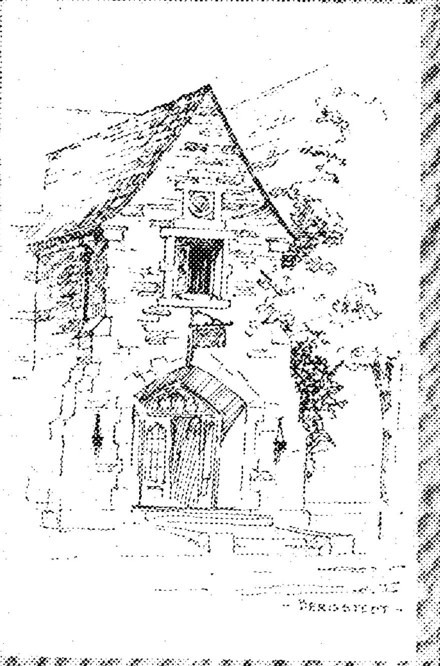
The MINNESOTA TECHNO-LOG

MONTHLY MAGAZINE OF THE TECHNICAL STUDENTS

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED



Vol. X OCTOBER, 1929 No. 1

—2

The MINNESOTA TECHNO-LOG

University of Minnesota

October, 1929 — Volume X — June, 1930

INDEX

A

	Month	Page
Airplane Engines B. J. Robertson	Jan.	113
Avigation A. R. Heller, E '30	Nov.	46

C

Chemical Studies in Electrical Discharge Tubes Geo. Glockler	Feb.	148
Chemists Take Spring Trip	May	253
Cloud Formations Hal B. Pittlekow, Aero '31	May	256
Consolidation of Railroads J. P. Shirley, C. '32	Jan.	122
Cub Engineers Boyden Sparkes	Feb.	151

D

Diploma Mills Cheat Students of Millions	Mar.	160
Drying of Lignite, The	Dec.	77
Duluth's Novel Bridge C. D. Ottinger, C. E. '31	Apr.	218

E

Engineer's Bookstore, The	Oct.	12
Engineering in Grain Handling J. Donovan Jacobs, '31	June	290
Engineering Review	Feb.	149
Engineering Review	Mar.	185
English for Engineers R. W. Siler	Feb.	145
Electrification of Passenger Terminals H. A. Dahl, E '22	Nov.	44
Esquisses and Rendues E. R. Cone, Arch. '31	May	254

F

Faculty Sketches—		
Charles Boehnlein	Mar.	189
Henry A. Erikson	Dec.	85
Clifford I. Haga	Apr.	225
Robert T. Jones	Nov.	51
Frank B. Lindsay	May	259
Fifty Years of Electric Light	Oct.	8
Freshman Week	Oct.	15

H

Health Protection in Industry and Laboratory Dr. George Schultze	June	292
How to Get a Patent Ray Belmont Whitney	Mar.	190
How to Get a Patent Ray Belmont Whitney	Apr.	223
Hydro-Electric Power in Washington C. Edward Magnusson, E '96	Oct.	5

I

Iron Mining in the Lake Superior District R. O. Cash and T. H. Mitchell	Apr.	220

L

Load Capacity and Lubrication of Ball Bearings J. R. VanDyke	Dec.	80
Long Tunnel Survey, A D. F. Brocchi	Oct.	10
Loud Speakers H. E. Hartig, '18 E	Oct.	9

M

Mathematics for Engineers R. W. Siler	Jan.	120
Military Science for Engineers R. W. Siler	Mar.	184
Motoring Overseas Francis C. Shenehon, BCE '85, CE '00	Feb.	146
Moving Pictures in Color G. E. Mathews, Ch. '21	Jan.	118

O

One Word More Frank B. Lindsay	Mar.	181
Opportunities in Engineering Journalism	Oct.	16
Oscar Fegas, Engineer preeminent	Feb.	158

P

Placing Concrete in Winter W. C. Hill, Ex '30	Jan.	116
Porcelain Insulators J. Robert Ginnaty, E '29	Mar.	182
Professor Springer and Patents Harmond Grabert, E '30	June	289

R

Recent Thoughts on the Nature of Matter S. C. Lind	Apr.	217
Rushmore Memorial, The Steve Gadler, E '32	May	260

S

Stability of River Boats S. E. Nortner, C '16	Jan.	117
Student Activity Index	Nov.	62
Student Activity Index	Dec.	98

T

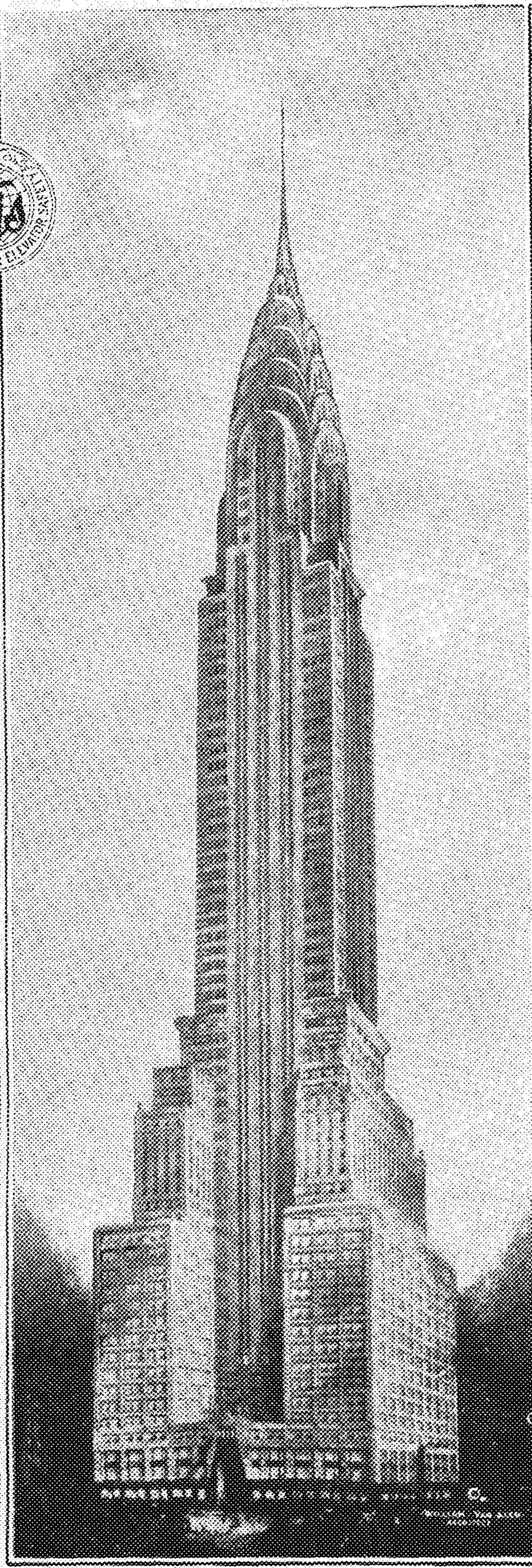
Timely Re-Statement of Fundamental Mechanical Principles John V. Martenis	Nov.	41
Torsional Vibrations in Crankshafts Ralph J. Hooker	Dec.	82
Tutshi, From an Adventure of Young and Wise Travelers	May	249

V

Viking Homecoming, 1929 J. R. Severson, Aero '31	Nov.	47

W

Wavelength of an Electron, The J. W. Buchta	Dec.	78
With a Minnesota Engineer in Europe P. B. Nelson, E '26	Nov.	58
Who Says We Can't Get Jobs? Marion Petri, IA '23	May	252



© 1929,
William Van Alen,
Architect

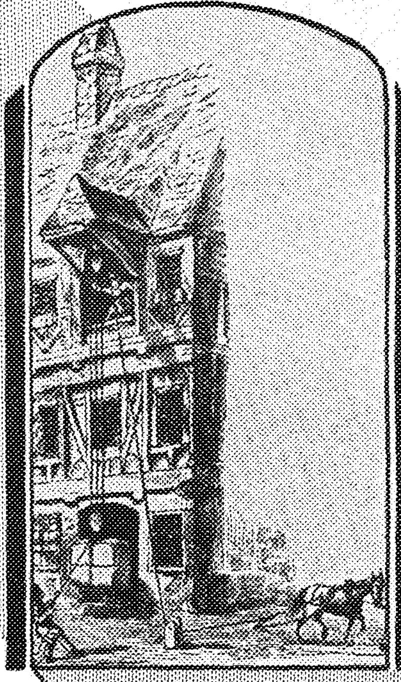
The World's Tallest Building

THE new Chrysler Building in New York will be the tallest building in the world. It will be equipped with thirty Otis Signal Control Elevators.

Here is additional evidence in support of the statement that "most of the world's famous buildings are Otis-equipped."

The world's first safe elevator was an Otis—and today the marvelous Signal Control elevator is an exclusive Otis development.

One of the early phases of Vertical Transportation



OTIS ELEVATOR COMPANY

OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD

THE UNIVERSITY OF MINNESOTA

THE MINNESOTA TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

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

VOLUME X — MINNEAPOLIS, MINN., OCTOBER, 1929 — NUMBER 1

CONTENTS

HYDRO-ELECTRIC POWER IN WASHINGTON - - - - - - - - - - - - 5
C. Edward Magnusson

FIFTY YEARS OF ELECTRIC LIGHT - - - - - - - - - - - - 8

LOUD SPEAKERS - - - - - - - - - - - - - - - - - 9
H. E. Hartig

A LONG TUNNEL SURVEY - - - - - - - - - - - - - - 10
C. D. Brocchi

THE ENGINEER'S BOOKSTORE - - - - - - - - - - - - 12

NEWS OF THE TECHNICAL CAMPUS - - - - - - - - - - - 13

EDITORIALS - - - - - - - - - - - - - - - - - 14

FRESHMAN WEEK - - - - - - - - - - - - - - - - 15

OPPORTUNITIES IN ENGINEERING JOURNALISM - - - - - - - - - 16

ALUMNI NEWS - - - - - - - - - - - - - - - - - 24

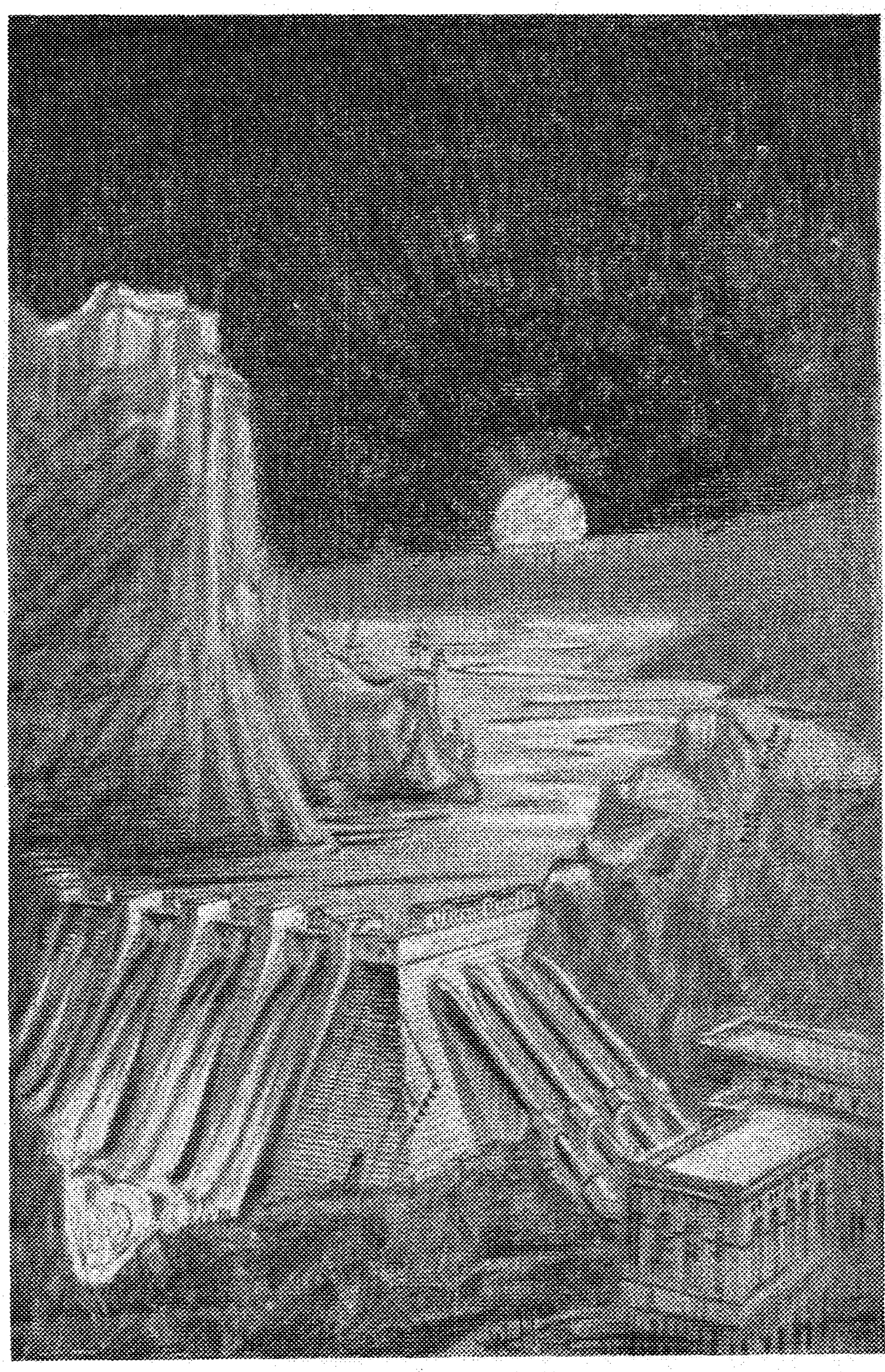
MEMBER OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

Chairman: WILLARD V. MERRIHUE, 1 River Road, Schenectady, New York.
Eastern Vice-Chairman: ROBLEY WINFREY, Engineering Hall, Iowa State College, Ames, Iowa.
Western Vice-Chairman: PAUL B. NELSON, 180 N. Michigan Ave., Chicago, Ill.

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

Entered as second-class matter April 9, 1925, at the post office at Minneapolis, Minnesota, under the Act of March 3, 1879. Office, 37 Electrical Building, University of Minnesota. Telephone, Dinsmore 2760.

 Subscription rate, $1.50 a year. Single copies, 25 cents. Advertising rates upon application.



Long Lake Power Plant
On the Spokane River

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume X | OCTOBER 1929 | Number 1

C. EDWARD MAGNUSSON, '96 E.

Hydro-Electric Power in Washington

C. EDWARD MAGNUSSON
Dean of the College of Engineering
University of Washington

TO those familiar with the natural resources of Washington it is a well-known fact that, aside from the land itself, the water resources—that is, water power and water for irrigation—head the list in future economic importance. In potential hydro-electric power Washington easily ranks first of all the states in the Union. The latest estimate by the U. S. Geological Survey credits Washington with 11,225,000 H.P. or 18.9 per cent of the total water power resources of the United States, on the basis of power used 50 per cent of the time and at 70 per cent overall efficiency, an increase of 40 per cent on previous estimates. A recent compilation* by Mr. Glen L. Parker, District Engineer, U. S. Geological Survey, of power data on the Columbia river shows that this stream alone has within the borders of Washington, 6,568,000 H.P., or almost as much available power as has generally been credited to the whole state. To readers not directly concerned with hydro-electric power, a comparative statement may be more illuminating than a table of statistical data. Thus the Columbia river proper, limited to the part lying within the borders of the state of Washington, and exclusive of all its tributaries, has more than twenty-seven times the power developed by the famous Wilson Dam.

*Columbia river power possibilities between international boundary and tide-water. U.S.G.S. 1925.

To gain insight into the hydro-electric power possibilities of any region, as the Pacific coast or the state of Washington, it is essential first to acquire clear concepts of three fundamental factors: (a) land elevation or topography; (b) annual and monthly precipitation; (c) natural and artificial water storage. After a broad and comprehensive view of the region under consideration has been acquired, the more specific factors of stream flow, static head, available dam sites, and so on, pertaining to individual power developments, can be studied to best advantage because modern power plants are not isolated units but parts of large systems of interconnected and, in a large measure, interdependent power developments.

Geographically, Washington may be considered as consisting of eight fairly distinct districts: the Olympic mountains, the Puget Sound basin, the Willapa hills, the Cascade mountains, the Columbia plateau, the Okanogan highlands, the Selkirk mountains and the Blue mountains.

Over two-thirds of the land area in Washington is mountainous and for the greater part extremely rugged. The mountainous regions, having more than five hundred glaciers, vast snowfields and timbered areas, form huge natural water power storage systems, as the precipitation during the winter months is held in congealed form until released by the summer heat. Mt. Rainier alone has twenty-two glaciers, which, with extensive snow fields, form an enormous ice storage system that provides an unceasing flow and power to the White, Puyallup, Nisqually and Cowlitz rivers.

The Cascade mountains form a huge ridge, dividing the state into an eastern and a western section, having strikingly different climatological and physiographic characteristics. The crest of the range varies from 3,500 to 6,500 feet in elevation, with an average of about 5,500 feet. It has a number of higher peaks such as Mt. Shuksan (9,038 feet), Mt. Stuart (9,470 feet), Star peak (8,400 feet) Boston peak (8,850 feet), Castle mountain (8,840 feet), North Star mountain (9,500 feet), etc. Rising above the geologically mature range like young sentinels, are five snow-capped volcanic cones: Mt. Baker (10,750 feet), Glacier peak (10,436 feet), Mt. Adams (12,307 feet), Mt. St. Helens (9,671 feet) and Mt. Rainier (14,408 feet). The range varies in width from 125 miles on the Canadian border to about 50 miles on the Columbia river.

East of the Cascades along the northern border lie the Okanogan Highlands and, in the northeast corner, a small segment of the Selkirk mountains. The surface formation consists of a series of ridges in the general north and south direction, having an elevation of from 5,000 to 6,000 feet.

In the southwest corner are the Blue Mountains, a spur of the Rocky Mountains, rising about 4,000 feet above the surrounding plateau and having an elevation of from 6,000 to 7,000 feet above sea level.

In the western part of the state, the Olympic mountains form a well-defined geographic division having a general elevation of from 4,000 to 5,000 feet. Numerous peaks reach between 6,000 and 7,000 feet and the summit, Mt. Olympus, is 8,150 feet above sea level.

The Willapa hills cover a comparatively small area in the southwest corner of the state. They are of irregular contour, heavily timbered, and reach an elevation of about 3,000 feet. The Columbia plateau, which lies to the east of the Cascade mountains, was formed by an immense lava flow that covered almost the entire area. The beds in some places are 4,000 feet in thickness. Later geologic changes have caused warpings in the lava beds, which, with long continued water and wind erosion, have developed irregularities in the earlier unbroken surface. The Columbia, Spokane, and Snake rivers have cut great gorges, or canyons, in places more than a thousand feet deep, through the lava beds. The Grand Coulee and other canyons and coulees were produced by stream erosion, being the abandoned beds of large rivers.

Between the Olympics and the Cascades lies the Puget Sound Basin, the belt of lowlands extending from the Canadian border to the Columbia river. In the northern and central parts of the rolling plain the surface layer is glacial drift and comparatively level, while in the southern non-glacial section the topography is more irregular. Geologically, the Puget Sound Basin was formed by a great structural down-warp between the Cascades and the Olympics, followed by a submergence in which the major valleys, Puget Sound, were flooded.

While all the streams in the state empty either directly, or through intermediate waters, into the Pacific Ocean, the land surface is divided topographically into three watersheds or drainage areas: the Columbia river system, the Puget Sound Basin and the Pacific Coast belt.

More than passing notice must be given to the distribution and the seasonal variations of rainfall in order to appreciate fully the importance of water storage as a basic factor for hydro-electric power developments in Washington.

Three outstanding features should be observed:

(a) The great variation in the annual rainfall at the several stations: from over 137 inches at the Quinault station on the western slope of the Olympic Mountains to less than 7 inches in the Columbia Basin and in the Yakima Valley east of the Cascade range. Streamflow data on the Quinault river indicate that in some areas in the Olympic Mountains the annual rainfall is more than 250 inches.

(b) The marked irregularity in the distribution of the annual rainfall even within regions of fairly uniform topography, as the lowlands of the Puget Sound Basin. Thus, the annual rainfall in Olympia (54.96) is 60 per cent greater than in Seattle (34.07), while, in Everett (29.66), it is 13 per cent less.

(c) The large seasonal variation: in general, a wet-winter season with the greatest precipitation in November, December and January, and a dry-summer season with a minimum rainfall in July and August.

The underlying causes for the wide variations in the rainfall in Washington are found in three basic factors:

(a) That the moisture-bearing winds come from the Pacific Ocean, from a west-south-westerly direction.

(b) That the belt of "prevailing westerlies" over the Pacific Ocean covers the coast of Washington during the winter months but that it moves northward reaching Alaska during the summer.

(c) Topography: especially the geographic positions of both the Olympic mountains and the Cascade mountains.

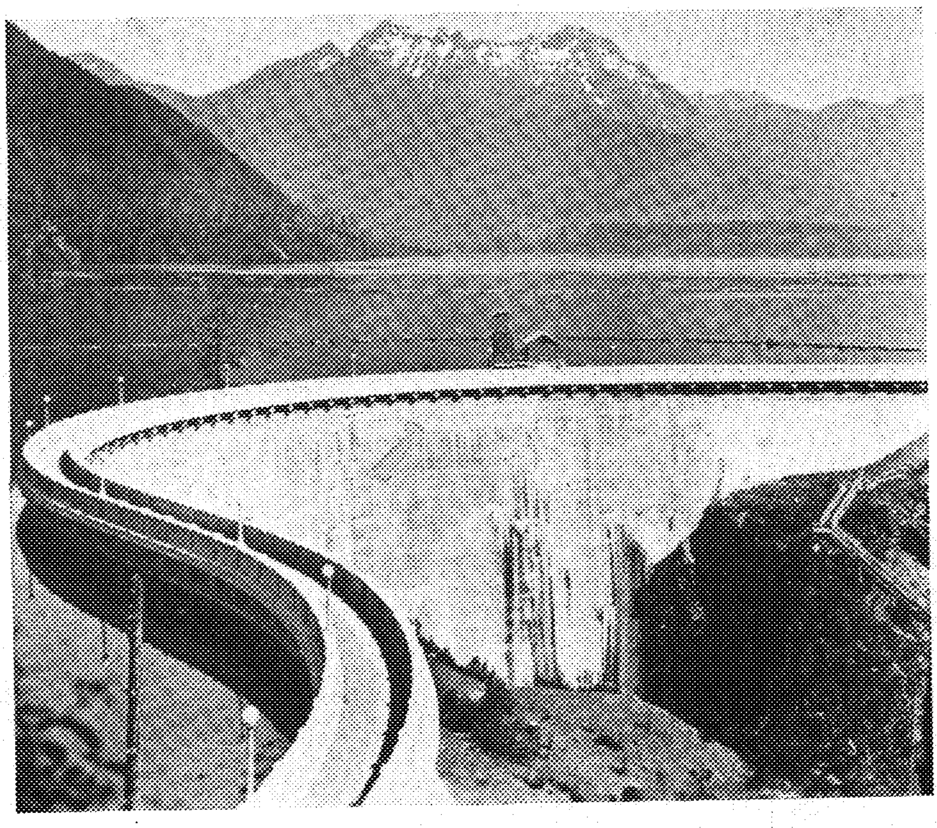
The first and third factors largely account for the wide variation in the annual rainfall, while the seasonal range is in the main caused by the second factor. The moisture-laden winds coming from the Pacific Ocean pass up the western slopes of the Olympic and Cascade mountains and, as the temperature decreases with elevation, this causes rapid condensation which produces heavy precipitation in these regions. On the eastern, leeward side, the air passing down the mountain slopes increases in temperature, with a corresponding rise in its moisture-carrying capacity and, as a consequence, the rainfall is comparatively light.

The total installed capacity of the hydro-electric power stations in the State was on Jan. 1, 1928, 706,622 horsepower, approximately 5 per cent of the available hydro-electric power in the State.

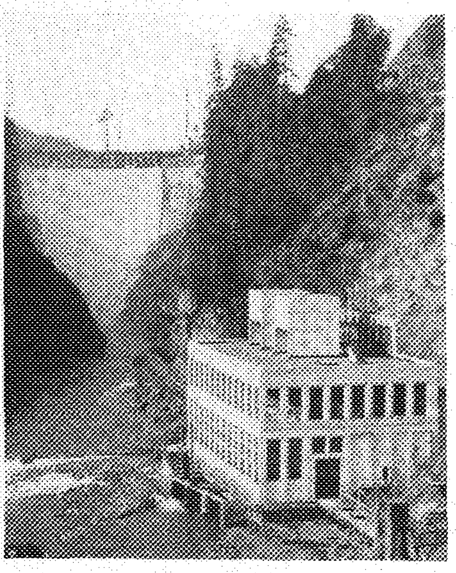
Power developments, however desirable, are of necessity limited to the amount of power that can be used economically. The demand for electric power in the State of Washington is, at present, increasing at the approximate rate of 50,000 H.P. a year and it is self evident that on a sound economic basis the development of new power units can not proceed at a greater rate than the increase in the consumption of electric power.

During the past four years, five important power developments with installed capacities of 197,700 H.P. have been completed and placed in operation. Of these, the Newhalem or Gorge power plant, on the Skagit river, Seattle Municipal system, was completed first, and operation started in September, 1924. Generators with a rated capacity of 50,000 H.P. deliver power to Seattle over a hundred mile, three-phase transmission line at 165,000 volts. Construction work for additional power developments on the Skagit river is in progress.

The Lake Cushman power development, the Tacoma Municipal power system on the Skokomish river, first delivered power to the city of Tacoma early in the winter of 1926. The Cushman plant has an installed generator



LAKE CUSHMAN DAM
Constant Angle Arch Type; 275 ft. high, 85 ft. long at the base and 880 ft. long at the crest. Mt. Eleanor in the background.



BAKER RIVER POWER DEVELOPMENT
Installed capacity: 40,000 K.W. Power transmitted at 110,000 volts to Bellingham, Everett, Seattle and other industrial centers.

capacity of 50,000 H.P. Power is transmitted to Tacoma at 110,000 volts and a distinctive feature of the transmission line is the 6241.5 ft. long span across the Narrows, the longest power span in the world.

The Baker river power development is the third of the five important power plants recently constructed in the state. It is located on the Baker river near Concrete and is owned and operated by the Puget Sound Power & Light Co. More than 50,000 H.P. of electric energy are delivered over a 110,000 volt transmission line to Bellingham, Everett, Seattle and other industrial centers.

The fourth recent power development (17,500 H.P.) is at Glines Canyon on the Elwha river and relates specifically to the paper and pulp industry. It is claimed that the Glines Canyon plant has the distinction of being the largest automatically operated power station in the world.

The fifth and latest important power development, owned and operated by the Washington Water Power company, is on the Chelan river, and has in Lake Chelan, the premiere natural water storage basin in the State. The first unit of 32,200 H.P. was completed and placed in operation last September. A second unit of like capacity is at present under construction.

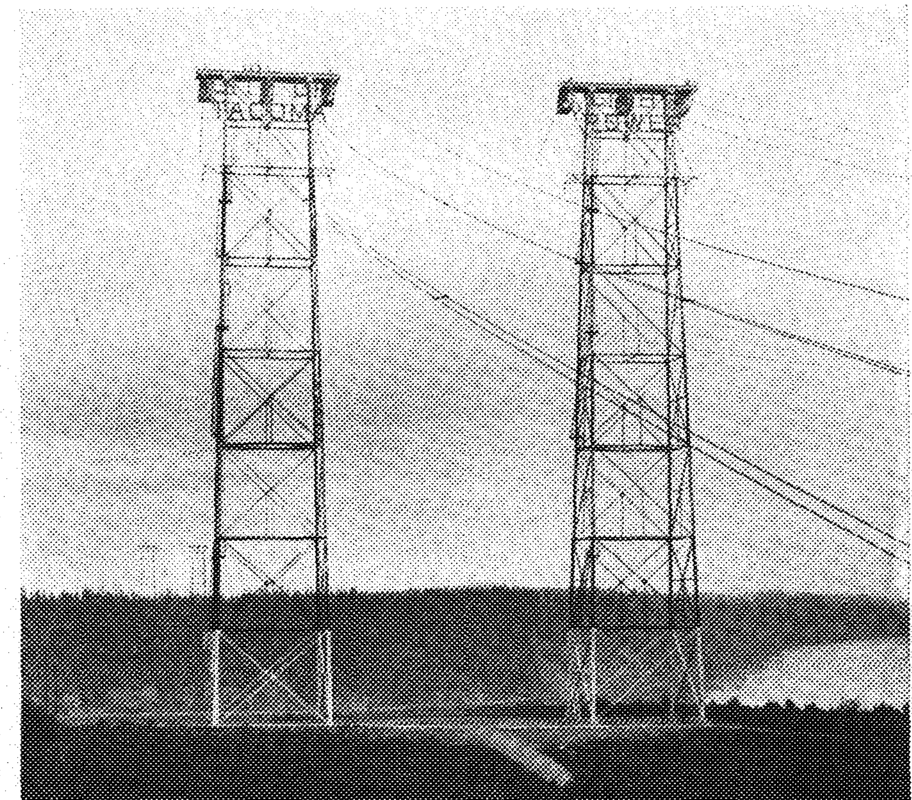
To estimate the probable power output on any given power site that may be developed at a reasonable cost, is a difficult problem. To determine the location and cost of dam foundation, the extent of the storage facilities, and other factors, require extensive borings and detailed investigations of the geologic formations and other factors of each proposed site. Different assumptions as to available storage facilities, the cost of dam construction, and what should be considered a "reasonable cost" per horsepower, will often lead to widely differing estimates of the available power.

Washington not only leads all other States in potential waterpower, but, what is likewise important, the concentration (water power per square mile of land area) is nearly three times as great as in its nearest competitor—Oregon—four times that of California, ten times that of Georgia and thirty-five times that of Minnesota. Moreover the geographic features are favorable for economic transportation of electric energy from all parts of the state to tidewater industrial centers. The general contour of the land, and, in particular, the geographic lay of the Puget Sound Basin, in connection with the Cascade mountain passes, make feasible the construction of trunk transmission lines by which it is possible to unite all the power plants and distribution systems into a super-power system covering the entire state. Although less than five per cent of the available water power has as yet been developed, two 110,000 volt transmission lines cross the Cascades, so that the generators on the Spokane river, at the eastern end of the state, already operate in synchronism with power plants in the Puget Sound Basin.

Interconnection of power plants is in general desirable, and in Washington especially advantageous, as minima stream-flows of the several rivers come at different seasons of the year. Thus all the rivers, except the Skagit, west of the Cascades, have maximum flow in the winter, the minimum in August and September, while conditions are essentially the reverse for the Skagit and the Columbia. Therefore, when completely developed the interconnected hydro-electric power plants will supplement each other so as to provide a continuous unfailing supply of power during the entire year, with little, if any, need of auxiliary stand-by steam plants.

While the natural water resources in Washington are very large and of basic economic importance, it must be kept in mind that to develop these resources whether for irrigation or electric power requires the expenditure of huge sums of money. It has been estimated that merely to develop the available hydro-electric power in the state, that is, generating stations and transmission lines, will require a capital investment of over a billion dollars. In addition, large sums will be required for substations and distribution systems necessary to retail the energy to individual customers. Concurrent with the development of the power resources must of necessity be a corresponding expansion in industry within the state. Factories, mills and a wide variety of industrial plants, requiring many times as much capital investment as the power developments, will be constructed and placed in operation within the state because dependable power is a

(Continued on page 34)



SPAN ACROSS THE NARROWS NEAR TACOMA
This is the longest power transmission line span in the world. Distance between points of cable support on towers: 6241 ft., 6 in. Height of towers from concrete base to point of cable support: 316 ft., 6 in. Clearance of cables above high tide minimum, 200 ft. Aluminum and black paints used on alternate panels to safeguard against collision by aircraft.

Fifty Years of Electric Light

A world-wide celebration commemorating the discovery of electric light on October 21, fifty years ago, is now in progress

FIFTY years ago in a small laboratory at Menlo Park, New Jersey, a group of determined men were working on a problem. Guiding them and inspiring them by his genius was Thomas Alva Edison. To attain their goal they gave up what most of us consider indispensable—pleasure, home-life, friends, and a large percentage of their sleep. They were doing the most discouraging kind of work, that for which there is no perceptible return; and they were doing it in the face of assertions that their aim was foolish and impossible of accomplishment.

Edison and his associates were trying to make an incandescent lamp that would work. That, however, was only the first step in their larger task, "the subdivision of the electric light." This term, which grew up at the time, meant making the electric light commercially practicable as a substitute for gas. The light must be cheap, efficient, and in independent units. Not only that, but it must be measured for billing and constantly available. The "subdivision of the electric light" was declared flatly to be impossible by the leading scientists and electricians of the period.

The first requisite—the successful incandescent lamp—was made October 21, 1879. Edison knew, on that date, that in all its fundamentally essential details he had at last invented an electric lamp to take the place of the ordinary gas-lighting burner. He realized this after discovering the surprising endurance of a carbonized cotton-thread electric burner, when brought up to brilliant incandescence in an all-glass globe exhausted to nearly a perfect vacuum, and made permanently air-tight by having the conducting wires sealed into the glass by fusion. This lamp was broken open in order that reasons for such an attenuated and delicate burner might be found out. Thus the atmosphere of romance which has surrounded this lamp by reason of the dramatic suddenness with which it flashed out of the previous darkness in the art of electric lighting, has not attached to its physical self; but is preserved only in the memories of the inventor and a few surviving assistants. It cost Edison $40,000 in money, or practically every cent he had from his previous inventions. He, alone, made more than 16,000 tests of various materials in his quest for a satisfactory lamp filament.

The making of the lamp, however, was only the first step towards practical electric lighting. The sources of power—the dynamos—then existent were woefully inadequate. Edison turned his attention to them, and soon had more than doubled their efficiency. The next problem was the distribution of the electricity to the lamps. Edison turned his attention in this direction, and invented the "three wire system" in use today.

Not only did Edison create the electric lighting system, but he put it into practical operation in New York City where it was a complete success. Thus he proved to the world that he had given it something useful.

It is doubtful if even Edison foresaw the full usefulness of the electric light. Today, as we look around, we realize that not a single activity of our modern civilization could do without it. Without the electric light our economic system would be disastrously crippled; and prosperity such as we now enjoy, would be impossible. The remarkable and unprecedented development of the last half century would have been impossible. For electric light has doubled the creative life of man. He is alive and active for 24 hours instead of 12. From our prosperity, in which electric light is a factor of prime importance, and from our modern improvements, which have been made possible by the electric light, comes our happiness for which, therefore, we owe much to Thomas Edison.

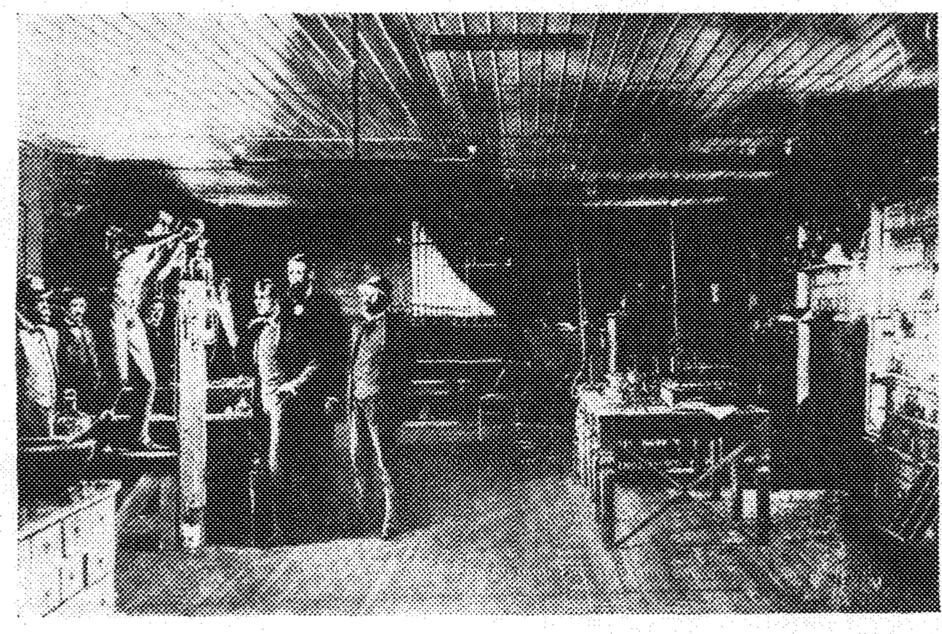
It is given to few men to look over the span of fifty years and see with mortal eyes the blessings their genius has conferred upon mankind—rarely is it possible for a grateful people to express to a living man their appreciation of his gifts to them. *Light's Golden Jubilee* is an opportunity for this country—for the whole world—to express its gratitude to Edison, its greatest living benefactor. It will be one of the greatest tributes ever paid to a living man, because it is inspired by one whose deeds place him definitely among the immortals. It takes its bigness, its impressiveness, its constructiveness from the man it honors.

Light's Golden Jubilee takes the form of a series of light festivals the first of which took place at Atlantic City on May 31st. There, hundreds of thousands of visitors joined the residents of the community who turned out en masse to witness a gorgeous spectacle of light and color in which land, sea, surf, and sky mingled and were bathed in all the hues of the rainbow.

Two weeks later another brilliant chapter was written in the history of the celebration when the cities of Niagara Falls, New York, and Niagara Falls, Ontario, dedicating their fifth annual Festival of Lights to the celebration of *Light's Golden Jubilee*, observed a four day festal period which for sheer beauty and magnificence probably has never been surpassed anywhere in the country.

Saturday, August 31st, was designated

(Continued on page 18)



EDISON EXHAUSTING AIR FROM HIS FAMOUS "FORTY-HOUR" LAMP OF 1879.

Loud Speakers

In the public address system installed in Minnesota's new scoreboard a speaker's voice is amplified 6,000,000 times, making it audible in all parts of the stadium

By H. E. Hartig
Professor of Electrical Engineering

SOME folks have great reputations as loud speakers. To the occupants of the apartment below, the title may seem altogether appropriate and well earned. However, when the best performances of the best of the loud speakers are investigated by cold-blooded, fact-seeking scientists, the power of man's voice appears altogether Lilliputian. A cicada sitting on the limb of a tree in the hot August sun and singing its love song (or what does it sing?) may be heard over a distance of several miles. Only the sun-bronzed hero of a popular novel can approach that record. And yet the cicada is no larger than a man's thumb. What cause for complaint would not apartment dwellers have if man's voice were in proportion to his size!

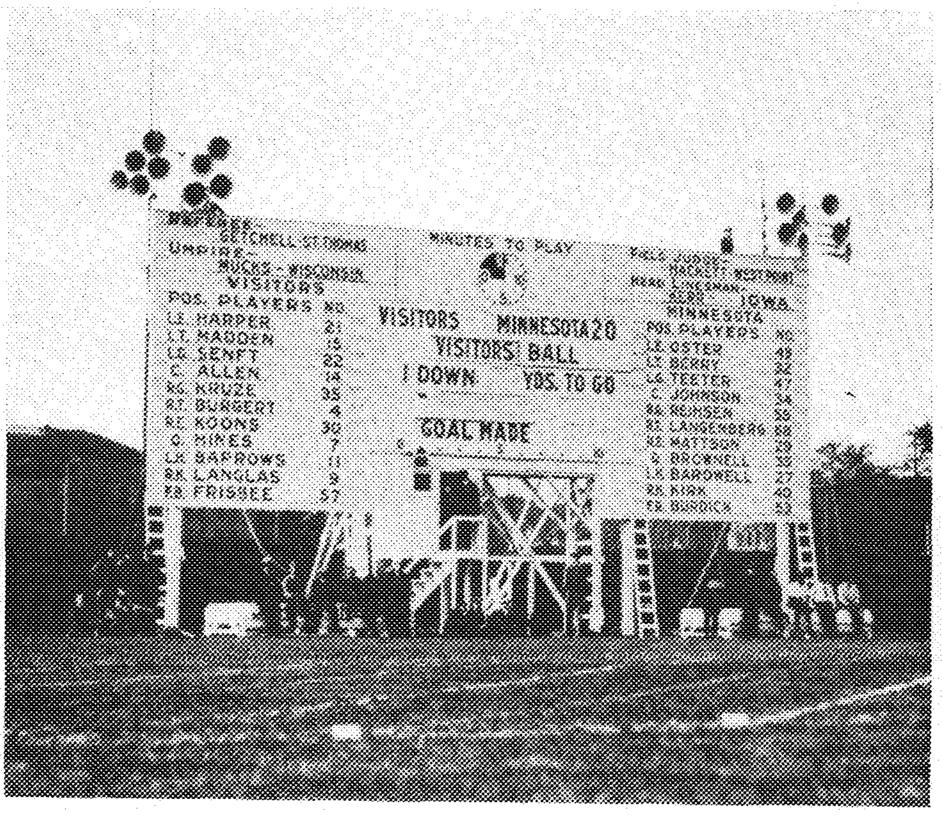
To appreciate the small amount of power in the speech of even so-called powerful speakers, we should have to talk in terms of fly power, or perhaps flea power. But since neither of these units of power has been very accurately determined, we shall have to let the mere suggestion suffice. The scientific unit we shall use, while it is very definite and precise, is much less familiar. The microwatt is the one millionth part of a watt. Can you imagine what one such unit of electrical energy would do in an electric light bulb, or for that matter, a thousand such units. Yet the average speech power of the individual is only 10 microwatts, while the most breath-taking efforts of the most powerfully voiced man do not exceed 5000 microwatts.

When the football crowds start streaming into the Stadium, when the band begins to play and drums begin to roll, when 40 thousand football-mad rooters rise up in their places and roar with hoarse voices, then the pigmy voice of a single man is lost. To get the attention and convey information to such a vast and restless throng requires a great multiplication of the power of man's voice. Scientific advances of recent years have made this possible and the University possesses a so-called Public Address System, by means of which a speaker located in a sound proof booth built into the Stadium score board, may speak in an ordinary tone of voice and be heard by the spectators in the Stadium through the 20 horns mounted at the top of the score board. Amplifiers multiply the speaker's voice until it has energy six million times greater than originally. When the amplifiers are worked at their highest level of power, the air in the immediate neighborhood of the score board fairly throbs and the speaker's voice can be felt as well as heard.

A great deal of apparatus is required to obtain this result. The sound originating in the booth is picked up by a high quality microphone of the same type used for radio broadcasting. The electrical energy from the microphone is increased by a portable amplifier at the scoreboard and then transmitted over carefully shielded lead-covered wires to the radio studio on the third floor of the Electrical Engineering Building. Here the incoming energy is fed into another control amplifier and from it to a final mammoth power amplifier and then over another pair of wires back to the scoreboard through a control panel and finally to the horns mounted on the top of the board.

In order to regulate and direct the sound output of the horns, it is necessary for the operators of the system in the Stadium to get reports from monitor observers in the audience. A telephone line is installed with outlets at strategic positions in the Stadium at which observers with portable telephones are located.

As the reader may imagine, the great amount and highly technical character of the equipment required for the Public Address System makes its maintenance a job of considerable magnitude. The general direction of the System is under the control of Dr. W. F. Holman of the Department of Buildings and Grounds and his electricians lay wires and do other construction work necessary. The actual work of operating and maintaining the system is done by students of the electrical engineering department. At present, M. M. Garrison, a senior electrical, is the chief operator with L. G. Swendson, a junior electrical, as understudy. They are called upon to put the system into operation for many and various occasions. The work this year has already included setups in the Field House, in front of the new Auditorium, at the dedication of the new Elliot Hospital, and in the Stadium.



MINNESOTA'S NEW SCOREBOARD

This new scoreboard is thirty feet square and has all information on it to furnish a complete visual record of the game. A speaker may stand in the soundproof box at the rear of the board and address the entire crowd.

A Long Tunnel Survey

The Cascade Tunnel which was completed last spring is one of the most notable engineering achievements in railroad history

By D. F. Brocchi
Great Northern Railway

On the morning of the 27th of September, 1925, we boarded Great Northern No. 4, bound for Scenic in the heart of the Cascade Mountains to make a hasty preliminary survey for an 8-mile tunnel.

Topographical

The general direction of the Great Northern Railway is easterly from Seattle to Scenic, where it turns northwesterly, climbing the side of a mountain for better than three miles. After turning 249 degrees on a 10° curve, mostly in the Horse-shoe Tunnel, it returns along the same mountainside in the opposite direction, turns around Windy Point, thence it follows a northerly direction for 2¼ miles to Tye and the west portal of the present Cascade Tunnel. It is still climbing in the tunnel to the east portal, which is 13,873.1 feet or approximately 2⅝ miles from the west portal on a course of N. 52°E. Cascade Tunnel is also the name for the station at the east portal. At Cascade Tunnel begins the down grade, while the general direction continues northeasterly for 2 miles, then gradually changing to easterly and southeasterly to Berne, very nearly five miles from the east portal.

From the sketch map attached it will be seen that a straight line from Scenic to Berne is one side of a quadrilateral, therefore, much shorter than the sum of the other sides, Scenic to Tye, Tye to a point 2 miles eact of Cascade Tunnel and from this point to Berne, even if these sides were straight, and, with the exception of the tunnel, they are far from such. If to this difference we add the loop Scenic to Horse-shoe Tunnel and back to Windy Point, the contrast is far more startling, as will be seen later from the result of the survey.

So much for distance.

Cascade Tunnel is 504 feet higher than Berne. A tunnel on the hereinbefore mentioned straight line would then eliminate 504 feet of a climb both going east and going west. This feature alone is more far-reaching than it appears at first sight, reducing as it would the ruling grade Scenic to Berne from 2.2 per cent to less than 1.6 per cent. So much for grade.

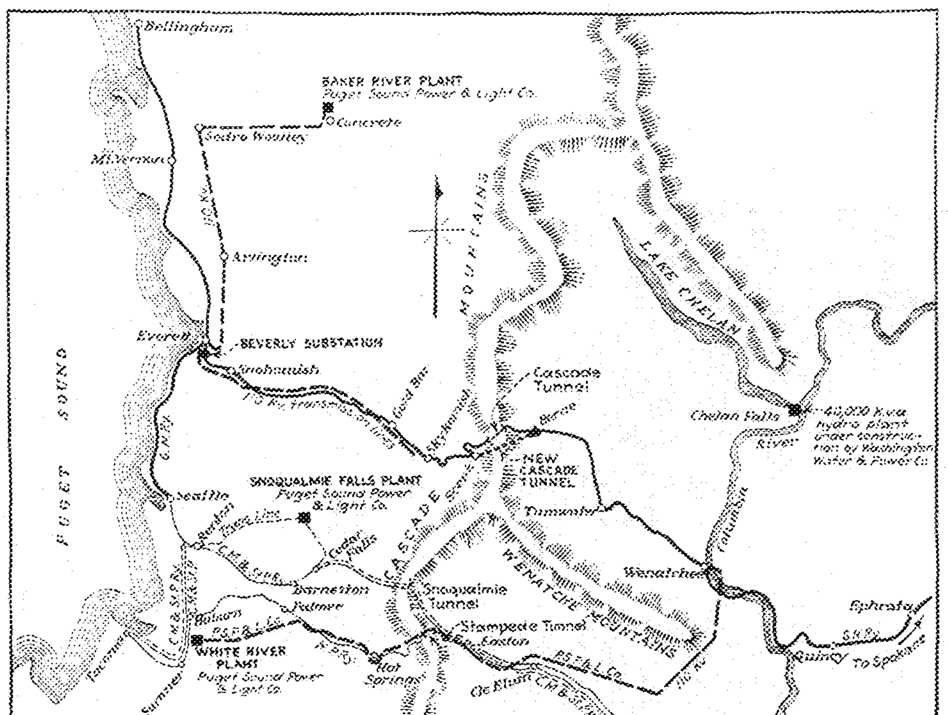
At eight o'clock on the morning following our advent e v e r y b o d y that amounted to anything, meaning all except the draftsman, were bundled up in mackinaws, slickers, hats, caps, boots, gloves and tin pants of many hues and designs, loaded with transit, level, pickets, rods, plumb bobs, axes and the rest of the traps, all ready to go.

It was to be a hasty survey, a race against the winter storms that might be here in less than a month, and they did not forget it. The mess of notes that was turned in that evening, kept the draftsman busy all the next day with some to spare. Neither was there any let-up in the pace. From start to finish of that hasty survey he had to work overtime morning noon and night under penalty of losing his reputation, if not his position.

There was not much snow at Scenic that winter, but rain, mud and wet brush served as efficient substitutes, witness waterproof boots, pants, coats, and hats that would soak through like sponges. Although everyone was supplied with two or more changes, many a morning meant getting inside of wet shirts and drawers.

The survey was based on the axis of the present tunnel. A traverse line of twenty-four courses was run along the track from the west portal to a station at Windy Point, a base line of 1,060 feet established on the Steven's Pass Highway down below, angles were read from its ends to the station at Windy Point and at this station the angle was read subtending the base line. This was the first and one of the very few cases where time was taken to obtain a check on the preliminary work. The triangle closed with an error of less than 30 seconds, in spite of the rush and the quality of the instruments on hand. Having calculated the remaining sides of the triangle, from the eastern end of a long stretch of straight track immediately west of the depot, a network of preliminary lines was spread out to cover a wide area from the present track to what seemed the most suitable location for a portal, 1¾ miles to the east, and connecting with the Windy Point triangle.

The location of the east portal came next in order. Preliminary lines to cover the required area were run at Berne beginning at a point in a long piece of straight track very much as it was done at Scenic. A good location for the portal was not difficult to find, the direction of the mountainside being very nearly at right angles to the proposed tunnel at many points. Having located two optional sites,the party adjourned to the east portal of the present tunnel and joined its axis there with the survey at Berne with a traverse line of 39 courses along the track.



A Map of a Part of the Great Northern Railway Including the Section Electrified, and the Location of the New 7¾-mile Tunnel.

This was the last link, completing as it did a continuous survey from the proposed west portal at Scenic to the proposed east portal at Berne and connecting with the present track at both places.

The possibility of shortening the tunnel very materially was suggested in the form of open track up the Mill Creek valley from Berne, but it was not necessary to extend the survey very far to discover that the grade would have been too steep. The survey, however, was continued to where the creek crosses the proposed tunnel line, the same point being 2.3 miles west of the proposed east portal, for the purpose of locating the site for a vertical shaft, and it was found that a shaft at that point was practical.

On the 24th of October all field work was completed and a few days later our report was sent to headquarters.

Contrary to expectations, instructions to disband did not materialize, but we were kept busy on other work until the 25th of November, when at a meeting of the Board of Directors, the construction of the new tunnel was approved, to be undertaken without delay, and orders were received to throw the line over the hills.

No measuring of distances was to be done, but a line of backsights and foresights was to be produced from portal to portal. Tunnel driving could then be commenced at both ends in the proper direction. The difference in grade due to the difference between actual and calculated distances could not affect appreciably the driving that could have been done to the time when data would be available for the final grade, but the difference in alignment between the true line and the one calculated from a "hasty survey," might have been too large to be overlooked, even for a few hundred feet.

The entire line could be covered from 8 sighting points; West Portal, a peak rising to an elevation of 5,520 feet, Big Chief Mountain, 5,515 feet in elevation, a lower mountain immediately east of Mill Creek, still a lower one on the other side of Berne, back to a point on the mountainside over the east portal, ahead again to a lower point east of Berne and back to the east portal.

The longest sights were west portal to the west peak, 12,000 feet, to Big Chief 10,000 feet, to the mountain east of Mill Creek 11,500 feet, and to the highest point east of Berne 12,000 feet.

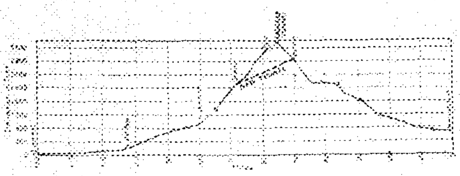
Instruments that could be depended upon to keep their adjustment having been furnished, a point was selected in one of the preliminary lines at Scenic and one at Berne, the instrument centered on the Scenic point, the angle turned from the preliminary line as calculated to obtain the direction of the Berne point, and a party started on their way up to the west peak to clear the line of sight and plant a sighting target where the telescope was pointing.

The west peak was the meanest one to climb. The snow was deep up there, the boys having to take turns about breaking trail, but the goal was reached before noon. A gap was cut in one of the few patches of timber that crested the top, and after a hub had been set according to signals from below, a sighting target was erected over the point.

The transit party now took their turn at climbing the west peak, while the axemen took theirs at Big Chief. As this point was reached with the projection, the same work was started at Berne.

Cowboy

On the whole everything was proceeding all right, but when the hub on Big



Profile and Comparison of Present and Proposed Lines.

Chief was set for the transit, a blizzard came, blowing the sighting target on the west peak out of line.

As soon as it began to look bright up there again, a party of two was sent up with axes and a pocketful of spikes to straighten up the target, a Scenic old-timer, familiar with the trails and accustomed to the mountains, and a young chap dubbed Cowboy for no other reason than that he was wearing a cowboy hat, who so far had won first prize for good nature, willingness and pep.

Gone before sunrise, they kept plugging along taking turns at breaking trail. The snow was deeper now, and often they would sink to their armpits. The sun shone for a short while, but soon went out of sight, a sharp wind began to blow and a blizzard followed. When Cowboy noticed that his partner was showing signs of weakness, he let him follow, breaking trail alone to the top. It was dusk when they got there and all they could do was prepare to pass the night by a campfire. They got one going at last, but wet wood in the face of a blizzard could not be trusted to burn alone. It had to be coaxed and attended to right along. Before the night was very old the partner gave out, laid down and went to sleep. Cowboy did not rest that night, fighting against the storm until morning to keep the fire burning and save both from freezing to death.

At daylight they dug down with their axes to bare ground, secured the framework back on its feet with tree limbs and spikes, replaced the torn muslin target with stout canvas and started on their return trip. It took the balance of the day to get back to Scenic. After telling the story, Cowboy was greeted with a handshake and ordered to bed.

Later when the draftsman, anticipating a triangulation, was looking for conventional names to label the points most likely to be used, selected "Cowboy" for the west peak. The name gradually found its way in other quarters, was accepted all around without comment and placed officially on the maps, where we sincerely hope it is put to stay.

Although the going was getting worse as the winter advanced, the line was being pushed forth with remarkable speed, until near the end of the third week the glad news was received that from the west the transit crosshairs could be seen projected on the clearing from the east. When the line was produced to Berne, it missed the required point by only 6 feet.

Did this mean accurate work or did it mean coincidence? It meant both. The party had done as well as could have been done under the circumstances, angels could do no more, but the circumstances did not justify an error of only 6 feet in eight miles. It was not consistent with the great number of short courses of the preliminary survey, with the condition of the equipment, with the rushing haste of the work from start to finish. It was a case of compensation of errors, and such it was assumed to be, as was evidenced later by instructions for precise surveys.

No adjustment was made of the line as projected, the east portal being just as practicable 6 feet one way or another from the selected point. That was enough for a start and on the 27th day of November, 1925, the contractor made his appearance.

Clearing for the right of way, portals and camp-sites were the first operations, followed by construction of camps, breaking ground for the pioneer tunnel at Scenic and drift at Berne in December and grading a road to the site of the Mill Creek Shaft.

The pioneer tunnel is 8′x9′ in section and its axis is 66 feet southeasterly from the axis of the main tunnel. Its principal object is to expedite the work by keping its face well in advance of the main tunnel and driving crosscuts at convenient intervals in order that the excavation of the main tunnel may be carried on simultaneously at several headings. Among other advantages of the pioneer tunnel may be mentioned additional facilities for removal of spoils, drainage, air circulation and opportunity for engineers to furnish alignment and grade.

The north fork of the Tye River crosses over the tunnel 1,820 feet east of the portal, only 95 feet above subgrade. This feature was taken advantage of by driving a shaft inclined 30

(Continued on page 20)

The Engineer's Bookstore

The Engineer's Bookstore this year has declared a dividend of over $7,600—the largest dividend in the history of the store

THE 1929 dividend of the Engineers' Bookstore as declared by the board of directors is the largest dividend in the history of the store. Dividends as follows have been paid each year since the store was started:

1920-1921	$2,127.98
1921-1922	3,858.10
1922-1923	4,894.55
1923-1924	5,897.23
1924-1925	5,317.24
1925-1926	5,900.81
1926-1927	6,966.91
1927-1928	7,061.61
1928-1929	7,663.96

Prior to the beginning of the Engineers' Bookstore, books had been purchased from the Minnesota Co-operative, through the Engineering Student Council. Sophomores, juniors, and seniors were required to order their books in advance and make a deposit. No provision was made for freshmen whatever, and the total college enrollment was only about four hundred. In 1919, there was a tremendous jump in enrollment and this plan proved itself inadequate to the needs of the college. Stocks of books and all other engineering supplies were woefully inadequate and great delays occurred. Accounts were never satisfactorily closed. The situation was chaotic.

Studies were made of cooperative stores at other institutions and in 1920, the Engineers' Bookstore was started under the following plan: government was placed in the hands of a board of eight directors—three professors appointed by the dean, and five students, elected, one each from the departments of civil, electrical and mechanical engineering, the School of Architecture and the School of Chemistry. Operation was placed in the hands of a full time manager under their direction. Sales were to be at normal retail prices and earnings to be repaid to members in proportion to their individual purchases. Membership was to be secured by a deposit of five dollars, which deposit was to be returned upon leaving school permanently.

The store was successful from the outset and the volume of business grew steadily. Opposition soon developed, but the legality and propriety of its existence were conclusively demonstrated and its services continued.

Aside from its primary duty of supplying the exact materials needed at the time needed, of proper quality and price, the store has rendered the college other services as opportunity offered. An Engineers' Bookstore Loan Fund of $1,000 has been established with the University, a beautiful and much needed trophy case was presented to the college, trophies for participation in engineering activities have been awarded and other organizations assisted in various ways.

The men who will direct the store for the coming year are: Professor O. S. Zelner, Professor W. H. Kirchner, Professor C. A. Mann, Leonard Melkus, architecture, Clinton MacMullen, chemistry, James Bailey, electrical engineering, Roland Stoebe, civil engineering, Ralph Baskerville, mechanical engineering, and Harold D. Smith, manager of the bookstore.

Sales for the year 1928-29 were $63,802.80. A profit and loss statement for the year and a balance sheet as at May 31, 1929, are shown below.

Annual Financial Report of The Engineer's Bookstore

PROFIT AND LOSS STATEMENT FOR THE YEAR ENDED MAY 31, 1929

Sales		$63,802.80
Cost of Goods Sold		
Inventory June 1, 1928		$6,887.58
Purchases		47,079.63
Freight, Express and Drayage		1,013.12
Total		$54,980.33
Less: Inventory May 31, 1929		7,862.38
Cost of Goods Sold		$47,117.95
Gross Profit on Sales		$16,684.85
Less: Expenses		8,925.04
Operating Profit		$7,759.81
Additions to Income		
Cash Discount on Purchases		$356.24
Interest Received on U. S. Bonds and Notes		366.04
Other Interest Received		98.17
Adjustment of Cap and Gown Deposits		5.00
1921, 1922 and 1923 Unpaid Dividends Cancelled		270.57
1925 Dividend Adjusted		.50
Total		$1,096.52
Gross Income		$8,856.33
Deductions from Income		
Loss on Sale of Bonds	$156.21	
Income Tax Paid	13.08	
Bad Debt Losses	24.82	
Total	$194.11	
Net Income for Period		$8,662.22
Add: Surplus Balance June 1, 1928		10,118.36
Total		$18,780.58
Deduct:		
Cost of plate for Trophy Case Presented Engineering College		4.50
1929 Dividends Declared		7,663.96
		$7,668.46
Surplus Balance May 31, 1929		$11,112.12

BALANCE SHEET AS AT MAY 31, 1929

Assets

Current Assets	
Cash on Hand and in Bank	$804.81
Certificates of Deposit	1,000.00
Accounts Receivable	429.13
Inventory	7,862.38
Total Current Assets	$10,096.52
Investments	
U. S. L. L. Bonds and Treasury Notes—General Funds	$17,346.72
U. S. L. L. Bonds—Cap and Gown Replacement	1,350.00
Total Investments	$18,696.72
Fixed Assets	
Store and Office Equipment—Net Book Value	$400.00
Cap and Gown Rental Costumes—Net Book Value	1.00
Total Fixed Assets	$401.00
Total Current Assets	$10,096.52
Total Investments	18,696.72
Total Fixed Assets	401.00
Total Assets	$29,194.04

Liabilities

Current Liabilities		
Vouchers Payable	$189.88	
Deposits on Caps and Gowns	25.00	
Dividends Payable	8,677.04	
Total Current Liabilities		$8,811.92
Memberships and Surplus		
Memberships Paid in	$9,270.00	
Surplus	11,112.12	
Total Memberships and Surplus		20,382.12
Total Liabilities		$29,194.04

News from the Technical Campus

A. C. S. Meets at Minnesota

THE National meeting of the American Chemical Society, fall session, was held in Minneapolis Sept. 9-13. The total registered attendance was 1175, of which 170 were women. Representatives were present from every state in the Union and from eleven foreign countries, Minnesota running highest in attendance with Illinois a close second. A woman from Siam had the honor of coming the farthest to attend. Not since the winter of 1910 has Minnesota had the privilege of being host to the national meeting.

Among the outstanding features were the address by President Irving Langmuir of the General Electric company on "Modern Concepts of Physics and Their Relation to Chemistry," the Award of the Priestley Medal to Mr. Francis P. Garvan, the Symposium on "Chemical Activation by Light and by Ionizing Agents," and two innovations in arrangements. The distinguished foreign chemists present included Prof. Max Bodenstein, Director of the Institute of Physical Chemistry, University of Berlin, and the recognized authority on gas kinetics; Dr. M. Polanyi of the Kaiser Wilhelm Institute; Dr. Karl F. Bonhoeffer, also of the Kaiser Wilhelm Institute; Dr. Francis Perrin of the University of Paris; and Prof. A. E. Chichibabin of the University of Leningrad.

A departure from previous methods and a very pleasing one, was the strict time schedule, worked out by Dr. S. C. Lind, general chairman, and Dr. Geo. Glockler, program chairman; this chronological arrangement entailed considerable work by the men in charge but its advantages are both obvious and numerous; it is hoped that the plan will be used for future meetings. Another innovation was pre-registration; although the plan was tried for the first time this year, twenty-five per cent availed themselves of the opportunity to avoid difficulties and delays.

One of the highlights of the meeting was the award of the Priestley Medal for Distinguished Service to Chemistry, to Francis P. Garvan of New York. Because of illness, Mr. Garvan was unable to attend the meeting, and the medal was given to Wm. W. Buffum, general manager of the Chemical Foundation, of which Mr. Garvan is president. Mr. Buffum left immediately to deliver the Award to Mr. Garvan. During the presentation, a telegram of congratulations was received from President Hoover. The address, "Random Thoughts of a Lay Chemist," which Mr. Garvan had prepared, was read by Prof. Julius Steiglitz, of Chicago University. Other distinguished persons on the stage during the Award were President Irving Langmuir, Governor Theodore Christianson of Minnesota, Mayor W. F. Kunze of Minneapolis, President L. D. Coffman of Minnesota, Dean Freeman of Minnesota, Professor Glasoe of St. Olaf, Honorary Chairman G. B. Frankforter, two former presidents of the Society, and President-elect Wm. McPherson. The program was broadcast over WCCO and WABC. It is estimated that at least twelve hundred people were present at the ceremonies.

Eight trips were planned for the information and enjoyment of those attending. Five of these were to various industrial plants in the Twin Cities; one, a sight-seeing trip around the Cities; another, a trip through the Mayo clinic at Rochester; and the last, an all-day excursion to and through the iron range near Hibbing and Cloquet; over a hundred made use of the chance to see Minnesota's beauty spots and largest industry.

Seventeen sections of the Society held sessions, at which a total of 272 papers were presented, 34 of them by University of Minnesota professors. In addition to these more formal meetings, several group luncheons and dinners were arranged. Phi Lambda Upsilon, national honorary chemical fraternity, held its annual convention during the Friday and Saturday following the meeting.

The *A. C. S. Minnesotan*, published daily, was of great value in informing the chemists of the progress of events, registration, announcements, etc. It has also been arranged to make available sets of the papers presented.

A very complete exhibit of scientific apparatus, books, and chemicals was provided, which proved to be of deep interest to the delegates. In fact, several undergraduates assisting during the convention have a large supply of rulers, charts, and catalogs. Of more than usual interest also to these would-be chemists was the symposium on "Selecting the Chemist-Elect." The valuable hints, frank comment, and brilliant repartee will never be forgotten by the audience.

Besides the entertainment at the smoker, there was provided a dance and a golf tournament. Frank Stodola, of Minnesota, was the golf champ, the matches being played at the Midland Hills course Thursday afternoon.

Faculty Appointments

John D. Ackerman has been appointed assistant professor in the department of mechanical engineering. Mr. Ackerman was graduated from the Moscow Aeronautical School in 1916. He also received a B. S. in aeronautical engineering from the University of Michigan in 1925.

Leland L. Antes, who received his bachelor's degree in electrical engineering from the University of Texas in 1927 has been appointed instructor of electrical engineering.

A teaching fellowship in the Experiment Station was awarded to Henry A. Davidson, B. S. Arch. Eng. '27.

Claud C. Gage, who graduated from the University of Michigan in 1929 from the school of aeronautics has been appointed instructor in the department of mechanics.

Ralphe J. Hooker has been engaged as an instructor in the mechanical department. Mr. Hooker was graduated from Oregon State in 1928 with the bachelor's degree in mechanical engineering.

Herluf P. Nielson has been appointed instructor in the mechanical department. Mr. Nielson received his bachelor's degree in mechanical engineering from the University of Nebraska in 1923, and was awarded a master's degree from Rensellaer Polytechnic Institute in 1925.

Herbert D. Owens has been appointed instructor in mathematics. Mr. Owens received a bachelor's degree in electrical engineering from Ohio State in 1927. He was also awarded a master's degree in physics from Ohio State in 1929.

Albert J. Plath has been engaged as a teaching fellow in the department of civil engineering. Mr. Plath was graduated from Iowa State where he received a bachelor's degree in general engineering.

Christian Preus has been awarded a teaching fellowship at the experiment station. Mr. Preus received a B. A. from Luther College at Decorah, Iowa, in 1924, and a B. S. from the University of Minnesota in 1927.

Carl Everett Swanson, B. S. E. E. '27, has been appointed instructor in the electrical department.

James R. VanDyke has been given an assistant professorship in the department of mechanical engineering. Mr. VanDyke received a bachelor's degree in mechanical engineering at the University in 1918, and was awarded his master's degree in 1922 at Pennsylvania State.

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

Editorial Staff

J. P. Shirley - - - *Managing Editor*
W. Gerald Warrington - - - *Publicity Manager*
(Business Manager 1928-29)
Harold S. Wang - - - *Circulation Manager*
O. Reginald Lindstrom - - - *News Editor*
Winfield Foster   Maurice King

Business Staff

J. Lamont Warrington - - - *Business Manager*
Morris J. Hauge - - - *Business Associate*
John S. Madden - - - *Advertising Manager*
James Spicola - - - *Collections Manager*
E. C. Carlberg   R. N. Soukal   R. H. Comstock

Success

A. A. HIPPIAS received his bachelor's degree in 1900. His college career was characterized by indefatigable attention to books. A. A. Hippias was not endowed by nature with a retentive memory or a versatile disposition. Through four long years, he plugged and plodded, studied and crammed. Hippias never flunked, Hippias never played. On receiving his much coveted degree Hippias was engaged by All Wool Woolens to sell custom made clothes in rural districts. He was given a horse named Fanny, a buggy, a sample case and a tape line and told to get orders. Knocking at farm doors, winding along deserted roads, the life of Hippias was horribly monotonous. But Hippias would not quit. Ten years later he was still driving Fanny along deserted roads, still knocking at farm doors. But soon there came noises of a distant war, and Hippias found himself in khaki,—a buck private in the army of Democracy. Some time later, Hippias returned, took off his buck private's uniform and was given his old job selling All Wool Woolens. In 1922 his territory was changed, and Hippias saw his sales mount for now he drove a smart roadster over asphalt roads. And then one day Hippias was called into the head office and made sales manager of All Wool Woolens. And another day Hippias received countless handclasps, countless expressions of good-will,—for Hippias was now seated behind a mahogany desk. Hippias had been named president of All Wool Woolens, "For meritorious and steadfast service" as the board of directors had said.

Take the case of Bill E. Snooks. Snooks left preparatory to marry a charming girl from a nearby preparatory school. But in the following year, Snooks was admitted to Raford College where he distinguished himself by being a constant annoyance to the Dean. Snooks did not like to study; he preferred football. Then the Dean found it wise to rid himself of Snooks, so Bill entered Mayhem University of Junction, Iowa. There Snooks was injured in football practice, and decided to work on the *Mayhem Crier*,—weekly student publication. But the new Dean thought that Mayhem could continue—and again Snooks left college, this time for ever. He obtained a job selling subscriptions to monthly magazines. A year later he was in South America promoting an irrigation project in the Argentine. The following year, he sold bonds for a Wall Street organization. But Bill did not stick. The knock of Opportunity sounded so loud, the next pasture appeared so green, that he was constantly on the move. He was always prepared to grasp the new opportunity, always ready to undertake a new pursuit, and the result? Today Bill E. Snooks is chairman of the board of directors of Golgonia Mines, president of South American Irrigation Consolidated, majority stockholder of Mad Cap Oils, Ltd., and receives an annual income that runs well into six figures. And what is his axiom of success? "Opportunity loves a sport,—take a chance."

Illustrations might be reproduced *ad infinitum*. A number of periodicals continuously devote their pages to the recounting of similar biographical sketches of success. And the public loves them, absorbs every word of the remarkable story of Mr. I. Stayed Putt, or Mr. I. Tooka Chance, simply because such stories show the multiplicity of methods employed in reaching the Top. They demonstrate that there is no open road to success, no door that leads inevitably to independence, that responds unquestionably to the "Open Sesame." They show that every one, whether genius or moron, Phi Beta Kappa or Kappa Beta Phi can make the grade. They show that diversified paths lead to the same goal, that there are countless ways to Get There. They give us all a chance, a ray of Hope that may lead us through this failure or that repulse to the desired pinnacle of success.

Come In!

IT is a well known platitude that nothing in this world can remain in the same condition for any length of time and continue to live. All things, either animate or inanimate must move forward or back; stagnation means decay and eventual disappearance.

We believe that the magazine produced last year was the best that has ever been given to the technical colleges. Of course your opinion may differ—in that case you are the man that we want to see.

When many of the dependable men on the staff graduated last June the magazine sustained a distinct loss and this loss will, of necessity, have to be made up from the men that remain in school. If you have any ideas, any desire to write, any desire to work, any constructive criticism, or any plain kicks to offer, room 37 in the Electrical Engineering building is where you ought to be. There are several good positions open on both the editorial and business staffs, and with your cooperation we will make 1929-30 a year to be remembered in technical magazine work at Minnesota.

Progress

ONE by one we have seen disappear those glorious relics of a forgotten age. During the vacation period just closed,—new steps were made for the northern entrance to the main engineering building. No more will the heavily burdened student labor to scale those treacherous cascades of ice. During the vacation period those two dismal structures that wasted between the School of Chemistry and the main engineering building have disappeared. No more will proud heads bow in shame at sight of those forbidding dwellings.

Our campus is then fair and smiling. A beautiful spot to soften the time hardened eye of criticism. But hold—there is one stronghold that remains untouched by the advances of construction, that has defied even the assaults of renovation. It has opened its arms to the battling elements of corrosion until it stands today a mere shadow, a scarcely discernible shell of its former self.

Have you examined the old M. E. building with its tottering stairs, its forlorn aspect? The present is not unthankful to the past, but asks much of the future.

Freshman Week

Freshman week, which was started on the Minnesota Campus three years ago, now has a definite place and purpose in the new student's matriculation

ONCE upon a time (all good stories start that way, and we may as well be conventional) a freshman came to Minnesota from a far off place. Of course, the fact that he picked Minnesota is not strange, nor was the fact that he thought that he was above the average in physical, mental and moral make-up to be remarked upon, for this is characteristic among first year students. What is to be noted, however, is the fact that before he had been here three months his entire attitude had changed, and because he had discovered that as an individual he was of no account, and that the institution could use his space more readily than his presence, he remained here to continue his studies. Others of his class were not so wise, and in a very short time had been requested to transfer their abilities to regions where strong backs and weak minds could be used.

This commonplace little story may illustrate something that has been known for a long time—that all entering students must learn to adapt themselves to surroundings entirely different than those to which they have been accustomed. It was to help all entering students that Freshman Week was devised three years ago, and the fact that each year a larger class has been registered than the year before speaks for the success of the work.

Primarily, freshman week is designed to help new students through a difficult registration procedure and to give them assistance in straightening out the difficulties that come up in connection with this program. However, there is another duty which the upperclassmen perform, and it is of as much, if not more value than the assistance given in registration. They help the students to become school-minded, and endeavor to show the freshmen that they can reach the mistakes that have been made by former freshmen, in the hope that the freshmen they are aiding will be able to profit by the examples cited.

In the days before Freshman week was established there was no assistance offered, and the freshman, with the suspicion of the newcomer was particularly suspicious of any that was given. Upperclassmen looked upon the new student as something that could be hazed, and apart from that, took little interest in his problems. Registration for new and old students alike took place at the same time, and not infrequently the new students spent their first week in school straightening out the kinks in programs that would have taxed the capacity of a senior.

