcast transmitter. This is the line over which the speech comes to the transmitter from the Nicollet Hotel amplifiers. The second line from the downtown studios is patched directly to the automatic control. A telephone dial is connected to this line at the Nicollet Hotel. In case of emergency, the operator dials a certain pair of numbers. This starts the motor-generator in the generation room, lights the filaments, and connects the antenna to the transmitter. The second pair of numbers follow at a short interval which allows the power tubes to come to the operating temperature. This connects the high voltage, lights the warning signals and throws the carrier on the air. In a similar manner two other pairs of numbers dialed at proper intervals completely shut down the equipment. A duplicate dial located in the operating room of the University provides facilities for local control, demonstration and test.

The studio at the University is especially designed with respect to acoustic properties. It is equipped in the most modern style for the artists' convenience. The reception room which adjoins is separated by a window so that the artists need only be in the studio when actually broadcasting. Local monitoring equipment includes loud speakers in each room, which can be connected as required by the operator. A local telephone also connects the reception and operating rooms. Outside programs are received by means of a super-hetrodyne receiver, while programs broadcast by this station are monitored by means of a vacuum tube rectifier.

Remote control programs from special points require additional equipment. The regular University organ concert which has been featured throughout the year on Tuesday afternoons illustrates a typical remote control arrangement. Two microphones are located in the Music building, one for organ pickup and one for the announcer. A portable Western Electric 24 A (two stage) audio frequency amplifier located backstage is used to select the proper microphone, raise the gain, and retransmit the output to the terminal board in the station. Here it is patched to the 8A amplifier where the gain is again raised before being broadcast by the transmitter.

It is interesting to investigate some of the emergency combinations which can be easily arranged in a system of this type. During the early part of last October the final game of the World Series, and the Minnesota-Notre Dame football game were to be played at the same time. It was decided that the football game would be of the greatest interest to the Northwest, and that it was to be broadcast from the higher-powered station at Anoka. However, the baseball game began about two hours earlier, so it was started from Anoka on 417 meters with the announcement that at 2:30 p. m. the wavelength would

change to 278 meters. At exactly 2:30 p. m. the New York World series game was switched from Anoka to the University. Simultaneously, the game was switched from the amplifier at the Nicollet Hotel to that at the University. The football game was then remote controlled from the stadium through the Nicollet amplifier to the Anoka station. All these changes were made without the loss of a single word of either program.

At certain times, particularly on Monday evening, programs originating in the University Studios are broadcast from the Anoka station. Occasionally it occurs that an artist cannot reach the University studios conveniently for the evening program but can go to one of the downtown studios instead. In this case, he is announced as usual from the University studio and the program is then switched immediately to the studio from which he is to broadcast. At the same time the loudspeaker is switched on in the studio that the announcer may hear the broadcast. When the artist concludes his part of the program, the University studio is again cut in and the program continues without a break.

Professor Clarke, instructor in Esperanto, has for two years maintained a class of more than 2300 paid students without credit, in the University's first experiment on radio classes. Plans are progressing rapidly to maintain a "University of the Air" and already the first class for credit, a class in French conducted by Professor Frelin of the department of romance language, is in existence. Each Friday afternoon Mr. Frelin meets his class on the air at 4:45 p. m. to discuss problems. In other respects the class is maintained on the usual correspondence basis. It is expected that in the future, more development will be made along these lines, for in this manner a small staff of men can come in useful contact with increasingly large numbers of people.

A Modern Protective Film

(Continued from page 235)

The cotton must produce clear, water white solutions, and must be stable on ageing.

Solvents

The field of cotton solvents is at no time up to date. The producers of such chemicals have been busy and are in keen competition with each other, and each month sees the recommendation of some new solvent for use in lacquers. There are certain requirements for solvents, which may be briefly stated as high solvent power, chemical neutrality and non-toxicity. They must be colorless, odorless or pleasant smelling, and stable to light and air. The boiling-point must be compatible with the other ingredients. Solvent mixtures are chosen with regard also to drying time, flow, and the residual or occluding solvent.

- Alcohol (Methyl)
- Esters:
  - (Ethyl Acetate, Butyl Acetate, Amyl Acetate)
  - (Butyl Propionate)
  - (Diethyl Phthalate)
  - (Diethyl Carbonate)
  - (Beta Chlorethyl Acetate)
  - (Ethyl Lactate)
- Ketones:
  - (Acetone)
  - (Camphor)
- Acetone Oils:
  - (Diacetone Alcohol)
  - (Mesityl Oxide)
- Aldehydes:
  - (Furfural)
- Miscellaneous—
  - Cellosolve (mono ethyl ether of ethylene glycol)

Non-Solvents

Non-solvents or dilvents are added to lacquers to cheapen the product, as the solvents are expensive and a total loss. Certain non-solvents have been found to be beneficial as retarders of too rapid drying, as an aid to flowing, and as solvents of gums. All of the non-solvents must follow the same requirements as those for solvents, except that of solvent power, with the added necessity of being compatible with the balance of the formulation. Non-solvents are:

- Coal Tar Hydrocarbons (Benzol, Toluol, Xylol)
- Aliphatic Hydrocarbons (Solvent Naphtha)
- Alcohols (Ethyl, Butyl)
- Turpentine. Solvenol (Refined Pure Oil)

Plasticizers

A plasticizer is a substance added to a lacquer to give the resulting film plasticity or life. It is preferably a solvent for cotton, having an extremely low vapor pressure. It should not oxidize in air and is best when neutral and colorless.

- Castor Oil
- Linseed Oil
- Triphenyl Phosphate
- Tricresyl Phosphate (Lindol)
- Butyl Stearate
- Butyl Tartrate
- Dibutyl Phthalate
- Higher ethers of Ethylene Glycol.

Tung or China Wood Oil is used to give a "crystallized" lacquer effect.

Linseed Oil is ordinarily thought of as an oxidizing oil, and would be unfitted for use in a lacquer upon exhibition of this property. The nitrocellulose film mechanically prevents such action.

Gums and Resins

These substances are used because they give luster, hardness and adhesion to the lacquer films.

- Natural Gums:
  - Shellac
  - Damar
  - Zancibar Copal
  - Congo Copal
  - Kauri Copal
  - Manila Copal
  - Elemi
  - Pontianac
  - Sandarac
  - Mastic
  - Manta
  - Gilsonite (Fossil bitumen) black.
- Synthetic Gums:
  - Ester
  - Cumarone—Indene Resins
  - Albertol

The gums and resins are incorporated in the lacquers as a "gum cut" composed of 50 per cent gum and 50 per cent solvent mixture compounded of both solvents and non-solvents which will be included in the lacquer formula.

Pigments and Dyes

The colored enamels are pigmented with many of the materials used in the paint industry. The pigment used must be neutral, and need not have the high oil absorption value which was necessary in paint. This will revive interest in pigments which were useless in the other industry.

In formulation, there are several factors to be considered. Water is a precipitant of cotton, so it must not be permitted to condense on a drying film, or it will cause "blushing." A film having a whitish cast or opacity is said to have blush or cotton blush. There is another type of blush which is caused by the precipitation of the gum, and is known as "gum blush." At all times during drying, the cotton and gum must be held in solution, or blush or gum blush will occur. Butyl alcohol is one

of the best anti-blush and flow agents now available. Cracking, pinholing and chalking are usually the result of the faulty use of gums.

Cracking first shows in fine hair lines which increase in length and width till the film is of no value. Pinholing is evidenced by the appearance of tiny rust spots on the metal backing the lacquer film. These spots increase in size and cause the failure of the film. It is thought that there are small holes in the film itself. Chalking is the wearing away of the film by its drying out and really becoming chalky.

The manufacture of lacquers is carried out in various ways, but the main steps are identical. The cotton arrives wet with 30 per cent alcohol, and is used in this condition. It is put in revolving drums or tanks equipped with agitators, and the non-solvents are added. This is done to thoroughly wet the cotton with non-solvent.

If solvent is added directly to dry cotton, the outer surface of fibers and lumps is gelatinized, and further solvent action greatly retarded, and in some cases completely stopped. This "lumping" or "balling" is prevented by the wetting with non-solvent.

The wetted cotton now is ready for the solvent mixture. After complete solution is effected, the resulting liquid must be freed from undissolved matter such as unnitrated cellulose and dirt. Clarification is done in centrifuges or filter presses, or by settling. This is now known as a "cotton cut."

Gem cuts are made by dissolving the gums themselves in a solvent mixture as described above. The solution is made in tanks equipped with agitators or revolving drums. Clarification of a gum cut is accomplished in the same manner as that prescribed for "cotton cuts."

The gum and cotton cuts are now ready to mix in a revolving drum or pebble mill. The balance of the ingredients, namely the plasticizer and the pigment, are added in this operation. It is of paramount importance that this mixing be thorough as the smoothness of the finished film is directly dependent upon the intimacy of the mixture and the fineness and distribution of the pigment.

Lacquers for all sorts of finishing can be made by a proper variation of formula. The two outstanding uses for lacquers are in automobile and furniture finish. The chief objection which lacquers had to meet was the lack of high lustre or the satin finish obtained. The best lacquers were those of the dull finish, so the manufacturer desired to sell his best product rather than the high lustre film which he could produce, but which he knew was inferior. The situation was met by educational advertising. The public only thought that the best finish for their automobiles and fine furniture was the brilliant one. About eighty per cent of last year's cars proudly displayed a satin nitrocellulose lacquer finish, and that the public accepted them as best need not be proven. This year's record is pointing to a larger use in the field.

The economies effected by the use of lacquers are many. The film produced is a great deal more lasting than that obtained from varnishes and enamels. It has been roughly estimated that the lacquer will last three times as long as the old finishes. Overhead in plants using lacquers is greatly reduced because of the quick drying property. This is exemplified by the automobile refinishing industry, since a good varnish job requires one to four weeks for completion. A first class lacquer job can be done and released in two days, and the labor cost is also less. One man with a spray gun can do the work of three or four men with brushes, and do it vastly better. The introduction of lacquer in manufacturing processes permitted the addition of many mechanical devices which eliminated the human factor and aided in our effort for standardization.

The Equation of Life

The engineer habitually deals in terms of variable quantities, and now we have an engineer expressing life as a mathematical formula. The following is the equation of life, as derived by Professor F. W. Springer, acting head of the electrical engineering department:

"If we regard life as sufficiently and intimately associated with physical, mental and spiritual force, we may express an individual in terms of his force (F). Let Fw be the want force; Es a helping, diverting, or retarding force, to the satisfaction of wants; dHF one element of the 'force of habit'; G good, B bad; and K a constant or factor involving temperamental, directional, and other variations of heredity, then—

$$(F) = \left[\left\{ Fw + (\pm wEs) \right\} + \int_{B}^{G} dHf \right] K$$

The force of an individual (F) equals his net constructive or active want force Fw; vectorially combined with wEs, which is positive or negative depending upon whether it is with or against Fw; the combination vectorially combined with the summation of his 'force of habits' integrated between the good and bad limits G and B; all multiplied by the factor K. The maximum effect will occur when all of the above act in the same direction.

"K is an important factor which depends largely upon hereditary traits such as those of the genius, inventor, and includes temperament. The K of a normal or ordinary person would be unity, of a great genius, greater than one, and of a congentual imbecile, nearly zero.

"When Fw is relatively large, even when wEs is negative, the individual dominates and controls his environment. In other cases the environment moulds him as may be.

"The above equation can be read for a business, thus: (F) business strength; Fw active force of conducting the business in buying, selling and management; wEs favorable and unfavorable business conditions; the integral includes the assets and liabilities, and K is the factor fixed by the inherent characteristics and methods of conducting the business, which sometimes become traditional."

It doesn't take any considerable amount of gray matter or originality to criticize.

Become satisfied with your success and you will begin to wither and shrivel up.

The greatest task in the struggle for success is preventing the other fellow preventing your reaching your goal.

Many a man seems to have a clear head because there is nothing in it.

NEWS FROM THE TECHNICAL CAMPUS

(Continued from page 239)

Graduate Miners Are Bid Farewell at Annual Banquet

Members of the senior class of the School of Mines met for the last time around the banquet table at the annual senior farewell banquet given at the Schester Cafe Friday, April 22, by the junior class of the school. The event has been given each year by the members of the junior class for the past 29 years.

The farewell address was given by Cyril Johnson, a junior, to which Lowell Arnold, senior class president, responded. Other talks were made by Clarence Katz, freshman president, "Bud" Landeen, and Herbert Boeger, junior class president, who was also toastmaster and chairman of general arrangements. The banquet arrangements were taken care of by James Helbling.

Engineers Help to Organize First Minneapolis Airplane Factory

Two engineering students, George A. MacDonald, and Leon Dahlem, have helped in the organization of the newly established Mohawk Company, makers of a light, fast, sport model airplane which is designed to be of use to hurried business men. W. C. Cumming, designer of the plane, is chief engineer of the company, Leon Dahlem is president, and George MacDonald is vice president and chief pilot.

The company started operations April 28 on construction of a plane which will be entered in the annual Ford reliability tour in August, and the National air races in September. The plane is two passenger with a speed of 110 miles per hour, and a fuel consumption of one gallon of gas to 25 or 30 miles. The latest type of Rickenbacker radial aircooled motor of 60 horse power, which has just been developed and placed on the market, will be used.

MacDonald and Dahlem are both Ensigns in the Naval Reserve with designations as naval aviators. They took the aviation course which the Navy gives to university students, and received their commissions last year.

Engineers Bookstore to Donate Trophy Case

At last the College of Engineering is to have an honest to goodness trophy case. For four years every one has known that a fitting house was needed for the ever growing array of cups, shields and medals brought home by Saint Pat's athletes, and the Engineers Bookstore has now stepped forward and unselfishly donated a trophy case that will be the envy of the entire campus.

Designed by Kenneth A. Backstrom, senior architect and member of the Board of Directors of the Bookstore, the case will stand 8 ft. 5 in. high, and 4 ft. 10 in. wide. Mr. Backstrom has specified that the case be made of bleached walnut frame with the front and sides of plate glass. The interior of the case will be lined with black velvet and the cups placed on individual brackets as the need arises. Above the center of the case, enclosed in a classic pediment, will be the regular engineering monogram composed of a triangle superimposed on a capital M, and underneath will be a ribbon bearing the inscription ETOILE DU NORD. Millwrights, in commenting on the originality of the design, said that this was one of the best designs for a case of this kind that they had ever seen.

The contract was let on May 2 to the L. Paulle Company, who estimated the cost of the case to be about $250.

The position of this case in the engineering building has not been decided upon. There have been several places advocated, but only two have been seriously considered: in the corridor between the Library and the Dean's office, and in the entryway of the Dean's office.

The unselfish work of Mr. Backstrom and the Bookstore will be deeply appreciated by the coming classes and both deserve a great deal of praise for the initiative they have shown.

She (as it is beginning to rain)—Oh, dear! It's beginning to come down.

He (absent mindedly)—Will a safety pin help?

AROUND THE WORLD WITH OUR ALUMNI

(Continued from page 241)

ELECTRICALS

'16—Walter W. Simons has informed us that he believes in being up to date. During the past two years he has been employed by the Grimes Radio Corporation of New York, the Frigidaire Company at East Orange, N. J., and is now traveling for the Vitaphone Corporation. He has adopted the famous navy slogan, "Join Vitaphone and see the United States," as his work takes him to practically every large city in the country.

'19—Albert E. Peterson is loudly proclaiming the arrival of an eight pound baby boy. He has recently given up his work as an efficiency engineer, and is now working on employee training conducted by the public relations department of The Commonwealth Edison Company.

'20—Walter J. Larson has resigned his position as production engineer of the Euclid Lamp Works of the General Electric Co., and is now taking a course in the foreman training department at the Ohio State University.

'21—Laurence W. Hayward, who has been with the General Electric Co. for some time, is now with the Combustion Engineering Corp. of Chicago where he holds the position of construction superintendent.

'24—Manley B. Monsen, after completing the training course of the Northern States Power Co. is now employed by the Wisconsin Division of the District Engineering Department.

CIVILS

'17—Duane Leroy Taylor completed work for M. S. degree in electrical engineering at Columbia University in 1925. He is now Assistant Engineering Superintendent of the navy yard at Brooklyn.

'17—John H. Murray, former track captain, is employed by the city of Flint, Michigan, where he is doing city planning work.

'18—George W. Putnum has left the Missouri Board of Health where he was Director of the Division of Sanitary Engineering, and has accepted a position with the Chicago Department of Health.

'26—Edward S. Gould, who is now employed in the city assessor's office of Minneapolis, is ready to accept congratulations. At present he is applying his technical knowledge toward walking the floor nights with a new set of twins. Address any advice to 315 Ontario St. S. E., Minneapolis.

GETTING OUT A PAPER

Getting out a paper is no picnic.

If we print jokes, folks say we are silly.

If we don't, they say we are too serious.

If we publish original matter, they say we lack variety.

If we publish things from other papers, we are too lazy to wrtie.

If we stay on the job, we ought to be out rustling news.

If we are rustling news, we are not attending to the business in our own department.

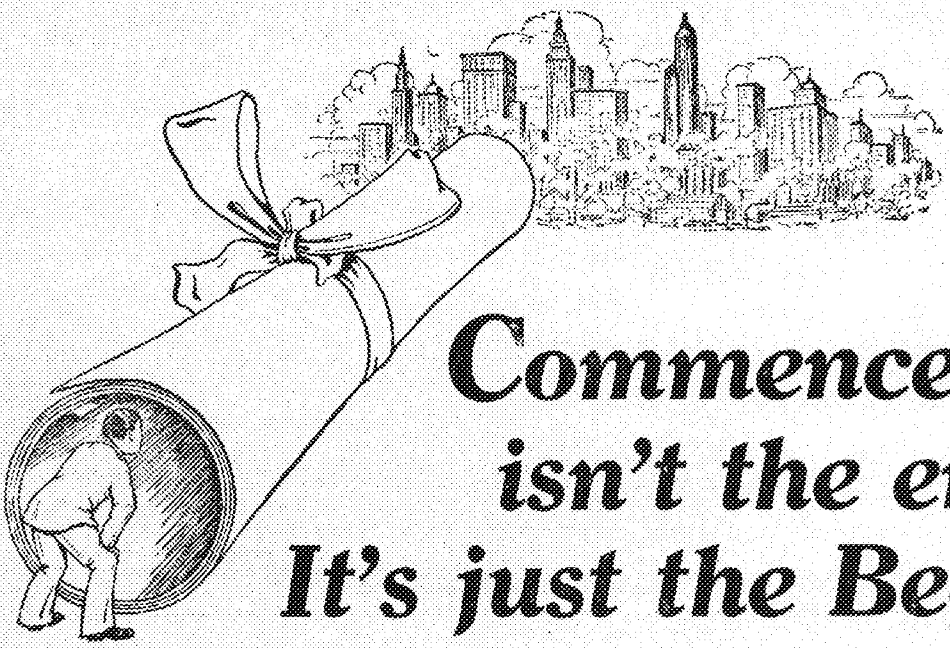
If we don't print contributions, we don't show proper appreciation.

If we do print them, the paper is full of junk.

Like as not some fellows will say we swiped this from the exchange.—We did.

Answers to "Ask Me Another" Questions

1. (a) Ascanio Sobrero, an Italian, 1846; (b) Alfred B. Nobel, a Swedish chemist.
2. Blasting caps and electric blasting caps.
3. Nitroglycerin.
4. (a) Joseph A. Holmes. (b) Scott Turner.
5. Sulphur, charcoal, and Chili saltpeter.
6. Faster.
7. A galvanometer or an ohmmeter-galvanometer.
8. Block-holing, snakeholing, and mud-capping.
9. 17,500 feet a second.
10. December, 1679, at Ottawa, Ill., by Father Hennepin.
11. In parallel.
12. Gelatin.
13. Fulminate of mercury.
14. Twenty-five pounds.
15. (1) That the explosive is in all respects similar to the sample submitted by the manufacturer for test.
    (2) That detonators, preferably electric detonators, are used of not less efficiency than those prescribed—namely, not weaker than a No. 6 detonator.
    (3) That the explosive, if frozen, shall be thoroughly thawed out in a safe and suitable manner before use.
    (4) That the quantity used for a shot does not exceed 1½ pounds (680 grams) and that it is properly tamped with clay or other non-combustible stemming.
16. Ammonia dynamite, gelatin dynamite, straight nitroglycerin dynamite.
17. The Explosives Engineer.
18. FFFF, FFF, FF, F, C, CC, CCC.
19. (a) James F. Callbreath. (b) H. Foster Bain. (c) Stephen S. Tuthill. (d) J. R. Boyd. (e) Gen. R. C. Marshall, Jr. (f) W. S. Hays.
20. The Moffat Tunnel, in Colorado, length 6.19 miles.
21. Squarely across (not on an angle).
22. Wood.
23. By burning.
24. Pennsylvania.
25. Dynamite. A free copy of a book entitled "Dynamite—The New Aladdin's Lamp," can be obtained by writing to The Explosives Engineer, Wilmington, Delaware.



Engineers and Athletics

(Continued from page 238)

has been awarded only to members of engineering teams or to individuals winning all-university championships. I am in favor of keeping this key as symbolic of the highest award obtainable—an all-university championship. I believe, however, that the winner of the engineering tennis tournament should also be awarded this key as he ranks with an all-university champion.

"There should also be some form of award made to the winners of other engineering tournaments as they are justified in winning some sort of recognition. The awards will tend to create more enthusiasm in athletics.

"Men recommended for the gold key symbolic of an all-university championship are Larry John, tennis, and Arthur Burris, golf."

A New Field of Engineering

(Continued from page 242)

but do not definitely fit a person for any specific pursuit which might be followed after graduation.

If an outside activity can be found to better equip one for his chosen work following graduation, it might well be considered as another course in school work in which personal initiative can be taken, and should be taken to provide for a better trained future career. Through experience to be received by working on a college publication such as the MINNESOTA TECHNO-LOG, students can aspire to positions as technical magazine staff writers following graduation. Such a career, however, must be planned, and it is but seldom that college men know specifically what they intend to do following graduation. A person who has planned his career along any line seems certain to advance faster and further than a person who has not given the subject much thought.

There are no doubt many students in the technical colleges here at the university, who would make fine workers on a technical magazine, and trying out one's capabilities is the only way of finding out. Scholastic work along these lines can be obtained both from the journalism department of the university or from the engineering English department. Work on the TECHNO-LOG or any other publication would provide for actual experience in such work, and is necessary training if one is planning on taking up such work after graduation.

The TECHNO-LOG can always use more men on both the editorial and business departments of the paper. In commercial technical publications the advertising and business side of the publication is very important, and training along these lines is useful.

If you as a reader, whether inexperienced or experienced, are interested in the field in general or have any desire to work on the staff, we would be glad to have you make a visit to the TECHNO-LOG office.

The Engineer as City Manager

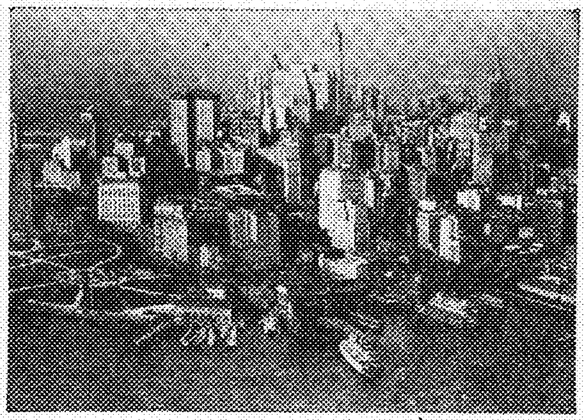
(Continued from page 233)

this country now have established graduate courses designed to fit men for the city manager profession. It remains only for the municipalities to come to a realization of the need for experts in government. Then the manager profession can develop into a profession attractive to capable, trained administrators.

1902 1927

Recognition, Reputation, Repetition

JUST a quarter of a century ago four young men, with a broad background of training and experience in the engineering construction field, formed The Foundation Company. Today the company is at work in every continent, in both hemispheres, and on both sides of the Equator, on engineering construction of almost every known type.



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OVER FIFTY OF THESE LARGE BUILDINGS REST ON FOUNDATIONS BUILT BY THE FOUNDATION COMPANY IN NEW YORK

WATER PIPES BEING LAID BY THE FOUNDATION COMPANY FOR THE MUNICIPALITY OF CUZCO, PERU

DURING the early years the activities of this organization were centered on Manhattan Island and principally on its southern tip where foundation work was most difficult; now, subways in England, river control and land reclamation in Greece, bridge piers in Japan, a power plant in Venezuela, dredging in Colombia, and general construction of all kinds in Peru, are some of the many undertakings of magnitude engaging The Foundation Company, all over the world.

As indicative of the service rendered by The Foundation Company over this period of years, these partial lists of repeat contracts have special significance. In one case no less than thirty contracts have been awarded by one owner.

Cleveland Cliffs Iron Co.		Pennsylvania Railroad		U. S. Government	
Mine Shaft	1909	Bridge Piers	1913	Navigation Dams	1911
Power House	1911	Bridge Piers	1917	Gun Shrinkage Pits	1917
Power Dam	1917	Pumping Stations	1918	War Construction	1918

THE FOUNDATION COMPANY

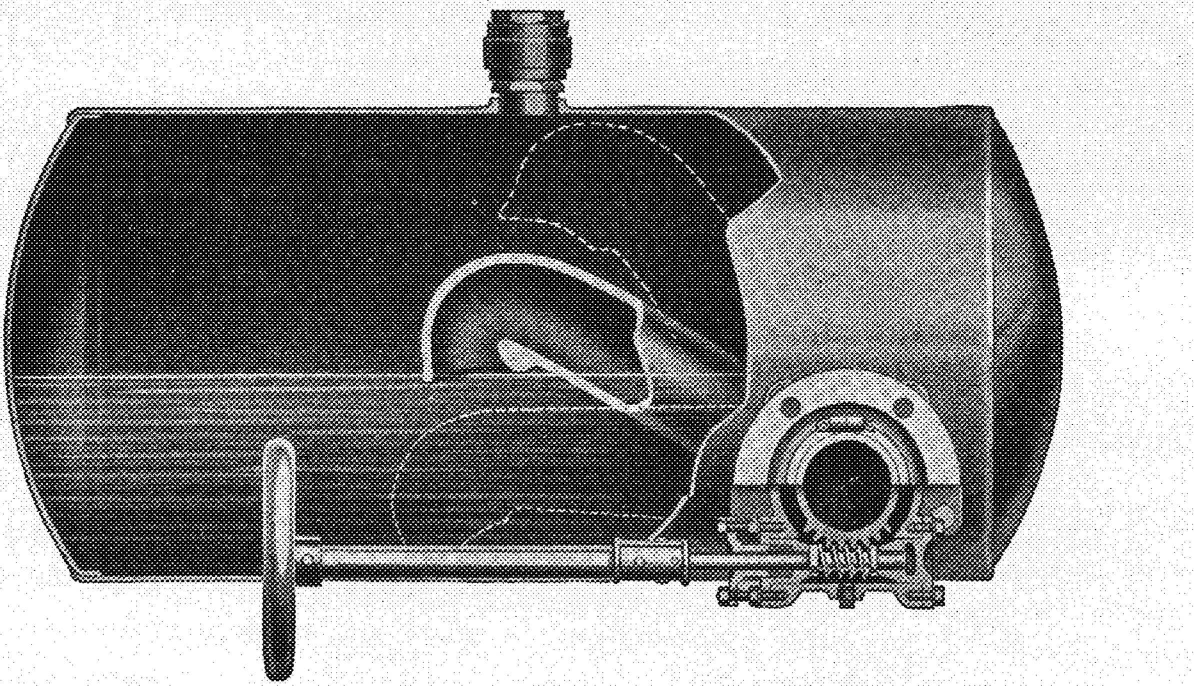
CITY OF NEW YORK

Office Buildings
Industrial Plants
Warehouses
Railroads and Terminals
Foundations and Underpinning
Filtration and Sewage Plants

ATLANTA
PITTSBURGH
CHICAGO
SAN FRANCISCO
LOS ANGELES
MEXICO CITY
CARTAGENA, COLOMBIA
LIMA, PERU
MONTREAL
LONDON, ENGLAND
BRUSSELS, BELGIUM
TOKYO, JAPAN

Hydro-Electric Developments
Power Houses
Highways
River and Harbor Developments
Bridges and Bridge Piers
Mine Shafts and Tunnels

BUILDERS OF SUPERSTRUCTURES AS WELL AS SUBSTRUCTURES



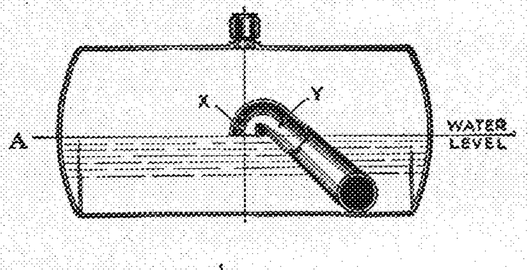
—another reason why Koehring Pavers Produce Dominant Strength Concrete

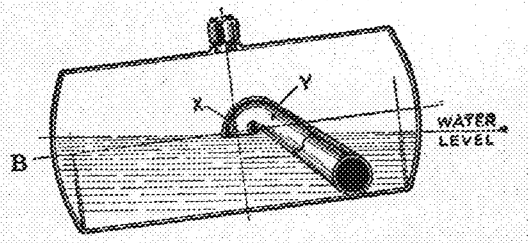
Vitally important to the resultant strength and durability of concrete is the admittance of an accurate amount of water into the mixing drum at exactly the right instant. Long ago the Koehring Company recognized this fundamental requirement and set to work to devise an automatic water measuring system.

Today, the system is as nearly exact and accurate as human ingenuity has been able to design. A balanced three-way valve is automatically opened at a certain point, by the charging skip as it is raised, admitting the water into the mixing drum at exactly the right instant. The regulating hand wheel governs to a minute accuracy the amount of water which is to be used per batch.

All dribble is eliminated by the syphon-gravity principle which draws the water through a straight 3½ inch pipe into the mixing drum. Straight flow from the tank to drum secures a fast, clean discharge.

This is another pioneering development by Koehring engineers which with the Koehring batch meter, Koehring boom and bucket, and Koehring five action re-mixing principle produces standardized, dominant strength concrete of unvarying uniformity.





A and B illustrate clearly why changes of grade do not materially affect the accuracy of water measuring when using the Koehring system. X represents the volumetric center of the tank and Y the measuring arm.

"Concrete—Its Manufacture and Use" is a 210 page treatise on the uses of concrete, including 26 pages of tables of quantities of materials required in concrete paving work. To engineering students, faculty members and others interested we shall gladly send a copy on request.

KOEHRING COMPANY
MILWAUKEE WISCONSIN

MANUFACTURERS OF PAVERS, MIXERS—GASOLINE SHOVELS, CRANES AND DRAGLINES

The Lund Press, Inc., Minneapolis

The MINNESOTA TECHNOLOG

Published Monthly by the TECHNICAL COLLEGES of the UNIVERSITY of MINNESOTA

JUNE

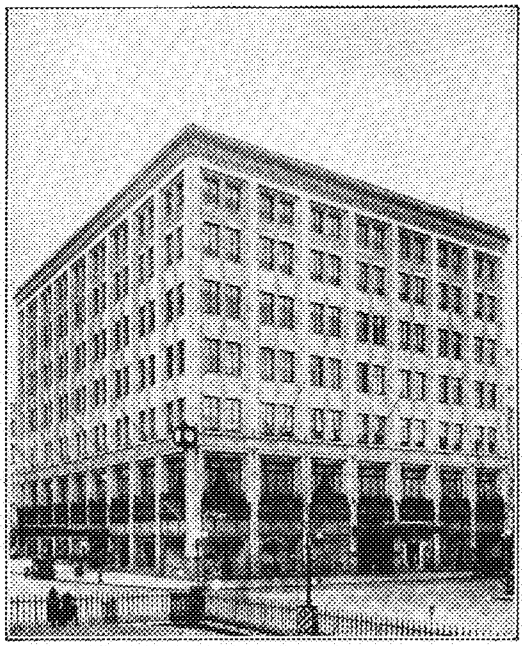
Volume VII 1927 Number 9

MEMBER ENGINEERING COLLEGE MAGAZINES Associated

"TO ERR IS HUMAN"

But Frequently Annoying

THE old style Department Store elevators required an *operator*, who could not only run the elevator, open and close the doors, and keep people away from the front of the car, but could also answer questions, invite attention to wares on various floors, and suggest patronage of special merchandise.



The Otis Automatic Department Store elevators with the Micro-Drive, or self-leveling feature, have made it possible for the operator to spend practically all of his time in taking care of the passengers, directing them to departments for which they inquire, and advising of special sales, with few operating distractions except that of releasing the doors.

The operation of this type of elevator is entirely automatic, with the exception of the releasing of the doors by the attendant, which results in the automatic closing of the doors and the car starting automatically and running to the next floor, where it automatically stops, and is exactly leveled with the landing, and the doors open automatically.

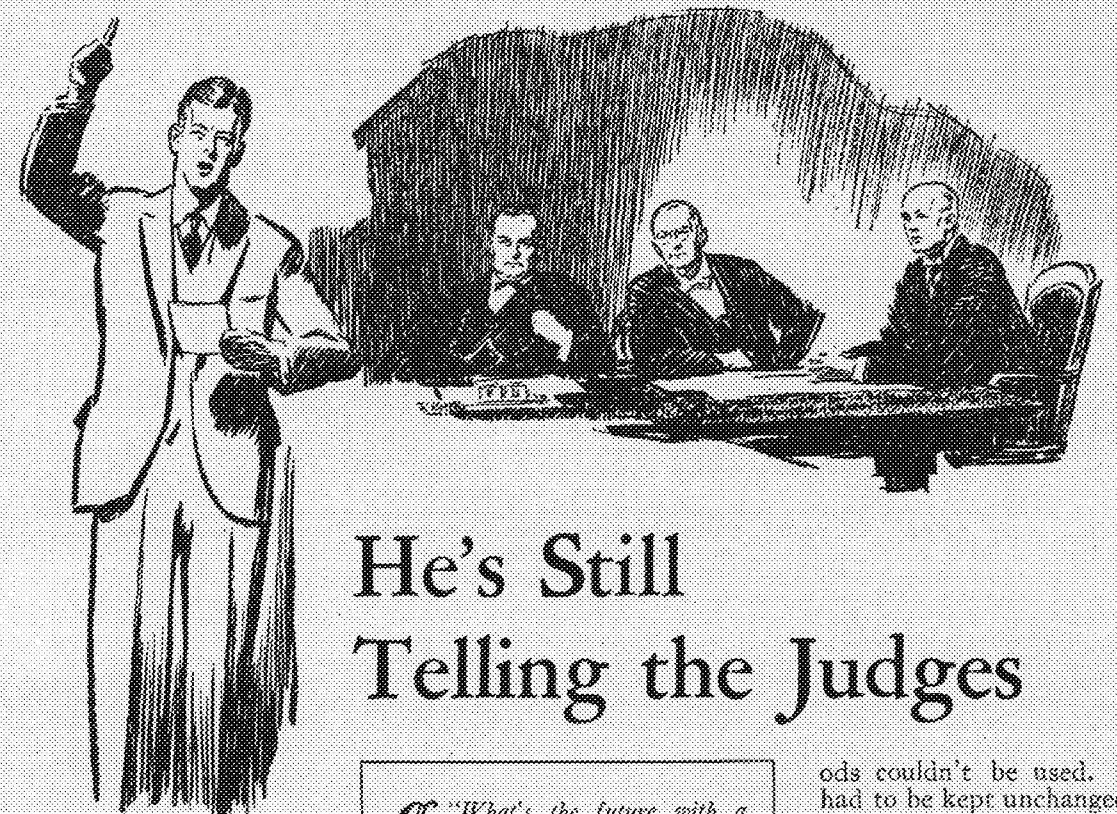
Delays no longer result from bringing the elevator to a perfect level with the floor, due to inexperienced operators, nor is there now any danger of careless passengers stumbling over the door sill, requiring constant admonitions to "Watch your step". This is accomplished by the Micro-Drive, or self-leveling feature of the machine, which automatically brings the car to an exact level landing and maintains that level, irrespective of change in load on the platform. If it is desirable to have the elevator run past some of the floors, either regularly or on certain trips, the operator can accomplish this by merely moving a switch.