Compare then, the conditions that existed then and those of today. New students are met at the depots and on their arrival at the campus are given a definite registration procedure to follow. There are no upperclassmen registering at the same time, and information booths are ready to answer questions for the students that do get mixed.

As for the upperclassman, barely one-half of his work is done when the freshman is on his way to registration. The remainder of the week is spent in attempting to give the student a true perspective of college life, and in directing him into the path that will eventually lead to a degree. Some new men pay attention to the lectures that are arranged, but for the some that spent their time dreaming of the glorious time that they are going to have for four years, we are repeating a bit of the advice that was given.

The purpose of this article is not to glorify the upperclassmen who returned to school a week early to help the freshmen, but to point out a few of the salient facts that should be remembered from the lectures that were given, and to show, if possible, the way to salvation for those men who are entering with the old spirit of "I know it all."

In the first place the freshman engineer should have paid attention to the lecture on "How to Study" by Professor Bird of the department of psychology. This lecture was printed in the freshman handbook. Above all else the men at the university are students, and before anything else can be accomplished it is necessary that the study program of the college be carried out. The rah-rah boy of the early post war days is a thing of the past and although there are many men now who profess a liking for the lighter side of life, you will usually find that they get their work done first.

In another part of the handbook you will find a talk from Dean Nicholson, the dean of student affairs, and a message from our own Dean Leland. These men know what they are talking about, and their views on Freshman study are sound. No man ever came through Minnesota in four years who did not use the hint given by Dean Nicholson. "First prove that you are capable of handling the work for which you are here—the scholastic."

Freshmen students are encouraged during their first week to learn to know their campus, and to learn the traditions that have been set up and followed

(Continued on page 33)

TEN COMMANDMENTS FOR FRESHMEN.

1. Thou shalt do thy work from day to day as it is assigned to thee, that by so doing thou shalt stay more than one quarter in this college.

2. Pay thou particular attention to the math courses of thy freshman year, for the mathematics of this college is strange, the courses do verily extend from Dan to Bersheba, and one course follows hard upon the next.

3. Thou shalt not take more cuts in any class than are allowed by the edicts of the Student's Work committee, and if thou art wise, thou wilt not take any, for an hour cut is an hour lost, and at the same time an hour that has to be made up in sore labor and travail at the end of the quarter.

4. Thou shalt remember to visit thy post office box once a day, for the ways of Deans are strange, and when they call, they expect an answer.

5. Thou shalt not look upon the lips of women during thy first quarter for Woman was made for Frosh to avoid.

6. Look thou neither to thy right hand nor thy left during the first quizzes of the quarter, that at the final exam thou shalt not be tempted to look upon thy neighbor's sheet and by so doing, hand in wrong answers to thy instructor.

7. Thou shalt remember that thy instructor does not wish to see thy face again, and so shalt thou do thy duty to the S. P. C. A. by passing all courses as they are offered.

8. Thou shalt remember that drill is to be taken seriously for the first two years that thou shalt not find thyself out in the cold at the order of an irate dean.

9. Understand ye the manner in which thy college is governed, that upon certain specified days you may cast your vote with celerity and intelligence for the man that you are told is the best fitted to govern you.

10. Take thou thy activities in small doses from thy second quarter in school until thy graduation, but let no man say of thee that thou drinkest to excess at any one fountain.

Live then, my son, and obey these rules, for verily they are the true guide to success in this college, laid down by men who are supposed to know what they are talking about.

Opportunities In Engineering Journalism

By Blair Converse
Iowa State College

LAST fall I wrote to the editors of about 100 engineering publications and to the publicity or advertising directors of about the same number of engineering industries, asking them to tell me what qualities and training they require of men for employment, whether or not engineering experience after graduation from college is a prerequisite to employment, and whether or not, other things being equal, they would give preference to a candidate for a position who had had some journalism training in college. I received 110 replies. The striking thing about these replies was the interest which most of the correspondents showed in the idea of giving some journalistic training to engineering students. This was evidenced not only in what was said but in the length and tone of the letters. Speaking in figures, 87 editors and publicity and advertising directors heartily endorsed the idea of some journalistic training for engineers who anticipate going into editorial or advertising work. Only five thought that for one reason or other it was inadvisable. Eighteen letters were non-committal, most of them from concerns which do not have a publication or a publicity or advertising department.

The opinions of these men as to just what amount and kind of journalistic instruction should be given to engineers varied considerably, but there seemed to be unanimity that such training would serve in two major ways. First, that it would be valuable to engineers who did not anticipate making advertising or editorial work their profession by helping them to an articulateness which engineers normally lack. Second, that such training would be very valuable for a man who anticipated technical journalism work. All of the 87 who replied affirmatively said that they would give preference to a man with such training, other qualifications being equal.

Mr. R. W. Estry, director of advertising for the Barrett company, New York, wrote, "There are splendid openings for young men who show a special aptitude for writing. I recall a few months ago, the McGraw, Hill company, publishers of industrial magazines, made a country-wide search for a man who had technical training and yet could use that technical training in writing advertisements for their own publications. As far as I know, the McGraw, Hill company have not been able to find that particular man. I just mention this case as it shows that there is a special need for such men."

L. H. Butler, manager of publicity for the B. F. Goodrich Rubber company, wrote: "I have felt for some time that there was great need for a curriculum which would combine engineering and journalism in just some such plan as you have in mind."

Mr. H. S. Fairbank, highway engineer with the Bureau of Public Roads, says: "May I say first that I believe the need for men especially trained for the work of conducting the public relations and public information departments of governmental and industrial organizations administering engineering work and service of a public character will greatly increase in the future."

The following is from a letter from G. W. Vos, superintendent of advertising for Texaco Petroleum Products: "Furthermore, without any strictures on the engineering profession, it has been my experience that most engineers would benefit materially by some course which would improve their means of expression. The present tendency for machine builders to use publicity and advertising almost makes a movement such as your projected one a necessity."

Howard B. Rose, editor of *Western Highways Builder*, Los Angeles, writes: "It seems to me that a very important part of an engineer's training has been overlooked if some provision for training in journalism has not been provided. Several engineers whom I have known left the engineering field proper to take high salaried positions on editorial jobs. With the great amount of money that is now being spent in the manufacture of all kinds of equipment there is a growing need for trained engineers in advertising and publicity positions."

Mr. C. E. Davies, managing editor for the American Society of Mechanical Engineers, writes: "In connection with the editorial work on *Mechanical Engineering* and the other publications of the Society, I find it difficult to secure men who can put the manuscripts we receive in good shape. We have a great many manuscripts which are engineering, but very poor sense and very poor English. We do not have a flood of candidates for editorial work of this kind."

Mr. A. S. Armagnac, editor of *The Heating and Ventilating Magazine*, writes: "Your favor of the 27th ult., is very interesting to me. For the last two years we have been going through the throes of trying to get men with engineering training to write on technical subjects, especially short items of a technical character. Our experience has been that such ability is very rare. In fact, it has been pathetic to see so many men, who know their engineering, fall down completely when it comes to writing even on the subjects with which they are most familiar. Few of them are even able to write the King's English."

The letters that I received indicate that men for editorial and publicity positions are usually recruited in one of three ways—they are technical men who have shown some ability as writers in their reports or in articles they have prepared; or they are newspaper men; or people who have held secretarial positions.

There is a side issue to this survey which may be of interest to you—it was to me—and that is the opinion that some of these editors held of the products of our schools of journalism as potential employees in the technical field. I can sum this opinion up in some such way as this, that the graduates very frequently are capable and imaginative writers, but they do not particularly value the importance of subject matter and its accurate presentation. For instance, Mr. E. T. Howson, editor of *Railway Engineering and Maintenance*, and managing editor of the *Railway Age*, has this to say: "In this resume I feel that I should be frank in telling you of the almost universal feeling of these editors that the courses in journalism now offered in colleges and universities throughout the country are of little or no value to them, for students in these courses are trained almost entirely for daily newspaper work and come to the business press with little or no conception of the practical problems of the engraver, the printer and the make-up man, and with the expectation that their duties will consist almost solely of writing feature articles and editorials."

Another editor, Mr. Charles G. Peker, of the *Eastern States Building Developer*, writes: "I have had many applications from graduates of schools of journalism. They can write, but to be an editor requires something beyond this. There must be a knowledge of the mechanics of printing and engraving, and some artistic sense so as to get pleasing layouts. Then there must be the ability clearly to state in an interesting way, something really worthwhile."

These are no doubt somewhat extreme positions but they should be accepted as a sincere and at least somewhat enlightened opinion, and I wonder if we looked deep into our consciences if we would not agree that there is some justification for these criticisms.

I have only one or two comments to make growing out of this study. Of one thing I am very sure, that there is

(Continued on page 34)

Fifty Years of Electric Light

(Continued from page 8)

as Edison Day at the National Air Races held in Cleveland, August 24th to September 2nd. Features of the program were: tributes to Edison broadcast over a nation-wide hook-up; the *Light's Golden Jubilee Derby*, a race of air-mail pilots to Milan (Edison's birthplace) and return; musical show featuring George M. Cohan's song, "Edison Miracle Man"; and a parade of girls representing the various stages of light down through the ages coming to a climax with the modern incandescent lamp and the unveiling of a large photograph of Thomas Edison.

The opening night of the national convention of the American Legion, our country's largest convention, held in Louisville, Kentucky, September 30th to October 3rd, was dedicated to Thomas Edison and *Light's Golden Jubilee*. It was the most brilliant and colorful convention ever held. Because of Louisville's central location more than 100,000 visitors from every state in the Union and twelve foreign countries attended.

Light's Golden Jubilee culminates in a world-wide celebration on October twenty-first, the exact fiftieth anniversary of Mr. Edison's successful experiment. On this eventful night the attention of the world will be focused upon Dearborn, Michigan, where Henry Ford has started the foundation of a perpetual tribute to Edison. There, in connection with the Edison School of Technology, which he has endowed and built as a perpetual monument, Menlo Park lives again. Surrounded by structures of modern technical education, the buildings in which the Age of Light came into being stand as they stood on that day fifty years ago. Not reproductions or exact replicas; but the very buildings themselves, down to the last detail. And it will never be a dry, lifeless, museum. At a twist of the hand the steam will rush through the lines, the old generators will hum, the old lamps will light. All the machinery is oiled, greased, and ready.

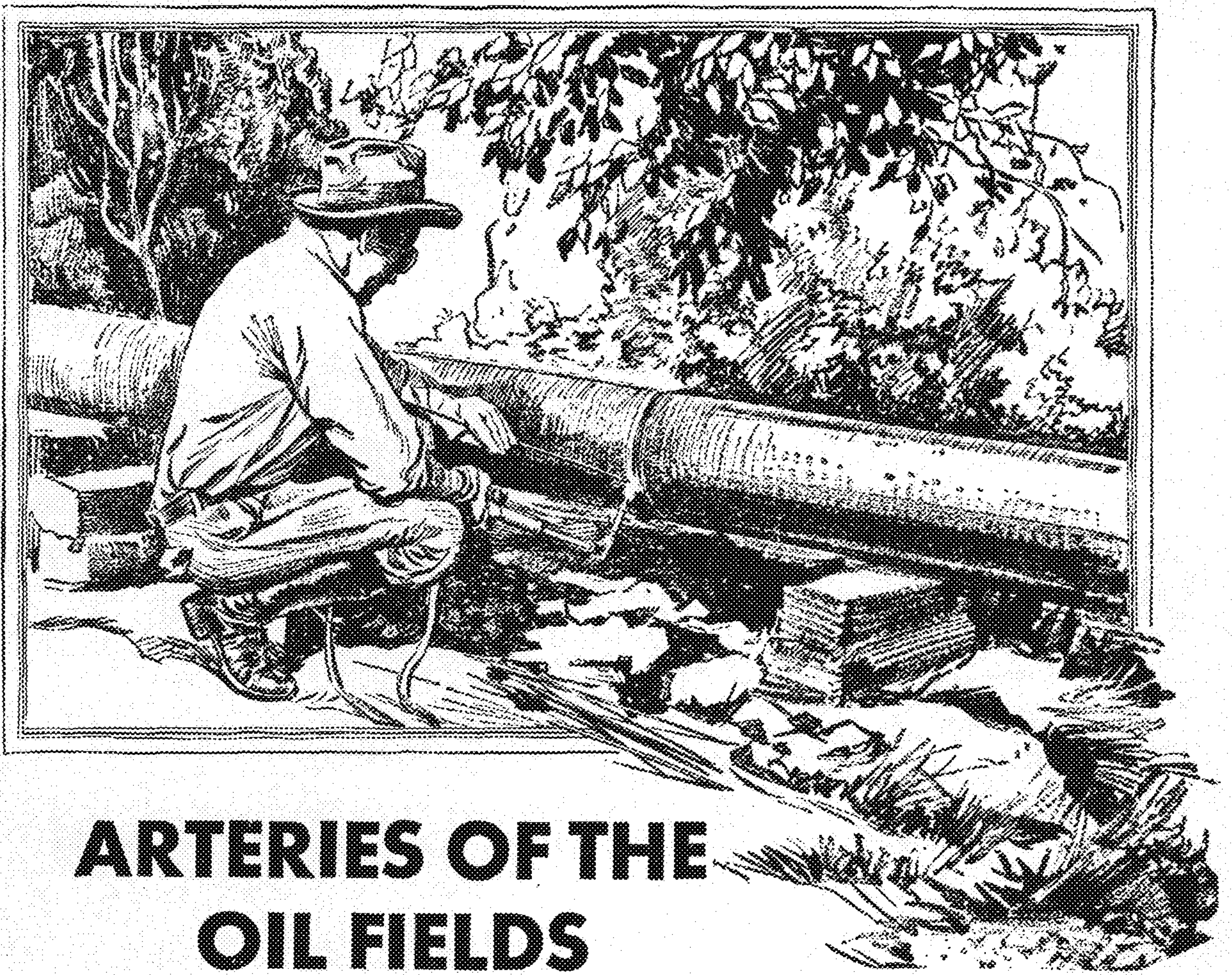
THOMAS A. EDISON AT WORK IN HIS LABORATORY.

Under such condition will *Light's Golden Jubilee* come to fulfillment. First will be the dedication of the Edison School of Technology by Edison himself. Second comes the dinner which Henry Ford will give to Edison and a large group of distinguished citizens that evening. After the dinner the guests will go to the laboratory, and there Mr. Edison will re-enact his great experiment. At the same time, outside, a spectacular lighting display will be going on. One of the largest radio hook-ups ever put together for a single event will broadcast these proceedings. We realize how appropriate this is when we remember that it was Edison who discovered the so-called "Edison Effect" which is the basis of every radio tube used today.

On that same night cities, towns, and villages,—organizations, and homes,—in this country and abroad will be celebrating *Light's Golden Jubilee*. For it is a celebration in which everybody can—and has good reason to—take part.

In the meantime, throughout the summer, all mediums of communication—radio, moving pictures, newspapers, magazines, and the speaker's platform—are reminding the public of Thomas A. Edison and his contribution to our civilization. The Federal Post Office has issued an Edison stamp. The *Light's Golden Jubilee* general committee is headed by President Hoover, and consists of some of the most prominent men and women of the day. The celebration is rapidly assuming the proportions of a great national movement.

At a very early stage of the celebration—as early as July first—the Committee had received much information from foreign countries as to their plans for participating. Austria and Japan have definite plans for extensive celebrations to take place early in October. France, also is very enthusiastic, and is anxious to cooperate with this country. Italy, Germany, Holland, Sweden, China, Mexico, Brazil and Argentina are all working up plans, but the details have not been announced at the present time.



A Long Tunnel Survey

(Continued from page 11)

degrees to the horizontal and tapping the pioneer tunnel at a point 2,315 feet from the west portal. Started in January and completed in March, it became known as the Tye River Incline and turned out to be quite a life saver, offsetting as it did the slow progress in the pioneer tunnel from its portal, due to soft and wet ground.

In February ground was broken for the main tunnel at the west portal and the Mill Creek Shaft.

The shaft was located from the point established on Big Chief and the distance from the east portal, required to obtain the elevation of the tunnel, was calculated from the Mill Creek survey.

Precise Surveying

With the coming of spring came the program for precise surveys to determine the length of the tunnel, to retrace the tunnel line over the hills and to determine elevations to the highest possible degree of accuracy.

No expense was spared to furnish the best instruments available and nothing was said as to the time allowed to complete the work.

The precise traverse follows in a general way the lines of the quadrangle described above to illustrate the preliminary survey (see map). Its courses are AC, CE, EF, FG. Point "A" is on the axis produced easterly of the proposed tunnel, 797 feet east of the east portal.

"C" and "E" are on the axis of the present tunnel produced easterly 10,828 feet to "C" and westerly 365 feet to "E." Point "F" is 7,735 feet southwesterly from "E," and "G," 4,912 feet southerly from "F," is a point in the proposed tunnel axis 828 feet east of the west portal.

Substantial stakes were driven at convenient intervals along the traverse and the elevation of each stake determined to the nearest hundredth of a foot with a wye level. The slope distances between fine brads driven in the stakes were measured to the nearest hundredth of a foot with a 300 or 500 foot tape, as the occasion required, noting at the same time the temperature registered by a thermometer attached to the tape, the tension in pounds on the spring scale handle, the number of supports under the tape and weather conditions. To abbreviate the office work required to reduce the measurements, a tension of 30 pounds was applied in all cases.

The angles at "C," "E" and "F" were measured by two observers, each taking three readings in succession on the repetition method, the horizontal circle and vernier being graduated to read to the nearest 10 seconds.

The third day of April, 1926, saw the completion of the field work begun on the 2nd of the preceding month.

The reductions of the measurements was done by two computers working independently at first, then together to eliminate all possible mistakes. It involved correction for calibration, horizontal sag, slope, compensation of horizontal sag for slope, tension, temperature and elevation.

The tapes were calibrated at each 100 feet of length by comparison with U. S. Standards in Seattle. The difference was very small for all points, so that proportioning between points by straight line graphs was more than sufficiently accurate.

The horizontal sag correction was also obtained from a graph giving the shortening for 30 pounds tension in function of the length of each span of the tape. To correct for slope required the solution of a right angle triangle, and the compensation of sag for slope was given on a graph in function of the sine of the slope angle. The tension correction for 30 pounds was also given by a graph in function of the observed distance, but the temperature correction shown on a graph for the full 300 or 500 foot tape, had to be reduced to the observed distance on the slide rule. The altitude correction was intended to reduce all measurements to the elevation of the west portal and was scaled on a graph.

The distance from east portal to shaft was obtained by a triangulation of a single triangle, the base line being the first 11,538 feet of the line from "A" to "C," and the apex a point "D" on the tunnel axis 1,230 feet east of the shaft, as measured by the same system used on the precise traverse. The angles of this triangle closed with an error of 4 tenths of one second.

From the third of June to the 26th of July, 1926, the measurement of the traverse was repeated, after the original stakes had been pulled out and redriven at different points. The results of the two operations are as follows:

	1st Measurement	2nd Measurement
AC	13,837.977	13,836.190
CE	25,062.681	25,061.449
EF	7,734.764	7,734.637
FG	4,912.389	4,912.012

While the difference is very small in

(Continued on page 22)

(Continued from page 20)

all cases, the fact that it is of the same sign in all would tend to indicate that it is due to the same cause. The only changes involved in the 2 operations were a partial change in personnel and a change in weather conditions. Probably it was due to both, but circumstances would seem to point to weather conditions as being most influential. There was snow on the ground during the first measurement only, and while the tape was being dragged over it, the thermometer never came in contact with it, registering therefore a higher temperature than the average temperature of the tape. It is interesting to note in this connection that a difference of 10 degrees between the two temperatures would result in an error very nearly equal to the average discrepancy between the two measurements. Even so it was felt that the value of the first measurement could not be disregarded and it was decided to adjust each side of the traverse by applying ⅔ of the required correction to the first measurement and the remaining ⅓ to the second measurement.

The distance AG having been calculated and the distances "A" to east portal and "G" to west portal determined by precise measurements, the former twice and the latter once, the length of the tunnel portal to portal was found to be 41,142.00 feet or 9.9 feet longer than previously calculated from the preliminary survey.

In the meantime precise leveling between Scenic and Berne had been carried on by four independent parties, the mean of the results, which differed very slightly, being taken as correct.

While the second measurement of the precise traverse was in progress, a triangulation system was laid out between portals as an additional check upon the accuracy of the work. The side AC of the Traverse Line had been measured twice, using precise methods, and this side was accepted as the base line for the Triangulation. This Triangulation served the purpose of furnishing additional proof that no gross errors had been made in figuring the traverse.

Log cabins with stoves, blankets and other conveniences had been erected by this time at the various points along the line to facilitate this and similar work that might come up in the near future. All of this involved a great deal of packing up the steep and dangerous slopes.

To retrace the tunnel line over the hills a special theodolite was purchased, of such generous dimensions that it could only be carried conveniently in 3 separate sections. The telescope measures 22 inches in length with 1¾ inches clear objective, a maximum power of 45 and a straddling level (usually known as a "striding level"—O. S. Z.) equal or superior to a standard railroad wye level.

The lines were retraced at first several times with the smaller instruments, as the large theodolite, requiring a permanent base, could not be used on a tripod.

After shifting the points a few inches this way and a few inches that way, it was deemed safe to erect the theodolite piers consisting of a 6 inch pipe imbedded in a concrete base and threaded at the top to receive the base of the instrument.

With this the final refinements were added by independent observers, until all agreed that it was a perfectly straight line, if there was one.

Comparing with the original projection, the largest deviation was found to be approximately 1.5 feet on Big Chief Mountain.

Data were now available for an accurate comparison between the present and the proposed route from Scenic to Berne, as tabulated below:

	Present Route	Proposed Route	Proposed Gain
Length	17.68 miles	10.01 miles	7.767 miles
Max. Curvature	10°	6°	4°
Tot. Curvature	2,159°	228°	1,941°
Max. Grade......	2.2%	2.2%	
Tunnel Grade..	1.695%	1.5652%	0.1298%
Summit Elev.	3,385 ft.	2,881 ft.	504 ft.
Tot. Rise West.	532 ft.	28 ft.	504 ft.
Snowsheds	6.04 miles	None	6.04 miles
Bridges	0.23 miles	0.04 miles	0.19 miles

Driving Tunnel

The contractor in the meantime had not been idle. The camps at Scenic, Berne and Mill Creek were growing steadily and rock was pouring rapidly out of five openings.

At the west portal a top center heading was followed by a top heading enlargement and this by a bench excavation completing the full tunnel section up to and including August, 1926.

The pioneer tunnel was in better ground after April, especially beyond the Tye River Incline, and in June crosscut No. 1 was shot through 1,003 feet east of the west portal and continued along the center part of the main tunnel as a center heading 10′x10′.

At Berne a center heading of the same dimensions was being pushed ahead somewhat more rapidly than at the west end, thanks to better material and no water to speak of.

In July 1926 the Mill Creek Shaft reached the appointed depth of 659 feet or 38 feet below subgrade, the additional depth being required for sump and other purposes. It was up to the engineers now to tackle the most ticklish problem on the job. The tunnel had to be projected from the mountain top down to the bottom of a well 659 feet deep.

The use of a transit was precluded by three rows of 10″x10″ cross braces 6

(Continued on page 30)

Around the World With Our Alumni

Civils

'17—Hjalmer N. Bruce is now the fond father of a bright baby girl. Any of the old guard wishing to get in touch with him may reach him at 3431 Eleventh Avenue South, Minneapolis, Minnesota, or at the A. M. Chesher Printing company where he still works.

'22—Lawrence E. Teberg, Minnesota's football captain in 1921, was recently confined to the U. S. Veteran's hospital at Minneapolis. At the present time he is steadily improving and is able to spend an occasional weekend at his home, 1707 Stanford Avenue, St. Paul, Minnesota.

'23—H. M. Hill is another man who is falling from the ranks of single men. His engagement to Miss Rachel L. Hana was recently announced. "Congrats," H. M.!

'25—Earl O'Brien is working in the chief engineer's office of the Bell Telephone company at Chicago. He writes: "I am living at 57 Forest Ave., Riverside, Illinois. So far I am not bald, but my golf score is slowly turning my hair grey—."

Mechanicals

'26—Wesley J. Anderson is among the old guard that have strayed from the path of the righteous, or maybe we should say into the path, for he was married to Miss Hazel M. Fritz of McKeesport, Penn., on June 26. His new home is at 1849 South Euclid Ave., Berwyn, Ill.

'27—George P. Vye is now living at 309 West 106 Street, New York City. He took his M. E. degree at Yale last year, and for the present is connected with the Equitable Trust company of New York.

'23—Lloyd A. Peck, assistant general manager of the Laundry Owners National Association, was recently in Minneapolis for the national convention of the association held at the Nicollet Hotel from November 14-18.

Electricals

'16—Walter W. Simons, general service superintendent of the department of educational talking pictures, with Electrical Research Products, Inc., has blossomed forth as an author. His recent article on the development of the talkies in his fraternal magazine was a peach. How about shipping us a story when you have time, Walt?

'23—Alva W. Merritt is now assistant division engineer for the Little Falls-Cayuna division of the Minnesota Light and Power company.

'25—Grant C. Nierling has forsaken the northern climate at Schenectady for the tropical breezes of Brazil. His new address is Sao Paulo, Brazil, in care of the International General Electric company.

'27—John P. Kriechbaum has left Fort Wayne, Indiana, and is now living at 4153 Aldrich Avenue South, Minneapolis. His engagement to Louise Elizabeth McConn was announced last summer, and the ceremony is scheduled to take place sometime in October. As all his class will remember, Johnny was the electrician for two very successful Arab shows, and we are all wishing him "the best."

'28—Leland B. Read is located in St. Louis. He is an experimental engineer with the Carter Carburetor Company there.

'28—J. F. Kolchevar is one of the Minnesota men who have found their ideal in the Ideal Electric company at Mansfield, Ohio.

'28—G. Clinton Hawkins gave up his post graduate work at the close of the winter quarter to go to Watertown, South Dakota, as a radio engineer for the station KGCR. Any one wishing to get in touch with "Clint" may reach him care of the station at Watertown.

'29—J. E. Specht is enrolled in the Graduate Student Course of the Westinghouse Electric and Manufacturing company, East Pittsburgh, Pennsylvania. He is also attending the University of Pittsburgh where he is studying for a master's degree.

Lloyd A. Russ, '29 E. E., former circulation manager of the MINNESOTA TECHNO-LOG, member of the University hockey squad of last year, is now in the employ of the Westinghouse Electric & Manufacturing Company. From Sharon, Pennsylvania, he writes:

"I am now on one of my various 'observation' tours to the different plants. My stay here lasts one month till October 15th, during which I spend from one to five days in each of the different departments depending on their importance. As you probably know, this plant is devoted entirely to the manufacture of transformers and I find it very interesting. We have two classes a week and thereby obtain a fair review of what we studied at school as well as to learn the why and wherefor of the construction and assembly. Up to the present time, I have been associated with the die stamping and arc welding of tanks, the coil winding department, and several sections where the smaller transformers up to 200 kva are assembled. Next week or rather the remainder of my time here I have been assigned to the department which recently shipped out four single phase transformers of 33,000 kva each. This department is equipped with a million dollar test floor and the aisle is considered the largest of its kind in the world.

"I have been with the company now since the first of July and have definitely segregated for transportation sales with the possibility of getting into marine sales. My schedule for the year is all made out

(Continued on page 32)

News from the Technical Campus

(Continued from page 13)

Palmer Writes Book

Ben W. Palmer, known to present and former engineering and architectural students at the University as a Minneapolis attorney, who has for a number of years given the engineering course on business law, has just published a "Manual of Minnesota Law." This is the first and only available one volume statement in simple language of the Minnesota law of today relating to business subjects, and containing the matter of practical value in hundreds of volumes of Minnesota statutes and court decisions.

The book treats of contracts, agency, partnership, corporations and real estate. It also contains a full text on Uniform Negotiable Instruments Law and Uniform Sales Act. There are also chapters on chattel mortgages and conditional sales contracts, bailments and carriers, banks and banking, bankruptcy, wills and estates, automobiles, credits and collections.

The more important rules are fully illustrated by the facts of decided cases, and the author has drawn on actual experience to make the book of practical value by warning against various pitfalls in practice and suggesting means of avoiding them.

Another feature of the book is the set of forms which are filled out with illustrative material in the blanks and further explained by cross references to the sections of the text in which the law relating to the subject covered by the form is set forth. Thus, for example, notice of cancellation of contract for deed is set out, together with exact law relating to payment of mortgage registry tax and the manner of service of the notice. This method has been followed in regard to a great many other matters of practical importance.

Chemists Go East

Although many of the seniors have had a hard time trying to decide where they should go to make their fame and fortune there are a few who have already signed on the dotted line and are making definite plans for the future. Clifford Butler, Kerwin K. Kurtz and Carlyle Linden are expecting to make some big "booms" when they go to the Hercules Powder company. Another trio consisting of Howard Draper, Donald Fuller and Harold Rehfeld are going to stretch things at Akron, Ohio, for the Goodrich Rubber company. Leonard Moore and Lawrence Nelson are going to do great things for the Dupont and the Proctor and Gample companies respectively.

The School of Chemistry is gaining recognition each year and we feel that these men will add much to the already distinguished group of alumni as will other seniors who have not at present selected the company with which they will affiliate.

A. I. E. E. Meets

On Thursday, October 3, the Minnesota section of the American Institute of Electrical Engineers held their first regular meeting of the year. After the dinner held at the Minnesota Union, an address was given by Mr. John Lapham of the North Central Electric Association. Mr. Lapham outlined the celebrations that have been held throughout the country in honor of Thomas A. Edison and referred to the electrical wizard as "the man who perhaps more than any other has been instrumental in the material advancement of the present era. According to Mr. Lapham an imitation of the laboratory in which Mr. Edison developed the incandescent light will be erected at Dearborn, Michigan, and on October 23 Mr. Edison will re-enact step by step the process by which he designed the first incandescent lamp.

According to Mr. Fenton, president of the student branch, there will be two additional meetings of the A. I. E. E. in the near future. On October 28, Mr. J. F. Wentling of the research division of the Western Red Cedar Association will speak on "Poles"; and on November 27th, President Smith of the A. I. E. E. will talk on "The Quest of the Unknown."

WLB Staff Organized

On October 11 a meeting of all the student operators of WLB, University of Minnesota radio station, was held in the studio on the third floor of the electrical engineering building. The purpose of the meeting was to explain the status of the station to the new student operators, and to make up a staff that could take up the work for the fall quarter. At the meeting schedules were outlined and operators were assigned to the different nights.

For this year's broadcasts a complete new transmitter is being installed. This transmitter will use crystal control of the frequency and will be capable of operating on all the important amateur bands as well as the special frequencies assigned to the station for experimental use only.

Plans are being laid for additional new equipment and a further expansion of the operating schedules as soon as the new transmitter is completed and operation is in full swing.

The purpose of maintaining the station at the University is to afford a means of testing out new equipment under operating conditions as well as to give operators a chance to improve their ability with the aim of obtaining a higher grade of license. Communication is established with other colleges and universities.

Engineer Talks On Circuit Breakers

E. K. Reed of the Westinghouse Electric Company, recently addressed the Central Stations Class in electrical engineering on the new Deion Circuit-Breaker. Mr. Reed reviewed the early history of circuit breakers and pointed out the fact that heretofore all circuit-breakers had been designed as a result of practical experience. The new Deion breaker, however, is the result of a strictly theoretical procedure.

The Deion Circuit-Breaker was produced under the direction of Dr. Joseph Slepian of Westinghouse. According to Mr. Reed the operation of the Deion Breaker is based on the established principle that as the cycle of an alternating current becomes zero an arc which the current supports can easily be broken, for the air through which the arc passes has a high insulating value almost immediately after the the voltage becomes zero. In interrupting a circuit the breaker draws a single arc in the air and under the influence of a magnetic field, moves this arc into a chamber where it is divided into a multiplicity of short arcs in series. As the current wave passes zero, the air in the path of each short arc assumes a definite insulating value at once. With the requisite number of short arcs for the particular service voltage desired the impressed voltage is unable to restrike across the arc-paths; current cannot rise on the succeeding alternation, and the circuit is interrupted.

A Long Tunnel Survey

(Continued from page 22)

feet apart down the full depth, with a maximum space of 7 feet between rows. Plumb lines had been used before successfully and plumb lines were used.

The shaft measured 6'x22'-4" in cross section inside the timber lining, the longer sides being parallel to the axis of the tunnel, and the inner face of the timbers on the northwesterly side 8'-3" southeasterly from that axis leaving 1'-9" clear overlap of the opening of the shaft beyond the edge of the tunnel.

Two piano wires of 15½ gauge were suspended 19 feet apart over the top of the shaft from substantial support having provision for very fine lateral adjustment and a 60 pound plumb bob properly fitted with sheet iron fins was attached to the lower end of each wire at the bottom of the shaft.

Two tubs consisting of an oil barrel cut in halves and roofed over to exclude the drip, were provided to immerse the bobs in machine oil, but there was a sadly disappointed crew at the bottom of that hole, when the bobs refused to perform according to expectations, remaining motionless no matter where they were placed in the tubs.

Somebody suggested water in place of oil, and it worked like a charm. It was an uncanny fascination to watch the unusually slow and deliberate motion of the wires describing a gradually closing spiral and finally coming to rest.

Two transits were used simultaneously to establish points on the line indicated by the wires, and the operation repeated over and over until the same points were covered by the cross hairs time after time. These points were used to line up all driving from the shaft east and west to meet the heading from the portals. On the west a top heading followed closely by a full tunnel section to be advanced for 1,200 feet, a pioneer tunnel beginning at a cross-cut from a point near the shaft and in line with the pioneer from the west, and center headings from crosscuts No. 18 and 17, at distances of 1,100 and 2,900 feet from the shaft. On the east a center heading was driven 3,141 feet from the shaft at which point work was discontinued in January, 1927, leaving the remainder of the center heading to be driven from the east portal.

MAKING HISTORY

In 1915 the world record for driving tunnel in a 31 day month was broken in the Roger's Pass Tunnel with a progress of 932 feet. In August, 1926, the pioneer of the new Cascade Tunnel advanced 937 feet, bettering that record by 5 feet. In September, 1926, the center heading from the east portal was driven 984 feet and in October, 1926, the world record was broken for the third and last time up to the date of this writing, with the imposing figure of 1,157 feet.

During the second week of January of this year, ring drilling was commenced at the west portal. From one setting of the drilling machines the entire tunnel section surrounding the center heading can be made ready to blast in one round at intervals four feet apart.

All operations were carried on continuously day and night, Sundays and holidays included. Every day like any other day.

Freshman Week

(Continued from page 15)

by students that have gone before. No school without traditions and history can mean much to a new man, for without past leaders to emulate and admire he is lost. If you did not go on the campus tours you missed a vital part of your freshman preparation and it will be well worth your while to stroll around the campus, noting the various buildings and landmarks, and to think over the traditions that have grown up around them.

Among the traditions at Minnesota is one, more powerful than all the rest, of loyalty. Men on the campus are loyal to the school as an institution of which they are proud, loyal to the teams that go out to fight for her glory and loyal to their own college. As freshmen the class of 1934 will be asked to keep up this tradition, and it is up to you men individually to do your share.

In closing, it is only fair to remind you that you are in a course that is rated as one of the hardest on the campus, that you are here of your own free will, and that the record that you hang up is entirely your own affair. The upperclass advisor that will be assigned to you will give you all the help that he can, if you take your problems to him, but in the final analysis, you are standing on your own feet. If you pay attention to the rules of the game you will win, and you have been coached in the rules as well as we know how. If you flunk, no one will miss you, but if you are serious, you won't flunk. Go to it!

Alumni Notes

(Continued from page 24)

and the time, ranging from two weeks to two months, is taken up mostly by test, railway motors, locomotives, switchboards, industrial motors, etc. I return to Pittsburgh from here and stay there till January 15th when I am scheduled for Philadelphia for two months.

"The whole Minnesota crew is duly registered now so you can expect wonders in the line of promotion and engineering. Our fellows aren't taking anything from the rest of the students and can hold their own in any 'bull' session or beer drinking contest—so you see the training that we received from the Alma Mater was sufficient. The bunch from last year rated very high in Sales School and are now being transferred to the District offices. Art Burris is in Chicago and Clarence Niel expects to go to New York. I correspond regularly with John Newhouse and we each paint such wonderful pictures of our respective companies that, at times, we believe them ourselves."

Self-unloading vessels increase efficiency in handling loose bulk cargoes.

Hydro-Electric Power in Washington

(Continued from page 7)

prime requirement for present-day industry.

Another important characteristic of hydro-electric power developments is permanency of the investment. Hydro-electric power plants, transmission lines and distribution systems permanently increase the taxable wealth of the State. The permanent economic welfare of the people in the community served is closely interwoven with the best interests of hydro-electric power utilities. Gas, oil and even coal bring prosperity for a short period only, while water power is a permanent asset, everlasting as the hills. A golden key to Washington's future greatness and economic independence lies in the water resources that must be made productive through power developments and irrigation. With every year that passes hydro-electric power and irrigation in Washington, as measured by manufactured goods and agricultural products, will aid and supplement each other to a greater extent than is possible in any other state.

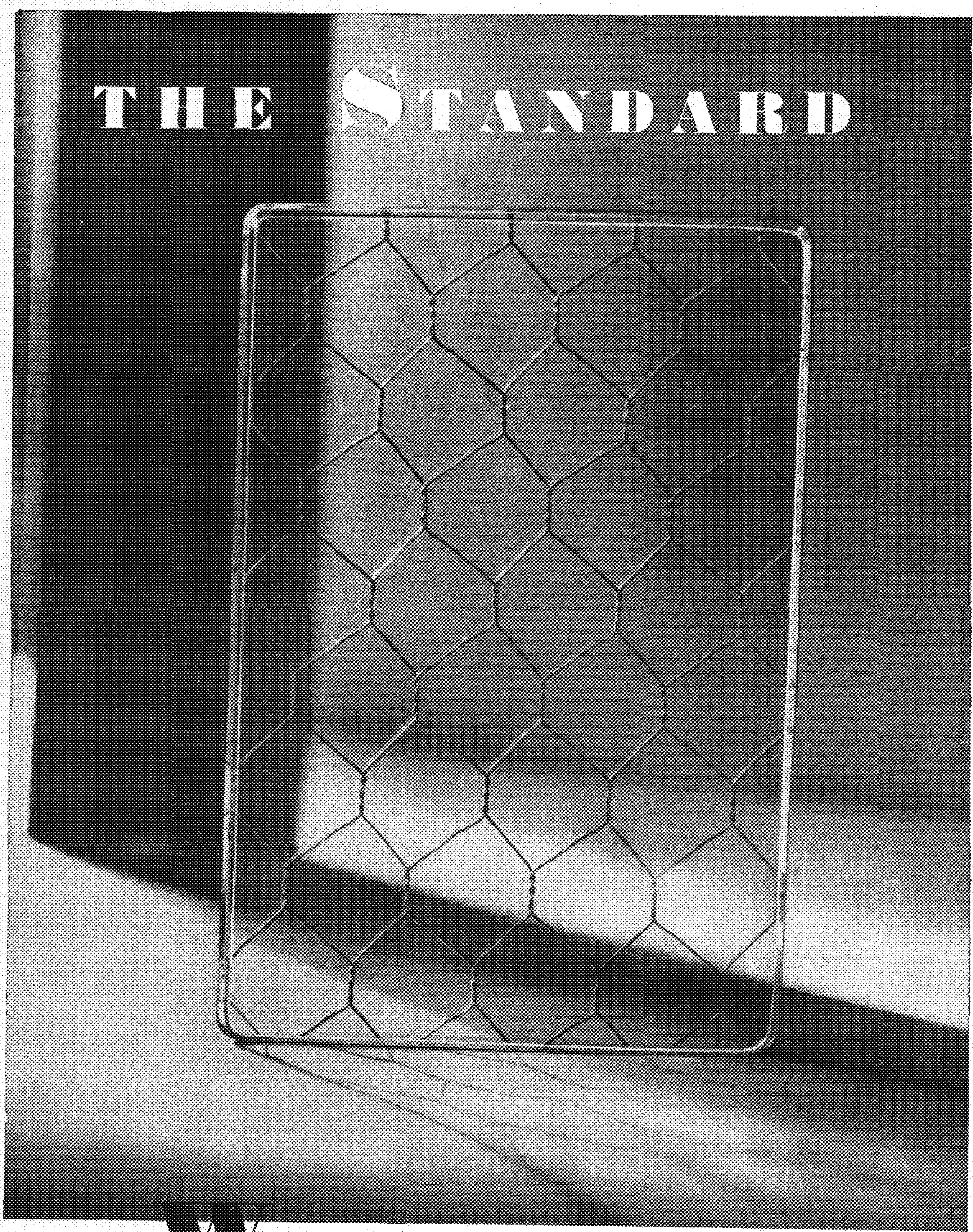
Adoption of a five-bladed hydraulic turbine runner, the first ever built, effected an estimated saving of 25 per cent in the total cost of an Ohio plant.

Opportunities in Engineering Journalism

(Continued from page 16)

an opportunity for departments of journalism to perform a real service in giving some journalistic training to engineers with the idea of preparing a few men for editorial and advertising work in this field and of giving to a larger number of engineers some training in clear and effective writing. My own feeling is that a course in engineering journalism should be primarily a course in engineering, and secondly a course in journalism. I am not sure that such students should major in journalism. It may be better for them to major in the engineering college if provision can be made for them to take a journalism sequence of limited scope.

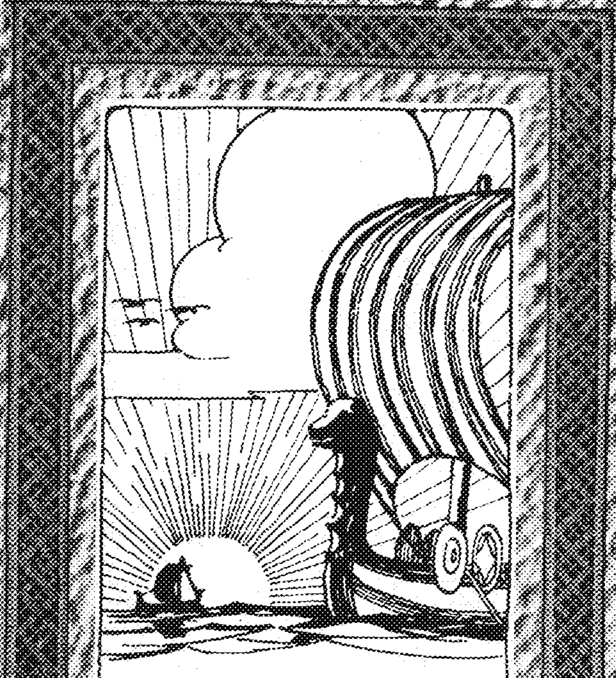
They should be thoroughly drilled in news writing with special reference to engineering subject matter. They should be given some work in magazine feature writing and by all means in copy editing. Beyond this I think considerable emphasis should be given to such matters as the mechanics of printing and illustrating, layout and makeup, and such instruction should be given if possible by men who have themselves had experience on engineering publications and who know engineering as well as journalism.


THE STANDARD

The MINNESOTA TECHNO-LOG

MONTHLY MAGAZINE OF THE TECHNICAL STUDENTS

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED



Vol. X NOVEMRER, 1929 No. 2

A NEW DESIGN

BOX-HEADER BOILER

The new C-E Single-Seam Box-Header Boiler is a distinct advance in construction and design over ordinary box header practice.

In the new design —

The wrapper or butt strap joining the tube and hand hole sheets is — ELIMINATED.

ONE ROW OF RIVETS JOINS THE TUBE SHEET DIRECTLY TO THE HAND HOLE SHEET.

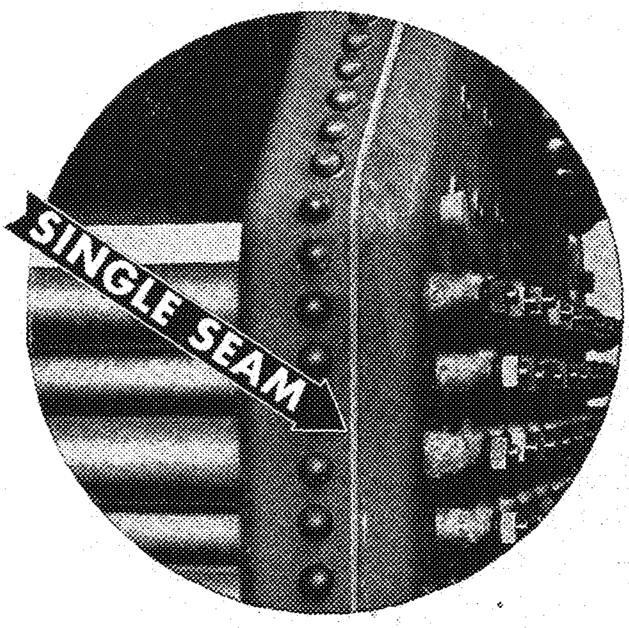
The row of rivets on the tube side of the wrapper strap is — ELIMINATED.

THERE IS ONLY ONE CAULKING EDGE and this faces the outside — making inspection easy and removing all rivets out of the hot gas and fire zones.

Three thicknesses of metal at the caulking joint at the ears are — REDUCED TO TWO THICKNESSES.

This new design provides an unusual factor of safety. For instance, in the standard unit sold for 160 lb. to 250 lb. working pressure, the header joint is adequate for a working pressure of 450 lb.

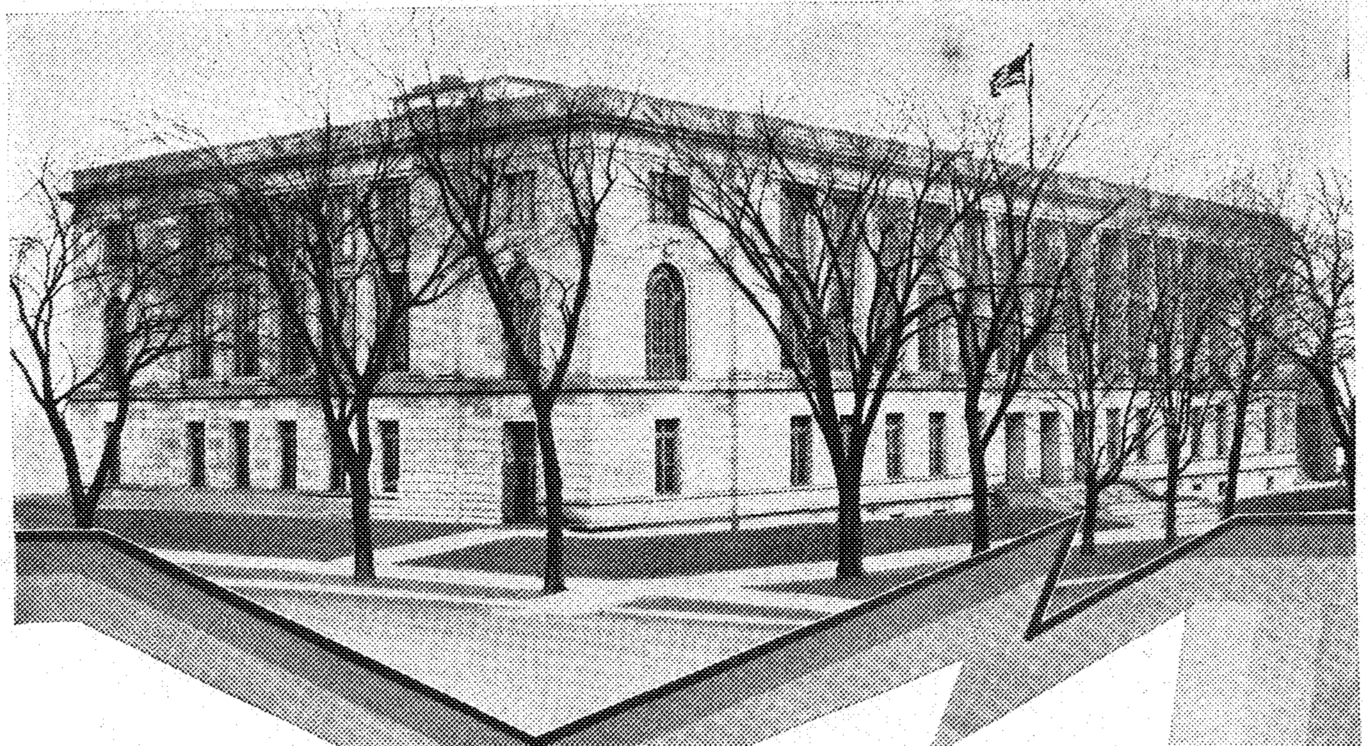
A careful inspection of this new boiler will convince you that the C-E Box-Header Boiler is a better Box-Header Boiler.



COMBUSTION ENGINEERING CORPORATION

International Combustion Building
200 Madison Avenue, New York

A Subsidiary of
International Combustion Engineering Corporation



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

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

VOLUME X   MINNEAPOLIS, MINN., NOVEMBER, 1929   NUMBER 2

CONTENTS

PAGE

COVER INSERT—*M. V. Bergstedt*

FRONTISPIECE: "THE WORLD'S TALLEST BUILDING"
G. C. Peterson

TIMELY RE-STATEMENT OF FUNDAMENTAL MECHANICAL PRINCIPLES - - - - 41
John V. Martenis

ELECTRIFICATION OF PASSENGER TERMINALS - - - - - - - - - - - 44
H. A. Dahl

AVIGATION - - - - - - - - - - - - - - - - - - 46
A. R. Heller

1929 VIKING HOMECOMING - - - - - - - - - - - - - - 47
J. R. Severson

AROUND THE WORLD WITH OUR ALUMNI - - - - - - - - - - - - 48

EDITORIALS - - - - - - - - - - - - - - - - - - 50

NEWS FROM THE TECHNICAL CAMPUS - - - - - - - - - - - - 52

PHOTOGRAPHS TRANSMITTED ON BEAM OF LIGHT - - - - - - - - - 56

WITH A MINNESOTA ENGINEER IN EUROPE - - - - - - - - - - - 58
Paul B. Nelson

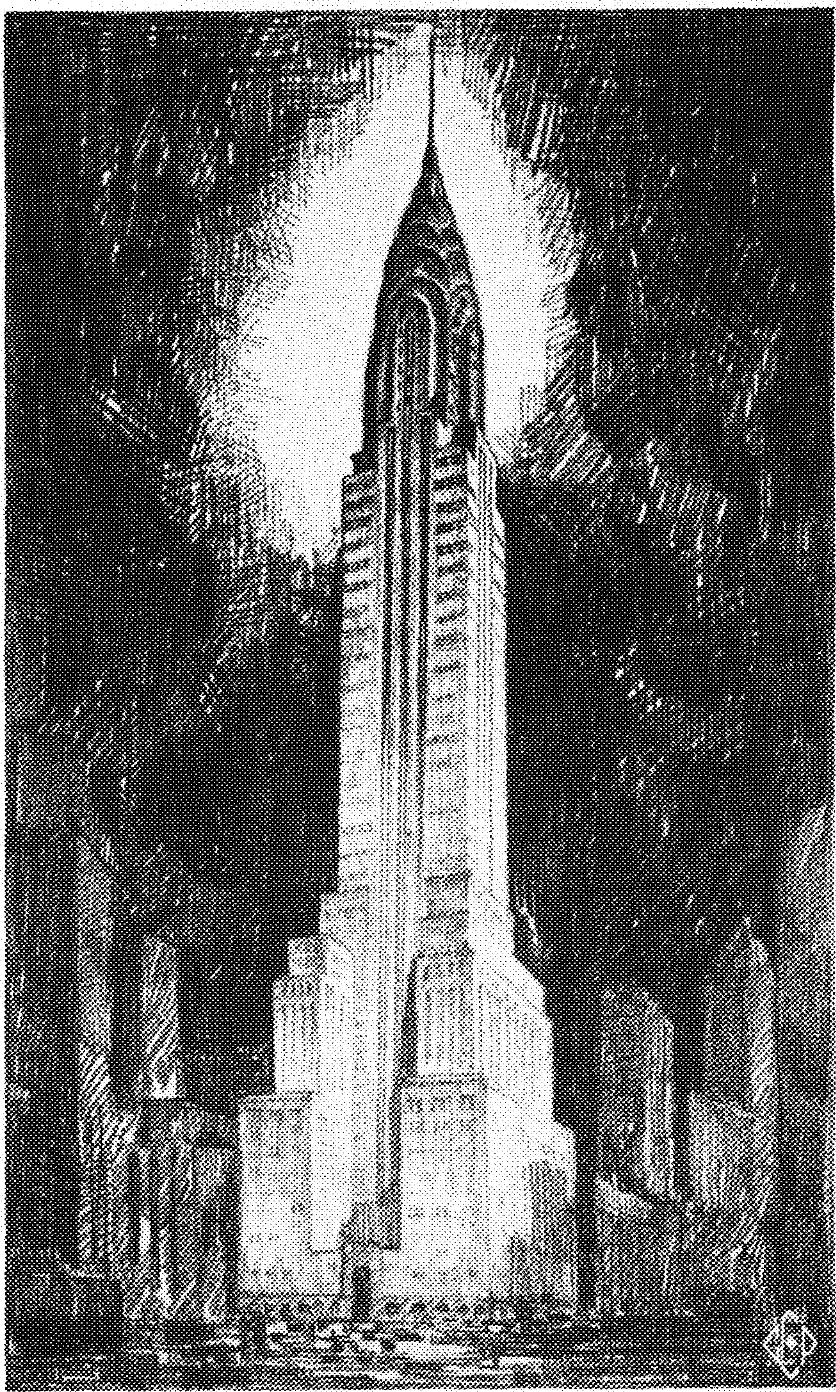
STUDENT ACTIVITY INDEX - - - - - - - - - - - - - - 62

MEMBER OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

Chairman: WILLARD V. MERRIHUE, 1 River Road, Schenectady, New York.

The Cornell Civil Engineer
The Transit
Iowa Engineer
Colorado Engineer
Nebraska Blue Print
Penn State Engineer
Armour Engineer
Sibley Journal of Engineering
Rose Technic
Michigan Technic
Minnesota Techno-Log
Ohio State Engineer
Oregon State Technical Record
The Pennsylvania Triangle
Wisconsin Engineer
Illinois Technograph
Tech Engineering News
Kansas State Engineer
Princeton E. A. News Letter
Kansas Engineer
Purdue Engineer
Auburn Engineer

Entered as second-class matter April 9, 1925, at the post office at Minneapolis, Minnesota, under the Act of March 3, 1879. Office, 37 Electrical Building, University of Minnesota. Telephone, Dinsmore 2760. Contents copyrighted and permission must be secured for re-publication. Subscription rate, $1.50 a year. Single copies, 25 cents. Advertising rates upon application.



The World's Tallest Building

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume X | NOVEMBER 1929 | Number 2

Timely Re-statement of Fundamental Mechanical Principles

BY PROF. JOHN V. MARTENIS, M. E.

Chief, Machine Design Division, University of Minnesota

MACHINE design has passed through many stages in its progress up to the present status of the art when it may properly be considered a science. There is room for improvement in methods and practices at present used in many industrial design departments where some of the men do not possess the training and background necessary to apply sound design principles or are not capable of making a thorough analysis of the forces entering into the operation of a machine. Empiricism and approximations or guesses have have been too prevalent in design work. The use of diagrams and tabulated standards which were developed to meet certain conditions in design practice are commendable but the use of such labor saving devices necessarily must be restricted to the particular conditions for which they were produced. The chief of the test department of one of our large industries would not use a formula quoted in a standard handbook without first checking the formula to learn whether its derivation accorded with the conditions for which it was to be considered as applicable.

QUALIFICATIONS

In a general sense, a designer must possess a vivid imagination coupled with the power of visualizing the objective; one who has a knowledge of shop limitations and is well versed in the qualifications of available construction materials. New developments come from the ability of the designer to apply sound engineering principles in novel forms of service. The insistent demand for economy in production, in many cases, has forced the designer to seek new forms of construction as well as better qualities in the materials to be used for the machines. Concentration, persistency and patience are essential to the success of a designer.

The "stooping over a drafting board" bogie has acted as a deterrent to many young engineers who undoubtedly would develop into high class designers. The experience gained in the design department gives one a better appreciation of the problems that must be met in the production program of any industry.

In some industries the development engineers always are selected from the machine design staff.

This article was originally published in MACHINE DESIGN *and is reprinted by special permission.*

PROCEDURE

There are several lines of thought which the designer should follow. First, an analysis of every known force (average and maximum) which may be met in the normal operation of the machine. Undue consideration of imaginative forces usually will result in badly proportioned machines. Second, the selection and arrangement of the materials to best resist the strains. A good designer will make use of those forms of cross section which are best adapted to carry the known loads with the least amount of material and labor in its manufacture. Third, the modification of the theoretical design to meet manufacturing requirements. So many advances and improvements have been made in the machine tool field that there are relatively few things that cannot be made in a well equipped shop but the cost of production must be considered where trade competition is to be met. Fourth, the design must be a clear representation of the designer's thought to the workman. A lack of required views or dimensions in a design usually causes delays and errors that should have been avoided.

CONSIDERATIONS

The design of a machine brings into consideration two viewpoints, namely, theory and production. From the theoretical standpoint, the machine must combine certain mechanical principles to produce specific results; from the production standpoint, the machine must be a practical development of mechanical ideas. The success of a machine will usually depend upon its ability to produce the article for which it is built with accuracy and celerity. Accessibility to the various members, and lubrication of the rubbing parts are very essential to the life and upkeep of any machine.

The designer should strive to simplify suitable mechanical combinations to attain desired results, for in a general sense a simple machine is preferable to one which is complicated in its make-up. The items of cost, replacements and repairs should be considered seriously in the design. Present practice in machines of standard types tends toward interchangeability of parts, thus avoiding the necessity of carrying large stocks of repair parts. In the early days of automobile practice there seemed to be a desire on the part of each manufacturer to incorporate peculiar standards of screw threads and sizes of tires for his particular car, thus causing a serious inconvenience to the car owner in making simple repairs or replacements.

OBJECT OF MACHINES

Normal man does not willingly choose to do the things which require hard physical labor or infinite patience but seeks to devise ways and means to circumvent the necessity of such tasks. To move a large stone, man prefers to use a lever or other mechanical device as a substitute for physical exertion. To draw heavy loads, man first trained animals, then devised machines to accomplish these tasks.

The mental exercise required for the development of machines and devices to relieve man from the performance of tedious and irksome tasks produced the machine designer.

A machine must be capable of producing those things for which it was designed with accuracy and expedition. Ordinarily, a machine must justify its creation by a significant increase in or economy of production. In many branches of industry, a machine will not be seriously considered unless it can pay for itself within a certain limited period and this condition usually requires operation at the highest permissible speed.

Machine Materials

Metals furnish almost exclusively the materials from which machines are built although non-metallic substances have certain desirable characteristics which are utilized for specific purposes.

Of the metals, iron is the most important because of its adaptability, obtainability and relatively low cost.

Much research work has been done within the past few years to learn more about the possibilities of combining various metals to obtain desirable qualities and information of value to the machine designer has been brought to light.

Iron both in the cast and refined forms has been the principal material used in machine construction because it lends itself to a wide variety of purposes and is more generously distributed by nature than other materials. Iron is rarely used in its pure form because it gains desirable qualities only by combining it with other materials and can be fabricated to meet those qualities by specifying the kinds and amounts of foreign materials required.

Design Practice

The designer of the present time is able to work under more favorable conditions than prevailed a few generations ago due to increased knowledge of materials and stress action, also due to the various improvements in machine practice.

The old maxim of machine design, "what looks right is right," came from long years of experience with qualities of materials and shop equipment prevalent in the past years also from the behavior of the machine in the performance of its task. This maxim is by no means obsolete at the present time because the experienced designer becomes accustomed to those proportions which have served him well and in many cases confirmed by well-established methods of stress analysis. Therefore, his sense of proportion is developed in a particular field of design and becomes somewhat intuitive in his design work.

In general design work, average stress values are commonly applied but there is no assurance that the material used will conform to the average because of hidden imperfections which often elude the tests and scrutiny of the inspector. These facts unconsciously influence the judgment of the designer who is reluctant to take chances which may reflect unfavorably to him.

When untrammeled by a suspicion of the materials with which he works and given a wide range in the selection of the materials, the designer will be relieved of much of the uncertainty of personal judgment and guess.

Factor of Safety

Due to the uncertainties in the structure and the loads that may come upon a material, great care must be exercised in the amount of stress used in the design. In order to safeguard against failure, a fraction of the ultimate strength is used. The factor by which the ultimate strength is divided to obtain the working stress is called the "factor of safety." The application of a suitable factor of safety requires sound judgment and a complete knowledge of working conditions. A factor of safety is determined by:

(1) Inexpediency of using the full breaking strength of a material. At times a simple machine part is designed to break as a matter of safety to the rest of the machine.

(2) Hidden flaws and internal stresses. This includes blow holes, laminations, cooling strains, etc.

(3) Unforeseen and wide variations in load conditions.

(4) Fatigue of the material due to a large number of stress repetitions.

(5) Destructive action on the material by external agents.

(6) Poor workmanship.

If a doubt arises in the mind of the designer relative to the working conditions of the material used, then he should err on the side of safety. Materials of doubtful qualities should be safe-guarded by ample safety factors. Acting under steady load conditions, a material of known characteristics may be stressed nearly to its elastic limit, a condition which undoubtedly occurs many times in screwed and in riveted fastenings.

In general, larger safety factors are used when the piece is cast rather than hammered or rolled due to the improved molecular structure resulting from hammering or rolling the material.

Live loads require larger safety factors than dead loads.

Repeated stresses require larger factors than steady stresses.

Alternations of stress action, from tension to compression or to shear also require larger factors than those of a steady character.

The magnitude of the safety factor to be used in any given case can only be given in a suggestive way because of the multiplicity of conditions that may arise.

There will be found differences of opinion among designers in the selection of a safety factor.

As a rule, the safety factor is chosen largely from the character of the stress action caused by the load which may be grouped under three principal divisions, namely, steady, varying, shock.

The following factors of safety are taken from reliable sources and can be used in normal design work. Dead load conditions have been omitted due to the infrequency with which absolute dead loads occur in machine practice.

Material	Kind of Stress		
	Steady	Varying	Shock
Cast iron	6	10	20
Wrought iron	4	6	10
Steel (hard)	5	6	15
Steel (structural)	4	6	10
Timber	6	10	15

The values given in Table I have been taken from various sources and show average practice but should not be used if exact test values are obtainable.

Data on alloy steels will be found in the literature of the American Society for Testing Materials, also in bulletins of steel companies.

In selecting a suitable working stress for a material, the proper factor of safety should be applied to the ultimate stress.

Where values have been omitted in the table, data was lacking or the variability in the range of quality of the material was such that it would serve no useful purpose to quote the values given.

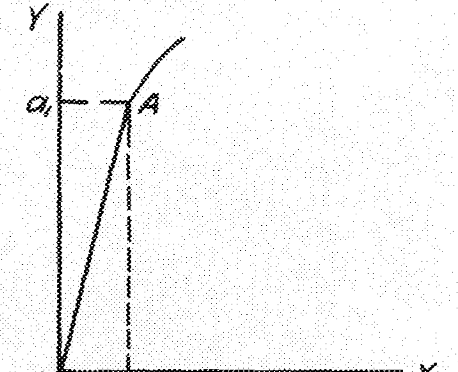
Stress Analysis

Preliminary to the discussion of stresses it will be necessary to define the meaning of various terms used.

Stress is the internal resistance to an external force or load tending to change the form of a body.

Strain is a change of form of a body and may be either temporary or permanent.

All materials are more or less elastic and there is a definite relation between the stress and strain for each material. This relationship can be shown by a stress-strain diagram, in which the stress-



es are laid off on the Y axis and the strains on the X axis. Since the stress is proportional to the strain, the diagram shows a straight line and

$$\frac{stress}{strain} = \frac{Oa_1}{Oa}$$

and holds true up to a definite point for each kind of material after which the strain increases at a higher rate. In the diagram, the point A represents the limit to which the stress may go without causing a permanent deformation, for up to this point the material returns to its original shape *O* when the stress is removed. The point *A* is the upper limit of perfect elasticity of the material and is called the elastic limit. It is apparent that *A* represents the upper limit to which a machine part could safely be stressed. Elastic limit is the unit stress when the permanent deformation first occurs. The yield point corresponds closely to the elastic limit. Modulus of elasticity is the ratio of unit stress to unit strain. Ultimate strength of a material is the unit stress at which rupture occurs.

Simple Stresses

Forces encountered in machine practice are tension, compression and shear. Tension is a pulling force tending to elongate a body in the direction of the pull and induces a tensile stress. Compression is a pushing force, opposite in sense to tension, tending to shorten a body in the direction of the push and induces a compressive stress. Shear is the tendency of two opposite forces acting in parallel planes tending to cut a body into two parts and induces a shearing stress. A combination of forces acting at the same time induces compound stresses in a body.

When a body is subject to any one of the three stresses, the same general relations hold, namely: $P = S \times A$, in which P=load; S=unit stress; A=area of cross section.

The above simple relation does not take into account the strain or deformation, therefore the modulus of elasticity must be taken into account when the stiffness of a piece is considered.

Let P=load; S=stress; A=area of cross section; E=modulus of elasticity; L=length of piece; e=strain or amount of deformation. Then,

$$e = \frac{PL}{EA}$$

This expression applies for both tension and compression by substituting proper values.

The value of the modulus of elasticity of steel is the same regardless of the quality, therefore all grades of steel acting under like stress conditions will be equally stiff under the same load but the strength will be determined by the stress value of each grade.

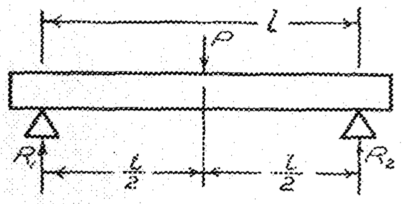
When a piece subjected to compression has a length greater than six times its diameter, the above formula does not apply for it is then considered a column and its stresses must be determined by column formulas.

Force Moments

The moment of a force is the rotative tendency of the force in its action on a body and is measured by the product of the force and the perpendicular distance from its line of action to the point about which it tends to rotate the body. If the effect is to produce bending in the body, the moment is called a bending moment; if the effect is to produce a twisting of the body, the moment is called a twisting moment or torque.

Bending Moments

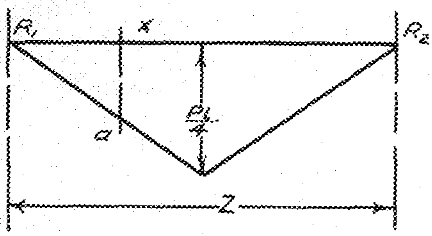
Consider first, a simple beam resting on two supports, thus,



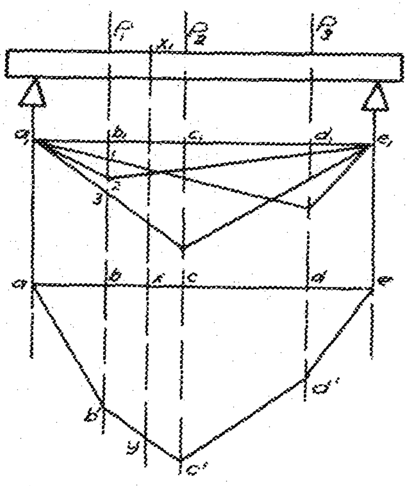
Neglecting the weight of the beam, the sum of reactions at the supports equals the load or $P = R_1 \times R_2$, and the maximum bending moment is

$$\frac{Pl}{4}$$

The bending moment diagram for this case can be shown, thus,



A graphical solution of a problem has a two fold value: first, it gives a picture of the conditions and second, it can be used as a check on a mathematical solution. To be of working value, the diagram must be laid out to a definite scale. The bending moment at any point X is aX. In case more than one force is acting on the same beam a bending moment diagram can be drawn for each and from these a combined diagram is constructed. In the combined diagram the bending moment for any section of the beam is obtained by taking the ordinate in the plane through the given point. For instance,



Points b^1, c^1, d^1 are located in the plane of the respective forces and at a distance below the reference line a to e equal to the sum of the ordinates found in the individual bending moment diagrams shown above, thus, in the plane of the force P_1, the ordinate b to b^1 is the sum of b_1 to 1, b_2 to 2, b_3 to 3. The bending moment at any point such as X_1 is X to y.

For every force acting on a member there is set up a resistance equal and opposed to the acting force; also for every bending moment there must be an equal resisting moment.

The resisting moment is made up of two factors, the stress and the section modulus. The stress value depends upon the material and the section modulus upon the geometric form of the member.

Section modulus is the term applied to the moment of inertia of a section divided by the distance from its neutral axis to the outermost fiber or

$$Z = \frac{I}{c}$$

in which Z = section modulus; I = moment of inertia; c = distance from neutral axis to outermost fiber of a section.

From foregoing considerations, the following general equation can be used for problems involving bending moments only.

$$Pl = S\frac{I}{c} \text{ or } M = SZ$$

in which M represents the algebraic sum of the bending moments. The condensed table of bending moments given on the following page includes only a few of the typical forms of loading.

Extended tables of bending moments will be found in standard handbooks also in steel company handbooks.

Torsion

Torsion is the effect produced by two equal and opposite couples acting in planes perpendicular to the axis of a member.

Torsion or twisting moment induces a shear effect and is found in the analysis of rotating pieces such as shafts.

In the sketch, the force P acts at the end of radius R, tending to produce a rotation.

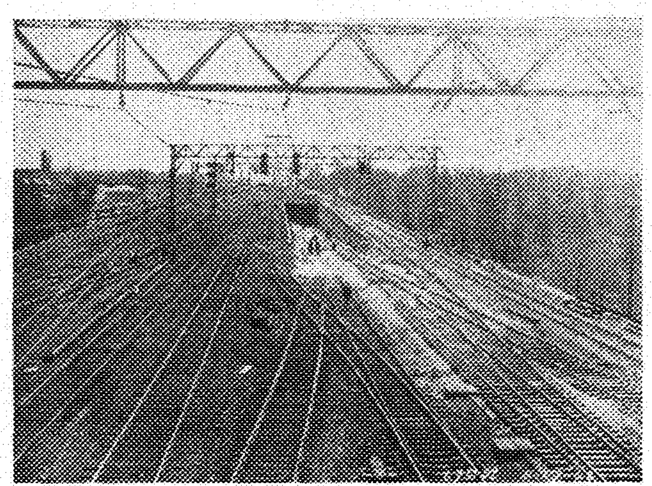
The resistance offered to torsion is found in the shear stress of the material and the section modulus derived from the polar moment of inertia. The equation therefore becomes,

$$PR = T = \frac{S\pi d^3}{16}$$

and letting

$$\frac{\pi}{16} = \frac{1}{5} \text{ (approx.)}$$

(Continued on page 66)



ELECTRIFIED TERMINAL
Tracks of the Illinois Central looking south from 67th street, showing entrance to the duckunder tunnel for the south branch.

Electrification of Passenger Terminals

By H. A. Dahl, '22 E.E.
Westinghouse Electric Company

THE capacity of a transportation system is determined by the section which forms the greatest restriction to the free movement of traffic. On the transportation systems having inadequate terminal capacities or facilities, traffic may be so held up that the flow over the entire system is restricted and under such conditions, expansion of terminal facilities is justified at almost any cost. In many instances it has been found that electrification is the simplest and best solution of the problem and ultimately, even if not initially, the most economical. This is particularly true where local conditions do not permit the enlargement of the terminal area. Electrification with its possibilities for multiple deck tracks, increased speed and reduced number of train movements, is an effective solution for such problems. In fact, if all of the advantages of electrification are utilized to the limit, the capacity of a steam terminal may be increased several hundred per cent.

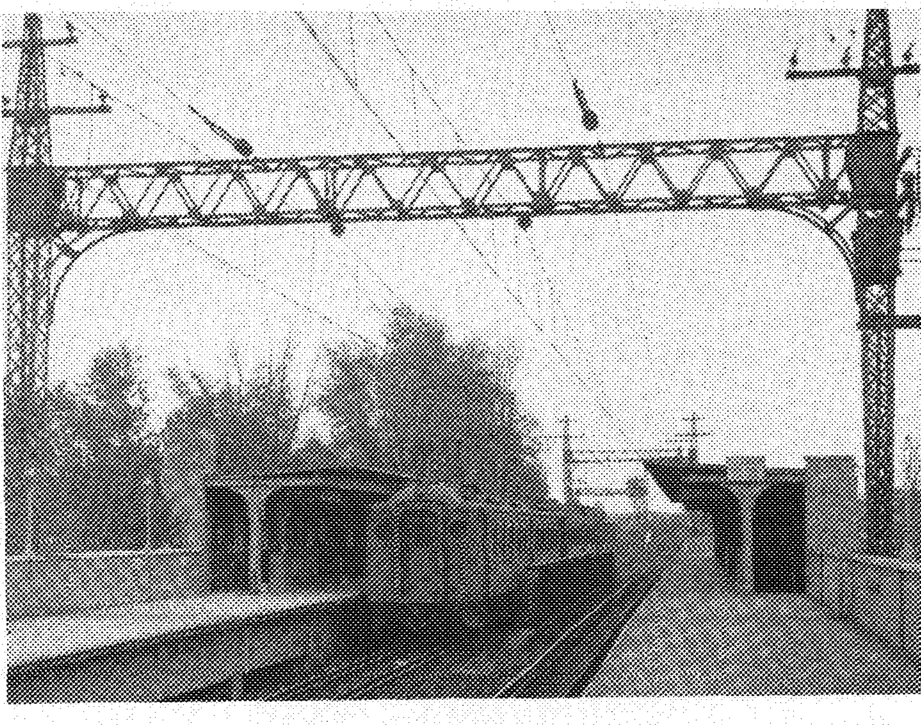
One of the greatest features in connection with terminal electrification is the ability of electric trains to operate under ground, thereby opening up a wealth of possibilities in locating the passenger terminal in the most advantageous location from the standpoint of convenience to patrons. Obviously, subway construction is expensive but there are times when it is justified, particularly so in the central part of large cities where the so-called air rights can be sold.

The Pennsylvania railroad and New York Central terminals in New York City are outstanding examples of the possibilities of terminal electrification. Both terminals illustrate the value of air rights and the Pennsylvania railroad station in particular, shows how trains and traffic can be brought into the heart of the metropolitan area by means of subways. The Pennsylvania terminal in New York City is joined to the west bank of the Hudson and to the east bank of East River by tunnels which between these two points do not reach the surface except at the station.

Another example of where congestion may be lessened by electrification is the passenger terminal having considerable suburban traffic. Here the results are obtained chiefly because of the decreased number of train movements in the terminal and also because of the quicker movement obtained with electric motive power. With locomotive operation and a stub-end terminal, the minimum number of track movements for each train-turn-around is six, whereas, with motor car trains the minimum number is but two. If the train is to be broken up, the number of movements is increased but will be less under electric operation on account of the greater flexibility obtained in train make-up.

With motor car trains and a good track layout it is possible to make the track movements almost coincide with the train movements. This not only means less idle time for the cars in the terminal but an appreciable reduction in congestion at the throat of the terminal because of the reduction in switching and track movements. In a stub-end terminal such as the Pennsylvania Railroad, Broad Street terminal at Philadelphia, where there are many through trains, electrification of part of the suburban service with motor car trains makes it possible to handle probably double the number of trains which formerly could be handled by steam locomotives. With complete electrification of the through trains, also, the capacity will be increased still further.

Aside from the relief offered at the terminal, the operation of motor cars in place of steam trains in suburban service makes it possible to offer a much higher grade of service which will considerably increase the volume of traffic. This is brought about not only by the faster schedules offered and the absence of soot



MULTIPLE UNIT TRAIN, NEW YORK, WESTCHESTER AND BOSTON and cinders, but by the more frequent service it is feasible to give.

The cost of equipment for electrification is determined by the peak traffic condition, which for a passenger terminal electrification is of several hours duration during morning and evening rush hours. It is evident, then, that fixed charges are determined by the peak traffic whereas operating charges are largely a function of the train miles and car miles operated. However, there is one operating charge which is also controlled by peak traffic. This is the power cost, which for a typical terminal electrification will be about fifty per cent for demand, measured during peak traffic, and fifty per cent for energy based on the total kilowatt hours used. Since fixed charges are not increased by off peak operation and the energy charge for off peak operation is much less than the average energy charge, it is evident that the additional cost of such operation is little more than crew expense. Therefore, it is profitable where electric operation is employed, to give a fair amount of service throughout the day. Two and three car motor car trains may be operated frequently whereas steam trains of this length would be prohibitive on account of the expense.

The faster schedules possible with motor cars in suburban service are accomplished by the more rapid acceleration. An accompanying curve shows the accelerations which can be obtained on a tangent level track with motor car trains and with the steam trains of four and eight cars. In this comparison the same car bodies and loads were assumed, and the motor car includes the weight of a suitable two-motor, single-phase electrical equipment and modern airbrakes. The steam locomotive assumed has a total weight in working order of 200 tons with 180,000 lbs. on the drivers and a maximum tractive force rating of 41,000 lbs. These proportions are believed to be representative of locomotives now used in suburban service. The comparative data are based on a motor car loaded weight of sixty-three tons; a loaded weight of fifty tons for the cars hauled by the steam locomotive; a total weight of a four-car steam train, including the locomotive, of 400 tons; and of a four-car multiple-unit train, 252 tons. The weight of an eight-car steam train is 600 tons; and of an eight-car multiple-unit train, 504 tons.

The locomotive assumed has the necessary capacity to haul seven cars at approximately the same free running speed as can be made with the motor car trains on tangent level track. It is evident, therefore, that when operating in long-run service the steam locomotive hauling a seven-car train can make approximately the same schedules as the motor car trains. In this connection it should be understood that the performance of motor car trains is substantially the same irrespective of the number of cars to a train.

Although approximately the same schedules can be made in long-haul service with either locomotive-drawn trains or motor car trains, the difference is very marked in short-run service. The following tabulation shows the approximate schedules which can be made in short runs with the two types of motive power assumed.

In calculating the schedule speeds shown, stops of twenty seconds, twenty-five seconds and thirty seconds were assumed for the 0.5 mile, 1.0 and 1.5 mile runs respectively,

SCHEDULE SPEED—MPH.

Av. Run Miles	Steam Train 4 Cars	Steam Train 8 Cars	Motor Cars 4 Cars	Motor Cars 8 Cars
.5	16.5	14.8	17.9	17.9
1.0	22.9	20.8	24.8	24.8
1.5	27.7	24.8	29.5	29.5

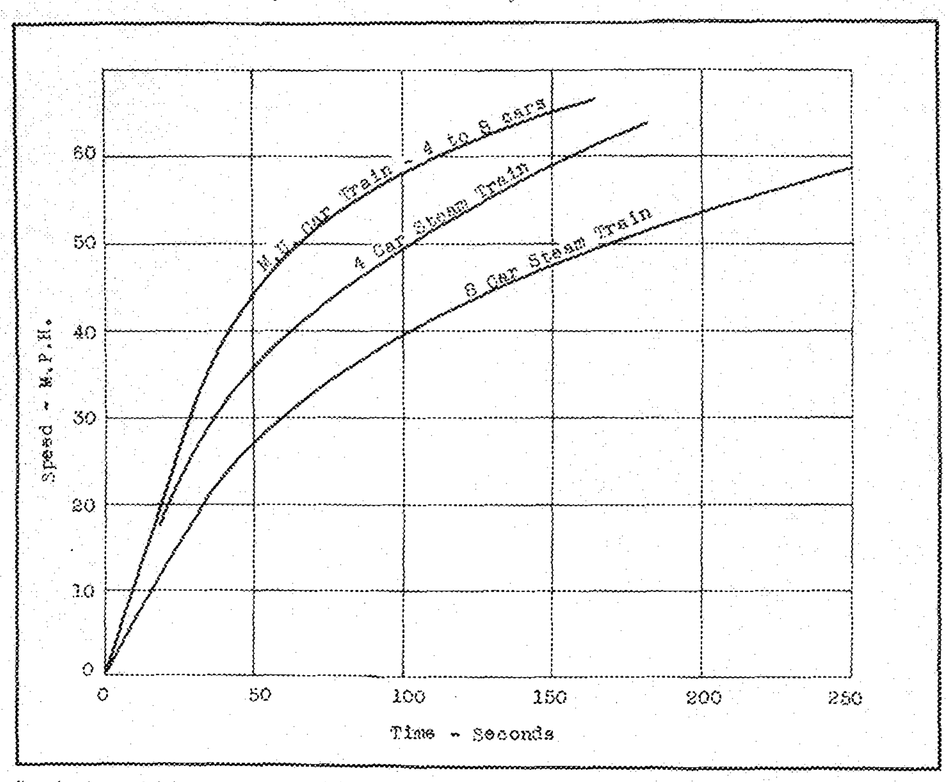
with a definite time added to the calculated minimum wheeling time for each run to give a reasonable speed margin.

With electric locomotive-drawn trains it is feasible, of course, to have a higher percentage of the total train weight carried on the locomotive drivers than can be done with steam locomotives and hence obtain a higher accelerating rate. The schedules which can be made in short-run service with properly designed electric locomotives are therefore, somewhat better than can be made with steam locomotives, but obviously the accelerations will be slower than with motor cars and the schedule speed also less.

Electrification of suburban traffic on most systems, will result in reduced cost of operation. The maintenance for equipment of either motor cars or electric locomotives will be less than with steam locomotives. On account of the faster schedules and quicker turnarounds possible, the number of cars required will be less and for the same reason and also because the number of men for each train crew can be reduced, the crew hours will be less. The cost of electric power furnished by a modern power system should be less than the cost of fuel.

The general statement cannot be made that the reduction in operating expense obtained by the electrification of a metropolitan passenger terminal will justify the expenditure for enough electrical equipment to move the volume of traffic which has been moved by the existing steam facilities. The investment for electrical equipment sufficient to move this volume of traffic provides a tool which is available for handling a considerable increase in traffic with only a small additional investment for rolling stock and possibly substation equipment. Furthermore, the investment for the suburban service can also be utilized for ultimate electric operation of through trains and this should be considered in laying out the terminal installation.

Electrification whether motivated by one cause or another, is a major improvement which can be readily expanded with the needs of the service. It is the eventual step in the case of a continually growing suburban traffic operated by steam.



Speed of multiple unit cars compared with that of steam trains, showing much faster acceleration for the multiple unit trains

AVIGATION

A. Robert Heller, E. E. '30

THE title, probably new to most readers, is one recently coined by the Airways Division, and means the science of aerial navigation.

The great need of making night flying safe, arising out of mail plane transportation has caused this branch of aeronautics to assume a rapidly growing importance and is the object of extended research by the Airways Division, which was organized primarily for this purpose in July, 1926.

The work may be divided into three main fields: the lighting of airways and airports, the dissemination of weather and other important information to pilots and airports, and the means of keeping the pilot from straying off his course, which when navigating solely by instruments, was often done, due to side drift and uncertainty of speed caused by winds.

There are two designs in airport lighting in use in this country, one in which there is a central flood-lighting system, and the other in which the lights are distributed around the boundaries of the airport. Special cut-offs are used to obviate glare, and precautions are taken to eliminate shadows. There are one or more beacons at the airport, and also due to the fact that landings are generally made into the wind, because of diminished landing speed, the wind cone is fully illuminated. Other lights, for ceiling indicators, hazard indicators, and hangar illumination are used in addition.

The airways are lined at intervals of ten miles with beacon range lights, which cast their beam more or less in the direction of flight, thus acting as a sort of course indicator to the pilot. Intermediate landing fields are also being built between airports to facilitate safe landings in emergencies. These fields are close enough together so that safe landing is almost certain, with the multi-motored planes now in use. Colors are advantageously used to give a distinctive meaning to the various lights.

However, though these devices are of great aid to the pilot, they are insufficient in themselves, and he must rely on some other means for guidance in time of fog, low ceiling, etc.

Radio was here called upon to do its share and various course indicators have been developed to assist the pilot in maintaining his course. The first work of this kind was done by the Bureau of Standards for the Army Air Service in 1921.

The main scheme may be outlined as follows: an antenna consisting of two large loops affixed to a stationary pole the bottom of which terminates at the radio beacon transmitting station, has its terminals connected through a switching arrangement to a radio transmitter. Here, with a process of keying which sends two separate and distinct signals through the antenna, a directional effect is given to them by the two loops. These are heard with equal intensity along the bisector of the intersection of the loci of the two signal strength fields. Fig. 1.

This equal intensity system was later superseded by one in which the signal was heard as a continual dash when the course was being followed, and as the original component signals when off-course.

A talk on Aerial Navigation was given before the radio communication class (E. E. 161) on October 16, by Mr. Stewart Bailey, who is with the Lighthouse Bureau of the Department of Commerce as an assistant radio engineer. He spent last year in Panama installing marine radio beacons and is now stationed in Detroit.

Mr. Bailey was a prominent man on the campus, a member of Tau Beta Pi, Eta Kappa Nu, and several other organizations. He received his bachelor's degree in 1927 and his master's degree year later. His very interesting lecture furnished the basis for the following article.

This aural system, although fairly efficient required some skill on the part of the pilot in telling how far off-course he was, and also subjected him to a certain amount of physical and mental discomfort, because of his having to hear the signal continuously and because of his wearing earphones constantly.

In looking for further improvements, the Department of Commerce, after having called for aid from various organizations who had had experience on the problem, finally developed a visual indicator which is being put into use at the present time. This is called the tuned reed indicator.

Although previous to the reed indicator, experiments were conducted on visible light- and double-reading instrument indicators, difficulty in their providing an exact course estimate has retarded their development.

The tuned reed indicator consists of two spring steel reeds vibrating at the same frequency of the modulated signals sent out simultaneously in the two loops, 65 and 86.7 cycles per second. Elinvar has recently replaced steel because it is not affected by temperature changes.

In place of the headphones, the audio output of the receiver is fed into two coils wound around the reeds. When the pilot is on the course, both reeds will vibrate with the same amplitude, whereas if he is off course in either direction, one reed will vibrate at a lesser amplitude than the other, and all the pilot must do to regain his course is to turn his plane in the direction of the shorter reed.

The instrument is ruggedly built, each reed being tipped with white against a black background to insure good visibility. No outside apparatus is required beyond the ordinary airplane radio receiver.

Because the radio beacon stations are fixed and unfortunately the air routes are usually not on a straight line between stations, means had to be found to shift the course at the station.

An instrument called a goniometer, developed by Army engineers, which is nothing more than a gigantic variometer, was connected between the two loops and the transmitter. By varying this, the fields were distorted as shown in Fig. 2 and the course shifted as a result.

The addition of a vertical antenna to the loops and added antenna resistance produced a similar result by decreasing the size of one field as shown in Fig. 3.

With one of these tuned reed indicators and accessory instruments, J. Doolittle flew a course and landed without seeing either course or landing field.

The same receiving set which is used for the above purpose may be used to gather weather information to supplement the indicator. This is broadcast

(Continued on page 64)

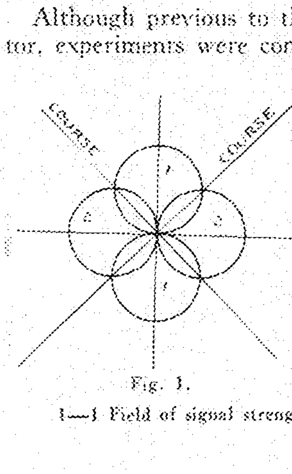


Fig. 1.

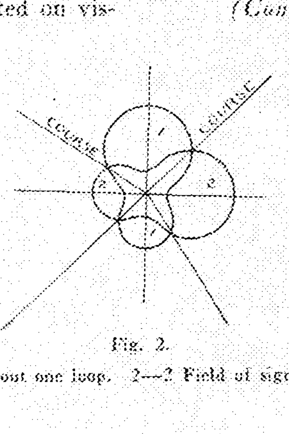


Fig. 2.

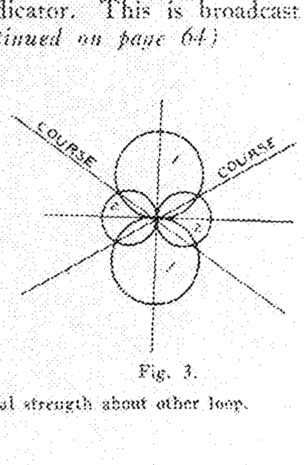


Fig. 3.

1—1 Field of signal strength about one loop. 2—2 Field of signal strength about other loop.

1929 VIKING HOMECOMING

By J. R. Severson
Associate Chairman of Homecoming

HOMECOMING! The word itself brings up a picture in the minds of men who have never seen the inside of a college classroom, but for the graduate it means everything, and in the spirit which accompanies the occasion the undergraduate picks up something of what the day will mean to him after he too is an alumnus.

It is a return—a return to the scene of four years of test, trial and happiness; a return for a short day to the life that made the man. There is something indefinable that brings old friends back to the scenes dear to their friendship sure that they will not go away disappointed.

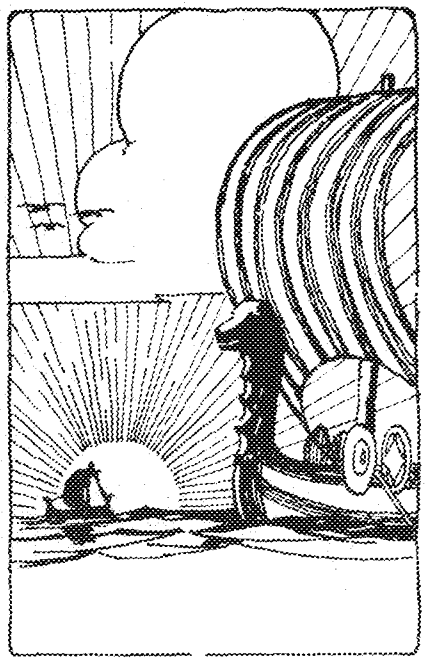
Minnesota Homecomings have been a success in the past, with alumni returning from all over the world to make merry at their alma mater. The celebration this year will be no exception, if the plans that have been laid are carried out. Walter W. Finke, general chairman for this year, and one hundred and seventy-five assistants have been working for the past six weeks in their attempt to put the project across to the alumni, the Twin Cities, and the state in general.

"But why the large corps of aides?" you ask. "What is there about the meeting of a few thousand people that requires so many people to put it over?" This article may answer that question, and in any eventuality it will give you an insight into what is done in the Homecoming office.

The first problem to be solved is that of bringing the celebrants together. Every alumnus is interested in his college, and the interest is centered on the day set aside for his return. For this purpose a booklet is prepared, and that in itself is no one man task, for letters and articles from prominent faculty members must be obtained, pictures and drawings must be secured, and the whole made up into a book that will interest the reader.

But the work that is involved in that operation is little compared to the work necessary to get 16,000 of those booklets into the mails and into the hands of the alumni. Each book is mailed in an envelope that contains a Homecoming badge, a coin card and a return envelope. After the booklets are packed, they are sorted according to states and cities, tied and bundled, and then mailed. You may have thought that the U. S. Postal service attends to details such as that, but they don't and are very emphatic about it.

The booklet once out and latent enthusiasm supposedly aroused, it is up to the committee to keep interest building up until the day of the celebration. This is no easy job, and that is one reason for the large publicity group in the committee list. Stories must be written for all city and out of town newspapers in the state. On top of that, the committees must be on their toes to take advantage of every chance opportunity for publicity, and if chances do not occur, it is up to them to plan affairs that will call attention to the Homecoming motif.



With the Alumni theoretically on their way, other committees are formed and begin working to coordinate the welcome that they will receive. To do this a theme is chosen, which, to be effective, must embody the traditions of the University and the state. An additional coordinating force is necessary, and to this end, a slogan is chosen. The decorations of the various buildings, the Greek letter organizations, and the decorations throughout the city are all based on the motif thus created. It is easy to see that the handling of decorations over an area the size of the Twin Cities means work for somebody, if the decorations are to be effective.

A feature of the campaign to arouse interest is the radio pep-fest, usually held a few days before the game. Artificial and uninteresting as it sounds, the enthusiasm of a group of cheer leaders and the University band in the narrow confines of a broadcast studio has been effective in stirring up the alumni of the northwest. Various schemes have been used to popularize the program; this year telephone calls from alumni outside a five hundred mile radius are to be rebroadcast for the benefit of former student that will be listening in. Prizes are being given to the alumnus phoning from the greatest distance and to the listener handing in the closest guess to the score of the homecoming game.

So much for the preparations—now comes the welcome and entertainment that brings the alumni together instead of leaving them in scattered groups at the houses of the various organizations with which they were affiliated in school.

As has been customary in the past, there is a pep-fest the night before the game. Cheer leaders of former days, rooter kings of the present, and former all-American players take turns in working the crowd to a fever heat. The bonfire, about which throngs mill back and forth, has grown bigger each year until now it makes the parade as light as day. As the fire dies, the excitement mounts and is brought to a climax with the Minnesota Rouser, the "Locy" and the thundrous salutes from aerial bombs and torpedoes.

Saturday morning is devoted to the parade throughout the campus district. This year the city itself will be brought closer to the celebration, for the parade, with seventy-five floats, is including the downtown district of Minneapolis on its route. This is the first time since 1922 that a campus parade has gone through the business district, and everyone is waiting the event with anticipation.

Saturday afternoon and the Homecoming game need no description to any man who has ever seen the battles between Minnesota and Michigan for possession of the Little Brown Jug—traditional symbol of victory in the annual battle between these universities. No alumnus has ever yet been able to say that he has seen a game that was not full of fight, no matter how disappointed he may have been if Minnesota was on the short end of the score. This year the Jug is at Minnesota, and if the fates so will, here it will stay for another year.

With the scattering of the alumni, the major work of the committee is finished, but the work of the committee heads goes on, for all the bills have to be settled and a complete report of the work done drawn up for the use of the committee that follows next year.

The expenses of Homecoming are many and varied. Publicity costs money, decorations, booklets, buttons, fireworks and a thousand and one minor items add their total. This expense is met by the sale of buttons to the alumni

(Continued on page 64)

ABOUT THE WORLD WITH OUR ALUMNI

Architects

'24—Isadore W. Silverman placed second in the 1929 Paris prize competition sponsored by the society of Beaux-Arts Architects of the United States. The winner of the competition spends two and a half years studying at L'Ecole Des Beaux Arts in Paris.

'27—While designing houses in Phoenix, Arizona, where "the climate is much too warm for comfort," Harold Ekman was visited by Wally Strand. Wally is a radio technician with the Stewart Warner company. Harold has just returned from a two weeks trip through southern California.

'27—L. B. Anderson and Walter J. Huchthausen, '28, are holding an Arab reunion at Harvard where they are doing post graduate work. Both are former art editors of the TECHNO-LOG.

'28—Roy N. Thorshov and Nate Juran, after spending the summer at Fontainbleu, France, are back in the U. S. again. Fontainbleu is located thirty miles from Paris, and is noted for the excellency of its art school. Nate can be reached at 541, 3120 Broadway, New York City.

'29—S. Leach is no longer a bachelor, having married Helen Shirk of Owatonna, Minnesota.

'29—Fred Hakenjos, former art editor of the TECHNO-LOG, is studying at Columbia on a scholarship. Everyone is wishing you all the success in the world, Fred.

Chemists

'97—Herbert C. Hamilton, one of the first graduates of the School of Chemistry, is now with the Parke-Davis company.

'05—F. C. Frary is director of research for the Aluminum Company at New Kensington, Pennsylvania. Mr. Frary, who took his graduate work at Minnesota in '06 was with the Oldbury Electric company before the war. During the war he served with the Chemical Warfare Service as major.

'06—Jacob Cornog has followed the example set by other men and is married to Miss Emma Ripley, a Minnesota graduate of the same year. He is on the staff of the University of Iowa, at Iowa City.

'08—Russell S. McBride, assistant editor of "Chemical and Metallurgical Engineering" is the father of a young son.

'09—Frank C. Whitmore is doing his share toward the future of engineering in this country for he is the proud father of three sons and a daughter. Dean Whitmore, to give him his full title, will be remembered as a former instructor in the school of Chemistry here, and is now Dean of Chemistry and Physics at Penn State College, State College, Penn.

'10—H. W. Dahlberg is director of research for the Great Western Sugar company at Denver, Colorado.

'10—Farrington Daniels is now professor of physical chemistry at the University of Wisconsin. He spoke at the symposium of the American Chemical Society in Minneapolis this summer.

G. H. Morse, '22, Attends Rifle Meet

GEORGE H. MORSE

George Humphrey Morse, of the 1922 class of mechanical engineering, University of Minnesota, was a member of the American Legion National Rifle Team, which placed fifth in Class B, at the annual matches this fall at Camp Perry, Ohio. Selection of the 13 members of the squad was made from expert riflemen representing every state in the Union, and the final choice was made of men who came from 11 states, including New York and California. Mr. Morse was the only man from Minnesota. This was the first year that the American Legion entered a team in the matches. In addition to the medal for his team's success, he won third place in the national individual Davey Crockett match, placed as Expert in the Running-Deer matches, and won three other Expert medals.

Early in the World War Mr. Morse volunteered as a gob, serving at the Great Lakes naval training station for a time. He was then assigned to the Dunwoody Institute naval aviation ground school, and was selected for the advanced training at Miami, Pensacola and Key West. He was commissioned an Ensign, with the "wings" of a pilot, and was an instructor of flying.

He was a student at the Summer Naval School of Culver, Culver, Ind., and he graduated from East High School, Minneapolis, winning honors in athletics at both schools. At the University of Minnesota he was a member of the track squad. He is a member of Theta Delta Chi and of Theta Tau. Later he graduated from the Minnesota College of Law, where he was initiated into Sigma Delta Kappa.

Chemists

'10—A. M. Buswell is doing research work on paper formation in an attempt to make paper from cornstalks. His method involves the removal of the pith from the stalk with a bacteria which destroys it, releasing marsh gas and carbon dioxide. The removal of the pith by this method saves one-half of the digestion ordinarily necessary and strengthens the paper while the marsh gas that has been released can be used for the generation of electric power. Mr. Buswell heads the State Water Survey of Indiana in his capacity of professor of Chemistry at the state University there. He is married and has two sons.

'11—Ernest A. Stoppel is technical director and research chemist for Valentine and company in Brooklyn, N. Y.

'13—Victor Yngve is research chemist for the National Carbon company at Cleveland, Ohio.

'15—M. J. Blish, a former teacher at the farm experimental school and a graduate student of Minnesota, is professor of research chemistry at the Agricultural Experimental station of the University of Nebraska. He is located at Lincoln, Nebraska.

'16—Alfred W. Gauger is director of Mines and Mining experiments at the University of North Dakota, Grand Forks, N. D. Mr. Gauger received his Ph. D. at Princeton.

'22—Stephen F. Darling has finally settled down as professor of Chemistry at Lawrence College in Appleton, Wisconsin, after spending a year abroad on a Harvard traveling fellowship. Mr. Darling received his Ph. D. at Harvard after taking two degrees at Minnesota.

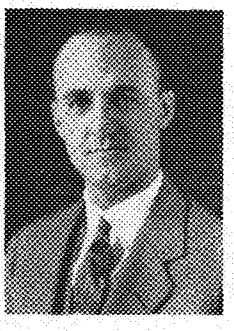
'26—Marvin C. Rogers, former circulation manager of the TECHNO-LOG, writes:

"Since leaving Minnesota after graduation in 1926, I have been here in Ann Arbor. I attended the University of Michigan during the three years from the fall of 1926 to the spring of 1929, and I received both the Master of Science degree and the Doctor of Philosophy degree, the former in 1927, and the latter in 1929. My work was done in the Department of Chemical Engineering.

"I am now a Chemical Engineer with the Whiting-Swenson Company of which Professor W. L. Badger C '08 is president. The company is organized to do research, development and design for the chemical engineering industries. It has just been organized, and we are now at work on several research projects as well as the design of two complete plants. The work looks as though it will be most interesting, and should give all of us some very good experience.

"I expect to come to Minneapolis for the Michigan-Minnesota game next month and I will try to find time to stop in and see the office. I don't think I have been in the office since I worked on the staff some years ago. I certainly hope that Minnesota can repeat the results of the game which was played here at Ann Arbor two years ago."

Obituary



HARVEY COLE ESTEP, M. E. '08, widely known in the field of technical journalism, and closely identified with American and European engineering and industrial activities, died recently in Cleveland, Ohio, of heart disease.

Mr. Estep was born at Stampede Tunnel, Washington, on September 27, 1886. His early life was spent on the Pacific coast in the Puget Sound district where he was constantly in touch with engineering activities. His father, H. C. Estep, was one of the prominent railway construction engineers in the period of northwest railway expansion, and was directly responsible for the location and construction of portions of the Great Northern, Northern Pacific and other railways.

His father's work on the Minneapolis and St. Louis caused the Estep family to move to Minneapolis where Harvey attended Central High School and was graduated in 1904.

Entering the University of Minnesota in the fall of that year, Mr. Estep became identified with many campus activities. In his senior year he was chosen editor-in-chief of the *Year Book*, an annual publication of the Society of Minnesota Engineers. Through the efforts of Mr. Estep the first issue of the *Minnesota Engineer*, a quarterly publication, appeared on the campus in 1909.

Immediately after his graduation from the University he became affiliated with the editorial staff of the Penton Publishing company, as assistant to Robert Thurston Kent, who was at that time engineering editor of *Iron Trade Review*. In 1914 Mr. Cole became associate editor of *The Foundry* and engineering editor of *Iron Trade Review*.

His interest centered in foundry technique and management, and through his connection with *The Foundry* and his activity in the various technical and trade associations he contributed largely to the advancement of the industry throughout the world. He contributed papers to the American Foundrymen's Association, and was editor of the *Transactions* of that society for a number of years. He exhibited a keen insight into the needs of foundrymen and rendered valuable assistance in improving the technical and scientific practice of the art.

For a time during the war, he was secretary of the Cast Ammunition committee of the Ordnance department, engaged in the manufacture of grenades, trench bombs, and other cast ammunitions. Immediately after the close of the World War, Mr. Estep was sent to London, England, where he established the main office of the Penton Publishing Co., Ltd., with branches in Paris, France and Berlin, Germany. He remained in Europe until 1924 when he returned to Cleveland to take up his executive duties as vice-president of the Penton publications.

Mr. Estep was president of the Johnson Publishing company, director of the American Foundrymen's association, secretary of the Foundry Equipment Manufacturers' association and a member of the American Iron and Steel Institute, the British Iron and Steel Institute, the American Society of Mechanical Engineers, the Institute of British Foundrymen, and L'Association Technique de Fonderie de France. He was also a member of the Engineer's Club of London, and numerous other fraternal, social and honorary societies.

Civils:

'00—Louis Yager, Assistant Chief Engineer of the Northern Pacific Railway, has his home in St. Paul. Right now he is attending the International Engineers' Congress in Japan. Mr. Yager is president of the American Railway Engineering Association.

'22—Howard B. Palmer is another graduate of Minnesota who is connected with Kimberly Clark company, but he is located at Neenah, Wisconsin.

'23—George S. Schaller makes quantity surveys and estimates. He is located in the Builders Exchange, Room 701, in St. Paul, Minn.

'23—H. M. Hill has fallen from grace, for he was married on September 4 to Miss Rachel L. Hanna of Minneapolis. He is with the U. S. Engineer's office at St. Paul and he is working on the Hastings Dam project at the present time. He may be reached at 2338 Marshall avenue, St. Paul.

'23—Lloyd R. Peck is now assistant general manager of Laundry Owners' Association. He was in Minneapolis recently during the National convention of the association, and was one of the committee that arranged that meeting. He may be reached at La Salle, Illinois.

'23—Glenn Nelson has left the Pacific Engineering company for George Adams-Roulfe, Consulting Engineeer, at 4300 Colorado street, Long Beach, California. His work lies in supervision and design of construction, and his specialty is rock crushing plants. He is still single—and still has his hair. What more can a man want?

'24—Herbert Liese is working for Foley Brothers construction company as an engineer. "Herb" is superintending the bridge construction at Hunt Spur, Michigan. His home address is 519 10th avenue S. E., Minneapolis.

'24—E. C. O. Erickson is now designing engineer with Kimberly Clark company of Appleton, Wisconsin.

'26—J. R. Hoffman is still with the Chicago, Milwaukee and St. Paul Railway, and is located at Lanark, Illinois.

'26—C. W. Bunnell is on underground construction with the Metropolitan Sewerage Commission at Milwaukee, Wisconsin. He may be reached at 720 36th street in that city.

'26—Carl R. Liese is now mine foreman under a three year contract with the Anglo-Chilean Consolidated Nitrate corporation. His address is Casilla 17, Tocopilla, Chile, South America. Carl says that he is doing well and likes the work. We are willing to bet that he uses a typewriter—that address would give a man writer's cramp.

'27—C. C. Lande is working with H. B. Palmer at Neenah, Wisconsin. He is holding down the assistant engineer's post with the Kimberly Clark company.

'28—Clinton Morse is another of those engineers who believes in seeing the world. He is connected with the Panama Canal Commission, having the position of junior engineer. Clint is working on the Madden Dam project which will provide additional water storage for the canal. The dam will provide a 160 ft. head and when completed will cover 25 square miles. The only fault he can find with the country is the amount of rainfall—there is altogether too much of that.

'28—Donald J. Riddell is working for the General Electric company in turbine test building number 60, and while at work may be reached at 18 Union Street, Schenectady, N. Y. According to Don, "Minnesota is a pretty swell place to live in."

Electricals

'23—O. M. Burrill now lives in Schenectady, N. Y., where he is in charge of the broadcast receiver department for the radio engineering section of General Electric company. E. W. Engstrom, A. Haedecke and W. A. Hargrave are all in this department. Burrill's address is 2155 Plaza, Schenectady, N. Y.

'23—Le Roy A. Grettum and his wife, formerly Miss Eleanor M. Keefes, a graduate of Minnesota, in '22, now boast two future engineers, John Henri and Victor Charles. Le Roy is in charge of construction and maintenance of all transmission and distribution lines of the Mississippi Valley Public Service company at Winona, Minnesota.

'25—E. E. Winkemwerder heads the Chicago office of the Acme Wire company of New Haven, Connecticut. His home address is 840 N. Michigan avenue, Chicago, Illinois.

'26—Stuart Bailey has been in Panama but is now located with the U. S. Engineers radio station at Detroit, Michigan.

'28—Frederico P. Noguera, who has been working in Brazil since his graduation, writes:

"The company I work for is the Emprezas Electricas Brasileiras and it is a subsidiary of the Electric Bond & Share Co. from the states. We have properties in the states of Pernambuco, Bahia, Espirito Santo, Rio de Janeiro, S. Paulo, Parana and Rio Grande do Sul. In the

(Continued on page 60)

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

EDUCATION does not mean teaching people what they do not know. It means teaching them to behave as they do not behave. It is not teaching the youth the shapes of the letters and the tricks of numbers, and then leaving them to turn their arithmetic to roguery, and their literature to lust. It means, on the contrary, training them into the perfect exercise and kingly continence of their bodies and souls. It is painful, continual and difficult work to be done by kindness, by watching, by warning, by precept, and by praise, but above all—by example. —John Ruskin.

"Et Tu Brute"

IT is right for you to be ambitious. Without a will to raise yourself above the common level, without a desire to make yourself distinguished—to gain a "different" place in the world,—there can be no progress,—instead will develop an indolent, stupid fellow, scarcely deserving the name of an individual, certainly not a personality, nor an entity.

Brutus was ambitious, and yet the last words of Julius Cæsar are tragic and classical advice to every egotist. And therein lies the text. For ambition is like all the other gifts that lead man Godward,—it may be used or abused. Unless tempered with a noble control, ambition is singularly ignoble. The campus politician striving merely for power because of the opportunity it offers for self-display, for making a frog pond "big shot" of himself. Such ambition is not a blessing, but a curse, and it is the curse from which our civilization, our nation, and our campus suffer alike. This mere striving after power and place without a saving sense of the responsibility conferred by that place and power, is ignoble.

The supreme and final test of any work is the satisfaction given to the doer. Can you look your handwork in the face, and not be ashamed? In short, do you, can you shoot squarely with yourself? Let us abandon "Golden Rules" for the present,—even then, if you play the game and play it squarely with yourself,—of necessity you play squarely with the world.

No critic, nor court, nor clown may hold the power of decree when you yourself are brought to bar for the workings of your ambition,—you, yourself are sole arbiter, final judge, and omnipotent deity.

Kangaroo

ENGINEERS have given their first dance of the season. Small attendance recalled the Freshman fiasco of last year,—a dance which remained undanced.

Future promoters, future engineers should recall:

You can't sell the world
Without telling the world.

Mass Minds

MENTAL inertia is one of the heaviest handicaps of American industry. Constructive imagination is rare, easily discouraged or frightened and too prone to be bluffed by a conservative board of directors.

Mental inertia in college is one of the key battles which an institution of learning must conduct. Professors attempt to dispense knowledge to unwilling or passive students, must force pupils to study, spur them by prospects of D's and E's and F's.

But this procedure, that indomitable feeling of right and power which characterizes most instructors, is certain to vitiate the strength and poison the imagination of the student. It is more of a scourge, than a spur.

The lessons absorbed in the class room carry over in substance and pervade the entire life of the individual. Not the fact that HCl when heated decomposes into this and that,—that is soon forgotten; but the fact that individuality is smothered, self-confidence is forfeited,—these remain long in memory.

Mass production, over-expansion are the evils at work. To be counteracted, but how?

Re: Grade-Posting

ONCE upon a time there was a rule, and to the best of our knowledge it is still in force, forbidding the release of student grades and records to inquisitive persons. Just why this rule was enacted has always been something of a mystery, for twice a quarter it is violated by the people who enacted it, and who enforce it rigidly as far as strangers are concerned.

If there is any reason for the posting of student grades on the walls of Main Engineering, we have yet to find it. If the faculty believes that low marks will be raised because the recipient sees that the next man in line has received a higher grade, there is a reason; but we are distinctly under the impression that very few grades have been raised in this manner. There may be a few changed for this reason during the first year, but after a man has been in school for more than one year, he is perfectly reconciled to seeing the potential Tau Beta Pi's take the high marks.

We do believe, however, that the grades a man receives for the work that he has done are just as much his own personal property as the pay that he receives for a job. If he feels that the information should be broadcast to everybody that is at all interested, that is his business, and his business alone. The way matters stand at the present time, every man knows just what every other man has received, and while it may give him some inward satisfaction if his grades are of the highest, the chances are that he is rather disgusted with the whole proceeding.

Inasmuch as no other college on the campus takes this method of distributing marks, there must be some other means available. In reality, it is only the mid-quarter marks that are affected, for the term marks are mailed to each man as a matter of course. Would it not be a lot simpler for each instructor to return the midquarter examination with the grade marked on the paper? If there was a difference between the grade on the midquarter examination and the grade that the student was to receive, this difference could be indicated on the same blue book with little extra trouble.

No matter what solution is adopted, let us get away from this grade school method of penalizing and rewarding students.

"Another Bone Crushing Team"

AGAIN a champion Minnesota team has had what sport writers throughout the country choose to call a surprising upset in meeting defeat after having a seemingly open path ahead to the Big Ten title.—This for the fourth consecutive year. It seems to be a habit, this upset toward the middle or end of the season, and at such a rate it will not be long before the headline "Minnesota Has Championship Team" will take a place with the time-honored joke streamer "Stagg Fears Purdue."

Why is it that these teams made up of Sampson, Hercules, Ghengis Khan in the forward wall and Ajax, Jack a'Demps and Paul Bunyan in the backfield are always so strangely upset? It is in these very misrepresentations that the answer rests.

What reason have sports writers had for playing up Minnesota as a bone-crushing, impossible-to-stop, thundering herd? Under able coaching the University has had football men of which it may well be proud, men who will go down in the history of sport as exceptional athletes. But were these teams what newspapers represented them to be?

Minnesota has been the victim of a rather cruel jest. Its teams have been built up on paper until the confidence of the squad and its backers has arisen to such heights that a tumble is as sure as the weak foundation upon which that confidence is laid. While Iowa rooters bemoaned their poor team Twin City gamblers were giving 20 points on Minnesota. Confidence is a valuable asset, but beware when it becomes blind!

High pressure advertising methods are, perhaps, all right in their place—however, in our opinion, such methods, when applied to football, serve only to breed overconfidence and ultimate downfall.

Order!

THE results of second quarter sorority rushing on the campus this year will be watched with keen interest as another step in the advance of the Greeks upon their old enemy, public opinion. The time has definitely passed when such organizations can exist entirely as frivolous undergraduate activities.

But, while there appears no distinct need of reform, the question of rushing methods of professional fraternities stands largely unconsidered and untouched. Where they possess houses in which students live, these societies are not in essentially different positions than academic fraternities. Yet first-quarter rushing here is the accepted mode.

If the principle is correct in one case it is equally applicable in the other. We rise to a point of order.

Questionnaire

ENGINEERS should divide their proper education into three parts,—the scientific, the physical and the social. The scientific is well accounted for,—class room lectures, recitations, quizzes, labs, and the entire compendium of curricular activities make it a certainty that the graduating engineer is well schooled in technical data and procedure. In this day of athleticism, no member of an undergraduate body may justly complain that opportunity has not been presented for him to develop an excellent physique. Athletics are placed within reach of every one. The University squads, intra-mural-competition, the athletics maintained purely for engineers make it easy for well coordinated, well ordered, properly muscled bodies to be developed.

The social, however, is that phase of engineering education most woefully disregarded. How few engineers are acquainted with music, or the arts, are even capable of self-expression, or a true enjoyment of the theatre?

This third phase of education, the cultural in the restricted meaning of the word, can be mastered during those short periods of relaxation offered to every one.

And hence the questionnaire appearing in this issue that the TECHNO-LOG may know, and hence various student organizations, just where engineers who are interested or who have talent may be located. That every engineer may be given the opportunity to become a part of the extracurricular life of the University.

Faculty Sketches

ROBERT T. JONES

ROBERT TYRE JONES, professor of architecture, was born in Cincinnati, Ohio, in the year 1885. His academic training was received at Vincennes University, Indiana. "Vincennes," remarked Mr. Jones, "was where George Rogers Clark saved the northwest from the Indians and the British, but I had nothing to do with that; I came later." After being graduated from Vincennes, Mr. Jones entered the University of Illinois where he studied architecture. Upon his graduation Mr. Jones worked in Ohio, Pennsylvania and California before winning his academic spurs by becoming instructor and subsequently assistant professor of architecture at the University of Illinois.

Shortly before the opening of the World War, Mr. Jones went to Europe to study the architecture of England and the continent. His especial interests led him to the chateau country of France and the lake district of Italy, where he spent the greater portion of his time.

During the War he served in the concrete ship division of the United States Shipping Board, supervising the manufacture of the light aggregate used in the construction of the vessels.

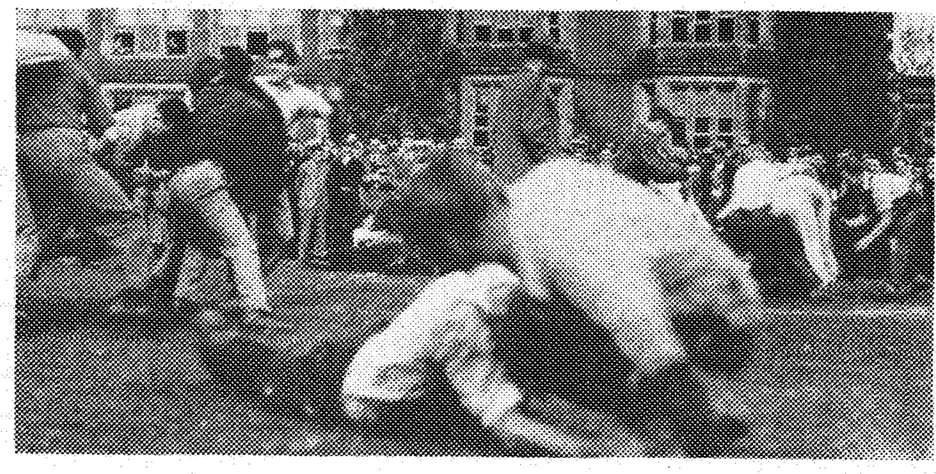
In 1920, Mr. Jones came to the University of Minnesota as assistant professor in the School of Architecture, and was later appointed professor of architecture.

Mr. Jones takes particular delight in hunting and fishing, and avails himself of every opportunity to go canoeing on the lakes and streams of northern Minnesota. Mr. Jones and his young son frequently may be seen departing from their home for a few days of "roughing it" in the northern woods. He is also a great lover of music, and has found time for a great amount of vocal work. His interests in literature are widespread, but center chiefly in books of travel.

Every architectural student is exposed to Mr. Jones' diverting sense of humor, and is led through the intricacies of building construction by a series of chalk talks, doubly instructive and interesting because they are backed by a great wealth of experience.

Mr. Jones is a member of Acacia, Scarab, and an honorary member of Tau Sigma Delta. He is on the Students' Work Committee, national technical director of the Architects Small House Service Bureau and editor of *The Small Home*,—monthly publication of the Bureau.

NEWS FROM THE TECHNICAL CAMPUS



MADDEN SUPERVISES FRESHMAN-SOPHOMORE MUD RUSH

THE Freshman Class recently defeated the Sophomores 265 to 245 in the annual Class Scrap. The freshmen by a superiority of numbers and weight were enabled to out-fight their seniors and win three out of five contests to carry off the championship.

The push-ball contest was easily captured by the freshmen, who rushed the huge ball across the field leaving little doubt in the minds of the spectators as to the relative strength of the warring groups.

In the bag rush,—a game devised by Professor Zelner especially for the annual Scrap, the Frosh were again victorious and it appeared that the Sophomores would suffer a complete rout. The cowboy joustings, however, found the Sophomores in their proper field. The final score of the contest gave them four out of five victories. In the greased pole contest the Sophomores strengthened their grasp on the honors of the day by carrying off 70 points to 30 for the yearlings.

With the score 245 to 215 in favor of the Sophomores, the leader of the Frosh called his warriors together and urged them to give their all in the Tug of War which was the next and final event. And the Freshmen followed the advice of their captain, pulling the exhausted Sophomores through a stream of icy water furnished by the City Fire Department, and by so doing established the supremacy of the Freshmen in the Class Scrap of 1929.

W. Gerald Warrington, last year's able business manager of the MINNESOTA TECHNO-LOG, was in charge of general arrangements. Professor Otto B. Zelner acted as referee and faculty adviser.

R. E. Kirk Goes to Montana College

Dr. Raymond E. Kirk, formerly associate professor of inorganic chemistry, resigned his post at the University last spring to accept a position as head of the department of chemistry at Montana State College at Bozeman, Montana.

He was graduated from the University of Nebraska in 1915, received his master's degree at Iowa State college in 1917, and his doctor's degree at Cornell University in 1927. He has also taken advanced work at the University of Chicago and the University of Minnesota.

Doctor Kirk commenced his teaching at Kearney, Nebraska, in 1911, acting as laboratory assistant. In 1914 he was appointed to the faculty of the University of Nebraska, and in the following year went to Iowa State where he remained until 1920. In that year he came to Minnesota as assistant professor of inorganic chemistry.

Aero Society Holds Meeting

The Minnesota Society of Aeronautical Engineers held their first dinner meeting of the fall quarter on Friday, November 1, in the Minnesota Union.

The principal speakers of the evening were, Dean O. M. Leland, Charles E. Boehnlein and J. A. Wise. Dean Leland, in tracing the development of the course in Aeronautical engineering at the university, told of the research that was undertaken by interested members of the faculty into the different courses that were offered throughout the country. The course at Minnesota was developed with the weaknesses of the other courses in mind, and is, according to experts, one of the most complete courses of its type in the country.

The Minnesota society was organized last year to give the students of aeronautical subjects a common meeting ground.

Arabs Discuss Plans for Year

The Arabs, men's dramatic club of the technical schools, held their first meeting of the year in the Minnesota Union on Tuesday evening, October 29. The meeting was devoted chiefly to the discussion of the plans for the year. It was decided that meetings should be held on the evenings of the first and third Tuesday of every month. An appeal was made to bring all the members to these meetings, and that all members start working on plots for this year's production.

Plans are under way for the club sponsoring a men's chorus in which all men in the technical schools will be eligible, and those taking part will be candidates for membership in the club. It is imperative that all men interested in the chorus turn out for it as there is no doubt but that it will prove to be popular on the campus in short time. In order that all those interested in this undertaking will have a chance to signify their willingness to try out for it a coupon will be found in this issue which if filled out and turned in will be answered by a notice to attend tryouts which will be held by Professor Otto Zelner.

At the next meeting of the club there will be an initiation of the men who were elected to membership last spring.

New Appointments Made to Faculty

Charles A. Koepke has been appointed Associate Professor of Mechanical Engineering and Director of Shop Laboratories. He is a graduate of Purdue University and was associated with the Studebaker Corporation in production engineering work before entering the teaching profession.

Before coming to Minnesota, Mr. Koepke held a position in the mechanical engineering department of the University of Wyoming.

Two new assistantships have been given to graduate students in the school of chemistry this year. They are Miss Nyline Eckles, who graduated from Carleton last June, and Samuel Yuster, who was graduated from the North Dakota State College in 1926.

Mr. Yuster has had considerable experience before coming to Minnesota. He taught high school mathematics and physics in Oberon, North Dakota, for a year and for the past two years has been associated with the San Francisco laboratories of the Bureau of Standards.

(Additional News on page 54)

A.S.M.E. Meets

In an atmosphere redolent with cider, cigarettes and good fellowship, the American Society of Mechanical Engineers and the Minnesota Society of Aeronautical Engineers held their first get-together on October 24. This is the first joint meeting of the societies since the formation of the aeronautical engineering organization last year.

The principal speakers of the evening were professors Du Priest and Martenis of the mechanical engineering department. Professor Du Priest outlined the relation that exists between student engineers and the national societies, while Professor Martenis told of the activities of the student branch at Minnesota for the benefit of the new members of the A. S. M. E.

Lloyd Kernkamp, president of the aeronautical engineering group spoke of the progress that the A. S. M. E. had made during the past year, and predicted a bright future for that organization when a national society is formed.

The next A. S. M. E. event will be the annual dinner. A prominent mechanical engineer of the twin cities will be asked to address the meeting, and a full program of entertainment is being planned. Because of the large enrollment in the second year of the mechanical course, the membership of the A. S. M. E. has increased greatly over that of last year.

Faculty Men to Return Soon

Hans H. Dalaker, professor in the department of mathematics and mechanics, has been seriously ill since November 1, and has been confined to his bed at the Swedish Hospital in Minneapolis. Although he has been pronounced out of danger he will not return to the University for quite some time.

William M. McClintock, assistant professor of mathematics and mechanics, who was absent from school since November 9, is well on the way to recovery, according to reports from the Miller Hospital, St. Paul, where he was confined during an attack of pneumonia. He is expected back in the near future.

Pi Tau Sigma to Convene in Ohio

The annual convention of Pi Tau Sigma, national honorary mechanical engineering fraternity, will be held at Cincinnati, Ohio, on November 22 and 23. Ray Sheppard, M. E. '30, president of the Gamma chapter, will represent the University at the convention. Professor John V. Martenis, supreme secretary-treasurer of the fraternity, also plans to attend the meeting.

A.I.E.E. Arranges Program for Year

The student branch of the American Institute of Electrical Engineers met in the Minnesota Union on the evening of October 23rd. Professor Kuhlman gave a report of the convention at Chicago. He emphasized greatly the help afforded by the society to graduate electrical engineers in giving them a chance to go to the meetings and get acquainted with the more prominent men in that field of engineering and also in hearing papers and speeches on recent developments in which they are interested. A film on "The Mysteries of Radio," furnished by the General Electric Company, and one on "The Rubber Industry in South America," furnished by the Goodyear company were shown, followed by a film comedy. Music and entertainment were given by Art Johnston and Dale Hill from the St. Anthony School of Music.

The A. I. E. E. student branch here has a very extensive program for this school year. Ransford Fenton, the chairman of the organization, announces that meetings are to be held monthly. Varied programs of movies from the Westinghouse and General Electric companies and speeches and reports by prominent engineers of the twin cities on local problems will be augmented by trips to the Northern States Power, Minneapolis Steel and Machinery, and American Telephone and Telegraph companies. Picnics and the annual banquet will be held in the spring quarter. The officers of the year are: Ransford Fenton, chairman; Charles Hendrickson, vice chairman; Wesley Taylor, secretary-treasurer; and J. Kuhlman, faculty advisor.

There will be a national convention of the student branches of the A. I. E. E. at Chicago in the early part of December. At this meeting papers on the later developments in the electrical lines and improvements in old apparatus will be read. Reports on the activities of the student branches will be given by the delegates. The Minnesota student branch will be represented by Rudy Hanson and the national group from Minnesota are sending Fenton.

Chemists Go On Sabbatical Leave

On a year's sabbatical leave, Dr. Nelson W. Taylor, assistant professor of physical chemistry, is now working on reactions of geological interest at the Kaiser Wilhelm Institute for Silikat Forschung at Dahlem, Germany. Dr. Taylor's studies deal with reactions which have taken place in the earth's interior during the formation of its crust. These reactions, which are connected with the Zonal theory of ore deposition are of special interest in mining and mineralogy fields.

Dr. George H. Montillon, associate professor of chemical engineering, and also on a year's sabbatical leave, is working on a chemical engineering fellowship at the University of Michigan.

Mann Addresses Architects

The Architectural Society held an open meeting during convocation hour on November 7 for the purpose of acquainting the new members of the department with the activities of the society. Professor F. M. Mann gave a short informal talk, in which he outlined the scope of organization's activities.

This year, the Society plans to sponsor a series of talks and discussions by prominent architects of the Twin Cities. They will also give the annual Smock Party and in the spring quarter the Architects' Jubilee will be held.

Local A.I.Ch.E. Begins 3rd Year

A large attendance marked the first smoker of the year of the student section of the American Institute of Chemical Engineers. The meeting was for the purpose of acquainting the chemical engineering students with each other and with the principles of the section.

An unusual method of getting the students acquainted was a number contest. Each student was issued a tag on which was printed a number. The object was for any ten students to get together so that their respective numbers totaled together would closest approach 126. The number that won was 104, the prize being a box of chocolates. As the chocolates numbered nineteen and the students entitled to the prize were ten, mathematicians had to be called to help divide the sweets. A prize was also given to the lowest combination.

Professor C. A. Mann, head of the department of chemical engineering, gave a short talk on the requirements and aims of chemical engineering as a profession. He emphasized the fact that a man, no matter how brilliant, could not be a success by himself. A man, in order to be successful, must have friends and personal contacts specializing in various subjects to whom he can turn when he is "stumped." According to this purpose, claimed Dr. Mann, the student section of the A. I. Ch. E. is entering its third year at Minnesota.

The large percentage of chemical engineering freshmen who attended helped to disperse the mammoth keg of cider and the boxes of doughnuts that were offered as refreshments.

(Continued on page 70)

Photographs Transmitted on Beam of Light

PHOTOGRAPHS and messages transmitted on a beam of light is the latest development of Dr. Vladimir Zworykin, prominent research scientist. The beam of light forms the only connection between a facsimile transmitter and receiver, which by electrolytic process reproduces images.

The extent to which Dr. Zworykin has developed his device reveals a new step in facsimile transmission. In the devices previously demonstrated, photographic development was necessary after the transmission had been completed. With the new receiver the transmitted image will be produced without further developing so that an onlooker may see the image being formed at the receiving end.

Not the least interesting thing about the facsimile transmission is the fact that the waves which form the image on the receiving end are carried from the transmitter on a beam of light. This beam of light acts in the same way as the invisible waves of a radio station.

To the casual onlooker, the facsimile transmission is extremely interesting. First the picture to be transmitted is placed on a cylinder on the sending device. As the transmission starts a beam of soft light gleams from an ordinary appearing lamp and is trained on a reflector which may be placed at a considerable distance away. As the cylinder on the transmitter revolves, another on the receiver revolves at exactly the same speed. And passing across the cylinder is a long roll of paper upon which is being reproduced the original photograph or message.

These reproductions are five inches by six and one-half inches in size and they can be printed at the rate of one every four and one-half minutes. They may be reproduced continuously, one after another on the long roll of paper.

The transmitting equipment is the same as used in previous types. The only

PHOTOGRAPHS BEING REPRODUCED BY MEANS OF A BEAM OF LIGHT

change in the equipment is in the receiving end. In the sending set, an ordinary photograph or typewritten letter is placed on the cylinder which rotates slowly and at the same time progresses longitudinally. A beam of light is sharply focussed on the surface of the picture and in this way every point of the picture is explored by this beam of light. The reflected light is gathered by a parabolic reflector which conveys the reflection to the photo-electric tube, or "electric eye" which issues an electrical impulse corresponding to the density of the image on the photograph.

The impulses from the photo-electric tube are simplified, then passed through the gas-glow tube which produces the carrier beam of light. This beam is trained on another photo-electric tube in a parabolic reflector located across the room. The photo-electric tube transforms the variations of intensity of the beam into electric impulses which, in turn, are transmitted to the receiving equipment.

Instead of changing the electrical impulses into light again, as in previously demonstrated equipment, the new device reproduces the picture by sending the actual current through a specially compounded paper. The action of the electricity on the chemicals in the paper, through electrolysis, changes the color of the paper and recreates the original image.

To accomplish this, the special paper from the roll is passed first through a water bath in order to make it more conductive, thence over a cylinder which is rotating in synchronism with the transmitting cylinder.

On the surface of the cylinder there is a knife edge curved in spiral from one side to the other. On top of the paper there is a straight knife edge which with the spiral edge forms the two electrical contacts of the receiver. As the cylinder with the spiral rotates it produces the sliding contact along the straight edge. This contact makes one line with each revolution.

P. B. Nelson (left) and A. S. Bull

With a Minnesota Engineer in Europe

By Paul B. Nelson, E. '26
Managing Editor, The Techno-Log, 1925-26
Eastern Vice-Chairman, E. C. M. A.

Back in '25-'26, Paul B. Nelson, E. '26, edited The Minnesota Techno-Log while A. S. Bull, Arch. E. '27, managed the business end of the magazine.

Came graduation—the first job—changing about. . . .

One day last summer they met again . . . . in Paris. And for old times they sought the nearest cafe. The photo tells the rest.

Nelson was doing publicity work in France at the time. Bull is export sales engineer for the Insulite Co.

IT was my third day in Rome. The time so far had been spent in continuous sightseeing and I confess that ruins, marble busts, and paintings of the old masters were getting tiresome. This morning we were "doing" the Vatican galleries.

"Somebody ought to see this gallery who would appreciate it," I remarked inwardly. No sooner thought than around the corner of a Roman god walked Lawrence B. Anderson, Arch. '27, winner of about all the architectural prizes in his day, and my art editor on Techno-Log back in 1926.

Needless to say, this unexpected meeting changed the entire aspect of Rome for me. The remaining art galleries were interesting in his company and the balance of my sojourn in the Eternal City was most enjoyable, both day and night.

A traveler always meets alumni in the most unusual places. A few days after leaving Rome, the launch in which I was riding back from the Lido nearly bumped into (Andy's) gondola. One morning in Notre Dame cathedral in Paris I met Olaf Fjelde (Arch. '25). I often visited him in the student quarter where he lived that summer.

* * * *

After spending the past two summers traveling through the important countries of the Old World, I have arrived at some definite conclusions: European railroad and air systems are efficient; their long distance telephones and telegraphs really work; Germany is fast becoming its old industrial self; there is much intense feeling between many of the countries in Central Europe for the War is not forgotten; drunkenness is quite rare among *natives;* and all that's whispered about Paris and other continental cities is true.

Yes, their rail systems are mighty good. Take the Flying Scotsman, for instance. On this English "Twentieth Century Limited," one can travel from London to Edinburgh, in about eight hours—an average of over 50 m. p. h.!

Over there, you travel first if you are wealthy; second if middle class; third if an engineer, or even fourth, if they have it on the train. Third class in the British Isles is very good; most Americans ride second on the Continent.

The diners serve real food. This dinner on the *Mitropa,* German system, costs about 75 cents: appetizer; a very good soup; roast veal; browned potatoes; peas; brussels sprouts; cheese; coffee; and dessert. Many of the new dining cars offer the ultimate in beauty; and the service is unexcelled. And they have racks on each table to hold any bottles (?) if the train should lurch.

It cost me about $20 to fly from Cologne to Paris last August—a 12-hour train ride, but only three hours by air. Whenever I go from Chicago to Minneapolis by train, exactly twelve hours, I spend $18.41. Now figure that one out.

One often hears about the intricacies of foreign telephone exchanges. A new manual system was just installed in Paris, the inaguration being celebrated by a champagne party for the force.

My experience with long distance calls from Vienna and Berlin back to Paris leads me to believe that rates are lower and service as good as anywhere.

I speak very little French or German, still I was able to go into a post-office (the telegraphs are government owned and operated) and call *Opera 01-80* and get a connection over some hundreds of miles of wire in three minutes.

Telegrams get to you with dispatch. One delivered to me outside St. Marks in Venice had reached my friend's office only a few moments before and had been dispatched by boy in a gondola down the Grand Canal. I got it just after "finishing" the Doges Palace.

The messages may be sprawled in handwriting, typewritten, or pasted on strips, but they get there, just the same.

With typical resourcefulness, much of the former battlefields have been reclaimed. The French have carefully cleaned large sections near Belleau Wood and Chateau Thierry of all metal and "duds."

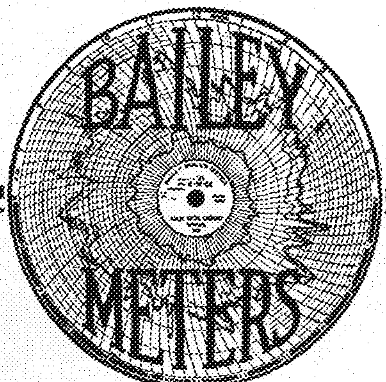
Some of the spots where fiercest fighting took place are now covered with dense undergrowth. But the blackened trunks of trees, protruding through this green foliage are a gaunt reminder of the days of '17.

One cannot ride through the great Ruhr valley in Germany at night and notice the sky, reddened by many blast furnaces, but realize that the Fatherland is fast assuming its place in the industrial world. Germany will pay off its debts; its factories and mills,—constructed and with mechanical skill unexcelled, will be a big factor in this come-back.

Throughout many parts of Germany and France, I have noticed construction of high tension lines. It is not unusual to see laborers setting the foundation for a transmission tower in a plowed field, which has never been cultivated except by oxen. Nearby, peasant women will be pounding clothes—the native method of doing the family washing.

Thus the old and new clash—a constant occurrence throughout an old land fast becoming modernized.

But the worst is yet to come. We were going down the Danube to Budapest on August 14, and, by the way, that damn stream is not blue!! A woman sitting near me on deck was reading the *Saturday Evening Post* for August 16!



Used by Leaders in Every Industry

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

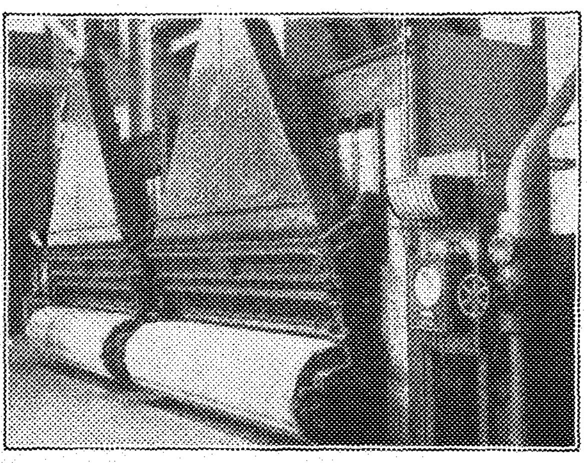
BAILEY PRODUCTS

Automatic Control	Liquid Level Gages
Boiler Meters	Manometers
Coal Meters	Multi-Pointer Gages
Draft Gages	Pressure Recorders
Fluid Meters	Tachometers
Gas Flow Meters	Temperature Recorders
Gravity Recorders	V-Notch Weir Meters

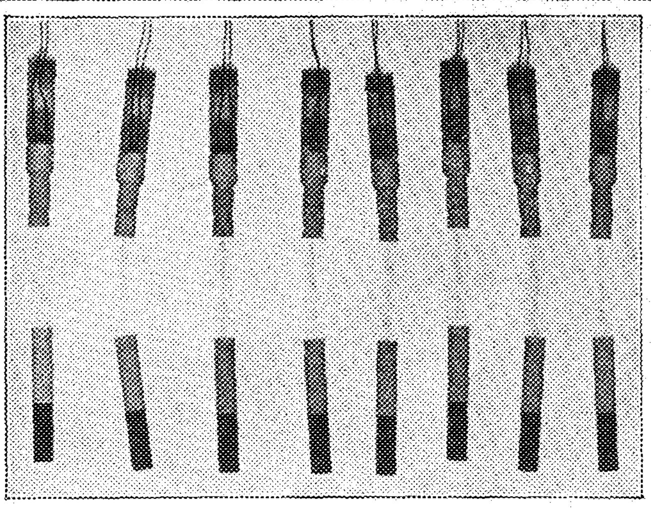
Write for Bulletin No. 81B

Bailey Meter Co.

Cleveland, Ohio



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



This illustrates the use of X-ray photography in testing for uniformity in Hercules delay electric blasting caps. The X-ray reveals, from top to bottom of each delay electric blasting cap, the lead wires, firing head, delay fuse (in which only the powder train shows), and the blasting cap.

WHY HERCULES DETONATORS ARE RELIABLE

EXHAUSTIVE attention was given to the basic design of Hercules Detonators. They are manufactured with painstaking care from materials selected and tested with equal vigilance. After all that is humanly possible has been done to control the manufacturing processes, the product is subjected to a series of elaborate and costly tests.

In making these tests, many branches of science are utilized. The X-ray looks through the copper shells to search out any flaw which previous to this scientific operation, could only be found by destroying the detonators. Microphotography is called upon to tell a significant story to the explosives chemist. All standard tests of recognized value as well as special tests devised in the Hercules laboratories are used to insure the reliability of Hercules detonators.

HERCULES POWDER COMPANY

(INCORPORATED)

Wilmington Delaware

HERCULES POWDER COMPANY, 941 King Street, Wilmington, Del.

Gentlemen: Please send me your book "Hercules Detonators."

Name...

Address...

2848

ABOUT THE WORLD WITH OUR ALUMNI

(Continued from page 49)

state of S. Paulo alone we serve about 135 cities and villages. In some places we have everything; light, power, street cars, telephone, busses and gas. The company is negotiating with several other properties and buying everything they can put their hands on.

"Due to my knowledge of Portuguese and English, I have been working in investigations and as assistant to directors and managers of some properties. Since my arrival down here, here is what I have done: After two months in Rio, I was sent, with a specialist from the States, to an investigation of a street car property in Bahia. I stayed there for six weeks and returned to Rio, where I remained, up to two months ago, as assistant to the manager of two properties in the state of Rio de Janeiro. While there, among other things, I made a study of the public illumination of Nictheroy (a city just across the bay from Rio) in order to improve it and to obtain a better contract for the company and the public. It was very interesting and I enjoyed it. Two months ago I was sent down here to study and develop the Power Sales Department. It happened, however, that just then the company decided to study the possibility of using Brazilian coal for a steam power plant and a coal by-product plant, and I was shifted to tackle this problem with a specialist from the States. I didn't want to take this job because I knew next to nothing about coal, but the specialist encouraged me by saying that he himself was an electrical engineer. I accepted then the job and have enjoyed it so far. After all, from the little I have seen, the engineering problems are nothing else but economic ones, and with a good guide, some studying and the foundations we had they are not so difficult.

"As far as opportunities with this company are concerned, there are good chances for young American engineers, if they get their salaries from the New York office. Living here is very high and, although my wife is very satisfied here, an American girl who cannot easily adapt herself to inconveniences will soon become discouraged and will be a hindrance to her husband."

"Fritz" can be reached at Cia. Brasileira de Forca Electrica, Caixa Postal 256, Porto Alegre-Rio Grande do Sul—Brazil.

'28—George Thwing, Jr., is acting as construction foreman running a concrete mixing plant on the Diablo Dam project 'way out west on the Skagit river near Seattle. According to George, the country abounds in bear, deer, cougar, marten, and other game. And some men think that work is hard!

Mechanicals

'09—Wilbur S. Williams has left Milwaukee and is located with the Williams Minnick Motor company at Sioux City, Iowa. He writes that he is glad to see any of the old gang that happen to come through his town, and has all the praise in the world for the University of Minnesota.

'29—Rolf M. Smith and Manford P. Hanson, active in University functions until they were graduated last June, are enrolled in the ranks of Frigidaire Corporation at Dayton, Ohio, as members of the junior executives' training class.

Smith and Hanson, both of whom hold B. S. degrees in mechanical engineering, are among 20 men representing 15 universities and colleges of the United States who are enrolled in the Frigidaire course.

Smith is a member of Alpha Sigma Pi fraternity and Hanson is a member of Pi Tau Sigma, the American Society of Mechanical Engineers, and the Society of Automotive Engineers.

The Minnesota graduates are now well along in an intensive 48-weeks' program consisting of practical experience in engineering, sales, service, production, materials, finance and inspection.

Smith's home is in Minneapolis and Hanson's home is in Chippewa Falls, Wisconsin.

'29—R. M. Johnson is now connected with the Bucyres-Erie company of South Milwaukee, Wisconsin. He is working in the design department, and from what we hear, likes his work very much.

'29—Realto Cherne is now with the Carrier Air Conditioning company and is living in Elizabeth, N. J. He writes that he has had the pleasure of drawing up the estimate for a proposed job in Moscow, Russia. The drawings were, of course, in Russian and all the dimensions in millimeters. Pat had the job of first "wrestling around changing the 'gunskies' and inchskies into English." Pat is now in the estimating department. In the class that just took up work at the company there was one man from the University of London, two from Stuttgart, Germany, one from Switzerland, and four from Cuba. From the looks of that line-up, Pat will be a full-fledged cosmopolitan in the near future.

STUDENT ACTIVITY INDEX

As the result of a constant demand for information by various student organizations, the TECHNO-LOG *publishes this brief questionnaire in the hope that it will become the means of acquainting students with technical campus activities and will aid the various organizations in ferreting out latent talent among the technical students.*

Please fill out this sheet as completely as possible and drop in one of the boxes for that purpose or bring it to the TECHNO-LOG *office in room 37 Electrical Engineering building.*

Name .... College .... Class ....

Address .... P. O. .... Telephone ....

What experience have you had in business, publicity, magazine, or newspaper work? ....

What experience have you had with stage design, posters, or other art work? ....

What dramatic or technical stage work have you had? ....

....

What musical instrument do you play? .... Do you sing? .... What voice? ....

Previous training? .... Chorus, Glee club, etc.? ....

Debate? .... Oratorical? ....

Other experience ....

....

HOMECOMING

(Continued from page 47)

and to the students and visitors to the campus on Homecoming day. The sale on the campus is handled in the time honored manner with sorority teams competing for trophies for the total and individual high in sales. So far this method has been successful.

Alumni returning for the game this year will have an additional reason for rejoicing. The new Memorial Auditorium is complete. This auditorium, pledged and paid for by the students at the time of the stadium drive, will be dedicated to the memory of Doctor Cyrus Northrop and presented to the University by the Greater University Corporation at 8:15 on Friday evening, November 15, just before the pep-fest starts. No more fitting time could be chosen for this ceremony than the night before Minnesota goes out to battle one of its most dangerous foes before the students that were responsible for this gift to the Minnesota campus.

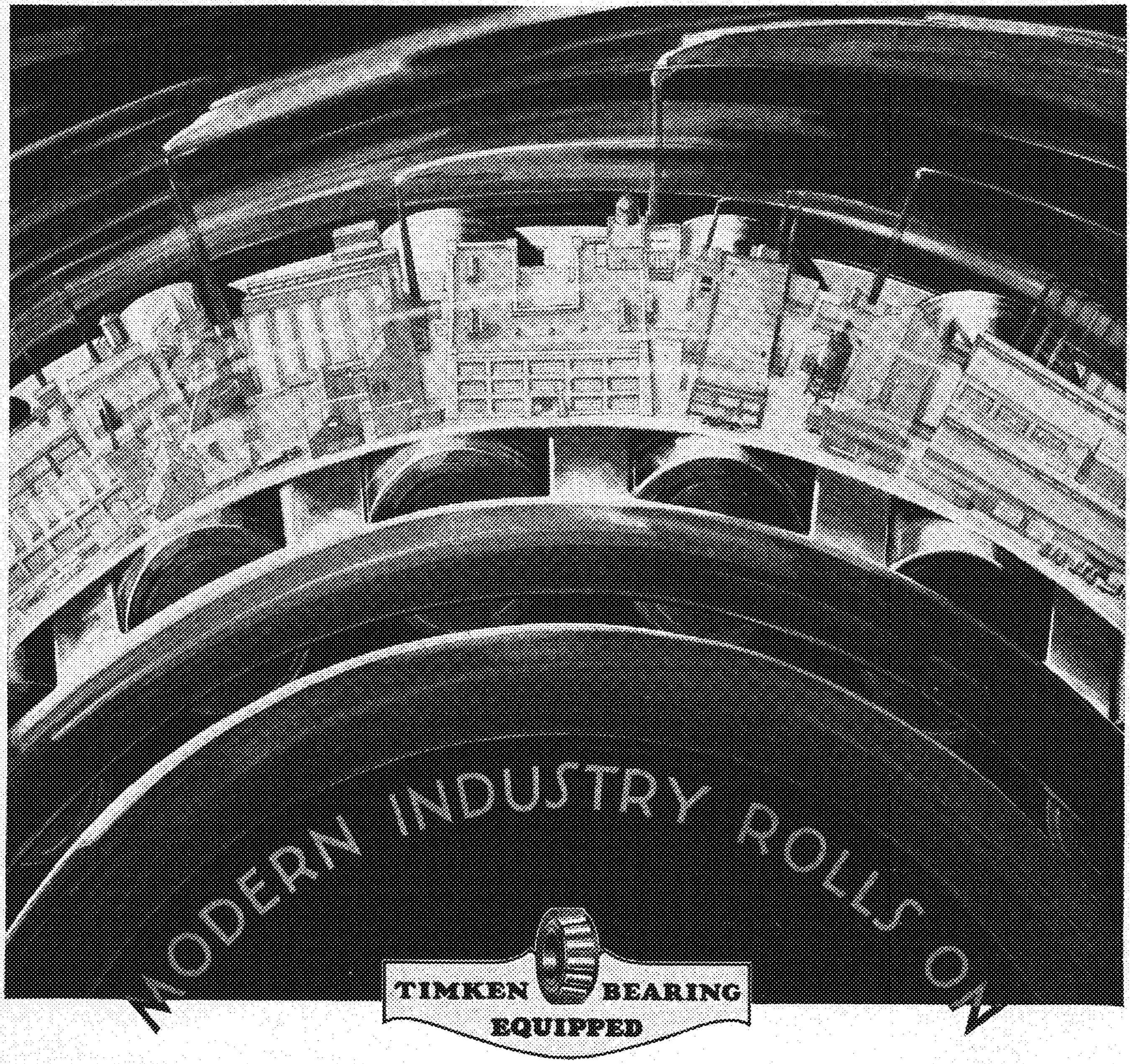
This article, written before the celebration, is necessarily incomplete. Each committee that tackles this project attempts to put on a better welcome than the committee that did the work the year before. The present group is no exception to the rule, and the plans that have been made are very complete.