The store of the Hecht Company at Washington, D. C. has five Department Store Control Elevators in operation, each of which travel at 400 ft. speed and carry a load of 3,000 pounds.

THE WORLD'S WORD FOR ELEVATOR SAFETY — Otis

O T I S   E L E V A T O R   C O M P A N Y

Offices in All Principal Cities of the World



He's Still Telling the Judges

C. M. Laffoon

"The speaker for the affirmative, ladies and gentlemen, will be Mr. C. M. Laffoon." That line was not unfamiliar to student groups at the University of Missouri a few years ago.

Now the undergraduate debater of other days is the Design Engineer in the Turbo-Generator Section of the Power Engineering Department. He is in his eleventh year at the Westinghouse Company.

Laffoon today is the builder of the fastest things that go, electrically. For those intricate high-speed machines, he must not only act as designer, but must often assist in selling, and must look after the service when problems arise in operation. Because the designer is the man who knows, he is the "speaker for the affirmative." "Honorable judges" are fact-seeking engineers of electric light and power companies.

"What's the future with a large organization?" That is what college men want to know, first of all. The question is best answered by the accomplishments of others with similar training and like opportunities. This is one of a series of advertisements portraying the progress at Westinghouse of typical college graduates off the campus some five—eight—ten years. Write for booklet reprinting the entire series.

Out of a clear sky one day Westinghouse called for a high-speed generator for use in commercial transmission of radio messages. There was no such machine. Laffoon designed one. Then, through an unexpected change in a trade situation, the machine was not used. Did it go to the scrap heap? Read and see.

Industry had been seeking a better way to melt expensive metal of high heat resistance—aluminum, platinum, certain alloy steels, and the like. Ordinary smelting methods couldn't be used. Properties had to be kept unchanged; and the great heat liquefied the ordinary crucible as well as the metal. Laffoon's discarded radio-generator was found to offer an ideal application to a new high-frequency induction furnace for melting those special metals; and so Laffoon designed that machine.

You can measure the advance in high-speed turbo-generator apparatus by comparing the models of 1918 (when Laffoon entered the particular field to which he has contributed), with those of 1926. Then 25,000 KVA was some machine. Now, at 62,000 KVA, no limit is set on the future.

High-speed machines must be fitted to the individual needs of customers. After understanding what the customer wants, the design engineer must determine the size, weight, dimensions and performance, depending on voltage, frequency and speed of the installation. Then he must "follow through."

Men who "follow through" in any phase of electrical engineering may have confidence in their careers at Westinghouse.

Westinghouse

THE MINNESOTA TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

VOLUME VII. MINNEAPOLIS, MINN., JUNE, 1927 NUMBER 9

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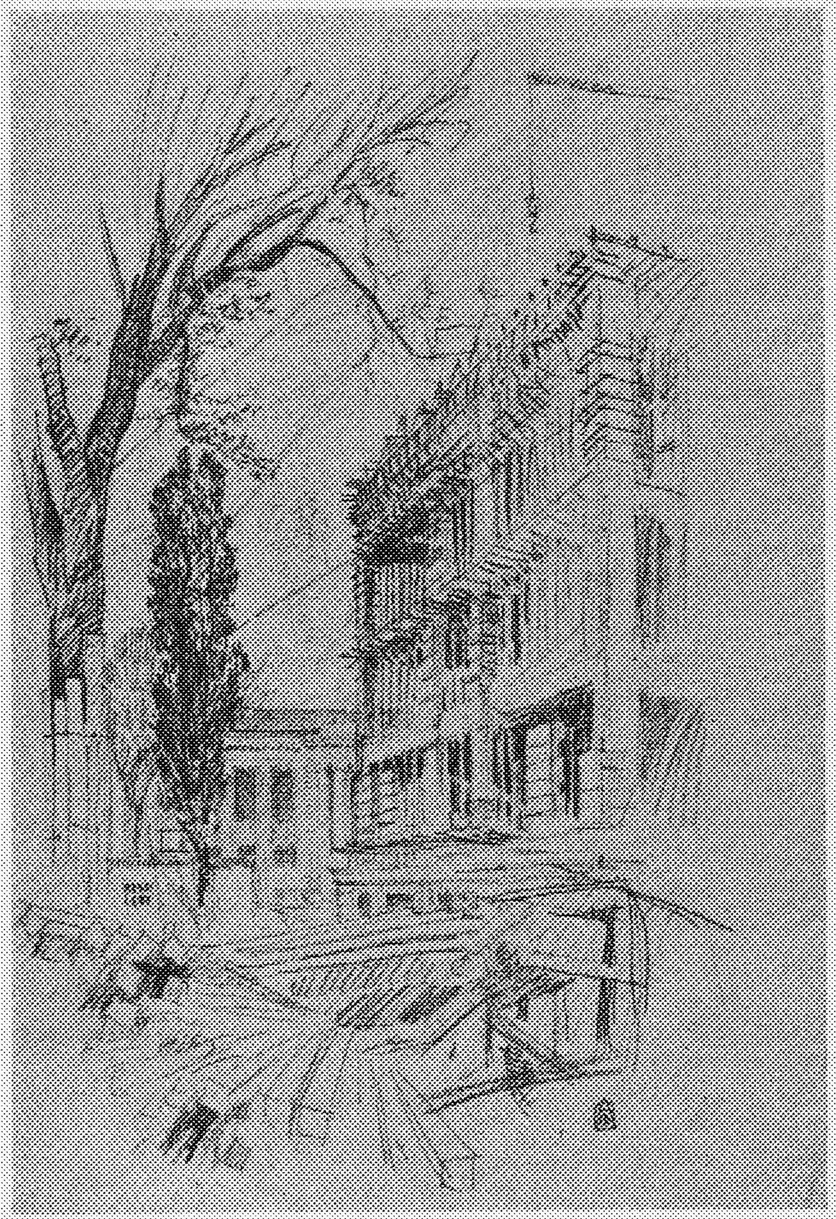


LAWRENCE B. ANDERSON

Towards a Greater Minnesota

---The New Physics Building

The MINNESOTA TECHNO-LOG

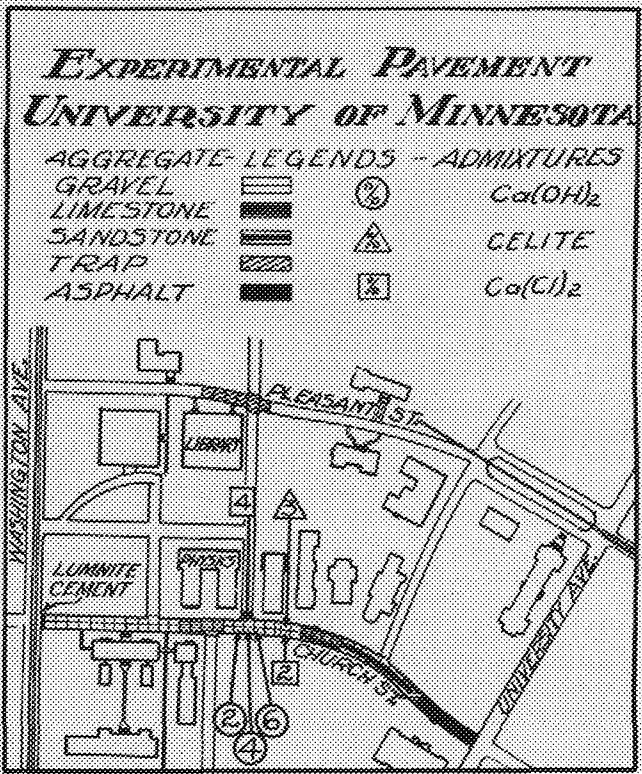
University of Minnesota

Volume VII | JUNE 1927 | Number 9

Observations on a Test Pavement

By FRED C. LANG, C '08
Associate Professor of Highway Engineering, University of Minnesota.

A PAVEMENT built on the University Campus for experimental purposes was described in the November, 1925, TECHNO-LOG. This pavement was constructed by Nelson-Enblom Company during the summer of 1925 on Church and Pleasant Streets. All except 233 lineal feet of asphalt in front of the Armory and 10 lineal feet of Lumnite cement concrete at the Washington Avenue end of Church Street was of Portland cement concrete proportioned one (1) part cement, two (2) parts sand, and three and one-half (3½) parts coarse aggregate by volume.



The coarse aggregate consisted of gravel pebbles, crushed sandstone, trap, and limestone. Certain well-known admixtures were incorporated into some of the gravel sections. With the exception of some fine sand in the first section, the fine aggregate was uniform and of good quality. Different methods of reinforcing were used, but as there are no evidences of structural weaknesses and the pavement is practically free from cracks, no comparisons can be drawn at the present time except to question whether so much reinforcing was necessary. All of the concrete pavement had integral curb and the slab was seven (7) inches thick. Transverse expansion joints were placed every 36½ feet. In the center a deformed metal plate forming a continuous longitudinal joint was placed.

Since November, 1925, further tests on the quality of the concrete have been completed and observations have been made of the surface condition.

Quality of Concrete

The chart shows results of compression tests on 6"x12" cylinders which were made at time of construction, and on 4.4" cores drilled from the slab in October, 1926. The picture shows some typical cores. All of the tests show the concrete to be of good quality.

Inasmuch as the methods of curing must be considered in any comparison of tests showing quality of concrete these will be briefly explained. Lumnite cement concrete molded specimens were made in late afternoon, left outside until the next morning, then taken to laboratory and placed in moist curing room where they remained until tested. The pavement slab was completed about 4:30 P. M., covered with water between 9 and 10 P. M., water was drawn off about 9 A. M. the next day, after which there was no further curing. Portland cement concrete molded specimens were placed in the shade until sufficiently hard for burying along side of slab. They were kept wet four or five days, then taken to laboratory and after capping were placed in moist curing room where they remained until tested. The slab was covered with canvas as soon as it could be placed without injury to the surface. The canvas was kept wet until the following day when it was removed and the slab covered with two inches of earth which was kept wet for ten days.

All cores were placed in moist curing room after drilling. All cores and cylinders were tested wet as taken from moist curing room.

Some of the results shown on the chart are quite interesting.

Lumnite cement concrete had attained practically its ultimate strength in one day. The one year cylinders had much better strength than the cores drilled from the slab. This indicates that the slab may not have been properly cured. Lumnite cement generates considerable heat during the setting period, and the best methods of curing were not well established.

The highest core strength was attained with hydrated lime used as an admixture but this relation is not apparent in the molded specimens.

The tests on molded specimens do not show any consistent advantage in use of admixtures.

The sandstone aggregate shows higher strength on both cores and molded specimens than other aggregate without admixture. The number of gallons of water per sack of cement was not corrected for absorption.

Surface Condition

Until March, 1927, very little surface scaling was noticeable, but there is at present considerable scaling especially where the slab has been subjected to more than the ordinary amount of traffic. On March 18, 1927, the total surface scaled was measured and is as follows:

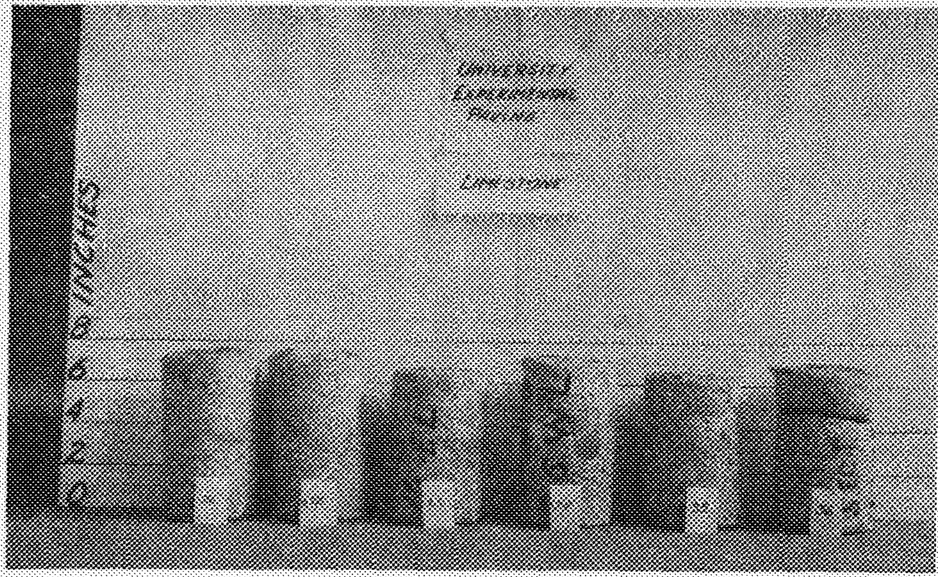
Description	*Total Number Sq. Yds.*	*Per Cent Surface Scaled*
Fine sand, gravel aggregate	182.5	0.264
Gravel coarse aggregate	1,824.17	0.125
Limestone coarse aggregate	973.33	0.386
Sandstone coarse aggregate	973.33	0.002
Trap coarse aggregate	851.67	0.521
Gravel with 2% hydrated lime	60.83	0.000
Gravel with 4% hydrated lime	60.83	0.000
Gravel with 6% hydrated lime	60.83	0.000
Gravel with 2% calcium chloride	60.83	0.000
Gravel with 4% calcium chloride	60.83	1.370
Gravel with 3 to 3½% Celite	60.83	0.845
Gravel with Lumnite cement	38.10	0.000

Coarse sand was used unless otherwise stated.

Per cent of admixture is on weight of Portland cement used.

Sections are without admixture except as shown.

On Church Street 93½ per cent of scaling has occurred on section north of new Physics building, and, of this, 95.9 per cent is on the west side of the street where truck loads of concrete aggregates have been hauled to new Physics building now under construction. On Pleasant Street over 90 per cent of the scaling is where traffic turns in going into drive way on north side of Library. This would indicate that more scaling is to be expected on remainder of pavement. The scale is about one-tenth (.1) of an inch thick. Aside from appearance it is not considered that scaling is detrimental. Various reasons may be assigned for surface scaling. It is caused by a thin surface layer of weak mortar which breaks away from the underlying concrete under traffic. It is probable that pavement was over-finished, bringing excess water and fine inerts to the surface. Scaling is usually most evident after a pavement has gone through two winters.



CORES DRILLED FROM THE EXPERIMENTAL PAVEMENT

These specimens were typical of the cores taken from the paving. After drilling, they were placed in a moist curing room and then tested wet.

The pavement is practically free from cracks. There is one crack 17 feet long.

Deflection under loads has been reported near southeast corner of drill field. This is probably caused by settlement of fill which was made at this place. Up to the present time the deflection has not been serious enough to cause cracking. No deflection or cracking is apparent where the pavement was constructed over the old railroad cut on Church and Pleasant Streets. Prior to paving the fill was soaked with water. Extra reinforcement was also used.

The ten feet of Lumnite cement concrete adjacent to Washington Avenue shows considerable wear on surface. This section is subjected to unusually severe conditions as automobiles turn on it in going from Washington Avenue to Church Street, and also due to applying brakes when stopping in going from Church Street to Washington Avenue. There is considerable more wear, however, on the Lumnite cement concrete than on the adjacent Portland cement concrete. The integral curbs on the Lumnite cement section have been broken off. This may in part be due to a thrust from expansion of sidewalks. The chart, however, indicates that the quality of the concrete as represented by cores drilled from slab is not as good on the Lumnite cement section as on the Portland cement concrete.

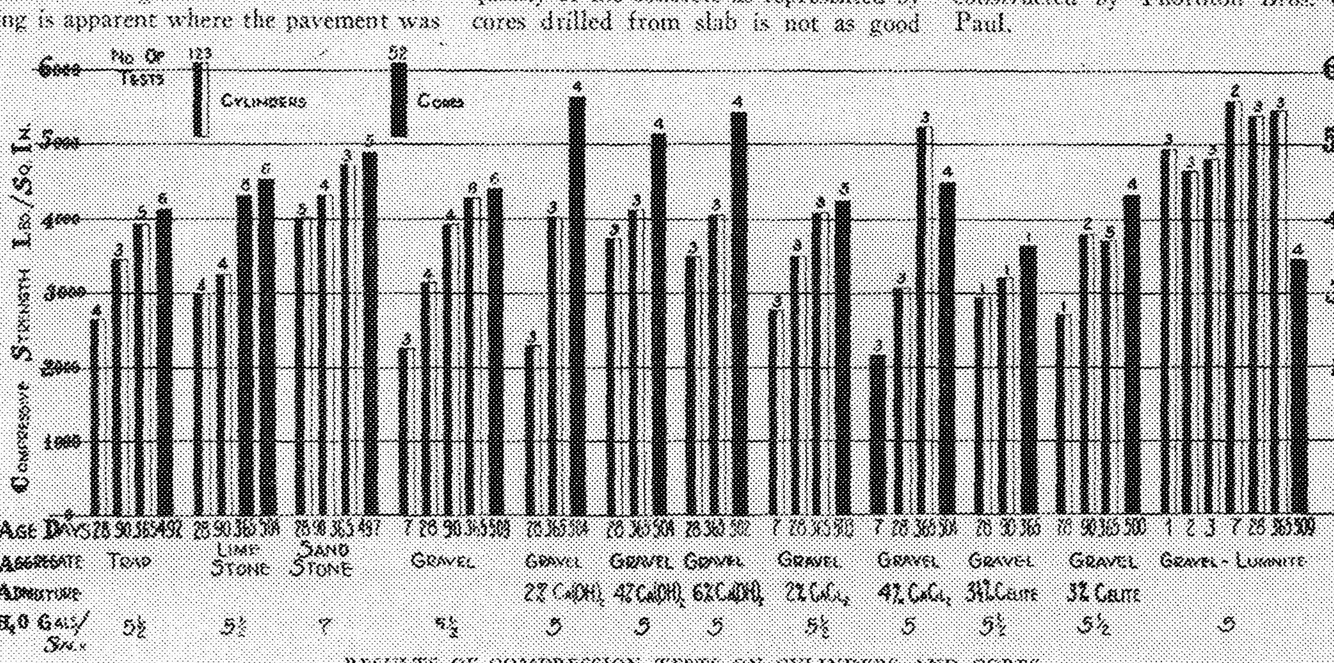
The asphalt section in front of the Armory is a 1.5 inch sheet asphalt constructed on a 5½ inch asphaltic concrete base except that for approximately 30 feet the base is 5 inches and the surface 2 inches. This pavement is in excellent condition. On about the south 30 feet there are some circular cracks which indicate that the sheet asphalt mixture was too hard. This may be caused by using asphalt of too low a penetration or too high a per cent of filler for the amount of asphalt used, or by over heating.

Black base is the name commonly applied to asphaltic concrete foundations. Portland cement concrete is the type usually used although some have been constructed on macadam. Asphalt surfaces are frequently laid over old partially worn out brick and stone block pavements. The proponents for this type of foundation give several reasons why it is superior to the customary Portland cement concrete base. Among these are:

1. More shock absorbent, therefore the impact from traffic is less destructive.

2. Better bond between base and surface, in fact the base and surface knit together to form an integral structure.

The asphalt section was donated and constructed by Thornton Bros. of St. Paul.



RESULTS OF COMPRESSION TESTS ON CYLINDERS AND CORES

Garbage Incineration in Minneapolis

Sanitation and a flexible service are major considerations in the operation of the municipal plant recently constructed in this city.

By J. L. Blackshaw, *Mech. Eng. '28*
Tau Beta Pi Essay

THE problem of garbage destruction in any community other than very small villages and towns necessarily is a problem which must be met by the civic organization of that community. The collection of the garbage is a matter which may or may not be municipal, but in practically all cases, the final destruction of the garbage is a duty which the community itself performs.

Before the year 1900, it was common practice for each town or city to have a common, open, garbage dump located in an outlying district. Here the garbage was left to slowly decompose. Obviously, such dumps were breeders of flies and vermine of all descriptions. The odors arising from such places, together with the unsightliness, caused the neighboring property to have little value. To better these conditions, various schemes were attempted. One scheme was to bury the garbage. It was hoped that the garbage would disintegrate under the ground. However, it was found that unless the garbage was deeply buried, the obnoxious odors still remained; and if deeply buried the garbage did not disintegrate. Another method was the cooking of the garbage and the subsequent feeding of it, in the form of swill, to hogs. These hogs were usually owned by the city. This latter method, while all right for small communities could not cope with the large volumes of garbage thrown away by the inhabitants of a large city. A more positive and sanitary system was sought to handle this problem of waste refuse. The problem has been well solved by the modern incinerator or garbage destructor.

A refuse incinerator consists of the following parts:

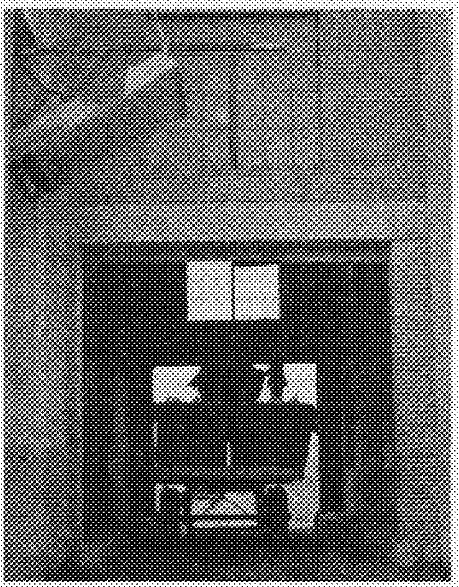
1. A furnace built of brick, heavily braced with structural steel, and containing one or more cast-iron grates and an ashpit.

2. An opening or special chute for charging garbage into the furnace.

3. Necessary ducts, valves, and blowers for delivering the requisite quantity of air into the furnace, and for bringing the oxygen into contact with the combustible parts of the garbage.

4. The necessary flues and chimney to conduct the gases of combustion out of the furnace and into the atmosphere. In a good incinerator, the hot gases preheat the forced-draft air through suitable piping.

5. An opening, with means for removing the residual clinkers and ashes from the grates and ashpit.



UNLOADING DRIVEWAY
Six garbage tanks, with a total gross weight of 13,200 pounds, are carried on these trailers.

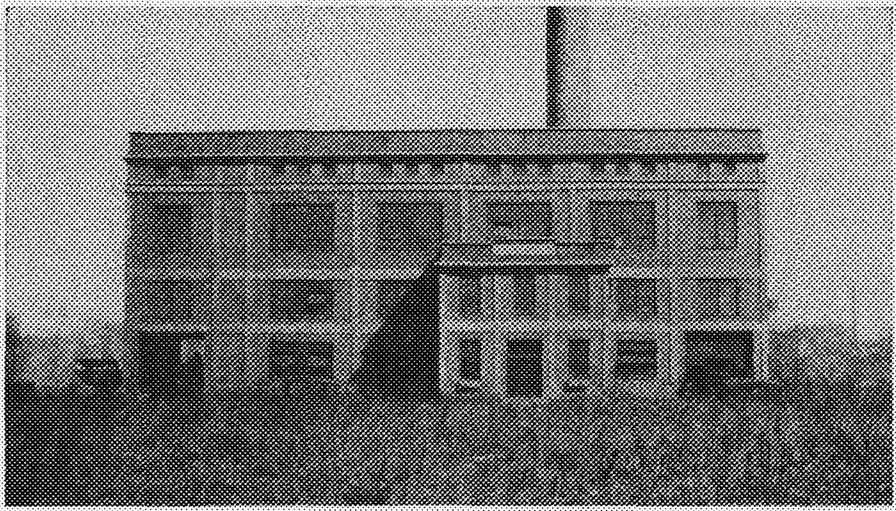
In 1901, Minneapolis built one of the first incinerators in the world of the present day type. This incinerator is still serving Minneapolis during times of peak load. Due to the growth of the city, a new incinerator was contracted for in 1925 and was opened during the first months of 1926. This incinerator is much like the earlier one except that it has many refinements both for the handling of the garbage and for the care of the furnaces.

The building in which this new incinerator is housed measures roughly one hundred and twenty-five feet long, sixty feet high and forty feet wide. It is of modern reinforced concrete and brick construction, with architectural features much like a present day school building. On each side of the building, there is a large covered driveway in which the garbage collection trucks unload. Inside the building are three Goder incinerators of late design. The rated capacity of these three incinerators is 210 tons of standard garbage every 24 hours. Actually, they will burn more than this amount. The office and furnace room are located on the ground floor. The second floor contains the forced-draft blowing fans, switchboard room, and men's rest room. The entire top floor is devoted to the storage of garbage, and the charging of the garbage into the furnaces.

Garbage, in Minneapolis, is collected into rectangular steel tanks which are ten feet long, four feet wide, and three feet high. A motor truck carries one tank along a determined route. City employees dump the wrapped garbage from the various sources into the tank. When the tank is full of the refuse, the truck is driven to a transfer station where the tank is lifted bodily from the truck chassis and deposited on a huge trailer which can hold six of the tanks. The tanks are moved with a crane at the transfer station. Each garbage tank, when loaded, has a gross weight of approximately 2,200 pounds. The tare weight of one of the steel tanks alone is 800 pounds. A towing truck takes the loaded trailer to the incinerator from the transfer station.

At the incinerator, another electric crane is connected to the four corners of a tank, and carries it to the charging

IN THE FURNACE ROOM OF THE INCINERATOR
The temperature of combustion is kept above 1250° F. to insure the destruction of all odors and bacteria. 100 pounds of coal are required for every ton of garbage.



THE FRONT OF THE MINNEAPOLIS INCINERATOR

This plant houses three Goder incinerators whose combined capacity totals 210 tons of garbage every twenty-four hours. Note the unloading driveway at each end.

floor where it is stored. When an incinerator furnace is in need of garbage, the crane is again connected to the tank, and moves the tank with its contents to the charging chute. Here the tank is tilted so that the fourteen hundred pound charge of garbage falls through ingenious weighed charging doors, down down a twenty-five foot chute, and onto a drying grate. As it is needed, the garbage is manually pulled from the drying grate onto the combustion grate a few feet lower down. Here the garbage, except for unburnable material, is completely consumed with the aid of a small amount of bituminous coal.

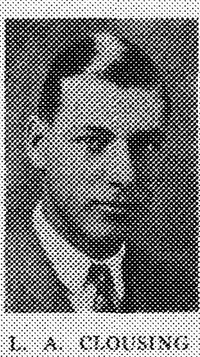
The products of combustion pass into a breeching, which is connected to the other furnaces also, and from there pass up the large chimney. The unburnable material is at intervals pulled from the grates and is allowed to drop to storage bins in the basement. This material, when cool, is then collected and is transported to a common dump.

The temperatures of combustion are always maintained above 1250° F., for when the combustion takes place above this point, all odors are destroyed as well as all of the bacteria. However, coal is needed to burn the garbage though the B. T. U. content of a pound of ordinary wet garbage is around 2,000. In the Minneapolis incinerator, approximately 100 pounds of coal are used to burn one ton of garbage.

The test of a garbage incinerator is simply a modified boiler test. The weight of garbage charged is obtained on the charging floor where large scales permit the weighing of the garbage tanks. The amount of coal fired is determined from scales on the furnace floor. Temperatures in the furnaces are obtained from pyrometers, and the power consumed in running the blower fans is found from wattmeters. The coal is sampled in the approved manner. The garbage is also sampled in a manner similar to that of taking a coal sample. The representative garbage sample serves the same purpose as that of the coal sample. Both are for the determination of moisture content and calorific value. By proper combination of the data mentioned above, together with other minor items, similar to those obtained in a boiler test, input, output, efficiencies, and running data may be obtained.

In the Minneapolis incinerator, no use is made of the heat which passes as waste heat up the stack. Sanitation is considered the goal of the plant, and not extreme economy. It is, however, feasible to use the hot exhaust gases for the generation of steam, and through this means derive heating and power energy for a very little additional expenditure. Such installations are very popular in European countries where waste heat means much more than it does here, since the supplies of heat-giving materials are limited.

STAFF APPOINTMENTS *for* 1927-1928



L. A. CLOUSING

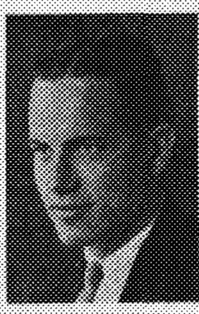
LAWRENCE A. CLOUSING, junior electrical engineer, has been elected managing editor of the MINNESOTA TECHNO-LOG for the coming year by the TECHNO-LOG Board. Concurrent with his election, Mr. Clousing appointed Curtiss Crippen, sophomore civil engineer, as business manager, and this appointment has been confirmed by the board.

Mr. Clousing has been active on the TECHNO-LOG staff during the past three years and has been serving as editor-in-chief of the magazine for the present year. During this year, also, he was publicity chairman for the Arabs' play, "Broadcast," for the Electrical party, and for Engineers' Day. He has recently been commissioned as ensign in the U. S. Naval Reserve. Lawrence Clousing is a member of Eta Kappa Nu, honorary electrical engineering fraternity, and of Theta Xi fraternity.

Curtiss Crippen has advanced rapidly on the business staff of the TECHNO-LOG, starting in the circulation department where he became circulation manager, finally becoming assistant advertising manager. He was active on the business staff of the Arabs Dramatic Club, and is a member of Delta Upsilon fraternity.

Four other major appointments on the staff have also been made by the new editor. Gordon Harris, who has been associate editor for most of the year, will take Clousing's former position of editor-in-chief. Carl Swanson, who has worked faithfully during the entire year as advertising manager, will be elevated to the position of business associate.

Walfred Swanson, a newcomer on the staff, who has shown his ability by his work as chairman of general arrangements during the recent convention of the American Radio Relay League, will take over the position of local advertising manager. Oswald Mikkelson will retain the position of circulation manager which he assumed during the April issue.



CURTISS CRIPPEN

The last meeting of the year of the MINNESOTA TECHNO-LOG board was a joint meeting of the old and new boards at which officers for the coming year were elected. George Ferguson was elected president of the board; Stanton Wallin, vice president; Dean Taylor, secretary; and Carl Barthelemy, treasurer. Other members of the board are Donald Stevens, Erling Amundson, and William McGinnity.

IN RECOGNITION

Tau Beta Pi

Tau Beta Pi, honorary engineering fraternity, annually elects 25 members from the technical colleges of the University of Minnesota on the basis of high scholarship and good character. Of this number, 13 are elected during the fall quarter, and 12 are chosen in the spring elections. The men chosen from the junior class this spring are: J. C. Barnes, Frank E. Blackmore, Joe L. Blackshaw, A. M. Braaten, Glendon C. Brown, W. W. Dreveskracht, W. J. Huchthausen, Ralph P. Johnson, Kerwin K. Kurtz, W. G. Lundquist, G. J. Schroepfer, and Robert M. Tousley.

Chi Epsilon

Members included in the spring elections of Chi Epsilon, honorary civil engineering fraternity, are: Leo McNally, Ben Mayeron, Olaf K. Normann, and J. J. Vorisek.

Eta Kappa Nu

New members of Eta Kappa Nu, honorary electrical engineering fraternity are: A. M. Braaten, Emil Engquist, Albert H. Lee, and F. H. Seegar.

Pi Tau Sigma

Spring elections to Pi Tau Sigma, honorary mechanical engineering fraternity, include: Carl Barthelemy, William Fritzberg, Wilbur H. Japs, and L. P. Samoilovich.

Tau Sigma Delta

Tau Sigma Delta, national honorary society in architecture, elected the following new members: Ai Flegal, Esther Hargrave, Walter J. Huchthausen, and Sidney L. Stolte.

Phi Lambda Upsilon

Members elected to Phi Lambda Upsilon, honorary chemical society, are: Walter A. DeLong, Ivan D. Jones, Burrell F. Ruth, Kenneth C. Lampert, Lawrence Zelney, Winifred W. Swanson, L. M. Greene, Clinton E. Rohrer, Ernest B. Sandell, Kerwin K. Kurtz, and Arvid Lyden.

Pi Delta Epsilon

Engineers included in the membership of Pi Delta Epsilon, honorary journalistic fraternity, are Sheldon F. Johnson and Carl F. Luethi.

Sigma Xi

Sigma Xi, honorary research fraternity, elects new members on the basis of original scientific study. The men chosen his year include: chemistry, John B. McKee, Lester L. Johnson, William H. Schlafge; engineering, Ikel C. Benson, Russell E. Backstrom, Henry R. Reed, Carl B. Feldman; undergraduates in the School of Mines and Metallurgy, Lee C. Armstrong, Theophil E. Jerabek.

Iota Sigma Pi

New members of Iota Sigma Pi, honorary chemical sorority, are: Dr. Grace Medes, Grace Devaney, Kathleen Dietrich, Amy Macomber, Mollie White, Evalyn Bergstrand, and Mary Shipman.

Dupont Fellowship

The Dupont Fellowship in chemistry was this year awarded to Miles A. Dahlen.

Iron Wedge

Iron Wedge, honorary senior men's society, includes the following engineers in its membership: John Beal, John Hoving, and Russel Sorenson.

Grey Friars

Engineers included in the new members of Grey Friars, honorary senior men's society, are A. S. Bull and Roger Wheeler.

Silver Spur

Silver Spur, honorary junior men's society, includes Joseph L. Armstrong and George Thwing, Jr., in its membership.

In general, students in the technical colleges of this university are here for the serious business of fitting themselves for their life work in as efficient a manner as possible. That some succeed more than others is inevitable, but the fact that these few do advance farther than others is due, in the large majority of cases, to their own more determined efforts.

Success in college may or may not mean success in the outside world, but nevertheless a student's record in school presents a fairly good indication of his ability to cope with the problems of life as he will find them after graduation.

The students listed have this year been honored by awards, elections to honorary fraternities, and appointments to various positions in extra-curricular activities.

Plumb Bob

Plumb Bob, honorary senior men's society in the College of Engineering and Architecture and the School of Chemistry, which elects its members on the basis of service to the university at large with special reference to the technical colleges, announces the election of the following men: Lawrence B. Anderson, Stuart L. Bailey, John Beal, Lloyd V. Berkner, Alvah S. Bull, Charles H. Burmeister, John E. Hoving, Carl F. Luethi, Russell L. Sorenson, Richard R. Trexler, George P. Vye, and Roger Wheeler.

A. S. C. E. Prizes

Prizes offered by the Northwestern Section, American Society of Civil Engineers, for the best papers written by members of the student chapter were given as follows: first, Frederick C. Teske, Jr., second (jointly), Hugh L. Turrittin and Joseph B. Paulson.

Colbert Ralph Bennett Prize

The prize offered by C. Ralph Bennett to the student in the College of Engineering and Architecture who produces the best piece of imaginative writing was awarded to Carter S. Johnson.

Architectural Awards

The Moorman prize in architecture was this year awarded to Lawrence B. Anderson.

The Magney and Tusler prizes were awarded as follows: first, Paul F. Eaton, second, Lawrence B. Anderson.

The American Institute of Architects' medal was given to Lawrence B. Anderson.

Prizes offered by the Minnesota chapter of the American Institute of Architects were awarded to Lawrence B. Anderson and Roy A. Nyquist.

The Scarab Medal in Architecture was given to Lester Cameron.

The School of Architecture Faculty prizes were awarded to Walter J. Huchthausen, first, and Nathan Juran, second.

The Alpha Alpha Gamma prize in architecture was awarded to Walter J. Huchthausen.

The William A. French prizes in Interior Decorating were awarded as follows: first, Grace Cameron, second, Dorothy Snyder.

Student Societies

New officers of the engineering student societies for the coming year are as follows: A. S. C. E., Frank Tebo, president, LeRoy Engstrom, vice-president, T. B. Jenson, secretary, and T. H. Thomas, treasurer; A. I. E. E., G. C. Brown, chairman, Clinton Hawkins, secretary, and Arthur Burris, secretary; A. S. M. E., Irvine Sinnott, president, Carl Barthelemy, vice-president, W. E. Petterson, secretary, and Herbert Hathaway, secretary.

All University Council

The technical colleges will be represented on the All University Council next year by Joseph L. Armstrong, College of Engineering and Architecture, George Swenson, School of Chemistry, and Wilmer Hedlund, School of Mines and Metallurgy.

Board of Publications

Sheldon F. Johnson will represent the College of Engineering and Architecture on the Board in Control of Student Publications next year. He has been elected treasurer of the Board for the coming year.

Bookstore Board

The Board of Directors of the Engineers' Bookstore for next year is composed of John Ramey, president, Arthur P. Burris, secretary, George Schroepfer, and Irvine Sinnott.

Technical Commission

The technical commission for the coming year will be composed of the following men: Irvine Sinnott, president, Glendon C. Brown, secretary-treasurer, Frank Tebo, and Homer Tatham. Joseph L. Armstrong will represent the All University Council on the Commission.

The
MINNESOTA TECHNO-LOG
University of Minnesota

THERE are a number of phenomena that occur upon this planet that appear to be in the nature of things no matter what the will of the man-made powers that be might dictate. One of the most outstanding is, of course, the force of gravity. Another one that is evident to all inmates of educational institutions such as the University of Minnesota is the assurance that sooner or later there will arise two warring factions to do bloody battle with each other over any one of a multitude of trivial reasons. They may be freshmen or sophomores; they may be lawyers and miners; or, as was recently demonstrated to the complete satisfaction of all, they may be engineers and foresters.

These scraps are welcome events to most of the participants and serve to break the monotony of college life, and the consensus of opinion among the warriors of the recent outbreak was that "a large time was had by all." Just as surely, these demonstrations are flies in the ointment of those who "view with alarm" the consequences which may result before the heat of the conflict dies down. The misgivings of the latter are justified, nevertheless, when one looks over the history of similar hostilities in other institutions.

Now and then, however, this pessimistic attitude is very effectually refuted, and it is to the greater glory of Minnesota that our campus is the scene of a most striking example of this. After the breaking up of the Engineers' Day parade by the foresters and the retaliation attack by the engineers on the following day, the two factions laid aside all difficulties in a get-together smoker and learned that they had many things in common.

It was decided that these followers of St. Patrick and Paul Bunyan, who were endowed with the finest college spirit on the campus, should join together to use their spirit in boosting Minnesota. And now, with plans well under way to form a forester-engineer rooter section at the football games in the fall, it is with great pleasure that we are able to cast a tolerant eye in the direction of the alarmists, and can look forward to a fine spirit of cooperation and constructiveness between the two schools in the future.

A STRANGE delusion has been prevalent on and about this campus to the effect that the final examinations in June mark the end of a school year. "Y'all through?" "It won't be long now!" "Look me over, boys, I'm done." These and similar expressions are standard greetings during that interval between the last assignment in math and the day the last grade is in.

To some, this period may truly be the last of the year. Many will go out for a short vacation, or will take some job to recuperate a sadly drained exchequer, and three months later will return to their books and slide rules. To others, it may be both an end and a beginning. Those immortal beings, the graduating seniors, certainly consider it the end of a long and, in most cases pleasurable grind. They also know that it is the beginning of a new era, for they are proudly stepping out after the first million—albeit in increments of $110 per month.

But to certain inhabitants of the engineering campus who are accustomed to park their hats in Room 37, Electrical Engineering Building, and who watch with interest the growth of the TECHNO-LOG, the end of the spring quarter is most certainly the beginning of a new year. Then it is that those selected to carry on the responsibilities of the publication start unfolding plans for the coming year. Contracts are signed, changes in makeup are outlined, staff appointments are made, subscription campaigns are planned—these and hundreds of other details incident to the production of a student magazine require much attention by the new managers.

This year, however, the spring quarter is not only the beginning of *a* year, but also has all the indications of being the beginning of *the* year. At the present time, the TECHNO-LOG is passing through a stage quite new in its seven years of life on the campus—that of beginning a year with a large staff of trained men at hand. Nearly every month has seen new men at work in some capacity on the magazine, and the introduction of a number of freshmen and sophomores on the staff is especially pleasing and promises great things for the future.

So ends the old regime and begins the new, and as we pass the keys over to the men who are beginning the new volume we wish to express the deepest appreciation to all who have made the present volume possible. The entire staff in all departments have worked together in the finest spirit of cooperation. The faculty of the technical colleges have done nobly in boosting the TECHNO-LOG, and they certainly deserve much thanks for their splendid efforts. To the personnel of The Lund Press and the Bureau of Engraving as well, go our sincerest good wishes for the fine cooperation given throughout the year.

And thus begins Volume VIII, and may each volume in the years to come be better and more representative of the ever increasing group of people that it aims to serve than any of its predecessors.

THE 1927 ALUMNI DIRECTORY

of the

Technical Colleges *of the* University of Minnesota

ABBREVIATIONS

Courses

A, Architecture; AE, Architectural Engineering; I, Interior Decoration; C, Civil Engineering; E, Electrical Engineering; M, Mechanical Engineering; G, General Engineering; Ch, Chemistry; Ch. E., Chemical Engineering; E. M., Engineer of Mines; E. M. (Geol.), Engineer of Mines in Geology; Met. E., Metallurgical Engineer.

Advanced Degrees

CE, Civil Engineer; EE, Electrical Engineer; ME, Mechanical Engineer; MS, Master of Science; MS (Arch), Master of Science in Architecture; MS(CE), Master of Science in Civil Engineering; MS(EE), Master of Science in Electrical Engineering; MS(ME), Master of Science in Mechanical Engineering; Ch.E., Chemical Engineer.

*Deceased

CHRONOLOGICAL DIRECTORY

College of Engineering and Architecture

FROM 1875 to 1896 inclusive, the first degrees awarded for the regular four-year courses were Bachelor of Civil Engineering (1875), Bachelor of Architecture (1877), Bachelor of Mechanical Engineering (1878), and Bachelor of Electrical Engineering (1891). In this period, also, a few professional advanced degrees were given, as Civil Engineer in 1888, Mechanical Engineer in 1894, and Electrical Engineer in 1896.

From 1897 to 1911 inclusive, the degrees of Civil Engineer, Electrical Engineer, and Mechanical Engineer were regularly awarded at the close of the four-year courses, and a few were given in 1912 and 1913. In 1908, however, five-year courses were established and at the end of the first four years, the degree of Bachelor of Science in Engineering was awarded for each of the three courses, civil, electrical, and mechanical, and also for a general course in engineering, which last had begun in 1900. Upon completion of the fifth year's work the professional degrees, Civil Engineer, Electrical Engineer, and Mechanical Engineer were given, the first being awarded in 1913.

In 1921, the first degree became Bachelor of Science in Civil Engineering, Electrical Engineering, or Mechanical Engineering. The degree of Bachelor of Science in Architecture was established in 1916. The general engineering course was discontinued in 1923. The new requirements for the professional degrees of Civil Engineer, Mechanical Engineer, and Electrical Engineer were adopted in 1921 and these degrees were placed in the Graduate School.

1875

Bachelor of Civil Engineering

*Leonard, Henry C. (B. S. 1873)
Rank, Samuel A. (B. S. 1875)
*Stewart, Clark

1876

Bachelor of Civil Engineering

*Gillette, Lewis S. (B. S. 1877, C. E. 1898)
*Hendrickson, Eugene A.
Thayer, Charles E.

1877

Bachelor of Architecture

*Pardee, Walter S.

1878

Bachelor of Mechanical Engineering

Bushnell, Charles S.

1879

Bachelor of Civil Engineering

*Dawley, William S. *Furber, Pierce P., Sr.

1883

Bachelor of Civil Engineering

Peters, William G. *Smith, Louis O.

Certificate in Civil Engineering

Holcomb, Alexander M.

Bachelor of Mechanical Engineering

Barr, John H. (M. S. 1888)

1884

Bachelor of Civil Engineering

Hoag, William R. (C. E. 1888)
*Loy, George J.
*Matthews, Irving W.

1885

Bachelor of Civil Engineering

*Fitzgerald, Patrick T. Reed, Albert I.

Bachelor of Mechanical Engineering

Bushnell, Elbert E.

1886

Bachelor of Architecture

*Woodmansee, Charles C.

1887

Bachelor of Mechanical Engineering

Crane, Fremont (B. S. 1886, C. E. 1898)

Bachelor of Mechanical Engineering

Andrews, George C.

1888

Bachelor of Civil Engineering

Andersen, Christian

Bachelor of Mechanical Engineering

Loe, Eric H.
Morris, John O. (M. E. 1903)

ADVANCED DEGREES

Civil Engineer

Hoag, William R. (B. C. E. 1884)

Master of Science

Barr, John H. (B. M. E. 1883)

1889

Bachelor of Civil Engineering

Coe, Clarence S.

1890

Bachelor of Civil Engineering

Burt, John L.
Dann, Wilbur W.
*Gilman, Fred H.
Greenwood, Williston
Hayden, John F.
Higgins, John T. (M. D. 1894)
Hoyt, William H. (C. E. 1898)
*Smith, William C.
Trask, Birney E. (C. E. 1894)

Bachelor of Mechanical Engineering

Gerry, Martin H., Jr. (B. E. E. 1891)
Nelson, Thorwald E.
Woodward, Herbert M.

1891

Bachelor of Civil Engineering

Chowen, Walter A. Douglass, Fred L. (C. E. 1899)

Bachelor of Electrical Engineering

Gerry, Martin H., Jr. (B. M. E. 1890)
Huhn, George P.

Bachelor of Mechanical Engineering

Aslakson, Baxter M.

1892

Bachelor of Architecture

Goodkind, Leo Plowman, George T.

Bachelor of Civil Engineering

Hankenson, John J. Higgins, Elvin L.

Bachelor of Electrical Engineering

Burch, Edward P. (E. E. 1898)
Burtis, William H.
Gray, William I. (E. E. 1898)
Howard, Monroe S.

Bachelor of Mechanical Engineering

Felton, Ralph P.
Gill, James H. (M. E. 1894)

1893

Bachelor of Architecture

Morse, George Washburn, Delos C.

Bachelor of Civil Engineering

*Anderson, Ole J.
*Batchelder, Frank L.
*Erf, John W.
Hoyt, Hiram P.
Mann, Fred M. (C. E. 1898)

Bachelor of Electrical Engineering

Chase, Arthur W.
Dewey, William H.
Guthrie, John D. (M. D. 1897)
Morse, George H. (E. E. 1911)
Reidhead, Frank E. (E. E. 1898)
Springer, Franklin W. (E. E. 1898)

Bachelor of Mechanical Engineering

Anderson, Ole A. (M. E. 1908)
Avery, Henry B. (M. E. 1898)
Couper, George R. (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. Rounds, Fred M.
(E. E. 1896) *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 B.
Lee, Engbret A. Woodman, Howard H.

Electrical Engineer

Abbott, Arthur L.
Chestnut, George L.
Hibbard, Truman
Lang, James S. (B. M. E. 1896, M. E. 1899)
Markhus, Olaf G. F.
Miller, William L.
Myers, Mortimer

Mechanical Engineer

Blake, Robert P. Lonie, James H.
Craig, Robert E. Savage, Edward S.
Cross, Charles H. Silliman, Henry D.

ADVANCED DEGREE

Master of Science

Magnuson, C. E. (B. E. E. 1896, E. E. 1905)

1898

Civil Engineer

Glass, Clifton A. Taylor, Edward W. D.

Electrical Engineer

*Dahl, Hans F. M. McKellip, Frank W.
Gilchrist, Charles C. Wagner, Adolph W.

Mechanical Engineer

O'Brien, John E. Wright, Roydon V.
Willson, Manton F. Zeleny, Frank

ADVANCED DEGREES

Civil Engineer

Crane, Fremont (B. S. 1886, B. C. E. 1887)
*Gillette, Lewis S. (B. C. E. 1876, B. S. 1877)
Hoyt, William H. (B. C. E. 1890)
Long, Fred W. (B. C. E. 1896)
Mann, Fred M. (B. C. E. 1893)

Electrical Engineer

Burch, Edward P. (B. E. E. 1892)
Gray, William I. (B. E. E. 1892)
Reidhead, Frank E. (B. E. E. 1893)
Springer, Franklin W. (B. E. E. 1893)

Mechanical Engineer

Avery, Henry B. (B. M. E. 1893)

1899

Civil Engineer

Anderson, John G.

Electrical Engineer

Artz, Emmanuel A. Huntoon, Milton B.
(B. S. 1897) MacKusick, 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. *Higgins, Charles C.
(C. E. 1907) Johnston, William W.
Daniel, T. Lester Newhall, William B.

ADVANCED DEGREE

Civil Engineer

Shenehon, Francis C. (B. C. 1895)

1901

Civil Engineer

Everington, James W. Quense, John H.
Gunstad, Paul I. (M. E. 1902)
Klemer, Frank H. Strate, Thomas H.
McKittrick, James

Electrical Engineer

Anderson, Martin E. Houts, Guy J.
Blake, Henry B. Roque, 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.
Bean, William L. (E. E. 1901)
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.
Crow, Harry A. (B. S. 1901)
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. Schumacher, John H.
(B. S. 1901) 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 B.
Fernald, Frank O. Rothi, Paul

Electrical Engineer

Bouman, Bernhard M. Morton, Harry G.
Cheney, Edward J. Otto, Frederick A.
Crabbe, George *Rosok, Peter A. M.
Goodwin, Victor E. Taplin, Robert B.
*Helms, Frank C. Tomlinson, L. C.
Howatt, John Wicks, John

Mechanical Engineer

Fager, Simon R. Stanton, Raymond E.
Otto, Robert W. Davis, Gilbert N.

Bachelor of Science (in Engineering)

Collins, Stewart G.

ADVANCED DEGREES

Mechanical Engineer

*Bray, George E. (B. M. E. 1894

Master of Science

Hickok, Jessie E. S. (B. S. 1896

1905

Civil Engineer

Bisbee, Elmer Jensen, John A.
Brockway, Royden R. Johnson, Nels
Burke, Roy L. King, Wesley E.
Cutler, Alvin S. McMillan, Franklin R
Feyder, William H. Mattison, Oliver
Finley, Joseph E. *Mueller, Henry J.
Gillette, George L. Nelson, Oscar E.
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 F
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 R.
Clipfell, Carroll D. *Pancratz, Alexander
Cutter, Francis C. Rydeen, Francis G. A.
Gerrish, Harry E. Sperry, Leonard B.
Harris, Sigmund (E. E. 1908)
Johnson, Austin G. Tuck, George A.

Bachelor of Science (in Engineering)

Gregg, Treshame D. (C. E. 190

ADVANCED DEGREE

Electrical Engineer

Magnuson, C. E. (B. E. E. 1896, M. S. 1897)

1906

Civil Engineer

Adams, Elmer E.
Alrick, Bannona G.
Alsop, Ernest B.
Bowen, Fred P.
Childs, Hervey B.
Childs, John C.
Hanauer, Monroe H.
Hayward, George L.
Malloy, Charles J.
*Murphy, John G.
Norelius, Lewis M.
Reed, Arthur L.
Wiesner, Frederick E.

Electrical Engineer

Albrecht, George M.
Bence, Paul F.
Calmeyer, John P.
Cohen, Nathan
Cooper, Leo H.
Cornelius, Martin
Dunn, Andrew P.
Englin, Charles F.
Fischy, Jacob O.
Glascock, Henry H.
*Gunther, Albert N.
Haeberle, Elmer H.
Hoff, Christopher
Hokanson, Clarence E.
Hubbard, Robert T.
Lang, Charles A.
Mowry, Harry W.
Payne, Harold G.
Roepke, Otto B.
*Schow, Harry A.
Schwedes, Walter F.
Shuck, Gordon B.
Stenger, Laurence A. (M. S. 1918)
Stone, Harris G.
Ungerman, Carl M.
Weber, Erwin L. F. (M. E. 1908)
Wiggins, Gerald G.
Zimmer, William A.

Mechanical Engineer

Armstrong, Thomas S.
Crawford, Wallace T.
Garber, Gabriel E.
Loye, Benjamin W.
*Matteson, Frank E.
Ringsred, Arthur C.
Rose, Norman W.

Bachelor of Science (in Engineering)

Swensen, Karl P. (M. S. 1907)

ADVANCED DEGREE

Civil Engineer

Gregg, Tresham D. (B. S. Eng. 1905)

1907

Civil Engineer

Batson, Charles D.
Blomquist, Hialmer F.
Cram, Clyde M.
*Dougherty, Joe
Dunham, John A.
Grant, James A.
Green, Fred H.
Haverson, Henry D.
Hawley, Harry G.
Hobart, Walter B.
Huston, David B.
Jones, Lewis A.
Kelly, Earl W.
Swenson, Charles A. (L. L. B. 1910)
Tondell, Mandel G.
VanCleve, Horatio P.
Yager, Louis

Electrical Engineer

Alton, Herbert D.
Andrus, Raymond J.
Baer, Louis E.
Countryman, Peter F.
Eddy, Lynne W.
Fairchild, Albert R.
Kerns, Ralph W.
Norcross, Arthur F.
Pearce, John H.
Rezab, John J.
Schow, William P.
Smith, Byron E.
Smithson, John E.
Sternberg, Carl
Uzzell, George W.
Woehler, William L.

Mechanical Engineer

Bell, Maurice D.
Bjorge, Oscar B.
*Brown, Oliver L.
Buhl, Paul S.
Burwell, Loring D.
Fee, E. Franklin
Gessert, George R.
Gilman, Nicholas A.
Krag, Walter C.
Meany, James M.
Nekola, John W.
Rawson, Ralph H.
Spring, Willis W.
*Stacy, Elmer N.
Stephenson, Oliver H.
Tubby, Oliver G.
Wagner, Otto H.

ADVANCED DEGREES

Civil Engineer

Ashbaugh, Lewis E. (B. S. in Eng. 1906)

Master of Science

Swensen, Karl P. (B. S. in Eng. 1906)

1908

Civil Engineer

Ash, James W.
Bergquist, Oscar J.
Borrowman, LeRoy F.
Brenchley, Harry E.
Comstock, John W.
Dallimore, Arthur N.
Doeltz, William F., Jr.
Dougan, Henry K.
Fleming, Douglas R.
Futher, Pierce P., Jr.
Gage, Hugh N.
Knowlton, Herbert H.
Kranch, William L.
Lang, Fred C.
Longfellow, Dwight W.
McCall, Harry J.
McCree, Andrew A.
Mowery, Clarence W.
Norelius, Lewis M.
Okes, Day I.
Olson, Melvin S.
Quinn, John J.
Robertson, Charles N.
Schlattman, Edward C.
Walker, George W.
Widell, Gustaf F.
Willis, Roy
Woodrich, Oscar F.

Electrical Engineer

Anderson, Frank A.
Bachrach, Alfred
Brown, George J.
Carter, Robert J. S.
Cosberg, James W.
Currie, Neill, Jr.
Frahm, Alfred R.
Hoppin, Glenn H.
*Hovelson, Henry
Kauffman, Roy
King, Alfred B.
McAfee, Allan L.
Pancratz, Frank J.
Peterson, Clarence A.
Prentice, Robert S.
Schildt, William F. H.
Schoepf, Alfred W.
Scobie, Francis G.
Sperry, Leonard B. (M. E. 1903)
Sturtevant, Percy G.
Svendsen, George P.
Swanstrom, Frank N.
Sweningsen, Oliver
Weibeler, William M.
Zimmerman, Louis P.

Mechanical Engineer

Anderson, Ole A.
Bingham, Stanley E.
Councilman, Halstad P. (B. S. Eng. 1909)
Cox, Richard F.
Estep, Harvey C.
Fleming, Frank R. (E. E. 1909)
*Frary, Hobart D. (M. S. 1909)
Harwood, Stanley G.
Hetherton, Percival
Morris, Thomas C.
Norelius, Emil F.
Norton, Clyde W. (M. E. 1909)
Peterson, George T.
Priedeman, George W.
Walsh, James (E. E. 1909)
Weber, Erwin L. F. (E. E. 1906)

Bachelor of Science (in Engineering)

Clarke, Charles P. (C. E. 1909)
Fruen, Arthur B. (C. E. 1909)
King, Robert N.
McKeehan, Louis W. (M. S. '09, Ph. D. '11)
Rowe, Harry B.
Schmid, Robert J.

1909

Civil Engineer

Childs, James A.
Ellison, Jay T.
Ellsberg, N. W.
Esser, Frank F.
Fiske, F. William, Jr.
Houston, Cecil C.
Hubbard, Fred A.
Hubbard, Henry A.
Hustad, Andrew P.
Ingberg, Simon
Jaques, Robert
King, Lawrence W.
Mitchell, John B.
Nelson, Edward S.
Okes, Sidney R.
Paul, Frederick T.
Sheffield, Fred W.
Shepard, George M.
Siverts, Samuel A., Jr.
Torrance, Eli

Electrical Engineer

Becklund, Walter C.
Brockway, Alvah E.
Cobban, Rollo J.
Converse, Clovis M.
Davies, Ralph M.
Fitts, Joel A.
Fleming, Frank R. (M. E. 1908)
Gadsby, Lester H.
Grant, Fred R.
Harris, Clayton
*Hitzker, Albert J.
Hopkins, Mark L.
Hornibrook, James W.
Japs, Bernard G.
Johnson, Herman R.
Kristy, George A.
Lindelef, Charles G.
McKenzie, Lauren F.
Murrish, Frederic E.
Poore, Orson B.
Robison, Archer R.
Stillman, Marcus H.
Todd, Milo E.
Turner, Leslie E.
Vita, Theodore
Walling, Benjamin B.
Walsh, James (M. E. 1908)
Williams, Fred M. (B. A. 1905)

Mechanical Engineer

Beery, Charles B.
*Bieri, John B.
Birnberg, Zingel C. J.
Buck, Frederick W.
Buhl, John E.
Forfar, Donald M.
Holmgren, Charles E.
Kircher, Frank J.
Kircher, George A.
Knopp, William R.
Lambert, Edwin M.
Mark, Walter J.
Morris, John E.
Moyer, Malcolm B.
Nemec, Frank L.
Shippam, Willis
Souba, William H.
Starrett, Howard M.
Udell, Carl D.
Williams, Wilbur S.
Wright, Harris H.

Bachelor of Science (in Engineering)

Curtiss, Lindsley B.
Councilman, Halstad P. (M. E. 1908)
Norton, Clyde W. (M. E. 1908)

ADVANCED DEGREES

Civil Engineer

Anderson, Ole A. (B. S. M. E. 1893)
Clarke, Chas. P. (B. S. Eng. 1908)
Fruen, Arthur B. (B. S. Eng. 1908)

Master of Science

*Frary, Hobart D. (M. E. 1908)
McKeehan, L. W. (B. S. Eng. '08, Ph. D. '11)

1910

Civil Engineer

Adams, Benjamin W.
Asleson, Hans
Bolme, Ole M.
Boyum, Benjamin C.
Brownell, Otto E.
Chapman, Burton L.
Dahlquist, Philip L.
Ekman, Claes T.
Gazen, George M.
Godward, Alfred C.
Jevne, George W.
Leach, Edward W.
Meyer, Carl F.
Motl, Charles L.
Nason, George L.
Olson, Arthur O.
Overholt, Harley G.
Sawyer, Emerson D.
Sommerfeld, Adolph A.
Timperley, William D.

Electrical Engineer

Anderson, Oscar P.
Anderson, Oscar V.
Beck, Vernon S.
Conley, Wilfred E.
Dahlstrom, Raymond E.
Finke, Walter J.
*Hagstrom, Herbert E.
Hansen, Christian
Hustad, Byron P.
Jesperson, Clarence M.
Johnson, Leonard T.
Josephson, Eliot B.
Landeen, Arvid G.
Nelson, Carl H.
Phelps, Ray R.
Powles, James W.
Reid, Harry A.
Skytte, Ernest E.

Mechanical Engineer

*Atkinson, William B.
Comb, Fred R.
Cook, Harry C.
DuToit, George A., Jr.
Fleming, Laurence T.
Frear, Jenness B.
Kaplan, Eugene V.
Martin, Wallace H.
Meixner, Bernard A.
Mover, Amos F.
Nichols, Browning, Jr.
Pease, Maynard W.
Wesbrook, Donald M.

Bachelor of Science (in Engineering)

Salisbury, Willis R.

1911

Civil Engineer

Ainslie, Arthur F.
Arnesen, Herbert P.
Boerner, Francis C.
Cottingham, William P.
Croft, Ernest B.
Elfstrum, Axel E.
Enger, Edward H.
Fieldman, David P.
Hodnett, Ralph M.
Hoffman, Michael J.
Johnson, Carl A.
Kvitrud, Ingvald
Maney, George A.
Mark, Reuben A.
Mattison, George C.
Methven, Clyde L.
Miller, Erwin J.
Orbeck, Martin J.
Roth, Lewis M.
Siverson, Sigvel J.
Smith, Sydney H.
Swedberg, M. Roy
Walby, Arthur C.

Electrical Engineer

Ashworth, Roy H.
Blossom, George W.
Burrows, Robert P.
Butterworth, Allan C.
Chapman, Arthur G.
Demarest, Charles S.
Drinkall, Leon R.
Emerson, Lynn A.
Forsberg, William P.
Fredrickson, Harry B.
Hansen, Maurice J.
James, Henry C., Jr.
Johnson, Edward J.
Jones, Watkin W.
Lyford, Dartt H.
McCoy, Ira C.
McQuillin, Raymond E.
Markuson, Oscar S.
Mittag, Albert H.
Nebel, Walter H.
O'Brien, Raymond J.
Pengilly, Joseph H.
Riegel, Louis F.
Shepard, Donald D.
Soulek, Joseph H.
*Stinson, Will V.
Walker, William A.
Wilson, Glenn W.

Mechanical Engineer

Barnum, Marvin C.
Bishop, Ira L.
Farnam, Julian P.
Kasper, Walter F.
Larson, Martin S.
Olstad, Oscar A.
Oram, Robert C.
Owens, Leo E.
Sneve, Jack S.
Woodman, Joseph C.

Bachelor of Science in Science and Technology

Hoffman, Ralph M.
Klopsteg, Paul E. (M. A. 1913, Ph. D. 1916)

ADVANCED DEGREE

Electrical Engineer

Morse, George H. (B. E. E. 1893)

1912

Civil Engineer

Adams, John W., Jr.
Curtis, Thomas H.
Flygare, August L.
Hatfield, Raleigh W.
West, Robert W.

Bachelor of Science in Engineering (Civil)

Anderson, Harvey B. (C. E. 1913)
*Bailey, William H. (C. E. 1913)
Bingen, William J. (C. E. 1913)
Cummings, Elmer F. (C. E. 1913)
Diamond, Grover W.
Giertsen, Marcus O. (C. E. 1913)
Haberle, Edward L. (C. E. 1913)
Jorgens, Charles R. Danevia (C. E. 1913)
Kapphahn, Raymond J. (C. E. 1913)

Bachelor of Science in Engineering (Civil)

King, Forest V. (C. E. 1913)
Kriz, Joseph J. (C. E. 1913)
Pagenhart, Clarence C.
Pease, Raymond A. (C. E. 1913)
Peterson, Barney J. (C. E. 1913)
Ryan, Loiel S. (C. E. 1913)
South, Willard A. (C. E. 1913)
Souther, Morton E. (C. E. 1913)
Swenson, Hjalmer S. (C. E. 1913)
Torgerson, Irving E. (C. E. 1913)
Wangaard, Oscar H. (C. E. 1913)
Welin, Arthur G. (C. E. 1913)
Wolff, Henry E. (C. E. 1913)

Electrical Engineer

Anderson, Arthur R.
Bill, Earl McM.
Dorrance, Albert P.
*Purves, Leland E.
Streich, Harry C.
Young, Charles N.

Bachelor of Science in Engineering (Electrical)

*Avis, Samuel L. (E. E. 1913)
Benham, Claude F. (E. E. 1913)
Brewster, William E. (E. E. 1913)
Daum, H. Arno
Holenstrom, 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)
Kingstrom, 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.
Sansen, Bert R.

ADVANCED DEGREES

Civil Engineer

Anderson, Harvey B. (B. S. Eng. 1912)
*Bailey, William H. (B. S. Eng. 1912)
Bingen, Wm. J. (B. S. Eng. 1912)
Cummings, Elmer F. (B. S. Eng. 1912)
Giertsen, Marcus O. (B. S. Eng. 1912)
Haberle, Edward L. (B. S. Eng. 1912)
Jorgens, Charles R. D. (B. S. Eng. 1912)
Kapphahn, Raymond J. (B. S. Eng. 1912)
King, Forest V. (B. S. Eng. 1912)
Kriz, Joseph J. (B. S. Eng. 1912)
Pease, Raymond A. (B. S. Eng. 1912)
Peterson, Barney J. (B. S. Eng. 1912)
Ryan, Loiel S. (B. S. Eng. 1912)
South, Willard A. (B. S. Eng. 1912)
Souther, Morton E. (B. S. Eng. 1912)
Swenson, H. Seymour (B. S. Eng. 1912)
Torgerson, Irving E. (B. S. Eng. 1912)
Wangaard, Oscar H. (B. S. Eng. 1912)
Welin, Arthur G. (B. S. Eng. 1912)
Wolff, Henry E. (B. S. Eng. 1912)

Electrical Engineer

*Avis, Samuel L. (B. S. Eng. 1912)
Benham, Claude F. (B. S. Eng. 1912)
Brewster, Wm. E. (B. S. Eng. 1912)
Herrmann, Raymond R. (B. S. Eng. 1912)
Hovden, Conrad D. (B. S. Eng. 1912)
Mathes, Robert C. (B. S. Eng. 1912)
Merriell, Elmer W. (B. S. Eng. 1912)
*Nelson, George A. (B. S. Eng. 1912)
Pardee, Charles A. (B. S. Eng. 1912)
Ringstrom, Ivan G. (B. S. Eng. 1912)
Thuras, Albert L. (B. S. Eng. 1912)
Towle, Neal C. (B. S. Eng. 1912)

Mechanical Engineer

Chapin, Harold S. (B. S. Eng. 1912)
Clark, Wm. G. (B. S. Eng. 1912)
Crane, Eugene C. (B. S. Eng. 1912)
Dinsmore, Arthur T. (B. S. Eng. 1912)
Hirleman, Clark W. (B. S. Eng. 1912)
Mikesh, Martin A. (B. S. Eng. 1912)
Morton, Harold S. (B. S. Eng. 1912)
Rand, Lars (B. S. Eng. 1912)
Ruemmele, Albert E. (B. S. Eng. 1912)

1914

Civil Engineer

Larson, Albin

Bachelor of Science in Engineering (Civil)

Brenchley, Walter C. (C. E. 1915)
Burnett, Harold V.
Dimond, Harvey G.
Doolittle, William Y.
Ekberg, Carl E. (C. E. 1915)
Hustad, John C. (C. E. 1915)
Johnson, Edgar W. (C. E. 1915)
Lagaard, Maurice B. (C. E. 1915)
Larson, Louis (C. E. 1915)
Mitchell, Lester M. (C. E. 1915)
Nordstrom, Carl T.
Ott, Leonard E. (C. E. 1915)
Price, John R.
Rankin, Renville S.
Rockwell, Harvard S.
Sears, Dow I.
Weatherill, Cedric S. (C. E. 1915)
Weigel, Howard N. (C. E. 1915)

Bachelor of Science in Engineering (Electrical)

Adler, Eugene H. (E. E. 1915)
Bizek, Peter P.
Chapman, Wendell P.
Dunham, Roy O. (E. E. 1915)
Elliott, A. Douglass (E. E. 1915)
Fallon, Eugene L. (E. E. 1915)
*Garvey, 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)
Skordalsvold, 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

Brenckley, Walter C. (B. S. Eng. 1914)
Ekberg, Carl E. (B. S. Eng. 1914)
Hustad, John C. (B. S. Eng. 1914)
Johnson, Edgar W. (B. S. Eng. 1914)
Lagaard, Maurice B. (B. S. Eng. 1914)
Larson, Louis J. (B. S. Eng. 1914)
Mitchell, Lester M. (B. S. Eng. 1914)
Ott, Leonard E. (B. S. Eng. 1914)
Weatherill, Cedric S. (B. S. Eng. 1914)
Weigel, Howard N. (B. S. Eng. 1914)

Electrical Engineer

Adler, Eugene H. (B. S. Eng. 1914)
Dunham, Roy O. (B. S. Eng. 1914)
Elliott, A. Douglass (B. S. Eng. 1914)
Everett, William R. (B. S. Eng. 1913)
Fallon, Eugene L. (B. S. Eng. 1914)
Harris, Harold R. (B. S. Eng. 1914)
Jackson, Otto E. (B. S. Eng. 1914)
Johnson, Carl J. (B. S. Eng. 1914)
Johnson, Elmer W. (B. S. Eng. 1914)
Jones, George R. (B. S. Eng. 1914)
Loeffler, Henry S. (B. S. Eng. 1914)
Putz, John H. (B. S. Eng. 1914)
Robertson, Burton J. (B. S. Eng. 1914)
Schroeder, Carl W. (B. S. Eng. 1914)
Tallmadge, Everett S. (B. S. Eng. 1914)
*Wuest, Karl F. (B. S. Eng. 1914)

Mechanical Engineer

Colvin, James A. (B. S. Eng. 1914)
Gemmell, John H. (B. S. Eng. 1914, B. S. 1918, M. B. 1919, M. D. 1920)
Hammond, Laurence D. (B. S. Eng. 1914, B. S. 1918, M. B. 1919, M. D. 1920)
Hartnes, James L. (B. S. Eng. 1914)
Hubbell, Arthur C. (B. S. Eng. 1914)
Mayer, Harris J. (B. S. Eng. 1914)
Peterson, Albert L. (B. S. Eng. 1914)
Rockwood, Fletcher (B. S. Eng. 1914)
Snow, Clarence J. (B. S. Eng. 1914)
Thayer, Paul Wm. (B. S. Eng. 1914)

1916

Bachelor of Science in Architecture

*Albee, Pierce
Heath, Donald C.
Liebenberg, Jacob J.
Tannehill, Louis Wm.