AVIGATION

(Continued from page 46)

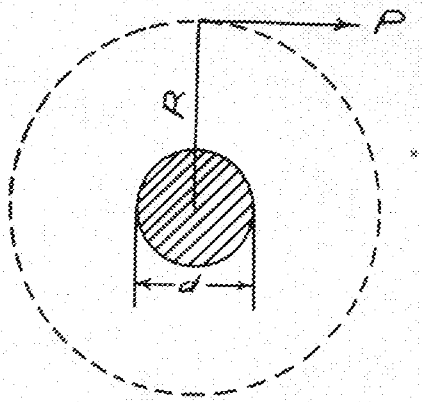
from the radio beacon stations, three of which have already been located at Hadley Field, New Brunswick, New Jersey, Cleveland, Ohio, and Bellefonte, Pa. About 200 miles seems to be the practicable distance between stations for certain transmission.

Communications between airports is mostly done by wire, because strange as it may seem, the Department of Commerce is not lavishly supplied with radio channels. Teletype and telegraph are used, the former being the least efficient on long lines. By cooperating with the telegraph companies speedy service has been maintained.


MODERN INDUSTRY ROLLS ON
TIMKEN BEARING
EQUIPPED

Re-statement of Mechanical Principles

(Continued from page 43)



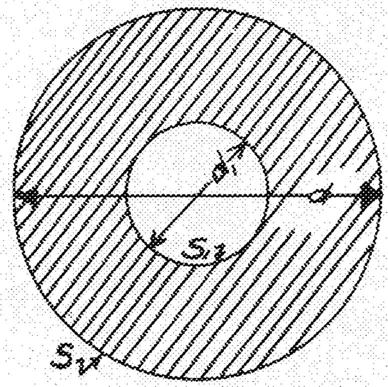
the general expression relating torsion, shear stress and diameter of a solid cylinder is,

$$T = \frac{Sd^3}{5}$$

HOLLOW CYLINDER

The widespread use of hollow members, such as shafts, spindles and axles is due to the inherent advantages of this form over the solid type. The effect of forging and cold rolling on the structure of steel is to induce overstressing of the metal at the center of the piece. Moreover a hollow member is stronger than a solid one for the same weight of material. The cross section of a hollow cylinder forms an annular ring.

In the sketch, let d = outside diameter; d_1 =



inside diameter of the annular ring.

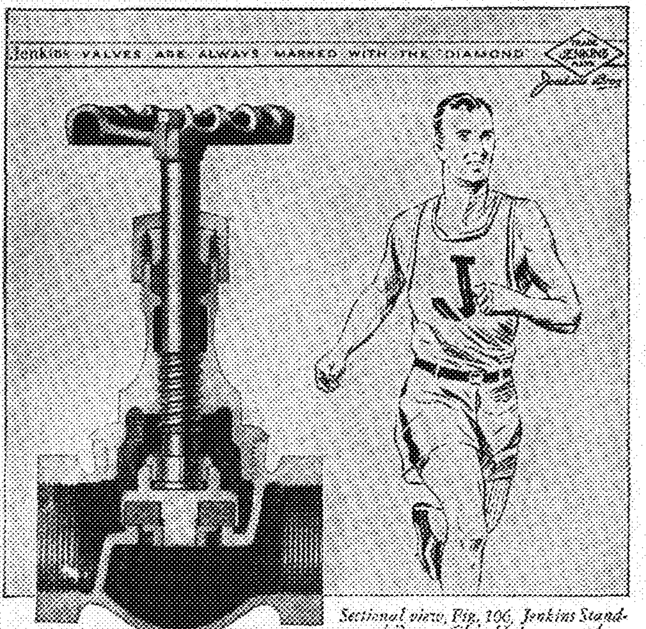
Solid cylinder,

$$S\,Z = \frac{Sd^3}{5}$$

Bore,

$$S_1\,Z_1 = \frac{S_1\,d_1{}^3}{5}$$

(Continued on page 68)



Sectional view, Fig. 106, Jenkins Standard Bronze Globe Valve, screwed.

Where body stamina counts

In the long grind, it's the athlete with the stamina who lasts.

So, too, with a Jenkins Valve. It's the body stamina that counts, that keeps the valve in the line, unaffected by the strains of pipe weight and settling, lifting, expansion, contraction or frequent operation.

Jenkins bronze valves are cast of virgin metal; Jenkins iron body valves of a high quality, close-grained mixture. Metals are analyses-controlled by Jenkins metallurgists. Skillful design is provided to make possible an even distribution of metal throughout the valve body.

Jenkins Valves are made in bronze and iron, in standard, medium and extra heavy pattern—a valve for practically every valve need.

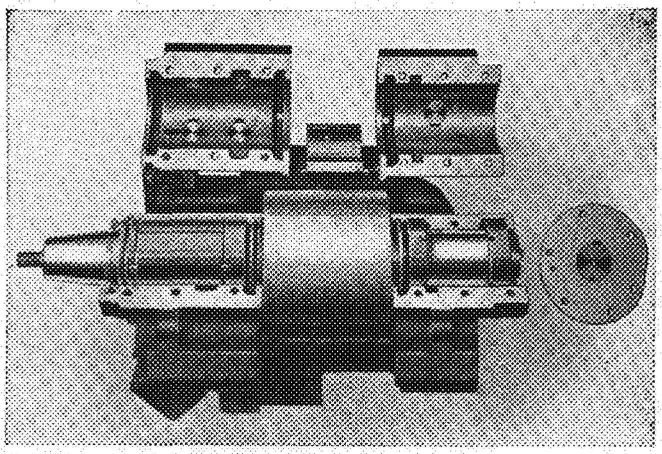
Send for a booklet descriptive of Jenkins Valves for any type of building in which you may be interested.

JENKINS BROS.

80 White Street . . . . New York, N. Y.
524 Atlantic Avenue . . . . . . Boston, Mass.
133 No. Seventh Street . . . . . Philadelphia, Pa.
646 Washington Boulevard . . . . . Chicago, Ill.

JENKINS BROS., Limited
Montreal, Canada London, England

Jenkins
VALVES
Since 1864



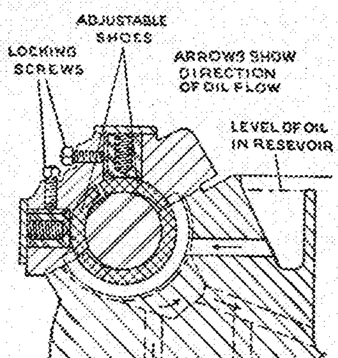
UNIQUE SPINDLE CONSTRUCTION

—an important feature of the "30 series" Brown & Sharpe Plain Grinding Machines

ADJUSTMENT of the wheel spindle boxes in these machines is made while the machine is running and is extremely simple—the success of the adjustment in no way depending upon the skill of the operator.

A turn of the locking screws releases the plungers which are actuated by springs of the correct tension. These plungers automatically apply sufficient pressure to bring the adjustable shoes to their proper positions. Tightening the locking screws positively clamps the plungers, holding the shoes in their new positions. The springs can apply only the correct pressure upon the shoe, preventing a break in the oil film by too closely adjusted boxes and consequent injury to the spindle.

This feature is only one of the many reasons for the success of these machines wherever they are installed. An interesting booklet describing them will be sent at your request.



BROWN & SHARPE
BROWN & SHARPE MFG. CO. PROVIDENCE, R. I., U. S. A.

(Continued from page 66)

Annular ring,

$$T = S Z - S_1 Z_1 = \frac{S d^3}{5} - \frac{S_1 d_1^{\ 3}}{5} =$$

$$\frac{S (d^4 - d_1^{\ 4})}{5 d}, \ since\ S_1 = \frac{S d_1}{d};$$

or

$$T = \frac{S d^3}{5} \frac{(d^4 - d_1^{\ 4})}{(d^4)} =$$

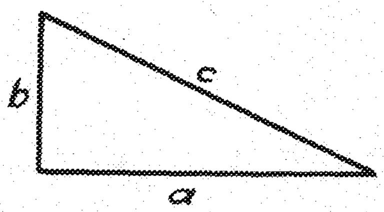
$$\frac{S d^3}{5} \left[1 - \left(\frac{d_1^{\ 4}}{d} \right) \right]$$

COMBINED STRESSES

Rotating members of transmission machinery are frequently subject to a bending action together with torsion and in such cases the combined effect of the two forms of loading must be considered.

Bending takes place in the axial plane of the member and twisting in a plane perpendicular to the axis, therefore it will greatly simplify the solution of a problem if these forces can be directly set off on the perpendicular sides of a right triangle and the combined effect shown by the hypotenuse of the triangle.

There is a marked difference between the tensile and shear stresses of steel, therefore a relation must be established between the bending and twisting moments before they can directly be combined.



Referring to the sketch, the known relations between the sides of a right triangle can be expressed by,

$$C = \sqrt{a^2 + b^2}$$

Let M = combined moments; B = bending moment; T = twisting moment; then

$$M = \sqrt{B^2 + (KT)^2}$$

K being a constant to be determined.

For bending moment only,

$$B = SZ = \frac{S\ d^3}{10}$$

and for twisting moment only

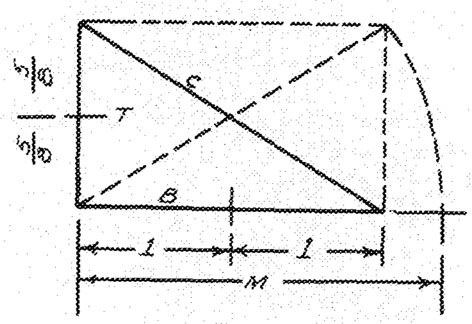
$$T = S_1 Z_1 = \frac{S_1\ d^3}{5}$$

Equating the bending and twisting moments,

$S Z = K S_1 Z_1$; *and since* $Z_1 = 2Z$, *assuming* $S_1 = 0.88$ *for medium steel, then* $SZ = K0.882Z$, *or* $K = \frac{5}{8}$

This value of K will apply to the qualities of steel commonly used for shafts but in any case a suitable value for K can be found.

To apply this method for the solution of a problem, lay off the bending moments on the X axis to a given scale and the twisting moments on the Y axis to ⅝ of the given scale.



Since the combined moment is found in terms of a bending moment, it can be referred to the bending moment scale on the horizontal or "X" axis and read off directly. This method of solving problems involving combined moments will later be used for the determination of shaft diameters.

NEWS FROM THE TECHNICAL CAMPUS

(Continued from page 54)

Light Institute Opens in New York

Manufacturers of electrical equipment have recently completed a Lighting Institute on the seventh floor of the Grand Central Palace in New York City. In this institute the public will find a full-sized street 180 feet long and 20 feet wide, and a cross street 85 feet in length. Both of these model streets have all the characteristics of any modern city thoroughfare. There can be found everything to meet the business and social requirements of the average small town,—a department store, bank, office and industrial buildings, combination service and gas filling stations, a school, modern home, art gallery and theatre large enough to seat about 300 persons. The street's unique lighting system will be used to demonstrate proper highway lighting as this particular street can be lighted with 20 different degrees of intensity. Various types of traffic signals will also be demonstrated.

The permanent exhibition occupies 40,000 square feet, or an entire city block. It is to this experimental laboratory that the scientists, engineers, architects, designers, and others interested in electrical art will come for the solution of their problems. It will also be a meeting place for students of technical schools and colleges, lighting engineers and public utility men interested in the production of better lighted cities, homes and business establishments.

E.C.M.A. Editors Meet at Purdue

Sixty-five delegates representing 23 college engineering publications, met Oct. 31 to Nov. 2 at Purdue University at the ninth annual convention of Engineering College Magazines Associated. Both editors and business managers attended.

Several representatives of national engineering publications were present at the meetings. The majority of the speakers expressed the thought that engineering graduates were preferable to journalism graduates for positions on engineering publications because the engineering student knows the field and can easily be taught to write while the journalism student must be taught the technical side of the work.

The convention will be held next year at Boulder, Colo., when the Colorado Engineer will be the host.

Scarab to Hold Convention Here

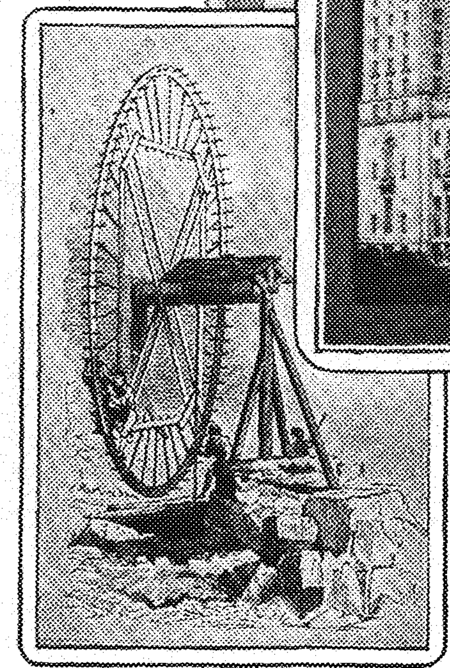
In conjunction with the national convention of Scarab to be held at Minnesota on November 27, 28, and 29, there will be an exhibit of the sketches which comprise the Scarab Traveling Sketch Exhibit. This annual exhibit was instituted for the purpose of benefitting the members of Scarab and their fellow students. It offers competition and an opportunity for comparison of the work of various schools throughout the country. In addition to the national prizes, Minnesota offers several cash prizes for the three best sketches in any medium submitted for the national exhibit by any member of the architectural department of the University.

The Scarab Traveling Exhibit will be displayed on the third and fourth floors of the Main Engineering Building from November 20 to December 2.

Khons Temple of Scarabs of Minnesota will be host to the national convention of Scarab, professional architectural fraternity, on November 25, 26, and 27. This convention will bring to Minnesota representative architectural students from the leading universities in the United States.

THE ROYAL YORK HOTEL, TORONTO, CANADA

Ross & MacDonald, Architects *Sproat & Rolph, Associate Architects*



Reproduction of an old wood-cut showing one of the early phases of Vertical Transportation

The Minnesota Techno-Log

MONTHLY PUBLICATION OF THE TECHNICAL STUDENTS

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED

Vol. X DECEMBER, 1929 No. 3

THE MINNESOTA

TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

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

VOLUME X | MINNEAPOLIS, MINN., DECEMBER, 1929 | NUMBER 3

CONTENTS

PAGE

COVER INSERT—*The Cyrus Northrop Auditorium*

FRONTISPIECE—A RANGER CABIN AT JACKSON LAKE

THE DRYING OF LIGNITE - - - - - - - - - - - - - - 77

THE WAVELENGTH OF AN ELECTRON - - - - - - - - - - 78
J. W. Buchta

LOAD CAPACITY AND LUBRICATION OF BALL BEARINGS - - - - - - - 80
J. R. Van Dyke

TORSIONAL VIBRATIONS IN CRANKSHAFTS - - - - - - - - 82
Ralph J. Hooker

EDITORIALS - - - - - - - - - - - - - - - - 84

NEWS OF THE TECHNICAL CAMPUS - - - - - - - - - - - 86

AROUND THE WORLD WITH OUR ALUMNI - - - - - - - - - 90

STUDENT ACTIVITY INDEX - - - - - - - - - - - - - 98

Entered as second-class matter April 9, 1925, at the post office at Minneapolis, Minnesota, under the Act of March 3, 1879. Office, 37 Electrical Building, University of Minnesota. Telephone, Dinsmore 2760. Contents copyrighted and permission must be secured for re-publication. Subscription rate, $1.50 a year. Single copies, 25 cents. Advertising rates upon application. Alumni Directory, 50 cents.

A Ranger Cabin

Jackson Lake, Wyoming

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume X — DECEMBER 1929 — Number 3

THE DRYING OF LIGNITE

THE drying of lignite is the research problem of Irvin Lavine, Ch. E. '24, who is at present acting associate professor of chemical engineering in the absence of Mr. G. H. Montillon who is on sabbatical leave at the university of Michigan. The importance of this problem is self evident when one realizes that the State of North Dakota alone possesses 600 billion tons of lignite. Any added information tending to improve this fuel is a contribution to the economic welfare of the northwest.

The lignite fields in North Dakota are located entirely in the western part of the state. A United States Geological Survey report estimates that there are 28,000 square miles of workable lignite beds.

Tables No. 1 and 2 show the average proximate and ultimate compositions of Dakota lignite and other coals:

TABLE 1.

Proximate Analysis of Fuels

	Lignite	Bituminous	Anthracite
Fixed carbon	30%	50%	80%
Volatile matter	27%	35%	1.5%
Moisture	36%	5%	3.5%
Ash	7%	10%	15%
B. T. U. per lb.	6,000 to 7,000	14,000	13,000 to 44,000

TABLE 2.

Ultimate Analysis of Fuels (moisture and ash free)

	Peat	Lignite	Bi-tuminous	An-thracite
Carbon	55%	68%	85%	94%
Hydrogen	6%	5.5%	5%	2.5%
Oxygen	36.5%	24.5%	7%	1.5%
Nitrogen	1.5%	1%	1.4%	1%
Sulphur	1%	1%	1.6%	1%

A study of the two tables indicates that lignite is characterized by (1) a high moisture content and consequently low heat value as mined and (2) by high oxygen content in proportion to carbon.

Besides its high moisture content, lignite also possesses the property of disintegrating or slacking when exposed to the atmosphere. This is due to the very rapid loss of moisture of the outer surface of the lump without a corresponding loss of moisture from the interior. In consequence of these properties of lignite the profitable shipping radius of lignite is limited and transportation must take place in closed box cars.

A study as to the drying characteristics of lignite with a view to working out a method of improving its heat value at a profit, is, therefore, of great importance. The working out of a satisfactory commercial drying process involves a complete study as to the nature of the water in the lignite.

At the meeting of the American Chemical Society held in Minneapolis in September, 1929, Mr. Lavine and Mr. Gauger reported their findings on the vapor pressure of the moisture in lignite. They concluded that the water is held in fine capillaries.

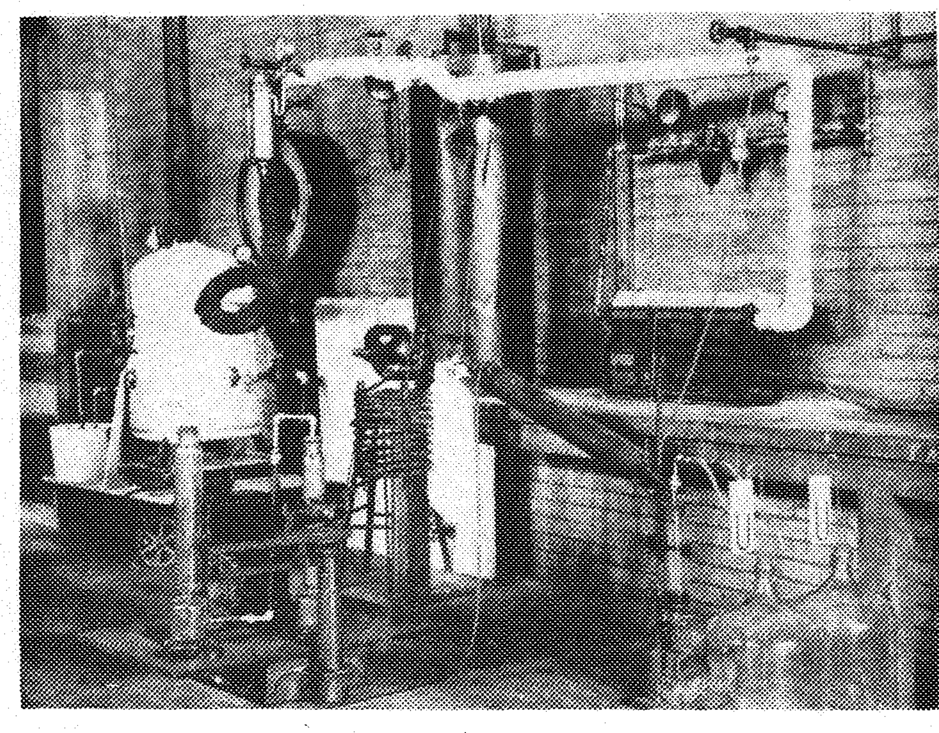
The problem being conducted at the School of Chemistry has to do with the drying of lignite to prevent slacking and simultaneously increasing the heat value of the fuel by decreasing its water content.

In the process, the lignite is charged in an auto clave and is then subjected to an initial steaming period during which saturated steam is admitted to the auto clave until a pressure of about 150 pounds or more per square inch is reached. After remaining in steam at the maximum pressure for a short time, the pressure is gradually diminished and finally dry air is blown through the auto clave.

In this treatment, the lump of lignite is heated through and through without any evaporation of water, since the steam is saturated. When the air is blown through, evaporation takes place throughout the lump and slacking should therefore be minimized.

The process works successfully with Austrian Brown Coal. It is Mr. Lavine's purpose to determine whether this method is practical for North Dakota lignite.

In conjunction with the main problem as undertaken by Mr. Lavine, there are three others working on the lignite problem. Robert Adams, Wentworth Eaton, and Maurice Lavine, graduate students in Chemical Engineering are assisting Mr. Lavine in the lignite work. Mr. Eaton is to determine the critical oxidation temperature and the tendency toward spontaneous combustion of the dried lignite; while Mr. Adams is to work on the low temperature carbonization of the dried lignite, and Mr. M. Lavine is continuing the vapor pressure studies of the water in the lignite. The results of these experiments will be reported next year.



ASSEMBLY OF APPARATUS USED BY DR. LAVINE IN THE RESEARCH PROBLEM

THE WAVE LENGTH OF AN ELECTRON

By J. W. Buchta
Associate Professor of Physics

A FEW years ago such a title as the above would have been considered suitable for an article in the *Ski-U-Mah,* but certainly not for one in the Techno-Log unless the writer would attempt to be humorous. However, today some of the most important contributions to physical science have this or a similar title. The only properties of an electron which were subject to direct measurement previous to 1927 were its charge (e) and the ratio (e/m) of charge to mass. Sometimes a size and form were assigned to the electron but these rested upon assumptions and hypotheses that are very likely not true. Now we may add the wave length of an electron as a property that is subject to measurement.

In 1924 a French physicist, de Broglie, put forward the hypothesis that electrons might have wave properties. The idea was developed and extended in the next few years by other European scientists until they formulated a new mechanics, a new method of interpreting and explained a number of electronic, atomic and radiation phenomena that were not satisfactorily accounted for by older theories. The new mechanics has been called Wave-Mechanics. One of the first experiments to confirm the predictions of the new theory concerning the wave nature of electrons, was made by Davisson and Germer of the Bell Telephone Laboratories. It is mainly with the work of these two men that we shall concern ourselves. The material of this article is practically entirely taken from papers published by them.

Before the advent of the new theory, Davisson and Germer had been making measurements on the scattering of electrons from metal surfaces. Electrons from a hot filament, similar to the filament in a radio tube, were accelerated in an electric field and allowed to bombard a metal target. The arrangement of the source of electrons, or "electron gun," target and electron collector is shown in Fig. 1, except that in some experiments the electron beam was normal to the surface of the target as shown in Fig. 2. The electron collector was connected to a galvanometer to measure the current. This collector could be rotated in a given plane so that any angle from 90° or greater to nearly zero could be obtained between its axis and the beam of electrons. In the set-up with normally incident electrons, the target could also be rotated about the direction of the electron beam as an axis as is indicated in Fig. 2. By this arrangement the number of electrons coming from the target in any direction could be determined.

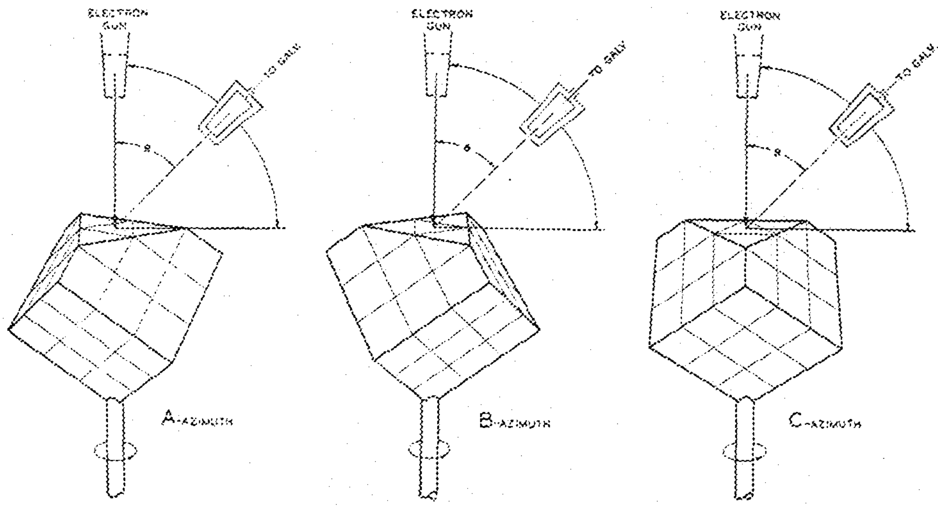


FIG. 2. APPARATUS WITH CRYSTAL TARGET.

The original purpose of the experimenters was to determine some of the characteristics of the electric force fields about atoms of the target by determining the directional changes of the paths of the electrons. Ordinary metal surfaces containing many small crystals were used. The electron collector was built up of two parts, the inner chamber being kept at a negative potential with respect to the outer shell and metal target so that only those electrons which had lost no energy in striking the target could enter. The electric field set up at the opening of the collector stopped all the slower electrons. With this arrangement such curves as shown in the middle diagram of Fig. 1 were obtained. The curve is plotted with polar coordinates, the length of the radius being proportional to the current at any given angle. These curves show no striking characteristics except that a large number of the full velocity electrons are reflected nearly directly back from the target when the beam of electrons strikes the target approximately normally. The curve drawn shows also a small "bump" at an angle near 90° from the beam of primary electrons for the conditions under which this particular curve was taken.

It happened that during the course of the experiments a target with relatively few crystals in its surface was used. Such targets, it was found, gave an entirely different curve. The right hand curve of Fig. 1 was taken with such a target. Under these circumstances there are certain directions relative to the surface of the crystal and direction of the incident electrons in which the number of scattered electrons is large compared to neighboring directions. By using a *single* large crystal as target, curves such as those shown in upper part of Fig. 3 were obtained. After a thorough cleaning of the target, curves of Fig. 4 were obtained. For these curves, the target was fixed and the angle between the collector and incident beam changed by moving the collector. Each curve is for a different velocity of incident electrons. For incident electrons that have been accelerated through a field with a 54 volt drop of potential, there is a very pro-

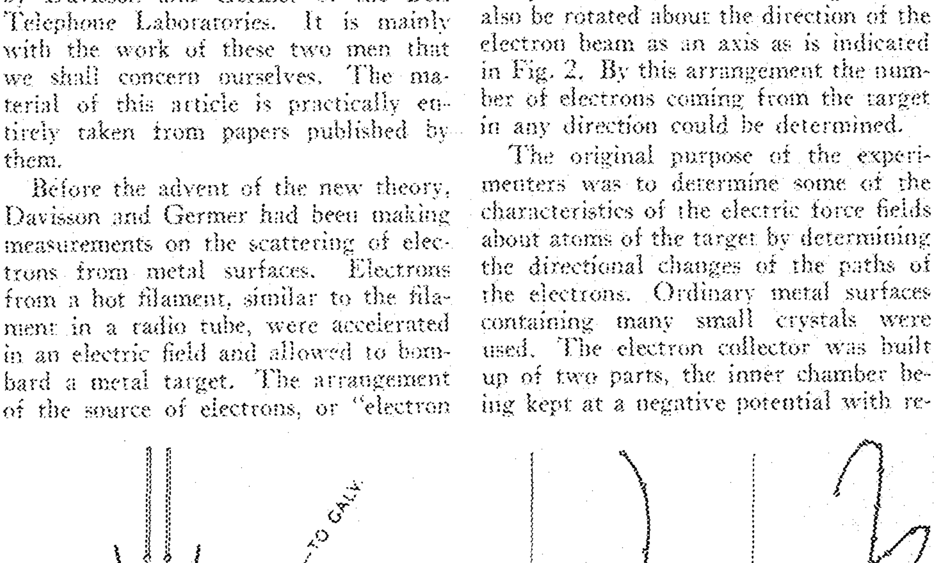


FIG. 1. ARRANGEMENT OF ELECTRON GUN AND COLLECTOR CURVES OBTAINED.

nounced maximum with the collector in the A-azimuth and at 50° colatitude. Electrons with higher or lower initial velocities did not show as large a maxi-

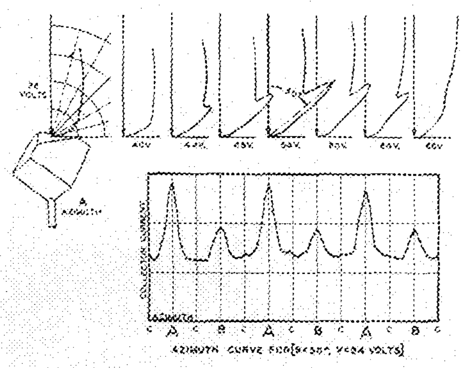


FIG. 3. CURVES SHOWING DIFFRACTION BEAM IN A-AZIMUTH AND VARIATION OF BEAM INTENSITY WITH AZIMUTH WHEN COLATITUDE IS FIXED.

mum at *this* angle. However other velocity groups did show maxima at other angles. If now one keeps the collector at the 50° angle and uses "54 volt velocity" electrons, but rotates the crystal target about its axis, he obtains a curve such as shown in Fig. 3 (lower part). The curve repeats itself every 120°, or three times per revolution. If the collector is placed in a different position with respect to the crystal axes, for example in the so-called B-azimuth instead of the A-azimuth as shown in Fig. 3, a set of curves having the same general character is obtained but the maximum is found at a different colatitude angle and the primary electrons must have a different velocity to give this maximum. Such a set of curves is shown in Fig. 5. These curves show that beams of electrons are scattered in definite directions in space relative to the surface of the crystal and the incident beam of electrons. These electron beams are sometimes called "diffraction beams."

To account for these curves it seems we must consider the nature of the crystal used. The crystal was of nickel which is of the face-centered cubic type. Fig. 6 illustrates the arrangement of the atoms in the crystal. The crystal surface

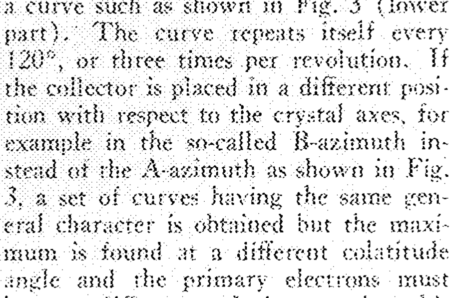


FIG. 4. SCATTERING CURVES SIMILAR TO THE UPPER CURVES OF FIG. 3 TAKEN AFTER THE CRYSTAL SURFACE HAD BEEN FREED FROM ABSORBED GAS BY HEATING.

used was one obtained by cutting the crystal at right angles to the cube diagonal, thus giving a surface in which we have a triangular arrangement of atoms. This trigonal symmetry shows itself in curves of Figs. 3 and 5. Fig. 2 indicates the azimuths noted in the other diagram.

Evidently the crystal structure determines the direction of scattering.

Before stating the conclusion reached concerning this experiment we should mention another group of observations. When a single crystal was used and the angle of incidence fixed at other than normal incidence, an intense beam was found coming from the crystal at the same angle with the normal that the incident beam made with it; that is, there was regular reflection as we would have with a beam of light. This is true, however, for only particular values of angles and electron velocities. With the angle fixed and the velocity of the incident electrons varied, a curve such as that shown in the lower part of Fig. 7 was obtained. The maxima of intensity occurred at almost equal intervals when plotted against the square root of the accelerating voltage or against the velocity of the electron. These beams are sometimes called "reflection beams."

To sum up the experimental results, when an electron beam is directed normally on a single crystal surface, the scattered electrons having the same speed and energy as the incident electron,

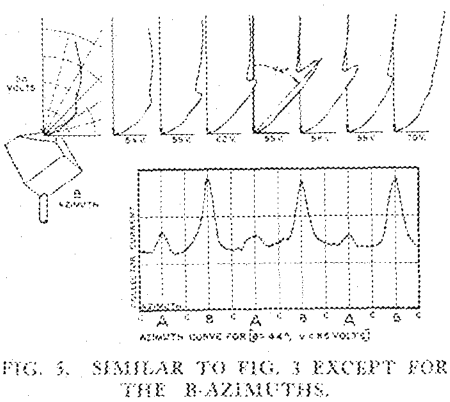


FIG. 5. SIMILAR TO FIG. 3 EXCEPT FOR THE B-AZIMUTHS.

come off in definitely directed beams, the direction of these diffraction beams being dependent upon the velocity of the incident electrons and the structure of the crystal. When the incident beam is directed other than normally to the target surface, regularly reflected beams are found, their intensity varying periodically with the velocity of the incident electrons. How can we account for these results in terms of an electron in the form of a spherical charge 10^{-13} cm. in diameter? The atoms are very much larger and spaced at distances equal to 100,000 times the diameter assigned to the electron. With such large relative distances we would hardly expect the arrangement, even though it be orderly, to effect the distribution of the scattered electrons.

If one is familiar with the scattering or diffraction of X-rays by a crystal he will immediately recognize the similarity with the electron beams found here. When X-rays are scattered by a crystal there are very definite directions in which maximum intensity of the scattered rays is obtained. These directions depend on the wave length of the X-rays and the structure of the crystal. From one layer of atoms we would expect maximum intensity to occur in direction of the regularity reflected ray regardless of wave length. But if more than one layer of atoms is effective in the reflection, the waves from these various layers must have a phase relation which will give reinforcement in order to get a maximum even in the direction of

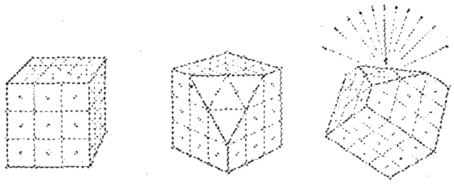


FIG. 6. DIAGRAMS OF NICKEL LATTICE, OF CUT LATTICE, AND OF LATTICE INCIDENT AND SCATTERED BEAMS.

regular reflection. The difference in path from the various layers must be an integral number of wave lengths. Fig. 8 will show that the necessary relation is $2d \cos \theta = n\lambda$ where $n = 1, 2, 3$, etc. and the other terms represent quantities as indicated in the figure. The symmetry of the crystal allows one to consider planes other than those parallel to the surface. These also give reflected beams, which when they combine outside the crystal are usually called the diffraction beams. Fig 9 shows how with normal incidence, beams would be obtained in various directions. The distances in Fig. 9 are given in Angstrom units (10^{-8} cm.).

Without going into the details of the demonstration it may be said that every beam of scattered electrons is located in exactly the same position as if the incident beam were a beam of X-rays of definite wave length. The same equation for maximum intensity, and the same crystal constants are used in the calculation. The wave length so measured for the electron is just that predicted by the new wave mechanics, that is h/mv where h is Planck's constant 6.55×10^{-27} c.g.s. units and mv the momentum of the electron. We can get the relation of wave length to accelerat-

(Continued on page 100)

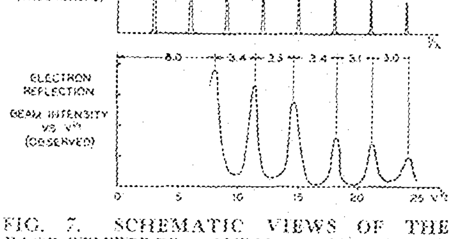


FIG. 7. SCHEMATIC VIEWS OF THE FACE-CENTERED CUBIC CRYSTAL OF NICKEL.

LOAD CAPACITY AND LUBRICATION OF BALL BEARINGS

By J. R. VAN DYKE
Assistant Professor of Mechanical Engineering

THE old belief among mechanical men that ball bearings were suited only to carry the lightest loads began in the days when the bicycle industry was being developed. When heavy loads and high speeds were applied to the then very crude types of ball bearings, failure resulted.

Since those early developments, much experimenting and research has been required to bring ball bearings to their present state of perfection.

Load capacities of ball bearings depend upon the following factors:

1. Material in balls and races
2. Size of balls
3. Curvature of raceways
4. Number of balls
5. Polish or finish of raceways and balls
6. R. P. M.

1. The balls and races of ball bearings under load are subjected to stresses due to compression. It is well to recall that the "apparent elastic limit" of steel in compression is practically the same as in tension, and that the ultimate strength in compression is practically equal to the apparent elastic limit. In tension, the apparent elastic limit for soft steels has been found to be between sixty and seventy per cent of the ultimate strength, and higher for hardened steels. Therefore, the same steel when subjected to compression has a lower ultimate strength than it has when subjected to tension.

The elastic limit in compression is the beginning of lateral flowing of the metal. The stress required to start lateral flow of the metal depends upon the freedom with which the metal can flow. The usual condition under which the elastic limit is found is with a specimen compressed over its full cross-section with freedom to flow laterally in every direction.

When the specimen is compressed uniformly over only a portion of its surface and the elastic limit is exceeded, the metal finds escape only by flowing laterally against the resistance of the unstressed metal surrounding the compressed area. Evidently the elastic limit under this condition is much higher than before, due to the restricted flow.

When only a portion of the surface is compressed, as is the case with a ball, the metal near the center of the compressed area is forced to flow under the direct stress. This tendency to flow out laterally is restrained by rings of metal which are confined and compressed vertically, but not beyond the elastic limit. The metal at the center of a surface compressed in this manner, in order to find an escape, must be forced out against a much wider ring of metal than in the previous case. For this reason, the elastic limit now is very much higher than when compressed by a flat disc.

The elastic limit of the material that is to be used in ball bearings is of very great importance. The higher the elastic limit the greater is the load that the material can safely support.

In cases where the load is applied as it is in ball bearings, there seems to be no such thing as a sharply defined elastic limit. Professor Stribeck* found from his study of steel balls, steel balls and flat steel plates, and steel balls and curved steel plates compressed together, that his curves showing permanent sets touch the axis of the abscissae near the origin. He was, however, unable to determine with certainty the point of contact with the abscissae or the trend of the curves in that region.

Let us consider that at first only a single element of the test piece is involved. By increasing the load, additional elements become stressed to a lesser degree than is the first. When the first element is stressed to the elastic limit, there is no definite point reached for the load is not then supported by the one element alone, but is supported by many elements which are less highly stressed than is the first. With increasing loads, more and more elements become stressed up to and beyond the elastic limit, but at no time, within practical limits, are all of the supporting elements stressed up to the elastic limit or beyond. We should expect that the change from no permanent deformation to that of some permanent deformation or set,—passing the elastic limit, in other words,—is a very gradual one. That is practically what Professor Stribeck found in his investigations.

Many experiments and practical experience with materials in service have shown that materials with a high elastic limit also have a high *fatigue limit*. The load capacity depends upon the elastic limit of the material, but the life of a ball bearing depends primarily upon the fatigue limit, for it is subjected to repeated stresses.

Another important property to be sought in the material is hardness. It must, however, not be too brittle for then shock loads would be dangerous. Hardness combined with a sufficient amount of toughness to withstand abnormal momentary loads is necessary.

These various properties of a material, high elastic limit, high fatigue limit, hardness, and toughness are all to be

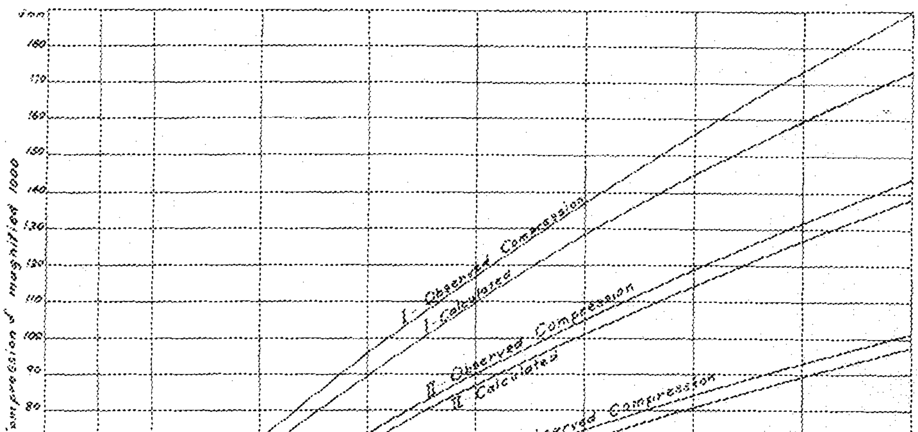
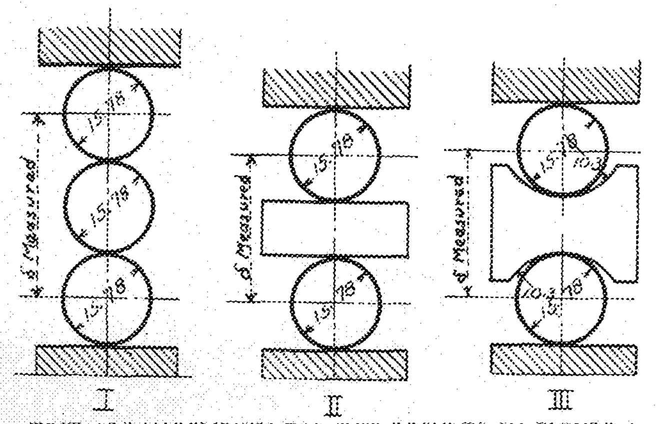


FIGURE 1. RELATION OF COMPRESSION AND LOAD FOR THE THREE TESTS.

* "Ball Bearings for Various Loads" by Professor Stribeck, Neubabelsberg, near Berlin.



TEST ARRANGEMENTS FOR THE RESULTS IN FIGURE 1.

found in alloy steel such as is used in the manufacture of ball bearings.

Case hardened carbon steel has been frequently used in the manufacture of ball bearings for economical reasons, but all high grade ball bearings made for heavy duty service are made of special alloy steel hardened throughout. Except in pieces of small size, pure carbon steel cannot be hardened uniformly throughout. Alloy steel of suitable composition can be very uniformly hardened and is therefore adapted to use for ball bearings.

2. Professor Stribeck found that

$$P = Kd^2$$

may be used as a basis for calculations of loads where P is the permissible load for one ball, K is the permissible load for a unit diameter or the permissible specific load. Since balls are manufactured to the English system of measurements, the unit for d in the above formula has been taken as ⅛ inch. A ball ⅝ inch in diameter is considered as 5 units in diameter and for this case

$$P = K\ (5)^2 = 25K$$

The permissible load, P, must be determined experimentally, and with P known in any case, K can be calculated.

With K determined for one size of ball, P may be calculated for other sized balls by using the same value for K. This holds true if the material and the shape of the ball supporting surface remain the same. If the material or the shape of the supporting surface is changed, P will have to be found again experimentally and K calculated as above.

Fig. 1 shows the relation of compression and load for three test arrangements, as reported by Professor Stribeck. The difference between the total and the permanent compression gives the elastic compression.

3. For ball bearings, the grooves or ball supporting surfaces range anywhere from flat surfaces to curved surfaces with radii only slightly greater than the radius of the balls. Balls may be subjected to loads increasing as the curvature of the supporting surface increases, but the curvature of the surface must never be equal to that of the balls, for then there would be sliding instead of rolling contact.

In large bearings for carrying great loads at slow speeds, the race curvature may be made very much closer to that of the balls than for high speed bearings. In the one case, the chief consideration is load capacity. In the other case, the consideration of load becomes less important as the reduction of friction becomes more important. In ordinary practice, the race curvature may be increased until the capacity of the ball is multiplied many times before the friction becomes objectionable.

4. The frictional work of a ball bearing decreases as the number of balls is decreased, but the load capacity increases directly as the number of balls. It is easy enough to see that if one ball is smaller or larger than the balls next to it, it will carry less or more load than it should. The limit of variation, by the best manufacturers, in the several balls working together in one bearing does not exceed one ten-thousandth of an inch.

5. In regard to the requirements of a good ball, Mr. Henry Hess says, "Surface finish to a very high degree is also essential. What is usually considered a very good finish indeed may be characterized as totally inadequate. The recognition of grinding or polishing marks not only by the bare eye, but with an ordinary pocket reading lens condemns balls utterly; this is true of a bearing having long life under high loads and speeds." Mr. Hess found in some endurance tests which he ran that "the higher the finish, the better the endurance."

Regarding this same subject, surface finish, Professor Stribeck says: "The gradual reduction of the frictional values is very noticeable with bearings whose race surfaces were only roughly ground after hardening. It is almost unnoticeable with races that have been so well finished that grinding scratches are not visible with the naked eye. This condition of the ball tracks is very important for the durability of races and balls."

In the case of small bearings with light loads but high speeds, the problem of making them quiet and smooth running becomes of greater importance than the problem of securing durability.

Polishing of the surfaces instead of merely grinding them aids materially in the prevention of rust which is very harmful to ball bearings. A rough cut steel surface will rust easily. Surfaces finished with a fine cut and ground are less likely to rust. Surfaces that are ground and highly polished are appreciably less likely to rust.

6. Ball bearings have never been rated according to the hours of life that can be expected of them under given conditions, but let us assume that a bearing running at 100 R. P. M. with a given load has a life of 5000 hours. If this same size ball bearing with the same load were run at 10,000 R. P. M. instead of 100 R. P. M., it would fail long before it had given 5000 hours of service. If, however, the load were decreased sufficiently, this same size bearing could be run at 10,000 R. P. M. and give the same number of hours of

(Continued on page 102)

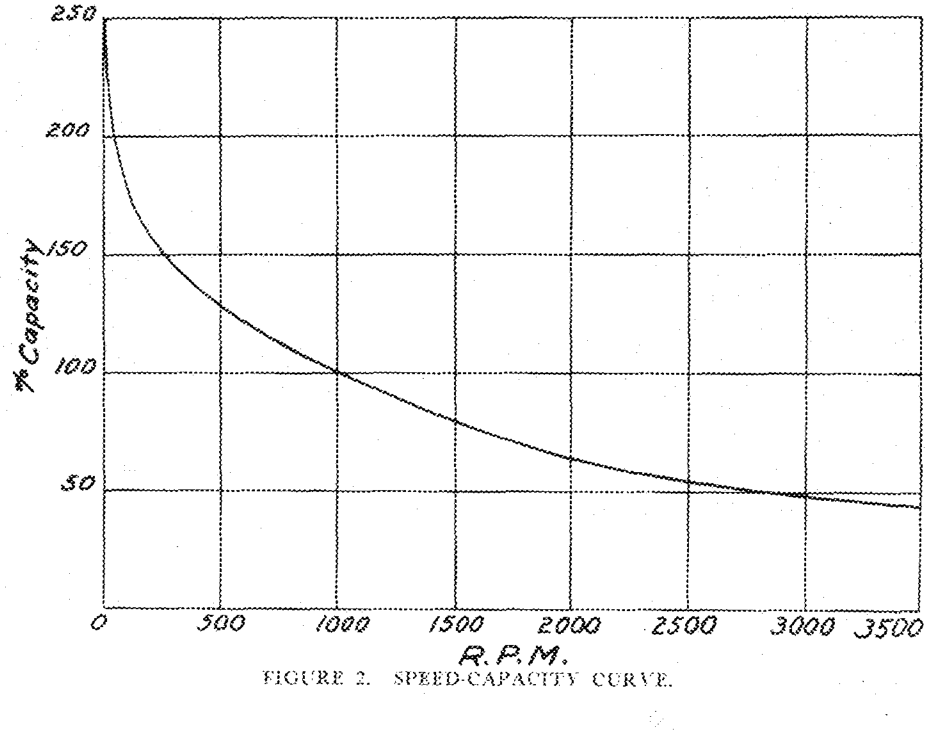


FIGURE 2. SPEED-CAPACITY CURVE.

TORSIONAL VIBRATIONS IN THE CRANKSHAFTS OF ENGINES

By RALPH J. HOOKER
Instructor in Mechanical Engineering

THE technical aspect of engineering as practiced in the field of machine design, has for several reasons advanced far beyond what is contained in the regular undergraduate curricula. The student's first comprehensive understanding of this fact comes with his first job.

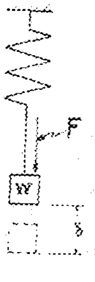


FIG. 1. TENSION SPRING.

The reasons for this advance in technical skill are through the demands of customers requiring that the machines they purchase will, for a given weight or space occupied, produce more than they did several years ago. To meet this demand designers have been speeding up their machines to increase their output.

In the slower moving types of machines the dynamic relations are reasonably negligible and the various parts can be designed on a basis of static laws. Not so with the high speed machines; here the dynamic forces become a larger percentage of the total forces acting and they and their results must be dealt with accordingly.

One design problem in particular that has had to be dealt with on a dynamic basis is the design of crankshafts for internal combustion engines. The dynamic relations in these engines, the Diesel engine in particular, are such as to set the shaft vibrating about its own axis. This phenomenon is known as torsional vibration.

By way of explaining this fact we will now reconstruct a few of the relations as found when various members vibrate about a point of static equilibrium.

Probably the best way to introduce this to the uninitiated is to start with the common tension spring as shown in Figure 1.

When the weight W is displaced from its position of equilibrium and released, vibrations of a sinusoidal character ensue, which are graphically represented in Figure 2. The curve as shown is the time-displacement curve of *free vibrations*, that is, the vibrations once started, neglecting frictional losses, will continue indefinitely at the same amplitude. Practically, however, the amplitude will decrease, the period remaining constant, somewhat as shown by the ordinates of the curve in Figure 3. This decreasing amplitude as shown is a function of the frictional losses, such as air friction and internal friction in the steel spring itself or hysteresis.

Another phase which complicates the displacement of the spring is that due to a variable force F acting on the suspended weight W. In case the frequency of the disturbing force is different from that of the free vibrations, the amplitude will vary as shown in Figure 4. The time from one zero amplitude to the next is known as the "period of beating," and can be explained by reference to the figure. The resultant curve is the algebraic sum of two vibrations, one the free vibration of the spring, and the other the forced vibration of the variable force F.

This same variation takes place whether the period of the disturbing force is larger or smaller than that of

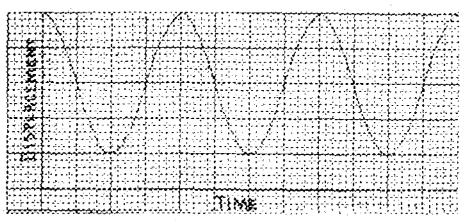


FIG. 2. TIME-DISPLACEMENT CURVE FOR FREE SINUSOIDAL VIBRATIONS.

the free vibrations. The only difference is a change of phase between the disturbing force and the resultant vibration. When the disturbing force has an increasing frequency, the amplitude of the forced vibrations will be as the increasing ordinate of Figure 5, and when

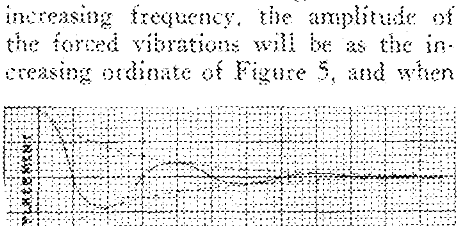


FIG. 3. TIME—DISPLACEMENT CURVE FOR FREE SINUSOIDAL VIBRATIONS OF DECREASING AMPLITUDE.

the frequency of the variable force and the free vibrations are equal, the crest of the curve represents the resultant vibration. As the frequency of the disturbing force increases beyond that of the natural frequency, the amplitudes are as the decreasing ordinate of the curve, for example, from the crest outward. When the periods of the disturbing force and the free vibrations are equal, the amplitude of the forced vibrations will be represented by the crest of the curve in Figure 5.

Theoretically the amplitude would become infinite, the spring remaining intact, but because of the frictional dissipation of energy in the system, the amplitude curve will be somewhat modified as shown. This modification is known as damping.

With the above well in mind we can proceed to apply it to the vibration of a crankshaft. As any vibration is caused by the elasticity of the member under consideration one can readily understand that if the left flywheel of the crankshaft in Figure 6 were rigidly held and a twisting moment applied to the rotor on the right and then suddenly released, that it would perform a torsional vibration about its axis.

In the case of an engine shaft, instead of the flywheel being rigidly held, which is comparable to a mass of infinite proportions, it is replaced by one of finite mass, having a certain predetermined mass moment of inertia. Therefore when a variable twisting moment is applied to the shaft proper, it will vibrate by respect of its own mass moment of inertia and elasticity of the shaft section.

By this time the comparison between the vibration of a spring, and the torsional vibration of a shaft should be quite clear. But the student may ask what causes the vibration, since in a multi-cylinder diesel engine the rotative speed is practically constant throughout the revolution. True, the coefficient of fluctuation can be and is largely determined by the flywheel,—that infinite mass mentioned above.

The cause of the torsional vibration is the result of a very uneven torque curve. The torque curve as shown in Figure 7 is typical of the four stroke cycle machine in that there are two idle pumping strokes between the power and compression strokes.

For the purpose of our discussion we will consider only that portion of the curve between sections a-a and b-b. It will be noticed that within a rotated angle of about fifty degrees, the torque has gone from a high negative value to

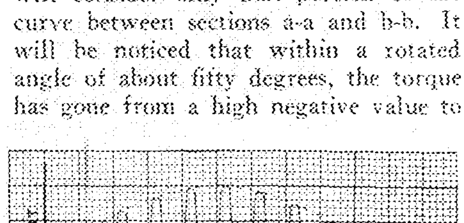


FIG. 4. TIME-DISPLACEMENT CURVE OF FORCED VIBRATIONS.

a higher positive and within that time has approximately increased as the ordinates to a straight line. Therefore we can readily see that it is a hammer blow in magnitude. From these hammer

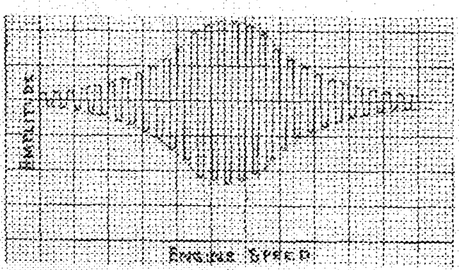


FIG. 5. RESONANCE CURVE FOR FORCED VIBRATIONS.

blows it can be easily appreciated that if the shaft system contains both mass and elasticity, vibrations are sure to follow and their amplitude will be determined by the same factors as for the spring problem, for example frequency, damping, etc.

When the speed of an engine is such that the frequency of the impressed torque—hammer blows—equals the natural frequency of the free vibrations then the engine is said to be in a critical speed and if allowed to run, the shaft would break sooner or later. This is caused by fatigue of the shaft section resulting from a great number of repetitions of stress. That there have been a great number of shafting failures from this cause, is one reason for the more careful analysis given this problem in the last few years.

Designers, to safeguard their shafts, try to keep the operating speed as far removed and above the critical as possible.

In some cases this is not attainable as the only way of raising the natural frequency, likewise the critical, is by increasing the stiffness of the shaft section in torsion or by reducing the mass moments of inertia of the crank webs and flywheel. Since at best the clearance for increasing the shaft section is small and also costly the only other alterna-

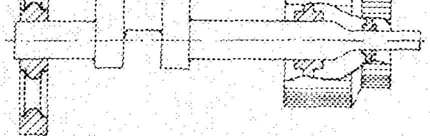


FIG. 6. CRANKSHAFT.

tive is to lower the critical. In constant speed machines, such as those driving generators, this lowered critical is not an entirely dangerous condition. As the shaft speed is raised, starting from zero, the engine speed will go through the critical range, but since there is a perceptible lag between the building up of a dangerous amplitude and the impressed torque, the engine speed will have increased during this time to such a value as to have little or no effect on producing a shaft vibration of large amplitude. The above statements of course should be taken with a grain of salt as it would only be permissible to have such a condition in those engines which can be raised in speed very quickly.

Recalling what has been said above regarding the cause of the shaft vibration, namely the variation of the impressed torque on the shaft proper, we see that vibrations of some nature must always be with us. There has been one cause of vibration that so far has been neglected, but nevertheless is of some importance, namely that due to positive and negative accelerations of the reciprocating masses. This fact can readily be seen by the application of a few fundamental laws of dynamics.

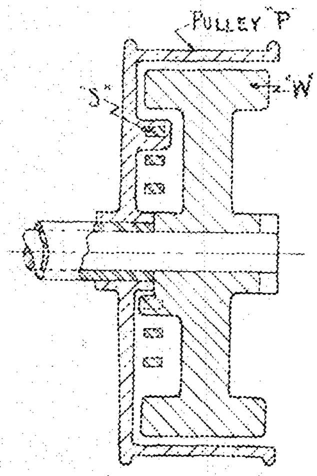


FIG. 8. DIAGRAMATIC SKETCH OF THE MOVING PARTS OF THE GEIGER TORSIOGRAPH.

Since we have in an elementary way correlated certain relations concerning the cause and effect of torsional vibrations we should, to make the story complete, say something of their measurement.

The Torsiograph designed by Dr. A. Geiger has for its principle of operation, the difference in angular velocity of two rotating bodies. One wheel, the pulley P as shown in Figure 8 is connected directly to the vibrating shaft through a special belt. It has the same variation of angular velocity as the shaft to which it is connected. The second wheel W is quite heavy and has a large mass moment of inertia. It is connected to the first wheel by a flexible spiral spring S. When the instrument is connected to a shaft system, the pulley P will assume the same vibratory motion but the wheel W because of its large mass will perform a uniform rotation. This difference in angular displacement of the two bodies is transmitted through a system of levers to a pen which records the curve of the shaft vibrations on a paper tape. In order that the torsiogram will have some point of reference with respect to the crank angle on the recorded vibrations there is a pen connected electrically to the fuel valve. When the fuel valve opens the pen is made to move so that it will make a jog in an other-

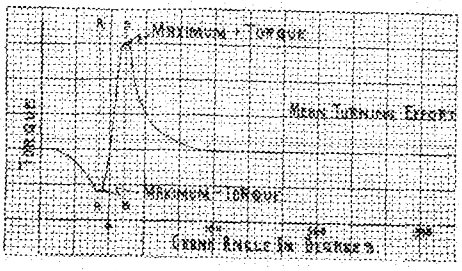


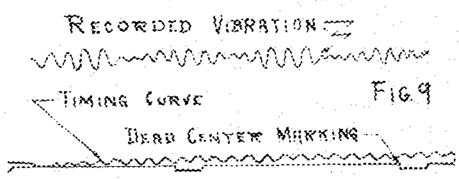
FIG. 7. GAS PRESSURE TORQUE CURVE FOR 4 STROKE CYCLE DIESEL ENGINE.

wise straight line. In a four stroke cycle machine the fuel valve opens every two revolutions, then the distance between jogs will be two revolutions, while for two stroke cycle machines, it will open every revolution. In order that the R. P. M. of the engine shall also be obtainable for the torsiogram there is a pen connected to a vibrating arm which produces a wavy line the frequency of which is about 1500 per minute. From the distance of waves on the timing curve between them the R. P. M. can be obtained quite accurately.

A torsiogram is shown in Figure 9 and contains the recorded shaft vibrations, the timing curve and the dead center marking for the R. P. M. determination. The scale of the torsiograph can be varied to suit the conditions of the problem at hand and is as high as 24 to 1, so that for small amplitudes the torsiogram will give an amplified picture of the shaft vibrations.

Since the student does not as a rule come in contact with the problems that confront practicing engineers, the writer has tried to present to him in a non-technical way something of those problems.

For this reason he hopes he has given the student something to think about outside, but closely connected with his studies. Also that there is a close relationship between his studies here and the problems he will face upon graduation.



THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

World Engineering Congress

GREAT gatherings of engineers from all corners of the world, such as met at Tokyo last month, represent a force for the advancement of human effort that does not always find adequate recognition.

The World Congress is to be commended not so much because it will advance the cause of engineering, but because it promotes universal kinship. The papers that are read there are not necessarily of overwhelming importance, but the cordial international relationship that will be engendered is of prime importance. Differences of tongue, creed and race are dissolved more effectually by this gathering of doers and builders than by countless paper peace parleys at the Hague.

Antioch Plan

THE Antioch plan of education proposes a curriculum particularly beneficial to the study of engineering. Its chief feature provides a course of study that gives the student equal time for study and for practical work,—a scheme designed to crystallize major interests and develop inherent capabilities.

In the typical American university, the student frequently finds himself unguided in his vocational selections, and unencouraged in those endeavors in which he is most interested. This type of learning, which is provided particularly by courses leading to the degree of bachelor of arts or philosophy gives the student an admirable background of general learning, but it seldom places him in direct contact with life. In fact, the reverse is generally true—the student finishes his college work—an unguided spar of flotsam to be battered and buffeted, disillusioned and finally baffled by the very thing for which so much preparation had been made.

In schools of engineering,—laboratory periods are provided. These to furnish the practical side of education,—yet these contacts are too infrequent, are oftentimes more theoretical than practical. Let us consider the civil engineer. The civil graduate can plan the construction of a highway, can lay out sketches for correctly sloped curves, can make adequate allowance for drainage. But can that same engineer construct that highway, could he figure accurately the cost of doing such a piece of work? If so, why are there so few successful contractors who are engineering graduates?

The argument condenses to a definition of practical. By practical is not meant the preparation that is needed by a research man, before he can successfully prosecute his work. By practical is meant the counter-part of theoretical,—the dollar and cents cost of producing a generator to conform to given specifications. And yet where in our engineering schools is mention made that such a thing as cost exists?

Cost is certainly a controlling factor in industry. It is the primary stimulating force in competitive operation. And yet engineers are allowed to enter the business world with no trained knowledge and very little acquired knowledge of costs. Theoretical subjects are given the place of honor in the curriculum because they train the mind. This same mental development can certainly be achieved by intensive study of the practical,—by the study of costs.

Resourcefulness

IN building the Big Four-Ohio River bridge at Louisville, the engineers and contractors faced a difficult task. Among early plans, the use of timber falsework was discarded and the whole design was based on utilizing the existing span to support the new steel. Here additional difficulties were met,—the new bridge weighed 6,000 pounds per foot, while the old bridge was designed to support but half as much, furthermore the piers were not wide enough to permit the erection of a new span outside of the trusses. The feat was accomplished nevertheless, by erecting the new trusses within the old and using a separate wind chord outside of the main trusses to provide lateral rigidity,—then by carefully checking deflection at the center as work progressed.

Here is a noteworthy example of construction designed to meet existing conditions. Few contractors have not at some time or another harbored the feeling that the engineer is a much better paper designer than a practical planner. The design, not the construction, is vital to the engineer. The charge is probably made many more times than it has been deserved, but it nevertheless is frequently true.

The design and subsequent construction of the Ohio River bridge is just another example of the effectiveness of the practical engineer. He senses the difficulties in construction that will be encountered, realizes their effect upon cost,—hence lays his plans in order to utilize most efficiently the tools which he has been given. And these tools are the resourcefulness obtained through experience and a practical engineering education.

Congratulations

TWO engineering college student publications, the *Auburn Engineer* and the *Marquette Engineer*, were admitted to membership in the Engineering College Magazines Associated at the national convention of the group which was held at Purdue University during the last week of November.

We believe that the admission of these publications to the E. C. M. A. will prove beneficial both to the magazines and to the association.

The Techno-Log extends its congratulations and best wishes for a successful future.

Gjennem Kikkerten

SOME time ago streamer headlines proclaimed that student operated vehicles would be banned from the campus. University officials, employing penny-snatching tactics, decided that faculty members must pay $1.00 per month for parking privileges,—for this consideration yellow lines will be painted, parking spaces reserved for faculty members that they may not be discommoded by early rising students. And it goes,—with harmony apparently forgotten and justice blundering blindly.

MANY heard the account of the military ball over the radio. Too bad they couldn't have been there. Pompous generals and popular colonels led beautiful damsels draped in Lavin's most approved mode to the martial strains of Slats Randall and his boys. Outshone was *Ski-U-Mah's* doughnut feast, belittled was the Frosh hop - skip - and jump fiasco. Waxen figures, stereotyped expressions, dazzling colors, rouge that turned livid under bottled sunlight, and conversation that scintillated and sparkled with "wonderful, . . . simply adorable . . . perfect . . . so nice . . . and" . . .

The next morning while taking a Bromo at Walgreen's we heard the following: "Do *you* know, dearie, that Colonel so and so was there, and with—well,—*who* do you suppose? None other than the old girl *herself*,—and *to think*, that the dear boy had *never* met the little honey before.—But it probably doesn't matter,—she's a big shot on the campus. President of this and that, secretary of, — well, you know, just *too* active for *words*. So why *shouldn't* he take her? *E-magine* him being irritated just because he had to spend a few *measly* dollars for a ticket. Why, there are countless men who would be only *too willing* to lead the grand march with that baby. And yet they tell me that some people. . . .

FACULTY SKETCH

HENRY A. ERIKSON

HENRY A. ERIKSON, chairman of the department of physics, was born at Mount Morris, Wis., in 1869, of Norwegian parents. He attended grade school there and graduated from high school at Willmar, Minnesota. After a short time he entered the University of Minnesota and graduated in 1896 with the degree, B. of EE. The next year he taught physics and chemistry at Rochester High School. He then returned to Minnesota as an instructor in physics; during this time he studied under Dr. Eddy, and received the coveted doctor's degree in 1908. Obtaining a year's leave of absence, he went abroad to study at the Cambridge University under J. J. Thompson. The following summer he traveled on the continent, visiting all of the countries in northern Europe. During the next four years he was an assistant professor and in 1914 he was given an associate professorship.

The opening of the school year 1915-16 found him a full Professor and Chairman of the Department of Physics, which responsible position he has held ever since. His Department has had a very interesting history. At its inception, the department was located in the east end of the Minnesota Union; later, it was moved to the Armory and had laboratories in the basement. Two years afterwards a shift was made to a new building overlooking the knoll, where they remained until Christmas of 1927, when the present building was ready for occupancy.

Dr. Erikson has been working on the ionization of gases and has published twelve articles in this field. He discovered the initial air ion. This research has been carried on in addition to his long-continued efforts to obtain a new building for his department.

He is a member of Sigma Xi, Tau Beta Pi, Theta Chi, a Fellow of the American Association for the Advancement of Science, and of the American Physical Society.

A FEW days ago the world's largest college daily procured a bit of news from a source shrouded in mystery. A bit of information from another source, equally mysterious, a fragment of vague rumor, a guess, a supposition, and a deal of grade "A" balderdash became intimately mixed with the original news and, the whole, well seasoned with editorial comment, was served hot.

The story, given good, black headlines and the most conspicuous place on the front page, caused a stir on the campus when the papers were first read. The afternoon dailies took up the cry, spreading the news of students' degeneracy and lawlessness prevalent at the University; of universal gambling for high stakes, of wild orgies, and irate deans—all of this from a two-bit poker game—or was it bridge?

Talk of this episode had about died when screaming black headlines proclaimed the expulsion of several students as the result of a drunken brawl in a fraternity house.

Pehaps the facts in the second story were all true,—we suppose such a story might be possible even in a college daily. The *Daily* states that it prints such material because it cannot suppress news,—and in another column naively states that it withholds the names of the students out of consideration for their reputations. What of the reputation of the University? Fine doin's,—these stories! Fine advertising to the people who have no knowledge of the true state of affairs; fine advertising to parents whose sons and daughters may some day wish to enter the University; fine advertising to the state legislature from which the University must seek funds; and last and finest of all,—fine advertising to the future employers of University graduates.

IT has been said that the finest years of a man's life are those spent in college—that his best and most enduring friendships are formed there.

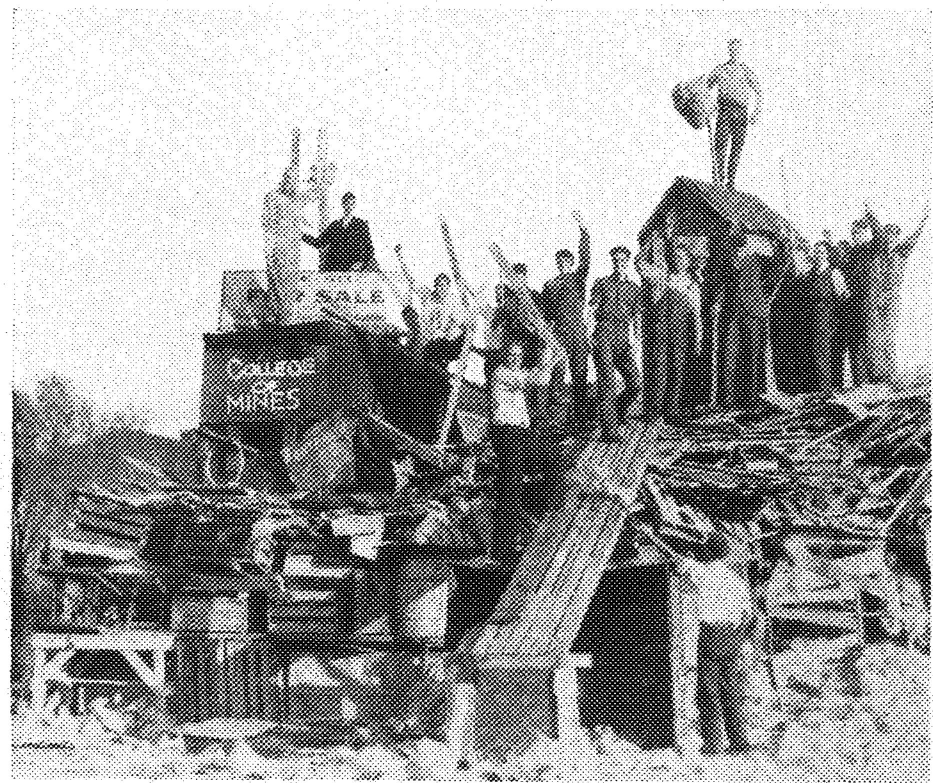
This *is*, perhaps, true of the man who joins a fraternity or who interests himself in one or more outside activities. However, the majority of Minnesota men have no fraternal connections nor do they enter extra-curricular activities. It has been our experience that the classroom and the laboratory do not furnish much opportunity for social contact, and as the average engineer has a rather full schedule, it is rather hard to see just where his opportunity lies for formation of these friendships.

In a small college where the students live in campus dormitories there is no difficulty in this way.

As not every man cares to join a fraternity or is financially able to do so, the only suggestion we have to make is "Get interested in some outside activity."

—Oscar Fegas

NEWS FROM THE TECHNICAL CAMPUS



Freshman engineers started their school year right by building a mammoth bonfire on the eve of the Iowa game. Two weeks previously the frosh had trounced the sophomores in the annual class scrap by a score of 265 to 245. Seeking to add to their victories the frosh in competition with the homecoming fire to be collected by the foresters, built one of the largest bonfires ever burned at the university. Only the homecoming fire, which was finally built by combined forces of the foresters and engineers, eclipsed the frosh conflagration. For years it has been the custom for engineering freshmen to build a bonfire for a pep fest preceding an out-of-town football game.

Engineers Elect Officers for Coming Year

The following are the results of the recent elections held in the technical schools:

George Meffert, senior civil, was chosen president of the senior class of the College of Engineering and Architecture defeating John Madden and George Langenberg. Ray Higgins received but one vote more than Cameron Kay to win the senior presidency of the School of Chemistry. Wesley Taylor defeated Albert Goffstein for technical school representative on the All-University Council. Reginald Lindstrom was elected to the TECHNO-LOG board from the School of Chemistry.

Among the juniors, Frank Laska was chosen president of the engineers, while Charles Winding was elected in the School of Chemistry.

Merlin Burnes and Carl Henning were named sophomore presidents of Engineering and Chemistry respectively. Marshall Wells was chosen freshman president.

Perrine Talks to A.I.E.E. on Photo-Electric Cells

Dr. J. O. Perrine addressed the American Institute of Electrical Engineers, Minnesota Branch in the New Physics Auditorium on December 11 at eight o'clock. Dr. Perrine spoke on "The Application of the Photo-Electric Cell to Communications." The lecture was illustrated with sounds, pictures, and experimental equipment.

Dr. Perrine is a graduate of the University of Iowa in the class of 1909. Upon his graduation, he was engaged as an instructor at the University of Michigan, but returned to Iowa in a short time where he was made professor of physics. After serving in the Signal Officers Training Corps during the War, Mr. Perrine entered Cornell University where he obtained his doctor's degree in Physics. He is at present employed in the department of information of the American Telephone and Telegraph company, part of his duties consisting of editorial work on the Bell Technical Journal.

Scarab Convenes Here

The 13th National Annual Convention of Scarab, held at the University of Minnesota, on November 25 and 26, was characterized as the most successful which has ever been held.

The first gathering was a smoker at the Phi Sigma Kappa house Sunday evening. As the feature of the evening, Professor Roy Childs Jones gave a timely and interesting discussion of "Tall Buildings." His talk was illustrated, and traced the development of the skyscraper with particular reference to changes in design and silhouette which have occurred in the last thirty years.

Business sessions were formally opened on Monday morning with an address of welcome by Professor F. M. Mann, head of the Department of Architecture. A theatre party at the Minnesota that evening ended the day's activities.

A pleasant interlude on Tuesday was a luncheon for Scarabs and their guests at the Alpha Rho Chi house. After the luncheon, through the courtesy of Professor Mann, the delegates were conducted by him through the new Northrup Memorial Auditorium, and shown the possibilities of the lighting system, both with stage and house lights. That Minnesota had such a large auditorium so well equipped and so acoustically correct was the subject of complimentary comment. As architectural students, the group was also interested in the Mall and the "Greater University" development.