Bachelor of Science in Engineering (Civil)

Askew, Thomas A., Jr.
Biskup, William F.
Bruce, Hjalmar N. (C. E. 1917)
Carlson, Anders J. (C. E. 1917)
Doell, Chas. E. (C. E. 1917)
Ellingson, Elmer
Grow, Robert W.
Hendrickson, Norman E.
*Johnston, Ralph E. (C. E. 1917)
Kivley, Warren O.
Knauss, Archibald C. (C. E. 1917)
Larson, Carl
Lux, Arthur E.
McCullough, Bruce M.
Nortner, Sylvester E.
Pan, Wen P.
Peterson, Harold L. (C. E. 1917)
Peterson, William W.
Watson, Fred O.
Weinke, Ernest H. (C. E. 1917)
Williams, Charles A.

Bachelor of Science in Engineering (Electrical)

Abbott, Amos H. (E. E. 1917)
Anderson, Frank L.
Arenson, Timothy G.
Bleecher, George W.
Blomberg, Evar H. (E. E. 1917)
Brown, Louis M.
Burt, Fred R.
Butterworth, Russell I. (E. E. 1917)
Covell, Russell O.
Croswell, Daniel R.
Dow, William G. (E. E. 1917)
Edelman, Philip (E. E. 1917)
Ellefson, Selmer
Fasteman, 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 F.
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)
Olsison, 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

Steuger, Lawrence A. (E. E. 1906)
Wilcox, Hugh B. (E. E. 1914)

1917

Bachelor of Science in Architecture

Brown, Floyd W.
Buckhout, Donald H.
Gilman, Howard B.
Kreinkamp, Linton H.
Mixer, Walter R.
Paulsen, George F.
Prudden, George H., Jr.
Riedesel, George M.

Bachelor of Science in Engineering (Civil)

Boyce, Ellsworth R.
Brataas, Mark G.
Douglass, Addison H. (C. E. 1920)
Fossen, George
Linden, Henning
Luplow, Walter D.
Luxford, Ronald F.
Rader, Clarence McK. (C. E. 1917)
Riekman, Herman W.
Tryon, Philip D.
Wolfangle, Raymond J.

Bachelor of Science in Engineering (Electrical)

Becker, Ward E.
Boyum, Irvin L.
Carlson, Chauncy M.
Dunlap, Lemuel J.
*Ebert, Solomon B.
Eckenbeck, Evertt E.
Jacobs, Arthur R.
Juvrud, Edwin C.
Lilly, Clarence W.
Malmstrom, Axel L.
*McKibbin, Ray (E. E. 1918)
*Melby, Einar C.
Scott, Willard W.
Swenson, George W. (E. E. 1921)
Thomas, William A.
Wheeler, Herbert H.
Williams, Frederick J.
Willis, Benjamin S.

Bachelor of Science in Engineering (Mechanical)

Andersen, Edward I. (M. E. 1919)
Boehnlein, Charles (M. E. 1919)
Bros, Ernest T.
Brown, Homer L.
Carlson, Arvid F.
Ek, Gustav A.
Eustis, Irving N. (M. E. 1918)
Gerlach, Arthur C.
Guggisberg, Charles F.
Hektner, Joel
Holmstine, Arthur G.
Hvoslef, Frederik W. (M. S. 1919)
Jones, Edwin F.
Knutson, Harry
Larson, Victor F.
Murray, John H.
Nelson, Otis S.
Romero, Cirilo L. P. Y. (M. E. 1918)
Rosenbloom, Abraham E.
Swenson, Clarence O. (M. E. 1920)
Taylor, Duane L.

ADVANCED DEGREES

Civil Engineer

Bruce, Hjalmar N. (B. S. Eng. 1916)
Carlson, Anders J. (B. S. Eng. 1916)
Doell, Charles E. (B. S. Eng. 1916)
*Johnston, Ralph E. (B. S. Eng. 1916)
Knauss, Archibald C. (B. S. Eng. 1916)
Peterson, Harold L. (B. S. Eng. 1916)
Rader, Clarence McK. (B. S. Eng. 1917)
Weinke, Ernest (B. S. Eng. 1916)

Electrical Engineer

Abbott, Amos H. (B. S. Eng. 1916)
Blomberg, Evar H. (B. S. Eng. 1916)
Butterworth, Russell I. (B. S. Eng. 1916)
Dow, William G. (B. S. Eng. 1916)
Edelman, Philip (B. S. Eng. 1916)
Gannett, Danforth K. (B. S. Eng. 1916)
Irwin, Frank H. (B. S. Eng. 1916)
Loye, Donald P. (B. S. Eng. 1916)
Mori, Nathaniel 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)
Turnquiest, Axel A. (B. S. Eng. 1916)

Mechanical Engineer

Johnson, Ira L. (B. S. Eng. 1916)
Moody, Chester S. (B. S. Eng. 1916)
Ritchie, John R. (B. S. Eng. 1916)
Stone, Charles W. (B. S. Eng. 1916, M. S. 1919)

1918

Bachelor of Science in Architecture

Forsberg, Enock E.
Kaplan, Seeman
King, Harvey M.
Moorman, Albert J.

Bachelor of Science in Engineering (Civil)

Battles, Leon E.
*Chamberlain, Herbert D.
Deutsch, Richard E.
Eliassen, Sigurd
*Gould, Reed D.
Konstantinopoulos, Nicholas (Konstants)
Nickerson, Neal C.
Smith, Cedric B. (B. A. 1914)
Smolensky, Martinian G.

Bachelor of Science in Engineering (Electrical)

Brooks, Harold L.
Gibbs, Clayton T.
Hartig, Henry E.
Hotchkiss, Fred W.
Levin, Jake M.
Ross, Russell H.
Schlenk, Hugo, Jr.
Smith, Donald C.
Smith, Hugh A.
Talbot, Thomas F.

Bachelor of Science in Engineering (Mechanical)

Abrahamson, Howard B.
Anderson, Hilder A.
Bierman, George H. (M. E. 1919)
Francis, Paul E.
Greenberg, Morris
Hagerman, Oliver S.
Kivley, Ray C.
Muller, Carl C.

Bachelor of Science in Engineering

Peterson, Harold R.
Putman, George W.

ADVANCED DEGREES

Electrical Engineer

*McKibben, Ray (B. S. Eng. 1917)

Mechanical Engineer

Eustis, Irving N. (B. S. Eng. 1917)
Romero, Cirilo L. P. Y. (B. S. Eng. 1917)

1919

Bachelor of Science in Architecture

Buenger, Edgar
Deane, George B.
Deneen, David J.
Emery, George C.
Fraser, George
Hamilton, Jefferson M.
Hammett, Ralph W.
Schwartz, John S.
Wright, Stewart V.

Bachelor of Science in Engineering (Civil)

Coe, Edward H.
Elstad, Rudolph T.
Hawlick, Henry I.
Rosenthal, Oscar L.
Sushan, Harry M.

Bachelor of Science in Engineering (Electrical)

Christensen, Edgar W.	Marshall, Donald E.
Cotton, Ernest H.	Nelson, Gustav A.
Drinkall, John F.	Olson, Richard H.
Duncan, George B.	Peterson, Albert E.
Grimes, David	Peterson, Arthur P.
Hartman, Walter K.	Petrich, Alfred C.
Heinemann, John R.	Pierson, Joe W.
Jordan, Frank W.	Reeve, Charles H.
Klass, Frederick	Sander, Theodore, Jr.
Langland, Harald S.	Swanson, Edwin W.
Lee, Oscar C.	

Bachelor of Science in Engineering (Mechanical)

Baker, Arthur W.	Moffat, George N.
Bros, Raymond J.	(M. E. 1920)
(M. E. 1920)	Pavek, William J.
Cosh, Richard A.	(M. E. 1920)
Dowd, Archie J.	Williams, Arthur H.
Elliot, Harry C.	Wunderlich, Milton S.
Foltz, Ross M.	(M. E. 1920)
Hartzberg, Edward M.	

Bachelor of Science in Engineering

Briggs, Hiram K.	Kroeze, Herbert A.
Gee, Harry J.	Lewis, Carroll E.
Kapphahn, Ernest H.	Lilly, Eugene

ADVANCED DEGREES

Mechanical Engineer

Andersen, Edward I. (B. S. Eng. 1917)
Bierman, George H. (B. S. Eng. 1918)
Boehnlein, Charles (B. S. Eng. 1917)
Hvoslef, Fredrik W. (B. S. M. E. 1917)

Master of Science

Stone, Charles W. (B. S. Eng. 1916, M. E. 1917)

1920

Bachelor of Science in Architecture

Anderson, Milton J.	Loye, Edwin M.
Kleinschmidt, Florian A.	Lyon, Glenn H.
Korslund, Harry J.	Raugland, Arnold I.
Lin, Shu M.	

Bachelor of Science in Engineering (Civil)

Alexander, George D.	Johnson, Byron F.
Bencke, Walter E.	Larson, Amandus C.
Berg, Karl A. E.	Lebeck, Carl E.
Bernt, Hans E.	Lende, Henry M.
Bleifuss, Donald J.	Malmberg, Victor A.
Dever, Francis A.	Nelson, Donald O.
Fitzgerald, William J.	Neville, Earle L.
Friar, Floyd M.	Pless, Arnold G. M.
Gilbert, Roy	Purdy, Irving B.
Gould, Edward S.	Seemann, Ernest W.
Hanke, Carl C.	Sherwood, Edward B.
Hansen, Carlos C.	Stehle, Gilbert C.
Holm, Edwin R.	(M. S. Eng. 1922)

Bachelor of Science in Engineering (Electrical)

Aske, Irving E.	McKenzie, Leonard F.
Bauer, Ruben B.	Mayer, Albert F.
Carlson, Victor H.	Miller, George W.
Ellsworth, Charles D.	Mitchell, Alexander C.
Engquist, Victor E.	Molskness, Nels S.
Goss, Harold R.	Nelson, Clarence L.
Groth, Arthur W.	Noel, Clay W.
Hunt, Gates E.	Peterson, Peter I.
Janzen, William H.	Peterson, Richard M.
Jules, Harold A.	Peterson, Vance C.
Kingsley, Norman W.	Price, Clarence R.
Knowles, Everett H.	Siegmann, Chester W.
Kruse, Orlin O.	Strothman, Russell A.
Larson, Walter J.	Triem, Ralph H.
Lee, Walter J.	Waldron, Ralph E.
Lockwood, Raymond A.	Westberg, Russell E.

Bachelor of Science in Engineering (Mechanical)

Anderson, Helmer N.	Merrill, Lewis E.
Ball, Hampton B.	(M. E. 1921)
Cerney, Glen C.	Odegaard, Harold T.
Curry, Ezra B.	Powell, Knox A.
(M. E. 1921)	*Reasoner, Clayton M.
Czock, Jacob H.	(M. E. 1921)
Egilsrud, Fridtjof S.	Rhame, Paul W.
Fortune, Harry G.	(M. E. 1921)
Gerow, Theron C.	Shellenberger, Hiram R.
Hayes, Edward J.	Tuve, George L.
(M. E. 1921)	(M. E. 1921)
Joachim, William F.	Wallfred, John E.
(M. E. 1921)	Waterous, Fred A.
	William, Myrl J.

Bachelor of Science in Engineering

Didriksen, Philip H.	Moore, Clarence F.
Hanrahan, Edmund C.	Swenson, Gustav A.
Harris, Nathan	Vallacher, Theodore L.
Madsen, Olav	Wyly, Lawrence T.

ADVANCED DEGREES

Civil Engineer

Douglass, Addison H. (B. S. 1917)

Mechanical Engineer

Bros, Raymond J. (B. S. 1919)
Moffat, George N. (B. S. 1919)
Pavek, William J. (B. S. 1919)
Swenson, Clarence O. (B. S. 1917)
Wunderlich, Milton S. (B. S. 1919)

1921

Bachelor of Science in Architecture

Anderson, Milton L.	Larson, Edwin
Dahl, George L.	Melander, Albin R.
Damberg, Rheuben P.	Thorshov, Olaf
Gewalt, Carl H.	Wills, Arthur D.

Bachelor of Science in Civil Engineering

Barber, Harold A.	Henry, Burt C.
Carpenter, Hugh W.	Jensen, Cyril D.
Christlaw, George M.	Johnson, Alphonse N.
Daly, Richard T., Jr.	Johnson, Carl S.
Dehn, Eitor A.	McCubrey, Everett J.
Del Plaine, Carlos W.	Mackintosh, William S.
(C. E. 1922)	Muessel, Robert W.
Enke, Fred A.	Simmonds, Richard R.
Grochau, Earl H.	Sverdrup, Leif J.
Hallady, Leslie L.	Weis, Wallace D.
Hanson, Edwin L.	Werdenhoff, James H.

Bachelor of Science in Electrical Engineering

Anderson, Edward S.	Loye, Percival E.
Austin, Paul D.	McKibben, Lloyd S.
Barger, Harold L.	McVean, Norman S.
Barnes, Dean M.	Maine, Basil C.
Beardmore, Albert E.	Manderfeld, Emanuel C.
Berg, Samuel A.	Mangney, Elmer J.
(B. A. 1921)	Miller, Andrew L.
(E. E. 1922)	Nelson, Richard L.
Briggs, William G.	Palmer, Roy A.
Carlson, Carl P.	Pearson, Charles W.
Colson, Lauren G.	Peterson, Harold W.
Donahoe, Robert E.	Podosin, John
Hammerstrom, Aleck A.	Satori, Roy H.
Hayward, Laurence W.	Shuirman, Gabe
Hougan, Sander	Stanius, Godfrey
Johnson, Edgar F.	Sweet, Ray B.
Johnston, Charles K.	Wahlquist, Hugo W.
Larson, Ludvig C.	Wessale, George
(E. E. 1923)	Wilson, Paul R.

Bachelor of Science in Mechanical Engineering

Arneson, Lloyd O.	Lewis, George R.
Elmer, Lloyd A.	Luce, Alexander W.
Farmer, John W.	(M. E. 1923)
Forsberg, Elmer J.	Reuter, Peter T.
(M. E. 1922)	Roy, Milo C.
Gjesdahl, Maurice S.	Umbehocker, Frank
Hamlin, Lehan H.	Vaule, Sven A.
Johnson, Carl A.	von Rohr, Herbert H.
(M. E. 1922)	

Bachelor of Science in Engineering

Beeman, Harry J.	McLean, Milton D.
Carlton, Richard P.	McMeekin, Glenn D.
Cowin, Clifford C.	Martin, Curtis R.
Dills, Lyle A.	Noble, John F.
Godwin, Kenneth A.	Papenthien, Roy O.
Jacobson, Howard C.	Young, Joseph E.
Liddle, Ralph W.	

ADVANCED DEGREES

Electrical Engineer

Swenson, George W. (B. S. Eng. 1917)

Mechanical Engineer

Curry, Ezra B. (B. S. Eng. 1920)
Hayes, Edward J. (B. S. Eng. 1920)
Joachim, William F. (B. S. Eng. 1920)
Merrill, Lewis E. (B. S. Eng. 1920)
*Reasoner, Clayton M. (B. S. Eng. 1920)
Rhame, Paul W. (B. S. Eng. 1920)
Tuve, George L. (B. S. Eng. 1920)

1922

Bachelor of Science in Architecture

Bakken, Laurence H.	Haines, Howard N.
Croft, Edna K.	Kreinkamp, Herbert A.
Damberg, Paul S.	Little, Alice V.
Dawson, John W.	Moorman, Frank S.
Gerlach, Henry C.	Smit, Catherine
Graf, Donald T.	Stewart, George A.
Hahn, Stanley W.	Willner, William E.

Bachelor of Science in Civil Engineering

Anderson, Nels S.	Bailey, George R.
Andrus, Harry J.	Berdan, Hubert J.
Chernus, Maurice	Newberry, Lester W.
Cook, Walter K.	Ost, Roland E.
Cray, Seymour R.	Palda, Chas. H.
(C. E. 1923)	Palmer, Howard B.
Erickson, Edwin C. O.	Paulson, Thorwald S.
Espenett, Edward L.	Peterson, Neander E.
Feder, Max	Pinska, Lawrence F.
Fraser, Carlisle G.	Reardon, John M.
Frost, Herbert J.	Rosenthal, Paul
Greenberg, Jack	Silverman, Emil M.
Hortskotte, Arthur E.	Slade, Loring
Johnson, Ellsworth	Soshnik, Edward J.
Keeler, Jasper F.	Stoutland, Oliver A.
Kelley, William	Swanson, Clifford L.
Levens, Alexander S.	Tarbell, William P.
(M. S. in C. E. 1924)	Teberg, Lawrence E.
Lund, Earl H.	Thompson, Claudius A.
(C. E. 1923)	Tierney, Festus P.
Markson, Christian O.	White, Arden D.
Mattson, Dewey F.	Wilson, Charles A.
Morrison, John E.	Wood, Victor R.

Bachelor of Science in Electrical Engineering

Aultfather, David H.	Magnuson, John E.
Bergstrom, Marlow B.	Mentzer, Clarence A.
Bisbee, Bertin A.	Merritt, Alva W.
Bjonerud, Earl S.	Mintz, Nathaniel
Bochus, Gerald H.	Nielsen, Walter M.
Bosshardt, Wilmert C.	Nordlien, Berger W.
Carlson, Richard E.	Olson, Arnim G.
Cooley, Gilbert	Oscarson, Gerhard L.
Dahl, Hjalmer A.	Pangburn, Carroll G.
Downie, John M.	Plank, Howard G.
Drost, Henry F.	Ransom, Glen B.
Dunnum, Orney E.	Rome, Robert C.
Ellestad, Irwin M.	Rood, Arnold E.
Enger, Arne	Sannicola, Joseph F.
Fiske, Harold C.	Selander, Karl W.
Forbes, Henry C.	Sorensen, John E.
Hagelin, Lawrence W.	Steffens, Robert A.
Heidelberger, Roy J.	Tuve, Merle A.
Hendrickson, Arnold B.	Wickman, Martin F.
King, John E.	Willard, Arthur C.
Linhoff, Carl H.	Williams, Percival H.
McEachin, John	Wilson, Abner W.
McMillen, James S.	

Bachelor of Science in Mechanical Engineering

Aure, Roy	Katter, Reuben L.
Bros, Chester W.	Kelsey, Howard C.
(M. S. in M. E. 1924)	Kleinschmidt, Arnim R.
Carlson, Ernest F.	Kumm, Arthur W.
Clark, John S.	Mikesh, Edward S.
Curtis, Verne F.	Nordenson, Arnold
Eddy, Clarence	Nordstrom, Ernest A.
Fahland, Frank, Jr.	Olmstead, Charles F.
Hensey, Clayton E.	(M. E. 1923)
Hilgedick, Ralph V.	Peters, Walter C.
Hoffman, Richard H.	*Rood, Olaf T.
Holmsten, Victor T.	(M. E. 1923)
Katter, Calvin K.	Rosendahl, Harold R.

Bachelor of Science in Engineering

Adams, Edward H.	Forssell, William
Brown, Harry	Hayes, Harold
Capstick, Donald	Meili, Rudolph E., Jr.
Dock, Chester	Olson, Clarence

ADVANCED DEGREES

Civil Engineer

Del Plaine, Carlos W.

Electrical Engineer

Berg, Samuel A. (B. S. Eng. 1921, B. A. 1921)

Mechanical Engineer

Forsberg, Elmer J. (B. S. Eng. 1921)
Johnson, Carl A. (B. S. Eng. 1921)

Master of Science in Engineering

Stehle, Gilbert C. (B. S. 1920)

1923

Bachelor of Science in Architecture

Backstrom, W. A.	Nielsen, Eunice V.
Holien, Edward O.	Sime, Theodore L.
Johnson, Elving L.	Strom, Arthur
Markuson, Miner J.	Walquist, John A.

Bachelor of Science in Architectural Engineering

Luedeman, Clarence H.	Sutherland, Samuel J.

Bachelor of Science in Civil Engineering

Aasland, Arne	Bergford, Rolf E.
Abramson, Harry W.	Buhr, Leo
Aldrich, Louis W.	Christlieb, Frank B.
Aslakson, Carl I.	Cribbs, Harry E.
Berg, Swan P.	Curry, Byron K.
Bergford, Lester M.	Darrell, James E.

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.
Pease, Harold A.
Pulver, Richard F.
Rath, Harvey C.
Reeve, Howard E.
Russell, Winfred W.
Ryan, Robert M.
Sampson, Clifford L. (M. S. 1925)
Schottler, George J.
Schweiso, Clifford C.
Scott, Herbert L.
Sickel, 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.
Kraft, 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
Dedie, Richard J.
Erickson, Carl E.
Garrow, Julian R.
Gillard, Herbert W.
Grant, Elberth R.
Guerin, George V., Jr.
Guesmer, George O.
Gustafson, Reuben W.
Hankins, Nathaniel R.
Hartington, 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.
Somers, 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.
Eckberg, Curtis R.
Frazee, Leonard M.
Furber, John B.
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.
Mangney, 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.
Borst, 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.
Grabel, 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 R.
Rosseau, Clifton C.
Saltwick, Andrew
Sartell, Page M.
Seho, Arthur O.
Sesseng, Gunnar
Simms, Charles G.
Stachle, Haswell E.
Stauffacher, Edward L.
Thomas, W. Alan
Tuttle, Stanley B.
Wagner, John W.
Willson, Stuart V.
Woolman, Harry D.

ADVANCED DEGREES

Master of Science in Civil Engineering

Levens, 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.
Melander, Edwin W.
Olson, Edwin E.
Peterson, Everett L.
Rigg, Alwin E.

Bachelor of Science in Architectural Engineering

Brimeyer, Ferdinand J.
Elmburg, LeRoy M.
Grisson, Aubrey H.
Larson, Emil L.
Pesek, Cyril P.
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 U.
Berg, Thorsten H.
Bertossi, Clarence F.
Bird, Harold E.
Blue, Clarence W.
Bonner, Donald R.
Brose, William C.
Burns, Dwight T.
Caribom, 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.
Boe, Lester I.
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.
Peterson, Lewis E.
Postma, John
Reed, Henry R.
Richardson, Philip E.
Robertson, Kenefick
Schenckloth, Harry H.
Schuck, Roy D.
Shavor, George J.
Smith, Harold D.
Solomonson, Lawrence D.
Steinert, Emil
Taylor, Richard G.
Thomas, Richard L.
Thomson, Andrew
Thyberg, Clarence W.
Tunell, Clement R.
Uutinen, August L.
Upton, Albert P.
Westigard, Glenn A.
Wieland, Willard W.
Winslow, Harry J.
Wurzbach, Henry A.

Bachelor of Science in Mechanical Engineering

Algren, Axel B.
Backstrom, Russell E.
Beseler, Herman F.
Bjerre, Folmar I.
Boss, Ronald W.
Caswell, Thomas 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
Martino, Anthony D.
Mills, Hartzel
Pendergast, Webster G.
Peterson, Laurence L.
Robinson, Parke D.
Sauba, 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)
Morrill, Raleigh D. (B. S. M. E. 1909, E. E. 1922, Maine)
Morris, Frank A. (B. S. M. E. 1924)

1926

Bachelor of Science in Architecture

Frenzel, Herman
Kronick, T. Gerald
Lighter, Clyde W.
Naslund, Gustave A.
Potter, Robert P.
Stageberg, Oswald C. R.

Bachelor of Science in Architectural Engineering

Kranzfelder, Robert H.
Rasey, Raymond F.
Redin, R. Kenneth

Bachelor of Science in Interior Decoration

Ehrenberg, Muriel L.
Guesmer, Marie W.
Snyder, Dorothy E.

Bachelor of Science in Civil Engineering

Balkin, Samuel W.
Bolstad, Roswell C.
Breeden, James R.
Bunnell, Charles W.
Comfort, Thomas H.
Cooper, R. Conrad
Croswell, Leslie D.
Dergan, Raymond C.
Drilla, Robert L.
Fenton, Paul C.
Flasten, Percy H.
Foster, Kenneth W.
Gould, Edward C.
Haakensen, N. Theodore
Halbkat, Frankon J.
Hoffman, John R.
Jakkula, Arne A.
Johnson, Clifford S.
Johnson, James R.
Johnson, Raymond A.
Juell, Barton
Kelly, Raymond R.
Krefting, Arthur S.
Lewin, Sherman W.
Liese, Carl R.
Lindstedt, Philip C. A.
Lipchick, Alex A.
Lorens, Edward R.
Lund, Clarence V.
Manson, Philip G.
Meyerdick, Clarence E.
Nasvik, Adolph C.
Neubauer, Loren W.
Nyvall, Clifton S.
Ohman, Uno G.
Peterson, Garvin E.
Sandberg, Clifford H.
Schulz, Alex A.
Young, Edward F.
Young, Truman P.

Bachelor of Science in Electrical Engineering

Agetun, Edwin O., Jr.
Anderson, Lowell W.
Ayshford, Loren C.
Barron, John H.
Berghs, Charles J.
Bergman, Hilder W.
Beveridge, Robert A.
Bullard, Henry M.
Carman, Willard J.
Christen, Ray L.
Coon, Lawrence C.
Dahl, Merle G.
Deinema, George R.
Deterling, Edward A.
Dimmick, Merton A.
Etem, Victor
Faulkner, Louis L.
Feldman, Carl B. H.
Ferguson, Kenneth R.
Fiene, Marcus
Forsmark, Ulrik E.
Gaalaas, George L.
Gemmell, Robert W.
Getchell, Earl
Graf, Alois W.
Gross, Leon A.
Haedecke, August D.
Hafstad, Lawrence R.
Hammond, Joseph A.
Hargrave, William A.
Hart, Maurice W.
Hartley, Lowell J.
Hilgedick, Winfred C.
Holcomb, Harry S.
Hummel, Carl
Irons, George R.
Jensen, Otto L. (B. A.)
Joesting, Frederick D.
Johnson, Clarence A.
Johnson, Welton V.
Jones, Richard W.
Kelly, William J.
Larsen, Einar H.
Lee, Albert A.
LeVesconte, Lester B.
Levy, Max L.
Lindquist, Oliver J.
Lostrom, Herbert W.
Lyberg, Verele C.
Lynskey, Joseph P.
Mackay, Donald H.
Mahachek, Ross
Mann, Alvin K.
Meader, Glenn S.
Mindrum, Arthur I.
Murdoch, George B.
Nelson, Paul B.
Nelson, Robert R. D.
Nimmer, Walter B.
Orning, Harold
Parry, John E.
Quine, William M.
Rhoades, Herbert E.
Robinson, Lawrence T.
Salstrom, Paul S.
Schroeder, Clarence A.
Schweppe, Walter A.
Scott, Franklin B.
Sjoberg, Roy H.
Slaggie, Eucharius L.
Tholstrup, Henry L.
Tighe, James S.
Walters, Robert P.
Wenrich, James R.
Wentz, Edward C.
Williams, William R.

Bachelor of Science in Mechanical Engineering

Anderson, Wesley J.
Bancroft, Henry K.
Beck, Hiram D.
Bennett, John C.
Bohannon, George W.
Burt, Paul R.
Cole, Ernest C.
Comfort, Clifford E.
Corbett, Theodore R.
Dewaji, Gunaker
DuBois, N. Warren
Farnleist, Carl H.
Grant, Russell S.
Hanna, Cyril C.
Hass, Paul O.
Kleinfeld, Leonard S.
Letson, Donald E.
Lundgren, Carl W.
Maney, James E.
Mork, George W.
Norrbom, Oscar E.
Nordenson, Willard H.
O'Donnell, Lawrence
Pierce, Walter H.
Pike, Jay R.
Roberts, Norman A.
Rollin, Harold E.
Slaby, Louis J.
Tucker, Carl W.

ADVANCED DEGREES

Civil Engineer

Coe, Edward H. (B. S. C. E. 1919)
Luxford, Ronald F. (C. E. 1917, M. S. 1925, Wisconsin)

Master of Science in Civil Engineering

Nichol, Frank E. (B. S. C. E. 1925)

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.

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

Burrowman, George L.
Dahlberg, Arnold V.
Frary, Francis C. (M. S. 1906, Ph. D. 1912)
Jackson, Myron B.
Langworth, 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.
Halverson, John O.
Kennedy, William W.
Mansel, Earle V.
Von Kuster, Edith I. (Mrs. W. Johnson)

Bachelor of Science in Chemical Engineering

Davies, Edwin T.

1908

Bachelor of Science in Chemistry

Anderson, Edward X. (M. S. 1909)
Badger, Walter L. (B. A. 1907, M. S. 1909)
*Cressy, Charles K. (M. S. 1913)
Lowe, John M.
McBride, Russell S.
Porter, Allen H.
Whited, Oric O.

1909

Bachelor of Science in Chemistry

Bacon, Charles B.
Dresser, Eva L. (Alves)
Kuefner, 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.
Hennesy, Hugh J.
Johnson, Einer (M. S. 1912)
Leavenworth, Francis M.
McMiller, Paul R.
Olson, Arthur O.
Pettijohn, Earl (M. S. 1912, Ph. D. 1918)
Stoppel, Ernest A.

Bachelor of Science in Chemical Engineering

Baker, Russell E.
*Bolton, John B.
Callaway, Roy S.

Master of Science in Chemistry

Bell, Grace M. (B. A. 1909)
Daniels, Farrington (B. S. 1910)

Master of Science in Chemistry

Kepner, Ben-Hur (B. A. 1910)
Peterson, Andrew P. (B. A. 1910)
Poppe, Frederick W. (B. A. 1910, Lawrence)

1912

Brinton, Paul H. M.-P. (M. S. 1913, Ph.D. 1916)
Daniels, Elmer A. (M. S. 1913, Ph.D. 1917)
Hoffman, Henry J. (M. S. 1914)
Karatz, Lucian
*McLeod, John R.
Mitchell, Ralph W.
Nesse, Charles O.
Parkin, Guy G. (M. S. 1913)
Robinson, Rhea B.
Rockwood, Ralph H.
Schmidt, George H.
*Spriestersbach, David O. (M. S. 1915)
Wanless, Lynn A.

Bachelor of Science in Chemical Engineering

Edwards, Junius D. (Ch. E. 1913)
Goldstein, Milton M. (Ch. E. 1913)
Harshaw, John R.

Chemical Engineer

Brookow, 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

Felim, Arthur J.
Mastin, Marion G.
Miller, Ralph H.
O'Connell, Thomas C. (M. S. 1914)
Otterstein, Earl F.
Sutter, Hedwig M. (Mrs. R. Wilson)
Taylor, Cyril Stead
Yngve, Victor

Bachelor of Science in Chemical Engineering

Anderson, Fredolf T. (Ch. E. 1914)
Katz-Nelson, William
Kern, Herbert A. (Ch. E. 1914)
Peterson, Henry (Ch. E. 1914)
Porter, Ralph E. (Ch. E. 1914)

Chemical Engineer

Edwards, Junius D. (B. S. 1912)
Goldstein, Milton M. (B. S. 1912)

Master of Arts in Chemistry

Beck, Maud G. (B. A. 1905)
Skartvedt, Peter M. (B. A. 1906, St. Olaf)

Master of Science in Chemistry

Brinton, Paul H. M.-P. (B. S. 1912, Ph.D. 1916)
Cressy, Charles R. (B. S. 1908)
Daniels, Elmer A. (B. S. 1912)
Parkin, Guy G. (B. S. 1912)

Doctor of Philosophy

Cohen, Lillian (B. S. 1900, M. S. 1901)

1914

Bachelor of Science in Chemistry

Gauger, A. W.
Juvrud, Ingvald O.
Merton, Howard V.
Tibbling, Ernest F.

Chemical Engineer

Anderson, Fredolf T. (B. S. 1913)
Bierman, Harry C. (B. S. 1914)
Kern, Herbert A. (B. S. 1913)
May, Darwin R. (B. S. 1914, Ch. E. 1915)
Peterson, Henry (B. S. 1913)
Porter, Ralph E. (B. S. 1913)
Tinkham, Willis M. (B. S. 1914)

Bachelor of Science in Chemistry

Bray, Mark W. (B. A. 1912, Lawrence)
Hoffmann, Henry J. (B. S. 1912)
Kokatnur, Vaman R. (B. A. 1912, Bombay, India, Ph. D., 1916)
Yngve, Victor (B. S. 1913)

Doctor of Philosophy

Brown, Harold H. (B. A. 1909, M. A. 1910, Syracuse)

1915

Bachelor of Science in Chemistry

Fegan, Elmer T. (M. S. 1916)
Olsen, Leslie R.
Ringstrom, Hugo (M. S. 1917)
Toncheff, Stanil

Bachelor of Science in Chemical Engineering

Morse, Guilford A. (Ch. E. 1915)

Master of Science in Chemistry

Nietz, Adolph (B. A. 1913)
*Spriestersbach, David O. (B. S. 1912)
Ziegler, Mildred R. (B. A. 1914)

Doctor of Philosophy

Temple, Sterling N. (Ph. D. 1903, M. A. 1906, Hamline)

1916

Bachelor of Science in Chemistry

Dunningham, Merton
Souther, Benjamin L.
Morrow, Leon W.

Bachelor of Science in Chemical Engineering

Bell, Alexander D. (Ch. E. 1917)

Master of Science in Chemistry

Fegan, Elmer T. (B. S. 1915)
May, Darwin (B. S. Ch. Eng. '14, Ch. E. '15)
Newman, Allen T. (B. S. 1912, Nebraska)
Stenger, Lawrence A. (B. S. E. E. 1906)
Woolett, Guy H. (B. S. 1910, Ph. D. 1918)

Doctor of Philosophy

Brinton, Paul H. M.-P. (B. S. 1912, M. S. 1913)
Kokatnur, Vaman R. (B. S. 1912, Bombay, M. S. 1914)

1917

Bachelor of Science in Chemistry

Corson, Benjamin I.
Durham, Samuel W.
*Eckman, Lawrence R.
*Egge, Walter
Markus, Benjamin
Marr, Horace S.
Marshall, Olive W.
Owens, Jay C.
Rusk, Olaf S.

Bachelor of Science in Chemical Engineering

Burningham, Foster A. (Ch. E. 1918)
Domovsky, Aaron
Higburg, William
Kuentzel, Ward E.
Luft, Oscar W.
Strong, Frank D.
Washburn, Frederick M.
Widell, Gideon

Chemical Engineer

Bell, Alexander D. (B. S. 1916)

Master of Science in Chemistry

Barrows, Vera (B. A. 1906)
Cade, Arthur R. (B. S. Worcester Polytechnic Inst. 1915)
Joyce, Floyd E. (B. S. 1912, Iowa)
Lauer, Walter M. (B. S. 1913, Ursinus College, Ph. D. 1924)
Ringstrom, Hugo (B. S. 1914, B. S. 1915)
Seyfried, Lillian M. (B. A. 1915)

Doctor of Philosophy

Daniels, Elmer A. (B. S. 1912, M. S. 1913)

1918

Bachelor of Science in Chemistry

Joselowitz, Goodwin
Kesselman, Leo
Nelson, Harry G.
Pan, Wen Ping

Bachelor of Science in Chemical Engineering

Donauer, Max (Ch. E. 1925)
Hogness, Thorfin (Ch. E. 1919)
Johnson, Donald L. (Ch. E. 1919)
Kessel, Herbert (Ch. E. 1919)
Neilson, Chris

Chemical Engineer

Burningham, Foster A. (B. S. 1917)

Master of Science in Chemistry

Schultz, Peter D. (B. A. 1914, Bethel College)

Doctor of Philosophy

Pettijohn, Earl (B. A. 1906, B. S. 1911, M. S. 1912)
Sternberg, Woldemar M. (B. S. 1908, Petrograd, Russia)
Woollett, Guy H. (B. S. 1910, M. S. 1916)

1919

Bachelor of Science in Chemistry

Beckel, Arthur C.
Brooks, Leslie C.
Engstrom, Leslie G.
Heck, Frank J.
Thorson, Stuart J.

Bachelor of Science in Chemical Engineering

Fischer, Earl B. (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. 1923)
Plummer, Clayton E. (B. C. E. 1914, Michigan)

1921

Bachelor of Science in Chemistry

Carl, Cady S.
Epstein, Hymen (M. S. 1924)
Kryger, Edward R.
Nygard, Edwin M.
Riley, Philip J.
Seymour, Merrill W.
Westerberg, Carl G.

Bachelor of Science in Chemical Engineering

Aronovsky, Samuel I. (Ch. E. 1922)
Bezell, 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)
Eliestad, 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)
Halverson, Halvor O. (Ch. E. 1923)
Langseth, Axel O. (Ch. E. 1923)
Livermore, Harvey J.
Luger, Karl E.
Manuel, Douglas R.
Morin, William T. (Ch. E. 1923)
Morken, Carl H.

Bachelor of Science in Chemical Engineering

Schwartz, Marcel M.
Stone, Leslie F. (Ch. E. 1923)
Wyman, LeRoy L. (Ch. E. 1923)

Chemical Engineer

Aronovsky, Samuel I. (B. S. 1921)
Cornell, Reuben W. (B. S. 1921)
Lee, Melville R. (B. S. 1921)
Peterson, Marshall A. (B. S. 1921)
Riddington, Frederick W. (B. S. 1921)
Roberts, Wesley J. (B. S. 1921)
Schermer, Oscar C. (B. S. 1921)

Master of Science in Chemistry

Fulermer, Jervis M. (B. S. 1920, Washington State College)
Harris, Elmin E. (B. S. 1921, Hamline)
Heisig, Lucille Krantz (B. A. 1919)

Doctor of Philosophy

Hartshorn, Elden B. (B. S. 1912, Dartmouth)

1923

Bachelor of Science in Chemistry

Kampa, Edmund
Webster, Cora H.

Bachelor of Science in Chemical Engineering

Bostwick, Ross D.
Bruce, G. Norman
Eck, Lester J. (M. S. 1924)
Edgar, Donald E. (M. S. 1925)
Firth, Charles V.
Frederickson, Hubert M.
Hatch, Lloyd
McMillen, Elliott L.
Paulson, Paul M. (M. S. 1924)
Peterson, Clifford E.
Rademacher, Richard L. (M. S. 1924)
Sorenson, Ben. E. (M. S. 1924)
Thordarson, William (M. S. 1924)
White, Robert H. (M. S. 1924)

Chemical Engineer

Barrett, Joseph O. (B. S. 1922)
Cassel, Norman S. (B. S. 1922)
Chadbourne, L. Rodney (B. S. 1922)
Halvorson, Halvor O. (B. S. 1922)
Langseth, Axel O. (B. S. 1922)
Morin, William T. (B. S. 1922)
Stone, Leslie F. (B. S. 1922)
Wyman, LeRoy L. (B. S. 1922)

Master of Science in Chemistry

Anderson, Winslow S. (B. S. 1921, Bates College)
Bakken, Adolph C. (B. A. 1919, St. Olaf)
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)
Thordarson, William (B. S. 1923)
White, Robert H. (B. S. 1923)

Doctor of Philosophy

Fuson, Reynold C. (B. A. 1920, Montana, M. A. 1921, Calif.)
Kohlhase, Arthur H. (B. S. 1919, Hamline, M. S. 1921)

Kracek, Frank C. (B. S. 1920)
Lauer, Walter M. (B. A. 1913, Ursinus College, M. S. 1917)
Sarver, Landon E. (B. A. 1915, Randolph Macon, M. A. 1919, Lafayette)
Stoppel, Arthur E. (B. S. 1920, Ch. E. 1921)
Weber, Ludwig J. (B. S. 1920, Ch. E. 1921)

1925

Bachelor of Science in Chemistry

Anderson, Alvin P.
Gillman, Hyam
Ayers, Ellsworth B.
Hamm, Homer A.
Brinker, Howard C.
Vievering, William A.
Galvez, Nicolas L.

Bachelor of Science in Chemical Engineering

Bekkedahl, Norman P.
McKee, John B.
Coult, Lyman H.
Reiter, Alfred A.
Covell, Paul L.
Scandling, Joseph E.
Edmunds, Alvin M.
Sprung, Murray M.
Jewett, Ernest E.
Stier, Ruth I. (Mrs. Cecil Mayo)
Johnson, Lester L.
Johnston, Charles L.
Zeidlik, William J.

Chemical Engineer

Donauer, Max (B. S. 1918)

Master of Science in Chemistry

Chaney, Albert L. (B. A. 1920, Washington Missionary College)
Freche, Hertha R. (B. A. 1919)
Underhill, Editha (B. A. 1916, Vassar)

Master of Science in Chemical Engineering

Edgar, Donald E. (B. S. 1923)
Krantz, Rudolph W. (B. A. 1923, B. S. 1924)

Doctor of Philosophy

Morse, Minerva (B. A. 1915, M. S. 1920)

1926

Bachelor of Science in Chemistry

DeVaney, Grace M.
Thompson, Warren L.
Dysterheft, George A.
Westman, Bruce
Johnson, Waldo C.

Bachelor of Science in Chemical Engineering

Bunger, Harold A.
Schlafge, William H.
Haugsrud, Parmalee S.
Shirk, Loren H.
Jerabek, Henry S.
Smith, Allen S.
Kobe, Kenneth A.
Sverdrup, Edward F.
Kugler, Joseph H.
Tronson, John L.
Lewenstein, Abraham
Rauen, Theodore
Murray, Robert
Jordan, Wallace E.
Rogers, Marvin

School of Mines and Metallurgy

IN 1887 the General Faculty of the University recommended that the Board of Regents establish a "College of Mines and Metallurgy."

The "School of Mines and Metallurgy" was formally opened in January, 1892, with William R. Appleby in charge. Near the end of that year a reorganization was effected whereby the School of Mines and Metallurgy was temporarily affiliated with the College of Mechanic Arts, to form the College of Engineering, Metallurgy and Mechanic Arts. This organization continued until 1897. In March of that year the dissolution of the School of Mines from the Engineering College took place and from then on the school was known as "The School of Mines" until the present year when the name was changed to the "School of Mines and Metallurgy."

From 1894 to 1897 inclusive, the school granted to its graduates the respective degrees of Bachelor of Mining Engineering and Metallurgy. The year 1897 marked the beginning of the granting of the degree of Engineer of Mines and Metallurgical Engineer. Those men who had previously received the bachelor degrees were given, upon presentation of a satisfactory thesis engineers' degrees.

In 1911 a new course leading to the Degree of Engineer of Mines in Geology was established.

Beginning with the year 1927-1928 a student in the School of Mines and Metallurgy may work toward a degree recently established, that of Engineer of Mines in Petroleum, bringing the total number of degrees granted by the School of Mines and Metallurgy to four, namely, Engineer of Mines, Metallurgical Engineer, Engineer of Mines in Geology, and Engineer of Mines in Petroleum.

1894

Engineer of Mines

Christiansson, Peter

1895

Engineer of Mines

Wilkinson, Charles D.

1896

Engineer of Mines

May, Albert E.
Tanner, Wallace N.

1897

Engineer of Mines

Becker, George
Wales, Roland T.
Mills, Eugene C.

1898

Engineer of Mines

Brackenbury, Cyril
Walker, Clinton L.
McIntosh, Joseph B.

1899

Engineer of Mines

Bass, William C.
Warren, Frank M.
Peterson, Andrew Y.

1900

Engineer of Mines

Campbell, William L.
McCarthy, Edward P.
Chandler, Eugene D.
Teague, Harold W.
Egleston, Olver J.
Toll, Rensselaer H.
Hunt, Walter E.

1901

Engineer of Mines

Burgess, Thomas O.
Smith, Horal A.
Clapp, W. Howard
Taresh, John
Gholz, Arthur L.

Metallurgical Engineer

Sanderson, Henry S.
Smith, Elmo V.

1903

Engineer of Mines

Cohen, Samuel W.
Smith, Franklin W.
Field, Edward M.
Sowle, Lawrence K.
Flynn, John G.
Truesdale, William H. (M. S.)
Heard, Harold J.
Holden, Henry H.
Whiteley, Eugene E.
Rait, Donald M.
Winther, Arno

1904

Engineer of Mines

Bowman, Frank A.
Devereux, Francis C.
Hale, William H.
Houlton, Lewis K.
Keene, Amor F.
Kingston, Merton S.
McCarty, Andrew L.
Merritt, Lucien
Shouts, Sydney L.

Metallurgical Engineer

Brosius, Harold I.

1905

Engineer of Mines

Angst, Harry H.
Boyd, Robert R.
Cadwell, W. Chauncey
Calhoun, Allan R.
Curry, Duncan E.
Field, Thorold F.
Gulick, Hervey
Keller, Orrin E. M.
Loye, Henry E.
Lyzen, Walter W.
McKay, Henry S.
Merriam, Robert S.
Minder, Emil G.
Schrader, Erick J.
Ziesemer, Ralph A.

1906

Engineer of Mines

Brandt, John
Clement, Lester L.
Harrington, Guy P.
Howes, Frank T.
Kurtzman, Paul S.
Moenke, William F.
Morgan, Charles
Neustadt, Berthold R.
O'Connor, Edward S.
Rawson, Horace C.
Roze, William A.
Wallace, George W.
Wheeler, Walter H.

1907

Engineer of Mines

Bassett, Robert H.
Cowin, James
Gillan, Silas L.
Jackson, Charles F.
McRae, Randolph J.
Oberg, Anton C.
Olund, Henning E.
Parker, Walter H.
Probst, Elmer A.
Reed, Olaf
Smith, Edgar W.
*Steele, Charles W.
Swensen, Karl P.
Wiest, Michael A.
Ziesemer, Harry M.

1908

Engineer of Mines

Boyle, Patrick J.
Cullyford, James A.
Deichen, William A.
Edwards, Frank R.
Goodwin, William R.
Grimes, John A.
Hoass, Ole G.
Kennedy, John J.
Knickerbocker, A. K.
Locke, Alfred M.
Olmstead, John S.
Peterson, Joseph S.
Strong, John L.

1909

Engineer of Mines

Cole, Willard A.
Crowley, Jay
Gavin, Lawrence T.
Grant, Roy C.
Hagnason, Geo. B.
Hoyt, Samuel L.
Rood, Lynn
Santo, Julius H.
Taylor, Harold G.
Williams, Homer A.

1910

Engineer of Mines

Bischoff, Harry R.
Conkey, Charles R.
Devereux, Lawrence
Duncan, Kenneth J.
Farnam, Henry E.
Fritzberg, Ernest A.
Giltinan, George M.
Goodrich, Norman P.
Harmon, Benjamin G.
Heath, Clarence L.
Heidel, C. Sumner
Herring, William E.
Holler, Frederick W.
Johnson, Algot F.
Jones, Philo E.
Larson, Clarence L.
Leonard, Forest M.
McKenzie, James R.
Moody, Revillo G.
Newell, John R.
Ostrand, Peter M.
Stewart, G. Gordon
Strane, Archie J.
Swanson, Axel H.

1911

Engineer of Mines

Abbott, Theodore S.
Anderson, Joseph
Anderson, Walter C.
Bailey, Paul T.
Baker, Emory P.
Beck, Charles S.
Borgeson, Anshelm C.
Burgess, Robert J.
Crouse, Charles S.
Drake, George M.
Ekloff, Victor E.
Elliott, Jay R.
Fixen, Victor L.
Jahn, William F.
Kingsley, Neil S.
Lindholm, Milton S.
Rahilly, Harold J.
Tetlie, John R.
Walker, E. Harold
Walters, Charles W.
Wehr, Arthur J.
Whitson, Lloyd R.

Metallurgical Engineer

McCullough, Ervin W.

1912

Engineer of Mines

Bjorge, Guy N.
Coventry, Edward D.
Dickson, Robert H.
Hagstrom, Leonard J.
Harrington, George L.
Hewitt, Ezra A.
Knox, La Fayette
Kremer, Edward G.
Lea, John
Lewis, John W.
McAdams, Howard R.
Martin, Lynn
O'Brien, J. Charles
Olson, Walter S.
Perry, Joe B.
Prouty, Roswell W.
Quinn, Max F.
Stevens, Howard E.
Taylor, William L.
Wallinder, Arthur
Walter, Rollie B.
Woodis, Clark N.

1913

Engineer of Mines

Coady, Leo J.
Ely, Robert H.
Fosness, Arthur W.
Hammond, Arthur H.
Hanson, J. Bernard
Hendrum, Olaf
Ladd, Greeley
Michie, Roy G.
Nissen, Arvid (M. S.)
Ofsthun, Norman
Walker, Chas. A.

1914

Engineer of Mines

Anderson, Arthur P.
Bierman, Alfred C.
Eidemiller, Howard N.
Larson, Ernest L.
Potter, Orrin W.
Quinlan, Howard
Ravicz, Louis G.
Robertson, John H.
Wasson, Harold J.

1915

Engineer of Mines

Butler, William V.
Christenson, Alfred
Coller, Walter A.
Collins, Leon T.
Haugen, Albert C.
Heilig, Louis S.
Kerr, Charles D.
Neerland, Herman
Ramsing, Fred C.
Sanchez, Richard M.
Urquhart, George K.
Wade, Henry H.
Williams, Paul S.

1916

Engineer of Mines

Aronson, Sam.
Craig, John J.
Davies, Fred A.
Dovre, Adolph
Lee, Oscar
McDermid, Archie J.
McHardy, Roy H.
Nord, Harry H.

Metallurgical Engineer

Krogh, Alvin T.

1917

Engineer of Mines

Anderson, Edwin H.
Buresch, Charles E.
Dennis, Richard C.
Depp, J. Lawrence
Elson, Richard H.
Exster, Omer F. (M. S.)
Fearing, Edward J.
Harmon, Sydney
Levorsen, A. Irving
Woodruff, John J.

Metallurgical Engineer

Peterson, Paul A.

Engineer of Mines in Geology

Coryell, Lewis S.
Hubbard, W. Earle
Kwong, Yih Kun
Sweetman, Edwin A.
Wallace, Carleton S.

1918

Engineer of Mines

Armstrong, Harold K.
Cowin, Percy G.
Hsieh, Chung
Jerrard, Walther L.
Moga, John A.

Metallurgical Engineer

Allard, Raymond W.
Dowdell, Ralph L. (M. S.)

Engineer of Mines in Geology

Foley, Lyndon L.
Gannett, Roger W.
Ingersoll, Guy E.
Quinn, Howard E.

1919

Engineer of Mines

Frellsen, Sidney A.
Goldberg, Bert
Goldberg, Samuel B.
Mellem, Walter R.

Metallurgical Engineer

Pan, Wen Ping

Engineer of Mines in Geology

Hosted, Joseph O.

1920

Engineer of Mines

Ainsworth, Robert E.
Arnold, Lewis E.
Bailey, A. K., Jr.
Clark, Fred E.
Donaghue, Abner J.
Edwin, John
Frank, Harry O.
Johnson, Axel L.
Kersten, Erwin H.
Mark, Israel
Nichols, Clifford R.
Peterson, Clarence D.
Raiter, Clifford R.

Engineer of Mines in Geology

Copeland, Wm. A.
Wheeler, James D.

1921

Engineer of Mines

Butler, Roy G.
Chadbourn, Charles H.
Frank, Elden
Gandrud, Bennie W.
Johnston, Kenneth A.
Schenins, Carl H.
Sponberg, Edwin C.
Zanger, Eugene

Metallurgical Engineer

Hamernik, Frank J.
Dawson, Loren W.
Nichols, William J.
Wenger, Frank B.
West, Herbert S.

Engineer of Mines in Geology

Carlson, Edwin N.
Davies, Herman F.
Walz, C. M.

1922

Engineer of Mines

Adams, E. Maurice
Anderson, Oscar B.
Barker, Clifton T.
Barr, J. Carroll
Chang, Chen Ping
Echebarria, Luis de U.
Gustafson, Arnold A.
Hansen, Mayer G.
Hoffman, Louis
Hope, Lawrence I.
Johnson, Ralph C.
Kilp, Raymond G.
Lin, Sze Chen
Lovering, Thomas S. M. S., Ph. D.
McKenzie, Frederick R.
Moga, Gregory M.
Plut, Frank J.
Thoeni, Victor T.
Wilson, J. Byron

Metallurgical Engineer

Johnsen, Trygve

Engineer of Mines in Geology

Patton, Richard C.

1923

Engineer of Mines

Anderson, Alfred T.
Brawley, John N.
Brenner, Walter W.
Calhoun, Robert A.
Chang, Chi
DeVaney, Fred D.
Erickson, Arthur C.
Dinmore, Harry C.
Gallagher, Luke J.
Gow, Alexander M.
Hawlick, Hartley H.
Hezzelwood, George
Jeffers, G. B. (M. S.)
Kwong, Shou Kun
Levy, Julian H.
Lundquist, O. William
Pabst, Henry A.
Ridgway, Robert H.
Russell, Charles B.
Searles, John N.
Sjolinder, Anthony
Smith, Carl James
Swensen, Clifford H.
Thellin, Herbert E.
Tollefson, Everett H.
Vivian, Edgar W.
Winter, William M.
Wrbitzky, Harry M.

Metallurgical Engineer

Mooney, Frank E.
Persons, Robert W.
Queneau, Roland B.
Scheid, Adolph J.

Engineer of Mines in Geology

Clay, J. Withers
Conhaim, Howard J.
Erdmann, Chas. E.
Foss, Adolph L.
Friedl, Arthur J.
Griswold, Willis R.
Henkel, Howard
Kegler, Vern L.
LaTendresse, H. E.
Lilly, Richard J.
Middleton, John L.
Wilcox, Fred H.
Wolfer, Donald H.

1924

Engineer of Mines

Ballard, John A.
Brunner, Donald G.
Case, Leslie M.
Huang, Ta Heng
Hutchinson, Bernard C.
Jensen, Willard C.
Larsen, Raymond M.
Lee, Clarence O.
Moe, Cecil J.
*Olson, Stanley G.
Oscarson, Philip E.
Sung, Kuo Hsiang

Metallurgical Engineer

Curran, Francis J.
Forsyth, Arthur C.

Engineer of Mines in Geology

Graeber, Clyde F.
Knutson, Clarence J.
Nelmark, John H.
Stewart, James L.

1925

Engineer of Mines

Haley, A. J.
Hennen, E. H.
Kamb, Hugo R.
Kendrick, W. L.
Mann, Victor I.
Sherman, Howard P.
Trulander, William

Metallurgical Engineer

Johnson, George A.
Winter, Harry
Larpenteur, Bernard J.
Runke, D. H.
Scheid, C. F.
Sodoma, J. L.

Engineer of Mines in Geology

Olson, Walter S.

1926

Engineer of Mines

Alexander, J. W.
Bodal, Emil K.
Griffith, E. H.
Haase, C. C.
Johnson, A. M.
Martin, H. K.
Studer, R. J.
Van Duzen, E. N.

Metallurgical Engineer

Boreen, M. S.
Huck, G. M.
Johnson, R. L.
Thomassen, M. W.
Wiley, R. E.

Engineer of Mines in Geology

Andrews, T. F.

1927

Engineer of Mines

Aanes, Ole O.
Arnold, Lowell W.
Caddy, Howard T.
Coolidge, Marshall H. Jr.
Moyle, Robert M.
Nelson, Evald W.
Sylvester, Robert E.

Metallurgical Engineer

Deringer, Paul J.
Durfee, John C.
Gow, James T.
Jerabek, Theophil E.

Engineer of Mines in Geology

Armstrong, Lee C.
Bloom, John R.
Hendry, Lynne D.
Pixler, Everett T.

ALPHABETICAL DIRECTORY

College of Engineering and Architecture

Aasland, Arne '23 C
3400 Russell Ave. N., Minneapolis, Minn.

Aasland, Christopher '15 C
Box 996, Miles City, Mont.
Montana R. R. Co., Resident Engineer.

Abbott, Amos H. '16 E '17 EE
6th and Cedar St., St. Paul, Minn.
Northern States Power Co.
Supt., Gas Distribution.

Abbott, Arthur L. '97 E
Technical Director, Assoc. of Electragists, International. 15 West 37th St., New York City.

Abrahamson, Howard B. '18 M
St. Paul, Minn.
Northern States Power Co., Engineering Department.

Abramson, Harry W. '23 C
Chelsa Hotel, Sheridan Rd., Chicago, Ill.

Acker, Sidney H. '23 M
St. Louis and San Francisco Ry.,
Springfield, Mo.

Acomb, William E. '02 M
Waukegan, Illinois.
American Steel & Wire Company.
Supt., Waukegan Works.

Adams, Benjamin W. '10 C
604 N. Mead Ave.,
Glendive, Mont.

Adams, Edward H. '22 G
1004 Marquette Ave., Minneapolis.
Owner of E. H. Adams Construction Co.

Adams, Elmer E. '06 C
Spokane, Wash.
District Engineer, Great Northern Ry.

Adams, George F. '95 E
Realty Bldg., White Plains, N. Y.
Realtor.

Adams, John W., Jr. '12 C
2213 Grand Ave., Minneapolis, Minn.

Adams, William C. '05 E
Chief Engr., Northern Electric Co.
121 Shearer St., Montreal (Quebec), Can.

Adler, Eugene H. '14 E '15 EE
Hot Springs, S. D.
Water, Light and Power Co.

Ainslie, Arthur F. '11 C
Staples, Minn.

Ageton, Edwin O. '26 E
810 1st St. S. W., Watertown, S. D.

Albrecht, Ernest G. '25 E
St. Paul, Minn.
Tri-State Tel. and Telg. Co.

Albrecht, George M. '06 E
Allis-Chalmers Manufacturing Co.,
Milwaukee, Wis.
Patent Attorney.

Albrecht, Karl J. '25 E
Washington, D. C.
U. S. Patent Office,
Jr. Patent Examiner.

Aldrich, Louis W. '23 C
240 S. Broadway, Los Angeles, Calif.
Engineering Dept., City of L. A.
Civil Engineer, Street Design Division.

Alexander, George D. '20 C
916 New York Life Bldg., City.
J. W. Shaffer Co.

Algren, Axel B. '25 M
2300 2nd St. N., Minneapolis.
A. T. Rydell, Inc., Production Engineer.

*Allbee, Pierce '16 A

Allee, David A. '02 C
Room 643, Schenectady, N. Y.
General Elec. Co.

Alrick, Bannona G. '06 C
300 Builders Exchange Bldg., Minneapolis.
C. A. P. Turner Co.

Alsop, Ernest B. '06 C
Arling, Idaho.
Morrison-Knudsen Co., Engr. and Supt.

Alton, Herbert D. '07 E
2004 Sprague St., Spokane, Wash.
Electrical Contractor.

Amidon, Lee L. '23 M
Morgantown, W. Va.
Instructor, Dept. Steam and Exp.
Eng'g, W. Va. University.

Andersen, Christian '88 C
New Post Office Bldg., Portland, Ore.
Engineer, Bureau of Public Roads.

Andersen, Edward I. '17 M '19 ME
Attica, N. Y.
Attica Works, Westinghouse Elec. and Mfg. Co., Manager.

Anderson, Arthur P. '25 E
10 Illinois St., Chicago Heights, Ill.
Public Service Co. of Northern Ill.

Anderson, Arthur R. '12 E
1114 Mission St., San Francisco, Cal.
Lundstrom Hat Works, Salesman.

Anderson, Clifford H. '26 C
527 Sixth St. S. E., Minneapolis, Minn.

Anderson, Edward S. '21 E
International Falls, Minn.
Minnesota and Ontario Paper Co.
Elect. Const. Engr.

Anderson, Emil '05 E
240 Plymouth Bldg., Minneapolis, Minn.
Standard Electrical Service Co.

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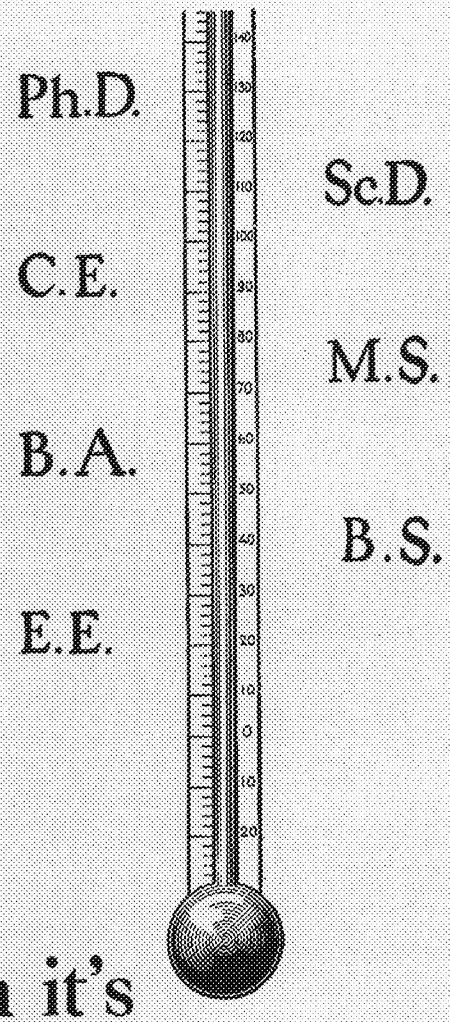


When it's 18,000 degrees—*in June*

B. A., B. S., E. E., C. E. and many others soon to be awarded to thousands of students throughout the land.

Degrees representing a wide variety of work, and all of them qualifying the graduate to enter the broad field of electrical communication.

For men of technical training, of course, and for many others besides—salesmen, accountants, purchasing men, potential executives—here is an industry in which America leads the world, but which is only on the threshold of greater things.

Western Electric Company

Makers of the Nation's Telephones

Number 70 of a Series

CHICAGO
McMillan, Franklin R. '05 C
Mackay, Donald H. '26 E
Maiser, Walter S. '23 C
Markoe, James C. '12 M
Meagher, Joseph '25 E
Messer, Harold D. '23 M
Moreno, Gerardo '23 E
Morris, John O. '88 M, '03 ME
Nasvik, Adolph C. '26 C
Newbery, Lester W. '22 C
Nimmer, Walter B. '26 E
Olson, C. Milford '24 C
Olson, Kenneth M. '25 C
Olson, Roy H. '23 E
Olson, Vernon H. '25 C
Pangburn, Carroll '22 E
Pardee, C. A. '12 E, '13 EE
Peoples, John S. '14 M
Peterson, Albert E. '19 E
Peterson, Clarence R. '25 C
Peterson, Vance C. '20 E
Pierson, Joe W. '19 E
Podosin, John '21 E
Postma, John '25 E
Putnam, George W. '18 G
Rankin, Dean W. '25 AE
Rankin, Renville S. '14 C
Rezab, John J. '07 E
Rickman, Herman W. '17 C
Rosenthal, Paul '22 C
Ross, Kenneth R. '24 M
Ruemmele, A. F. '12 M, '13 ME
Russell, Winfred W. '23 E
Sandberg, Clifford H. '26 C
Schroeder, Clarence A. '26 C
Sear, Arthur W. '23 M
Selander, Karl W. '22E
Sheekman, Harvey Z. '24 E
Skagerberg, Rutcher '15 E, '16 EE
Somero, Waino M. '24 C
Sorenson, John E. '22 E
Sperry, Leonard B. '05 M, '08 EE
Staehle, Gilbert C. '20 C, '22 MS
Steffens, Robert A. '22 E
Strate, Thomas H. '01 C
Strom, Arthur '23 A
Sullivan, Frederic V. '25 C
Swift, George E. '23 E
Taylor, Richard G. '25 E
Thompson, Everett '23 C
Turner, Leslie E. '09 E
Waby, Delton '23 M
Waligoski, A. Arnold '24 E
Ward, Alvin C. '23 E
Weber, Hanard P. '24 E
Wenrich, James R. '26 E
Wicklund, Paul E. '25 AE
Widell, Gustaf F. '08 C
Williams, Fred M. '05 E, '09 EE
Williams, Myrl J. '20 M
Williams, Percival H. '22 E
Williams, Wilbur S. '09 M
Willis, David C. '23 E
Wilson, Frank W. '23 E
Wyly, Lawrence T. '20 G

CHICAGO HEIGHTS
Anderson, Arthur P. '25 E
Heggen, Reuben '24 E

CICERO
Holmstine, Ralph D. '24 M
Jacobson, Reuben A. '25 M
Pavek, William J. '19 M, '20 ME
Wiggens, John B. '23 E

DECATUR
Elwood, Daniel H. '23 E

DIXON
Marcroft, Harold C. '24 E
Silverman, Emil '22 C

GENEVA
Kapphahn, Ernest H. '19 G

HOMEWOOD
Sommerfeld, Adolph A. '10 C

JOLIET
Emerson, Lynn A. '11 E
Halikat, Franklin J. '26 C
McCoy, Ira C. '11 E
Meyerdick, Clarence C. '26 C
Stoner, Clifford M. '24 C

LA GRANGE
Anderson, Ole A. '93 M, '08 ME

LA SALLE
Peck, Lloyd '23 C
Pierce, Walter H. '26 M

MAYWOOD
Kruse, Orlin O. '20 E

OAK PARK
Cottingham, George, Jr. '15 C
Forsmark, Ulrik E. '26 E
Juell, A. Barton '26 C
Olson, Arnim G. '22 E
Sausen, Bert R. '13 M
Wicks, John '04 E

OZARK
Ott, Leonard E. '15 C

PARK RIDGE
Teberg, Ernest J. '16 E, '17 EE

ROBINSON
Uzzell, George W. '07 E

ROCKFORD
Bates, Albert H. '05 M
Harwood, Stanley G. '08 M

THOMPSONVILLE
Kroll, Arthur J. '25 C

URBANA
Larson, Louis J. '14 C, '15 CE

WAUKEGAN
Acomb, William E. '02 M
Umbehocker, Frank '21 M

WESTERN SPRINGS
O'Brien, Thomas E. '25 C

XENIA
Weis, Wallace D. '21 C

INDIANA

BELFORD
Saltwick, Andrew '24 M

EVANSVILLE
Winslow, Harry J. '23 E

FORT WAYNE
Beveridge, Robert A. '26 E
Cass, Hoyt R. '24 E
Ellis, Carl E. '25 E
Richardson, Philip E. '25 E

GARY
Cotthingham, William P. '11 C

INDIANAPOLIS
Prentice, Robert S. '08 E
Ransom, Glen B. '22 E
Wagner, Adolph '98 E

SOUTH BEND
Mehandru, Behari L. '24 M
Muessel, Robert W. '21 C

VALPARAISO
Lauritzen, Carl W. '24 E

IOWA

AMES
Cosandey, Charles J. '25 E

BOONE
Lantz, Reuben '25 A

CEDAR RAPIDS
Blomquist, Hjalmar '07 C

CHARLES CITY
Finke, Walter J. '10 E

DAVENPORT
Auxer, William L. '25 C
Meyer, Malcolm B. '09 M

DES MOINES
Ash, J. Wesley '08 C
Reeve, Howard E. '23 E

DUBUQUE
Madden, Francis '03 C

JANESVILLE
Wild, Carl D. '15 C, '16 CE

LOGAN
Bradley, Byron H. '13 C, '14 CE

MARSHALLTOWN
Weatherill, Cedric '14 C, '15 CE

MASON CITY
Cribbs, Harry E. '23 C
Judd, Maurice D. '23 C
Ost, Roland E. '22 C

NEWTON
Stanius, Godfrey '21 E
Thayer, Paul W. '14 M, '15 ME

OAKLAND
Haines, Howard N. '23 A

OTTUMWA
Triem, Ralph H. '20 E

REDFIELD
Olsen, Arthur O. '10 C

SIOUX CITY
Arzt, Emmanuel A. '97 E, '99 EE
Mitchell, Lloyd S. '23 C
Ward, John, Jr. '23 C

WATERLOO
Nordenson, Willard '26 M

KANSAS

ARKANSAS
Werdenhoff, James H. '21 C

ATCHISON
Hastings, Clive '96 M

FORT RILEY
Grow, Robert W. '16 C

KANSAS CITY
Langman, Harley R. '24 M

MANHATTAN
Graham, Eugene C. '02 B
Kleinschmidt, Florian A. '22 M

PITTSBURG
Woodman, Howard H. '97 C

KENTUCKY

DUBLIN
Donahue, Stephen '25 C

LOUISVILLE
King, Harvey '18 A

MIDLAND
Peterson, Neander E. '22 C

PADUCAH
Bartholomew, Neal W. '25 C
Knapp, Lester '12 E

LOUISIANA

MARRENO
Fleming, Douglas R. '08 C

MERRARO
Mills, Hartzell '25 M

MARYLAND

BALTIMORE
Billau, Lewis S. '05 E
Peterson, Arthur F. '19 E
Tuve, Merle A. '22 E

COLLEGE PARK
Linden, Henning '17 E

MASSACHUSETTS

BOSTON
Emery, George C. '19 A
Lang, James S.
'96 M, '97 EE, '99 ME
McVean, Norman S. '21 E
Miller, Andrew L. '21 E
Nebel, Walter H. '11 E
Paulsen, Thorwald '22 C
Payne, Harold G. '06 E
Reuter, Peter T. '21 M
Walker, Frank B. '07 C
Webster, Harry M. '15 E
Woodward, Herbert M. '90 M