The entire convention was agreeably terminated by a banquet at the Nicollet Hotel Tuesday evening. Gordon Bestic, as toastmaster, brought out the best that was in the faculty and the delegates; and in such manner as to provide entertainment and amusement throughout the entire evening.

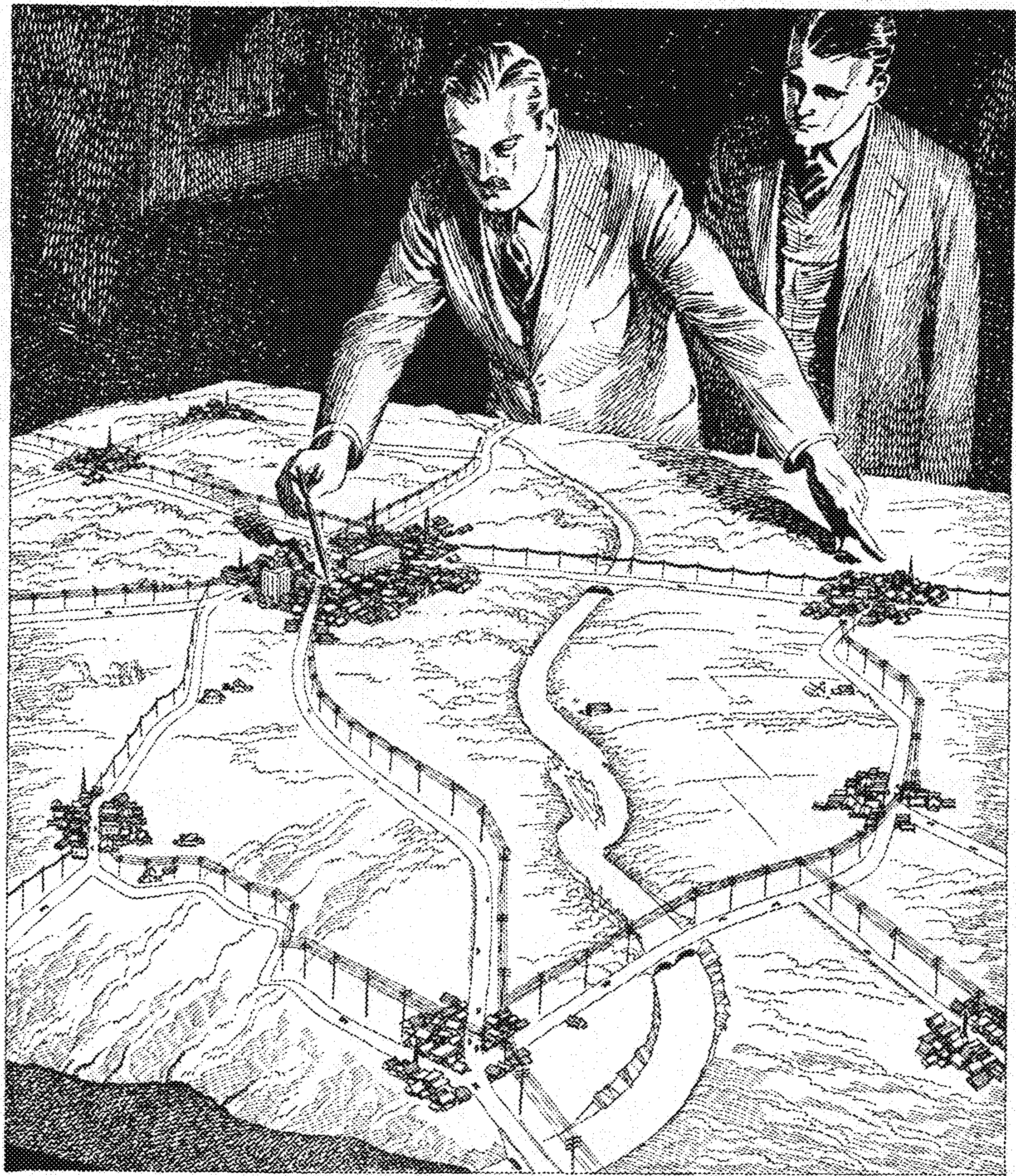
The 13th convention has designated Scarab at the University of Virginia as the entertaining temple next year. The famed hospitality of the Old Dominion augurs well for the 14th convention.

The Scarab Travelling Sketch Exhibit collected by Minnesota Scarabs and made up of contributions from the various architectural schools in the country, was larger than in previous years, and the subjects and media more varied. National prizes were awarded as follows:

First Prize:
- Aldermann, Armour Tech, Chicago.

Second Prize:
- Lever, Washington University, St. Louis.

The judges were S. Chatwood Burton, Elmer Young, and Ivan Doseff.



Key Town selling

—a new telephone idea

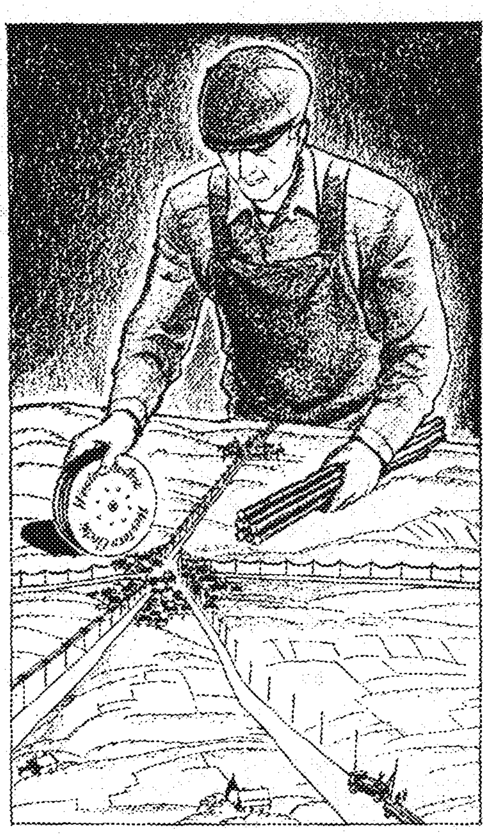
Commercial development men of the Bell System have originated a new use of the telephone which is proving economical and efficient for modern salesmanship. From important central towns the salesman makes periodic visits to customers and prospects *by telephone.*

To conceive this idea, to make it practical by selecting Key Towns on a basis of most advantageous rates to surrounding points, and to sell it as a business practice—all this illustrates how telephone service is as open as any commodity to constructive imagination.

Key Town selling is one of many indications of the steady demand, present and to come, for more and more telephone service.

* * *

How Western Electric helps to make the idea work . . . . . .



Each year the Bell System calls on Western Electric for more and more equipment. New lines and central offices must be built — old ones modernized and enlarged to take care of new and constantly increasing uses of the telephone.

Raw materials must be gathered from the ends of the earth — fashioned into telephone apparatus and supplies of all kinds — distributed to warehouses throughout the land and held in readiness. When the call comes, shipment and installation must often be made in record-breaking time to make good the ravages of fire or storm. All this is included in Western Electric's dependable service of supply which helps make possible a dependable service of communication.

Backing up the telephone companies of the nation is a big job — and one that never grows dull!

BELL SYSTEM

A nation-wide system of inter-connecting telephones

"OUR PIONEERING WORK HAS JUST BEGUN"

ABOUT THE WORLD WITH OUR ALUMNI

Architects

'24—Lawrence A. Tvedt is boasting about his new son while working 'way down south at Memphis, Tennessee, for the Gauger-Kormos Construction company. Lawrence and his family have changed their address to 1443 Tutwiler St., Memphis.

'28—Gilman C. Holien says his hair is not grey but that he is married. Holien, whose hobby is aviation, is a partner of Coffin and Holien, at 400 Sexton Bldg., Minneapolis. The firm makes architectural scale models. At present his home address is 693 Western Ave., N. St. Paul.

'29—Donald R. Schilken is draftsman for the Truscon Steel Company at Youngstown, Ohio. He is living at 1413 Bryson St.

Chemists

'24—Paul E. Millington is a research chemist at the Dupont Company in Wilmington, Delaware.

'24, '27G—Elsie I. Kilburn is an instructor at Vassar College, New York.

'25—Ellsworth Ayers has moved from Eldorado, Kansas, to Hammond, Indiana. He was formerly with the Skelley Oil Company.

'25—Harold G. Bunger is now an instructor in inorganic chemistry and chemical engineering at the Georgia School of Technology, Atlanta. After he was graduated, Harold worked for the Hercules Powder company, but returned here last year as a graduate student.

'26—Allan S. Smith is now at Fargo, North Dakota. He was formerly with the Atmospheric Nitrogen Corporation of Hopewell, Virginia, as supervisor of the test and inspection division.

'28—Ralph E. Brewer is now in Dickinson, North Dakota.

'28—R. F. Beard is a Fellow at the Mellon Institute in Pittsburg, Pennsylvania.

'29—Moses Gordon has been appointed teaching assistant in the School of Mines at the University of North Dakota. He is doing extensive research work on lignite. His address is Box 532, University of North Dakota, Fargo, N. D.

Civils

'15—The death of William A. Cuddy occurred recently in San Francisco, California. Funeral services were held at LaCrosse, Wisconsin.

'23—John J. Schlenk boasts a wife. He and his wife, formerly Miss Frances West, will live at 290 N. Cleveland Ave., St. Paul. John and Larry Erskine, '25 ME, were married on the same day.

'24—Lloyd L. Peterson, formerly with the Northern States Power Company at Fargo, North Dakota, is now with the Interstate Power company. He is assistant to the northern division manager. Lloyd married Margaret Hanson, '24, of Minneapolis.

IRVINE LAVINE, who obtained his bachelor of science in chemical engineering in 1924, is taking the place of Professor G. H. Montillon, who is on leave of absence.

Mr. Lavine was born in Minsk, Russia on November 26, 1902. When he was three years of age, his parents migrated to the United States, landing in Minneapolis in December 1906. He has lived in Minneapolis since then.

The death of his father in 1914 made it necessary for him to work his way through school. Accordingly he took possession of the corner at Eighth Street and Marquette Avenue in Minneapolis, where for several years he sold papers.

Graduating from North High School, Minneapolis, in 1920, he entered the University of Minnesota and graduated from the School of Chemistry in 1924 with the degree of bachelor of science in chemical engineering. The following year, he was appointed assistant in chemistry, which position he held until 1926. He was then appointed DuPont Fellow in Chemical Engineering for the year 1926-1927 at the University of Minnesota. During this period he completed graduate and preliminary work for the Ph. D. degree.

In July 1927 he was appointed assistant professor of chemical engineering at the University of North Dakota at Grand Forks. While there he began a research program with Dr. A. W. Gauger, who is director of the School of Mines at North Dakota, for the development of the huge lignite resources of that state. At present he is on leave of absence from the University of North Dakota.

On June 23 of this year he was married to Miss Marion Rosenblatt, of St. Paul.

Mr. Lavine is a member of Tau Delta Phi, being district chief of this organization, Phi Lambda Upsilon, Sigma Alpha Sigma, and Sigma Tau fraternities. His favorite hobbies are fishing and football, with basketball running a close second.

At the present time Mr. Lavine is conducting a research problem on the drying of lignite, having started this last year at the University of North Dakota.

Civils

'26—Theo. N. Haakensen has been transferred from Fort Banks, Winthrop, Mass., to Fort Shafter, Honolulu. Haakensen is a "looey" in the 64th Coast Artillery.

'28—Jas. P. Rydeen, whose home address is Taylors Falls, Minnesota, is doing topographic mapping with the U. S. Geological Survey in Corry, Pa. He spent January 6 to April 16 at Livingston, Alabama, where the survey hunted twenty foot contours and plotted them on the scale of 1:48,000. According to Rydeen, "the particular country we were in had, for every white person, about four negroes. These negroes lived in little shacks scattered over the cotton fields and did as little work as possible."

Jas. almost lost his clothing when their hotel burned down. He says if it hadn't been for a girl friend who happened to be near he would have had to re-outfit himself.

The southern country seemed to disapprove of the survey's intentions, for a river, usually about 300 feet in width suddenly spread to about two miles wide and held up their work.

'29—Janet Lieb is working at Hofstatter's, an interior decorating shop in the "little town." Janet is living at 3 Mitchell Place, New York city. A sister decorator, Lucene Bredding, is also in New York working at Huhler's, interior decorators.

Electricals

'92—Monroe S. Howard is at present in the employ of the United Artists Studio corporation at Hollywood, California. Mr. Howard says that since the advent of talking pictures, the leading studios have installed extensive systems for the recording of dialogue, music and incidental sounds and that most of his time is taken up with research work in the sound department.

'03—I. A. Rosok is manager of the Bisbee, Arizona, branch of the Arizona Edison company.

'19—A. C. Petrich is now northwest manager of the Garland-Affolter Engineering Corporation with headquarters in Seattle, Washington. Mr. Petrich was recently in Minneapolis on business and reported that his work consists chiefly in selling transformers, high tension insulators, and industrial control equipment. He said: "Seattle is indeed a very fine town in which to live—good hunting, fishing, yachting and mountain climbing are available to everyone." When asked about openings available for electrical engineers in the west, Mr. Petrich said that he be-

(Continued on page 92)

ABOUT THE WORLD WITH OUR ALUMNI

(Continued from page 90)

Electricals

lieved it is better for the graduate engineer to obtain some practical experience in the east under one of the large electrical companies and look to the west for the future.

'21—Ray R. Sweet, who was formerly chief engineer of WCCO in Minneapolis, has resigned his position to become supervising engineer with the Electrical Research Products, Incorporated. He will be engaged in the distribution and installation of the sound recording and reproducing equipment developed in the Bell Laboratories.

'28—Carl Swanson, former business manager of the MINNESOTA TECHNO-LOG recently left the Westinghouse Electric company to enter the sales department of the Minneapolis Electric and Manufacturing company.

'23—D. E. Thorne, in the cable office of the Western Union Telegraph company, has changed his address to 1723 Ryder St., Brooklyn, New York.

'24—Frederick R. Kappel has moved to 3540 Harriet Avenue, Minneapolis, Minn. He is still an interference engineer with the North West Bell Telephone company.

'27—John K. Borrowman is an inspector in the U. S. engineering office, 406 Federal Bldg., Milwaukee, Wisconsin.

'28—Lauren V. Boderholm is in the transformer engineering department of the General Electric company at Fort Wayne, Indiana.

'29—Thomas Finnell is a graduate student with the Westinghouse E. and M. Co. at East Pittsburgh.

'29—Lloyd Russ, who was circulation manager of the MINNESOTA TECHNO-LOG last year, is at present in the employ of Westinghouse Electric company, was recently in Minneapolis.

Mr. Russ was sent to the University by Westinghouse to interview senior electrical students in regard to work after graduation.

'29—J. Robert Ginnaty is now at Mansfield, Ohio in the employ of Westinghouse. He is at present engaged in the testing of ranges. Mr. Ginnaty writes, "The last few weeks have found me busier than the conventional cat on a tinned roof. Good old George Westinghouse does not believe in giving his boys much time in which to keep up their correspondence, or engage in any other extracurricular activities. I believe that it will be possible for me to return to St. Paul for the holidays, and if so,—we will have to arrange for an old fashioned Techno-Log banquet. I understand that you are promoting an engineering chorus, glee club or something of the sort. This is certainly a fine undertaking, and one which when backed by Professor Zelener is certain of success. It is something that the University has needed for a long time, and is certain to prove beneficial both to the individuals themselves and to the Engineering College."

ENSIGN LAWRENCE A. CLOUSING, E.E. '28

LAWRENCE A. CLOUSING, who was managing editor of the MINNESOTA TECHNO-LOG during the year 1927-1928, has spent the time since his graduation in flying with the United States Navy. Mr. Clousing was active in naval reserve work while he was a student at the university and shortly before his graduation he received a commission as an ensign in the naval reserve.

In July, 1928, he went to the naval air base at San Diego, California, to begin a year's active duty with the fleet. At the end of a year of service which carried him over a great deal of territory, he decided to continue flying for another year.

During last summer he had an experience that, had it not been for good luck and better management, might have been the occasion for an obituary notice in these columns. This was an airplane accident that cost him several weeks aboard the hospital ship *Relief*.

In describing the accident, "Larry" writes: "The plane I was piloting went into a spin from an altitude of about five hundred feet. I had the spin almost checked when we hit the ground, so we were not hurt so badly as we would have been had the spin continued all the way to the ground. However, the plane was completely wrecked, and my two passengers suffered some bruises, while I received a couple of cracked vertebrae."

Larry has since fully recovered and has returned to active duty. He expects to be in Minneapolis during the Christmas holidays.

While a student at Minnesota, he was known as an excellent journalist and as a student of literature. He is a member of Tau Beta Pi, Pi Delta Epsilon, Eta Kappa Nu, Sigma Delta Chi, Theta Xi, and Plumbob.

Mr. Clousing's present address: VJ one B squadron, Fleet Air Base, San Diego, California.

Mechanicals

'11—Marvin D. Barnum, as sales manager for the Wilcolator Company of Newark, New Jersey, has headquarters in New York City. He was formerly with the Zephyr Washed Air company of Minneapolis.

'25—Larry F. Erskine was married to Eleanor Anderson on September 14, 1929. Larry, who is with the Waldorf Paper Products Co., Myrtle and Pillsbury avenue, St. Paul, is living at 3411 Hennepin avenue, Minneapolis, Minn.

'29—E. C. Tanner is enrolled in the student course of Westinghouse at East Pittsburgh, Pennsylvania. Mr. Tanner is attending the University of Pittsburgh where he is studying for a master's degree.

'29—V. E. Halverson is working for Westinghouse at East Pittsburgh, Pennsylvania. Mr. Halverson plans to enter the machine design department upon completion of the graduate student course.

'29—F. L. Mayer is enrolled in the graduate student course of Westinghouse Electric company at East Pittsburgh. Upon completion of this course, Mr. Mayer is planning to enter to the radio department.

'29—Harold R. Shannon is at present at Fort Wayne, Indiana, in the employ of General Electric company.

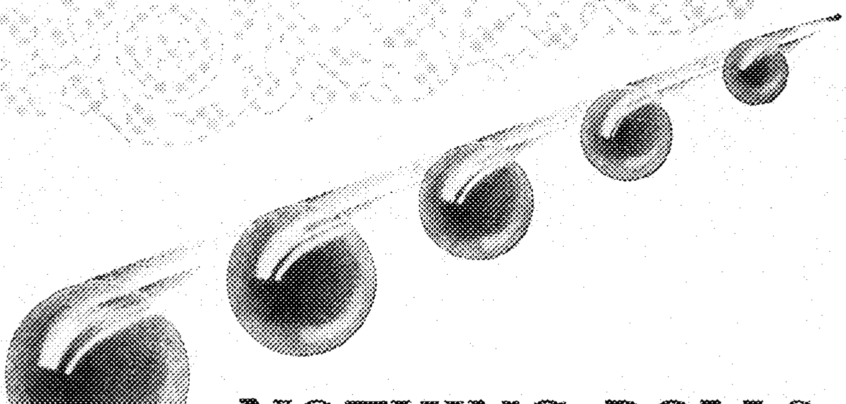
'29—Erling Saxhaug, in Washington with the Bureau of Standards, apparently has had great sport locating Minnesota graduates. To date he has found Dick Texler in the Patent Office, Leo Smilow, Don Stevens and Clint Hawkins, who are in the Lighthouse Bureau, and Will Norley, who is acting as mechanical engineer in the Navy Yard. According to "Sax," a mere bachelor doesn't rate. He has registered in evening classes at George Washington University.

'29—Frank Freeman gives his address as Phillipsburg, N. J., care of the Ingersoll Rand company, because he is "moved around like an old piece of furniture." He is now making drill steels in the blacksmith shop and swinging a sledge between times. Frank says that it is good thing that he is an M. E. or he'd sure miss the bull's eye with that sledge.

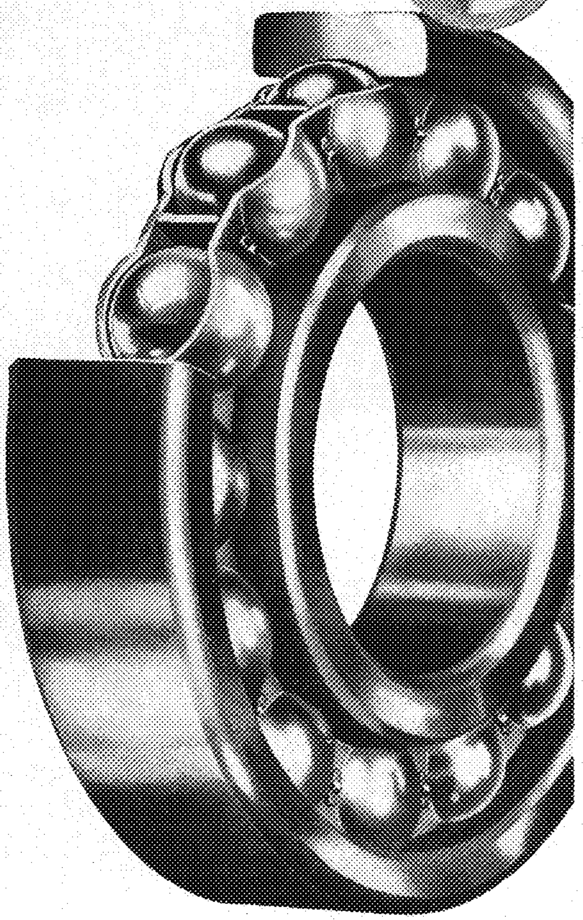
'29—Gordon Reed and Lester Rowell are both at Central Station Institute of Chicago and are spending their time taking courses in electrical measuring. They apparently have the old Minnesota spirit for they attended the Minnesota-Northwestern game at Evanston. We're glad that the team was able to come through, and we're hoping that the series of ups and downs in the game didn't do any permanent damage to your hearts.

'29—William H. Norley is at present employed by the government at Model Basin, Construction and Repair, Navy Yards, Washington, D. C. He is working on design and calculations concerning shapes of small boats as well as aeroplane models and problems.

NEW DEPARTURE BALL BEARINGS



NOTHING ROLLS LIKE A BALL



Designed upon nature's infallible laws of motion, the perfected ball bearing has proved itself invaluable to industry. *For nothing rolls like a ball*—and no ball rolls easier, truer and with less friction than a marvelously accurate sphere of highly polished steel.

Herein lies the reason for the unprecedented demand that has made New Departure the world's largest producers of anti-friction bearings for all industrial needs.

Wherever mechanisms revolve, the New Departure Ball Bearing has attained mastery over friction, wear and high upkeep expense. Makers of motor cars, airplanes, electric motors, electric household appliances, machine tools, farm machinery, mining machinery and many other devices that contribute to the world's progress—have proved conclusively that the New Departure Ball Bearing has the pre-eminent ability to give the utmost in service regardless of speeds and loads.

So universally is this fact accepted that it requires over 165,000 New Departure Ball Bearings daily to supply the demands of these manufacturers.

THE NEW DEPARTURE MFG. COMPANY
BRISTOL, CONNECTICUT
The Largest Bearing Manufacturer in the World

NEWS FROM THE TECHNICAL CAMPUS

Montillon Spends Sabbatical Leave at Mich.

Dr. G. H. Montillon, associate professor of Chemical Engineering, who is absent on sabbatical leave, is studying at the University of Michigan. He is conducting research in the department of experimental engineering on heat transfer in the heating of asphaltic products. Dr. Montillon was awarded the Fellowship of the Utilities Research Commission, composed of a group of manufacturers of chemical equipment.

As a source of heat, he is using a diphenol boiler rather than a steam or mercury boiler, thus conducting an additional piece of research in a new field. Dr. Montillon is a member of the American Chemical Society, Tau Beta Pi, Phi Lambda Upsilon, and Alpha Chi Sigma. He is accompanied by his wife and two boys, and will resume his duties here next summer.

Mann Attends Annual Meeting of A.I.Ch.E.

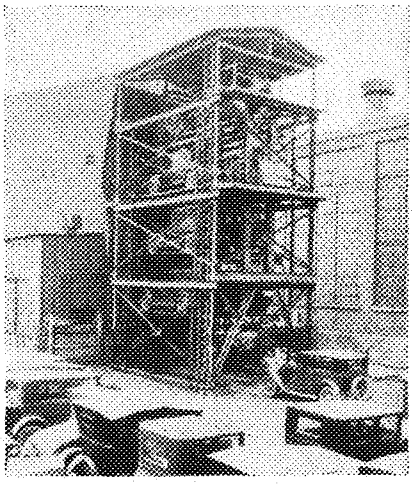
Charles A. Mann, chief of the division of chemical engineering, attended the twenty-second annual meeting of the American Institute of Chemical Engineers at Asheville, North Carolina, December 2. Papers read at the meeting covered the textiles, particularly rayon, and the manufacture of artificial fibers.

Ralph E. Montonna, associate professor of chemical engineering, and Dr. Mann are two of the four Minneapolis members of the Institute. Membership requires at least ten years of technical experience in some responsible position.

The A.I.Ch.E., which has about nine hundred members, is sponsor of the student branch. There are about twelve such branches.

The local student section of the Institute had its inception on the Minnesota campus about two years ago.

A Parking Machine of Recent Invention Might Solve the Perennial Campus Parking Problem



This four story automobile parking machine holds eight cars. One automobile is shown ready to be driven onto an empty stall.

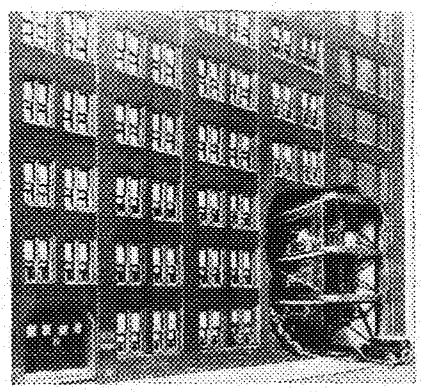
An unusual and unique "parking machine" recently developed by a prominent manufacturing company might be a possible solution of the serious parking problem which has confronted campus drivers for the last few years and which now rises to a crisis.

Parking the car in the last ten seconds before a first hour class would perhaps cease to be a serious problem with the installation of the "parking machine."

The machine consists of two endless chains passing over wheels at the top and bottom. Platforms are suspended between these chains, each providing space for one automobile. The housing for the machine is unique, having no floors. The machine is very flexible in its application. It may be built into a theatre, apartment house, department store, garage or wherever quick parking is a problem.

Machines are parked vertically as shown in the illustration, each platform providing for one car. It will deliver the car required, and only that car, by the insertion of a key, check, or coin in the slot. The delivery of the car is entirely automatic, thereby doing away with the necessity of attendants.

Listed among the advantages of this parking machine are parking in the center of desired locality, keeping downtown streets clear of curb-parked cars, reducing the necessity of street widening, and many other applications.



One of the many applications of the new automobile parking machine is in apartment buildings. This photograph shows a proposed method of installation in an apartment house.

Coffin Fellowships Now Open for 1930-31

The Charles A. Coffin Foundation, established some years ago by the General Electric company, has announced that applications are now being made for the Charles A. Coffin Fellowships for 1930-31.

The terms of the Charles A. Coffin Foundation made provision for the award of five thousand dollars annually for fellowships to graduates of the universities, colleges, and technical schools throughout the United States, who have shown, by the character of their work, that they could, with advantage, undertake or continue research work in educational institutions either in this country or abroad.

The fields in which these fellowships are to be awarded are electricity, physics and physical chemistry.

The committee, composed of Mr. Gano Dunn, representing the National Academy of Sciences, Mr. R. I. Rees, representing the Society for Promotion of Engineering Education, and Mr. Harold B. Smith, representing the American Institute of Electrical Engineers, desires to make the awards to men who, without financial assistance, would be unable to devote themselves to research work. The fellowships will carry a minimum allowance of five hundred dollars. This allowance may be increased to meet the special needs of applicants to whom the committee decides to award the fellowships.

Candidates for the Charles A. Coffin fellowships should file applications on forms provided for that purpose, and obtainable from the secretary. Applications will be welcomed from seniors desiring to do research work as a part of the requirements for an advanced degree as well as graduates for universities, colleges, and technical schools, but any award to a senior will be conditioned upon his graduation.

The committee requests that all applications first be sent to the dean of the educational institution at which the applicant is, or has been, in attendance within the year. The committee desires that the dean or other college executive in turn file all the applications received by him at the same time, together with a statement naming the *two* men applying who in his opinion or the opinion of the faculty are best qualified to receive the award.

Applications must be filed with the committee by March 1, 1930, and should be addressed to the Secretary, Charles A. Coffin Foundation, Schenectady, N. Y.

NEWS FROM THE TECHNICAL CAMPUS

Tau Beta Pi Elects

Tau Beta Pi, honorary engineering scholastic fraternity announces the election of the following men from the senior class: Homer Brown, Harold Clausen, Walter Buehl, Donald Kendall, Ernest Krou, Waldo Larson, Vernon Norman, Sigmund Pass, Earl Peterson, Helgi Punkari, Adolph Ringer, Robert Sandelin, Karl Sommermeyer, Seval Sorenson, Hubert Tierney. The men chosen from the junior class are Morris Newman and Oscar Swenson. Informal initiation took place at the Alpha Chi Sigma fraternity house.

M. S. A. E. Hears Farnum

Lieut. W. C. Farnum, president of the examining board for army cadets, was the principal speaker at the second dinner meeting of the Minnesota Society of Aeronautical Engineers. The meeting, held November 20, marked the appearance for the first time of the new class in aeronautical work.

In his speech, Lieutenant Farnum stressed the completeness of the training given by the army to all men registered in its flight courses, and told of the work that was done in each of the three years that the cadet spends learning to fly. The army course, training men for national defense, has become the most popular flight school in the country, and although college graduation is not a prerequisite for admission, the preference is given to men of college training for it has been proven that they make the best pilots. At the present time there is a waiting list that would take over a year to remove.

Lloyd Kernkamp, president of the society, welcomed the freshmen that turned out for this meeting, and urged them to bring more along to the next. The society, limited to men registered in aeronautical engineering, brings prominent men in aviation to address the students once a month at a dinner meeting, and is the one means that students in this department have of getting together socially while on the campus.

Arabs Initiate Six

Arabs, Engineering Dramatic Organization, initiated six men on Wednesday evening, November 27. The new members are Don Bayers, Steve Gadler, John Madden, J. Lamont Warrington, Gerald Warrington, and Glenn Yaeger. Room 204, Minnesota Union, furnished the setting for the dramatic interpretations offered for the diversion of active members of the organization, by the initiates.

Testing Machine Installed

The experimental engineering department has installed a new Amsler Universal testing machine during the past summer. The machine, which was imported from Switzerland, is equipped for the testing of materials for compression and elasticity.

It works on the hydraulic principle, the force being applied through the medium of oil. Its maximum capacity is 30,000 pounds. The machine is equipped with a recording device which plots the relation of stress to strain according to Hooke's law.

Smith Talks to A. I. E. E.

The Minnesota section of the A. I. E. E. was host to its national president, Professor Harold B. Smith, at a dinner meeting held at the Minnesota Union on the evening of November 27. This has been the first time in its history that a president has talked to the local section.

Following the dinner Professor Smith gave an address on "The Quest of the Unknown." The talk, illustrated with slides, dealt with electrical research in high voltage A. C. engineering which he has investigated since 1893. He showed the first practical transformer for producing a line voltage of 10,000 volts and followed with the development of transformers, by himself and his assistants up to the present day limit of 340,000 volts. Professor Smith predicted that by 1932 the limit will have been raised to 400,000 volts or more.

He also showed some slides on the creation of artificial lightning in the laboratory. He stated that some of the results in his experiments with over a million volts were very "shocking" both to himself and his co-workers.

Professor Smith graduated from Cornell in 1891. The following year he was appointed professor of electrical engineering at the University of Arkansas. From 1893 to 1896 he was director of electrical engineering at Purdue University. Since then he has been associated with the Worcester Polytechnic Institute as professor and head of the department of electrical engineering. Besides being president of the A. I. E. E., Prof. Smith is a member of the A. S. M. E. and the B. I. E. E.

STUDENT ACTIVITIES INDEX

As the result of a constant demand for information by various student organizations, the TECHNO-LOG *publishes this brief questionnaire in the hope that it will become the means of acquainting students with technical campus activities and will aid the various organizations in ferreting out latent talent among the technical students.*

Please fill out this sheet as completely as possible and drop in one of the boxes for that purpose or bring it to the TECHNO-LOG *office in room 37 Electrical Engineering building.*

Name .... College .... Class ....

Address .... P. O. .... Telephone ....

What experience have you had in business, publicity, magazine, or newspaper work? ....

What experience have you had with stage design, posters, or other art work? ....

What dramatic or technical stage work have you had? ....

....

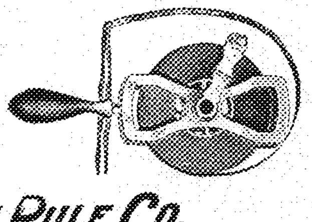
What musical instrument do you play? .... Do you sing? .... What voice? ....

Previous training? .... Chorus, Glee club, etc.? ....

Debate? .... Oratorical? ....

Other experience ....

....




Honesty
Character
Savings

THE WAVE LENGTH OF AN ELECTRON

(Continued from page 79)

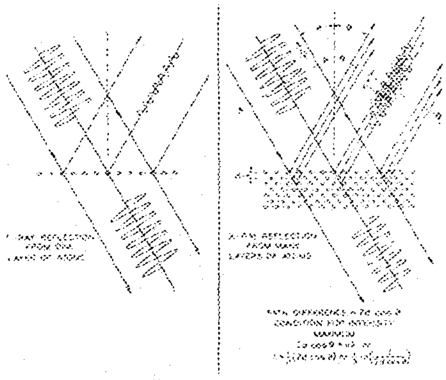


FIG. 8. DIAGRAM ILLUSTRATING THE SELECTIVE REFLECTION OF X-RAYS FROM A CRYSTAL.

ing potential in the following manner. We have $\frac{1}{2}mv^2 = \frac{Ve}{300}$ where we equate the kinetic energy to the difference of potential energy.

$$\text{Now } \lambda = \frac{h}{mv} \text{ or } v = \frac{h}{m\lambda}$$

$$\text{Hence } \tfrac{1}{2} m \left\{ \frac{h^2}{m^2 \lambda^2} \right\} = \frac{Ve}{300}$$

or $= \frac{12.25}{V^{1/2}} \times 10^{-8}$ cm. when the numerical values are substituted and V is measured in volts. Thus a 54 volt electron has a wave length of 1.67×10^{-8} cm., a wave length which in optics would be in the X-ray region.

Since, for regular reflection from layers parallel to the crystal surface, we must satisfy the equation

$$2d \cos\theta = n\lambda \text{ or } \frac{1}{\lambda} = n \frac{1}{2d\cos\theta}$$

with n set equal to integral values, and from the above, V is proportional to $V^{1/2}$, we can now explain Fig. 7. Close observation however shows that the maxima are not spaced at exactly integral values of $\frac{1}{2d \cos\theta}$. But if we extend our formulas to include an index of refraction of the electron waves, we can then locate these maxima quite accurately by assuring the index of refraction is unity for very fast electrons and becomes somewhat larger for slower electrons. This it seems is additional evidence that the electrons have wave properties.

Attempts have been made to polarize the electron waves but so far without success; possibly because we do not have the proper polarizing device.

The question is often asked, "Is the electron then really a wave?" "Can we no longer think of it as a small concentrated charge?" To each of these questions we can answer "yes" and "no." As far as determining the direction the electron will move or where we may find it, we shall need to consider it a wave. And that is exactly the same basis we have for thinking of X-rays or light as a wave motion. To locate light or X-rays we solve the problem as if light were waves. However, some of the effects of light are not acounted for by a wave nature, for example, the photo-electric effect and Compton effect. Similarly we may locate an electron when scattered by a "grating" by considering it as a wave but many of its effects such as charging an electroscope, are accounted for by other properties. Thus we are apparently as justified in speaking of the wave length of an electron as we are in speaking of the wave length of an X-ray.

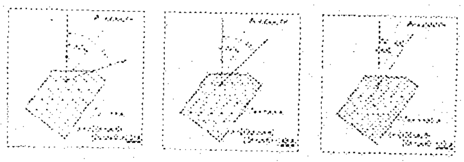


FIG. 9. PRINCIPAL DIFFRACTION BEAMS IN A-AZIMUTH FOR X-RAYS.

A new generator which develops 220,000 horse power has recently been installed in the Hell Gate Station, New York City. It is the largest turbine type generator in the world.

A ferro-chrome alloy that will repeatedly withstand temperatures of 2,000 degrees Fahrenheit, in contact with molten metals has recently been developed.

Lead "mattresses" are used to act as shock absorbers between the foundations and the steel work of skyscrapers.

LOAD CAPACITY OF BALL BEARINGS

(Continued from page 81)

service, 5000, as it did under the first given conditions.

Practical experience has proved the above general rules as regards speed and capacity. Manufacturers of ball bearings usually give their catalog rating of capacities for the whole range of speeds for which the bearing is designed. Fig. 2 shows the relation between capacity and speed for radial type ball bearings, and is based upon actual catalog ratings.

There is no such thing as a fluid-borne load where ball bearings are used, for it is not possible for an oil film to form between the balls and the raceways. The problem of lubricating ball bearings is therefore entirely different from that of plain bearings and very much simpler.

The lubricant is not so important in ball bearings as might be imagined by those who are familiar with plain bearings. Ball bearings generally run cooler when dry than with a lubricant. This, however, does not mean that lubricant should be kept out, for, on the contrary, lubrication is exceedingly desirable.

One of the worst enemies of ball bearings is rust or corrosion of any kind. Not only do the surfaces become pitted and thereby weakened as a result of rust, but the oxide of iron is a destructive abrasive which starts wearing the bearing. To prevent this condition, it is necessary to provide proper protection. The most important function of a lubricant in a ball bearing is to provide this very necessary protection. The actual lubricating property of the lubricant used is not so important as its freedom from acid and its effectiveness as a preventative of rust.

It is as necessary to lubricate between the separators, or retainers, and balls as it is to lubricate between any two rubbing surfaces. The ball separator does not carry the bearing load, and, therefore, the friction between the balls and separator is small, but some lubricant should be used.

Grease is usually found to be satisfactory for speeds up to 500 or 600 R. P. M. Heavy oils serve well in this same range of speed. For speeds from 500 or 600 R. P. M. up to about 2500 R. P. M. medium or light oil should be used. For higher speeds, light or very light oil should be used, according to the speed. If the temperature surrounding the bearing is more than 150° F., then heavier oils than those suggested above may be used with satisfaction. For bearings that take shafts much larger than 2" diameter, due allowance should be made for the higher speeds at which their parts will travel.

When oil is used, the housing of the bearing should be filled up to about the center of the lowest ball so that the balls can carry the oil to all parts. If more oil than this is put in, it will only be churned about, especially if the speed is high, and may cause excessive heating.

When grease is used, the housing of the bearing should be filled about one-half or three-quarters full. When grease is thrown or pushed out of a bearing, it does not flow back as readily as does oil, and, therefore, a greater supply of it is necessary to insure proper lubrication.

Aside from the difficulty of keeping thin oils in ball bearing housings that are not especially designed to retain it, thin oils could be used for all speeds, low as well as high. The only reason for suggesting the use of heavy lubricants when the speeds are low is to avoid the loss of the lubricant from housings that are not tight enough to retain a thinner lubricant. For high speeds, thin oil must be used and the housing must therefore be made tight enough to retain it.

The frequency of renewing the lubri-

(Continued on page 106)


EFFICIENCY
FACTROLITE glass contributes to efficiency by making possible the fullest use of daylight. 900 prisms to the square inch break up the rays of light and soften the glare. It speeds production by transforming blinding daylight into working light. Factrolite (Plain or Wire Glass) sold by distributors everywhere. Send for samples.
FACTROLITE
MISSISSIPPI WIRE GLASS CO. . . . 220 5TH AVE., N.Y.

NEWS FROM THE TECHNICAL CAMPUS

Air Maps to Be Sold

The U. S. Coast and Geodetic Survey is establishing a mailing list in order that those who wish may receive prompt notification when new airway maps are for sale. The airway strip maps published at present are drawn to the scale of 1 to 500,000. These strip maps show roads, sections, railroads, towns, elevations and place special emphasis on features of importance to aerial navigation such as airports, auxiliary landing fields, beacons, high-tension lines and magnetic courses. After their compilation, flights are made over the territory covered to check their accuracy.

Pi Tau Sigma Initiates

Pi Tau Sigma, honorary Mechanical engineering fraternity, announces the initiation of the following men for 1929: Class of 1930, R. J. Baskerville, W. J. Eckley, A. E. Bauer. Class of 1931, P. K. Honey, R. E. Harden, R. M. Meyers, P. J. Wiggins.

H. B. Wilcox, professor of mathematics and mechanics, co-author of the present text on statics and dynamics, was taken in at this time as an honorary member.

Mortar and Ball Elects

At a banquet honoring fifteen initiates and three newly installed officers, the Minnesota Chapter of Mortar and Ball, national honorary artillery officers fraternity, started its tenth year.

The officers were changed this year from four to three by combining those of first and second lieutenant into one. The new officers are, R. W. Stoebe, Captain; Clarence M. Haupt, Lieutenant, and George L. Otterson, Sergeant. They succeed John J. Skidmore, Eugene Weber and Robert Ramsdell, and Roland Stoebe respectively.

The fifteen initiates are Charles E. Calverly, Irving G. Grant, John A. Swanson, Stanley J. Larson, Lloyd B. Knutsen, Kenneth H. Newton, Clifford C. Mellin, Harold V. Kindseth, H. Duncan Watson, John J. Connoy, John M. Merzweiler, Wendell E. Johnson, Henri B. Brunet, Ford O. Rowell and Russell L. Koerger.

Lieutenant John Cassidy acted as toastmaster at the banquet. Lieutenant Ericson and Major Shippam were guests of honor.

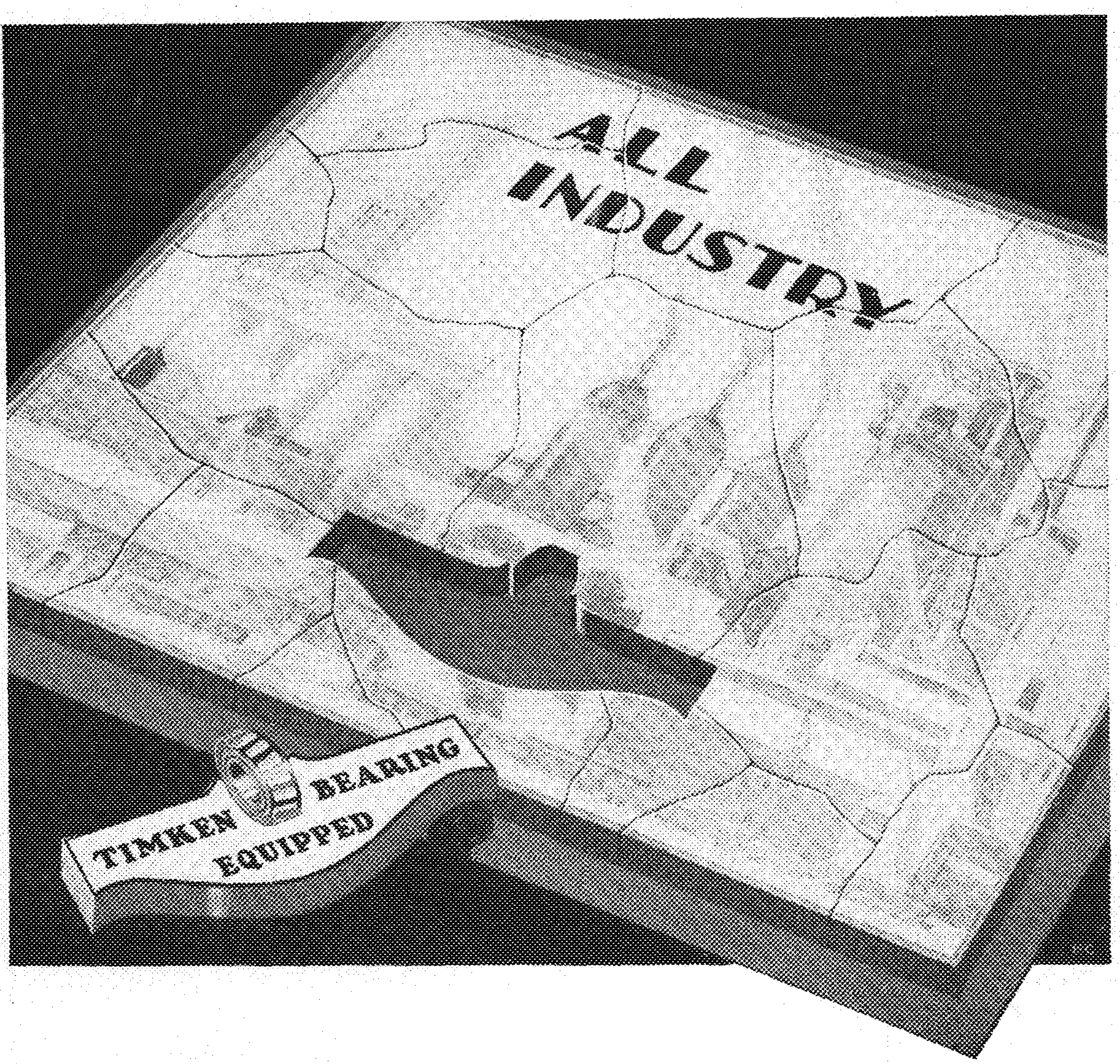
If you wish to be agreeable in society you must consent to be taught many things which you know already.

Eta Kappa Nu Elects

Eta Kappa Nu, honorary electrical engineering society, has added seven men from the senior and junior classes to its roster. The men who have successfully passed the trials of an informal initiation and quizzes, and who were formally initiated on December 4th, are: Helgi Punkari, Milo Rollins and Donald Kendall, all seniors; and Morris Newman, Alfred O. C. Nier, and Andrew Hustrulid of the Junior class. Rudolph Hanson, another junior who was attending an A.I.E.E. convention in Chicago at the time of the initiation, will join the actives soon.

A. S. M. E. Holds Smoker

The American Society of Mechanical Engineers in conjunction with the Minnesota Society of Aeronautical Engineers recently held a smoker in the Minnesota Union. The purpose of the meeting was to introduce the new members of both organizations to the faculty members of the department of mechanical engineering. Professor Mattenis outlined the activities of the student branch, while Professor Du Priest spoke of the relationship existing between academic and professional engineering societies.



Solving The Production Puzzle

What puzzles Industry most is Waste. The moment "Timken Bearing Equipped" is placed into the picture, the bearing problem is solved—Waste meets its Waterloo; friction loses its grip; lubricant becomes a matter of little or no consequence; machinery stays young; costs catapult downward; profits soar skyward—for Timken is *the one bearing that does all things well.*

Timken Bearings will figure even more prominently in future production plans throughout all industry, and student engineers will find that a thorough understanding of Timken applications and possibilities is one of their most valuable assets.

Let the load be all *radial*, all *thrust or both in combination* . . . let the burden be heavy . . . the pace killing . . . the exclusive combination of Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken steel adapts itself to the situation and carries on.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN *Tapered Roller* BEARINGS

A. C. S. Elects Officers

The Minnesota section of the American Chemical society elected the following officers at its last meeting: Dr. A. A. Schaal, chairman; C. C. Furnas of the U. S. Bureau of Mines, vice-president; Professor George Glockler, secretary; and Professor G. B. Heisig, treasurer.

At the last meeting of the year, Professor Charles A. Kraus spoke on "Atmospheric Elements." Dr. Kraus has taught at Massachusetts Institute of Technology and at Clark University, and is the author of the American Chemical Society monograph on the properties of electrical conducting systems.

Austria to Have Festival

Max Reinhardt, of "The Miracle" fame in this country, will be the most important figure in the staging of the world-famous dramas in the Reinhardt and Mozart Festivals, which will take place in Salzburg, Austria, beginning the last week in July and continuing until the end of August, 1930, it was announced today by Kommerzialrat Georg Jung, proprietor of the Grand Hotel de l'Europe, in Salzburg, Austria, who is visiting the United States in the interest of this event.

Appearing under Mr. Reinhardt's direction will be such figures, by now noted in America, as Alexander Moissi, Emil Jannings, and Werner Kraus and many others. The great Melba, now well advanced in age, and retired, will be one of the features. These Festivals, which have now become an annual feature in Salzburg, regularly draw a great attendance of Americans. It is expected that this year's, which is by far the most ambitious of these events so far, will prove even more attractive than the others.

Pi Tau Pi Sigma Elects

Pi Tau Pi Sigma, honorary Signal Corps fraternity, held its fall formal initiation Sunday afternoon, December 8, in the Minnesota Union.

Following the initiation ceremonies there was a banquet at the Curtis Hotel at which Lieutenant Comstock acted as toastmaster. Following the dinner Major Farel welcomed the new members and Lieutenant Biltz responded on behalf of the new men. Lieutenant Carl E. Swanson of the O.R.C. spoke on "Pi Tau Pi Sigma from the standpoint of an alumnus." Several others were called on for impromptu talks.

The newly initiated members are, Francis Biltz, Wesley Taylor, Lyman Swendson, Stanley Olin, Gerhart Quanrud and Leland Bauck.

Harder Talks in Milwaukee

Oscar E. Harder, professor of metallography, addressed the Milwaukee chapter of the American Society for Steel Treating Tuesday, November 12, on the "Fundamentals Principals of Metallography as Applied to the Microscopic Examination of Metals and Alloys."

Professor Harder, who has been chairman of the Northwest chapter for about two years, was recently elected to the board of directors of the national organization for 1930-31. The national organization has about five thousand members.

BALLBEARINGS

(Continued from page 102)

cant depends very much upon the operating conditions of the machinery. Under conditions where the bearings can be kept clean, renewal might be made two or three times a year. Under more severe conditions where it is possible for dirt, sand, or other abrasive material to work into the bearings, renewal of the lubricant should be made much more often, once a month or, possibly, once a week, depending entirely upon the conditions. A close observation for a short time after the installation will enable one to better estimate the proper period of time for renewals, and thus prolong the life of the bearing.

Reproduction of an old wood-cut showing one of the early phases of Vertical Transportation

UNITED SHOE MACHINERY CORP. BLDG., BOSTON, MASS.
Parker, Thomas & Rice, Architects *Henry Bailey Alden, Associate Architect*

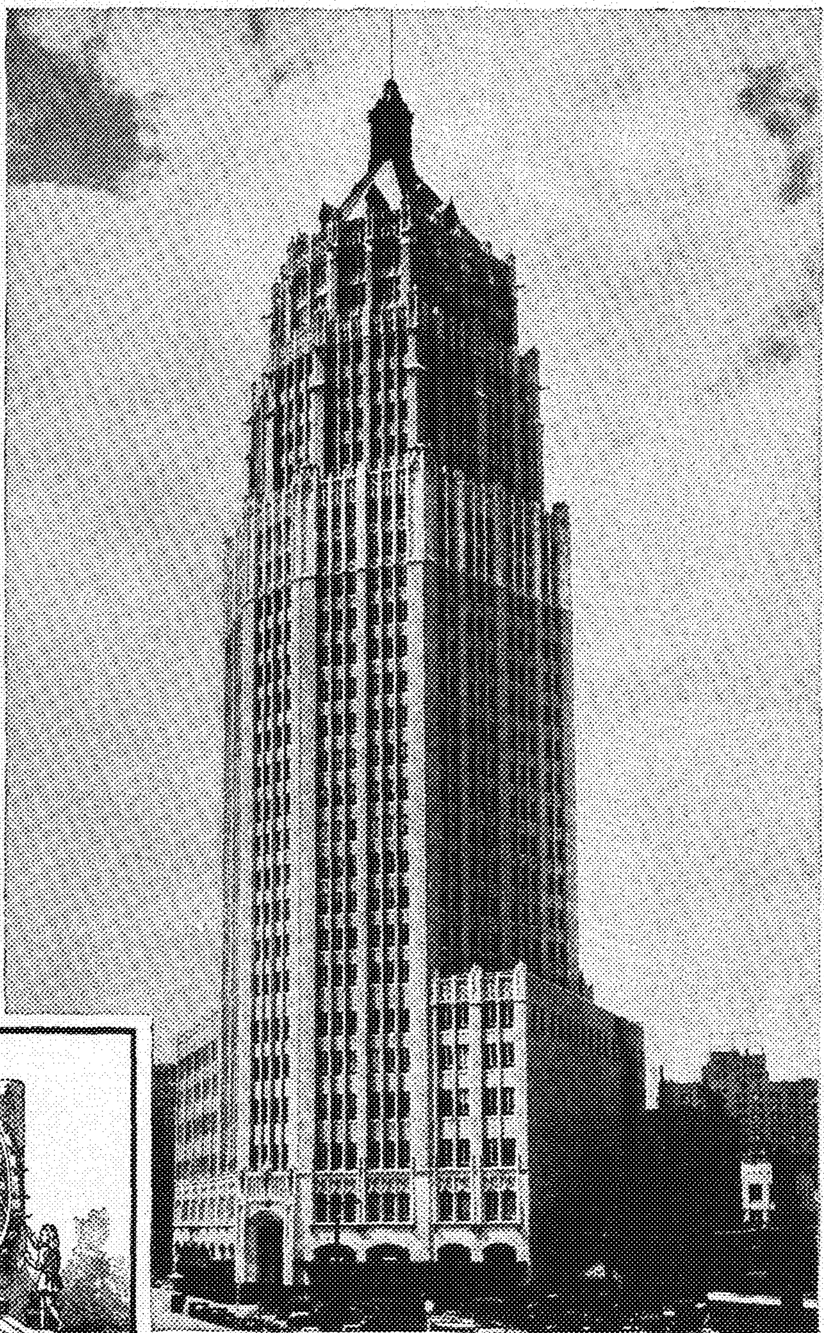
The MINNESOTA TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL STUDENTS

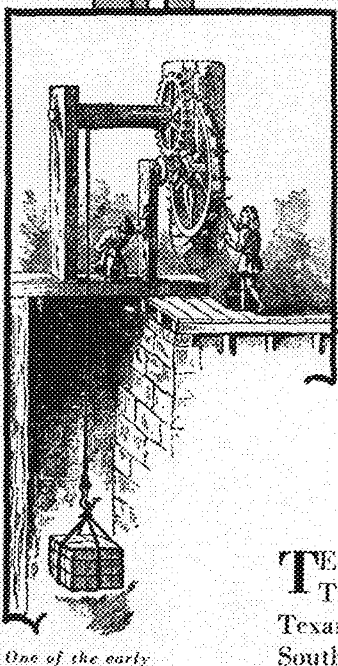
MEMBER ENGINEERING COLLEGE MAGAZINES ASSOC.

Vol. X JANUARY, 1930 No. 4

Balance
All Cameron Pumps are placed in perfect static and dynamic balance before shipment. This is conducive to long life, and minimizes wear on the rotating parts.
Cameron Pumps are built and sold by Ingersoll-Rand Co., 11 Broadway, New York.
Ingersoll-Rand
Cameron Pumps



SMITH-YOUNG-TOWER BUILDING, SAN ANTONIO, TEXAS
Atlee B. Ayres — Robert M. Ayres, Architects



One of the early phases of Vertical Transportation

THE MINNESOTA

TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

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

VOLUME X | MINNEAPOLIS, MINN., JANUARY, 1930 | NUMBER 4

CONTENTS

PAGE

AIRPLANE ENGINES - 113
B. J. Robertson

PLACING CONCRETE IN WINTER - 116
W. C. Hill

STABILITY OF RIVER BOATS - 117
S. E. Nortner

MOVING PICTURES IN COLOR - 118
G. C. Matthews

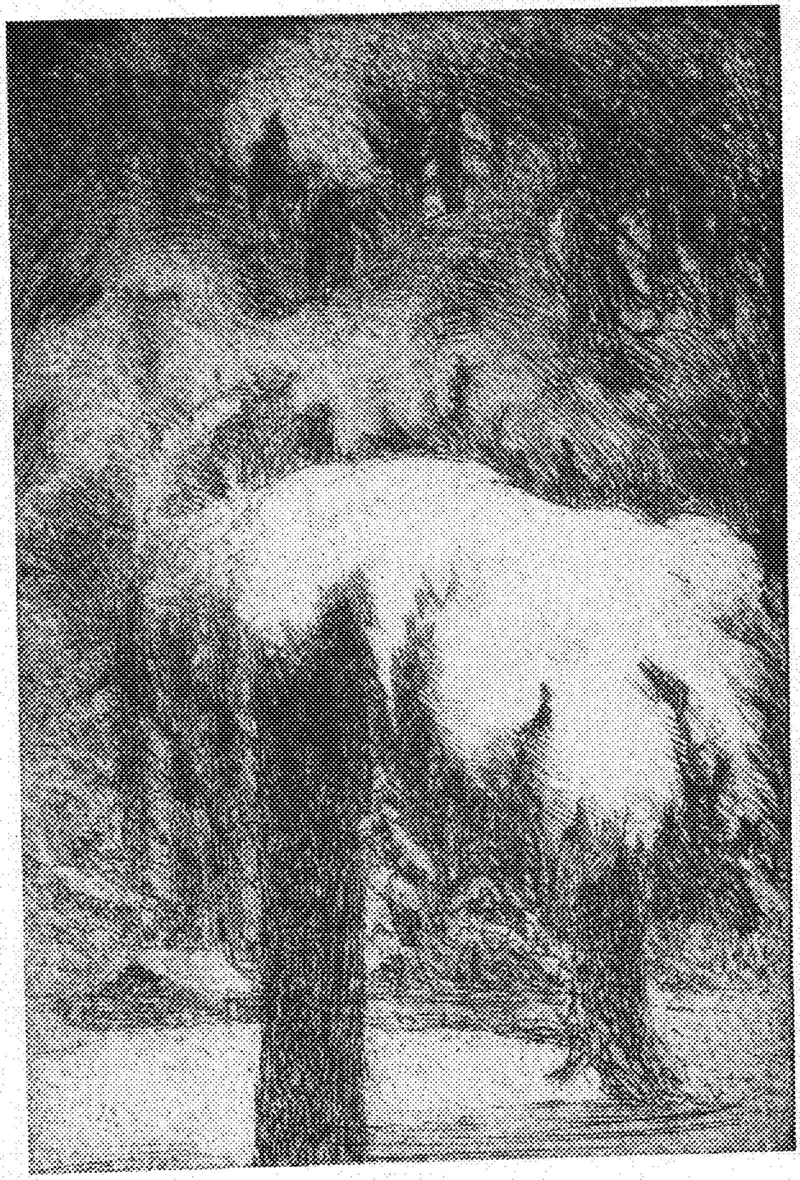
MATHEMATICS FOR ENGINEERS - 120
R. W. Siler

CONSOLIDATION OF RAILROADS - 122
J. P. Shirley

EDITORIALS - 124

ABOUT THE WORLD WITH OUR ALUMNI - 126

Entered as second-class matter April 9, 1925, at the post office at Minneapolis, Minnesota, under the Act of March 3, 1879. Office, 37 Electrical Building, University of Minnesota. Telephone, Dinsmore 2760. Contents copyrighted and permission must be secured for re-publication. Subscription rate, $1.50 a year. Single copies, 25 cents. Advertising rates upon application. Alumni Directory, 50 cents.



WINTER AMONG THE PINES

From an Etching
by
S. Chatwood Burton
(Dept. of Architecture)

"When Winter Comes"

The MINNESOTA TECHNO-LOG

University of Minnesota

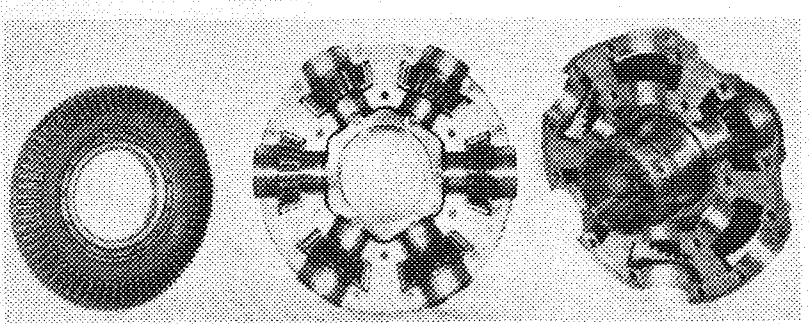
Volume X JANUARY 1930 Number 4

AIRPLANE ENGINES

By B. J. ROBERTSON

Director of Experimental Laboratory

AT a time when every motorist wore large gauntlets, goggles, and a long linen duster, and when no driver would think of passing a brother in distress, in fact, every stalled car was surrounded by a large and interested crowd who always insisted upon advising the owner what he ought to do to get the thing started again, when nearly every car was stalled at least once a day, and when a motor trip of a hundred miles was considered an achievement, at that time, about 1903, the famous Wright Brothers had the temerity to entrust themselves in the air with a motor scarcely more reliable than the one by the roadside.



PATENTED 2:1 REDUCTION GEAR USED IN PRATT & WHITNEY ENGINES.

Their first flight was made with a four cylinder engine like the common four cylinder engine of today, except that it was tipped over on its side so that the cylinders were horizontal. A second engine which they used in 1906 when giving exhibition flights was also four cylinder in-line, water-cooled, but upright like our modern automobile motors. It was much lighter than the engines of its day, and developed 30 to 35 horse power, just a little less than the engine in the Model A Ford. It weighed 180 pounds, about six pounds per horse power. It used a gasoline pump instead of a carburetor and turned over 1800 times per minute, an extremely high speed for that time but a very moderate speed today when some racing engines reach 6000 revolutions per minute.

The Wrights realized that light weight was a prime requirement, and it is still of first importance, i. e., relative light weight. An engine weighing 1500 pounds may be relatively lighter than one weighing 150 pounds. If the 1500 pound engine develops 1200 horse power, it will weigh 1¼ pounds per horse power, and if the 150 pound engine develops 25 horse power, it will weigh 6 pounds per horse power and will be relatively the heavier engine of the two. Of course, the large engine will require a large plane and cary carry 15 or more passengers, while the small plane with the 25 horse power engine will do well to perform successfully with its pilot as the sole load. Twenty-five pounds gross weight of plane, fuel and passengers per horse power is the maximum load with which it has been possible to take off. Lindbergh's gross weight was slightly more than 23 pounds per horse power. Fifteen to 18 pounds per horse power is the average gross load of passenger planes; Navy pursuit planes carry as little as 7 pounds gross load per engine horse power. Larger engines weigh less per horse power.

Huge planes were beyond the imagination of those who developed the first engines; e. g., one of the first attempts of the Curtiss company was an engine known as their number A-2,—it was between 3 and 4 inches wide, 10 inches long, and 17 inches high, and weighed 50 pounds. It would have compared favorably with a hardware salesman's sample case and was a wonder in compactness, but developed only 7 horse power and was never used in an airplane.

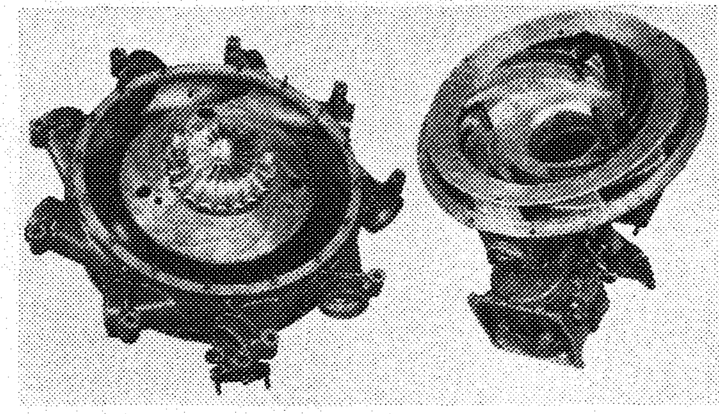
The struggle for less weight per horse power has gone on and is still the goal of many engine manufacturers. An extra pound of engine weight calls for an extra pound of fuselage, wings, etc., and the two extra pounds again call for more horse power, so that an extra pound of engine weight increases the gross weight of the ship about 3 pounds. The average weight of the modern high grade airplane engine is now between 1½ and 2 pounds per horse power. Automobile engines average about 10 pounds, and truck and tractor engines about 20 pounds per horse power. At 1½ pounds per horse power, the engine of a collegiate Ford would weigh about 25 pounds and for safety sake might be carried into the house whenever the owner feared it might be tampered with. Unfortunately, such low relative weights can be obtained only in engines of several hundred horse power. Engines for small planes, such as would ordinarily be bought by individuals, weigh from 2½ to 3½ pounds per horse power.

Reducing the weight of the engine is an expensive process, and it has been accomplished by very ingenious design and by the use of new alloys of aluminum, magnesium, copper, nickel, etc. Some of these alloys are lighter than aluminum, also stronger, but, as may be expected, they are expensive. For commercial work, the more expensive engine is often the cheapest in the long run, not entirely on account of reliability, but on account of operating expense and because engine weight can be supplanted by pay load. Keeping in mind that every pound of added engine weight increases the gross weight of the ship three pounds, it may be shown that an engine costing $24.00 per horse power may be actually cheaper than an engine costing $12.00 per horse power.

The relative weight of an engine can generally be decreased by increasing its speed. A light engine at high speed may deliver as much as a heavy engine at low speed. The average gasoline engine converts about 20 per cent of the energy in the fuel it burns into power. The faster the engine turns over, the more gasoline will be drawn into it and burned, and, consequently, more power will be realized. However, the useful speed of any engine is limited by the inertia of the reciprocating parts and the time required to admit the gasoline and air and to exhaust the burned gases through the valves. The principal objection to speeding up the airplane engine is the decrease in propeller efficiency at high tip speeds. Eight hundred feet per second is a desirable maximum; in fact, the propeller is most efficient when the speed of the plane is about one-third of the tip speed, so that the maximum r. p. m. varies with the kind of plane, length of propeller, etc. For the ordinary sized propeller, speeds of from 1400 to 1800 r. p. m. are good averages. Any gain in engine power by increasing the speed is likely to be offset by losses in the propeller and the net result is the burning of more gasoline without the corresponding advantage in airplane performance. The Wright brothers used a chain and sprocket reduction drive; modern engines use reduction gears. Drives of many ingenious constructions have been used, but the added weight of the gears often cancels the gain in lightness obtained by speeding up the engine. There are arguments, of course, on both sides of these questions, and you will find geared engines and direct connected engines marketed by very reliable manufacturers.

Figure 1 shows a recently developed 2:1 reduction gear used on Pratt and Whitney engines. The propeller is fastened to the plate carrying the small bevel gears. One of the large bevel gears is fastened to the engine crank shaft while the other is stationary. Thus the propeller speed is one-half the engine speed. The stress is divided between six small gears, and a maximum strength is obtained with minimum weight.

The airplane engine should offer the least possible head resistance to propulsion through the air. One of the chief objections to the radial engine is its large frontal area. A large number of experiments were made on different forms of cowling at Langley Memorial Field, resulting in the development of a cowling which would reduce friction and allow proper cooling of the engine. The plane with the cowling shown in Figure 2 attained a speed of 137 miles per hour, while 118 miles per hour had been the maximum with the ordinary type of cowling, a net gain of 19 miles per hour or 16 per cent. The engine appeared to be adequately cooled.



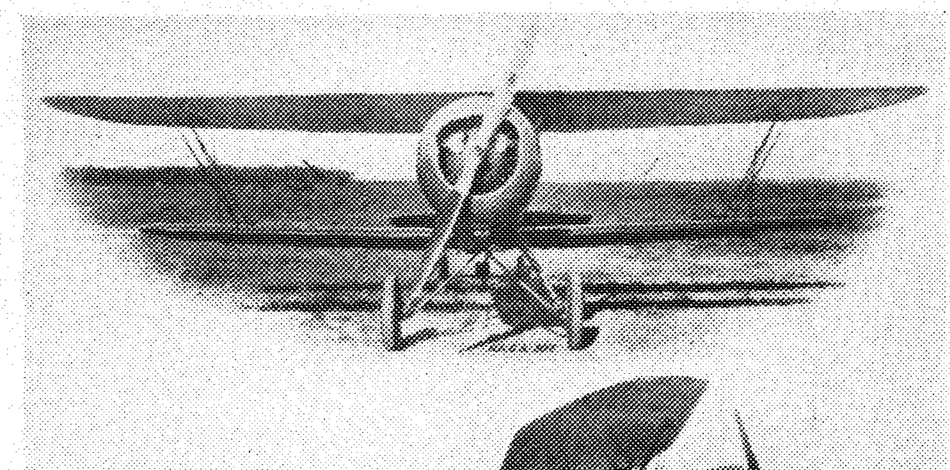
INTERIOR OF INDUCTION SYSTEM.

On account of the head resistance, air-cooled in-line engines have been developed with considerable success in the smaller horse powers.

Compactness is also desirable and has been accomplished to a marked degree in water-cooled engines, but the water-cooled engine must be equipped with a radiator, which offers additional head resistance.

Very recently the United States government experimented with ethyl glycol which has a boiling point of 387° F., for use as a cooling liquid, with the object of running the engine at higher temperatures and thus reducing the heat given to the cooling medium, and, also, increasing the cooling capacity of the radiator. Obviously, the hotter the radiator, the more heat it can dissipate to the surrounding air. It was found that radiators could be greatly reduced in size and the head resistance cut down.

An extreme case of compactness of design is illustrated in the Packard X type of engine. The cylinders are arranged in four rows of six cylinders each, two rows at the top and two rows at the bottom, so that looking at the engine from the end, it has the appearance of the letter X. The cylinders were placed so close together lengthwise that the crank cheeks were made round and served as the crank shaft bearings. Thus the crank shaft became 7½ inches in diameter. 1250 horse power was developed by this engine with a weight of 1⅜ pounds per horse power. This one engine is equivalent in power to 14 large Buick engines.



CURTISS AT-5 AIRPLANE WITH NO. 10 COWLING.

In 1917, the time between overhauls on airplane engines was about 10 hours, while engines now travel 30,000 miles and even 50,000 miles btween overhauls. This record is not excelled, even by high-priced automobiles. While the airplane engine operates continuously at from 75 to 85 per cent full power, the automobile engine operates at 25 per cent full power a large portion of the time. The ignition is waterproof and often shielded so that it will not interfere with radio transmission to and from the ship. Two complete and independent ignition circuits are employed, with two separate magnetos, and two spark plugs in each cylinder.

The Department of Commerce Survey for the first half of 1928 shows that only 16.6 per cent of the accidents in civil air navigation were caused by engine trouble, while 43 per cent were due to errors by the pilot. The mechanical portion of the aircraft is much more reliable than the human machine. Before a manufacturer can place his engine in a plane approved by the Department of Commerce, he must have submitted his engine for a 50 hour test at its full rated horse power. Ten five-hour tests are run, and a failure rejects the engine. The airplane engine has become one of the most reliable in the entire internal combustion engine family.

Many readers will recall the fatal balloon trip of Captain Gray when he endeavored to establish a new altitude record. The instruments in his balloon indicated he had been up 8 miles and that, although he had a supply of oxygen with him at that altitude, it became exhausted before the balloon could descend and he suffocated. The density of the air became so low that sufficient oxygen was not available to support life. Engines depend on the oxygen in the air and suffocate at high altitudes. A formula for the air pressure at any altitude is:

$$h = 62900 \log_{10} \left(\frac{14.7}{p} \right)$$

Where
h is the altitude above sea level
p is atmospheric pressure

The air density varies directly as the pressure and inversely as the temperature, but the temperature drops only about 3.4° F. per 1000 ft. increase in altitude, so that the decrease in pressure is much the greater factor, and, consequently, the air becomes less and less dense until there is not a sufficient amount of oxygen to combine with the fuel. Mixtures of air and gasoline will explode when the ratio of air to gasoline by weight is between 20 to 1 and 8 to 1. Beyond these limits, the mixture will not ignite. About 15 to 1 is the ideal proportion. Unless some provision is made to reduce the gasoline fed by the carburetor nozzle as the altitude increases, the mixture will become too rich and the engine will stop. Aircraft carburetors are provided with means to reduce the gasoline flow or arranged to allow less restricted air flow at high altitudes. Either method compensates for the tendency of the mixture to become too rich, within moderate limits.

Another remedy is to use superchargers. A very reliable supercharger driven by an exhaust gas turbine is manufactured by the General Electric company and a number of gear driven superchargers are also used. Army pursuit planes with the General Electric turbo superchargers have reached an altitude of 20,000 feet in 11 minutes and can continue to climb at that altitude at the rate of 1500 feet a minute. The maximum ceiling with this equipment is 32,000 ft. Such superchargers often operate at 30,000 r. p. m. Captain Street and Captain Stevens of the War Department recently reached a height of 7 miles in an airplane with a supercharged engine.

Many Radial engines are provided with a gear driven centrifugal type of supercharger such as is shown in Figure 4. It is placed between the carburetor and the inlet manifold and acts as a distributor for the fuel and air mixture.

The impeller blades are shown on the left, together with the connectors for the inlet pipes to the various cylinders. The distributing channels with the carburetor attached are shown on the right. This type of supercharger produces a pressure of from one-half to one pound in the inlet manifold, and may be geared up to produce three pounds pressure. If an engine were supercharged enough to maintain sea level pressures at high altitudes, and consequently, sea level horse power, the engine will speed up and probably exceed the safe engine speed because the propeller will not absorb its rated power where the air is so rarified.

Diesel engines have been under development for trucks, tractors, and automobiles for a number of years and are not yet in common use. The Packard Motor Car company has developed a radial air-cooled Diesel engine weighing three pounds per horse power which has been flown successfully, and is preparing to build them commercially. The engine has been developed by L. M. Woolson of the Packard company and Dr. Dorner, inventor of the Dorner engine in Germany.