CAMBRIDGE
Forssell, William O. '22 G
Graf, Donald T. '22 A
Lockwood, Raymond '20 E
Plowman, George T. '92 A
Silverman, Isadore W. '24 A

FRANKLIN
Tomlinson, L. C. '04 E

NORWOOD
Korslund, Harry J. '20 A

PITTSFIELD
Currie, Neill, Jr. '08 E
Goodwin, Victor E. '04 E

SPRINGFIELD
Jones, Ivor V. '15 C

MICHIGAN

ANN ARBOR
Barnum, Charles R. '24 A
Dow, William G. '16 E, '17 EE
Hourn, Frederick W. '12 E, '14 EE
Orbeck, Martin J. '11 C

BESSEMER
Holmberg, Abner W.
'15 M, '16 ME

DETROIT
Ascher, Raymond C. '23 M
Babcock, Vernon M. '23 E
Brooke, Harold L. '18 E
Dale, Dallas W. '24 M
Dedic, Richard J. '24 C
Elliot, Harry C. '19 M
Hoppin, Glenn H. '08 E
Huntoon, Milton B. '99 E
Loye, Benjamin W. '06 M
Malmstrom, Axel L. '17 E
Nelson, Elmer A. '23 C
Rand, Lars '13 ME, '12 M
Shepard, Donald D. '11 E
Staehle, Haswell E. '24 M
Wennerlund, Elias C. '99 M
Wilk, Benjamin '13 C, '14 CE
Young, Edward F. '26 C

FLINT
Anderson, Joseph A. '24 M
Murray, John H. '17 M
Rhame, Paul W. '20 M
Simms, Charles G. '24 M

GRAND RAPIDS
Lyon, Glenn H. '20 A
Mahoney, William L. '13 E, '14 EE
Nelson, Edwin W. '25 C
Tallmadge, Hiram '16 E, '17 EE

IRONWOOD
Sears, Dow I. '14 C

JACKSON
Briggs, William G. '21 E

ROGERS CITY
Sandvig, Lawrence A. '26 C

SAULT ST. MARIE
Fenton, Paul C. '26 C
Sawyer, Emerson D. '10 C

MINNESOTA

ALBERTA
Schlattman, Edward C. '08 C

ALBERT LEA
Dock, Chester '22 G
Pless, Arnold '20 C

ALEXANDRIA
Lewis, John G. '24 E

ANOKA
Childs, Hervey R. '06 C
Reed, Arthur L. '06 C

ATWATER
Swenson, Charles '07 C, '10 LLB

AUSTIN
Bisbee, Bertin A. '22 E

BARNUM
Wood, Victor R. '22 C

BELLINGHAM
Strege, Henry '24 E

BEMIDJI
Shuirman, Gabe '21 E

BLOOMINGHAM
Scott, Elmer C. '15 C, '16 CE

BRAINERD
Croswell, Leslie D. '26 C
Davison, Joseph H. '03 C
Jones, Harold W. '25 C
Skarolid, Charles J. '24 E

BRECKENRIDGE
Brataas, Mark '17 C

BUHL
Walker, George W. '08 C

CALLAWAY
Chilton, Edward G. '13 C, '14 CE

CANBY
Thompson, Theodore S. '24 C

CANNON FALLS
Slade, Loring '22 C

CARLTON
Nickerson, Neal C. '18 C

CHISHOLM
Anderson, George T. '15 C
Elstad, Rudolph T. '19 C
Hammerstrom, Aleck A. '21 E
Olson, Elmer J. '23 C

CLOQUET
Schlenk, John J. '23 C

CORDEN
Peterson, Everett L. '25 A

COLERAINE
Battles, Leon E. '18 C

CROOKSTON
Riedesel, George M. '17 A

DETROIT
Gunstad, Paul I. '01 C
Hvoslef, Frederick W.
'17 M, '19 MS

DULUTH
Anderson, Milton J. '20 A
Bishop, Ira L. '11 M
Bleifuss, Donald '20 C
Buck, Frederick W. '09 M
Burke, Ray L. '05 C
DeFreece, Paul K. '23 C
Dinsmore, Arthur T.
'12 M, '13 ME
Dorsey, John G. '15 C, '16 CE
Fee, E. Franklin '07 M
Flaaten, Percy H. '26 C
Gilbert, Roy '20 C
Grettum, Walter A. '24 E
Hibbard, Sheldon S. '23 M
Holbeck, John I. '24 E
Holmes, Raymond H. '25 E
Hoyt, William H. '95 C, '98 CE
Hustad, Byron P. '10 E
Jaques, Robert '09 C
Kapphahn, R. J. '12 C, '13 CE
Kelly, Earl W. '07 C
Knutson, Harry '17 M
Larson, Victor F. '17 M
McEachin, John L. '22 E

DULUTH

Magnuson, John E. '22 E
Martino, Anthony '25 M
Melander, Albin R. '21 A
Mitchell, L. Morris '14 C, '15 CE
Mork, George W. '26 M
Nelson, Edward K. '24 M
Nelson, Einer '24 M
Nystrom, Paul E. '24A
Olin, Henry A. '23 E
Olson, Arthur L. '24 M
Pulver, Richard F. '23 E
Quinn, John '08 C
Ringsred, Arthur C. '06 M
Rose, Norman W. '06 M
Ross, Russell H. '18 E
Schwedes, Walter F. '06 E
Seemann, Ernest W. '20 C
Simmonds, Richard R. '21 C
Sneve, Jack S. '11 M
Spring, Willis W. '07 M
Stewart, Clarence H. '03 C
Tennstrom, Carl H. '23 C
Tondell, Mandell '07 C
Turnquist, Axel A. '16 E, '17 EE
Williams, William R. '26 E
Wilson, Walter E. '24 C

ELK RIVER

Longfellow, Dwight W. '08 C
Normann, Rolf A. '24 C
Washburn, Delos C. '93 A

ELY

Kauppinen, Heino '25 E

EVELETH

Damberg, Paul S. '22 A
Nastlund, Gustave A. '26 A
Shavor, George J. '25 E

FAIRMONT

Curtis, Thomas H. '12 C
Eustis, Irving N. '17 M, '18 ME
Kasper, Walter '11 M
Starrett, Howard M. '09 M

FARIBAULT

Crawford, Wallace '06 M
Hanrahan, Edmond C. '20 G
Klemer, Frank H. '01 C
McKellip, Frank W. '98 E

FEDERAL DAM

Poore, Orson B. '09 E

FERGUS FALLS

Frankovitz, John J. '05 E
Hallan, Christian '02 C

GAYLORD

Deterling, Edward W. '26 E
Hecht, Henry W. '24 E
Johnson, Raymond V. '24 C

GLENCOE

Hankenson, John J. '92 C

GRANITE FALLS

Lende, Henry M. '20 C

GROVE CITY

Nelson, Richard L. '21 E

HALSTAD

Forseth, George O. '25 M

HASTINGS

Howard, Monroe S. '92 E

HIBBING

Blomberg, Evar H. '16 E, '17 EE
Friedman, Edwin A. '25 E
Pan, Wen P. '16 C
Reeve, Charles H. '19 E
Scott, Franklin B. '26 E

HOPKINS

Anderson, Harvey B. '12 C, '13 CE

HUTCHINSON

Higgins, Elvin L. '92 C
Sherwood, Edward R. '20 C

INTERNATIONAL FALLS

Anderson, Ed. S. '21 E
Hass, Paul O. '26 M
Wilson, Roy A. '25 M

KEEWATIN

Bingen, William J. '12 C, '13 CE
Leach, Edward W. '10 C

LAKE CITY

Tews, Arthur W. '24 C

LESUEUR

Little, LeRoy C. '24 E

LITTLE FALLS

Donahoe, Robert E. '21 E, '22 EE
Ryan, Lojel S. '12 C, '13 CE

LONG LAKE

Kelley, William '22 C

MANKATO

Gerlach, Henry C. '22 A
Kleinschmidt, Armin R. '22 M
Nelson, Edgar M. '24 E

MAYNARD

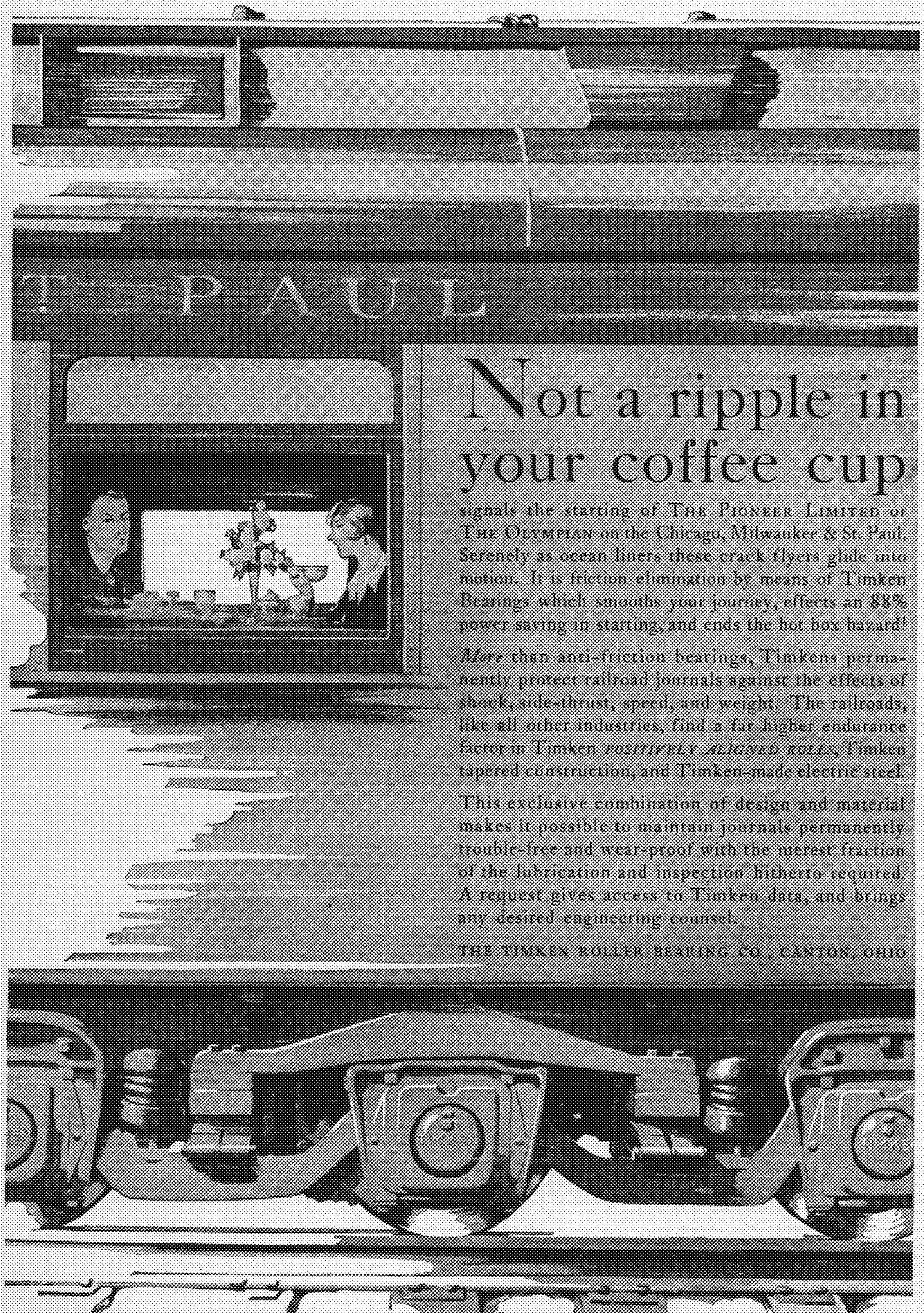
Johnson, Alexander B. '15 C

MENDOTA

Braddock, Edward '24 C

MINNEAPOLIS

Aasland, Arne '23 C
Adams, Edward H. '22 G
Adams, John W. '12 C
Alexander, George D. '20 C
Algren, Axel B. '25 M
Alrick, Bannona G. '06 C
Anderson, Clifford H. '26 C
Anderson, Emil '05 E
Anderson, Frank L. '16 E
Anderson, Helmer N. '20 M
Anderson, Hilder A. '18 M
Anderson, John G. '99 C
Anderson, Joseph W. '15 E
Anderson, Matthew '24 E
Anderson, Nels S. '22 C
Andrus, Raymond J. '07 E
Arstad, Leonard O. '24 E
Aske, Irving E. '20 E
Asleson, Hans '10 C
Austin, Paul D. '21 E
Avery, Henry B. '93 M, '98 ME
Bacheider, William H. '24 C
Backstrom, Russell E. '25 M
Backstrom, Wilburg A. '23 A
Bakken, Lawrence H. '22 A
Balkin, Samuel W. '26 C
Bancroft, Henry K. '26 M
Barger, Harold L. '21 E
Barnum, Marvin C. '11 M
Beck, Vernon S. '10 E
Beery, Charles B. '09 M
Bell, Maurice D. '07 M
Benson, Ikel C. '25 E
Berg, Swan P. '23 C
Berg, Thorsten H. '25 C
Bergford, Lester M. '23 C
Bergford, Rolf E. '23 C
Bergquist, Edwin T. '24 C
Bergstrom, Marlow R. '22 E
Beseler, Herman F. '25 M
Bevan, R. Louis '24 C
Biskup, William F. '16 C
Bierre, Folmar I. '25 M
Bleecker, George W. '16 E
Blue, Clarence W. '25 C
Boehnlein, Charles '17 M, '19 ME
Boerner, Francis C. '11 C
Bordeau, Sanford P. '25 E
Bouquet, Otto T. '23 E
Boyum, Irvin '17 E
Brenchley, Harry E. '08 C
Bros, Bernard M. '23 M
Bros, Chester W. '22 M
Bros, Ernest T. '17 M
Bros, Raymond J. '19 M, '20 ME
Brossard, Henry F. '25 E
Brown, Floyd W. '17 A
Brownell, Otto E. '10 C
Bruce, Hjalmar N. '16 C, '17 CE
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
Burt, Paul R. '26 M
Capstick, Donald W. '22 G
Carlbom, Leonard H. '25 C
Carlson, Anders J. '16 C, '17 CE
Carlson, Warren E. '24 E
Carr, Harvey '03 C
Carter, Robert J. '08 E
Chalmers, Charles H. '94 E, '03 EE
Chernus, Maurice C. '22 C
Childs, James A. '09 C
Christen, Ray L. '26 E
Christensen, Arthur L. '25 E
Clarke, Charles P. '08 C, '09 CE
Collins, Stewart G. '04 G
Colvin, James A. '14 M, '15 ME
Comb, Fred R. '10 M
Cooper, Leo H. '06 E
Cooper, R. Conrad '26 C
Corbett, Theodore R. '26 M
Corser, John '16 M
Cote, Rhoda H. '25 ID
Critchett, Edward F. '13 M, '14 M
Croft, Edna K. (Miss) '22 A
Croft, Ernest B. '11 C
Crounse, Avery F. '03 G
Curtis, Verne '22 M
Cutler, Alvin S. '05 C
Dahlstrom, Raymond E. '10 E
Davies, Ralph M. '09 E
Dawson, John W. '22 A
Deane, George R. '19 A
Deinema, George R. '26 E
Del Plaine, Carlos W. '21 C, '22 CE
Diment, J. Morton '24 E
Dimmick, Merton A. '26 C
Dindorf, Edward C. '23 C
Doell, Charles E. '16 C, '17 CE
Doolittle, William Y. '14 C
Dorrance, Albert P. '12 E
Douglass, Addison H. '17 C, '20 CE
Dresser, Harry S. '16 M
Drinkall, Leon R. '19 E
DuToit, George A. '10 M
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
Ellingson, Elmer '16 C
Elliott, A. Douglass '14 E, '15 EE
Ellsworth, Charles D. '20 E
Elmburg, LeRoy M. '25 AE
Elsberg, Nels W. '09 C
Enger, Arne '22 E
Enger, Edward H. '11 C
Erickson, Clarence P. '25 A
Erickson, Edwin C. O. '22 C
Erickson, Henry A. '96 E
Erskine, Robert K. '24 M
Estabrooks, Clyde F. '24 M
Everett, William R. '03 E, '15 EE
Fager, Simon R. '04 M
Farmer, John W. '21 M
Farnam, Julian P. '11 M
Feldman, Carl R. H. '26 E
Felton, Ralph P. '92 M
Ferguson, Kenneth R. '26 C
Fiene, Marcus '26 E
Finley, Joseph E. '05 C
Fiske, Harold C. '22 E
Fitzgerald, William J. '20 C
Flindt, Richard H. '23 C
Ford, Robert E. '95 E, '03 EE
Forfar, Donald M. '09 M
Forsberg, Enock E. '18 A
Fossen, George '17 C
Foster, Kenneth W. '26 C
Frantz, Willard F. '25 C
Friar, Floyd M. '20 C
Fruen, Arthur B. '08 G, '09 CE
Fusher, J. Roscoe '24 E
Garber, Gabriel E. '06 M
Garthus, Ira B. '24 E
Garzon, Julian R. '24 C
Gee, Harry J. '19 G
Gemmell, John H. '14 M, '15 ME
Gerlach, W. D. '26 A
Gerow, Theron G. '20 M
Gerrish, Harry E. '05 M
Gillete, George L. '05 C
Gilman, James B. '94 C
Gjesdahl, Maurice S. '21 M
Godward, Alfred C. '10 C
Goebel, Rudolph C. '13 E, '14 EE
Gould, Edward S. '20 C
Gray, William I. '92 E, '98 EE
Green, Chauncy L. '24 E
Greiner, Harry S. '24 E
Guesmer, Marie W. (Miss) '26 ID
Guggisberg, Charles F. '17 M
Hafstad, Lawrence R. '26 E
Hagelin, Lawrence W. '22 E
Hammer, Harold E. '25 E
Hammond, Laurence D. '14 M, '15 ME, '19 MB, '20 MD
Hankins, Nathaniel R. '24 C
Hanna, Cyril C. '26 M
Hansen, Christian, Jr. '10 E
Harrington, Russell A. '24 E
Harris, Harold R. '14 E, '15 EE
Nathan, Harris '20 G
Harris, Sigmund '05 M
Hartig, Henry E. '18 E
Hartney, James L. '14 M, '15 ME
Hartzberg, Edward M. '19 M
Hawkins, Harvey C. '23 E
Heath, Donald C. '16 A
Heidelberger, Otto F. '23 E, '24 MS
Helmick, Dan S. '15 C
Herberg, Sanford '24 C
Herrick, Carl A. '02 M
Herrmann, Raymond R. '12 E, '13 EE
Hibbard, Truman '97 E
Hickok, Mrs. Harvey (Miss Jesse E. Stevens) '96 C, '04 MS
Higgins, John T. '90 C, '94 MD
Hildebrandt, H. A. '99 E
Hill, Edward L. '25 E
Hill, Hibbert M. '23 C
Hirleman, Clark W. '12 M, '13 ME
Hobart, Walter B. '07 C
Hoffman, John R. '26 C
Holcomb, Harry S. '26 E
Hopkins, Mark L. '09 E
Hotchkiss, Fred W. '18 E
Houlton, Amos D. '01 E
Houston, George S. '02 C
Hubbard, Henry A. '09 C
Huhn, George P. '91 E
Hustad, Andrew P. '09 C
Hustad, John C. '14 C, '15 CE
Jackson, Otto E. '14 E, '15 EE
Jacobsen, Arthur C. '24 E
Jacobson, Frank H. '24 E
Jacobson, Howard C. '21 G
Jakkula, Arne A. '26 C
Jensen, John A. '05 C
Johnson, Alphonse N. '21 C
Johnson, Clifford S. '26 C
Johnson, Edgar W. '14 C, '15 CE
Johnson, Elmer W. '14 E, '15 EE, '23 ME
Johnson, Enan C. '25 E
Johnson, Ira L. '16 M, '17 ME
Johnson, James R. '26 C
Johnson, Nels '23 C
Johnson, Robertson B. '25 E
Johnston, Charles K. '21 E
Jones, George K. '14 E, '15 EE
Kaplan, Serman '18 A
Kapple, Frederick R. '24 E
Katter, Reuben L. '22 M
Keeler, Jasper F. '22 C
Kelly, William J. '26 E
Kinsell, William L. '00 E
Kline, Frank W. '24 E
Knoll, Franklin O. '25 E
Kotz, Walter E. '23 C
Krafft, Edwin A. '24 A
Krefting, Arthur S. '26 C
Kronick, T. Gerald '26 A
Kvitrud, Ingwald '11 C
Lagaard, Alex S. '13 E, '14 EE
Lambert, Edwin M. '09 M
Lang, Charles A. '06 E
Lang, Fred C. '08 C
Langland, Harold S. '19 E
Larson, Amandus C. '20 C
Larson, Carl '16 C
Larson, Glen M. '23 M
Laurence, Paul A. '12 G
Lebeck, Carl E. '20 C
Lebeck, Torarin E. '24 E
Lee, Oscar C. '19 E
Levens, Alexander S. '22 C
Levin, Jake M. '18 E
Lewin, Sherman W. '26 C
Lewis, Berkeley R. '25 E
Lewis, Edward B. '05 M
Lewis, George R. '21 M
Liebenberg, Jacob J. '16 A
Lighter, Clyde W. '26 A
Lindstedt, Philip G. '26 C
Lipchick, Alex A. '26 C
Love, Percival E. '21 E, '22 EE
Lund, Clarence V. '26 C
Lund, Roy V. '24 C
Lundgren, Carl W. '26 M
Lundquist, C. Vernon '25 M
Lutz, Richard E. '13 E
Lyberg, Verele C. '26 E
McClung, Karl '25 E
McCullough, Bruce M. '16 C
McKay, Earle D. '15 C, '16 CE
McKenzie, Leonard F. '20 E
McLeland, Lyle K. '24 E
Mabbott, Leonard E. '24 E
Malmgren, Richard '25 E
Maney, George A. '11 C
Maugney, Elmer J. '21 E
Magney, Hilding O. '24 E
Mann, Alvin K. '26 E
Mann, Fred M. '93 C, '98 CE
Markuson, Miner J. '23 A
Marshall, Chester R. '23 M
Mattison, Oliver '05 C
Mayer, Harris J. '14 M, '15 ME
Meader, Glenn S. '26 E



ST. PAUL
Not a ripple in your coffee cup
signals the starting of The Pioneer Limited or The Olympian on the Chicago, Milwaukee & St. Paul. Serenely as ocean liners these crack flyers glide into motion. It is friction elimination by means of Timken Bearings which smooths your journey, effects an 88% power saving in starting, and ends the hot box hazard!
More than anti-friction bearings, Timkens permanently protect railroad journals against the effects of shock, side-thrust, speed, and weight. The railroads, like all other industries, find a far higher endurance factor in Timken *POSITIVELY ALIGNED ROLLS*, Timken tapered construction, and Timken-made electric steel.
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THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

Minneapolis
- Meih, Rudolph E. '22 G
- Mentzer, Clarence A. '22 E
- Merriell, Elmer W. '12 S, '13 EE
- Merrill, Lewis E. '20 M, '21 ME
- Meyer, Herbert W. '14 E
- Mindrum, Arthur I. '26 E
- Mixer, Walter R. '17 A
- Moiskness, Nels S. '20 E
- Moore, Clarence '20 G
- Morris, Frank A. '24 M
- Morse, George '93 A
- Morton, Harry G. '04 E
- Mowery, Clarence W. '08 C
- Moyer, A. F. '10 M
- Nash, Russell O. '23 E
- Nason, George L. '10 C
- Nelson, Clarence H. '25 E
- Nelson, Clarence L. '20 E
- Nelson, Gustaf A. '19 E
- Nelson, Nels B. '04 C
- Nelson, Oscar B. '05 C
- Nelson, Paul B. '26 E
- Nelson, Robert B. '26 E
- Nemer, Frank L. '09 M
- Neubauer, Loren W. '26 C
- Newhall, William B. '00 M
- Nichol, Frank E. '25 C
- Nickerson, Edward '25 E
- Nielson, Eunice V. '23 A
- Noble, John F. '21 G
- Nordenson, Arnold '22 M
- Nordlien, Berger W. '22 E
- Nordstrom, Milton E. '25 C
- Nordvall, Glenn '23 E
- Norrbom, Oscar '26 M
- Nyvall, Clifton S. '26 C
- Olmstead, Charles '22 M, '23 ME
- Olsen, Melvin S. '08 C
- Olson, Edwin E. '23 A
- Orning, Harold '26 E
- Orr, George M. '15 M
- Otto, Robert W. '04 M
- Parker, Helen R. '25 ID
- Parker, Robert M. '24 C
- Parry, John E. '26 E
- Paul, Frederick T. '09 C
- Pelley, Lloyd L. '24 E
- Pendergast, Webster G. '25 M
- Persom, Otto C. '24 AE
- Pesek, Cyril P. '23 AE
- Peterson, Harold W. '21 E
- Peterson, Laurence L. '25 M
- Pike, Jay R. '26 M
- Powell, Louis H. '24 C
- Pratt, B. A. '15 C
- Prendergast, Arthur '93 C
- Priedeman, George W. '08 M
- Quiggle, Arthur W. '13 C, '14 CE
- Raugland, Arnold I. '20 A
- Redin, R. K. '26 AE
- Reed, Henry R. '25 E
- Reidhead, Frank E. '93 E, '98 EE
- Rhoades, Herbert E. '26 E
- Ritchie, John R. '16 M, '17 ME
- Robertson, B. J. '14 E, '15 EE
- Robinson, Parke D. '25 M
- Roos, Frank T. '24 C
- Rosenberg, Rahil A. '24 A
- Rosendahl, Harold R. '22 M
- Schaller, George C. '23 C
- Schilling, Theodore '24 E
- Ryan, Robert M. '23 E
- Ryan, W. T. '05 E
- Salisbury, Willis R. '10 G
- Sampson, Cliff. L. '23 E, '25 EE
- Schlenk, Hugo '18 E
- Schmidt, Roland L. '23 C
- Schuck, Roy D. '25 E
- Schwartz, John S. '19 A
- Schweiso, Clifford C. '23 E
- Scott, Herbert L. '23 E
- Sebo, Arthur O. '24 M
- Sesseng, Gunnar '24 M
- Shenehon, Francis '95 C, '00 CE
- Shepley, Charles R. '02 C
- Siverts, Samuel A. '09 C
- Sjoberg, Roy H. '26 E
- Skurdalsvold, P. '15 C, '16 CE
- Slaby, Louis J. '26 M
- Smith, Harold D. '23 E
- Smith, Verna G. '25 ID
- Snyder, Dorothy E. '26 M
- South, W. A. '12 C, '13 CE
- Springer, F. W. '93 E, '95 EE
- Stephens, Clifford '23 C
- Stephenson, Oliver H. '07 M
- Sternberg, Carl '07 E
- Stimart, Elwood L. '24 E
- Stone, Charles W. '16 M, '17 ME, '19 MS
- Sutherland, Samuel J. '23 AE
- Svendsen, George P. '08 E
- Swanson, Edwin W. '19 E
- Swanson, Paul H. '23 C
- Swanson, Philip G. '23 M
- Swanstrom, Frank N. '08 E
- Swedberg, M. Roy '11 C
- Sweet, Ray R. '21 E
- Swenson, George '17 E, '21 EE
- Swenson, Gustav A. '20 G
- Swenson, H. Seymour '12 C, '13 CE
- Taplin, George C. '24 E
- Thayer, Charles E. '76 C
- Tholstrup, Henry L. '26 E
- Thomas, Richard L. '25 E
- Thompson, Harry T. '16 E, '16 EE
- Thomson, Andrew '25 E
- Thorshov, Olaf '21 A
- Thyberg, Clarence W. '25 E
- Tighe, James S. '26 E
- Timperley, William D. '10 C
- Todd, Milo E. '09 E
- Torrance, Eli '09 C
- Trask, Alfred S. '23 E
- Trask, Birney E. '90 C, '94 CE
- Trcka, Benj. C. '24 E
- Tryon, Philip D. '17 C
- Tucker, Carl W. '26 M
- Tupper, Charles E. '15 M
- Turner, Roy H. '15 E, '16 EE
- Ungerman, Carl M. '06 E
- Uutinen, August L. '25 E
- Upton, Albert '25 E
- Vaale, Sven A. '21 M
- Vincent, Jay C. '03 E
- Walby, Arthur C. '11 C
- Walling, Benjamin B. '09 E
- Walquist, John A. '23 A
- Wangaard, Oscar H. '12 C, '13 CE
- Watson, Fred G. '16 C
- Weigel, Howard N. '14 C, '15 CE
- Wentz, Walter W. '14 E, '16 EE
- Westigard, Glenn A. '25 E
- Whitney, Alfred C. '03 G
- Wichman, Martin F. '22 E
- Wilcox, Hugh B. '14 E, '16 MS
- Williams, Charles A. '16 C
- Williams, Roy N. '23 E
- Wills, Arthur D. '21 A
- Willson, Stuart V. '24 M
- Wilson, Eliel '01 M, '02 E
- Woehler, William L. '07 E
- Woodrick, Oscar '08 C

Montevideo
- Kircher, Frank J. '09 M
- Lawrence, Scott '15 E, '16 EE

Montgomery
- Soulek, Joseph H. '11 E

Moorhead
- Hopeman, Albert M. '05 C

Moose Lake
- Dungay, Herbert F. '25 C

Mora
- Handschu, C. E. '15 C

New Ulm
- Backus, Gerald H. '22 E
- Haeberle, Elmer H. '06 E
- Hummell, Carl A. '26 E
- Robertson, Charles N. '08 C

North Hibbing
- Lundquist, John V. '23 E

Oak Terrace
- Greene, Alfred B. '24 E
- Rathburn, George A. '24 M

Owatonna
- Hosfield, Raleigh '12 C
- Nelson, Mark L. '24 A
- Souba, John I. '25 M

Pelican Rapids
- Ranger, Donald R. '24 C

Perham
- Pancratz, Frank J. '08 E

Peterson
- Boyum, Benjamin C. '10 C

Pine City
- Nutting, Horace W. '25 C

Pine Island
- Parkin, Orrin G. '23 M

Pine River
- DuBois, N. Warren '26 M

Plainview
- Askew, Thomas A. '16 C

Proctor
- Bohannon, George W. '26 M
- Maney, James E. '26 M

Raymond
- Haims, Mark '25 C

Red Wing
- Cook, Harry C. '10 M
- Josephson, Eliot B. '10 E

Red Wood Falls
- Clipfell, Carroll D. '03 M

Renville
- Henry, Burt C. '21 C

Robbinsdale
- Merritt, Alva W. '22 E
- Shumway, Ernest J. '00 E

Rochester
- Boyce, Ellsworth R. '17 C
- Bross, Peter P. '25 A
- Leonard, Aubrey C. '23 C
- Pagenhart, Clarence C. '12 C

Rockville
- Freeberg, George '25 A

Rushford
- Engh, Harris S. '24 M

St. Cloud
- Jorgens, C. R. D. '12 C, '13 CE

St. James
- West, John C. '15 C

St. Paul
- Abbott, Amos H. '16 E, '17 EE
- Abrahamson, Howard R. '17 M
- Albrecht, Ernest G. '25 E
- Andrews, George L. '05 M
- Arnesen, Herbert P. '11 C
- Aure, Roy '22 M
- Baer, Louis E. '07 E
- Banovetz, John A. '25 C
- Barlow, Harry E. '03 C
- Bartow, Harry E. '03 C
- Beck, Hiram D. '26 M
- Beese, Harold U. '25 C
- Bennett, John C. '26 M
- Bingham, Stanley E. '08 M
- Bird, Harold E. '25 C
- Bohland, John A. '15 C
- Borst, Wellington L. '24 M
- Boss, Ronald W. '25 M
- Boyles, Ralph R. '15 M, '16 ME
- Brockway, Royden R. '05 C
- Brossard, Edward V. '23 M
- Brown, Harry E. '22 G
- Buenger, Albert '13 M, '14 ME
- Buenger, Edgar '19 A
- Bumgardner, Louis T. '23 E
- Calmeyer, John P. '06 E
- Carlson, Arvid P. '17 M
- Carlson, Chauncy M. '17 E
- Carlson, Ernest '22 M
- Carlton, Richard P. '21 G
- Chapman, Leslie H. '94 C
- Chapman, Wendell P. '14 E
- Christilaw, George '21 C
- Christlieb, Frank B. '23 C
- Collis, N. Stuart '24 M
- Comfort, Thomas H. '26 C
- Converse, Clovis M. '09 E
- Cooley, Gilbert '22 E
- Cornell, George M. '25 C
- Cotton, Ernest H. '19 E
- Crawford, Allen S. '12 M
- Cummings, Elmer '12 C, '13 CE
- Curtiss, Lindsley B. '09 G
- Darrell, James E. P. '23 C
- Daum, H. Arne '12 E
- Davis, Charles A. '05 E
- Davis, Gilbert M. '04 M
- Deegan, Raymond C. '26 C
- Dehn, Elter '21 C
- Deutsche, Richard E. '18 C
- Dewars, Allen G. '13 E, '14 EE
- Diamond, Grover W. '12 C
- Dills, Lyle A. '21 G
- Dimond, Harvey G. '14 C
- Donaldson, Frank A. '12 M
- Dougan, Henry K. '08 C
- Dunnavan, Ralph B. '23 E
- Duvall, Arndt J. '25 C
- Eggleston, Smith '25 M
- Egilsrud, F. S. '20 M
- Ellison, Jay '09 C
- Engquist, Victor E. '20 E
- Erskine, Lawrence '25 M
- Feeney, Wayne '23 E
- Feyder, William H. '05 C
- Fiske, Frederick W. '09 C
- Fleming, Frank R. '08 M, '09 EE
- Flygare, August L. '12 C
- Forsberg, Elmer J. '21 M, '22 ME
- Francis, Paul E. '18 M
- Fraser, Carlisle G. '22 C
- Frenzel, Herman '26 A
- Gage, Hugh N. '08 C
- Garen, George M. '10 C
- Gessert, George R. '07 M
- Giertsen, Marcus O. '12 C, '13 CE
- Gilstad, Arthur '23 M
- Goldberg, Maurice '23 E
- Goodkind, Leo '92 A
- Greenberg, Morris '18 M
- Grisson, Aubrey '25 AE
- Guerin, George V. '24 C
- Gustafson, Reuben W. '24 C
- Haberle, Edward '12 C, '13 CE
- Hayes, Edward J. '20 M
- Hedenstrom, Ernest A. '12 E
- Hendricks, Clifford '25 C
- Hendrickson, Norman '16 C
- Hewett, Maurice W. '13 C, '14 CE
- Hilgedick, Winifred '26 E
- Hiner, Walter G. '21 C
- Hoff, Christopher '06 E
- Hoffman, Michael J. '11 C
- Hoisveen, Leonard '25 M
- Holder, Laurence E. '24 C
- Hosmer, Orville H. '23 C
- Hovden, Conrad D. '12 E, '13 EE
- Irons, George '26 E
- Jackson, Earl D. '05 E
- James, Henry C. '11 E
- Jenkins, Clifford H. '25 M
- Joesting, Frederick D. '26 E
- Johnson, Carl A. '21 M, '22 ME
- Jones, Edwin F. '17 M
- Katter, Calvin K. '22 M
- King, Lawrence W. '09 C
- King, Wesley '05 C
- Klass, Frederick '19 E
- Knight, Ralph J. '15 C
- Koch, Karl L. '23 E
- Kochendorfer, Milton J. '05 E
- Kopper, Edward '14 M, '16 ME
- Krauch, William '08 C
- LaBonte, Anton '25 C
- Larson, Albin '14 C
- Larson, Martin S. '11 M
- LeBlond, Edmond J. '05 E
- Leonard, Thomas K. '15 C, '16 CE
- Levy, Max L. '26 E
- Lieberman, Henry '23 E
- Liese, Herbert W. '24 C
- Lilly, Clarence W. '17 E
- Lilly, Eugene '19 G
- Loeffler, Henry S. '14 E, '15 EE
- Logue, John F. '24 M
- Lostrom, Herbert W. '26 E
- Lovering, Harry D. '13 C, '14 CE
- Lux, Arthur E. '16 E
- McCartney, Floyd A. '13 M
- McCree, Andrew A. '08 C
- McCubrey, Everett J. '21 C
- McPherson, William B. '02 E
- Macgowan, Irvin '25 C
- Mackintosh, William S. '21 C
- Malley, Charles J. '06 C
- Manson, Philip W. '26 C
- Markson, Christian O. '22 C
- Mattson, Dewey F. '22 C
- Mayer, Albert F. '20 E
- Mayer, Joseph S. '24 E
- Meixner, Bernard A. '10 M
- Mertz, Karl J. '14 E
- Meserve, Ralph H. '23 E
- Meskal, George '23 C
- Methven, Clyde '11 C
- Mikesh, Edward S. '22 M
- Miller, Erwin J. '11 C
- Miller, George W. '20 E
- Miller, William C. '16 M
- Miller, William J. '24 E
- Mitchell, John B. '09 C
- Moore, John H. '24 M
- Moorman, Albert J. '18 A
- Moorman, Frank S. '22 A
- Morton, Harold S. '12 M, '13 ME
- Moll, Charles L. '10 C
- Moller, Carl C. '18 M
- Nelson, Edward S. '09 C
- Neville, Earle L. '20 C
- Nordstrom, Carl T. '14 C
- Norton, Clyde W. '08 M, '09 ME
- Odquist, Carl '23 C
- Okes, Day I. '05 C
- Okes, Sidney R. '09 C
- Olson, Clarence E. '22 G
- Oltman, Charles A. '93 C
- Palda, Charles H. '22 C
- Pause, Harold A. '23 E
- Peckham, Harold E. '23 A
- Peters, Walter C. '22 M

St. Paul
Peterson, A. M. '14 E
Peterson, Harold C. E. '25 C
Peterson, Richard M. '20 E
Pinska, Lawrence F. '22 C
Poulsen, George F. '17 A
Powles, James W. '01 E
Quinn, Ursula R. '25 C
Reardon, John M. '22 C
Rigg, Alvin E. '25 A
Ringstrom, Ivan G. '12 BS, '13 EE
Roberts, Norman A. '26 M
Rockwell, Harvard S. '14 C
Rockwood, Fletcher '14 M, '15 ME
Roe, Harry B. '08 E
Roth, Lewis M. '11 C
Roy, Milo C. '21 M
Rufsvold, Olav M. '15 C, '16 CE
Sander, Theodore, Jr. '19 E
Sauer, Arthur A. '23 C
Shepard, George M. '09 C
Sickel, Edwin C. '23 E
Siverson, Sigvel J. '11 C
Skon, Herman W. '15 M, '16 ME
Snow, Clarence J. '14 M, '16 ME
Souther, M. Edwin '12 C, '13 CE
Sprehn, George H. '24 C
Stanton, Raymond E. '04 M
Stevens, Everett B. '25 M
Stewart, George A. (Garnet) '22 A
Streich, Harry C. '12 E
Swenson, Theodore J. M. '12 E
Swift, Donald C. '24 E
Tallmadge, Everett S. '14 E, '15 EE
Teberg, Lawrence E. '22 C
Thomas, William A. '17 E
Villaume, Walter F. '23 C
Waldor, Ted N. '25 C
Walters, Robert P. '26 E
Waterous, Fred A. '20 M
Webster, Donald W. '13C, '14 CE
Weinke, Ernest '16 C, '17 CE
Welin, Arthur G. '12 C, '13 CE
Wellisch, Walton '23 E
Whitman, Edward A. '00 C
Williams, Fred J. '17 E
Willis, Roy '08 C
Wolf, Milton C. '25 C
Wolfangle, Raymond J. '17 C
Wolff, William S. '15 M, '16 ME
Wright, Stewart V. '19 A
Wunderlick, Milton S. '19 M, '20 ME
Wurzbach, Henry A. '25 E
Yager, Louis '07 C
Young, Joseph '21 G
Youngquist, Eder B. '25 C

Sandstone
Thompson, Claudius '22 C

Sauk Rapids
Gross, Leon A. '26 E

Slayton
Price, John R. '14 C

Spring Grove
Hansen, Carlos C. '20 C

Staples
Ainslie, Arthur F. '11 C

Stevenson
Quine, William M. '26 E

Stillwater
Englin, Charles F. '06 E
Gaalaas, George L. '26 E
Ovestrud, Melvin '13 M, '14 ME
Tierney, Festus P. '22 C

Thief River Falls
Prichard, Charles E. '25 C

Tracy
Peterson, Garvin E. '26 C

Twin Valley
Croswell, Daniel R. '16 E
Croswell, Thomas L. '15 C
Nilson, Wilhelm '02 E

Two Harbors
Johnson, Austin G. '03 M
Peterson, George T. '08 M

Tyler
Johnson, Anton A. '24 A

Virginia
Sannicolo, Joseph F. '22 E
Whitten, Robert C. '23 M

Wabasha
Berry, George F. '24 M
Murdock, George R. '26 E

Waconia
Martin, Curtis R. '21 G
Wessale, George '21 E

Wadena
Hayden, Claude E. '24 C
Hayden, John F. '00 C
Imsande, Fred '25 C

Waseca
Zimmerman, Louis P. '08 E

Washtucna
Bouge, Nathan H. '04 C

Waverly
Quinn, Edward I. '25 C

Wheaton
Heidelberger, Roy J. '22 E

Willmar
Bergquist, Philip L. '24 C

Winona
Aultfather, David '22 E
French, William O. '25 M
Grettum, Leroy A. '23 E
Hendrickson, C. Edward '25 C
McAndrews, Harry '25 C
Miller, Archibald T. '24 E
Miller, William L. '97 E
Slaggie, Eucharius '26 E

Winthrop
Haakenson, N. Theodore '26 C
Malmberg, Victor A. '20 C

MISSISSIPPI

Jackson
Kroeze, Herbert A. '19 G

MISSOURI

Gasconade
Chapman, Burton L. '10 C
Rasey, Raymond R. '26 C

Jefferson Barracks
Russell, Carl A. '16 E

Jefferson City
Espenett, Edward L. '22 C
Sverdrup, Leif J. '21 C

Kansas City
Fortune, Harry G. '20 M
Glass, Clifton A. '98 C
Koehler, Edwin F. '24 M
Swanson, Clifford L. '22 C
Wright, Harris H. '09 M

Knob Lick
Rydeen, Francis G. '05 M

New London
Glascock, Henry H. '06 E

St. Joseph
Grant, Elberth R. '24 C

St. Louis
Haines, Allen K. '13 E
Johnson, Noah '94 C
Nortner, Sylvester E. '16 C
Olson, Richard H. '19 E
Oscarson, Gerhard L. '22 E
Tuttle, Stanley B. '24 M

Sedalia
Butterworth, Russell I. '16 E, '17 EE

Troy
Ball, Hampton B. '20 M

MONTANA

Billings
Berg, Karl A. E. '20 C
Coleman, Frank D. '05 E

Boffman
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

Great Falls
Case, Gerald F. '23 E
Dow, James C. '00 E
Hougan, Sander '21 E

Havre
Haverson, Henry D. '07 C

Helena
Kivley, Warren O. '16 C

Livingston
Blake, Robert P. '97 M

Miles City
Aasland, Christopher '15 C

NEBRASKA

Lincoln
Lund, Earl H. '22 C, '23 CE

Mitchell
Rothi, Paul '04 C

Omaha
Bunce, Paul F. '06 E
Christensen, Edgar W. '19 E
Clark, John S. D. '22 M
Eddy, Horace T. '95 E, '96 EE
Ellestad, Irwin M. '22 E
Fischer, Harold W. '23 E
Johnson, Gustav A. '23 E
Johnson, James P. '23 E
Kingsley, Norman W. '20 E
Rome, Robert C. '22 E
Schneckloth, Harry H. '25 E
Teal, Clarence W. '24 E
Wallfred, John E. '20 M
Weibler, William M. '08 E
Wilcox, Halsey H. '15 E
Wilson, Paul R. '21 E
Zimmer, William A. '06 E

University Place
Japs, Barney G. '09 E

NEW JERSEY

Bayonne
VanCleve, Horatio P. '07 C

Carteret
Kerns, Clinton B. '15 M

East Orange
Wright, Roydon V. '98 M

Harrison
Anderson, Oscar P. '10 E

Kearney
Dowd, Archie J. '19 M

Newark
Frederickson, Harry B. '11 E
Gregg, Freshame D. '05 G, '06 CE
Williams, Arthur H. '19 M
Young, Charles N. '12 E

NEW MEXICO

Albuquerque
Larson, Fred '25 C

NEW YORK

Attica
Anderson, Edward I. '17 M, '19 ME

Bay Shore
McCullough, Robert T. '23 E

Brooklyn
Ely, Irving R. '05 E
Sushan, Harry M. '19 C
Taylor, Duane L. '17 M

Buffalo
Czock, Jacob H. '20 M
Dever, Francis A. '20 C
Frear, J. B. '10 M
Johnson, Carl S. '21 C
Keisey, Howard C. '22 M
Kirsner, Frank C. '24 M
Schildt, William F. '08 E
Swanson, Oscar E. '15 C, '16 CE

Ft. Hancock
Solomonson, L. D. '25 E

Ithaca
Barr, John H. '83 M, '88 MS
Fraser, George '19 A

Jersey City
Mikesh, Martin A. '12 M, '13 ME
Grimes, David '19 E

Long Island City
Boyd, Paul M. '24 M
Wagner, Otto H. '07 M

Mt. Vernon
Loye, Edwin M. '20 A

New Brighten, Staten Island
Marshall, Donald E. '19 E

New York City
Abbott, Arthur L. '97 E
Backstrom, Emil F. '24 A
Bauer, Ruben R. '20 E
Beckjord, Walter C. '09 E
Berg, Samuel A. '21 BA, '21 E, '22 EE
Bolme, Ole N. '10 C
Boman, Carl E. '05 E
Bosshardt, Willmert C. '22 E
Bouman, Bernard M. '04 E
Braden, Rene A. '23 E, '25 MS
Buhl, John E. '09 M
Buhl, Paul S. '07 M
Burns, Harvey L. '02 E
Chapin, S. Caryl '24 C
Cheney, Edward J. '04 E
Covell, Russell O. '16 E
Crabbe, George N. '04 E
Craig, Robert '97 M
Crane, Eugene C. '12 M, '13 ME
Dahl, Harold W. '24 E
Daly, Richard T. '21 C
Demarest, Charles S. '11 E
Dewey, William H. '93 E
Elmer, Lloyd A. '21 M
Gannett, Danforth '16 E, '17 EE
Gewalt, Carl H. '21 A
Hagerman, Oliver S. '18 M
Hahn, Stanley W. '22 A
Hilferty, Charles D. '96 M
Hokanson, Clarence E. '06 E
Holien, Edward O. '23 A
Ireland, Ray R. '03 E
Johnson, Ellsworth '22 C
Johnson, John E. '11 E
Kannenberg, Walter F. '23 E
Keller, Raymond W. '25 E
King, Alfred R. '05 E
Koepke, Walter E. '13 C, '14 CE
Laird, Lee R. '03 E
Landeen, Arvid G. '10 E
LeTourneau, Edward H. '05 E
Loye, Donald P. '16 E, '17 EE
McKeehan, Louis W. '08 G, '09 MS, '11 PhD
MacGregor, Helen '25 ID
Magoon, Herbert A. '24 A
Manderfeld, Emanuel '21 E
Markuson, Oscar S. '11 E
Mathes, Robert C. '12 E, '13 EE
Mitchell, Alexander C. '20 E
Morris, John E. '09 M
Mowry, Harry W. '06 E
Myers, Mortimer '97 E
Norcross, Arthur F. '07 E
O'Brien, Raymond J. '11 E
Olstad, Oscar A. '11 M
Otto, Frederick A. '04 E
Owens, Leo E. '11 M
Robertson, Phillip W. '01 M
Robison, Archer R. '09 E
Schroeder, Carl W. '14 E, '15 EE
Siegmann, Chester W. '20 E
Simons, Walter W. '16 E
Smith, Donald C. '18 E
Strothman, Russell A. '20 E
Swenson, Clarence Q. '17 M, '20 ME
Swenson, Karl P. '06 G, '07 MS
Thorne, Donald '23 E
Thuros, Albert L. '12 E, '13 EE
Tullar, Charles E. '01 E
Tunell, Robert H. '24 E
Wahlquist, Hugo W. '21 E
Wheeler, Herbert H. '17 E
Wiggins, Gerald G. '06 E
Willner, William E. '22 A
Zimmerschied, Clarence R. '23 E

Niagara
French, Edwin L. '02 E
Graling, Verney '99 E

Rochester
Savage, Edward S. '97 M

Schenectady
Allee, David A. '02 C
Anderson, Lowell W. '26 E
Beardmore, Albert '21 E
Bill, Earl M. '12 E
Boe, Lester L. '25 E
Burrill, Charles M. '23 E
Caswell, Thomas R. '25 M
Downie, John M. '22 E
Fallon, Eugene L. '14 E, '15 EE
Forsberg, Peter W. '11 E
Frazee, Leonard M. '24 E
Grant, Fred R. '09 E
Grobel, Lloyd P. '24 M
Haedecke, August D. '26 E
Hargrave, William A. '26 E
Hargraves, Robert A. '23 E
Hartley, Lowell J. '26 E
Heinemann, John R. '19 E
Lund, Jeffery L. '25 E
McCully, James '25 E
Marshman, Irving H. '24 E
Mittag, Albert H. '11 E
Morton, Lyle W. '24 E
Nierling, Grant C. '25 E
Peterson, Lewis E. '25 E
Parsons, Sidney A. '25 E
Rask, Louis G. '03 E
Robinson, Laurence T. '26 E
Satori, Roy H. '21 E
Tunnell, Clement R. '25 E
Warren, Laurence C. '24 E
Wiltgen, Edward '00 E
Woodman, Joseph C. '11 M

Syracuse
Jones, Robert A. '15 E, '16 EE
Linhoff, Carl H. '22 E
Morris, Thomas C. '08 M
West New York
Velz, Clarence '24 C
White Plains
Adams, George F. '95 E

NORTH CAROLINA

Durham
Nielsen, Walter M. '23 E
Greensboro
Little, Alice V. '22 A
Raleigh
Hemsey, Clayton E. '22 M

NORTH DAKOTA

Barton
Tyvand, James A. '24 E
Carrington
Cousins, Van Meter '25 E
Crosby
Russeau, Clifton C. '24 M
Fargo
Bertosil, Clarence F. '25 C
Juvrud, Edwin C. '17 E
Peterson, Albert L. '14 BS, '15 M
Peterson, Lloyd L. '24 C
Potter, Robert P. '26 A
Sheffield, Fred W. '09 C
Tarbell, William P. '22 C
Grand Forks
Schulz, Elton A. '16 E
Jamestown
Grime, Edwin M. '00 C
McCall, Harry J. '08 C
Minot
Huston, David B. '07 C
Molander, Edwin '25 A
Peterson, William W. '16 C
Sharon
Holmgren, Charles E. '09 M
Stanley
McGregor, Frazer A. '24 E

OHIO

Canton
Hektner, Joel '17 M
Letson, Donald E. '26 M
Cincinnati
Comfort, Clifford E. '26 M
Woolman, Harry D. '24 M
Cleveland
Arneson, Lloyd O. '21 M
Bierman, George H. '18 M, '19 ME
Brewster, William E. '12 E, '13 EE
Briggs, Hiram K. '19 G
Conley, Wilfred E. '10 E
Cowin, Clifford C. '21 G
Drinkall, John F. '19 E
Estep, Harvey C. '08 M
Etem, Victor '26 E
Hayward, Laurence W. '21 E
Hinman, Charles H. '24 A
Johnson, Leonard T. '10 E
Larson, Walter J. '20 E
Ludvigsen, Elliot '25 M
Reid, Harry A. '10 E
Rosenthal, Oscar L. '19 C
Taylor, Lyman D. '13 E, '16 EE
Columbus
Krag, Walter G. '07 M
Moffat, George N. '19 M, '20 ME
Dayton
Knopp, William R. '09 M
Ivorydale
Hamlin, Lehan H. '21 M
Rollin, Harold E. '26 M
Lakewood
Richardson, Wilbur P. '99 M
Lima
Cutter, Francis C. '06 M
Lockland
Donnelly, William H. '25 M
Mansfield
Goss, Harold R. '20 E
Noel, Clay W. '20 E
Wieland, Willard '25 E
Marion
Barron, John H. '26 E
Brose, William C. '25 C
Johnson, Clarence C. '26 E
Norwood
Kleinfeld, Leonard S. '26 M
Novelty
Madsen, Olav '20 G

Toledo
Buckhout, Donald H. '17 A
Youngstown
Birnberg, Zingel C. '09 M
Ramm, Theodore D. '13 E

OKLAHOMA

Bartlesville
Lee, Walter J. '20 E
Stauffacher, Edward L. '24 M
Fairfax
Burns, Dwight T. '25 C
Gobeli, Arthur W. '25 C
Oklahoma City
Montgomery, Albertus '13 C
Tulsa
Olaison, Clifford '15 E, '16 EE

OREGON

Corvallis
Martin, W. H. '10 M
Harrisburg
McAfee, Allan L. '08 E
Hood River
Smithson, John E. '07 E
Marshfield
Waldron, Ralph E. '20 E
Medford
Brockway, Alvah E. '09 E
Wood, John W. '05 E
Ontario
Countryman, Peter F. '07 E
Portland
Andersen, Christian '88 C
Anderson, Frank A. '08 E
Bjorge, Oscar B. '07 M
Cobban, Rollo J. '09 E
Cook, Robertson '02 M
Couper, George B. '93 M, '02 ME
Doeltz, William F., Jr. '08 C
Horstkotte, Arthur E. '22 C
Hubbard, Fred A. '09 C
Meany, James M. '07 M
Nelson, Donald O. '20 C
Rawson, Ralph H. '07 M
Shepherd, Burchard P. '95 M
Stoddart, Hugh A. '24 C

PENNSYLVANIA

Allentown
Reque, Styrk G. '01 E
Altoona
Moore, Norman '25 C
Bethlehem
Anderson, Fayette C. '24 E
Jensen, Cyril D. '21 C
Luce, Alexander W. '21 M, '23 ME
East Pittsburgh
Brown, Louis M. '16 E
Burt, Fred R. '16 E
Daniel, Thomas L. '00 M
Forbes, Henry C. '22 E
Gibson, Charles B. '05 E
Hauft, Hugo H. '25 E
Heins, Harold H. '25 E
Hussey, Norman W. '25 E
Johnson, Welton V. '26 E
Kaplan, Eugene V. '10 M
McEwen, Alexander '25 E
Monseth, Ingwald T. '24 E
Nelson, Carl C. '25 E
Schweppe, Walter A. '26 E
Simmon, Karl A., Jr. '05 E
Towle, Neal C. '12 E, '13 EE
Erie
Dunham, Roy O. '14 E, '15 EE
Rath, Harvey C. '23 E
Sturtevant, Percy G. '08 E
Harrisburg
Morse, George H. '93 E, '11 EE
Landisburg
Gerlach, Arthur C. '17 M
Lester
Burwell, Loring D. '07 M
New Kensington
Heath, Arthur C. '25 M
Philadelphia
Childs, John C. '06 C
Cross, Roland E. '23 M
Danner, Jake '01 E
Dunnum, Orney E. '22 E
Fairchild, Albert B. '07 E
Goetzenberger, R. J. '13 E, '14 EE
Groat, Benjamin F. '01 C, '08 LLB, '11 LLM
Hunt, Gates E. '20 E
Irwin, Vincent H. '13 E, '14 EE
Nelson, Carl H. '10 E
Pearson, Charles W. '21 E

Peterson, Harold L. '16 C, '17 CE
Sartell, Page M. '24 M
Sime, Theodore L. '23 A
Von Kohr, Herbert H. '21 M
Pittsburgh
Dahl, Hjalmer A. '22 E
Gemmell, Robert W. '26 E
Jules, Harold A. '20 E
Morrison, John E. '22 C
Skytte, Ernest E. '10 E
Willard, Arthur C. '22 E
Scranton
Eberhardt, Otto E. '03 E
Sharon
Steinert, Emil '25 E
South Philadelphia
Powell, Knox A. '20 M
Stowe
Williams, Edward H. '03 M
Wilkinsburg
Bullard, Henry M. '26 E
Jones, Richard W. '26 E
Koch, Winfield '25 E
Le Vesconte, L. B. '18 E
Wentz, Edward C. '26 E
Wilson, Abner W. '22 E
Wilmerding
Anderson, Wesley J. '26 M
Holmes, Roland W. '25 M

RHODE ISLAND

Providence
Kuhlman, Rudolph H. '23 M

SOUTH DAKOTA

Armour
Burtis, William H. '92 E
Brookings
Enke, Fred A. '21 C
Mark, Reuben A. '11 C
Mark, Walter J. '09 M
Hot Springs
Adler, Eugene H. '14 E, '15 EE
Huron
Ellefson, Selmer '16 E
Light Cap
Blake, Henry B. '01 E
Mitchell
Smith, Sidney H. '11 C
Sioux Falls
Boyce, Leonard F. '12 M
Countryman, M. Alden '25 M
Hult, George A. '16 E
Ransom, Ralph W. '23 M
Robertson, Kenefick '25 E
Watertown
Ageton, Edwin O. '26 E
Waubay
Meyer, Carl F. '10 C

TENNESSEE

Chattanooga
Irwin, Frank H. '16 E, '17 EE
Withee, Warren '15 C
Memphis
Kranzfelder, Robert H. '26 AE
Nichols, Browning, Jr. '10 M
Overholt, Harley G. '10 C
Slocumb, Mary G. '25 ID
(Mrs. Lawrence Tvedt)
Tvedt, Lawrence A. '24 AE
Nashville
Bunnell, Chas. W. '26 C
Grochau, Earl H. '21 C
Hansen, Arthur A. '23 C
Schultz, Alex A. '26 C

TEXAS

Austin
Helwig, Wm. F. '23 E
Dallas
Chestnut, Geo. L. '97 E
Dahl, George '21 B. S. (Arch)
Fernald, Frank O. '04 C
Harris, Clayton '09 E
Rounds, Fred M. '95 E
Smith, Donald T. '05 C
Fort Bliss
McQuillan, Raymond '11 E
Lubbock
Tuve, Geo. S. '20 M, '21 ME

UTAH

Price
Jones, Watkin W. '11 E
Salt Lake City
Ashworth, Roy H. '11 E
Beyer, Theodore A. '03 C
Brenchley, Walter C. '14 C, '15 CE
Stoutland, Oliver A. '22 C

VERMONT

St. Johnsbury
Stillman, Marcus H. '09 E

VIRGINIA

Danville
Furber, Pierce P., Jr. '08 C
Fort Humphrey
Luplow, Walter D. '17 C
Hampton
Joachim, Wm. F. '20 M, '21 ME
Wagner, John W. '24 M
Newport
Holmstine, Arthur G. '17 M
Quantico
Johnson, Byron F. '20 C
Richmond
Young, Truman P. '26 C
Roanoke
Fahland, Frank, Jr. '22 M

WASHINGTON

Centralia
Smith, Leighton '03 C
Everett
Beaulieu, Richard L. '02 C
Kelso
Phelps, Ray R. '10 E
Longview
Hetherton, Percival '08 M
Malden
Baker, Arthur W. '19 M
No. Yakima
Gilman, Nicholas A. '07 M
Pasca
Acker, Sidney H. '23 M
Puget Sound
Benedict, Geo. F. '03 E
Seattle
Bennett, Walter J. '03 C
Bowen, Fred P. '06 C
Bushnell, Chas. S. '78 M
Erickson, Carl G. '03 E
Grimshaw, William E. '02 M
Guthrie, J. De Mott '93 E
Hillman, Chas. K. '12 E
Hoffman, Ralph M. '11 Sc. & Tech.
McKenzie, Lauren F. '09 E
Magnusson, Carl E. '96 E, '05 EE
Pearce, John Henry '07 E
Petrick, Alfred C. '19 E
Quense, John '01 C, '02 ME
Schow, William P. '07 E
Sliuck, Gordon R. '06 E
Silliman, Henry D. '97 M
Weber, Erwin L. F. '06 E, '08 ME
Westberg, Russell E. '20 E
Spokane
Adams, Elmer E. '06 CE
Alton, Herbert D. '07 E
Crane, Fremont '86 BS, '87 BCE, '98 CE
Hayward, George J. '06 C
Wiesner, Frederick E. '06 C
Tacoma
Peters, William G. '83 C

WEST VIRGINIA

Charleston
Giltinan, David M. '15 M, '16 ME
Fairmont
Schoepf, Alfred W. '08 E
Harpers Ferry
Guesmer, Geo. O. '24 C
Morgantown
Amidon, Lee L. '23 M
Gill, James H. '92 M, '94 ME
Wheeling
Root, Frank R. '24 AE

WISCONSIN

Beloit
Christiansson, Hilmer R. '15 C
Cole, Ernest C. '26 M
Bruce
Brownell, Edward '26 C
Buhr, Leo '23 C
Chatek
Weston, Wm. S. '02 C
Chippewa Falls
Berdan, Hubert J. '22 C
Gray, Seymour R. '22 C, '23 CE
Vandreuil, Lionel '23 AE
Eau Claire
Dow, Clarence A. '13 E, '14 EE
Fairbanks, Geo. W. '23 E
Frahm, Alfred R. '08 E
Holm, Edwin R. '20 C

Eau Claire
McMillan, James S. '22 E
Monsen, Manley A. B. '24 E
Green Bay
Curry, Ezra Benham '20 M, '21 ME
Hudson
Kircher, Geo. A. '09 M
Hurley
Butterworth, Allan C. '11 E
La Crosse
Bergsland, Grant C. '23 M
Nordstrom, Ernest A. '22 M
Madison
Dunlap, Geo. M. '24 E
Hubbard, Robert T. '06 E
Knauss, Archibald C. '16 C, '17 CE
Knudsen, Esther M. '25 C
Larson, Ludvig C. '21 E, '23 EE
Luxford, Ronald F. '17 C
Meenah
Palmer, Howard B. '22 C
Milwaukee
Albrecht, George M. '06 E
Bauer, Roscoe W. '24 C
Brimeyer, Ferdinand J. '25 AE
Chapin, Harold S. '13 M, '13 ME
Greenberg, Jack '22 C
Hansen, Maurice J. '11 E
Hart, Maurice W. '26 E
Johnson, Elving L. '23 E
Johnson, Herman R. '09 E
Kendall, Walter '25 A
Lee, Albert A. '26 E
Mahachek, Ross F. '26 E
Manger, Henry J. '23 C
Newman, John M. '23 E
Ohman, George U. '26 C
Papenthien, Roy O. '21 G
Peterson, Peter I. '20 E
Price, Clarence R. '20 E
Reed, Albert J. '85 C
Roberts, Earl H. '15 M, '16 ME
Skrukrud, Odean M. '25 C
Swanberg, John H. '25 C
Thomas, W. Alan '24 M
Oconomowac
Plank, Howard G. '22 E
Oroville
Norelius, Emil F. '08 M
Norelius, Lewis M. '06 C
Portage
Odegaard, Harold T. '20 M
Racine
Rood, Arnold E. '22 E
Rothschild
Nee, Harold E. '24 E
Rubicon
Thurston, Harold H. '13 C, '14 CE
Spooner
Putz, John H. '14 BS, '15 EE
Superior
Deneen, Davis J. '19 A
Scobie, Francis G. '08 E
Wauwatosa
Cross, Chas. H. '97 M
West Allis
Foltz, Ross Melton '19 M
Smart, George A. '16 M

WYOMING

Casper
Fulton, Edw. G. '25 C
Yellowstone Park
Lindelei, Charles '09 E

ALASKA

Alaska
Aslakson, Carl I. '23 C

Valdez
Smith, Byron E. '07 E

AUSTRALIA

Melbourne
Bestor, George C. '24 C

CANADA

Edmonton
Morris, Robert '05 E
Montreal
Adams, Wm. C. '05 C
Spence, William J. '02 E
Westbrook, Donald McD. '10 M
Port Arthur
Souba, William H. '09 M
Toronto
Anderson, Oscar V. '10 E
Winnipeg
Borrowman, Leroy F. '08 C
Brown, Geo. J. '08 E
Schumacher, John H. '03 E
Weyburn, Sask.
Casberg, James W. '08 E

CHINA

Peking
Lin, Shu Ming '20 A
Tientsin
Eliassen, Sigurd '18 C

CUBA

Havana
Romero, Cirilo L. '17 M, '18 ME

HAWAII

Fort Shafter, Honolulu
Scott, Willard W. '17 E
Honolulu
Nelson, Scott A. '25 C
Kahuku
Engstrom, Elmer W. '23 E
Schofield Barracks
Coe, Edward H. '19 C
Parkhurst, Harleigh '09 E

INDIA

Bombay
Cerney, Glen C. '20 M
Shellenberger, Hiram R. '20 M
Kamptee
Dewaji, Gunaker '26 M

MEXICO

Guadalajara
Burt, John L. '90 C

PHILIPPINE ISLANDS

Fort Mills, Corregidor
Shippam, Willis '09 M
Manila
Weeks, William C. '94 C
San Juan
Mattison, Geo. C. '11 C

SOUTH AMERICA

Brazil
Thompson, Herbert L. '12 M
Chuquicamata, Chile
Carlson, C. Philip '21 E
Knowles, Everett H. '20 E
Maine, Basil '21 E
Tocopilla
Carlson, Victor H. '20 E
Maracaibo, Venezuela
Gerdes, Carl H. '25 B. S. (C. E.)