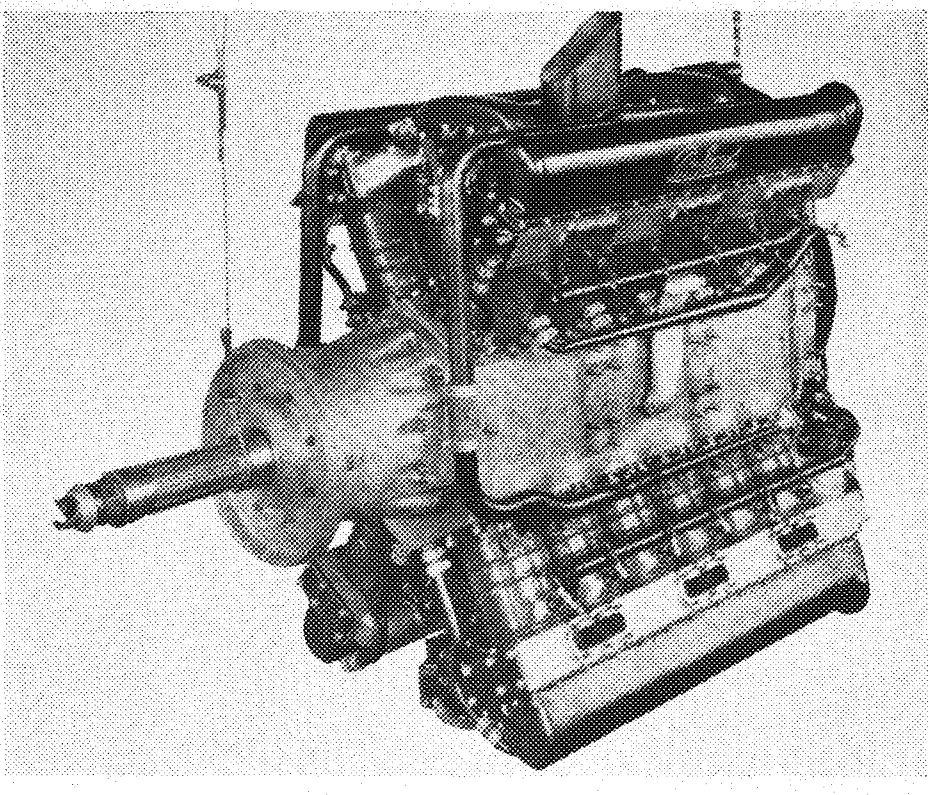
The Diesel engine uses a heavy fuel oil of low volatility which does not form explosive vapors in case of a leak or accidental spilling. Hence the fire hazard which is normally of considerable moment is greatly reduced. Less fuel per horse power hour is claimed for this engine and the cost of the fuel is perhaps one-third that of aviation gasoline.

Of course, no ignition apparatus is necessary, and a single valve performs the functions of both inlet and exhaust valves. No inlet manifold is necessary, as air only is drawn in on the suction stroke and the fuel injected by a fuel pump for each cylinder.

While this engine is called a Diesel engine, it operates more nearly on the Otto or explosion cycle and might more appropriately be called a compression ignition engine. The maximum pressures in the cylinder are about 1200 pounds per square inch, a little over twice those encountered in the Diesel engine and about three times those occurring in the gasoline engine. Junkers in Germany has also built an aircraft Diesel engine, while a large dirigible type of aircraft is being built in England which will use Diesel engines.

Air-cooled engines are built in horse powers ranging from 75 to 600 h. p.; water-cooled engines up to 1200 h. p. V, W, and X types are popular in the water-cooled engines, with the V type often inverted, as shown in Figure 5, since it allows more clearance between the ground and the propeller and better vision for the pilot. While in-line engines are used for small horse powers and radials, single and double row are used in the air-cooled engines.

The airplane engine is truly one of the marvels of the age. It is unbelievably light, its fuel economy is better than its predecessors and most of its contemporaries, except the Diesel. It is compact, it will stand full load and continuous service. It is reliable and operates over a wide range of temperatures, climates, and altitudes. Millions are being spent in research and development by the manufacturers and the government, and the future will see many improvements and perhaps radical changes in a power plant that is already far ahead of the dreams of a few years ago.



PACKARD X TYPE ENGINE

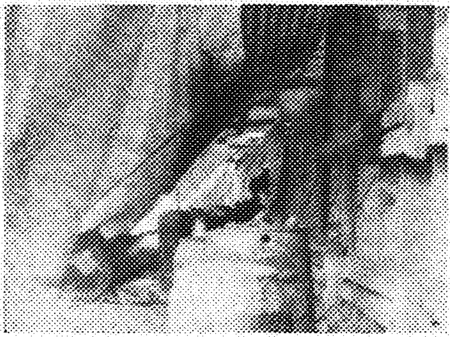


Figure 2. Beneath the Tarpaulins. Method of heating the air adjacent to forms by salamanders.

Placing and Protecting Concrete in Minnesota Winter

By W. C. HILL, Ex. '30

ONE of the greatest factors in considering northern construction is cold weather. Concreting in freezing temperatures has been a bugaboo for engineers and contractors ever since concrete has come into common use. Methods of overcoming the rigors of severely cold climates have been as varied and as many as there have been engineers in charge of construction.

In the construction of the Hastings lock and dam, a government project located on the Mississippi river, about 20 miles below St. Paul, Minnesota, a great deal of effort has been spent under the direction of the United States District Engineer to successfully place and protect concrete from the freezing northern temperatures.

Completing the main lock and guide walls during the summer, the Fegles Construction company of Minneapolis unwatered the cofferdam for the first section of the main dam across the river during the early fall. This dam—866 feet long, is of the movable steel gate type, composed of a 100 foot Boulé Dam section and 20 Taintor gate dam sections, each 30 feet wide. Looking downstream, the dam extends from the 110 by 500 foot lock on the right bank of the river to the foot of the bluff on the left bank where the main tracks of the Chicago, Milwaukee, St. Paul and Pacific railroad are located. The piers for the Taintor gates are 23 feet high and five feet wide resting on a continuous foundation course six feet thick and 45 feet wide. On top of these piers on the upstream end rests a concrete superstructure 12.5 feet high to support the craneway for the gates. No reinforcement except the steel anchor rods for the gates is used in the piers. On the downstream side of the first four Taintor gate sections is a spillway apron with 15 reinforced staggered baffle piers, seven by nine feet and five feet high. Around the edge of this apron is a reinforced stilling wall two feet thick and also five feet high. The floor of this apron, the Boule section (which is only a foundation course 6 feet thick and 38 feet wide), and six of the Taintor gate sections and piers were placed during the months of November and December, 1929.

During this time, the normal temperature ranged from just above freezing to well below zero. The objective sought in placing the concrete in a satisfactory manner was to see that it reached the form at a temperature from 60 to 140 degrees Fahrenheit, and that after placing, that the temperature of the air surrounding the wooden forms never dropped below 60 degrees during the first seven days, the forms being stripped at the end of this period. Temperatures of the concrete at the face of the structures at the time of stripping read as high as 68 degrees under atmospheric conditions that made an accurate reading of the temperatures very difficult.

Methods used to place the concrete at a satisfactory heat were very thorough. The sand in the stock pit was heated to from 90 to 200 degrees by four steam jets embedded in the sand. The gravel pit was likewise heated to 40 to 80 degrees, enough to take off the chill of the winter air. A 24-ton locomotive crane transferred the aggregates from these storage pits to a bin, having bottom gates opening onto an endless belt conveyor. From there the sand and gravel was elevated to the top of the mixing tower, seventy feet high and dumped into separate bins. These bins were lined with perforated steam pipes and both the sand and gravel were subjected to live steam. From these bins the aggregate was passed down to a hopper in which cement was dumped; thence to the mixing drum. Two mixers, each of one cubic yard capacity, mixed the concrete for one and one-half minutes, the water being piped directly from a vertical boiler alongside the mixing plant. Water ranging from 120 degrees to boiling was used.

The concrete mixture as delivered to the 36 cubic foot Kopple cars was of a temperature around 70 to 100 degrees. At this stage of production, care was taken that at no time was the heat of the mixed concrete to reach 140 degrees Fahrenheit, as "cooking" the concrete is just as injurious as freezing. In "cooking," the water is evaporated before the initial set, leaving the concrete dry and brittle and of little or no strength. This evil of over heating has long been known and precautions against it have been advocated by such an engineer as Mr. John F. Green, now regional engineer for Ford, Bacon & Davis of New Orleans, who supervised the construction of the Robert Street bridge, St. Paul.

After a run of about 600 feet from the mixing plant to the hopper in the cofferdam, the concrete was delivered into a Radio concrete bucket handled by a stiffleg derrick and placed in the form where it was easily puddled. During the time the concrete left the mixer and was placed in the form, there was a loss of heat ranging from 10 to 20 degrees, varying with the severity of the weather.

Immediately after a form was completely filled, perforated steam pipes supported on trestles were laid over the surface, and canvas and paper coverings placed over the entire form. In the case of the apron, steam pipes and canvas

(Continued on page 128)

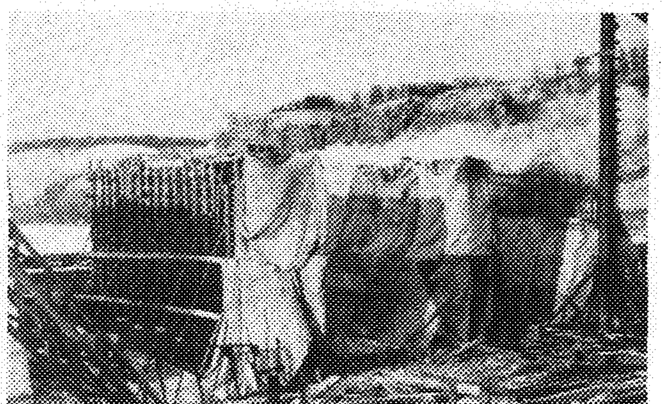


Figure 1. Forms protected from the cold. Showing the skeleton framework and use of both paper and canvas covering on the Taintor Gate piers.

STABILITY OF RIVER BOATS

By **CAPTAIN S. E. NORTNER, C.E. '16**

Pennsylvania State College

FROM time to time, there is recorded the loss of a river boat by capsizing on our rivers where channel depths are such as to limit navigation on an extensive basis, to that of the boats of the western river type. The publicity given to disasters of this class is measured, in general, by the attendant loss of life, so that in many instances, the loss of a boat is of interest solely to river folk and appropriate mention is accordingly found only in the periodicals of the operating profession or in the local newspapers. In a few cases, disasters, because of the loss of a considerable number of lives, have justified nation wide recognition by the press.

In general, the loss of river boats by capsizing, reflects a disregard for the laws affecting floating bodies, and it may be safely assumed that the application of the principles involved to such boats prior to their loss would have indicated instability. It is also quite probable that alterations made on boats under the direction of personnel ignorant of the effect and importance of the principles of equilibrium, has contributed in a large measure to the fact of the disasters.

While it is not apparent that river boats are subjected to investigations as to stability in the same degree as are ocean vessels, yet when operating in periods of high water with attendant increased stream velocities, or in strong winds they may approach, relatively, the same danger as do ships at sea under extreme weather conditions. Furthermore, the need of a cautious regard for details affecting stability is accentuated by the accepted type of construction of river boats, which is such as to encourage an

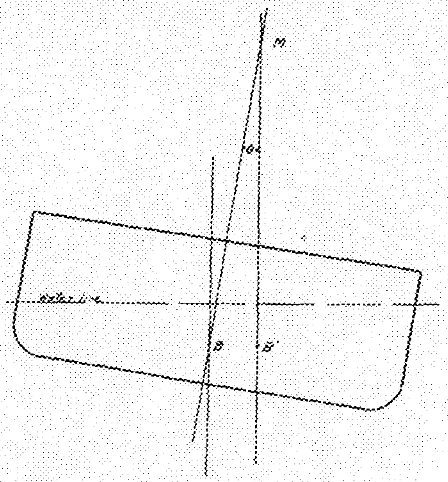


Figure 1

approach to instability, with the shallow hull for limited channel depths, and the abnormal height of superstructure necessary to secure desirable elevation of the pilot house for navigation purposes.

While the ken of the craftsmen associated with ship building is a veritable storehouse of information commensurate in extent with the heritage of the ancient profession, there is little need to consider any factor other than that of transverse roll when investigating the stability of river boats in operation and it is with this feature that this discussion deals. It is intended to set forth in an elementary way the involved data necessary to permit of as comprehensive an investigation of stability as is desirable for boats of unknown characteristics. The data should be of value for application to boats long in service and having changed characteristics due to seasonal repairs and alterations during service as well as boats subjected to extensive alterations as a part of new projects.

An investigation of the stability of a river boat when subjected to a trans-

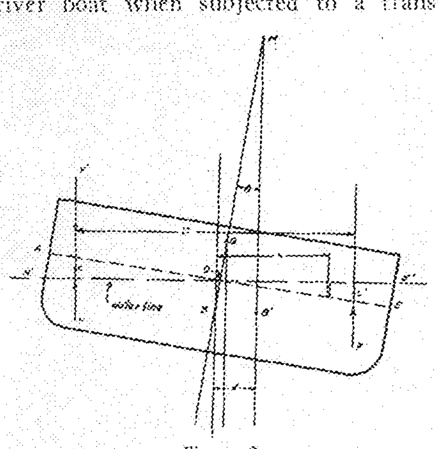


Figure 2

verse roll due to wind, current velocity or maneuvering, necessitates the determination of the location of the metacenter and the center of gravity in the transverse section.

The metacenter is a fixed point which is dependent on the displacement, the axis of inclination of the boat and also the form of the boat. It is the point at which the verticals through the centers of buoyancy of the boat, when erect and when inclined slightly, intersect.

Figure 1 shows the section of a hull inclined at an angle θ, B is the original and B′ the new center of buoyancy and M is the metacenter.

To determine the metacenter, consider figure 2, showing the section of a boat having a displacement volume V, inclined as before through an angle θ. M is the location of the metacenter, G, center of gravity, and B, center of buoyancy. Inclining the boat transversely through the angle θ, the wedge AOA′ emerges and EOE′ is immersed, so with parallel sides on the hull the wedges are similar and of equal volume, the same volume of water being displaced in either position and the water lines AE and A′E′ intersect at O the axis of symmetry. Call the volume of the wedge v.

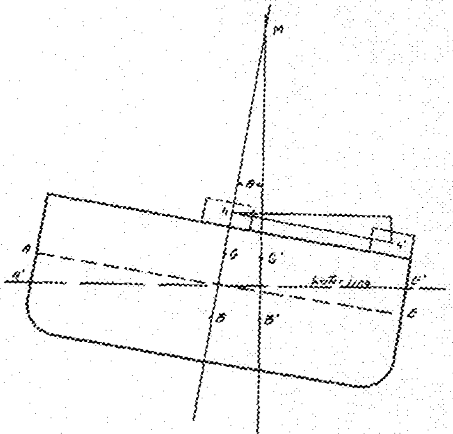


Figure 3

Let c indicate the location of the center of gravity of the wedge, then when the boat is upright a buoyant force F acts through c and is equal to vw, where w is the weight of a cubic foot of water in pounds. When inclined the force F′, equal to F, acts through c′ the center of gravity of the wedge EOE′, and F no longer acts, so it may be considered that a force F″ equal and opposite to F acts, the resultant of F″ and F′ being zero introducing a couple equal to wvD, D being the distance between the points of application of the two forces.

In the inclined position W the buoyant force acts through B′ at a distance d from B then

$$wVd = wvD, \text{ W being equal to wV}$$

Now consider a small vertical prism of the wedge EOE′ having a cross sectional area dA and at distance x from O. This prism produces a buoyant force, $wx\tan\theta dA$ and the moment of this force about θ, is $wx^2\tan\theta dA$. The sum of these moments for both wedges is equal to wvD or

$$w\tan\theta \int x^2 dA = wvD = wVd$$

As the sine is very nearly equal to the tangent for small angles and as $d = MB\sin\theta$.

$$\int x^2 dA = V(MB) = V(GM \pm GB)$$

Now the moment of inertia, I, of the water line plane through the longitudinal axis at O is $\int x^2 dA$ so that

$$GM = \frac{I}{V} \pm GB$$

Therefore, the metacenter may be located with respect to the center of gravity of the boat.

(Continued on page 136)

Moving Pictures in Color for the Amateur

By GLENN E. MATTHEWS, Ch. E. '21
Kodak Research Laboratories
Rochester, New York

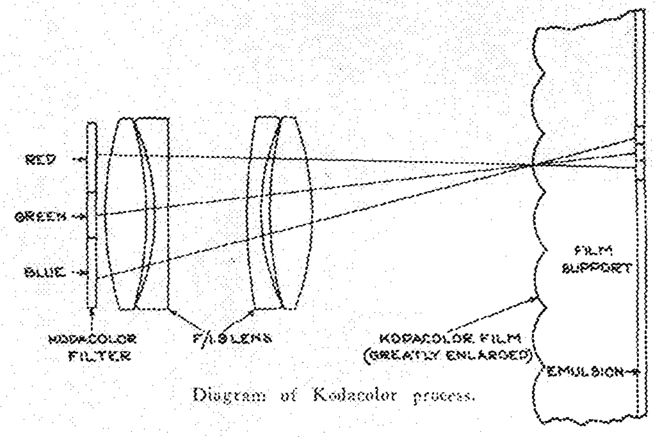
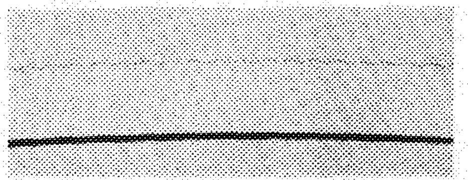


Diagram of Kodacolor process.

IN 1923 a new process of amateur cinematography was placed on the market by the Eastman Kodak company. The process depended upon the use of a film 16 mm. wide instead of 35 mm., the width of standard motion picture film as used in the theatres. This film, after exposure, is not developed to a negative and printed as is customary with 35 mm. film, but is developed by what is known as the *reversal* process. In this reversal process, the exposed image is first developed, and then the developed silver is dissolved in a *bleaching* bath, as it is called, which oxidizes the silver. This leaves behind the silver bromide which was not affected by the developer because it was not exposed to light. After a fresh controlled exposure to light, this remaining silver bromide is developed in its turn and gives a positive.

The thousands of films which are received each day from amateurs throughout the world are developed on intricate machines which were especially designed for the work. The machines are entirely automatic, the films being fed in as they come from the customer and taken out of the drying cupboard as positives ready for projection.

Since 1923, amateur cinematography has developed until now it is a large industry. The early apparatus has been supplemented by other forms of cameras and projectors, so that at the present time a wide range of extremely convenient apparatus is available for the public. As a general rule, at the present time, the cameras are driven by spring motors which are wound between exposures, and the trend of design is in the direction of cameras as small and compact as possible, so that an amateur motion picture camera is little more bulky than the very small and compact cameras used for still photography.


Cross section of Kodacolor film. Black line represents emulsion.

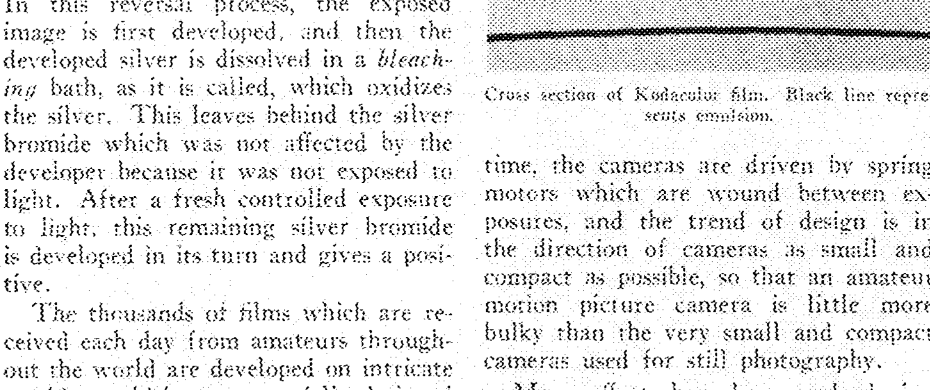
Many efforts have been made during the last quarter century to produce a successful process of natural color motion pictures. To obtain a full color rendering three primary colors are necessary, usually, red, green and blue-violet. The Gaumont process, for example, gave true natural color reproduction but it required special apparatus for making and projecting the pictures.

Suppose it were possible to rule a series of fine transparent red, green and blue-violet lines repeatedly across the surface of a strip of motion picture film and a panchromatic (all-color sensitive) emulsion were coated over this color line screen. Now if this film was exposed in a camera so that the light had to pass through the colored lines first before reaching the sensitive emulsion, there would be found on developing the film, a series of lines of varying shades of gray. Each of the ruled lines acts as a color filter and absorbs or allows to pass certain portions of the light. Now if the negative image instead of being fixed out is developed by the reversal process, a positive will be obtained, which, on examination before an illuminator, will appear in natural colors. Such a process is called a "screen" process.

The problem of ruling fine lines on a film or plate, however, presents extreme difficulties. Many screen processes have been worked out but all are open to certain objections from a commercial standpoint. A simple method of ruling lines is yet to be achieved but methods which simulate the results have been produced, a notable example of which is the Kodacolor process.

In 1908 Rudolphe Berthon, a French inventor, patented a process which realized most of the advantages of a screen film process without involving too great difficulty in making the film. In this process, a tri-color filter diaphragm is placed in front of the lens, while the film is embossed on the support side with a number of small lenses. The film therefore looks as shown in Fig. 1, where the corrugated edge represents the surface of the film base, in which the small lenses shown have been embossed. Below this area is shown the thickness of the base itself, and then a thick black line which represents the thickness of the emulsion. The film is put into the camera so that the embossed elements face the camera lens and the light must pass through them before it reaches the emulsion.

In principle, the screen effect is produced because each lenticular elemen


Comparison of pictures on (a) standard 35 mm., (b) regular 16 mm., and (c) Kodacolor films.

*Revised from a talk given before the North Jersey Section of the American Chemical Society on Jan. 14, 1929, Newark, N. J.

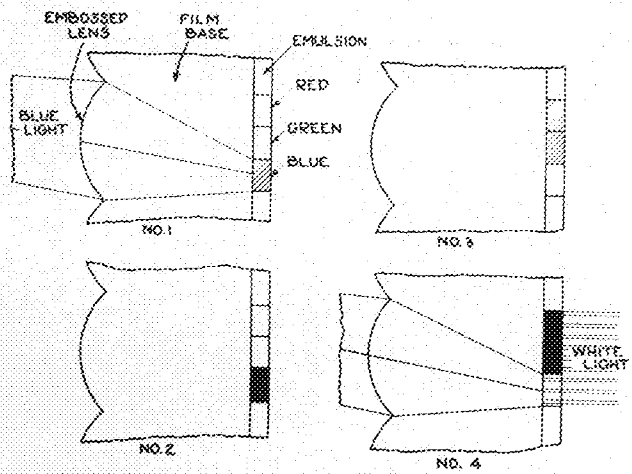


Diagram showing the action of blue light on a single lens element of Kodacolor film.

forms an image on the film of the tri-color diaphragm in the lens, thus producing as regular a pattern as *if a screen had actually been ruled on the base side of the film*. Herein lies the success of the process. The original negative made by this method was developed by a reversal process and the positive obtained was projected in a projector in which the three-color diaphragm was incorporated in the lens.

In order to produce satisfactory embossing, Berthon became associated with an Alsacian engraver, Anthon Keller-Dorian, and the Societé Keller-Dorian-Berthon was formed for exploiting the process. In 1925 the process was offered to the Kodak Company and was thought to offer possibilities of success, especially as it was closely akin in its requirements to the method of amateur cinematography which the company had already developed. Rights were therefore purchased and development was started with a view to perfecting its use with 16 mm. cine film.

A great deal of study was involved. It was necessary to standardize the methods of making the lenses on the film, to compound and make a suitable emulsion strongly sensitive to green and red light and yet with sufficiently fine grain for the minute structure of the separate color elements to be resolved, and especially to work out the best method of developing and reversing the film to retain the color rendering.

Consider now a piece of exposed and developed Kodacolor film in comparison with standard motion picture film and Cine Kodak film (Fig. 2). In appearance, the Kodacolor film (on the right) very closely resembles the regular Cine Kodak film (in the center). It is only on close inspection that its outstanding differences are noted, namely that the image is broken up into fine lines and the back of the film produces a characteristic squeak when the finger nail is pulled across the embossed lenses.

The making of Kodacolor pictures is an extremely simple operation. It is necessary only to insert the color filter into the lens of a Model B Cine oKdak fitted with an f/1.9 lens and thread the film in the camera. After the exposure has been made, the film is sent away for processing and is returned to the photographer. It can be projected either as an ordinary black and white picture on any amateur projector taking 16 mm. film, or it can be shown in colors by using a special color filter over the lens of either the Models A or B Kodascopes. (Fig. 3.)

To understand more clearly how the result is achieved, let us examine in greater detail the essential features of the process. The color filter is composed of three bands of red, green, and blue gelatin cemented between flat discs of optical glass. It slips inside and in front of the lens in place of the usual lens hood found on the Model B Cine Kodak. The secret of the Kodacolor process, however, lies in the film which has been embossed vertically on the back or support side with tiny cylindrical lenses. There are over two hundred of these lens elements in the width of the picture area (about two-fifths of an inch). In appearance the embossed surface when magnified, resembles somewhat a miniature corrugated washboard or a sheet of corrugated paper which has been pressed together until the valleys between the corrugations almost disappear. The color bands of the filter are arranged so as to be parallel with the embossed lens elements. The light sensitive emulsion on the film, of course, is panchromatic, that is, sensitive to all colors.

Each cylindrical lens element forms, on the emulsion behind it, a microscopic image of the filter, consisting of a red, green, and blue line as shown in Fig. 4. The film on the right side has been drawn to a scale many times larger than the other parts of the diagram. When an exposure is made the light passes first through the color filter, next through the lens, then through the embossed elements, the film base, and is impressed on the emulsion. If the subject is white, all three color filters allow light to pass and three lines are exposed under each lens element. If the subject is red, that is, it reflects red light, only the red parts of the filter transmit the light, and the emulsion areas illuminated by this section of the filter will be exposed. With colors made up of more than one primary color, it follows that more than one part of the tri-color filter will transmit the light.

Perhaps this may be made a little clearer if only one lens element and one color of light, say blue, is considered as shown in Fig. 5. Here it is seen that the blue light exposes an area about one-third that under the lens element (No. 1). On development this area becomes opaque (No. 2). The film is then bleached and the remaining silver salts are given a controlled exposure (No. 3) and developed up. Now the area affected by the blue light becomes clear and transparent while the areas corresponding with the red and green filter segments are opaque (No. 4). When white light is directed on this single lens section, it passes through the area where the blue light exposed the film and since the optical system is reversible, it follows that the light will strike the blue segment of the filter and form a blue

(*Continued on page 132*)

Kodacolor picture of child with red hat, against blue sky (left) and enlargement of a portion of the picture showing characteristic line composition.

MATHEMATICS FOR ENGINEERS

By R. W. SILER
Department of Mathematics and Mechanics

A STUDENT once said to me that he could not see why in the College of Engineering so much weight was given to the three subjects of mathematics, English, and that which is known as military science. Not being by nature averse to argument I told him that the three subjects were of fundamental importance in the education of an engineer and a man. Such statements, suggested the student, are more easily made than proved. It was up to me to prove mine, and the substance of what I said then in regard to mathematics I repeat here.

To begin with, it may be said that the attitude towards mathematics of the average man who has had but little actual contact with the subject is peculiar. He stands awed before a page out of any text on mathematics, and he wants none of it. For those who can manipulate the symbols he sees he has much the same feeling as for those who can play chess or decipher a railroad timetable. Such men are, to him, freaks, pure and simple. Undoubtedly much of this attitude of his is due to the fact that he sees little of what he is pleased to call "practical value" in the mental gymnastics of those who study the mathematics. Here he errs, and he very greatly errs. Whether chess and timetables have any practical value I leave to those who have been able to master their secrets, but of the practical value of mathematics there can be no doubt. By "practical value" of mathematics I mean its possible application to the material affairs of everyday life. And I suppose that if a popular vote were taken as to what type of human being best illustrated that which is known as a "practical man" the engineer would gain the honor. Which, I suppose, is because the engineer seems to the public never to have a thought other than one concerning m a t e r i a l and inanimate things.

Stop at any spot where a building is being erected and observe the crowd gathered to watch. The crowd marvels at the excavations, the foundations, the steel work towering up. If a young man is seen in the neighborhood carrying blue prints under his arm he is observed with profound respect. He is supposed to be an engineer, and capable of telling how high this building will go without tumbling down about the ears of those below, what it will cost, what it will bring in. And yet to prophesy these things with certainty is actually easier than to prophecy the actions of any one of the spectators standing open mouthed about. Why? Because as long as a man is supplied with the proper data, a sufficient knowledge of mathematics, pencil and paper, he can foretell with certainty that which will occur in the inanimate world. Here we see the use of mathematics and its limitations. Applied to the material world, the medium in which the engineer is popularly supposed to be wholly concerned, mathematics will never lead to an incorrect prophecy or estimate, can never do so. Where there does result error the trouble lies not with the mathematics but—as I have heard said—probably with arithmetic. Otherwise, with the data. The engineer thus possesses the gift of foresight denied to less fortunate men, and he reaches his conclusions through the use of mathematics. They who select a man to do a certain work are at best only making a guess as to the man's fitness; but they who select a properly designed machine are without doubts as to what to expect. The advantage of the machine here lies in the fact that its conduct is mathematically demonstrable, while human conduct is not. The point I am trying to make is that the engineer's value to society is, in the final analysis, his ability to speak with authority upon the future conduct and service of material subjected to certain physical conditions, and that the degree of this ability depends upon his use of Mathematics. It is a fact that the only power of prophecy which humanity possesses, the only prophetic power beyond chance of error, lies in this wonderful instrument of mathematics. All other prophecy is as doubtful as forecasting Minnesota weather.

I am quite well aware that there are competent engineers, even great engineers, whose present ability in algebraic processes would not satisfy one of our average freshmen, hard though that is to believe; but the fact remains that such engineers have somewhere in the past experienced mathematics, appreciated its eternal truths, and are now satisfied to base their forecasts upon the forecasts of subordinates who, they know, are closer to the subject. No doubt to the leaders in the profession the human problem, the necessity of developing human contacts and profiting by them, as contrasted with the problem of handling inanimate material, grows increasingly important. I suppose a good many undergraduate engineers already feel a preference for this side of the profession, are quite willing to let the material and unfeeling world with its mathematics go hang, and are prepared now to deal with the human element, to take charge of large projects. But after all, the public is interested in the engineer only because of what he knows of the material side of his profession. And that knowledge comes only through experience and actual contact with material. A knowledge, I repeat, which is based upon a comprehension of the mathematical truths underlying all engineering processes. Thus the student should understand that in his treatment of material the engineer is dependent upon mathematics, in one or more of its various forms; that a mathematical treatment, whether or not it is evident on the surface, lies at the basis of every engineering problem; that mathematics is the peculiar and inevitable instrument of engineering; that the engineer who has never studied mathematics, who is entirely without knowledge or grasp of the subject, must ever move in a fog of doubt as to just what he is doing or having done.

This, then, as I have stated it, is the great reason for so much of mathematics being given in an engineering course.

Are there any other reasons? Is there, for instance, any cultural value in mathematics? By cultural value I mean a value in developing the student outside of the narrow limits of his profession. Does the study of mathematics have what might be called spiritual value, value in the development of character? Does it have any broadening effect upon the student, does it bring him any knowledge of other races and times, of their accomplishments, of their comparative place in history? Does it carry the mind of the student beyond the subject, itself, into the fields of speculative thought, into some consideration of the problems of human conduct and existence and destiny? I have no doubt it does, or is capable of doing, these things.

In the first place the study of mathematics does require study, calling for perseverance, concentration, imagination. These are valuable qualities for a man to possess, practical though he may be; and as no man, no matter what his natural ability, can attain to any understanding of mathematics without some effort he must to some degree benefit by the study. Mathematics is one subject which cannot be poured from the head of an instructor into that of a pupil with the pleasant ease with which water is poured from a higher to a lower level. Probably for the average engineering student the development of the qualities I have mentioned is the most valuable indirect result of mathematical studies. But to the exceptional student, the man who digs deeper, there will be some consideration of the history and philosophy of mathematics, some investigation at both ends of this great edifice, at its foundations and its upper reaches, carrying the student into the realms of abstract thought. And this is cultural. Of course I realize that hard-bitten engineers, particularly the younger ones, are inclined to pooh-pooh this that they dub "culture stuff." And yet I am convinced that in the engineering profession the relative rank of those who follow it will be found to vary much as does their culture, their general knowledge of men and life beyond the profession. It must be remembered that there are two great reasons for education: one being the need to earn a living; the other the desirability of this culture I am speaking of. A man may graduate from a technical school with some training as an engineer, but far from being educated as a man, and such unfortunately is too frequently the case. But such a condition will certainly mark the graduate's limitations in his career, unless he later corrects it. Employers of college graduates constantly complain of the immaturity of these men. Whether or not the employers realize it this immaturity is largely due to lack of general knowledge, of anything approaching culture, resulting in inability of the student to apply his limited and specific knowledge to those greater things of which he knows nothing. It is true that familiarity with mathematics is not necessary to the cultured or well educated man. But on the other hand there is a cultural side to mathematics. Why then should not engineering students, putting as much time on the subject as they are required to, consider this aspect and make the best of it.

We come to the final use of mathematics in the engineering curriculum. It is as a means of elimination. Some people there are who advocate the giving of higher education to every man and woman desiring it. But as I have intimated before, there may be a very considerable difference between educating a man and training him for a profession. One may be highly educated yet have no professional training, or have professional training and not be any too well educated. Much may be said in favor of providing education, in its broadest and cultural sense, to all who care to avail themselves of it, but to give to every man who sojourns four years in college a diploma in engineering or medicine or law or some other profession is quite another matter. The professions are competitive and must remain so if they are to be worth their salt.

The first experience the engineer has of the competition in his calling is in preparing for it, and while the man who cannot get through an engineering course may gnash his teeth at the very mention of mathematics the graduate should thank the subject as permitting him a job when he enters the engineering world. I am inclined to believe that under present conditions this use of mathematics as a means of elimination is its chief value to a great number of technical students the country over. Certainly a great number of graduates go forth each year with too superficial a knowledge of the subject to make direct use of it: yet that they have managed to obtain some sort of a passing grade in it is assurance that they possess something of pertinacity, imagination, the ability to concentrate, and that they have not utterly escaped realization of the intimate connection between mathematics and engineering. This, then, is one reason why the student entering college finds in his first two years the successive courses in mathematics barring his way to the later strictly engineering subjects for which he feels he is so eminently fitted. He sadly learns, in the end, that the mathematics rather than his own estimate is what determines his fitness. This is as it should be. There should be some selection of men before they are cast upon the devoted heads of those instructors who teach the later engineering courses, and before the men are given diplomas permitting them to enter a profession already sufficiently crowded. This selection is best made by means of mathematics because, I repeat, of its closeness to engineering, and because of the mental effort and mental quality required in attaining to any familiarity with it. Those who have been prevented by mathematics from entering engineering will, I know, look with a hard eye upon the stuff. But on the other hand they who do win their diplomas can bless the subject. Even by the most utterly mercenary it should be blessed. For in narrowing the field of competitors it proves to have a quite calculable value in dollars and cents.

Prizes to Be Given for Articles

The TECHNO-LOG *announces two prizes of fifteen and ten dollars respectively, which will be awarded for the two best student articles to be received at the* TECHNO-LOG *office on or before February 25, 1930.*

RULES OF THE CONTEST

1. Articles may be submitted at any time from the date of publication of this issue issue until five o'clock on February 25.

2. Any student is eligible to enter one or more articles in the contest.

3. Articles may be on any subject, technical or non-technical, and may be of any length between 1,500 and 5,000 words.

4. Photographs or other illustrations submitted with the story greatly increase its chances of winning a prize.

5. Judgment will be made by the editors of the TECHNO-LOG *and their decisions will be final.*

6. The names of winners will be published in the March TECHNO-LOG.

7. All stories submitted will become the property of the TECHNO-LOG *and if suitable, may be published later.*

GERMAN ENGINEER PLANS TO IRRIGATE SAHARA

Herr Herman Sörgel, the German engineer, has conceived a plan for reducing the size of the Mediterranean Sea by constructing huge dykes, one across the straits of Gibraltar from Tarifa, Spain, to a point opposite on the African shore, and a second across the Dardenelles.

The plan will also provide irrigation for parts of the Sahara Desert, obliteration of the Adriatic Sea, giving Italy more room for her crowded population and more land for all border countries by a general lowering of the water level of the Mediterranean.

According to geologists, the land under the Mediterranean Sea was formerly a continent separated by thin bodies of water from Asia, Africa and Europe. A reduction in the size of the Mediterranean will reopen thousands of acres of this fertile land that was inundated when the natural dyke at Gibraltar was destroyed in the last glacial period.

Herr Sörgel purposes a canal from Tarifa and another from Morocco to the Atlantic to regulate the height of the water and the hydro-electric force arising from this flow utilized in pumping water for the irrigation of the Sahara.

According to the German engineer the maximum height of the wall would be approximately 1110 feet. Herr Sörgel has developed a highly technical plan to construct the dykes in the face of the terrific pressure.

UNIFICATION OF RAILROADS

By **J. PHELAN SHIRLEY, Jr.**

BY publishing a plan of unification for the 250,000 miles of railroad in the United States, the Interstate Commerce Commission has finally succeeded in consolidating its thoughts as to how the railroads should be consolidated. Sixty-eight pages were required containing in addition to expressions of individual commissioners' views, a plan for allocating approximately a thousand railroads among twenty-one systems, including the United States lines of the two Canadian systems, but leaving some two hundred terminal properties for later consideration. By the publication of this plan the Commission has assumed one of the most difficult economic tasks ever attempted by a regulatory body and has brought the railroads to the attention of Congress and the people to an extent unequalled since the passage of the transportation act in 1920. Somewhat to the apprehension of the railroads themselves, the question of consolidation shows signs of becoming an issue in Congress.

In devising a scheme for consolidation at this time, the commission is fulfilling a duty imposed by the transportation act of 1920, but which in the intervening time it has succeeded in postponing. That the commission has finally put forward a consolidation plan plan may be explained by the known views of President Hoover. Even as secretary of Commerce, he was considered a proponent of consolidation. Moreover, he took office at a time when rival ambitions of railroads was producing a state of chaos that could be resolved only by the issue of a general consolidation plan by a semi-governmental body. The stock market crash of October caused that plan to be hurried to completion. This was because certain railroad executives who agreed to aid President Hoover's prosperity program pointed out that consolidation would enable them to begin construction that had been indefinitely delayed and thus stimulate trade and afford employment.

The magnitude of the problem which some observers believe the commission has gone a long way toward solving may be judged by figures showing the extent of transportation in this country. The commission seeks to realign an industry that had a net operating income of $1,313,000,000 in the year ending August 1929. The mileage of United States railroads is from six to twelve times that of any other country with transportation facilities anywhere comparable. Furthermore the stated property investment of our railways totaled $25,313,637,268 a year ago and it increases by leaps and bounds.

The procedure in undertaking the investigation was governed by three fundamental principles: the first is that competition, presumably in service, must be preserved; the second is that existing routes and channels of commerce must not be disturbed; and the third, subject it will be noted, to the foregoing requirements, is that the financial aspects of such mergers must be kept in view. Without having regard to the fundamental principle involved, both in consolidation and the statutory rule of rate making, it might appear that these several requirements were stated in the order of their importance; in other words that the element of financial strength was less significant than the preservation of competition and of the existing traffic routes. But giving due regard to the matter in its larger practical aspects, it is evident that any plan adopted will not only be a mere paper plan, ineffectual and futile, unless the financial requirements are given equal weight with those of operation and traffic. For the plan can never be put into effect unless a financial motive for consolidation be afforded, and unless some such plan is put into effect, a positive bar to the attainment of uniform reasonable rates under which all carriers alike may thrive, will continue to exist.

Another general principle that was kept in mind by the Commission and no doubt had substantial effect upon its final plan is the necessity of encouraging alternate routes and gateways, in order to relieve present or prospective congestion at the great railway meeting points. A tendency has been strikingly manifest for many years for all the great systems to expend funds unstintingly upon their main stems, and all of these main stems tend to run together at certain nodal points, notably New York, Chicago, and St. Louis. Such concentration upon great cities is a natural response to the commercial forces which tend with increasing power to attract traffic, even though it may not be destined for that place but may be passed through en route to points beyond. The shippers' routing often dictates such shipments in order to take advantage of a change in market conditions. The result has been an undue congestion in times of emergency, which paralyzes the commerce of the country. There is always a certain proposition of business, however, which by careful attention to the matter might be consolidated and shipped by an alternate route, thus avoiding the center.

The undertaking of the Commission was made more difficult by the fact that an appreciable amount of the total railroad mileage of the United States is operated through the courts. The proprietary corporations have been adjudged insolvent and placed in the hands of receivers. This consideration of railroad affairs alone should demand the serious consideration of every intelligent citizen in our republic. Upon the correct analysis and treatment of the factors which have produced this situation depends the economic and political welfare of the future.

Many alleged causes have been advanced to account for the bankruptcy of transportation corporations. The railroads have constantly asserted that their troubles have been primarily due to unintelligent legislation and regulation. Originally they were opposed to all forms of legislative interference. In recent years, however, they have recognized the benefits as well as the inevitableness of consolidation and have come to favor centralization of control.

Expressed in general terms the complaint of these insolvent railroads has been that they have been subjected to regulation often misguided, or the result of the demagogic activities of politicians; which has added to their operating costs. Along with this tendency, the transportation companies claim that they have had to pay constantly increasing prices for their supplies and materials and that local and state authorities have steadily imposed upon them heavier burdens of taxation. They also declare that railroad employees have organized and through the sympathy of the public, have secured by collective bargaining periodic advances in wages which have had no economic justification, and have added further to the excessive operating costs. Finally the transportation companies declare that state and federal commissions, although composed of representatives of the public, have refused to recognize the financial burdens which have been placed upon the railroads by the public and their employees, and have refused to grant them relief from their alleged impoverished condition by permitting them to charge higher rates for their passenger and freight service.

Because of these conditions, railroad officials state that their costs of operation are advancing while the rates which they can charge are declining, and, as a consequence of their reduction in net income, they are unable to pay adequate returns upon their present capital investment, or to attract much-needed capital to the transportation industry. They can only see a further extension of railroad insolvency, consolidation, or, possibly, government ownership, if conditions surrounding them are not changed.

Railroad commissions, shippers, and railroad employees enter a general denial to these claims of the railroads. This might be expected. They assert, however, that the transportation companies have not been operated with economy and efficiency and their revenues properly conserved.

Regardless of the relative worth of the arguments, it is apparent from the survey given that conditions do not reflect an optimistic condition for the insolvent lines. By its plan for consideration, the commission seeks to alter the conditions which have contributed to this state of affairs, by co-ordinating the various lines so that the maximum degree of financial and operating efficiency may be obtained.

The preparation of such a plan also affords a unique opportunity for the evolution of a comprehensive plan for the development of national resources. Too often in the past, purely temporary or personal considerations of advantage or profit have determined the location of American railways. The administrative control of the terms on which the carrier companies may be allowed to ally themselves beyond the scope of the commission's plan, if wisely administered, should tend to diminish economic waste and promote commercial development. But such wise administration demands a comprehensive plan at the outset,—a plan that entails as a fundamental feature the development of the economic resources of the nation in the years to come.

Notwithstanding the many insolvent lines, the railroad machine as a whole, is highly efficient. It has steadily increased its capacity in recent years without a corresponding increase in capital expenditure. It moves freight faster and it makes a pound of coals and a gallon of oil go farther than ever before. If the machine is so efficient, the question may be asked as to why the commission now seeks to improve it. Railroad men already committed to the principle of consolidation assert that the railroads have realized all the economy possible from reducing expenditures, that "there is no more juice in that lemon." In the face of steady decreases in rates, with six of every seven changes authorized by the commission involving reductions, they say that the railroads must join the merger movement which is already well advanced in every other large industry. And this, too, from prosperous railroads. Why, they ask should the right to new mergers, when this does not involve restraint of trade, be denied only to the railroads? They contend moreover, that this was realized when the principle of consolidation was embodied in the transportation act, although the stated purpose of this inclusion was to so balance weak with strong lines that an equitable rate structure could be devised for each region. Those who oppose consolidation say that the unprecedented prosperity enjoyed by the railroads in recent years means that weak lines are gradually disappearing. Nevertheless powerful groups among the railroads have thrown themselves into campaigns for consolidation. They were opposed and the resultant situation called for some kind of arbitration by the Interstate Commerce Commission regardless of conditions at the time when the transportation act was made law.

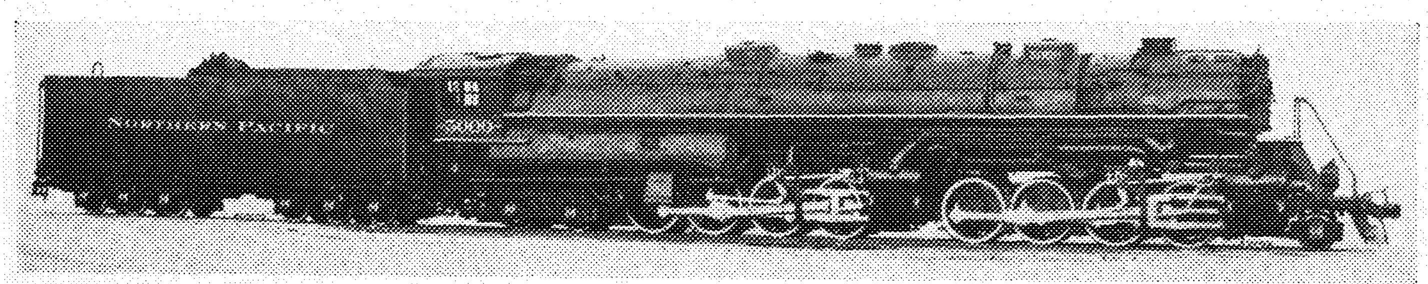
Submission of a plan for consolidation by the Commission is in respect to the East at least a culmination of an evolutionary process dating from around 1880. It was the orgy of railroad construction in the '80s that created many of the shorter lines in the East which have since been merged or are due to be merged into larger systems. The transportation act, passed when the railroads were changed from governmental to private control after the World War, therefore embodied in law a principle which had already been used in building the large Eastern lines.

The '80s were a strenuous period in American railroading. Railroads were built sometimes for no other purpose than their sale to other railroads. This was the case with the West Shore and the New York, Chicago and St. Louis. When the late Commodore Vanderbilt bought the latter road for the New York Central he remarked that its price would indicate that it was nickel-plated, hence its present name. Lacking regulation, competition was ruinous and accompanied by secret rebating and other expedients now unlawful. In one year it was possible to travel from New York to Chicago for $2 as a result of the competitive cut-rate methods in use. Naturally this era was followed by failure and receiverships.

The New York Central and the Pennsylvania built themselves to their present status by acquiring many weaker lines following the construction era. But this was before the Sherman act and the Clayton act. Passage of the former caused the New York Central to sell the Nickel Plate, which becomes an important unit in one of the five Eastern systems proposed by the Commission in its plan. It also prevented a merger of the Northern Pacific and the Great Northern, which the Commission's plan now says should be effected.

The plan which the Interstate Commerce Commission finally proposed calls for the integration of the approximately 200 Class I railroads and eight hundred minor carriers into nineteen systems from which were segregated the lines of the two Canadian systems entering the United States. Class I railroads are defined as those whose net operating income is in the neighborhood of $1,000,000 per year. The plans calls for five systems in the East based respectively on the New York Central, Pennsylvania, Baltimore & Ohio, Chesapeake & Ohio, and Wabash. In New England there would be systems based on the Boston & Maine and the New York, New Haven & Hartford. The same principles were applied to unification of the Western roads, and many of these like the Wabash, would become north-and-south in addition to being east-and-west lines. This suggestion and the mutualization of terminals proposed in the report have already aroused interested comment in the railroad field. Aside from these two features the plan is essentially a compromise. Claude R. Porter, who began the plan early in last year, would have had four trunk lines in the East, Joseph B. Eastman would have had nine. The plan does not give to the two large railroads which have filed merger petitions

(Continued on page 134)



A MODERN 12 WHEELED TENDER TYPE LOCOMOTIVE. THE WHEEL BASE OF THE LOCOMOTIVE AND TENDER IS 112 FEET.

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

Discrimination?

SUSPENDING undesirable students is the means by which the Engineering College maintains the high quality of its graduates. It is the means by which it keeps up its relative scholastic average as compared with other schools. It is the means by which the would-be engineer, obviously lacking in capacity to do the required school work, is forced to choose a vocation for which he is better fitted. And it is the means by which the school punishes the student who has the capacity but not the inclination to do his work.

Suspension is essentially a punishment. We do not object to the judicial use of this weapon to force the good-time-charlies to take their academic work seriously or go elsewhere for amusement. We *do* object, most emphatically, to its use to enforce a rule that is a discrimination against the self-supporting student.

This rule of mysterious origin, requires all students to pass nine credit hours. Those taking less than nine credit hours must pass all their subjects. Student A, taking the regular course of seventeen credit hours, is permitted to fail eight credits each quarter without incurring the displeasure of that august body of justice dispensers,—the Students' Work Committee. Having passed fifty-three per cent of his work, the student has met the scholastic requirements of his college, and is considered of sufficiently high calibre to continue his course and receive the coveted degree.

Student B, a self-supporting student carrying eleven credit hours, failed in three credit hours. Though he passed seventy-three per cent of his course, he is placed on probation, and should he repeat the unfortunate record the following quarter, he is subject, at the pleasure of the Students' Work Committee to be dropped from the roll for the balance of the school year.

He is being punished. Why? If he falls below the standard the school requires of its graduates, or he is lowering the sacred scholastic standing of the college, obviously A is a far worse offender. Is B paying the penalty for failing to take his school work seriously? Would a man value so little that which cost him so much?

We know at least three upper-classmen who are supporting families in addition to carrying sufficient credits to complete their engineering course in six years. One of them, a member of Tau Beta Pi, never came within miles of failing a course, yet he was once suspended because of incompletes received while he was a hospital patient. The other two students have C averages, yet because of the nine credit-hour requirement, they have been on probation numerous times. A failure of two subjects in three quarters would cause them to be suspended. They are required to pass eighty per cent of their courses, and against fifty-three per cent for the average student.

Is it logical that these men are unfitted to become graduates of the Engineering College of the University of Minnesota because they fail a subject occasionally? Is it just that they should be required to maintain a much higher scholastic average than the fortunate students with sufficient funds to permit themselves to devote their entire time to studies? Is it sensible to punish them like children for inability to pass one hundred per cent of their subjects?

We have no quarrel with the members of the Students' Work Committee. Theirs is a difficult and a disagreeable task. Within limits they have the power to permit a student, even against the nine-credit-hours ruling to remain in school,—but on probation. Small satisfaction this to the aforementioned B. He knows that even though the Committee may be in a lenient mood and not suspend him, by the rule he can be dropped for failing in one subject. Even though he never fails a course, if he is low in one grade at mid-quarters he is placed on probation and informed by circular letter that he must improve his work to avoid suspension. On his permanent record on file in the Dean's office is recorded prominently in red ink, a record of each probation. By the time he is graduated, although his scholastic average compares favorably with those of his class mates, his card is so plentifully deluged with red ink that it would be a shrewd employer's representative indeed who would get that impression that Student B was a desirable man to hire.

It is possible for a student, lacking in the mental capacity the college desires of its graduates, to devote full time to part of the regular course each quarter and eventually graduate. Perhaps this is the reason for the origin of the rule. It is fully as much to our advantage as the administration's that the calibre of our University's grades be kept high. Unfortunately the nine-credit-hour rule in no way keeps out this type of student. Permission is granted students doing work outside to carry part of a course. Since it is practically impossible to check up on the outside activities of every man, any student may represent himself as self-supporting.

We have searched in vain for a justification of this rule. The best defense we could obtain was the remark, frequently stressed by one of the Powers, that a student carrying less than a full course should pass all his subjects or get out. Quite right. But so should those carrying a full schedule. And it is possible to weed them out only after they fail fifty per cent of their work. Students in other schools of the University are judged on the impartial basis of percentage of work passed. What special condition can exist at the Engineering College that makes Student B the most undesirable type of student?

We know of colleges that make special provisions for aiding the self-supporting student. Oddly enough, these schools take that attitude that students who work their way through college are desirable, worth-while members of the student body. But, to the best of our knowledge, to the University of Minnesota Engineering College goes the unique distinction of being the only school that deliberately penalizes a student for having to support himself.

Self-reliant, self-supporting students do not ask that they be favored. They do ask that all students be judged alike on the just basis of percentage of work passed. They ask that the method of judging students on the honor point system as followed in other schools of the University replace the nine credit hour rule of the Engineering College.

We Suggest—

THE fall quarter of 1929 witnessed an innovation in the form of examination schedule, for instead of starting the quizzes on the Wednesday of the last week of the quarter, the final examinations were started on the Monday of that week. This was probably due to the location of Christmas on the calendar, rather than the desire of the pedagogues to give the students a holiday before the finals started, but this holiday before final examinations is something that has been tried in the older schools of Europe and is now adopted as standard practice.

Of course it will be admitted that the examinations given in these schools are harder than those given here, for they cover the work of two years, but the holiday given there is correspondingly long, usually of two weeks duration. It is strange that something of this sort has not been tried at Minnesota before, because our examinations are as important and cover as much territory, in comparison, as do those of the schools that are operated on the semester or yearly basis. For example, the University of Manitoba, operating on the semester type of scholastic year, gives a three day vacation before the Christmas examinations and a full week before the final examinations in May.

It might be worth while to make a comparison of the grades issued to students last quarter and those issued during quarters when the examinations were given on the day after school was dismissed. We think that the two day vacation, which could be easily given by starting examinations on Monday instead of Wednesday was beneficial, and we believe that a survey of grades would bear out our contention.

Re Grade Posting

AGAIN the entrance to Main Engineering has been becluttered with a mass of bulletins proclaiming to the world that Joe Matz received four F's and that I. Bone maintained a straight A average. We have noticed that in the past the TECHNO-LOG on several occasions has criticised the policy of the Dean's office, but the criticism has apparently fallen upon ears that hear not, or that will not change a policy out of pure perversity.

It is quite inane to send a report to the individual through the post office and duplicate this by sending a report to the world through these blatant bulletins. The inference to be drawn is that the wealth of funds provided by the state legislature must be absorbed by over-head, must not be used to increase salaries, nor to provide lounge rooms where students may rest and play bridge.

Here's a new argument that might appeal to the Powers. An inquisitive individual can examine the marks of all his classmates in detail. Supposing that the result of such a study (and this is not impossible) discloses the fact that he was one of the 75 who failed in a certain mathematics course which only eight men were able to complete successfully. Now this comes to the student as a horrible shock. It creates in him the wrong mental set, gives him that "gone" feeling, and acts as a drug precluding further efforts rather than a stimulant to spur him on with renewed industry. Hope is lost and the future becomes an impassable tract of brambled wilderness.

We urge the TECHNO-LOG to continue its attack, and let us add a prayer that it may be successful in wiping out this long practiced evil, that lacks every saving grace.

Well?

THOUSANDS of students throughout the country failed to return to school for the second quarter, or second semester.

There are many who maintain that thousands more, those who scraped through their first session at college "by the skin of their teeth," should also have concluded their careers in institutions of higher learning.

But the problem remains: free and universal education *versus* the education of those mentally equipped. Shall the good of the few be sacrificed for the good of the whole, or shall the good of the whole be sacrificed for the few?

It is usually asserted, though contested by some, that no man is the worse for four years of college. If everyone in the world were benefited by those years it at least could be expected to be very likely that the spirit of our age would be vastly improved. On the other hand, college in its present stage undoubtedly tends toward mediocrity. Very little opportunity is presented for expansion of either mind or soul beyond the confines of the textbook and the views of the professor who is limited to the specific. Like industry, it involves the uniformity of mass production to the elimination of the individual product.

The arguments of those who advocate the latter are more vigorously presented when one considers the viewpoint of perhaps the majority of professors: it is necessary to advance a certain percentage of students, regardless of qualifications. In Minneapolis schools, for instance, a student may stay in one grade only two years. At the end of that time he automatically passes on to the next grade. In other words, it would be possible for an ape, should he pass the scrutiny of the teacher by wearing clothes, to enter the university. On the other hand, it seems criminal for one who has the money to pay for an education to be deprived of whatever gleanings he can pick up from advanced learning, even though they consist of only hazy recollections.

The problem is complex, and one that cannot be decided by a single gesture. Yet logic points to only one conclusion, the segregation of the truly fit from those who through either inability or unwillingness are not in a position to compete with keener minds. After a period of exuberance in which college education is more or less the common course to take, we must return to the original definition, a place of technical learning. Qualifications must be the sole criteria of admission. Those who answer the call of learning must pay its price. As for the rest, the solution of the late Dr. Folwell, that of the expansion of Junior Colleges and high schools, is the most logical. The trend is all in this direction, but why wait for a trend to take its course?

Get Back to Work

UNQUESTIONABLY the best way to start off on the new year is to forget the last three months of the old year. Of course, if it will help any to recall that most of the damage was occasioned by a few low marks, a few unmentionable marks, and that after all our health, our heads, our hearts, and our friends remain basically sound, then it may be well to cast a thought or two backward. But the best thing is to forget the whole business and following the counsel of President Hoover,—get back to work. Or if we belong to the select group that has never worked,—then begin NOW;—or if we are listed among the 120,000,000 who have always worked, then keep on working. STOP only to give a thought and a hand to those who didn't make it last year; STOP only to keep cheerful in the firm belief that life's a great game after all.

ABOUT THE WORLD WITH OUR ALUMNI

Chemists

'25—Lester L. Johnson, now working with Roessler and Hasslacher of Perth Amboy, N. J., visited Minneapolis during the holidays with his wife and son.

'26—Marvin C. Rogers, who will be remembered for his activity in campus affairs during his undergraduate days, writes:

"I received my doctor of philosophy degree last June from the University of Michigan after having spent the three years since graduation from the School of Chemistry at Minnesota here in the department of chemical engineering. I am now working as a chemical engineer with the Whiting-Swenson company here in Ann Arbor. This company is a new company and has been organized to do research and development work, design and consulting, and general service to the chemical industry. The company is affiliated with the Swenson Evaporator company and with the Whiting Corporation of Harvey, Illinois. Professor W. L. Badger C '08 Minnesota, and who is now a professor of chemical engineering at the University of Michigan is the president of the company and my work so far has been directly with him.

"I would appreciate hearing from classmates of mine who may have something to say, and I assure them that I will answer all letters promptly."

'27—Harry Bercovitz, back for Christmas, has a position in the chemical division of the Patent Office, Washington, D. C. In addition, he is studying law at Georgetown University in order to become a lawyer.

'29—Carl Sweet is at present attending California Institute of Technology at Pasadena, California. Last year Carl was elected president of the Minnesota TECHNO-LOG Board; this year he reports that "in Dobney Lounge the other day I saw the TECHNO-LOG,—it was 'rubbing elbows' with Punch, Harper's, the World's Work, etc."

'29—Gus Erickson is studying at M. I. T. and doesn't find it too difficult to enjoy himself there.

'29—Howard Draper writes from Akron, Ohio, where he is working for the Goodrich Rubber Co., that he is having a wonderful time.

Civils

'09—James A. Childs recently made a trip through several of the Central Eastern states inspecting sewage treatment plants. Mr. Childs, now secretary and chief engineer of the Metropolitan Drainage Commission, was formerly with the Minnesota State Board of Health.

'20—Again Francis A. Dever changes his address. He is now in Gallitzin, Pennsylvania. Devers was located at Dennison, Ohio, as an assistant supervisor of the Pennsylvania Railroad.

'29—Fred Anway works for the division of management in the Bureau of Public Roads in Washington, D. C. His home is still at Cass Lake, Minnesota.

Shenehon Returns From European Trip

Francis C. Shenehon, a former dean of the College of Engineering and Architecture and now a consulting hydraulic engineer, recently packed up the family car and made a tour of Europe. Spending several months abroad during 1929, he motored about five thousand miles through England, Scotland, and Wales; and about seven thousand miles through Belgium, Germany, Czechoslovakia, Austria, Hungary, Switzerland, and France, returning home in November, 1929. A story of his trip will appear in an early issue of the TECHNO-LOG.

In 1927 Mr. Shenehon took an extensive trip through Europe, especially the Scandinavian countries, investigating their engineering developments, which he described in the February and March issue of the 1928 TECHNO-LOG. He noted especially a Swedish waterway project similar to the proposed St. Lawrence project.

Mr. Shenehon was graduated from the University of Minnesota as a civil engineer in 1895, and received his Masters degree in 1900. In 1909 he was appointed dean of the College of Engineering of the University of Minnesota. He left the university in 1917 to open a consulting engineer practice. On his return from Europe in November, Mr. Shenehon moved his office to the twentieth floor of the Foshay Tower.

Mr. Shenehon has taken an active part in the development of the St. Lawrence Waterway, of which he is an advocate. He is a member of the Metropolitan Drainage Commission of the State of Minnesota, of the American Institute of Consulting Engineers, and of the American Society of Civil Engineers.

'22—John E. Morrison, who is married and has a year old daughter, is now superintendent of miscellaneous and building construction for the Byllesby Engineering and Manufacturing company, 435 Sixth Avenue, Pittsburg, Pennsylvania.

'26—Roswell C. Bolstad recently took unto himself a wife, also a Minnesota graduate. He is an officer in the U. S. Coast and Geodetic Survey, and a member of Sigma Nu. The couple will spend the winter in Washington, D. C.

'27—Frederick C. Teske, Jr., being interested in operation and layouts of terminal and yards, is studying at Yale University on a Strathcona Fellowship in Transportation. Frederick, who is still single, resides at 165 Norton Street, New Haven, Connecticut.

'28—O. K. Normann was recently visiting at his home in Hopkins, Minnesota. He is making a study of unit road costs under the Bureau of Public Roads, Washington, D. C. His work takes him to all parts of the country, which gives authority to his report that Minnesota compares very favorably with other states.

'28—Leroy Engstrom is gauging streams in Ohio and Kentucky for the Geological Survey. His business address is the U. S. Geological Survey, 404 Engineering Experiment Station, Ohio State University, Columbus, Ohio.

'29—Theo. M. Jensen has returned to Minnesota as an instructor and experimentor in the experimental building. Ted was formerly with the Metropolitan Drainage Commission. 4319 Grand Avenue is his home address.

Electricals

'13—Allen G. Dewars recently spoke to senior electrical engineers on the student course of the Northern States Power company. Dewars, who has been transfered from the St. Paul office to Minneapolis, expects to take about ten or twelve of the graduating seniors.

'22—A. W. Merritt resigned his position with the Minnesota Light and Power company on January 1 to be a sales engineer for the Public Service company of Northern Illinois. His home address is 531 Marble Street, Joliet, Illinois. Merritt was with the Minnesota Light and company for three and a half years.

'23—Otto T. Bouquet has moved to the Alleron House in Chicago, Illinois. Otto was formerly a salesman for the Northern States Power company in Minneapolis.

'25—Richard G. Edwards, who is a substation designer with the Southern California Edison company, has moved to Pacific Palisades, California. He formerly lived in Los Angeles.

'26—Glenn S. Meader, although still with the Northern States Power company, has been transferred to the La Crosse, Wisconsin, office. Glenn was formerly in Minneapolis with the generator department but later transferred to Eau Claire, Wisconsin.

(Continued on page 130)

WHAT YOUNGER COLLEGE MEN
ARE DOING WITH WESTINGHOUSE

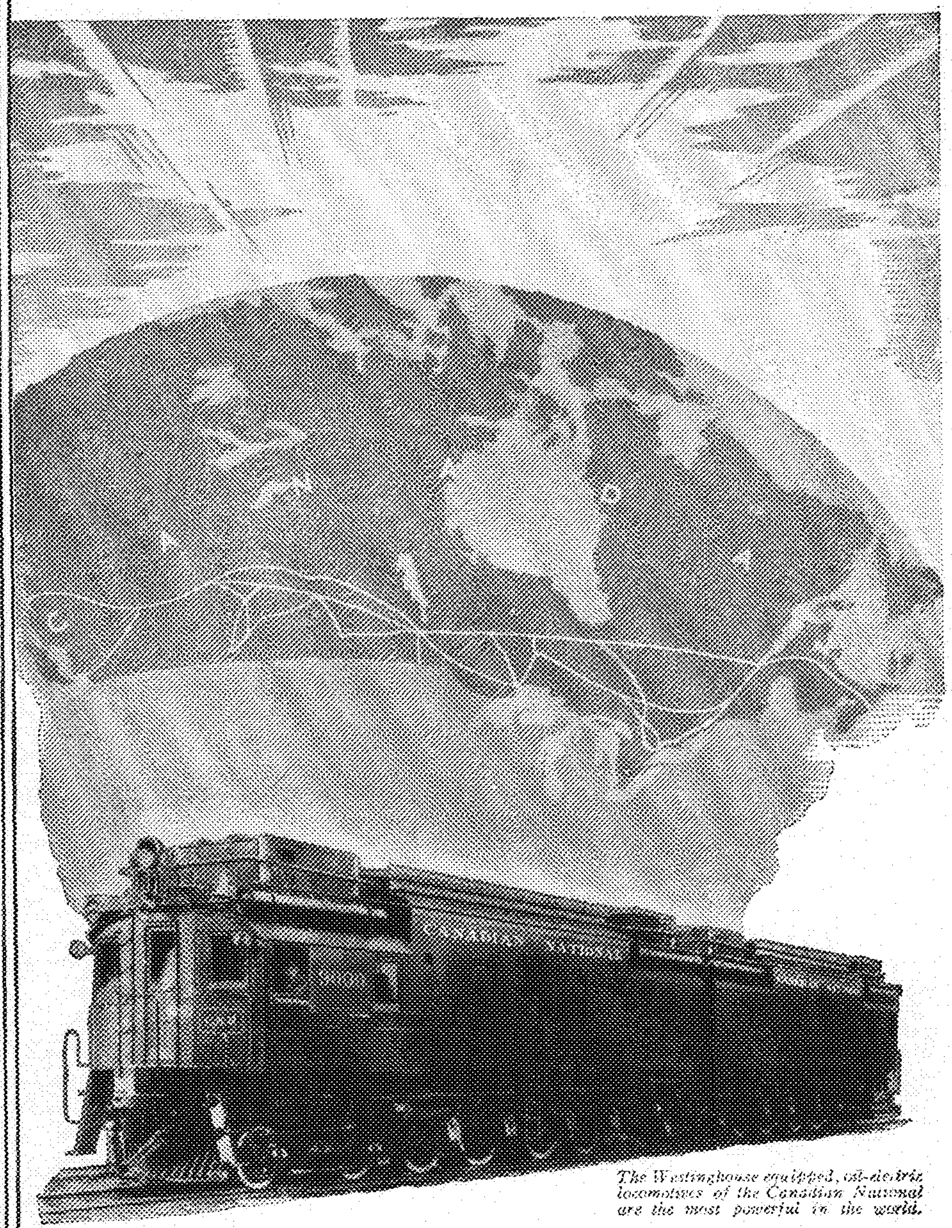
A. R. NELSON
Testing Engineer
Iowa State College, '23

H. R. MICHEL
Engineer of Purchases
Montana State College, '20

H. B. MAYNARD
Supt. of Production
Cornell, '23

J. A. WILSON
Headquarters Sales
Drexel Institute, '25

J. R. CUMMINGS
Application Engineer
University of Illinois, '21



The Westinghouse equipped, oil-electric locomotives of the Canadian National are the most powerful in the world.

The steam locomotive has a new rival

ATTENTION in railway circles focuses this year on a spectacular undertaking by the Canadian National Railways—the electrification of certain trains on non-electrified lines.

One great oil-electric locomotive is already in service. The largest and most powerful of its type in the world, this giant electric locomotive that carries its own generating plant develops 2660 horsepower, uses only .43 lb. of fuel per horsepower-hour developed at full load.

Many interesting features are incorporated in its design. The speed and voltage of the engine-generators are automatically controlled by the power demands. The engine exhaust is directed through automatically regulated economizers that heat the coaches and serve as well as mufflers. Control is placed at both ends, to enable running in either direction. Only in a difference in gearing need the passenger type units differ from those adapted to freight service.

In the development of this locomotive Westinghouse engineers co-operated with the Railway's own engineers and leading locomotive manufacturers and frame builders. Every year hundreds of important jobs in which electricity is involved are delegated to Westinghouse, the clearing house for electrical development.

Westinghouse

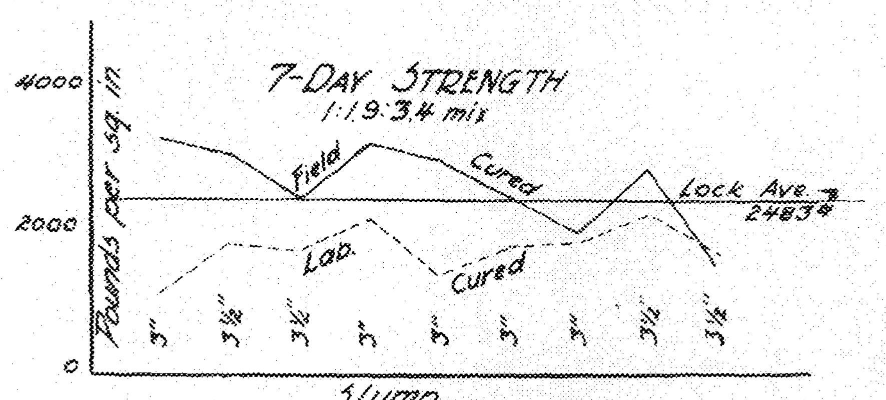
PLACING CONCRETE IN WINTER

(Continued from page 116)

covering were placed as the work of finishing the surface progressed, so that the top surface of the slab would not freeze, scale or crack.

On the piers, a skeleton framework was built to support the covering and have room for the salamanders to heat the form. This covering of the forms consisted of part paper and part canvas. The paper being of the rugged hemp process caught over a coarse-woven center of linen thread with an asphalt cement. Two six-foot tiers of such paper covering were built up from the bottom of the framework and the remainder was tightly covered with canvas. The paper stood up very well under the rough usage, tearing but little where the wind whipped it over protruding timbers. Steam pipes heated the tops of the forms and furnished the necessary moisture to the air while the salamanders heated the air along the sides of the forms. Great care was taken to close all openings at the bottom of the projecting covering, and along the side of the piers from three to five coke-burning salamanders were kept fired all the time the forms were heated.

Temperatures in these forms were read every three hours to keep an accurate record of the actual conditions of the heat. A humidity record was also kept which showed nothing below 50 per cent. The temperatures varied according to the outside weather, reading from 36 to 80 degrees. These readings were taken at top and bottom of the sides of the forms next to the timber framing, care being taken that the readings showed the actual conditions prevailing next to the form. The humidity readings were taken at the top of the pier at the finished surface of the concrete, as this was the portion heated by the live steam. Thus a check was kept on the effective moisture needed to cure the concrete.

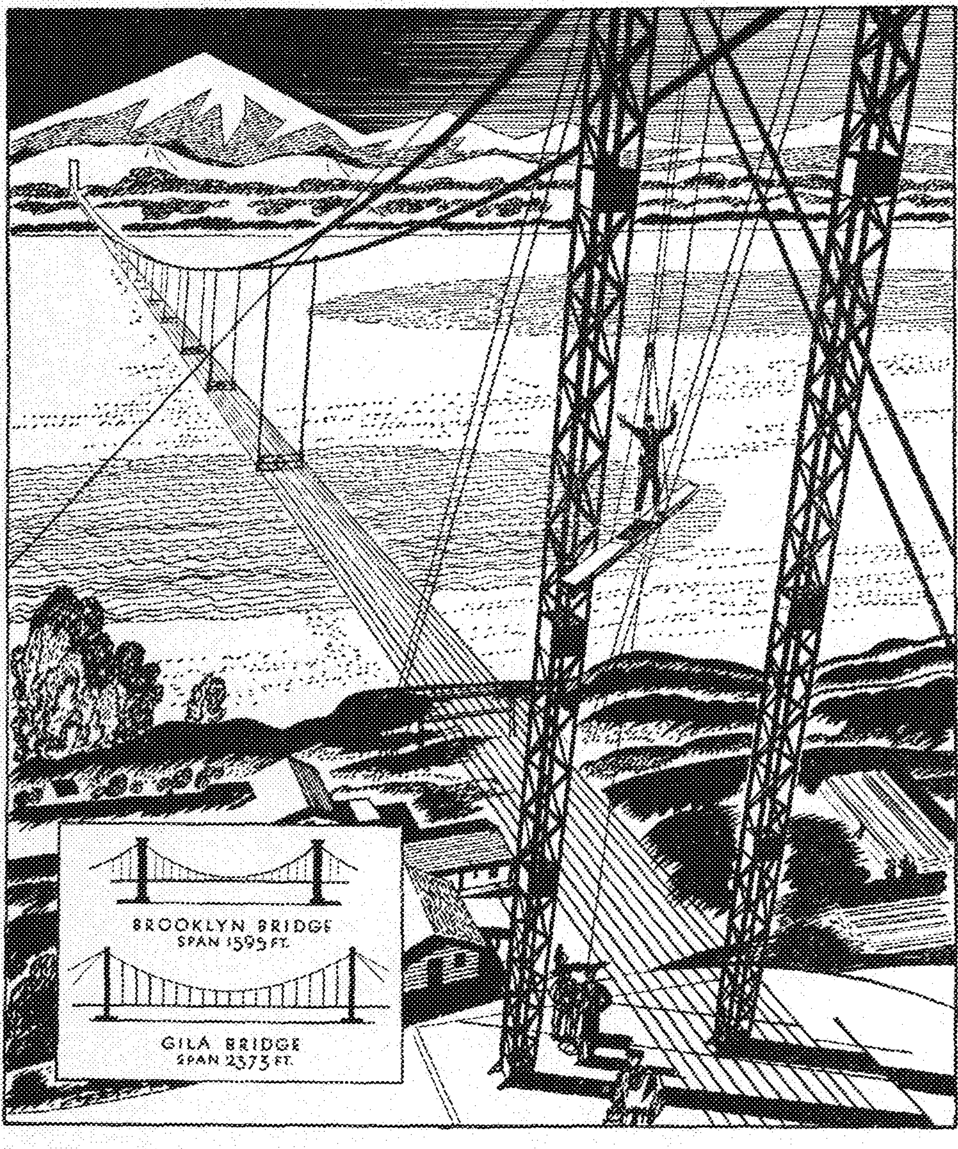


WINTER CONCRETE STRENGTHS COMPARED WITH SUMMER CONCRETE AVERAGE (lock)

Some questions arose about the effect the surrounding cold air would have on the internal temperature of the concrete. To answer these, two vertical temperature pipes were placed in the concrete within a pier. One was placed in the center of the pier at the bottom of the pour for the pier proper, while the other was placed 18 inches higher and six inches from the face of the concrete. Dairy thermometers were used which read as high as boiling, 212 degrees Fahrenheit. A temperature of 128 degrees was reached two days after placing the concrete, then followed a gradual declination until the protecting forms were removed when the temperatures dropped suddenly as shown by the accompanying graph. With the forms removed the inside temperatures show a lagging fluctuation with the surrounding normal temperature. A similar experiment was made during the summer in a section of the river wall of the main lock. Here a peak of 160 degrees was reached, followed by a gradual cooling, which indicates pretty clearly that concrete will heat sufficiently after it is properly placed and protected, to offset any freezing temperature encountered in this country.

To substantiate these findings and keep a record of the strengths of the

(Continued on page 138)



All in a day's work for telephone men

A specimen of construction work in the Bell System is the new catenary span carrying telephone wires across the Gila River, Arizona. The "natural" obstacle is no longer an obstacle while there are telephone men to find a way through it or over it.

This is but one example in a general expansion program. Others are such widely varied projects as linking New York to Atlanta by cable, erecting 200 telephone buildings in 1929, developing a $15,000,000 factory at Baltimore.

The telephone habit is growing apace, and the Bell System will continue to keep a step ahead of the needs of the nation.

BELL SYSTEM

A nation-wide system of inter-connecting telephones

"OUR PIONEERING WORK HAS JUST BEGUN"

ABOUT THE WORLD WITH OUR ALUMNI

(Continued from page 126)

Mechanicals

'26—Paul R. Burt has moved to 4112 Chicago Avenue, Minneapolis. Paul, who is designing conduit routes for the Northwest Bell Telephone company, married Miss Anderson, A. '26.

'29—William Swanson is still studying. He is a student in the building department of the Illinois Bell Telephone company at Chicago. At present he is living at 44 North Rockwell Avenue, Chicago, Illinois.

'29—Rolf M. Smith and Manfred P. Hanson are two of the twenty men from 15 colleges who are members of the Frigidaire Corporation's junior executives' training class. The course is a 58 weeks' training of practical experience in engineering, sales, service, materials, production, finance and inspection. The classes are held at the Frigidaire plant at Dayton, Ohio.

'23—Elmer H. Eige was recently appointed to an executive position in the Western Electric company. After his graduation, Mr. Eige entered the Western Electric company's student course. Following the student course Elmer became engaged in machine planning work. Later he entered into time standardization studies, his recent promotion puts him in charge of this work. Mr. Eige now lives at Berwyn, Illinois. He is married and has a daughter, Gayle.

'29—Chester L. Nelson has just completed his three months training course and is now employed in the estimating department of the Carrier Engineering Corporation of Newark, New Jersey.

'28—James J. Burke and Hilding L. Fritzberg are also with the Carrier Engineering Corporation. Burke was formerly in the Edison Building, Chicago, Illinois; and Fritzberg was with the Aerofin Corporation of Newark, New Jersey.

'27—Fred W. Little, formerly engineer of the Municipal Power Plant at Hibbing, Minn., has moved to Oak Park, Illinois. What's your job, Fred?

'26—Alois W. Graf, who is still examining applications for patents in composite and multiplex radio communication systems and automatic tuning arrangements for radio receivers, was married to M. Dorothy Swigert of Strasburg, Illinois, on November fifteenth. Mr. Graf is in division 51 of the United States Patent office in Washington, D. C., where he now lives.

'29—Donald E. Marshall has moved from 245 Rice Avenue West to 128 Fairview Avenue, West New Brighton, Staten Island, New York.

MOVING PICTURES IN COLOR

(Continued from page 119)

spot on the screen since no light reaches either the green or red filter segments.

In other words, all the tiny line areas transmit all, part, or no light according as the subject reflects all, or part, or none of the corresponding colored light. The various colors are recombined on the screen to reproduce the natural colors of the subject photographed.

Examination of an actual picture will make this principle clearer. Fig. 6 shows, on the left, a picture on Kodacolor film (actual size) of a child wearing a red hat. The child's head stands out in silhouette against a blue sky. In the enlargement on the right of one picture of the series, the characteristic line composition of a Kodacolor picture is readily discernible. When Kodacolor pictures are projected on the screen the lines, of course, are invisible at the normal viewing distance.

Note that the lines are alternately dark and light where the red hat is reproduced (shown by arrow A) thus allowing light to pass through the image so that it will be transmitted only by the red part of the color filter. In the area representing the blue sky, the lines are dark and light but in a different order than in the area of the red hat. This is best seen in the parts of the sky next to the hat (shown by arrow B). The sky area reproduces as blue on the screen since only the blue part of the filter will receive and transmit the light passing through that part of the picture.

The lens mount on Kodacolor cameras (Models B or BB Cine Kodaks) has been made so that the filter cannot be inserted until the diaphragm is fully open and as long as the filter remains in place, the diapraghm cannot be closed. This is necessary for two reasons, (1) to insure full exposure, and (2) to obtain true color rendering. If the camera diaphragm were closed to F/3.5 or F/4.5, for example, it would cut off parts of the color filter bands and spoil the color in the final picture.

In any process of color photography it is necessary to obtain with white light, equal exposures through the red, green, and blue filters. Since different coatings of the same kind of film may show differences in color sensitivity, some adjustment of the exposure ratio is necessary for the best results. In Kodacolor, this is made by means of a thin metal cap called the *ratio diaphraam*. Together with the dividing lines of the filter this diaphragm makes three rectangular bands for the red, green and blue. The bands are equal in width but vary in relative height according to the color sensitiveness of the different emulsions. The correct color diaphragm is attached to a leader on each roll of film so that it can be fitted onto the filter by the user.

In exposing Kodacolor film, the subject must always be in direct sunlight. In general, no diaphragm for controlling exposure according to the lighting is therefore necessary. In order to avoid overexposures under exceptionally brilliant lighting, as on the seashore, a neutral density of grey glass is inserted in front of the filters which effectively reduces exposure by one-half. The development and reversal of Kodacolor film is carried out on a continuous machine by a process similar to the one used for ordinary Cine Kodak film. A controlled second exposure regulates the density of the final pictures, and compensates for slight variations in camera exposure.

For projection of Kodacolor film, either the Model A or Model B Kodascope may be used when fitted with the proper attachments. These consists of a tri-color filter and compensating lens.

(Continued on page 138)

UNIFICATION OF RAILROADS

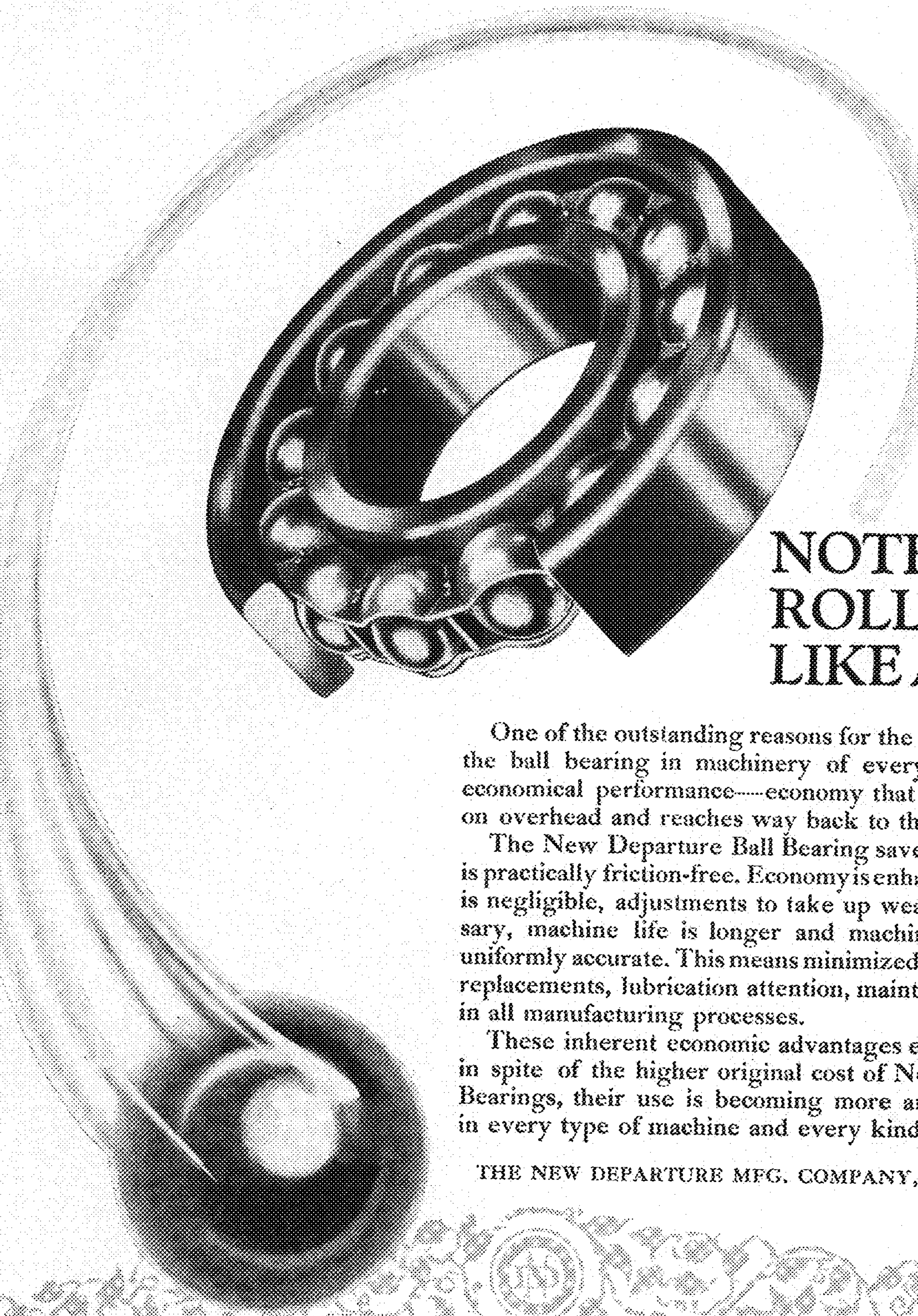
(Continued from page 123)

all that they wanted, but it gives them the roads they most eagerly sought. However, in making the Wabash the basis of a fifth trunk line, it gives that road all it asked in its petition and more.

In the Northwest, the commission has proposed three systems based on the Chicago & North Western, the Great Northern-Northern Pacific, and the Milwaukee. The commission's views as to the pending application of the Great Northern and Northern Pacific are indicated by the fact that these two properties are placed in a single system without the Burlington, which is constituted as a separate system with the addition of the M-K-T. To the Milwaukee is added the two lines now controlled by the United States Steel Corporation, the Duluth, the Missabe & Northern, and the Duluth & Iron Range. The actual task of consolidation, however, is gigantic. The new Milwaukee System, for example will include nineteen lines, the Great Northern-Northern Pacific has thirty-one, the Burlington has thirty-four. These must be welded now into mammoth machines whose components work in harmony with and for the increase of the general effectiveness of the whole.

While much of the plan is in accord with the expressed desires of the roads, most railroad officials take the position that further consolidation legislation is necessary to enable further consolidation to be brought about, even if the commission should, upon application, approve the terms and conditions proposed. For example, the present law provides only for consolidation into a single corporation and requires that the capitalization of the corporation which is to become owner of the consolidated properties shall not exceed the value of the consolidated properties as determined by the Commission. This would mean that a considerable period must elapse before a consolidation approved by the Commision could be authorized and made effective.

It will be seen that the publication of the plan will tend to clear the chaos into which the conflicting ambitions of the railroads have thrown the entire question of consolidation. Instead of the Commission having to adjudicate between opposing merger petitions, it will require the railroads to reconcile their plans to one of its own. While there is some difference of opinion, it is generally aggreed that the Commission cannot enforce its plan. It is empowered, however, to hold hearings, and this it in-



STABILITY OF RIVER BOATS

(Continued from page 117)

A convenient method of determining the moment of inertia of the water line plane of a boat is based on Simpsons rule. The half breadth plan of the load water line is divided by ordinates perpendicular to the center line, into an even number of parts, e.g. 8, with half interval ordinates in the two end parts. The Simpsons Multipliers for these ordinates are:

Ordinates:	1	1½	2	3	4	5	6	7	8	8½	9
Multiplier	½	2	3/2	4	2	4	2	4	3/2	2	½

The sum of the products of the multipliers and the cubes of the half breadths measured at each ordinate is determined. This sum multiplied by ⅓ the interval between ordinated times the factor ⅔ gives the moment of inertia about the longitudinal axis through the center of the water line plane.

The center of buoyancy is the center of gravity of the displaced liquid and may be determined by finding the moment of the volumes between water lines about the water line plane. This moment divided by the displacement gives the distance of the center of buoyancy below the water line plane. The displacement in cubic feet may be determined from the lines of the hull.

The location of the center of gravity of the boat is subject to calculation from the elements of the boat by taking moments about a convenient axis. This, however, is a laborious process and inaccuracies result from the complicated nature of the boat's structure. Recourse may be had to a more practical method of determination, that of the inclining experiment. This experiment may be performed for any condition of loading and changes in the loading may be allowed for in general. It consists essentially of moving a known weight K from amidships to one side through a distance hh' producing a small inclination θ, the inclining moment will then be very nearly K.hh', Fig. 4,

and the righting moment will be equal to W.GG'

But $GG' = MG\tan\theta = (BM - GB)\tan\theta$

Then $K.hh' = W(BM-GB)\tan\theta$

and $(BM-GB) = \dfrac{K.hh'}{W\tan\theta}$ or $GM = \dfrac{K.hh'\cot\theta}{W}$

(GM) is the metacentric height therefore the location of the center of gravity and the metacenter are known.

In making the inclining experiment, it is convenient to determine the angle θ by means of a plumb bob suspended in a sheltered place or a transit or level may be used to secure the angle of inclination, taking angle or rod readings on an athwartship base line.

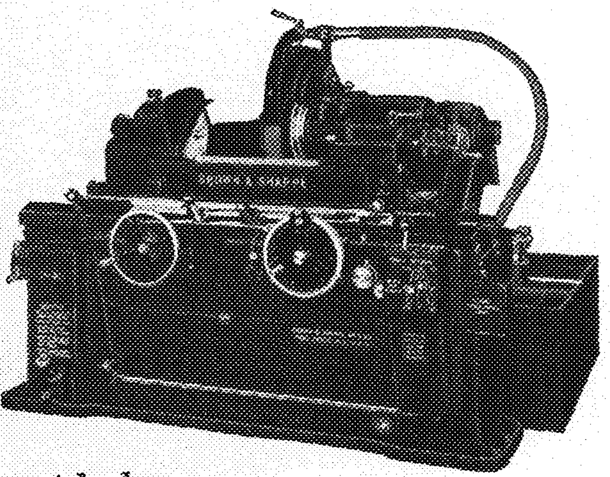
The boat should preferably be in a quiet pool made fast with a head line only, and there should be very little wind, which if possible should be a head or stern wind. The hold should be pumped dry, all objects likely to move should be removed, oil compartments should be full or empty and all men but the observers should be sent ashore when readings are taken. It is desirable to make a number of observations moving the weight from amidships to either side of the boat.

A river boat subjected to the calculations and the experiment as indicated in the preceding discussion, will have disclosed, its critical factors permitting conclusions as to its stability for it is upon the relative positions of the center of gravity and the metacenter, that equilibrium, stable or unstable, depends.

If the center of gravity and the center of buoyancy are in the same vertical,

(Continued on page 138)

Improving Grinding Practice



with the

Brown & Sharpe No. 30 Plain Grinding Machine

THE advanced design and the many unique features of the Brown & Sharpe No. 30 Plain Grinding Machine has led to the development of new methods which increase the production of accurate work, reduce the effort required of the operator and lead the way to substantial new savings.

Among the outstanding features of the No. 30 are the rugged construction, high speeds and feeds, centralized controls, inbuilt precision and ease of operation.

A catalog describing in detail the many features of the No. 30 or any other size in the "30 Series" will be sent at your request.

BROWN & SHARPE

BROWN & SHARPE MFG. CO. (BS) PROVIDENCE, R. I., U. S. A.

BAILEY METERS

Used by Leaders in Every Industry

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

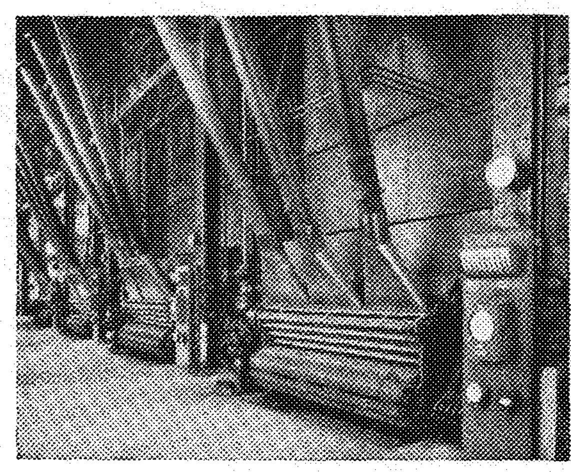
BAILEY PRODUCTS

Automatic Control	Liquid Level Gages
Boiler Meters	Manometers
Coal Meters	Multi-Pointer Gages
Draft Gages	Pressure Recorders
Fluid Meters	Tachometers
Gas Flow Meters	Temperature Recorders
Gravity Recorders	V-Notch Weir Meters

Write for Bulletin No. 81B

Bailey Meter Co.

Cleveland, Ohio



Bailey Meters in a Large Oil Refinery

RIVER BOATS

(Continued from page 136)

there is equilibrium; if the metacenter is above the center of gravity, there is stable equilibrium and if rolled slightly, the boat will right itself; if the center of gravity is above the metacenter, the boat may capsize.

The conclusion reached as to stability from an investigation as outlined, provides a basis for determining the extent of further study necessary in the case of a particular boat. Such a study may involve a further disclosure of stability under conditions of considerable inclination or the advisability of physical changes in the structure of the boat or the avoidance of certain projected alterations.

COLORED PICTURES

(Continued from page 132)

The simplicity of Kodacolor is apparent to anyone on his first trial of the method. Close-ups of people, especially children, of flowers, autumn foliage, or pageants make very pleasing subjects. Distant views over water showing reflections, mountain scenery, pictures of sunsets, or of colorful beach scenes also make satisfactory Kodacolor pictures. In short, this process has realized the dream of the photographer from earliest times of a simple method of reproducing accurately the colors of nature.

In the construction of the Vicksburg Bridge across the Mississippi pneumatic caissons were sunk to a depth of 110 ft.

PLACING CONCRETE

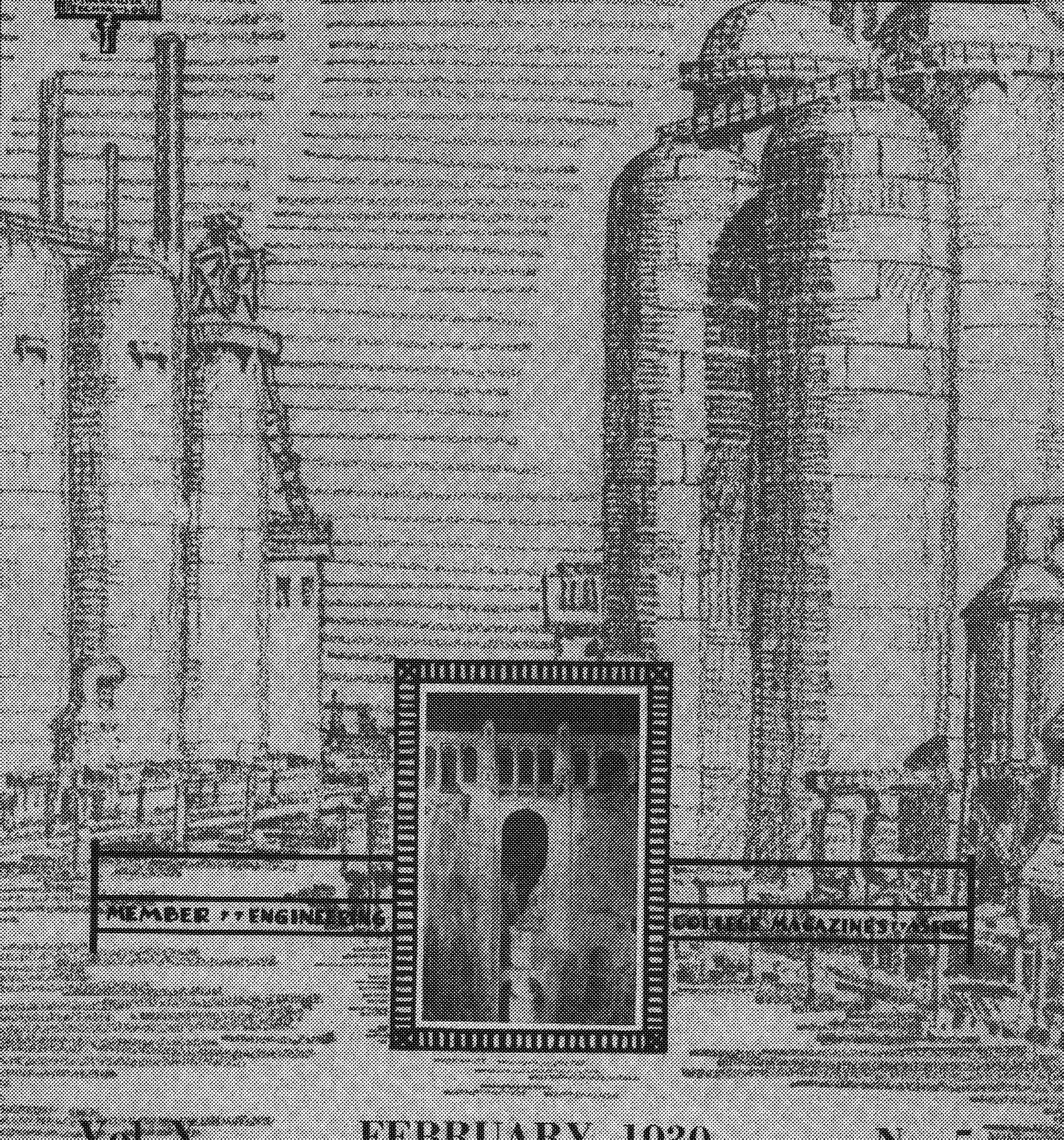
(Continued from page 128)

concrete in the dam, test cylinders were made and cured both under field and laboratory conditions. These have given a very good indication that the concrete placed under adverse conditions has equal strength as that placed during the summer. As shown by Plate 2 the field cured specimens have had a greater strength than the laboratory cured ones. Thus is brought out again that steam curing of concrete is far better than curing concrete under even well regulated conditions where the humidity and temperature are both favorable, and that with proper care to protection of the concrete, cold weather need never be a deterrent to construction.

The Lund Press, Inc., Minneapolis

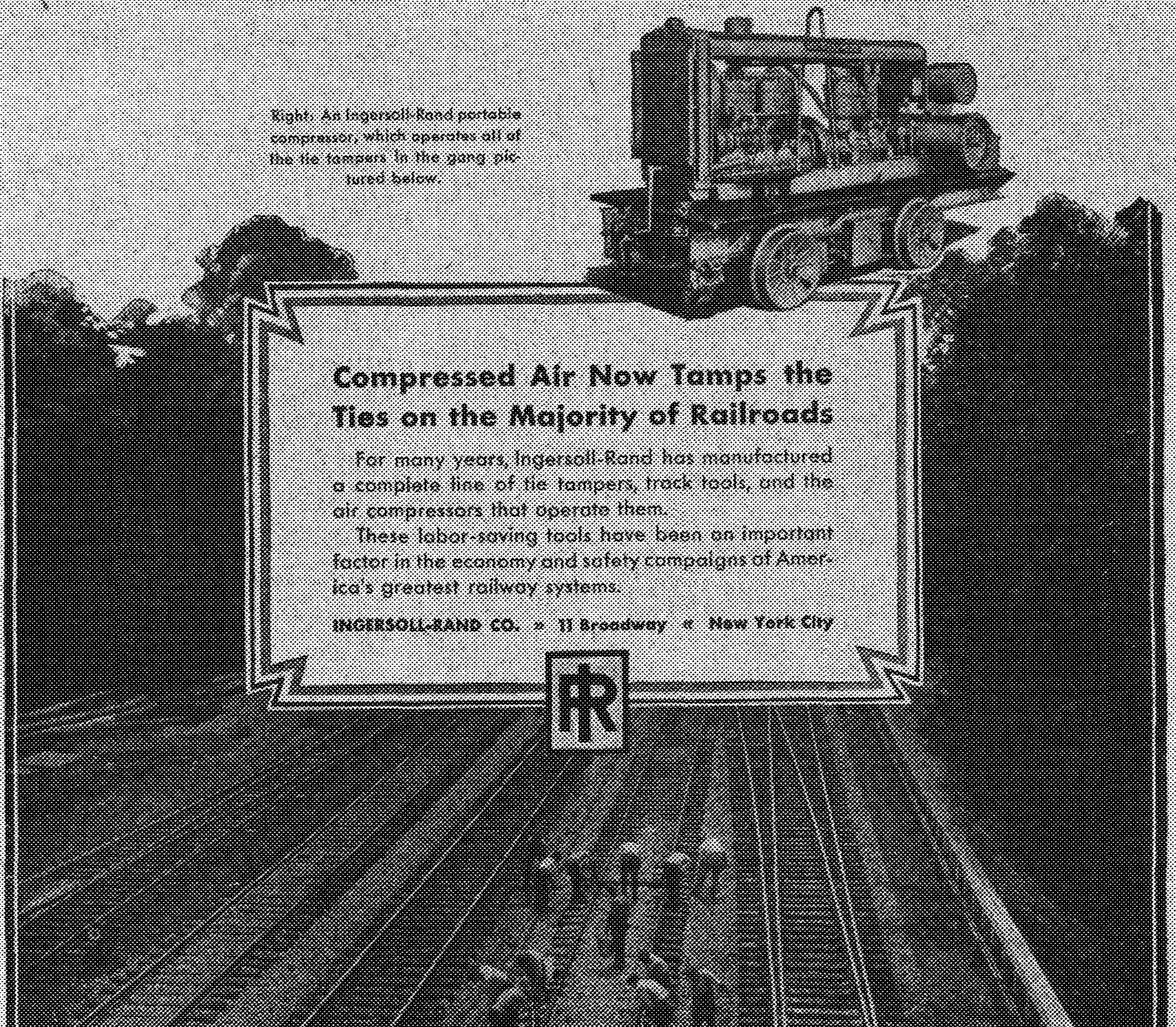
The Minnesota Techno-Log

MONTHLY PUBLICATION OF THE TECHNICAL STUDENTS

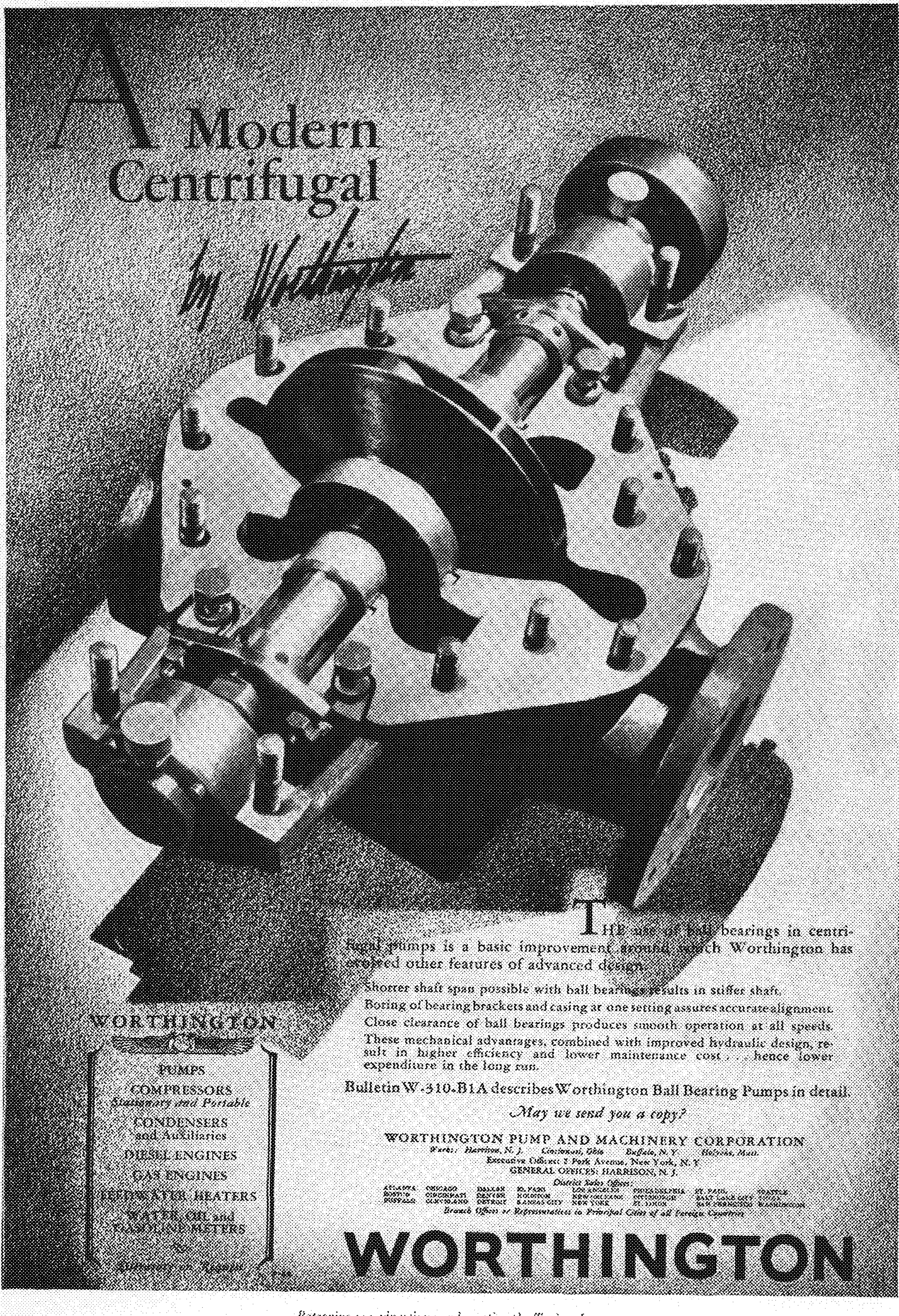


MEMBER ENGINEERING COLLEGE MAGAZINES ASSOC.

Vol. X FEBRUARY, 1930 No. 5



Right: An Ingersoll-Rand portable compressor, which operates all of the tie tampers in the gang pictured below.
Compressed Air Now Tamps the Ties on the Majority of Railroads
For many years, Ingersoll-Rand has manufactured a complete line of tie tampers, track tools, and the air compressors that operate them.
These labor-saving tools have been an important factor in the economy and safety campaigns of America's greatest railway systems.
INGERSOLL-RAND CO. » 11 Broadway « New York City
Ingersoll-Rand


A Modern Centrifugal
by Worthington
THE use of ball bearings in centrifugal pumps is a basic improvement around which Worthington has evolved other features of advanced design.
Shorter shaft span possible with ball bearings results in stiffer shaft.
Boring of bearing brackets and casing at one setting assures accurate alignment.
Close clearance of ball bearings produces smooth operation at all speeds.
These mechanical advantages, combined with improved hydraulic design, result in higher efficiency and lower maintenance cost . . . hence lower expenditure in the long run.
Bulletin W-310-B1A describes Worthington Ball Bearing Pumps in detail.
May we send you a copy?
WORTHINGTON PUMP AND MACHINERY CORPORATION
Executive Offices: 2 Park Avenue, New York, N. Y.
GENERAL OFFICES: HARRISON, N. J.
WORTHINGTON
PUMPS
COMPRESSORS
Stationary and Portable
CONDENSERS
and Auxiliaries
DIESEL ENGINES
GAS ENGINES
FEEDWATER HEATERS
WATER, OIL and GASOLINE METERS
WORTHINGTON

THE MINNESOTA

TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

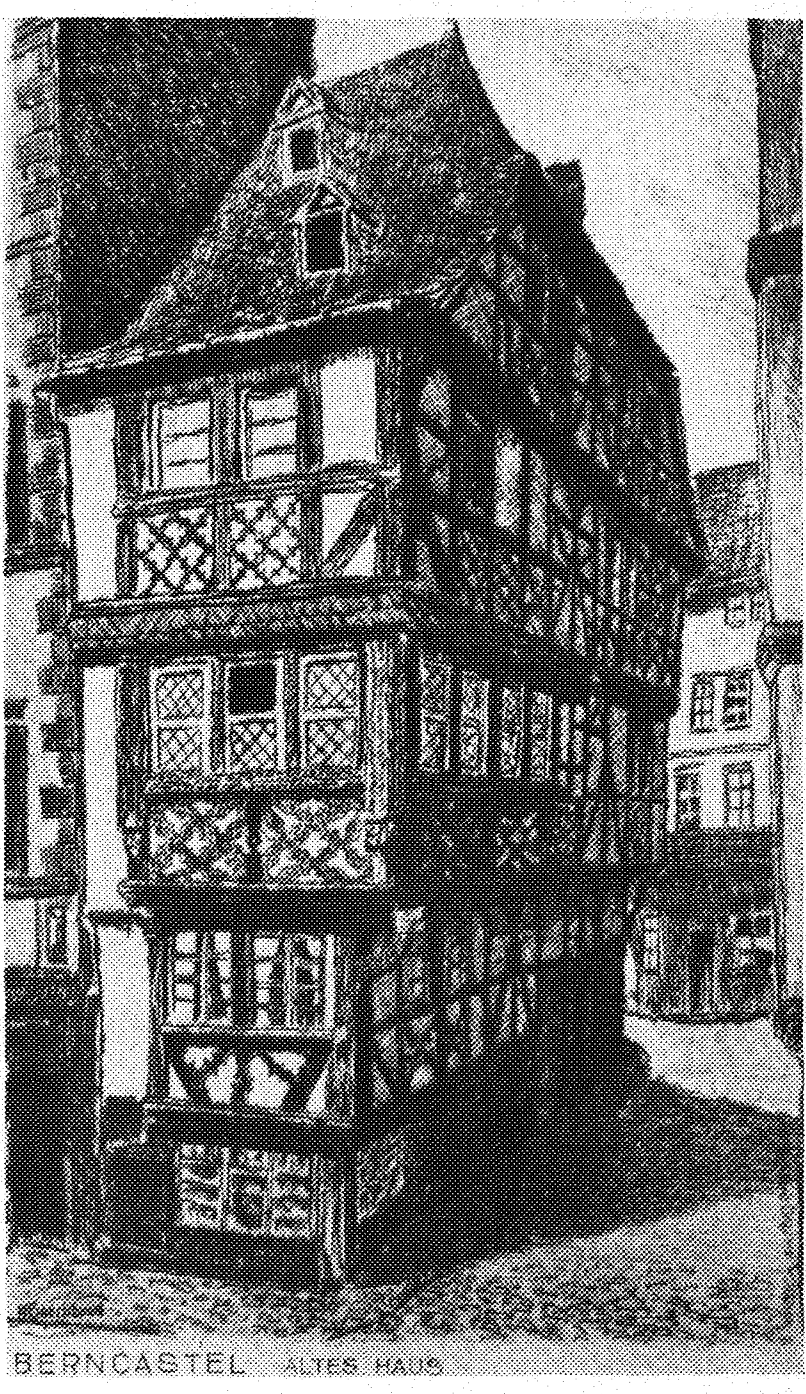
Published monthly from October to June inclusive, by the TECHNO-LOG *Association, composed of the students of the College of Engineering and Architecture, the School of Chemistry of the University of Minnesota.*

VOLUME X — MINNEAPOLIS, MINN., FEBRUARY, 1930 — NUMBER 5

CONTENTS

	PAGE
ENGLISH FOR ENGINEERS *R. W. Siler*	145
MOTORING OVERSEAS *Francis C. Shenehon*	146
CHEMICAL STUDIES IN ELECTRICAL DISCHARGE TUBES *George Glockler*	148
ENGINEERING REVIEW	149
CUB ENGINEERS *Boyden Sparkes*	151
NEWS FROM THE TECHNICAL CAMPUS	152
EDITORIALS	154
ABOUT THE WORLD WITH OUR ALUMNI	156
OSCAR FEGAS—ENGINEER PREEMINENT	158
DIPLOMA MILLS CHEAT STUDENTS OF MILLIONS	160

Entered as second-class matter April 9, 1925, at the post office at Minneapolis, Minnesota, under the Act of March 3, 1879. Office, 37 Electrical Building, University of Minnesota. Telephone, Dinsmore 2760. Contents copyrighted and permission must be secured for re-publication. Subscription rate, $1.50 a year. Single copies, 25 cents. Advertising rates upon application. Alumni Directory, 50 cents.



An Old House

Berncastle, Germany

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume X FEBRUARY 1930 Number 5

ENGLISH FOR ENGINEERS

By R. W. SILER

Department of Mathematics and Mechanics

IF I were asked what is the most important subject taught in the College of Engineering I would say that the subject is English. It is quite possible that the polite, though somewhat skeptical, retort to that would be, "Oh, yes; English has cultural value." To which I would be moved to counter with, "A thorough command of language is the most practical possession a man in any line of work can have." And then, I suppose, the fight would begin.

It must be remembered that in this country the medium of communication between men is the English language. Being that, it is, more than anything else, the medium by which an individual impresses himself upon the world. Admittedly, other things, such as manner and appearance, add to this impression, though in a far less degree; and I cannot imagine one getting very far with engineers simply on appearance. Not, at least, if one is of the male sex. The engineer's problem is with humanity as well as with material, and it is a question which of the two phases is the more important. As far as material is concerned no amount of English, forceful and choice though it may be, will help matters. There is but one language for the treatment of material, and that language is mathematics. An engineering problem, as far as the material side of it is concerned, is correctly treated if the mathematical treatment of it is correct. There are physical problems requiring only the simplest arithmetic, while others call for the most advanced mathematics; but in any case if the calculations of the engineer have been made correctly the problem of material has been solved. From this moment the problem becomes a human problem, a problem of execution rather than of design. It is no longer a problem in mathematics, but very largely a problem in the use of English, that medium by which the engineer brings other men to a recognition of his own capacity and the value of his work, and to the execution of his plans. It has always seemed to me the extreme of inconsistency when an engineer, having used that most precise of instruments, mathematics, shows himself inaccurate, incompetent, lame in the use of English.

The engineer's human contacts are with his own profession and with the public. Undoubtedly his technical ability will be more shrewdly judged by other engineers than by the public. But even so, these professional judgments are tremendously affected by how a man speaks and writes. Two things every engineer worthy of the title desires other engineers to believe he has are knowledge and intelligence. Certainly the man who uses English correctly, forcefully, confidently, must offer greater assurance of knowledge and intelligence than he who delivers his words otherwise. It is sometimes said that competency in English is occasionally used to hide a lack of knowledge; but even so, as long as good, brisk, apt English indicates intelligence—and it does do that—it is worth while in judging a man. An intelligent man can always gain knowledge.

This is the second of a series of three articles by Professor Siler. The first, "Why Mathematics for Engineers," appeared in the January TECHNO-LOG. *The third article, which deals with military training in the University, will be published next month.*

Even more in the case of the public than in that of his professional associates the engineer must depend upon English to prove his value and that of his work. The doctor and the lawyer find this necessary, and in the final analysis the engineer is quite as dependent upon the public as are men in other lines. The public is the patient, the client, the benefiter, the victim, whatever one cares to call it; but the fact remains that in the end it is the public that pays salaries and votes bond issues. This public, whether it be an individual of the public or a community, whether by spoken word or by written, must be approached through the medium of English. Every profession has a technical language of its own which, quite comprehensive within the ranks of the profession, is incomprehensible elsewhere. So far I have kept clear of lawyers, but I have heard doctors debate among themselves upon the afflictions of mankind, and their use of medical terms then has always left me overpowered. So a doctor would feel, I suppose, hearing engineers arguing and slugging one another with indeterminate stresses in structures, the peculiarities of alternating currents, processes of integration, and what not. Certainly the public, asked to pay the bills, cannot be persuaded by this technical jargon but only by plain English, vigorous, clear and convincing. A public befuddled is a public unconvinced.

Our courses in English, I believe, not only attempt to improve a student's use of English but also to familiarize him to some extent with literature. Literature, remember, is not simply a stringing together of words, pleasing and effective as that process may be. Literature has an intellectual content, and it is inconceivable that anyone studying it can escape intellectual improvement by doing so. The engineer's problem, being a human problem as well as a purely technical one, calls for a study of humanity as well as of materials, and whatever has been accomplished in the study of the human problem is to be found in literature. I do not refer here to that known as technical literature which, besides being usually more remarkable for technical qualities than for literary, at the best deals with problems of material. That, of material, is but half the engineer's problem, as I have said before. The professional man as much as any other will meet all types of individuals, and upon an understanding of those types will depend much of his success. How better can a young man, lacking actual contact with those types, familiarize himself with them than through what has been told of them in literature? Indeed a young man wandering out of college into the world altogether devoid of that knowledge inherent in literature, splendidly equipped though he may be as regards technical knowledge, must ever be a rather sad object. He will be a veritable babe in the wood. He will ever be doing other men's bidding, ever increasing other men's reputation and income, and ever being rewarded for it by being called a rather stupid fellow. *(Continued on page 170)*

MOTORING OVERSEAS

By FRANCIS C. SHENEHON

Consulting Engineer, Foshay Tower, Minneapolis, B. C. E. 1885; C. E. 1900.
Dean—College of Eng'neering and Architecture, 1909-1917.

FRANCIS C. SHENEHON

I SPENT some months on the continent of Europe in 1927 making a study of water power development in Norway, Sweden, Germany, Austria and Switzerland; and wrote two brief articles for the TECHNO-LOG on Hydro-electric Developments in the Scandinavian countries. The overseas trip of 1929 was less intensely professional than the earlier trip, although opportunities to investigate water power and sewage disposal in particular, were not neglected. In this paper it is purposed to touch upon the conditions of travel with an automobile as an essential part of the trans-Atlantic baggage.

The object of this paper is simply to state the advantages of one's own motor car as an essential item in seeing England and the continent comfortably, not too expensively and most effectively—without customs or other complications.

Perhaps three elements enter into the consideration of ways and means of traveling from one's own home town to England and the continent of Europe and returning again to one's own home town: First, Expense; Second, Comfort; and, Third, Efficiency of accomplishing the things which are the objectives of the overseas adventure. We—my wife and myself—purchased for our trip a 1929 4-passenger Chevrolet Six Convertible Landau, at a cost,—with extra tire, bumpers and Hades heater—of about eight hundred dollars. It has a wheel base of only 107 inches, which is distinctly advantageous for the hairpin turns in the Alps; and the back part of the top drops down for better views of snow-capped mountain crests. The car is exceedingly comfortable in its upholstered seats and in its yielding springs. It is so powerful—26 H.P.—that stiff roads in hill countries required mostly only intermediate gear.

THE MATTERHORN-SWITZERLAND

When leaving Minneapolis my Silvertown cord tires were practically new. I carried at the back two spare tires and a canvas-covered wardrobe trunk. Hand baggage was stowed inside. We left Minneapolis April 28th, 1929, crossed into Canada from Detroit and reached Quebec—after a side trip to Ottawa—a distance of 1,830 miles on the seventh day. It must be understood that we get a lot of enjoyment out of driving our car; and we do not follow the direct route between terminals; as later we returned from Montreal to Minneapolis by way of New York City. This is part of the efficiency element in automobile travel. In the expense element, it was a little cheaper to travel by auto, rather than by railway, to Quebec. We sailed on the Canadian Steamship "Empress of Scotland," gliding serenely down the stately St. Lawrence into the Gulf, where whales blow and icebergs gleam, across the blue Atlantic to England. It costs $285.00 for the roundtrip transportation of the auto—Quebec - Southampton and Antwerp - Montreal. This payment included membership in the Royal Automobile Club of Great Britain, the servicing of the car on landing in England and ultimately again at Montreal. Membership includes international license plates, a folio of documents making easy the crossing of boundaries in Europe, maps, and a book of recommended hotels. The hotels recommended by the R.A.C. are certain to be desirable and all rates for rooms, meals and garages are definitely set down. The Michelin Road Map should be provided for information concerning the quality and condition of the roads.

Our car was ready for travel two hours after the ship had reached the dock. We drove 5,050 miles in England and 7,050 miles on the continent of Europe, a little over 12,000 miles overseas. Counting all the elements of automobile expense: Interest on investment, depreciation, insurance, transportation over the Atlantic and the English Channel, repairs, washing and garage, gas and oil, and fees for use of roads—it cost us a little less than six dollars a day for the 164 days of our sojourn abroad. That means a cost of about eight cents a mile. Of course we sometimes stopped for a few days, or a week or more, without much driving in London, Edinburgh, Dresden, Vienna, Munich, Geneva, Paris and Brussels. Most of the time the car carried three persons, so the cost per person was about two dollars a day.

Francis C. Shenehon, dean of the College of Engineering from 1909 to 1917, was graduated from the University of Minnesota in 1895, receiving his master's degree in 1900. After leaving the University in 1917, Mr. Shenehon opened a consulting hydraulic engineering practice in Minneapolis.

Mr. Shenehon, who spent several months in 1927 in the Scandinavian countries studying their engineering possibilities, has taken an active interest in the St. Lawrence Waterway, of which he is an advocate. He is a member of the Metropolitan Drainage Commission of the State of Minnesota, of the American Institute of Consulting Engineers, and of the American Society of Civil Engineers.

It is obvious that a motorist, as compared with a motorless traveler, is relieved of the annoyance of time-tables or schedules, tickets and crowded trains and busses. He is relieved of the expense of porters and taxicabs and of railway or bus fares. He may travel when he wishes and where he wishes. He may penetrate the intimate places where life goes on without tourists. He may stop to pick flowers or for a wayside lunch. He is not brow-beaten by an itinerary. He is captain of his craft. He may stop to take a dip in the Irish Sea, or to buy Banbury buns, Devonshire cream or antiques. With one's own car travel becomes individualized and different from the tripper routine.

Our peregrinations led us through the New Forest of Hampshire, the coast towns of Dorset, and Dartmoor in Devon to Lands End in Cornwall; then northward with excursions into the mountains of Wales, through the Shakespeare country and the Lake Country into Scotland, through the tragic Glen Coe, past Ben Nevis to the Caledonian Canal; then north to Inverness—where it was daylight at ten o'clock at night—then south through Aberdeen to Edinburgh. Into England again and a grid-ironing of that blessed isle until we reached London. We then went on again, through Canterbury to Dover on the English Channel. Over five thousand miles of splendid road with not a single muddy or slippery stretch. Landing in Mid-May, we were lucky enough to meet the primroses, the hawthorns and the blue-bells and to travel north with them, at times through woods blazing with rhododendrons. In all this travel the service of the Scouts, of the R.A.C. and A.A. was continuous and helpful—traffic officers at cross-roads far from any towns. Driving on the left hand side of the road was natural after the first day.

We crossed from Dover to Ostend, Belgium. No complications anywhere in crossing borders. Not more than one bag out of six was opened for customs inspection. We had to pay a fee for the use of the roads in Belgium, Germany and France, from 24 to 40 cents a day. Making across Belgium, through Bruges, Brussels and Liege, the roads were of stratified rock set on edge. We had to deflate the tires to lessen the rattle. But it was only two days, then Germany. The industrial region of the Ruhr, at Essen, was the first objective for professional reasons; then the Rhine, and, swinging to the south and east, Nuremberg, Leipsic and Dresden, were visited. Then south through Czecho Slovakia to Prague, and on across the border again to Vienna on the Danube. Roads not so good in Czecho Slovakia, but never muddy or slippery. From Vienna south into the mountains, where roads were good, but narrow with steep grades: through beautiful country with interesting towns, we drove to Salzburg. Then we passed again into Germany and Munich. Then we drove through the Bavarian Alps, swinging north again through Oberammergau, Augsburg and some picture towns; and then towards the Rhine again at Karlsruhe and from there south through the Black Forest and across the Rhine into Switzerland at Basel.

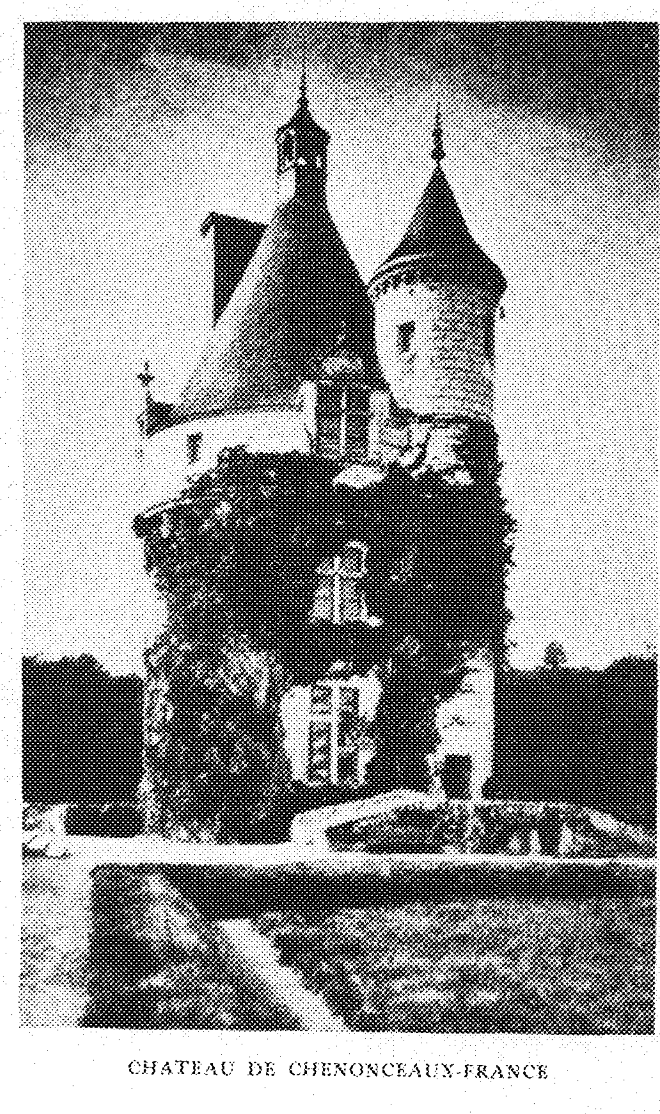
The roads in Switzerland are excellent, but in the Alps the grades are heavy—but seldom needing more than intermediate gear. We went over some of the high passes with massive scenery. After Geneva we slipped over the border south into France, with a night at Grenoble. After that a southern swing with some roads with rattling effects, to Nimes, Montpelier and Toulouse. Then north again through Cohors and Brive, and westerly, to Clermont-Ferrand. Here I had to buy four new Goodrich tires. It happened to be the best place in France to buy tires, manufactured there by Goodrich and Michelin. These cost but little more than the same tires in the United States. Paris was reached after passing through many cathedral towns. We sojourned there three weeks. Later, we took a ten-day trip through Normandy and Brittany.

After another rest in Paris, we left for Antwerp, to sail for home. Our trip from Paris to Antwerp took us over the line of the German invasion in 1914, through Chateau-Thierry and the cathedral town of Rheims, then on through Brussels. The scars of war have been so erased in the eleven years since the armistice that it is hard to believe that this was the arena of the most devastating war of all times. The cemeteries are the remaining visible evidences of that war madness.

As this paper is intended to be a statement of a method of travel with high efficiency in the objectives secured, with great convenience and comfort and at reasonable cost of transportation, it will be well to speak of a few things regarding maps, gasoline, oil, garages, repairs and hotels.

We had one general touring map of the continent of Europe, which sufficed until we later discovered the Michelin maps for France and similar maps print-

(Continued on page 168)



CHATEAU DE CHENONCEAUX-FRANCE

CHEMICAL STUDIES IN ELECTRICAL DISCHARGE TUBES

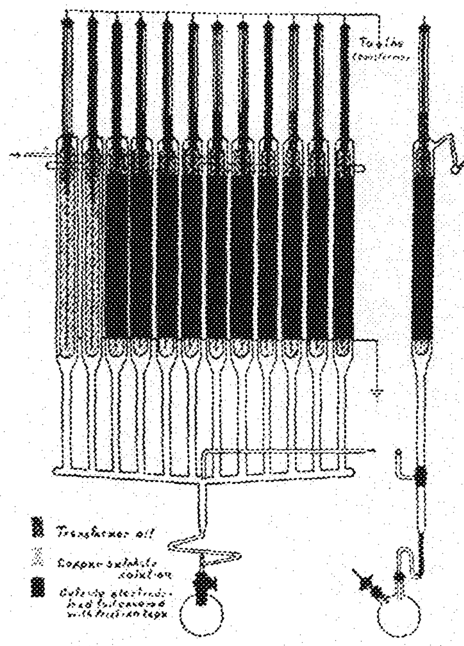
By **GEORGE GLOCKLER**
Associate Professor of Chemistry

IN two former articles in this journal we have described the research work that is being carried out at the School of Chemistry at Minnesota under the auspices of the American Petroleum Institute. In this note we would like to give further details of the studies and report on the progress made.

Our work had shown quite clearly that the liquid products obtained when gaseous hydrocarbons were subjected to an electrical discharge in an ozonizer, are very complex mixtures of hydrocarbons. If we for instance start with the gaseous hydrocarbon "Propane" and subject it to the action of the discharge we find not only products like hydrogen, methane and ethane but also molecules like butane, pentane, and hexane. It should be noted that the first two gases are evidently decomposition products of propane while the other gases are produced by a chemical synthesis taking place in the ozonizer. The liquid products formed must of course be made from the gaseous propane by a process of sythesis, because the liquid hydrocarbons are molecules of more complex structure than the propane we started with.

Just as we found that the gases resulting from the reaction are a mixture of different gases so we found that the liquid products are also a complicated mixture of many different hydrocarbons. If we wish to understand the chemical reactions taking place in the ozonizer we should have to know the resulting products both liquid and gaseous. It is necessary then to analyze the liquid oil produced. In order to carry out such an analysis it is obvious that one must have a large supply of the product at hand. The first step then was the attempt to produce a large supply of oil. For this purpose we arranged our apparatus consisting of twelve glass ozonizers through which we flowed butane gas from a tank. This apparatus was operated for a whole month and every day we were able to draw off a little oil that had been formed during twenty-four hours. By this process we finally accumulated about one liter of liquid condensate. The material has a yellowish brown color and was of the consistency of a light motor oil. By this process we prepared the largest amount of such a material that had been made in any research laboratory to date. It can be seen at once that the production of liquid fuel from waste petroleum gases by electrical discharge methods is not of economic importance. However the subject is of theoretical interest and as such furthers our knowledge of chemistry and of hydro-carbon materials in particular.

The next problem in our work was to analyze the synthesized liquid. It is well known to chemists that the analysis of a mixture of hydro-carbons like petroleum is a very difficult task and we were confronted with just this problem, for our oil had indeed very much the properties of a sample of petroleum. We realized the difficulties of the analysis and we set out to carry out this analytical study by attempting it in easy stages. Our first goal was to separate the liquid into a low, medium and high boiling fraction. This step was not difficult and we used the well-known methods of the organic chemist to separate mixtures by the process of fractional distillation. In this manner we obtained a light fraction which was quite colorless and had the consistency of gasoline. In fact this fraction is probably quite analogous to a gasoline as obtained from petroleum. The middle fraction is a yellow oil and is a material like a light lubricating oil. The heavy fraction has a deep reddish brown color and is very viscous and appears to be analogous to a very heavy lubricating oil.



TWELVE OZONIZER TUBES IN PARALLEL

The three fractions just described were still very complex mixtures which fact we discovered very soon as our work proceeded. We attempted next to separate the middle fraction by fractional distillation. But we were unable to cause a complete separation of this fraction. The fraction was separated into many subfractions but none of these behaved like a pure material. The constancy of the boiling point is a good indication of purity but none of the subfractions from the middle fraction showed such a constancy. Finally we had separated the middle fractions into so many subfractions that further distillation was not possible because the fractions were too small in volume. It will be necessary to make a still larger amount of product so as to obtain sufficient amounts of the final fractions needed for their identification.

It is seen then that the material is a very complicated mixture of different molecules and we should expect that the other two fractions are equally complex. The heavy fraction will be the more difficult to work with because the distillations will have to be carried out in a vacuum, and we have not yet studied it.

However we were successful in separating the lighter fraction into several subfractions and one of these we are able to identify. The fraction consists of octane. This is shown by the boiling point, the density, the index of refraction, the percentage of carbon and hydrogen, the molecular weight, etc. All of these properties show conclusively that this fraction consists of octane. We believe therefore that we have made a complete identification of this section of the material. It is a noteworthy fact that this subfraction was the largest subfraction from the light fraction. It should be noted that the octane molecule has eight carbon atoms in its chain while the butane molecule has four carbon atoms per molecule. It seems then that one octane molecule can be synthesized from two butane molecules by having them double up and unite with the elimination of hydrogen. This point is of considerable interest in connection with the ion-cluster theory of Lind. On this theory it is to be expected that octane molecules are to be formed from butane in largest amount, and this is indeed what is found. Of course many other reactions are possible as is shown by the very complex mixture produced.

In future work it is hoped to carry on the study and identification of some of the other larger fractions as obtained from the present series of distillation and to produce still larger quantities of the original mixture for a more detailed fractionation.

(Continued on page 168)

ENGINEERING REVIEW

The Calculus

THE most recent achievement of our faculty members is the issue of a contribution to mathematical literature, "The Calculus," by Professors H. H. Dalaker and H. E. Hartig. The book promises to be the most popular in its field since Granville published his well-known text. The authors have incorporated into the book all of the ease of learning and concise explanation which have characterized their teaching.

According to Professor Hartig, the chief fault of most calculus texts is the manner of presentation of formulae to the embryo mathematician. The new book does away with this to a great extent, substituting a method of building up the integral from the conditions of the problem. This is very advantageous to the student engineer as the calculus has such a wide variety of applications that no specific set of formulae can be devised to cover every problem. The courses following the study of the calculus depend largely upon the mathematical principles taken up previously for their results. The course as taught from this new text will aid the student in the solution of his problems in mechanics, as it is necessary to have a knowledge of the fundamental principles of the calculus to cover mechanics with any degree of success. Mere application of set formulae will accomplish little.

In order successfully to learn the principles of the calculus it is necessary to master the fundamental formulae of differentiation and integration. These have been presented in a concise, concrete table together with carefully selected and carefully graded exercises which supply the needed practice. The effort to be brief and to the point is shown in the comparative size of the book which is approximately half the size of Granville's text. Anything which is not of direct use to the student has been excluded. The first two chapters of the book deal with elementary principles of limits and notation. Differentiation is divided into five chapters, covering special rules, successive differentiation, implicit differentiation, and the treatment of trigonometric functions. The various applications of the derivative are discussed very thoroughly with clear, concrete explanations which make this bugbear of the engineering school very simple.

The book is divided into two parts, the second of which is a treatise of integral calculus. This portion of the text is by far the more important and the more practical of the two. Integration is studied in five chapters which involve the integration of rational fractions, integration by substitution, and the actual integration formulae. These formulae are presented in a table with suitable exercises to develop the student's ability. However, solution of problems by use of the integral is accomplished without resorting to formulae for the various work and energy equations. The entire integral is built up from the conditions of the problem. The student who learns the calculus in this manner has a tremendous advantage over the man who needs a set of cut and dried formulae to work each and every problem.

For this one point alone the authors deserve to be highly complimented on the fine piece of work they have turned out. The method of instruction enables the engineering student to handle very easily the difficult mechanics courses which follow the study of the calculus. The entire text has an ease of reading which is not common to the study of a course as the calculus. It may be likened to the text on the calculus by Thompson, "Calculus Made Easy." This well known work uses similar methods of presentation and treats the various phases of this subject in much the same way as the authors. All in all the new textbook is a fine addition to the long list of treatises already in existence.

Engineering Mechanics

VIEING with Professors Hartig and Dalaker for literary honors, Professors Brooke and Wilcox, early last fall announced the issue of *Engineering Mechanics*, a volume dealing with the subject of advanced mechanics. The new text is divided into three headings, statics, kinematics, and dynamics. The section on statics is studied for one quarter, and a second quarter is spent on dynamics and kinematics.

The subject of statics is treated in eleven chapters, the most important of which are the following: Concurrent Forces, Couples, Center of Gravity, Plane Statics of a Rigid Body, Friction, Work, and Moment of Inertia. Under concurrent forces the resolution of forces and polygon of forces are taken up, and presented in a very acceptable manner. Diagrams illustrating the meaning of the text enable the student to grasp very easily the principles set forth. In this chapter the authors also bring out the conditions necessary for a static equilibrium in both the graphical and analytic aspects.

Under the heading of couples the definitions and properties of couples are presented. Several highly important theorems are taken up and excellent illustrative examples serve to clear up this rather difficult topic in a very satisfactory manner. Among these postulates are the replacement of a force and a couple by a parallel force, and the parallel displacement of a force by the introduction of a couple.

The next chapter deals with one of the most important subjects of advanced mechanics, namely centers of gravity. The text puts forth several methods of finding centers of gravity of lines, plane areas, surfaces, and volumes. Each of these various procedures is clearly explained, and examples are given of each theorem. The theorems of Pappus are discussed and practical applications are demonstrated.

Perhaps the longest and most difficult chapter of this section of the book is plane statics of a rigid body. Resultants of a system of forces and the conditions of equilibrium are studied in detail. Problems of several different types dealing with systems of forces in a plane are presented together with methods of solution.

In the chapter on work the usual definitions and graphical are given together with a discussion of units, a topic which seems to be source of worry to the average student. The book also presents a discussion of work of a constant couple, resultant force, and systems of forces.

The last chapter of statics is the important conception of moment of inertia. The student is confronted with the parallel-axis theorem and the moments of inertia of various bodies. A short discussion is made of the polar moment of inertia.

As before mentioned the second half of the book deals with the subjects of kinematics and dynamics. Of the two, dynamics is by far the more important. As a consequence the discussion of kinematics occupies but a small section of the book. It deals mainly with the study of plane motion. The student is presented with the ideas of velocity and acceleration. The relation of the calculus to the concepts of velocity and acceleration is given in a very concise manner.

The subject of dynamics is discussed in six chapters, rectilinear motion, curvilinear motion, dynamics of a rigid body, motion about a fixed axis, plane motion of a rigid body, and impulse and momentum.

The chapter of rectilinear motion presents the equation of motion and the energy equation. These two concepts are very important, and will be used by

(Continued on page 168)

The Making of an Engineer
After you have spent 4 yrs. dreaming of air castles,
Dont slam the door
and tried numerous railroad offices etc. in search for a job, and they all turn you down –
Plug
5
You will take a job chaining. After spending 14 yrs. at this position the chief Engineer–
Calls for you, and asks what you did at the U. You tell him not much except that you kissed the Blarney Stone and was a firm follower of St. Pat.
And the "chief" decides you should be a full fledged Engineer because of your unfailing faith.
You'll be glad you kissed the "Brick".

CUB ENGINEERS

By **BOYDEN SPARKES***

THEY were cub engineers about to leave Tech and seek ways of applying what they had learned to the mighty forces of industry. For long years they had been grinding at textbooks and in the laboratory to discover the secrets of steam power, electric power and hydraulic power. But on this last day of their preparation they were addressed by a distinguished member of the profession to which, according to the testimony of their diplomas, they belonged.

"I want to talk to you," he began, "about a form of power which is scarcely refered to in your textbooks and which cannot be studied in your laboratories. Nevertheless, this form of power is the most important of all, because without it no engineering work can be done. Because little can be learned about it academically and nothing in the laboratory, you will leave this institution with your diplomas, but unprepared for engineering work in this one particular.

"I refer to human power—that which is exerted by the hand of man. You have heard much, and will hear a great deal more, in the course of the next few years, of the need of experience. In the last analysis, most of this experience has to do with acquiring a knowledge of this form of power. It is something which no one can do for you, and for that reason, if for no other, you must do it well for yourselves.

"This brings us immediately to the question of what you are going to do after graduation, and if I have anything useful to tell you, it is to advise that in looking for jobs you seek such employment as will bring you in closest contact with labor.

"You have all heard the old saying, 'A rolling stone gathers no moss,' and have perhaps heard the rejoinder, 'But it gets mighty bright.' The latter part of this should guide you in your work in the next year or so. Do not seek any job with the idea of staying in it for your lifetime. Seek, on the contrary, a series of different jobs which will give you immediate, personal, and manual knowledge of as many different kinds of labor as you can find. With your training you should be able to squeeze the average job dry of useful experience in a few months. Thanks to the present scale of wages, you will probably get more for it than you would as a beginner in engineering work. When you have completed such a post-graduate course of your own selection, you will be able to qualify for an engineering position far more advanced and with better pay than you would have reached had you begun it immediately upon graduation.

"Well up in the list of the sort of job I have in mind comes mixing and placing concrete, building of concrete forms and the placing of re-enforcement bars. Practically every kind of engineering calls for re-enforced concrete in one way or another. Every industry uses it extensively for buildings, foundations, and the like. Our present public-service plants would be impossible without it. There are a thousand and one things about this kind of work that can be learned quickly and readily by working at it, failing which the knowledge must be acquired by experience distributed through many years of incidental observation.

"The handling and placing of heavy machinery is the kind of job which in two months will give a man a personal knowledge of force, mass and association, and strength of materials which he cannot possibly gain in the laboratory. He will acquire that most valuable trait, a sense of proportion in these matters, and it will help him throughout his engineering work. He will also acquire a vocabulary which may be more or less useful, and he will get first-hand information on what the practical man on the job thinks about the machine designer.

"A fundamental principle of industrial operation is the keeping of costs, not only of material but of labor. So a third job to be sought is that of time clerk or material clerk on some consruction work. This kind of a job is easy to get. It is an advantage rather than otherwise if the operation is small, because on the small job the time clerk will have to go all over the work and check the men in place, whereas the large jobs are often run on a time-card-and-clock basis. A time clerk who goes over the job has an opportunity to learn more about what constitutes a man day than he would acquire in years of routine experience as a subordinate engineer. He will see all kinds of work being done, the progress of it from day today, and the records which he has to keep will show him time as compared with progress. He will also learn much about union rules and allocation of work among the unionized trades. This is all information of prime value and it can be had in a few months' time, at good pay.

"The examples I have given serve to illustrate the principle. There is more to be learned in this sort of work than dollars and cents, quantities and man hours. My grandfather, who built locomotives before the Civil War, used to say to me as a boy: 'It takes everybody to know everything.' From this viewpoint, I am advising you to seek experience out of which you will gain respect for and appreciation of the knowledge of the skilled mechanic. You will find him honest and helpful, and willing to meet you more than halfway if he thinks you know your job or are seriously trying to learn it. You will find that he has the deepest respect for his superiors when they know their work, and the utmost contempt for those who do not know what to expect or when a job is well done.

"In the last twenty-five years a great many men have come to me before or upon graduation from a technical school, and I have sometimes been able to place them along the lines I have been talking to you about. About two years ago a young man came to me who was then a junior in mining engineering, and said he wanted to get some practical experience during the summer. I wrote the manager of a Western mine and found he was very glad to co-operate. At the beginning of the vacation he went out and started in as a mucker. Following the blast, the muckers go in and load the rock into cars. In this particular mine, the day's work for a mucker calls for handling eighteen tons of rock. The man I am talking about came from a well-to-do family, and I learned afterward that at college he had been excused from physical exercise upon a doctor's certificate, because he was supposed to have a weak heart.

"When writing the superintendent about this man, I stipulated that the candidate was to have the whole works, which included a thorough examination by the company doctor. The doctor found him perfectly sound, and he was put to work. Three weeks after he started in he wrote to me. This is his letter:

"'I have waited this long before writing you because I would not write you exactly as I felt at the time—namely, sore: Wow! If I had known how soft I was or what I was getting into exactly, you would never have had the misfortune of knowing me. Believe me, the first week I was out here—the gas was pretty heavy in the mines—I could have committed murder, arson, bigamy or anything else to get out. However, I now feel much stronger and better for the work, and although I cannot heave my eighteen tons a day as yet, I hope to in the near future.

"'Everybody out here has been fine to me and they are so darn nice that one feels mighty small in comparison. I

(Continued on page 174)

**Reprinted by special permission from The Saturday Evening Post, copyright 1929 by The Curtis Publishing Company.*

NEWS FROM THE TECHNICAL CAMPUS

Sigma Xi Sponsors Lectures by Lind

The second of the Sigma Xi lectures on the sciences was presented February 6. The speaker on this occasion was Dr. Samuel C. Lind, director of the School of Chemistry. "Because of the recent advances in science," Dr. Lind said, "the barriers formerly existing between physics and chemistry are now 'nebulous.'" In discussing spectra analysis he explained "the rays emitted by an element determine its place in the periodic table. Spectra lines belong to the atom; spectra bands, to the molecule."

An interesting and unusual method of determining the age of ores and rock formations was briefly discussed: the rate of change of uranium into lead is known, and the lead thus produced does not change further; by analyzing the rock to determine the uranium and lead content, one secures the information necessary to calculate very accurately the age of the ore.

Dr. Lind dealt with the subject of isotopes in a very comprehensive manner. Contrary to general opinion, most of the elements have one or more isotopes; mercury has eight, for example, an isotope being the existence of an element in forms having identical chemical properties but different atomic weights.

In concluding, he mentioned the hydrogenation of petroleum to make a larger volume of gasoline than the original petroleum occupied, and the proposal made in Germany to hydrogenate coal and thereby obtain this fuel as a liquid. "The periodic table," Dr. Lind declared, "is the Rosetta Stone of the chemist."

Professor Beal Dies

Professor William O. Beal, chairman of the astronomy department for the past two years, died February 15 after an illness of a month. Professor Beal has been a member of the University faculty for nearly seventeen years.

Professor Beal attended Earlham College at Richmond, Indiana. He was awarded a doctor's degree from the University of Chicago.

The principal research problems which occupied the time of Dr. Beal were the measurement of double stars and astronomical photography. Since the death of Professor Leavenworth, former head of the astronomy department, Professor Beal has written several articles on the life and work of his former colleague. Although widely celebrated for his research work, Dr. Beal was at heart an educator, and it is in this field that he achieved his greatest fame.

Ryan Will Study in Europe On Sabbatical Leave

William T. Ryan, professor of electric power engineering, has been granted a sabbatical leave for the year of 1930-1931. Professor Ryan's study will be devoted to the dielectric phenomena of high tension engineering, with particular attention to the determination of the causes of dielectric losses.

Professor Ryan has been with the electrical engineering department since 1907 as an instructor in alternating current and power engineering. He was graduated from the College of Engineering in 1901. In recent years he has devoted much of his time to the valuation of public utility companies. He has also conducted extensive research on special types of interconnections for high tension lines. Several of his articles on this subject have been published in the Electric World. Other valuable data and information obtained by research has been published from time to time in both magazine and book form.

Professor Ryan will spend part of his leave in Europe. The rest of the year, he plans to study at one of the four universities in this country that are especially well equipped with high tension apparatus. According to Professor Ryan these four universities are: Worcester Polytechnic Institute, Purdue University, Stanford, and California Institute

(Continued on page 168)

Chi Epsilon Announces Initiation of Seven

Chi Epsilon, honorary civil engineering fraternity recently announced the initiation of seven new men. All the men initiated are members of the junior class, with the exception of George F. Snodgrass, who is a senior. The juniors are: Stanley W. Ekern, Sheridan E. Farin, Willard W. Fryhofer, Wendell E. Hohnson, Earl F. Porter, and John A. Swanson.

The Minnesota chapter of Chi Epsilon is looking forward to one of the most important years in its career, according to R. E. Hertel who is president, as the national biennial convention will be held in Minneapolis during the fall quarter of 1930.

A.I.Ch.E. Hears Bailey

"Engineering Problems Concerning Cereals," was the subject of a talk given by C. H. Bailey, professor of biochemistry in the College of Agriculture, at a meeting of the Minnesota section of the American Institute of Chemical Engineers which was held on January 29.