School of Chemistry

CALIFORNIA

Berkeley
Bostwick, Ross D. '23 ChE
Cartago, Inyo Co.
Marshall, Olive Wadleigh '17 Ch
Glendale
Poore, Charles D. '05 AC
Los Angeles
Durham, Samuel W. '17 Ch
Gillman, Hyam '25 Ch
Kessel, Herbert '18 ChE
Morin, Wm. T. '22 ChE
Oleum
Boxell, Morris L. '21 ChE
Palo Alto
Rask, Olaf S. '17 Ch
San Francisco
Dresser, Eva L. (Alves) '09 Ch
Ringstrom, Hugo '15 Ch
Vallejo
Bicknell, Henry R. '10 Ch

COLORADO

Boulder
Fulmer, Jervis M. '22 Ch
Denver
Dahlberg, Henry W. '10 ChE
Newman, Allen T. '16 Ch

CONNECTICUT

Bridgewood
Bacon, Charles B. '09 Ch

DELAWARE

Wilmington
Parrett, Arthur N. '20 ChE

DISTRICT OF COLUMBIA

Washington
Bekkedahl, Norman P. '25 ChE
Chaney, Albert L. '25 Ch
Doran, James M '07 Ch
Engstrom, Leslie G. '19 Ch
Hamm, Homer A. '25 Ch
Kracek, Frank C. '20 ChE
Kuentzel, Ward E. '17 ChE
McBride, Russel S. '08 Ch
Morey, George W. '09 ChE
Morris, Vlon H. '26 Ch

GEORGIA

Brunswick
Reu, Albrecht H. '19 ChE

IDAHO

Boise
Morse, Guilford A. '15 ChE

ILLINOIS

Champaign
Porter, Allen H. '08 Ch
Chicago
Brinker, Howard C. '25 Ch
Daniels, Elmer Anson '12 Ch
Fuhrman, Alvin O. '24 ChE
Gutsche, Frank C. '10 ChE
Katz-Nelson, Wm. '13 ChE
Kern, Herbert A. '13 ChE
Martin, Edmund W. '12 ChE
Owens, Jay C. '17 Ch
Reck, Robert C. '21 ChE
Schwartz, Marcel '22 ChE
Sternberg, Woldemar M. '18
Washburn, Fredrick M. '17 ChE
Evanston
Borrowman, Geo. L. '05 AC
Rockford
Underhill, Editha '25 Ch
Urbana
Bauer, Esther E. '24 Ch
Dietrichson, Gerhard '10 Ch

INDIANA

Gary
Frederickson, Hubert M. '23 ChE
Indiana Harbor
Merten, Howard V. '14 Ch
Indianapolis
Higburg, Wm. '17 ChE
LaFayette
Hauge, Sigfred M. '21 Ch

IOWA

Sioux City
Donauer, Max '18 ChE

KENTUCKY

Ashland
Porter, Ralph E. '13 ChE
Barbourville
Dyer, Walter S. '25 Ch
Louisville
Ernst, Robert C. '23 ChE
Smith, Allen S. '26 ChE

LOUISIANA

Baton Rouge
Fieger, Ernest A. '20 ChE

MARYLAND

Baltimore
Kester, Ernest B. '23 ChE

MASSACHUSETTS

Boston
Morrow, Leon W. '16 Ch
Cambridge
Darling, Stephen F. '22 Ch
Fuson, Reynold C. '24
Ludwig, Llewellyn G. '24 Ch
Yugve, Victor '13 Ch
Northampton
Morse, Minerva '20 Ch

MICHIGAN

Ann Arbor
Rogers, Marvin '25 ChE
Detroit
Gutsche, Edward J. '04 Ch
Hamilton, Herbert C. '97 ChE
Swart, Richard H. '21 ChE
Riddington, Frederick W. '21 ChE
Walker, George W. '09 Ch

MINNESOTA

Cloquet
Glenn, Harry W. '24 ChE
Aronovsky, Samuel I. '21 ChE
Delano
Bronkow, Herbert E. '12 ChE
Duluth
Hoff, John E. '20 Ch
Johnson, Donald L. '18 ChE
Luit, Hans L. '24 ChE
E. Grand Forks
Dahlberg, Arnold V. '05 AC
Ely
Pearson, Elmer A. '20 ChE
Fairmont
Coult, Lyman H. '25 ChE
Graceville
Hartnett, John G. '11 Ch
Hibbing
Anderson, Alvin P. '25 Ch
Markus, Benjamin '17 Ch
Pan, Wen Ping '18 Ch
International Falls
Busch, John S. '20 ChE
Cantwell, William F. '11 Ch
Lanesboro
Ellestad, Reuben B. '22 Ch
Mankato
Nelson, Chris '18 ChE
Minneapolis
Anderson, M. M. '20 ChE
Ayers, Ellsworth B. '25 Ch
Barber, Hervey H. '26
Beck, Maud G. '13 Ch
Beckel, Arthur C. '19 Ch
Bell, Alexander D. '16 ChE
Brinton, Paul H. '12 Ch
Brooks, Leslie C. '19 Ch
Bruce, G. Norman '23 ChE
Bunger, Harold A. '26 ChE
Cade, Arthur R. '17 Ch
Callaway, R. S. '11 ChE
Chadbourne, L. Rodney '22 ChE
Cohen, Lillian '00 Ch
Covell, Paul L. '25 ChE
Davies, Edwin T. '07 ChE
DeVaney, Grace M. '26 Ch
Eck, Lester J. '23 ChE
Edgar, Donald E. '23 ChE
Elmquist, Ruth E. '24 Ch
Firth, Charles V. '23 ChE
Fischer, Earl B. '19 ChE
Freche, Hertha R. '25 Ch
Goldstein, Milton M. '12 ChE
Grout, Frank F. '04 Ch
Halvorson, Halvor O. '22 ChE
Hammond, Kathryn D. (Kelley) '22 Ch
Hartkemeier, Leonard '24 ChE
Heisig, Lucille K. '22 Ch
Hopkins, Joseph I. '04 Ch
Humphrey, Gertrude J. '24 Ch
Johnson, Lester L. '25 ChE
Jones, Ernest J. '20 Ch
Kameda, Tohru '26 Ch
Karatz, Lucian '12 Ch
Kobe, Kenneth A. '26 ChE
Lauer, Walter M. '24 PhD
Lavine, Irvin '24 ChE
Lee, Melville R. '21 ChE
Leerskov, Gerhard W. '21 ChE
McKee, John B. '25 ChE
McMillen, Elliot L. '23 ChE
Manuel, Douglas R. '22 ChE
Mitchell, Donald F. '20 ChE
Nygard, Edwin M. '21 Ch
Olsen, Leslie R. '15 Ch
Otterstein, Earl F. '13 Ch
Pagel, H. Armin '23 Ch

Minneapolis
Peterson, Henry '13 ChE
Reiter, Alfred A. '25 ChE
Riley, Philip J. '21 Ch
Robinson, Rhea B. '12 Ch
Sarver, Landon A. '24 PhD
Scandling, Joseph E. '25 ChE
Schermer, Oscar C. '21 ChE
Schlafge, Wm. H. '26 ChE
Seyfried, Lillian M. (Mrs. W. H. Hunter) '17 Ch
Sorenson, Ben E. '23 ChE
Sullivan, Betty '22 Ch
Sprung, Murray M. '25 ChE
Sternberg, Heinie A. '20 ChE
Stier, Ruth I. (Mrs. Cecil Mayo) '25 ChE
Stone, Leslie F. '27 ChE
Stoppel, Arthur E. '20 ChE
Sutter, Hedwig M. '13 Ch
Sverdrup, Edward F. '26 ChE
Thorson, Stuart J. '19 Ch
Tindall, Jesse E. '25 ChE
Tinkham, Willis M. '14 ChE
Tronson, John L. '26 ChE
Wallfred, Carl L. '20 ChE
Wanless, Lynn A. '12 Ch
Webber, Fredrick W. '97 ChE
Weber, Ludwig J. '20 ChE
Webster, Cora H. '23 Ch
Westerberg, Carl George '21 Ch
White, Robert H. '23 ChE
Whited, Oric O. '08 Ch
Wilhoit, Albert D. '06
Zeidlik, Wm. J. '25 ChE
Ziegler, Mildred R. '15 Ch
Zima, Albert G. '24 ChE

Red Wing
Barrows, Vera '17 Ch
Cornell, Reuben W. '21 ChE

St. Louis Park
Rademacher, Richard L. '23 ChE

St. Paul
Backe, Edmund '24 ChE
Baker, Russel E. '11 ChE
Barnaby, William E. '09 ChE
Barrett, Joseph O. '22 ChE
Corl, Cady S. '21 Ch
Dahlen, Miles '24 ChE
DeWitt, Joseph H. '10 Ch
Dunnigan, Merton A. '16 Ch
Felion, Arthur J. '13 Ch
Halvorson, Henry A. '11 Ch
Hatch, Lloyd '23 ChE
Heck, Frank J. '19 Ch
Hennessy, Hugh J. '11 Ch
Hoffman, Henry J. '12 Ch
Johnson, Einer '11 Ch
Joyce, Floyd E. '17 Ch
Kampa, Edmund P. '23 Ch
Kennedy, Wm. W. '07 Ch
Koch, Arthur Louis '19 ChE
Kryger, Edward R. '21 Ch
Kugler, Joseph H. '26 ChE
Livermore, Harvey J. '22 ChE
McMiller, Paul R. '11 Ch
Nicholson, Harry G. '21 ChE
Nye, Lillian L. '10 Ch
Olson, Arthur O. '11 Ch
Parkin, Guy G. '12 Ch
Pennock, Edward M. '05 AC
Peterson, Marshall A. '21 ChE
Rockwood, Ralph H. '12 Ch
Roehrich, Victor '09 ChE
Smith, Sheldon H. '10 ChE
Toncheff, Stanil T. '15 Ch
Vievering, Wm. A. '25 Ch
Winslow, Raymond M. '19 ChE

MISSISSIPPI

University P. O.
Woolett, Guy H. '10 Ch

MISSOURI

Kansas City
Johnston, Charles L. '25 ChE
Tibbling, Ernest F. '14 Ch

St. Louis
Hawkey, Harold K. '19 ChE

MONTANA

Great Falls
Fegan, Elmer T. '15 Ch

NEW HAMPSHIRE

Berlin
Burmngham, F. A. '17 ChE

Hanover
Hartshorn, Elden B. '22 PhD

NEW JERSEY

Bloomfield
Widell, E. Gideon '17 ChE

Camden
Corson, Benjamin I. '17 Ch

Harrison
Wyman, LeRoy Linwood '22 ChE

Newark
Rose, Anton R. '04 Ch

New Brunswick
Von Kuster, Edith L. (Mrs. W. Johnson Kenyon) '07 Ch

Perth Amboy
Kohlase, Arthur H. '21 Ch
Paulson, Paul M. '23 ChE
Temple, Sterling N. '03 PhB

NEW YORK

Brooklyn
Moe, Claude P. '20 Ch
Stoppel, Ernest A. '11 Ch

Buffalo
Bakken, Adolph C. '23 Ch
Luft, Oscar W. '17 Ch

Canajoharie
Mastin, Marion G. '13 Ch

Chenango Forks
Harshaw, John R. '12 Ch

New York City
Resner, Raymond C. '02 Ch
Bierman, Harry C. '14 ChE
Hammer, George F. '20 ChE
Kokatnur, Vaman R. '14 Ch
Luger, Karl E. '22 ChE
Thordarson, Wm. '23 ChE

Niagara Falls
Dobrovolny, Frank J. '24 Ch

Rochester
Matthews, Glenn E. '20 Ch
Nietz, Adolph '15 Ch
Seymour, Merrill W. '21Ch

Yonkers
Rice, Edgar W. '03 Ch

NORTH CAROLINA

Raleigh
Anderson, Winslow S. '23 Ch

NORTH DAKOTA

Fargo
Sunde, Conrad J. '26 Ch

Grand Forks
Anderson, Edward E. '08 Ch
Gauger, A. W. '14 Ch
Harris, Elwin E. '22 Ch

Williston
Jackson, Myron B. '05 A. C.

OHIO

Canton
Edmunds, Alvin M. '25 ChE

Cleveland
Marr, Horace S. '17 Ch

Ivorydale
Cassel, Norman S. '22 ChE
Jewett, Ernest E. '25 ChE
Krantz, Rudolph W. '24 ChE
Shirk, Loren H. '26 ChE

Kent
Pettijohn, Earl '11 Ch

Mansfield
Langseth, Axel O. '22 ChE
Morken, Carl H. '22 ChE

OKLAHOMA

Norman
Swearingen, Lloyd E. '26 Ch

Okmulgee
Paul, Karl F. '24 ChE

OREGON

Maplewood
Curtiss, Faith (Sterling) '09 Ch

Portland
Juvrud, Ingvald O. '14 Ch

PENNSYLVANIA

Donora
O'Connell, Thomas C. '13 Ch

East Pittsburgh
Leavenworth, Francis M. '11 Ch
May, Darwin R. '14 ChE

New Kensington
Taylor, Cyril S. '13 Ch
Pippel, Herbert A. '20 Ch
Edwards, Junius O. '12 ChE
Frary, Francis C. '05 Ch

Philadelphia
Lowe, John M. '08 Ch

Pittsburgh
Selvig, Walter A. '09 Ch
Souther, Benjamin L. '16 Ch
Taylor, Carl A. '10 Ch

RHODE ISLAND

Providence
Tappan, Ruth W. (Mrs. Joseph Dowling) '22 Ch

SOUTH DAKOTA

Mitchell
Miller, Ralph Harrison '13 Ch

TEXAS

Beaumont
Bernhagen, Lewis O. '05 A. C.

Dallas
Bakke, Oliver M. '03 Ch

Port Arthur
Weetman, Bruce '26 Ch

VIRGINIA

Quantico
Strong, Frank D. '17 ChE

WASHINGTON

Napoleon
Longworth, Fred James '05 A. C.

Pullman
Levine, Arthur '23 PhD

Seattle
Linton, James H. '97 ChE

WISCONSIN

Appleton
Poppe, Frederick W. '11 Ch

Madison
Bray, Mark W. '14 Ch
Daniels, Farrington '10 Ch
Korfhage, Roy F. '20 Ch
Peterson, Clifford E. '23 Ch

Menomonie
Mitchell, Ralph W. '12 Ch

Milwaukee
Epstein, Hymen '21 Ch
Roberts, Wesley J. '21 ChE

CANADA

Ontario

Port Colburn
Kepner, Ben-Hur '11 C

Manitoba

Winnipeg
Joselowitz, Goodwin '18 C

ENGLAND

Felstead, Essex
Tronson, Carl A. '10 C

GERMANY

Gottingen
Hagness, Thorfin R. (For present Academic Year.) '18 Ch

PHILIPPINE ISLANDS

Bay, Laguna
Galvez, Nicolas L. '25 C

Malabon, Rizal
Roque, Feliciano T. '24 Ch

School of Mines and Metallurgy

ALABAMA

Bessemer
Morgan, Charles '06 E.M.

Birmingham
Cowin, Percy G. '18 E.M.

Tuscaloosa
DeVaney, Fred D. '23 E.M.
Gandrud, Bennie W. '21 E.M.

University
Lee, Oscar '16 E.M.

ARIZONA

Ajo
Olmstead, John S. '08 E.M.

Bisbee
Oscarson, Philip E. '24 E.M.
Smith, Franklin W. '03 E.M.
Ziesemer, Harry M. '07 E.M.

Calumet
Rait, Donald M. '03 E.M.

Casa Grande
Chandler, Eugene D. '00 E.M.

Clarkdale
Ekloff, Victor E. '11 E.M.

Inspiration
Donaghue, Abner J. '20 E.M.

Jerome
Hansen, Mayer G. '22 E.M.
Hondrum, Olaf '13 E.M.

Miami
McDermid, Archie J. '16 E.M.
Robertson, John H. '14 E.M.

Morenci
Beck, Charles S. '11 E.M.
Becker, George '97 E.M.

Prescott
Lytzen, Walter W. '05 E.M.

Ray
Hewitt, Ezra '12 E.M.
Truesdale, Wm. H. '03 E.M.

Warren
Lindholm, Milton S. '11 E.M.
Smith, Hoval A. '01 E.M.
Whiteley, Eugene E. '03 E.M.

CALIFORNIA

Bellflower
Bowman, Frank A. '04 E.M.

Berkeley
Bjorge, Guy N. '12 E.M.

Beverly Hills
Boyd, Robert R. '05 E.M.

Glendale
Gillan, Silas L. '07 E.M.
Hunt, Walter E. '00 E.M.

Grafton
Crowley, Jay '09 E.M.

Hollywood
Barker, Clifton T. '22 E.M.
Wallace, Carleton S. '17 E.M.

Jackson
Nichols, Clifford R. '20 E.M.

Kennett
Egleston, Oliver J. '00 E.M.

Lodi
Cullyford, James A. '05 E.M.

Long Beach
Ziesemer, Ralph A. '05 E.M.

Los Angeles
Ainsworth, Robert E. '20 E.M.
Arnold, Lewis E. '20 E.M.
Bass, William C. '99 E.M.
Clark, Fred E. '20 E.M
Collins, Leon T. '15 E.M
Gulick, Hervey '05 E.M
Henkel, Howard L. '23 E.M
Jerrard, Walther L. '18 E.M
Lea, John '12 E.M
McIntosh, Joseph B. '98 E.M
Ofsthun, Norman '13 E.M
Olund, Henning E. '07 E.M
Patton, Richard C. '22 E.M

Oakland
Walker, Clinton L. '98 E.M
Wallace, George W. '06 E.M

Ocean Park
Curry, Duncan E. '05 E.M

Pasadena
Clapp, W. Howard '01 E.M

Porterville
Perry, Joe B. '12 E.M

Rio Oso
Taresh, John '01 E.M

Riverside
Prouty, Roswell W. '12 E.M

Sacramento
Mills, Eugene C. '97 E.M.
San Diego
Holden, Henry H. '03 Met.E.
Yankee, Jims
Bailey, Paul T. '11 E.M.

COLORADO

Deer Trail
Woodis, Clark N. '12 E.M.
Denver
Sanderson, Henry S. '01 Met.E.
Gilman
Brunner, Donald G. '24 E.M.
Smuggler
Peterson, Joseph S. '08 E.M.

CONNECTICUT

New Haven
Erdmann, Charles E. '23 E.M.

DISTRICT OF COLUMBIA

Washington
Grimes, John A. '08 E.M.
Hoass, Ole G. '08 E.M.
Leonard, Forest M. '10 E.M.
Lovering, Thos. S. '22 E.M.Geol.
Ridgeway, Robert H. '23 E.M.

IDAHO

Burke
Ingersoll, Guy E. '18 E.M.
Conda
O'Brien, J. Charles '12 E.M.
Wallace
Merriam, Robert S. '03 E.M.
Shonts, Sydney L. '04 E.M.

ILLINOIS

Chicago
Baker, Emory P. '11 E.M.
Bodal, Emil K. '26 E.M.
Harmon, Benjamin G. '10 E.M.
Hutchinson, Bernard C. '24 E.M.
Johnson, Alfred M. '26 E.M.
Keller, Orin '05 E.M.
Lundquist, O. W. '23 E.M.
McKenzie, James R. '10 E.M.
Thoeni, Victor T. '22 E.M.
Wasson, Harold J. '14 E.M.
Winter, Harry '25 Met.E.
Chicago Heights
Scheid, Adolph J. '23 Met.E.
LaSalle
Holler, Frederick W. '10 E.M.
Neustadt, Berthold R. '06 E.M.
Peoria
Wrbitzky, Harry M. '23 E.M.

INDIANA

Gary
Mooney, Frank E. '23 Met.E.

IOWA

Ames
Clement, Lester L. '06 E.M.
Sioux City
Hoard, Harold J. '03 E.M.
Waterloo
Locke, Alfred M. '08 E.M.

KANSAS

Fort Riley
Wehr, Arthur J. '11 E.M.
Wichita
Carlson, Edwin N. '21 E.M.

KENTUCKY

Lexington
Crouse, Charles S. '11 E.M.

MARYLAND

Edgewood Arsenal
Nissen, Arvid '13 E.M.

MASSACHUSETTS

Brookline
May, Albert E. '96 E.M.

MICHIGAN

Crystal Falls
Anderson, Edwin H. '17 E.M.
Christenson, Alfred '15 E.M.
Houghton
Hamernik, Frank J. '21 Met.E.
Ramsay
Eidemiller, Howard N. '14 E.M.
Foss, Adolph L. '23 E.M.

MINNESOTA

Buhl
Johnston, Kenneth A. '21 E.M.
Chisholm
Borgeson, Anshelm C. '11 E.M.
Nord, Harry H. '16 E.M.
Coleraine
Chang, Chi '18 E.M.
Peterson, Andrew Y. '99 E.M.
Crosby
Fearing, Edward J. '17 E.M.
Mellem, Walter R. '19 E.M.
Nelson, Evald V. '27 E.M.
Thellin, Herbert E. '23 E.M.
Deerwood
Wenger, Frank B. '21 Met.E.
Detroit
Teague, Harold W. '00 E.M.
Duluth
Farnam, Henry E. '10 E.M.
Field, Thorold F. '05 E.M.
Fixen, Victor L. '11 E.M.
Frank, Elden '21 E.M.
Gavin, Lawrence T. '09 E.M.
Gustafson, Arnold A. '22 E.M.
Jeffers, Gordon B. '23 E.M.
Larsen, Raymond M. '24 E.M.
Oberg, Anton C. '07 E.M.
Rose, William A. '07 E.M.
Stevens, Howard E. '12 E.M.
Strong, John L. '08 E.M.
Easton
Herring, William E. '10 E.M.
Elcor
Anderson, Alfred T. '23 E.M.
Elk River
Houlton, Lewis K. '04 E.M.
Johnson, Ralph C. '22 E.M.
Ely
Duncan, Kenneth J. '10 E.M.
Santo, Julius H. '09 E.M.
Eveleth
Boyle, Patrick J. '08 E.M.
Ely, Robert H. '13 E.M.
Johnson, Axel L. '20 E.M.
Kerr, Charles D. '15 E.M.
Kingston, Merton S. '04 E.M.
McAdams, Howard R. '12 E.M.
Moyle, Robert M. '27 E.M.
Faribault
Gallagher, Luke J. '23 E.M.
Glenwood
Martin, Lynn '12 E.M.
Hanska
Haugen, Albert C. '15 E.M.
Hibbing
Anderson, Walter C. '11 E.M.
Bassett, Robert H. '07 E.M.
Brandt, John '06 E.M.
Kurtzman, Paul S. '06 E.M.
Loye, Henry E. '05 E.M.
Taylor, William L. '12 E.M.
Vivian, Edgar W. '23 E.M.
Ironton
Angst, Harry H. '05 E.M.
Deichen, William A. '08 E.M.
Plut, Frank J. '22 E.M.
Lakefield
Buresch, Charles E. '17 E.M.
Little Falls
Lundquist, O. W. '23 E.M.
Minneapolis
Allard, Raymond W. '18 Met.E.
Ballord, John A. '24 E.M.
Case, Leslie M. '24 E.M.
Chadbourn, Charles H. '21 E.M.
Christiansen, Peter '94 E.M.
Cole, Willard A. '09 E.M.
Conkey, Charles R. '10 E.M.
Cowin, James '07 E.M.
Craig, John J. '16 E.M.
Curran, Francis J. '16 Met.E.
Devereux, Lawrence '10 E.M.
Elliott, Jay R. '11 E.M.
Frank, Harry O. '20 E.M.
Field, Edward M. '03 E.M.
Frellsen, Sidney A. '19 E.M.
Kersten, Erwin H. '20 E.M.
Kilp, Raymond G. '22 E.M.
Kingsley, Neil S. '11 E.M.
Kremer, Edward G. '12 E.M.
Ladd, Greeley '13 E.M.
Larpenteur, Bernard J. '25 Met.E.
McHardy, Roy H. '16 E.M.
Mark, Israel '20 E.M.
Merritt, Lucien '04 E.M.
Moody, Revillo G. '10 E.M.
Rawson, Horace C. '06 E.M.
Reed, Olaf '07 E.M.
Runke, Donald H. '25 Met.E.
Smith, Edgar W. '07 E.M.
Sung, Kuo Hsiang '24 E.M.
Taylor, Harold G. '09 E.M.
Trulander, Wm. '25 E.M.
Wade, Henry H. '15 E.M.
Wheeler, Walter H. '06 E.M.
Wiest, Michael A. '07 E.M.
Wilson, J. Byron '22 E.M.
Minnesota
Hognason, George B. '09 E.M.
Montevideo
Aanes, Ole O. '27 E.M.
Michie, Roy G. '13 E.M.
North Hibbing
Anderson, Oscar B. '22 E.M.
Olivia
Winter, William M. '23 E.M.
St. Paul
Abbott, Theodore S. '11 E.M.
Brawley, John N. '23 E.M.
Coller, Walter A. '15 E.M.
Dowdell, Ralph L. '18 Met.E.
Drake, George M. '11 E.M.
Friedl, Arthur J. '23 E.M.
Goldberg, Bert '19 E.M.
Harmon, Sydney '17 E.M.
Howes, Frank T. '06 E.M.
Johnson, Trygve '22 Met.E.
Levy, Julian H. '23 E.M.
Moga, John A. '18 E.M.
Neerland, Herman '15 E.M.
Olson, Walter S. '12 E.M.
Quinlan, Howard '14 E.M.
Raiter, Clifford R. '20 E.M.
Rood, Lynn '09 E.M.
Sjolinder, A. '23 E.M.
Strane, Archie J. '10 E.M.
West, Herbert S. '21 Met.E.
Williams, Homer A. '09 E.M.
Wolfer, Donald H. '23 E.M.
Silver Lake
Jerabek, Theophil E. '27 Met.E.
Slayton
Minder, Emil G. '05 E.M.
Spring Valley
Kendrick, William L. '25 E.M.
Stillwater
Bisom, John R. '27 E.M.Geol.
Virginia
Erickson, Arthur C. '23 E.M.
Nelimark, John H. '24 E.M.
Sweetman, Edwin A. '17 E.M.
Wabasha
Searles, John N. '23 E.M.
Willmar
Coventry, Edward D. '12 E.M.

MISSOURI

Annapolis
Sebenius, Carl H. '21 E.M.

MONTANA

Anaconda
Jensen, Willard C. '24 E.M.
Ramsing, Fred C. '15 E.M.
Billings
Davies, Fred A. '16 E.M.
Davies, Herman F. '21 E.M.Geol.
Stewart, James L. '24 E.M.
Butte
Brenner, Walter W. '23 E.M.
Coady, Leo J. '13 E.M.
Haley, A. J. '25 E.M.
Rahilly, Harold J. '11 E.M.
Sherman, Howard P. '25 E.M.
Studer, Ralph J. '25 E.M.
Tanner, Wallace N. '96 E.M.
Helena
Heidel, C. Sumner '10 E.M.
Phillipsburg
Fritzberg, Ernest A. '10 E.M.

NEBRASKA

Crete
Hawlick, Hartley H. '23 E.M.

NEVADA

Comstock
Winther, Arno '03 E.M.
Goldfield
Wilkinson, Charles D. '95 E.M.
Gold Hill
Goodrich, Norman P. '10 E.M.
Tetlie, John R. '11 E.M.
Las Vegas
Toll, Rensselaer '00 E.M.
Reno
Schrader, Erick J. '03 E.M.
Virginia City
Burgess, Robert J. '11 E.M.

NEW JERSEY

Phillipsburg
Arnold, Lowell W. '27 E.M.
Caddy, Howard T. '27 E.M.
Haase, Conrad C. '26 E.M.
Rutherford
Butler, Roy G. '21 E.M.

NEW MEXICO

Hurley
Knox, LaFayette '21 E.M.
Santa Fe
Harrington, Guy P. '06 E.M.
McCarty, Andrew L. '04 E.M.
Valedon
Dickson, Robert H. '12 E.M.

NEW YORK

Albany
Dinmore, Harry C. '23 E.M.
New York City
Hennen, Edward H. '25 E.M.
Keene, Amor F. '04 E.M.
Kennedy, John J. '08 E.M.
McRae, Randolph J. '07 E.M.
Persons, Robert W. '23 Met.E.
Queneau, Roland B. '23 Met.E.
Ravicz, Louis G. '14 E.M.
Swenson, Karl P. '07 E.M.
Walters, Charles W. '11 E.M.
New Rochelle
Wales, Roland T. '97 E.M.
Niagara Falls
Woodruff, John J. '17 E.M.
Schenectady
Hoyt, Samuel L. '09 E.M.

NORTH DAKOTA

Jamestown
Dawson, Loren W. '21 Met.E.
Mandan
Olson, Walter S. '25 E.M.Geol.
Sylvester, Robert E. '27 E.M.

OHIO

Cleveland
Sowle, Lawrence K. '03 E.M.
Mansfield
Boreen, Milden S. '26 Met.E.
Marion
Johnson, Ralph L. '26 Met.E.

OKLAHOMA

Muskogee
Larson, Clarence L. '10 E.M.
Oklahoma City
Edwards, Frank R. '08 E.M.
Okmulgee
Leversen, A. Irving '17 E.M.
Ponca City
Knutson, Clarence J. '24 E.M.
Tulsa
Conhaim, Howard J. '23 E.M.
Elson, William H. '17 E.M.
Foley, Lyndon L. '18 E.M.Geol.
Giltinan, George M. '10 E.M.
Kamb, Hugo R. '25 E.M.Geol.
Williams, Paul S. '15 E.M.

OREGON

Linnton
Larson, Ernest L. '14 E.M.
Roseburg
Stewart, G. Gordon '10 E.M.

PENNSYLVANIA

Bethlehem
Deringer, Paul J. '27 Met.E.
Durfee, J. C. '27 Met.E.
Forsyth, Arthur C. '24 Met.E.
Gow, James T. '27 Met.E.
Hack, George M. '26 Met.E.
Johnson, George A. '25 Met.E.
Russell, Charles B. '23 E.M.
Swensen, Clifford H. '23 E.M.
East Pittsburgh
Krugh, Alvin T. '16 Met.E.
Easton
Thomassen, Mark W. '26 Met.E.
Library
McKenzie, Frederick R. '22 E.M.

*

New Castle
Barr, J. Carroll '22 E.M.
Griswold, Willis R. '23 E.M.

Pittsburgh
Copeland, William A. '20 E.M.
Wiley, Richard E. '26 Met.E.

TENNESSEE

Copperhill
Sodoma, Joseph '25 Met.E.

Isabella
Alexander, James W. '26 E.M.
Kegler, Vern L. '23 E.M.
Martin, Henry K. '26 E.M.

Memphis
Hanson, J. Bernard '13 E.M.

TEXAS

Amarillo
Hubbard, William E. '17 E.M.

Brownwood
Clay, J. Withers '23 E.M.

Cisco
Dovre, Adolph '16 E.M.
Lewis, J. Whitney '12 E.M.
Wilcox, Fred H. '23 E.M.

Dallas
Aronson, Sam '16 E.M.
Bierman, Alfred C. '14 E.M.
Tolleison, Everett H. '23 E.M.
Whitson, Lloyd R. '11 E.M.

Eastland
Olson, Walter S. '23 E.M.Geol.

El Paso
Quinn, Howard E. '18 E.M.

Fort Worth
Coryell, Lewis S. '17 E.M.Geol.

Freeport
Lee, Clarence O. '24 E.M.

San Angelo
Van Duzee, Everett N. '26 E.M.

Wichita Falls
Adams, E. Maurice '22 E.M.

UTAH

Eureka
Hezzelwood, George '23 E.M.

International
Nichols, William J. '21 Met.E.

Iron Springs
Urquhart, George K. '15 E.M.

Salt Lake City
Smith, Elmo V. '01 Met.E.

WASHINGTON

Davenport
Campbell, William L. '00 E.M.

Kelso
Jones, Philo E. '10 E.M.

Spokane
Newell, John R. '10 E.M.

WEST VIRGINIA

Clarksburg
Moga, Gregory '22 E.M.

WISCONSIN

Mayville
O'Connor, Edward S. '06 E.M.

Mellen
Spanberg, Edwin C. '21 E.M.

Milwaukee
Coolidge, Marshall H. '27 E.M.
Scheid, Carl F. '23 Met.E.

Superior
Moe, Cecil J. '24 E.M.

WYOMING

Laramie
McCarty, Edward P. '00 E.M.

Salt Creek
Walter, Rollie B. '12 E.M.

Sunrise
Moenke, William F. '06 E.M.

AFRICA

Congo-Belge

Elizabethville, Katanga
Walker, E. Harold '11 E.M.

North Rhodesia

N. Changa
Andrews, Thomas F. '26 E.M.Geol.
Armstrong, Lee C. '27 E.M.Geol.
LaTendresse, H. E. '23 E.M.Geol.

Portuguese West Africa

Angola
Ernster, Omer F. '17 E.M.

AUSTRALIA

Melbourne
Mann, Victor L. '25 E.M.

BELGIUM

Brussels
Butler, William V. '15 E.M.
Grant, Roy C. '89 E.M.
Middleton, John L. '23 E.M.

CANADA

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Ontario

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Swanson, Axel H. '10 E.M.

Haileybury
Bischoff, Harry E. '10 E.M.

Kirkland Lake
Heath, Clarence L. '10 E.M.

Quebec

Montreal
Cohen, Samuel W. '03 E.M.

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Honduras

Minas De Oro
Brosius, Harold I. '04 Met.E.

San Juancito
Zanger, Eugene '21 E.M.

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Huang, Ts Heng '24 E.M.

Mukden, Manchuria
Hsieh, Chung '18 E.M.

Peking
Chie, San Sieh '22 E.M.

Shanghai
Kwong, Yih Kun '17 E.M.

CUBA

Province Pinar-Del-Rio
Devereux, Francis C. '04 E.M.

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Skouriotissa, Nicosia
Jackson, Charles F. '07 E.M.

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Calhoun, Allan B. '05 E.M.

MEXICO

El Oro, Ostado De Mexico
Flynn, John G. '03 E.M.

Arizpe, Sonora
Hammond, Arthur H. '13 E.M.
John, William F. '11 E.M.

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McKay, Henry S. '05 E.M.

Chihuahua
Calhoun, Robert A. '23 E.M.

Sierra Mojada
Quinn, Max F. '21 E.M.

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Probst, Elmer A. '07 E.M.

Barranquilla
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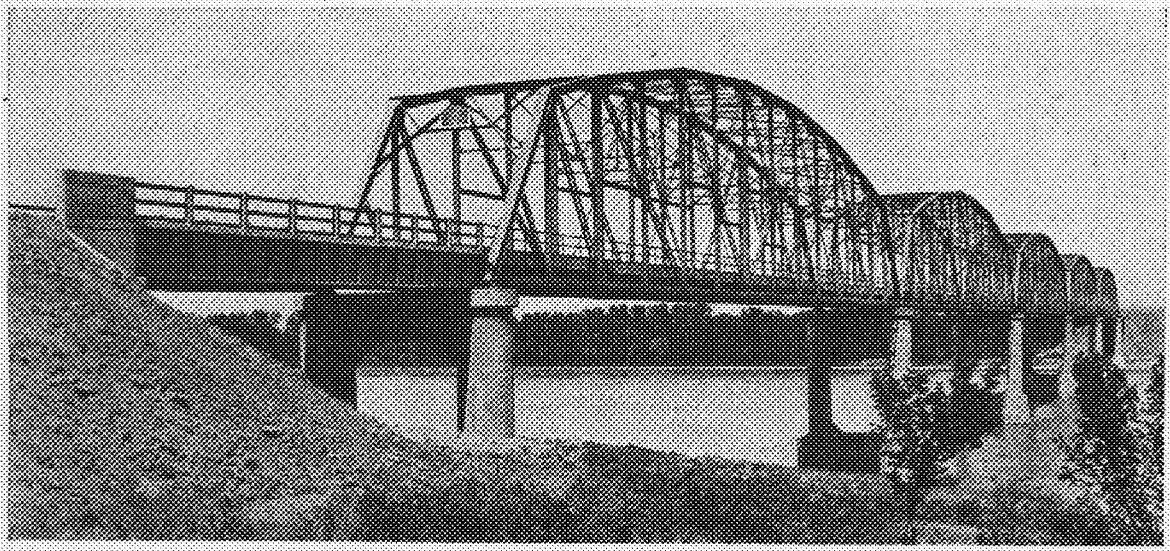

Minnesota Men Work for Flood Commission

Work to prevent floods on the Mississippi River like the recent flood this spring has involved a number of Minnesota men. Professors O. S. Zelner, H. D. Jones, and R. W. French are working under the flood commission to make plans for the prevention of floods in the future. Recently graduated students who are also working are Fred Teske, Erick Peterson, and Hugh Turrittin.

According to the plans of the flood commission floods may be prevented considerably by damming up the rivers during the flood seasons, thus causing reservoirs of water to be stored up during this time that would be released when all danger was over. The work of the Minnesota men has consisted of making surveys of the states of Minnesota and Wisconsin for the favorable locations of such dams, and in estimating the amount of cost and trouble involved. Professor Zelner has been touring the state making such a survey.

Dams have been planned on the Minnesota River near the present Mendota bridge, at Wabasha, and in parts of Wisconsin. The expense involved in this undertaking if carried through will be immense, as can be gathered from consideration of the damming of the Minnesota River.

This would first necessitate the building of a dam 45 feet high and about three-quarters of a mile in length on a mud bottom, the flooding of the trees in the valley, the removal of several bridges which if rebuilt would have to be about a mile long, the moving of parts of several towns, and moving of railroad track.

The making of calculations of expense and the design of the various parts of such a prevention program is a large part of the problem. According to Professor Zelner the cost will amount to a number of millions of dollars. A preliminary report on the survey was to have been submitted by the 15th of July, and a complete report later in the summer.

Yearly Index of Advertisers

October 1926 — June 1927

These advertisers during the past year have demonstrated their confidence in the MINNESOTA TECHNO-LOG. They have advertised for two reasons:

1. Because they want the TECHNO-LOG to succeed.
2. Because they believe TECHNO-LOG advertising pays.

Their good will is assured—they have shown that by advertising. Whether or not their advertising pays depends on *you*. When you see an advertiser, tell him you saw his ad in the MINNESOTA TECHNO-LOG, thereby boosting his business and your college.

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