In his talk, which was illustrated by a number of slides, Professor Bailey traced the cultivation and threshing of grains from early times to the present, stressing the advance from the early, crude methods to the modern practice which gains efficiency through the use of innumerable labor saving devices.

"Engineering," said Professor Bailey, "has made it possible for the modern bakery, by means of moving hearths, mechanical loaders, huge dough mixers and automatic wrapping machines, to bake bread and wrap it within half an hour."

In closing, Professor Bailey discussed the problems of storing grain, especially those of fermentation and spoilage caused by insufficient drying.

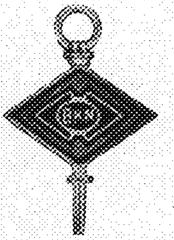
Algren Studies Insulation

A. B. Algren, assistant laboratory director in the department of experimental engineering, is at present engaged in a special research problem to determine the insulating properties of various materials used in building construction. Professor Frank Rowley, who is on leave of absence, is associated with Mr. Algren in the work.

The conductivity of the materials is measured by a hot-box method. In their experiments of last year on the same subject there was a variation of only three and one-half per cent between the theoretical and test results.

Eta Kappa Nu Initiates Seven New Members

Eta Kappa Nu, national honorary electrical engineering fraternity held its



initiation banquet on January 23 in the Andrews hotel in Minneapolis. Roy H. Comstock, toastmaster for the evening, called on Homer Brown to welcome the newly initiated members. Donald Kendall gave the response in behalf of the initiates.

The purpose and attainments of Eta Kappa Nu was the subject of a talk by Professor J. M. Bryant, head of the department of electrical engineering, who was the faculty speaker of the evening. Professor Bryant who is one of the few honorary members of the organization, was initiated by the Alpha chapter at the University of Illinois during the second year of the fraternity's existence.

"I am a firm believer in a well rounded education for the University student, but I believe that such education should have room for a good deal of serious scholarship," said Professor Bryant in concluding his talk.

After the formal talk, an open forum discussion of the aims of Eta Kappa Nu on the Minnesota campus was held.

The initiates were Robert Neir, Andrew Hustralid, Rudolph Hansen and Morris Newman of the junior class and Milo Rollins, Donald Kendall, and Helgi Punkari of the senior class.

Aero Engineers May Get Flight Training

Ora M. Leland, dean of the College of Engineering and Architecture, and C. B. McMann, pilot instructor with the Universal Air Lines, shared honors as speakers of the evening at the meeting of the Minnesota chapter of the American Association of Aeronautical Engineers, held January 31 in the Engineering building auditorium.

In his talk, Dean Leland said that plans were under way by which Aeronautical engineers would receive actual training in flying. Mr. McMann told the group of his many experiences in commercial flying.

The program was completed by a short speech by John D. Akerman, associate professor in Aeronautical Engineering, a group of musical selections by an eight-piece band, a moving picture showing, and a short talk on the purposes and accomplishments of the society by Lloyd Kernkamp, president of the Minnesota chapter.

H. W. Corbett Addresses Architects On Campus

Before a capacity crowd composed of the entire Department of Architecture and many outsiders, Harvey Wiley Corbett, one of the most prominent of American architects, appeared on Tuesday, Jauary 28, in the engineering auditorium.

Speaking extemporaneously, Mr. Corbett, who graduated from the Ecole des Beaux Arts in France, told of his student days in Paris and of his subsequent work as a draftsman and designer.

To the hopeful and expectant students present he stressed the importance of office experience for the young man desiring to enter the profession of architecture. "This experience," he said, "is the doorway between the student and the office." However in a more promising tone, Mr. Corbett pointed out that "practicing architects need the students more than the students need the architects. The complexity of building of modern times is such as to create a demand for a great number of professional men, and at the head of this group acting as a director, the architect stands. It is he who must be able, with his broad knowledge of the various problems of building, to weld together into a harmonious whole all the conflicting elements that appear in the science of building."

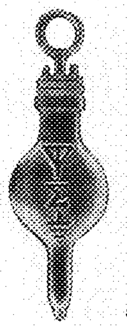
With his characteristic dry humor, Mr. Corbett said that in designing and building, the architect must struggle to erect a work that will make observers stop and say, "What is that?" But, he added, he must be very careful not to do something that will make the same observer say, "What the hell is that?"

On the evening of the same day, Mr. Corbett gave a lecture at the Minneapolis Institute of Arts, with members only admitted, on "Architecture of the Future." This was illustrated by slides of many of the most striking of the modern skyscrapers.

Perhaps the most fascinating part of the evening lecture was a brief explanation of the various new phases of the World's Fair to be held in Chicago in 1933. As advisory chairman of the Architectural Commission of the Fair, Mr. Corbett was in position to reveal many of the new features planned for that mammoth exposition. Among the particularly striking ones were: a symphony of lights, played as any symphony in music; electric transportation boats; moving sidewalks and escalators; and a general unification and concentration that will enable the visitor to see the entire exposition with a minimum of walking and standing.

Synton Holds Smoker For Radio Operators

"Professional Fraternities and Their Advantages" was the subject of a talk



given by Professor Milo E. Todd of the department of electrical engineering at a smoker given by the Minnesota chapter of Synton on Wednesday evening, February 19, in the Fireplace Room of the Minnesota Union.

In his talk, Professor Todd stressed the advantages of cooperation and organization among people of similar interests, and explained that the improvement of radio in early days would have been more rapid had their been greater organization among experimenters.

Robert W. Sandelin, a senior chemical engineer who is a member of the 151st Field Artillery, gave a short talk on the various systems of communication used by field artillery units in warfare. Mr. Sandelin stated that at present there is not much being done in the line of short wave radio in the army, but that there is much experimenting being carried out which will perhaps lead to small and compact radio outfits operating on very short waves and having a range of several hundred miles. The present portable army sets have consistent operating ranges of only one-half to two miles under ordinary conditions.

Synton is a national professional radio fraternity which had its inception on the Minnesota campus early in 1929.

N.C.E.A. to Meet in Minneapolis

Striving for a record attendance at the Annual Engineering Council of the North Central Electric Association, officials have just completed plans for their meeting which will be held at the Nicollet hotel, Minneapolis, February 24 and 25.

W. J. Sorenson, Fergus Falls, Minnesota, is chairman of the Engineering section, while W. H. Frost, Huron, South Dakota, is vice-chairman.

The conclave of some of the most brilliant engineers in the northwest will bring to light many of the important engineering questions of the day. Some of the topics to be under discussion in the general sessions program are: "Electrical Developments," by John Lapham; "Inductive Coordination Developments," Frank Fowle, Chicago, Ill.: "Lightning Studies and Surge Investigations," E. Beck, Pittsburgh, Pennsylvania, and reports by groups on "Overhead and Underground Accident Prevention," and "Electrical Apparatus."

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

APPARENTLY we have been laboring under a mistaken impression, for we believed that the alumni department of this magazine was one of its most popular features. Practically every subscribing alumnus who has visited the campus during the past few years has commented on it, and has mentioned the fact that to him, the department was of greater interest than any other portion of the book.

During the past few months it has become more and more of a task to find material, and now we are putting the proposition up to you. If you want the page write in and tell us and don't forget that we are interested in what you are doing, how your job is going, and how you are.

After all, it is up to you who are alumni to keep us supplied with information on your own activities and the activities of the other members of your class. The news that comes into the office of its own accord could be printed in large type on the back of a postage stamp. With the alumni backing the page and sending in material, the alumni section should be a complete success.

Throughout the present year, the TECHNO-LOG has printed several articles written by alumni,—but the number of contributions received at the office is entirely too small. Undergraduates are particularly interested in reading what has been written by their predecessors, and by former friends. The range from which to choose subjects is exceedingly broad. Anything from a trip to Junction Center and a swim in the old hole to the detailed account of the new job or the difficulties encountered in a research problem, prove of interest.

And so, Alumni, we appeal to you to aid the TECHNO-LOG that its alumni page may contain the life records of Minnesota graduates, that its articles may chronicle the thought and achievements of Minnesota men.

DURING the holidays plenty of criticism was hurled at the Volstead Act. Seems to us that the most effective contribution to the settlement of the prohibition problem was made in New York City on Christmas day when nearly one hundred cases of alcoholism were treated in the hospitals without a single fatality. From this it would appear that the quality of the stuff is improving with the years,—which in the final analysis is the main basis of contention. Possibly this improvement has merely required the kindly touch of ageing Father Time. If it can be established that a man can have a "short one" without taking his life in his hands,—then prohibitive prices, the Younger Generations, even the good old Constitution of the United States, et al, lay themselves open to adjustment. Famed Vice-president Marshall once said that this country needed a good five cent cigar. Today, in 1930, the crying need of this country is a conference on the Limitation of Wood Alcohol in Hair Tonics, to work out a formula by which liquor will cease to be lethal without necessarily ceasing to be nasty and potent. Senator Borah can then have his prohibition, and the boys can have their "benders."

IT is interesting to read the advice of those learned individuals who frequently take it upon themselves to name specifications that will pick out the type of individual eligible for a college education. "Sheepskins for the sheep. Goats must graze elsewhere."

Once was born, Connelly, son of a porter in the employ of a great mercantile house in St. Louis. James Smith, head of the firm, without adopting him, treated Connelly as a son.

In 1850, Connelly entered President Eliot's class at Harvard as a sophomore. His real name full of adventure and individualism was now given on the college roster as George Smith. In Cambridge this wild child of the west immediately bestirred the mischievous instincts of his staid and conventional classmates. Long hair that hung in ringlets about his shoulders was covered with molasses and subjected to the tonsorial shears. Connelly could not combat numbers, but his honor was not lacking. Dr. James Walker, at that time Professor of Moral and Intellectual Philosophy, upbraided Connelly in a matter of discipline, aroused that sense of honor; Connelly immediately challenged the old boy to fight a duel. And then we lose sight of Connelly.

Fellow classmates studying Latin were prompt to apply to him the name "Opifex," meaning a smith. This readily shortened to 'Pifex was his cognomen henceforth. Upon his graduation, 'Pifex was given a fat allowance by the Smiths. But he was a strange lad, given to peculiar habits, queer in many ways,—he finally wore out the good will of his patrons, and found himself no longer an endowed institution. For awhile Connelly again comes into view and we hear of 'Pifex as a tramp trying his luck in bucket shops on Wall Street, in the Chicago grain market, in mining camps. According to his modest Cambridge biographer, he was even seen in "sections of Philadelphia which did him no good." But after the death of James Smith, his widow offered to forget the past and 'Pifex returned to St. Louis.

Mrs. Smith died in 1891 leaving to Pifex her entire estate,—which he managed to hold despite a ten years' contest with Smith relatives. But he was now a soured recluse, he kept his shades drawn, cats were the only guests at his table, lawyers his only acquaintances. He wrote to the Class Secretary of his love for "our old Alma Mater." Other friends he had,—at his death, his servants "mourned him sincerely and waifs from an orphan home he had befriended in his life furnished a chorus" at his funeral. The bulk of his estate was left for the erection of three Smith Halls at Harvard.

'Pifex must have derived some benefit from his college or he never would have loved and remembered and endowed it.

Surely by all recognized standards Connelly was not the type of individual suited to a college education. But who has the authority or the knowledge to distinguish the sheep from the goat? In the final analysis the benefit that accrues to the individual himself is the only basis upon which this fitness may be judged. And where is there such an Oracle?

—OSCAR FEGAS.

Posting Grades

Editor of the Techno-Log:

IN your November and January issues, the desirability or necessity of posting students' grades at midquarter and at the end of the quarter is discussed. Perhaps some explanation will help to clarify the matter.

The object of posting the grades where they are accessible to everyone who chooses to examine them is not one of reward and penalty, although undoubtedly these factors may exist in the minds of some students. Naturally high scholarship is a source of satisfaction and low grades do not inspire much pride in their recipients. If certain students are motivated to do better work as a result of seeing their grades posted, for them, at least, the system may be justified. Possibly this is important enough to outweigh the disadvantages which others may see. That is a matter of conjecture.

On the contrary, the principal reason for posting the grades is the prosaic one of making them accessible to their recipients as promptly, efficiently, and authentically as possible, merely for their information. If individual letters or notices could be sent to all students so as to reach them, or most of them, as soon as they now see their posted grades, and without undue expense, there would be comparatively little reason for posting the grades. The Registrar of the University now mails grades to students after the close of each quarter. If our students received these notices as early as they now see their grades on the posted sheets, certainly it would not seem worthwhile to spend the effort, the time, and the money to compile the marks for posting. It appears to be true, however, that students generally do not receive their grades by mail until sometime after our sheets are posted. This is demonstrated by the fact that large numbers of students come to the College to get their grades from the sheets. They would not do so if they had already received them by mail.

> *These communications were prepared by Dean O. M. Leland in response to editorial comment which appeared in the December and January issues of the* TECHNO-LOG. *We believe that they explain matters which have long irked engineering students and which have never been clearly understood by the student body. Student comment on these subjects will be welcomed and should be addressed either to Dean Leland or to the* TECHNO-LOG.

Another important reason for posting grades lies in the desire that the student who receives a condition be informed of that fact as early as possible so he will have time to prepare for the condition examination. These examinations are held early in the quarter so students who fail may have a chance to repeat the course at once or to register for another course. If the grades are not received until the term begins, there is very little time to review a subject for a condition examination. By our system of posting the grades, they are made available at the earliest possible moment.

Since our grades are posted by classes and courses, it would not be difficult to try an experiment with a certain class, such as the junior electricals, for example, if they were to request it, wherein the grades of that group at the end of the quarter would not be posted nor given out at the Dean's Office, and would not be obtainable except by mail from the Registrar's Office. If those students suffered no inconvenience from this arrangement, the experiment could be extended to other classes and thus the desirability of the system from the students' standpoint could be investigated. For a fair trial, there should be at least thirty students in the test group, in all probability. If the students in Engineering, Architecture, and Chemistry, who now receive this service which those in other colleges do not receive, prefer to dispense with it, and depend entirely upon the mailed notices, surely it would be easy to test this sentiment at the end of this very quarter, upon the unanimous request of an adequate student group.

The question of midquarter grades is a different one inasmuch as these are not sent out from the Registrar's Office. There seems to be less objection to posting these and possibly it should be continued even if the posting of final grades were to be discontinued. If it were left to the separate instructors to issue the midquarters marks to their students, some confusion would undoubtedly result. Some would post their class lists on their doors with the grades, as is now done in some departments of the University. They would appear at various times and some students would miss them. Probably there would be inconvenience in going from place to place to get one's marks, and not much saving in publicity.

This entire matter of posting grades has been given a great deal of consideration for many years but no better system has been devised, it seems, for making the grades promptly available to students. Instead of being a cold-blooded, disciplinary process, as some students seem to view it, it is intended to be a useful service rendered to our students over and above what those in other colleges receive. It would be interesting to know how many of our students would prefer to see it abandoned altogether, leaving entire dependence upon the notices mailed from the Registrar's Office.

The Probation Rule

ACCORDING to the regulations of the Faculty, the student who does not pass in nine credits or in all of his work if registered for less than nine credits, is placed on probation. It must be admitted that this is an arbitrary rule, but so also would be a rule specifying fifty per cent of one's work instead of the nine credits. In fact, the fifty per cent rule was formerly used here but was unsatisfactory for various reasons and was replaced by the present one. The purpose of such a rule is not to provide a penalty but to determine which students should receive special attention, warning, or advice in the effort to get them to do better work. If the rule is successful in its operation, the student's work improves, he receives passing grades in nine credits and is removed from probation. A percentage rule may be no fairer than a fixed credit rule. The fairness is determined by the after-treatment.

It is the intention of the Faculty, of course, that every student be given fair and reasonable consideration, with the hope that he will successfully pursue his course. It has set the rule that a student who does not pass in fifty per cent of a full, eighteen-credit load is not doing satisfactory work and should be placed on the list to receive special attention and be urged to make a greater effort. Similarly, a student who carries less than a full load might reasonably be expected to pass in a larger percentage of it, as his load is lighter, and when he carries less than half of eighteen credits, he should pass in all of his work to be regarded as doing sufficiently satisfactory work to need no special supervision.

The assumption that all students who carry light loads are self-supporting is not always true. The degree of self-support varies from time to time as well as from man to man, and from job to job. The work is not standardized. Sometimes a self-supporting student can study while at work. Nevertheless, just as there must be a minimum standard for graduation, there must be a line of some sort below which a student should receive special attention.

Probation is not to be confused with dropping out of college, that is, suspension. The nine-credit rule does not drop a student. But if he repeatedly falls below this limit of

(Continued on page 168)

ABOUT THE WORLD WITH OUR ALUMNI

Architectural Engineering

'27—Paul F. Eaton is at present in Phoenix, Arizona, where he is working as an architect in the firm of Fitzhugh and Byron, architects and engineers.

'28—W. J. McGinnity is working in Chicago for Holabird and Roche, the architects who designed "333" North Michigan and other important structures in Chicago.

'29—Marvin L. Fergestad writes that he has been transferred to the Milwaukee office of the Insulite company where he is the sales engineer for that territory. His letter is as follows: "I had been here but a short time when I ran into Fritz Grossman (Arch. '28), and we have since taken an apartment together. Fritz is designing architect for the A. O. Smith corporation and is at present designing a ten story research and engineering building. I have seen Louis Schaller C. E. '29 quite frequently. He is a student engineer for the American Appraisal company.

"It is quite a custom in Milwaukee, for Minnesota engineers and architects to meet every Tuesday noon at the Blotz Hotel. We usually have about ten 'alums' present at these weekly gatherings, and we wish to extend an invitation to any engineers or architects who happen to be in Milwaukee to drop in and renew old acquaintances."

'29—Marvin S. Fergestad writes: "I was recently transferred from the main offices of the Insulite company in Minneapolis to Milwaukee as a sales engineer. I got down here January 8 just in time to miss a blizzard that covered this country with about a foot of snow. Driving in that would have been no fun."

Chemical Engineering

'97—Herbert C. Hamilton who has lived at 160 Webb Avenue for some time has taken an apartment at 150 Glynn Court, Minneapolis. Mr. Hamilton is doing research work in pharmaceutical chemistry and pharmacology for Parke Davis & company.

'04—Frank F. Grout, professor of geology here, recently attended a meeting of the Geological Society of America at Washington, D. C. At Washington, Professor Grout called a meeting of the subcommittee of the National Research committee. The members of the committee are working on granite masses.

'04—A. R. Rose, who is living at Edgewater, New Jersey, traveled through Europe last summer.

'10—Joseph H. Dewitt is still state parole agent for the Minnesota State Prison.

'10—Farrington Daniels and two coauthors from the University of Wisconsin, recently published a book, "Experimental Physical Chemistry." Professor Daniels is associate professor of chemistry at the University of Wisconsin.

'13—Victor Yngve was recently transferred by the National Carbon Company to Niagara Falls, N. Y. Victor, who was formerly in Cleveland, Ohio, is to have charge of the Process Engineering Laboratory at Niagara Falls.

'19—Frank Heck has an addition to his family, Mary Elizabeth. Frank is now in Rochester, Minnesota.

'19—Thorfin R. Hogness has accepted a position as associate professor of chemistry at the University of Chicago. He was formerly an associate professor at Gilman Hall, California.

'19—Mrs. Hertha R. Freche recently left the Aluminum Corporation of America. She is now in Chicago.

'20—Frank C. Kracek, who is with the geophysical laboratory of the Carnegie Institute at Washington, D. C., recently was married to Miss Opal Ferguson.

'21—Arthur E. Stoppel, assistant professor of chemistry here, was married Christmas day.

'22—Stephen Darling is now professor of chemistry at Lawrence University, Appleton, Wisconsin. After being in Europe on a traveling fellowship, Stephen got his master's degree at Harvard.

'24—Grace Devaney left the University of North Dakota last fall to join the staff of the Merrill Palmer school at Detroit, Michigan, as research chemist in the Nutrition department.

'25—Ruth I. Stier (Mrs. Cecil Mayo) returned to St. Paul recently. Mr. Mayo is now with the National Carbon company, which Mrs. Mayo plans to join soon. The Mayos have a three year old son, Jimmy.

'27—Henry Bercovitz, who is now in the patent department at Washington, D. C., recently visited his alma mater. He is studying law at the University of Washington.

'29—Fred Hovde, apparently still interested in athletics, has made the Rugby and track teams of Brasenose college, Oxford, England, where he is a Rhodes scholar, Fred writes he spent his Christmas vacation in the Alps skiing and studying. Poor Fred.

Civil Engineering

'13—Henry E. Wolfe is doing concrete designing for the Great Northern railroad at Seattle, Washington. He is in the assistant chief engineer's office.

'19—Oscar Rosenthal, formerly with the Lowden Machinery company in Cleveland, Ohio, was reported by Francis E. Dever as being in Pittsburgh selling something or other. What is it Oscar? Francis Devver is track supervisor of the Pennsylvania railroad at Cleveland, Ohio.

'21—Henry J. Beeman recently left the firm of John R. Magill company to become associated with Harold E. Egan and company, an organization which specializes in the leasing and management of business real estate.

'26—Carl R. Liese is 'way down south in Tocopilla, Chile, where, as pit foreman, he is making use of his engineering and Spanish. Apparently, Chile is to his liking as he has gained about ten pounds since leaving the United States in 1929. Carl, who was formerly in St. Paul with the Marion Steam Shovel company, is under contract to remain with the Anglo-Chilean Consolidated Nitrate Corporation for three years.

'27—Kenneth Johnson dropped in to visit his alma mater the other day. He was taking his vacation then, because, as he said, the office couldn't let such a valuable man go during the rush season. Kenneth, who is still trying to grow, is a junior engineer for the Illinois State Highway department at Elgin, Illinois. He is living at Illinois Park.

'28—Mons H. Benson has moved to 406 Federal building, Milwaukee, Wisconsin. He has "been assigned to the Milwaukee office this winter to draw plans for a new 25 ton steel derrick boat and dredge with quarters for new men. Last summer I spent in the field on concrete pier construction. Greetings to my friends at Minnesota." Mons is a junior engineer in the U. S. Engineers office.

'28—Paul Silliman recently won third prize in a contest conducted by the Greyhound Lines, motor bus operators, for the best cost reductions suggestions. Paul, who is in the cost department of the Chicago Garage, offered the following suggestions: (1) reduction of improvements to old equipment; (2) concentration of maintenance expense; (3) reduction of major overhaul expense; and (4) greater usage of equipment. Before his employment by the Greyhound Lines, Paul was in the city engineer's office of Seattle, Washington.

'21—Earl H. Grochau is now with the E. G. Holladay company in Birmingham, Alabama. He is manager of construction engineering.

'28—Olav K. Normann dropped in the other day to say that his job with the Bureau of Public Roads has taken him into twenty-eight states in the last two years. Good goin,' Olav.

'29—Louis M. Schaller, the former "big-shot" politician and extra-curricular man of the Technical campus, is seeing America first with the American Appraisal company of Milwaukee. He dropped in recently on his way to San Francisco—he had just come from a trip in Maryland and Pennsylvania—bubbling over with enthusiasm for his work.

"Bro.", who is working in the student course, is doing "real work for which the *company* collects about fifty dollars a day," although he has been with the company only about five months.

About his work he says: "Not a dull minute; everything different every hour; monotony is not known in this company."

'29—Paul Helseth is taking a "fast and furious" student course with the American Bridge company at Ambridge, Pennsylvania. Paul's work, which consists of work in designing, detailing and estimating, has taken him on inspection trips through all of the large mills and plants in the vicinity of Ambridge.

Electrical Engineering

'06—William A. Zimmer has been transferred to the Iowa Area of the Northwest Bell Telephone company at Des Moines, Iowa.

'08—William M. Weibler is one of Minnesota's most ardent football fans. He took in both the Northwestern and Iowa games. He is now in Des Moines, Iowa for the Northwest Bell Telephone.

'24—Clarence W. Teal recently played in a musical presentation of "Ten Nights in a Barroom" given by the Omaha Community Playhouse. Clarence was surprised in his dressing room by E. S. McConnell, '24, who is now with the Anaconda Wire and Cable company of Chicago, Illinois, and was then on his first trip through this territory.

'24—Leonard M. Frazee, in Pittsburgh with the Pittsburgh Coal company, is concerned mainly with power cost analysis and sub-station operation. He is working on bituminous coal mining operations especially regarding their power use.

'25—Henry A. Wurzbach, former secretary of the University Farm Y. M. C. A., is now in the long lines department of the American Telephone and Telegraph company at Omaha, Nebraska.

'25—Hugo H. Hanft, who now holds the position of locomotive design engineer, with the Westinghouse Electric and Manufacturing company, was graduated from the University of Minnesota with the degree of B.S. in E.E. in 1925. While in college he was elected to Eta Kappa Nu and Tau Beta Pi, served as president of the Junior Ball Association, Vice-Chairman of Homecoming, and was Captain of the swimming team.

Upon graduation, he entered the Westinghouse Student Course and spent one year studying in Germany. He has been identified with the design of large locomotives such as the St. Clair Tunnel Locomotive No. 9156, the Carnegie Steel Locomotive E-4, and the Northern Indiana Public Service company battery locomotive. He is now engaged in the development of special applications such as the applications of carbon pile resistors and tube type rectifiers for locomotive service.

'28—Louis W. Kritzer is now with the Northwest Bell Telephone company. His home is still at 205 Cecil Street S. E., Minneapolis, Minnesota.

'28—Gunnard T. Holt, working for his master's degree, teaches kinematics in both day and night school at the University of Cincinnati. Gunnard, whose home is 27 Lakefield Avenue, Cincinnati, Ohio, was formerly with the Minnesota Steel Corporation of Duluth, Minnesota.

'28—J. Marvin Cook recently acpuired a son, J. Marvin Cook, Jr. Cook is still with Cutler-Hammer, Inc., of Milwaukee.

'29—H. O. Larson writes, "Just quit my job with the Public Service company and am now working for the Western Electric company of Keary, New Jersey. Vic Vardahl is also with the Western Electric and we're both enjoying our jobs immensely."

'29—Glenn Williams apparently likes his work with the General Electric company. Glenn, who is in the student course, says, "Here, we do all the testing and have a wonderful opportunity to develop initiative and executive ability."

'29—"Clint" Hawkins is a junior engineer with the Beacon Lighthouse service in Washington, D. C. He is working under Don Stevens, '28EE.

'29—John W. Millunchick now lives in Wilkinsburg, Pennsylvania. He is in the graduate student course at the Westinghouse Electric and Manufacturing company in Pittsburgh.

'29—Roscoe L. Gill, who is working for the Public Service company of Northern Illinois at Waukegan, says that he likes his work as well as the company for whom he is working.

'29—J. Robert Ginnaty, editor of the TECHNO-LOG 1928-1929, who is at present in the employ of the Westinghouse Electric company writes from Derry, Pennsylvania, as follows:

"And how goes the world in the part of the United States called Minnesota? Where in the world were all you boys during the holidays? I had expected to hear from you quite frequently, but then the holiday season breeds a period of lassitude which does not provoke the expenditure of much energy. But even without the company of the 'office boys,' I was able to have a pretty fair time,—what with Bubbles, and such. But now I am back at work and have been behaving myself in a most sedate, sober and abstemious manner.

"Of course you know that I reported back to Chicago after the holidays and remained there until about the fifteenth of January. Karl H. Heidmann EE '29 joined me there and the two of us killed a day or two in and about the Windy City and then went to South Bend where we spent two weeks learning how the various kinds of Westinghouse lighting equipment are made. When one looks at the stuff, it appears quite simple, but when one really sees how it is designed and why it is designed in such and such a manner,—believe me, things are not so simple then.

"While I was there I ran across P. B. Nelson of E. C. M. A. fame, and had quite a chat with Art Burris. You know of course that he is back in Minneapolis at present,—working for the Minneapolis Electric and Machinery Company.

"Just last week end in Pittsburgh I saw J. Edwin Coates, a Minnesota man of 1927—I believe that he was on the staff of the TECHNO-LOG. Lloyd Russ is now in Philadelphia and the rest of the gang are pretty well scattered over the country. Pretty hard to keep track of them all,—but mighty enjoyable to be able to run into a representative of the old Alma Mater at almost every watering hole.

"Keep all the fellows off prohibition and out of trouble and do the same for yourself. Lots of luck. And damn it, write soon."

'25—Richard G. Taylor is continuing his work with the Commonwealth Edison company of Chicago. He writes as follows: "My work is in the engineering department. Lately I have been designing man-holes and conduit systems and making the circuit lay-outs for circuits and transmission lines. I have become the proud father of a boy and girl,—their names are Joseph Richard and Jeanne Edythe."

'26—Marcus E. Fiene and Mrs. Fiene are now living at Ballston Lake, New York. Mr. Fiene is working for General Electric at Schenectady.

Article Contest to end March 10

TECHNO-LOG *extends closing date of contest two weeks*

Because of the small number of entries, THE TECHNO-LOG *has extended the time limit of the article contest which was announced in the January issue. The closing date, which was originally set for the twenty-fifth of this month, has been advanced to March 10, giving a time extension of two weeks to those who have not as yet turned in their articles.*

A first prize of fifteen dollars and a second prize of ten dollars are being offered for the two best student articles to be submitted in this contest. The articles may be on any subject, technical or non-technical, and may be of any length over 1400 words. Winners of the prizes will be announced in the March issue of the TECHNO-LOG.

Mechanical Engineering

'23—G. A. Machmann who was formerly field representative for the Kelvinator company in the northwest territory is now with the Dry Ice Corporation of America at 501 Sixth Street South, Minneapolis. His present address is 330 E. 50th Street, Minneapolis.

'26—James E. Maney, formerly with the Duluth, Missabe and Northern railway, is now with Cleveland-Cliffs Iron Co. He is still on the range being located at Coleraine.

'29—Lester J. Rowell says he is enjoying his work as efficiency engineer at the State Line generating station of Hammond, Illinois. He promises to answer any letters written to him by alumni. Let's go!

'24—Edwin F. Kohler, now with the safety engineering division of the Standard Accident Insurance company at Detroit, Michigan, writes that he "was very pleased to find that Firth, '17EE, is working in this department. Now Minnesota has a majority of one over other colleges here. Don't let me miss the next issue of the TECHNO-LOG—it's good stuff."

OSCAR QUACKENBUSH FEGAS

OSCAR FEGAS
—Engineer Preëminent

Being a comprehensive and accurate review of the life and superhuman achievements of that coming idol of all good engineers—Oscar Fegas

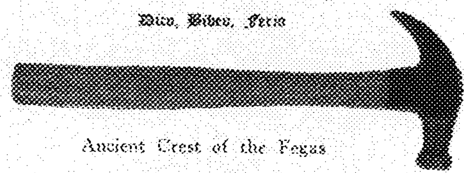
IN setting out on this,—my autobiography,—you must realize that it is with the utmost temerity. Caused, I believe by the fact that in those early years the precocious powers that have characterized my later life were not much in evidence. For example, I do not remember the exact circumstances surrounding my birth,—memories of those early years are sketchy.

Not long after my appearance on this World, I do, however, remember seeing my father,—or so I was informed. He was a decrepit fossil, who rubbed oil into his hair and parted it behind, the same as a first class bird dog. I remember his childish delight in animal crackers, and the fact that he wore a nightie instead of pajamas. He was like that. In all truth he dated back to the peak of mid-Victorian boobery when an ankle was a thrill, a calf a romantic experience and a kneecap an orgy. Besides he still believed in chaperones and had been practicing on the flute for some forty odd years. In defense of myself I have only to say that I was not consulted in the matter of choosing my father. You may well imagine from this description that my father was a man of his word, that his every breath was law. But even as a babe he had about as much authority over me as the Anti-Saloon League has over H. L. Mencken.

It so happened that I was the youngest of three children, but at the tender age of four I had so eclipsed my brothers in learning and general knowledge that they believed me to be a product of special creation. To prove that I do not boast, I will recount an incident that happened in those distant years. My father being somewhat of a jokester at one time gave each of us kids a short one from a tall bottle. My oldest brother at once replied, "That's whiskey." The next brother after smacking his lips said "Yes, she's whiskey." But when I spoke up after taking a short one and a short one for a chaser with "Yes, it's whiskey, but the darn stuff is cut," the old man collapsed.

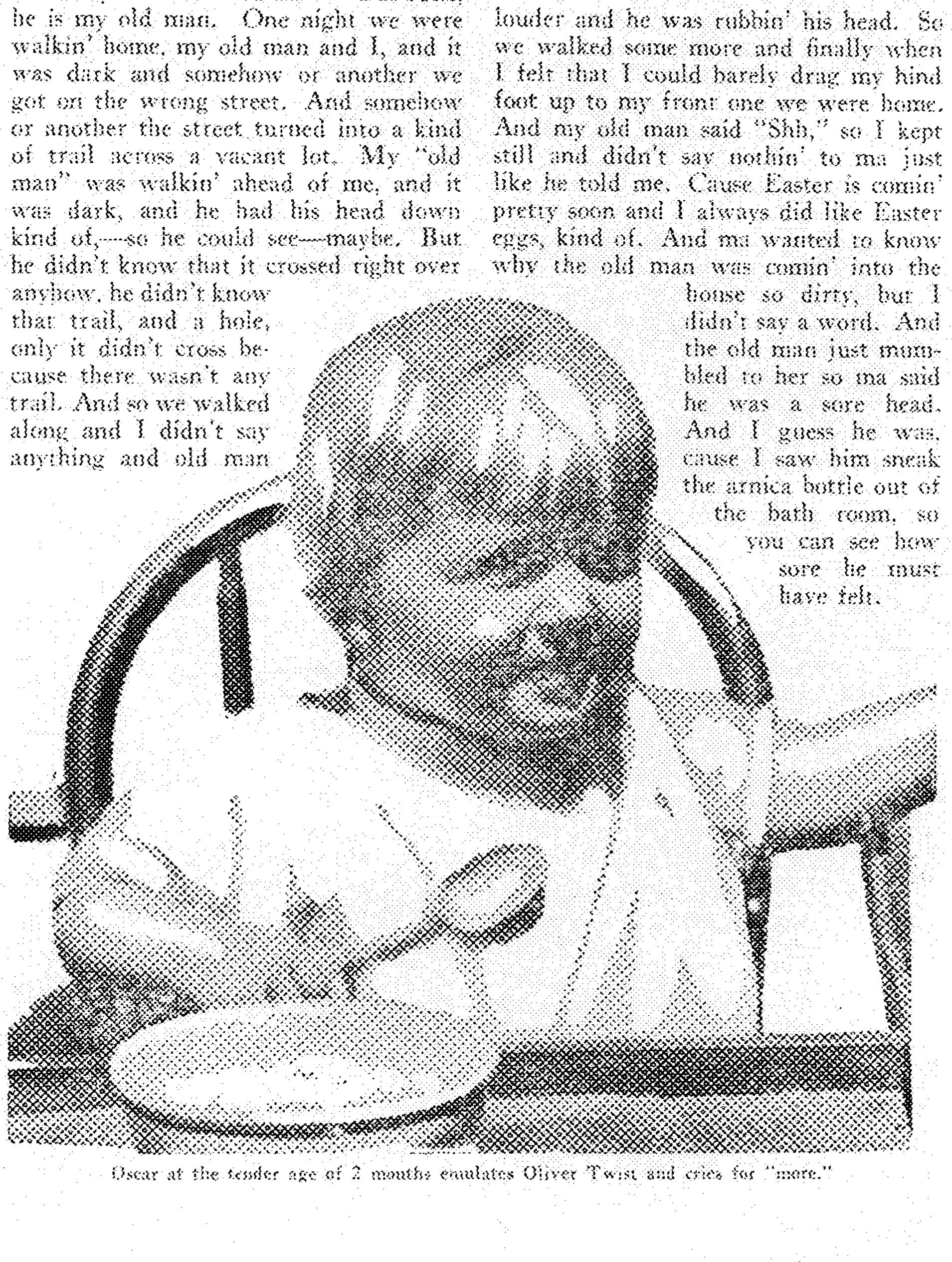
During the early years of my life I was so industrious as to keep a diary,—or as I naively called it, a note book. Hoping that some of its pages may illumine the story of my childhood, I take the liberty of inserting a few pages from that "Treasury of Truth,"—for in those days I was not expert in the art of dissimulation.

Monday. You might be surprised that I call my old man "old man." But Hell, he is my old man. One night we were walkin' home, my old man and I, and it was dark and somehow or another we got on the wrong street. And somehow or another the street turned into a kind of trail across a vacant lot. My "old man" was walkin' ahead of me, and it was dark, and he had his head down kind of,—so he could see—maybe. But he didn't know that it crossed right over anyhow, he didn't know that trail, and a hole, only it didn't cross because there wasn't any trail. And so we walked along and I didn't say anything and old man was mumblin' to himself. When all of a sudden we came to the hole and then I didn't see my old man, but I heard him all right. Well, so, I said, "Hmmm—should be steps here, huh, old man?" And he mumbled quite a bit only

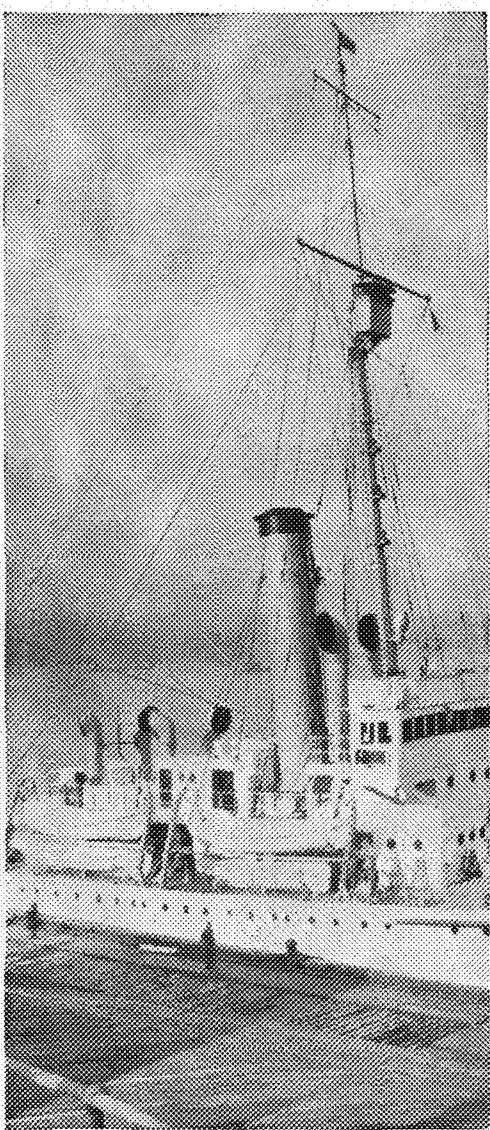


Ancient Crest of the Fegas

louder and he was rubbin' his head. So we walked some more and finally when I felt that I could barely drag my hind foot up to my front one we were home. And my old man said "Shh," so I kept still and didn't say nothin' to ma just like he told me. Cause Easter is comin' pretty soon and I always did like Easter eggs, kind of. And ma wanted to know why the old man was comin' into the house so dirty, but I didn't say a word. And the old man just mumbled to her so ma said he was a sore head. And I guess he was, cause I saw him sneak the arnica bottle out of the bath room, so you can see how sore he must have felt.



Oscar at the tender age of 2 months emulates Oliver Twist and cries for "more."



WHAT YOUNGER COLLEGE MEN ARE DOING WITH WESTINGHOUSE

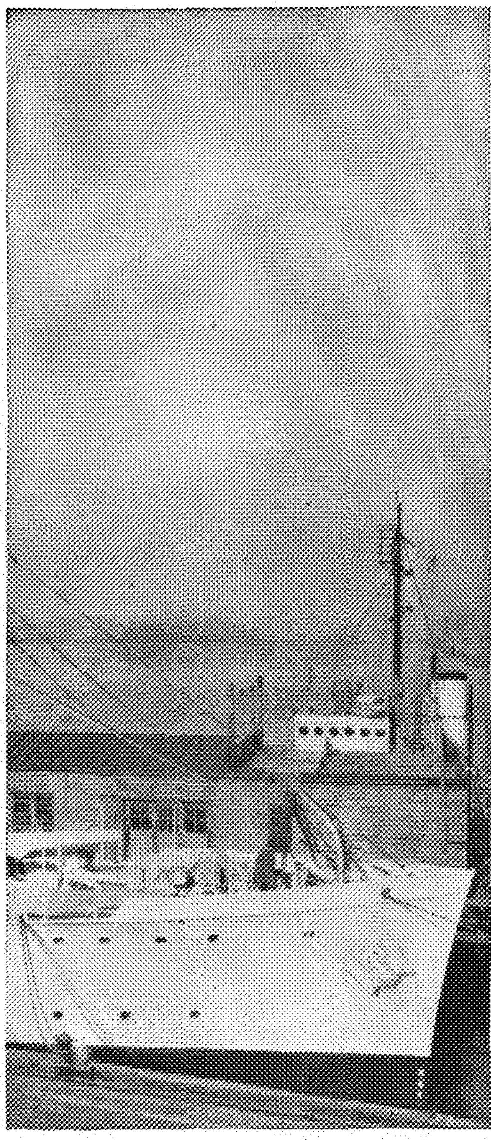
M. D. ROSS
Generator Design
University Toronto, '22

R. A. ALLEN
Headquarters Sales
Alabama Polytechnic Institute '24

W SCHAELCHLIN
Propulsion Control Engineer
State College '19
Zuerich, Switzerland

H. R. GOSS
Motor Design
University Minnesota, '20

C. M. WILLIAMS
Auxiliary Switching Design
University Illinois, '21



The Chelan, like four other Coast Guard Cutters recently completed, is equipped with Westinghouse turbine electric drive.

A shakedown test, a rescue, and a hundred thrills

A SCORE of carefree Coast Guard sailors, and with them a Westinghouse man from the Boston Office, headed in a "bum boat" for the cutter Chelan peacefully at anchor in the harbor of Hamilton, Bermuda Islands.

It had been an exciting shakedown test-cruise. The Westinghouse turbine, generator, motor and condensers had functioned perfectly, the sea had yielded up its bag of tricks, the Bermudas had fascinated every soul. And soon they would be bound for home.

But fate held new experiences in store. Five hundred miles off the Azores, the Newport, New York State training ship, had lost her propeller. The Chelan was called to the rescue. And with her, of course, went the Westinghouse man.

Three days at top speed on tropical waters, the excitement of rescuing a helpless crew, twelve days at a lazy towing speed, men overboard and a rescue at sea—thrills like those come to many Westinghouse men in line with their work at electrifying the world.

For Westinghouse, in a commanding position in electrical development, enters every field of industry where electricity is or may be employed. And Westinghouse men get a taste of every brand of human activity.

Westinghouse

Diploma Mills Cheat Students of Millions

American Association of Engineers Declares War on Educational Racketeers and Diploma Mills Unearthed by Investigation of This New $85,000,000 Industry

Chicago, Ill., Feb. 20.—School racketeers with their "diploma mills" are annually grinding out a grist of thousands of disillusioned and victimized young men and women in the United States, according to H. A. Wagner, president of the American Association of Engineers, in a declaration of war against "fake technical, trade and correspondence schools which are flagrantly operating in all parts of the country."

Steps will be taken immediately by the Association, Mr. Wagner announced, to expose and rid the nation of these "flourishing educational crooks," especially those operating in the technical and engineering field, promising their prospects $5,000 to $10,000 a year jobs after a few short easy weeks of home study. A committee of leading engineers has been appointed to wage a "merciless campaign" in co-operation with state and federal authorities.

In making public the proposed campaign against these spurious "mail order universities," whose campuses are often hideaway offices in disreputable buildings, Mr. Wagner disclosed some astonishing facts on the scope of bogus schools. For five years, he said the American Association of Engineers has been making a thorough nation-wide investigation of the correspondence school industry, which is doing an annual volume of business estimated at approximately $85,000,000.

Huge Sums Paid for Tuition

"The investigation of the American Association of Engineers," said Mr. Wagner, "revealed that reputable and disreputable correspondence schools are collecting annually tuition fees one and one-half times as much as the combined fees received by all the colleges and universities in this country. Staffs of 3,000 to 4,000 are not uncommon in these schools but there are often twenty or more high-pressure men drawing large salaries to one instructor, usually meagerly paid.

"Four times as many men and women are enrolled in correspondence and trade schools as in all colleges, professional schools and universities combined, or a total of more than 2,000,000 students. Stock companies whose purpose is to broadcast a synthetic education in any of 200 subjects from radio engineering to the breeding of rabbits at $100 upwards the course, payable at $5 per week, are capitalized at as high as $10,000,000. They may have a body of 100,000 to 125,000 students, stretching around the globe—the further from the home institution the better, so that it will be difficult for graduates to make trouble when they seek to capitalize on the 'education'.

Lured by Misleading Advertisements

"Prospective students are usually drawn from towns of 2,500 population or less in the western and mountainous sections of the United States. Seeking to better themselves, they are drawn by the enticing misleading advertisements in the popular magazines. One widely circulated magazine commonly displays more than a hundred school advertisements, a third of them being of alleged technical colleges. 'Free employment service for life!' 'A job waiting for you when you are half through the course!' '$10,000 a year jobs are plentiful!' 'A brilliant future awaits you in drafting—all you need is ability to read and write,' are some of the highly misleading statements these advertisements carry. Ten to thirty dollars per student is spent on these sucker advertisements and letter follow-ups.

"The prospect writes in, believing that getting an education is as easy as seeing a movie, and a promotion man is usually assigned to high pressure him into signing an application blank which may have the binding force of a judgment note. Enrolled as a student, the individual receiving a course in one of the sciences or flim-flam philosophies often becomes discouraged by this quick lunch type of education and quits. The 'diploma mill,' however, forces payment, and in fact profits tremendously from these lapsed courses. Less than 2% of these students complete the course. Those who do receive a handsome diploma resembling a stock certificate in a wildcat mine, and are turned loose in a few weeks to seek a job in competition with men trained by years of hard study.

"Eighty per cent of the students elect to take vocational courses. In some instances we have found schools that teach chiropractic, play-writing and dentistry awarding the degree of 'Doctor of Philosophy' for $8.50 cash, in advance.

"Some laudable efforts have been made to correct the correspondence school evil by the Federal Trade Commission, Better Business Bureaus, and the National Home Study Council, but they have far from completed the job. It takes strong persistent aggressive action to clean up this situation and drive these fake school racketeers out of the business."

To Clean Up Fake School Menace

Mr. Wagner said that the American Association of Engineers is especially interested in curbing the activities of the sixty or more so-called trade schools, particularly those giving technical and engineering courses. He said that the Chicago district has become the home of the worst offenders in the trade and correspondence school racket, and the Association's "clean up" campaign would center in this section of the country. Other cities cited as being infested with these questionable institutions were New York, Kansas City, Washington, Detroit, Los Angeles, Cleveland, Milwaukee and St. Louis.

"Graduates of these institutions," explained Mr. Wagner, "often apply to the Association for help upon finding that there are no technical jobs open for them. Often these unfortunates are Mexicans, Indians and cow punchers, some unable to speak English, others with scarcely a grade school education, who have been mulcted of their last dollar by a trade school and hope to obtain jobs as engineers or draftsmen immediately. After a short course of technical drool under incompetent instructors, using obsolete equipment in overcrowded class rooms, trade school graduates are in no position to compete with college trained engineers, and employers in interviewing them get a bad impression of educational standards in the engineering profession.

"Destitution among these victims often follows, with the result that chari-

(Continued on page 170)

Some decisions can't be put off *till tomorrow!*

The basketball player who took very long to decide between passing the ball and trying for a basket would soon lose his chances to do either.

And the man who keeps putting off his decision in the choice of a career may lose his chance to be very effective at anything. Isn't it true that not a few men up to their senior year are still very uncertain what work to take up after graduation?

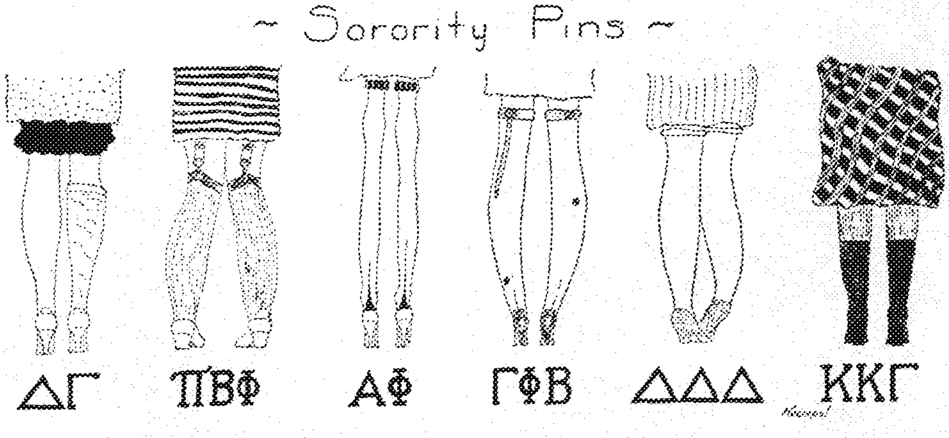
The result is that many a born artist, becomes an indifferent engineer, and many a potential lawyer, a poor salesman.

Put yourself under the microscope and then—*be* yourself.

Western Electric

SINCE 1882 MANUFACTURERS FOR THE BELL SYSTEM

DRIPPINGS FROM THE OIL CAN



Mullins: I asked her if I could see her home.

Meloy: Wha'd she say?"

Mullins: Said she'd send me a picture of it.

✠ ✠

Judge: I fine you $1.10 for beating your wife.

Prisoner: What's the ten cents for?

Judge: Federal tax on amusements.—*The Wisconsin Engineer.*

✠ ✠

Maid: The lady can't see you just now, she's in her bath.

Agent: Oh that's all right, you see, I sell soap.—*The Wisconsin Engineer.*

✠ ✠

She: I'm hungry.

He: What?

She: I'm hungry.

He: What?

She: I said I'm hungry.

He: Oh I see. I thought you said you were hungry.

Oscar Fegas suggests that the Minnesota campus be called the land of the thousand mud puddles.

✠ ✠

Warrington E '30: Grab a hold of one of these wires.

Madden E '30: All right, I got one.

War.: Feel anything?

Mad.: Nope.

War.: Good, I wasn't sure which was which—don't touch the other.

✠ ✠

Langenburg: "I can tell you the score of the game before it starts."

Fenton: "Well, shoot—what is it?"

Langenburg: "Nothing to nothing—before it starts."

✠ ✠

Miss Sundbeck: "I forgot my umbrella this morning."

Warrington: "How did you come to remember you had forgotten it?"

Miss Sundbeck: "Well, I shouldn't have missed it, only I raised my hand to shut it when it stopped raining.

Shirley: "Last week I bought a tire cover from you and now I want my money back."

Clerk: "Why?"

Shirley: "I put it on one of my tires and hadn't gone ten miles before the damn thing wore out."

✠ ✠

"Here, here, what's all the excitement?"

"A cave man just got into the Garden of Eden and Eve didn't know him from Adam."

✠ ✠

It was Field Day down in Hades and the engineers had come for miles around to take part in the festivities. The feature prize of the day was a ton of coal to be given to the man who had loved the most women in his sojourn on earth.

The first man to present himself was old Attababie, who in his day had taken unto himself a dozen wives, and was considered no slouch with the dames around Galilee.

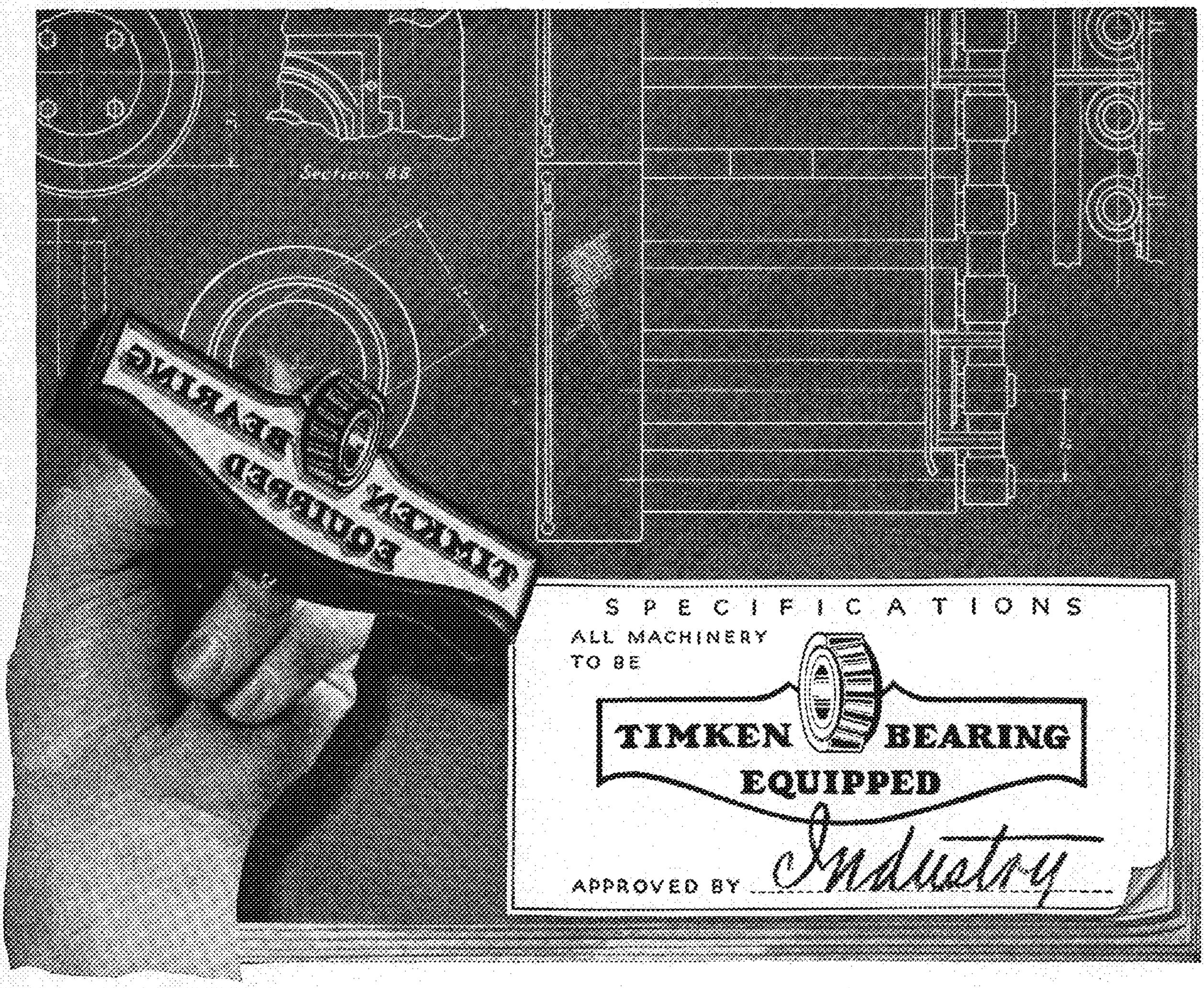
Then came one Ali Ben Doing, himself a mean baby with the wenches, who produced a photo of himself with his harem of a hundred hot mamas.

"You guys can go home," sneered a fella named Solomon. "Every day for two years was my wedding day, and seven hundred dames called me sweetheart."

He was just about to wheel away the ton of coal when a gruff voice stopped him.

"Who the heck are you?" roared Solomon.

"Listen, you piker," said the bozo, "I was an iceman in Salt Lake City for twenty years!"



Approved By Industry

America is sweeping aside obsolete methods and machines.

Machine buyers and builders have found a modern symbol of protection for production, freedom from friction, extended machine life, preserved alignment, reduced maintenance costs . . . they have found it in "Timken Bearing Equipped."

To all industry it means that all loads, whether all radial, all thrust or a combination of both, are capably carried by Timken.

Years of proof have brought recognition to this exclusive combination: Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken-made steel, and in the years to come, you who are student engineers to-day, will find it an indispensable aid in a continued national program of modernization.

Thus "Timken Bearing Equipped" will sweep on as industry's stamp of approval in the drive on wear and waste.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**

TO HONOR WASHINGTON, THE ENGINEER

Chicago, Ill., Feb. 22.—Declaring that the engineering achievements of George Washington have been "lost in the dazzling light of the halo of his glory as a soldier," the American Association of Engineers today called upon Congress to immortalize his engineering genius by creating a national memorial of the little stone house now standing in the Georgetown section of the District of Columbia which was used by General Washington and Thomas Jefferson when they were surveying the nation's capital in 1791.

The Association said that extensive research of history revealed that George Washington, who commenced his engineering career at the age of sixteen, was the real planner of the national capital—*not* Major Charles L'Enfant, who is popularly believed to have been the leading factor in this great engineering achievement.

Representative Fred A. Britten of Chicago, cooperating with the Association, has introduced a bill asking Congress to authorize an appropriation of $200,000 for the purpose of purchasing and restoring as a national memorial the historic Washington survey headquarters, which is now known as 3049 M Street, Northwest, Washington, D. C. This memorial would be a part of a national engineering museum, under the direction and control, and as a unit, of the United States National Museum.

"Every schoolboy knows Washington as one of the great generals of history," said William A. Boone Douglas, chairman of the Legal Research Committee of the Association, "but few of us know him as our great pioneer engineer. When only 16 years old, Washington set out across the unknown wilderness with his compass to survey the Virginia lands of Lord Fairfax.

"Washington was engineer officer under General Braddock in 1755. In 1774 he was engineer-in-chief of the Virginia Land Company. The Chesapeake and Ohio Canal was a realization of his early engineering scheme to connect Georgetown with the Ohio Valley.

"With the beginning of the Revolution in 1775, he laid aside his compass for his sword, but during the seven years' struggle there were as many engineering problems to solve as those of military strategy.

"Then victory, and to George Washington the Presidency of the young Republic. The question of a permanent residence for the government was continually agitated from 1783 to 1789. Philadelphia, Princeton, Annapolis, Trenton and New York City became the capital in rapid succession. When the Senate passed a bill fixing the seat of government on the Potomac river, President Washington, appointed engineer-in-chief by act of Congress, commenced to plan a city so beautiful that it would forever fit our nation's destiny. Thomas Jefferson, statesman and able technician was second in command.

"It was a tremendous undertaking, and Washington's greatest engineering project, for the Residential Act authorized only ten years in which to raise a city out of the wilderness. Like all chief engineers, Washington required competent technicians to execute the details, once the problems were solved. He employed Major Andrew Ellicott and Major Charles L'Enfant, both Revolutionary officers.

"Ten square miles was fixed as the maximum area of the capital, and Washington's vision is shown by his monumental plan to embrace the full area, and not the five square miles which Jefferson believed ample for the city. And it is said that the great engineer-general conceived a national highway leading from the capital to the Pacific, which has since been realized.

"Braving possible criticism because of his interest in the barge canal at Georgetown, Washington determined to build the city here where it would have the maximum river frontage and defensibility. And so it was chosen, for all time.

"We owe this magnificent city to Washington's engineering genius. To guard against disastrous fire he planned, with Jefferson's aid, regulations which restricted building materials to stone and brick, and established a maximum height. He insisted that the capitol, the President's house and other public buildings 'in form, size and elegance should look beyond the present day.' Advised by competent architects whom he had selected, including Dr. William Thornton, John Hoben, and Thomas Jefferson, President Washington made no mistake. The Capitol and the White House, which he started, are today architectural masterpieces.

"Washington, the engineer, purchased lots and constructed substantial houses, all of which have since been destroyed by the growth of the city. He loved the city of Washington and gave to it the last ten years of his life, never losing faith in its future greatness."

Fred G. Golden, secretary of the National Park and Planning Commission, is co-operating with the American Association of Engineers in the work of making a national shrine of the old George Washington engineering headquarters.

KNIGHT MOTORS

By **EDWARD NICKERSON, EE'25**

Graduate Student, U. of M.

IN 1925, THE TECHNO-LOG published an article of mine in which it was asserted, without proof, that the Knight sleeve valve motor was subject to a dynamic unbalance in the valve mechanism, and also that this unbalance would be eliminated without the introduction of any serious unbalance in the crank train if an engine were built as a 90° vee-type ten having the cylinder spacing prescribed for straight five engines by standard writers on engine balance, and having the crankpins so arranged as to make the firing order among cylinders of either block 1, 5, 2, 3, 4, or 1, 4, 3, 2, 5. It will be noticed that the arrangement of the eccentrics to drive one set of five sleeves (the outers or the inners of one block) would be the same as that of the cranks of the standard straight five crankshaft (that described by Cormac and at least one other leading writer on engine balance).

Today, the truth of my contention on this point is accepted. In 1927, Mr. Heldt published an article on 90° vee-type 10 cylinder Knight engines in which some of my contentions were explicitly admitted and the other tacitly (he found certain minor unbalances which my earlier article did not admit but he did not really contradict my contentions as to the possibility of a different cylinder spacing and crankshaft arrangement which resulted in the introduction of the unbalances, and he gave a general form for these unbalances which would reduce to zero if the cylinder spacing and crankshaft arrangement previously suggested by myself were used). He thus adds the weight of his authority to my previous contentions.

With the upward trend in the number of cylinders of cars in general, ten is no longer an unreasonable number to assume on a large car of high or medium price. Engines of less than eight cylinders each have been virtually relegated to the thousand and under price class, and one of America's most conservative manufacturers has announced a sixteen cylinder car. There is a rumor that another important manufacturer will soon follow suit.

The Knight motor is universally recognized as one in which high brake mean effective pressures are normally obtained. Mr. Heidt mentions one of approximately three hundred cubic inches which gives an output of nearly two hundred horsepower at 3400 R. P. M. It is not uncommon for a Knight motor to deliver a 100-lb. brake mean effective pressure at the torque peak. Of course the motor mentioned goes well above a 100-lb. brake mean effective pressure.

Knight motors have been selling well of late. One month not very long ago, according to accepted automobile statistics, there were seven Willys-Knights sold in Minnesota to every eight Buicks. Of course, this was the month just before the new model Buick was placed on the market, and was not a typical month, but it shows that the Knight motor car is not negligible today.

The Knight motor has not dominated in racing, but it has always given a good account of itself, and competition with it has done much to keep the poppet valve motor builders on the alert. One year a Knight powered motor car, with the smallest motor in the race, took fifth place at Indianapolis. The next year in an effort to show that poppet valve motors were still as good as Knight motors, one competitor made very good time with a motor whose N. A. C. C. horsepower rating was approximately the same as that of the one and one-half liter Miller of 2⅛" bore and 3" stroke, which has figured so prominently in recent racing events.

It is sometimes said that the use of extremely early valve openings and extremely late valve closings in Knight motors proves that the breathing is inefficient. However, few Knight motors, if any, have used valve timings as extreme in this respect as that of the Buick.

Drunk: "Say, officer, where am I?"
Officer: "Fifth and Hennepin."
Drunk: "Come on, officer, leave out the details; what town am I in?"

Larsen: "Read any books lately?"
Olsen: "No, but I have written exams on a couple that would be interesting if I had time to read them."

THE AUDITOR'S SLIP

"You are taking accounting at college, aren't you?" snapped the irate father to his wayward son.

"Yessir," answered the mechanical engineer.

"Then perhaps you can account for the pair of silk undies you sent home in your last laundry."

MOTORING OVERSEAS

(Continued from page 147)

ed in Vienna for Austria and Germany. These maps are beyond anything I am aware of in this country in the exact and easy information of the kind and condition of the roads to be traversed. These maps cost about sixteen cents for each section, and we had perhaps twenty sections in all. Gasoline normally costs from 50 to 60 per cent more than in the United States. In some remote places in Switzerland it was still higher. This higher cost of gasoline is compensated by the lesser mileage per day as compared with touring on our concrete speedways in America. Garage charges and hotel rates are much less than at home.

For repairs, parts are somewhat higher, but labor is decidedly cheaper. The result is lesser cost than at home. For General Motors cars—especially Chevrolet—no embarrassment comes from the need of new parts, as depots exist in every large country. Intelligent service in repair work for my car was omnipresent. The principal towns in England, Germany, Switzerland and France have Chevrolet dealers. I had to buy new clutch linings, new roller bearing ring, new Exide battery and new tires.

Should a group of four young persons wish to spend three months on the continent, with an average travel of 74 miles a day, utilizing for lesser depreciation a used car, with arrangements for carrying lighter bags on top, it is probable that the automobile cost from their own home town and back afterwards, would not much exceed a dollar and a half a day each. And it would be much more facile, more comfortable and satisfactory than in any other way.

STUDIES IN DISCHARGE TUBES

(Continued from page 148)

Our work on the condensation of the hydrocarbons by electrical discharge, especially butane may then be summarized as follows:

A quantity of liquid hydrocarbons (1041 cc.) has been prepared from gaseous butane by condensation in an electrical discharge. A system of twelve all-glass ozonizers was used for the purpose. The liquid product obtained was separated into 40 fractions by fractional distillation at various pressures. These fractions consist of very light, medium and also very viscous oils. One of the light fractions was studied in detail and found to have the following properties: b.p. 110-114.0°; index of refraction, 1.4021; density, 0.708; molecular weight, 114.7; percentage of carbon, 84.55; percentage of hydrogen, 15.45; empirical formula of an octane; unsaturation by halogenation, 22.5 mole per cent. These properties serve to identify this material as a mixture of octanes and octylenes. It is interesting to note that this largest fraction of the lighter oils consists of eight-carbon-atom molecules which can be produced from butane by simple doubling according to theory.

RYAN TO STUDY IN EUROPE

(Continued from page 152)

of Technology. Universities in the state of California are particularly well adapted to carry on study of this type because of the fact that there are more high tension transmission line in that state than any other in the Union.

Professor Ryan will return to the University in October 1931 and will continue in his present capacity in the electrical engineering department.

"Why is prohibition like the new long skirts?"

"Because the old familiar joints are still there, but they're all covered up."

DEAN'S LETTER

(Continued from page 155)

achievement in his studies, he is likely to be dropped because of his poor work, —not automatically by the rule. Students in this College are not dropped automatically. Each is an individual case and receives separate consideration.

If a student is carrying too much college work along with outside employment, and fails in some of it, he should take less work the next term so he can pass in all of it. Even if he is self-supporting, he should not be repeatedly on probation. Generally the self-supporting student has sound enough judgment not to attempt too heavy a load, but this is not always the case. He should not make the same mistake term after term.

We try to be fair to every student in considering the work he does. In no case does the self-supporting student fail to receive consideration insofar as the facts are known, and a real effort is made to find these facts. Many working students are assisted in various ways and given special concessions in recognition of the fact that they may be making a greater effort to obtain their education than others more favorably situated, and may have serious obstacles to overcome.

The present nine-credit rule seems to operate more fairly than the fifty per cent rule did, for probationary purposes, for students of all grades. The circumstances of each individual case are carefully considered, however, to avoid injustice to anyone.

O. M. Leland, *Dean*.

ENGINEERING REVIEW

(Continued from page 149)

the student all through the course. The momentum equation and simple harmonic motion are also discussed. The chapter dealing with curvilinear motion differs from the one preceding in that it has to do with angular velocities and accelerations instead of the linear quantities.

The remaining chapters are of less importance than the first two, and utilize to a greater or less extent the principles set forth in the preceding chapters.

The authors have succeeded very well in keeping the book well within the understanding of the average student. They are to be complimented on the fact that the text preserves throughout the method of concise, concrete presentation of the material.

Mexico City is to have a new $200,000 airport with 125,000 square metres of runways, a hangar 120 feet square and a large work shop.

ENGLISH FOR ENGINEERS

(Continued from page 145)

I have said nothing of the cultural value of English. Because of the rather general impression prevalent among engineering students that a man of culture is the sort who has fainting spells, or who out of work inhabits the lodging house district, perhaps it is as well not to stress this value. Suffice it to say that where men are so afflicted by faintings and lodging houses the trouble is in all probability due to an excess of something other than culture. Indeed I am convinced that culture has an ever increasing value in dollars and cents; that there is a very intimate relationship between culture and worldly position and income; so intimate, in truth, that while in the majority of cases men's culture varies in direct proportion to what is known as their worldly success, it is extremely difficult to tell how much of this advancement is due to a man's culture, how much to what are called his practical qualities. Therefore let no student fear that culture will so affect his morale, so weaken his will to succeed that he must beware of it. Culture simply fixes higher a man's standards of success, and that is all. It is comforting to think that an individual studying English for its immense practical value must in spite of himself gain something of culture.

In conclusion let me repeat that the engineer's problem is both technical and human, and, as far as I can judge, the human side is as important as the technical. The engineering college attempts to prepare for both phases. The subject it offers of fundamental importance in dealing with technical problems, problems of material, is mathematics. Its best preparation for the human problem is found in its offering of English. A young man well equipped in these two subjects is, I believe, well equipped for the engineering profession; or, at least, he has as complete an equipment as any school can give him for life. My opinion is that eventually this will be more generally recognized than it is now; when the engineering student digging his hard way through four consecutive years of mathematics will find relief in, say, three consecutive years of English. Why not?

A machine gun that fires 150 shots per minute and weighs but 17.5 pounds has been perfected by Russian engineers for the use of the Red Army.

DIPLOMA MILLS

(Continued from page 160)

table institutions must be called upon for aid. Often the American Association of Engineers has been able to recover tuition fees for poverty-stricken graduates, but reformation of bogus institutions of learning should be undertaken by the public itself at once.

"There are some legitimate correspondence schools with which we have no fight. These have proven the great value of home study and adequately fill the gap between high school and college. But we believe that the educational crooks who use the small-town boy's ambition for advancement for their own profit, and hand him a mess of technical rubbish to build his hopes upon, should be forced to reform. The public must be told their methods so that it will refuse to register with the diploma mills. When profits fall off, these shady institutions will be forced to clean up or go out of business."

The National headquarters of the American Association of Engineers is located at 8 South Michigan Avenue, Chicago.

It's okey to tell your girl she's the eighth wonder of the world, but don't let her catch you with the other seven.

NEWS FROM THE TECHNICAL CAMPUS

Welding Engineers in Demand

Recently the United States Civil Service Commission announced an open competitive examination for the position of senior welding engineer. The duties of this position as listed in the commission's announcements of the examination are as follows:

"To extend the application of welding in the construction of naval vessels, to keep in touch with the latest developments in the industrial field of welding, to have general oversight over the welding processes at navy yards with a view to coordinating and perfecting their methods: to initiate tests and research and to analyze the results of experiments: to prepare specifications for and advise as to the selection and purchase of welding appliances and materials; to criticize design and detailed structural plans of naval vessels as affecting and as affected by the application of welding, and in general to advise the Bureau of Construction and Repair, Navy Department, on all matters pertaining to the application of welding to ship construction."

The resume of the prerequisites for this position is quoted also in part as follows:

"In addition (to a college or university degree in engineering), must show that they have had at least six years of extended professional experience in engineering, consistent with the duties of the position, at least three years of which were of a responsible supervisory or administrative character, in which the applicant has been engaged in the direction or performance of important mechanical engineering work including research and development in connection with the industrial application of modern methods of welding. Such experience must indicate outstanding professional attainment and proven research and executive ability of a high order, and must show a high degree of progression in duties, responsibilities, etc."

The most significant thing in this announcement is that the entrance salary for this position in Washington is the highest entrance salary paid to any engineer under the United States Civil Service. Those interested in the progress of welding may view with satisfaction the attitude of the United States Government towards this field of engineering. The great strides made by welding in recent years in the whole industrial field have made it a vital and nearly universal method of joining metals in all lines of fabrication and repair. The importance which the Government attaches to the profession of welding engineering may be regarded as another step forward in the growing general confidence in and enthusiasm for welding.

Leland Attends Aero Conference in St. Louis

Dean O. M. Leland recently attended the National Conference on Aeronautical Education held at St. Louis, Missouri, from February seventeenth to the nineteenth.

The conference was called under the auspices of the educational committee of the Aeronautical Chamber of Commerce of America, and was held for the purpose of getting at the heart of the problems arising in the various phases of aeronautical education. Outstanding men in the educational field attended the meeting for the purpose of considering aeronautical education in colleges, elementary and secondary public schools, as well as ground school and actual flying education.

CUB ENGINEERS

(Continued from page 151)

thought I knew people, but I never realized that there could be a group of people so thoughtful of the other person when there was nothing to gain by it.'

"I also received a letter from the superintendent, highly recommending the spirit in which this young fellow had gone at his work, and saying that he had aranged to give him a quick course during the rest of the vacation, covering the three other departments at the mine. The man came back from the mine weighing twenty pounds more than before, rugged, alert and enthusiastic about his work. He did more and better work in his final college year than he had done in any previous year.

"This knowledge of human power, not only in its material but in its human aspects, is the missing link in academic instruction. It is that which I trust you will seek when you have completed that part of your engineering training which is so thoroughly and ably taught at Tech."

* *

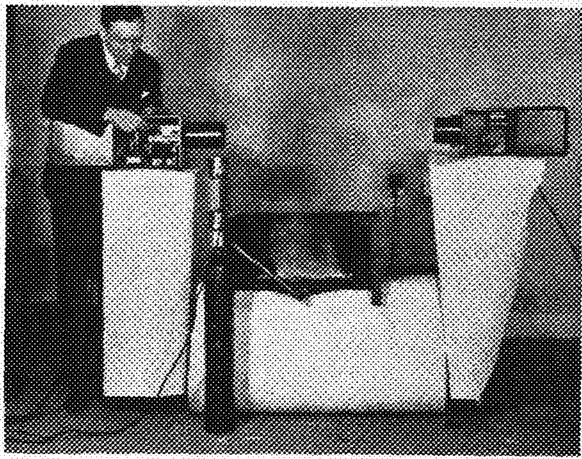
"Hey, Fellow, where have you been for the last hour?"

"Talking to the blonde at the cigar counter."

"Well, what did she say?"

"No."

SMOKE DETECTOR MIGHT PROVE ASSET IN LIBRARY

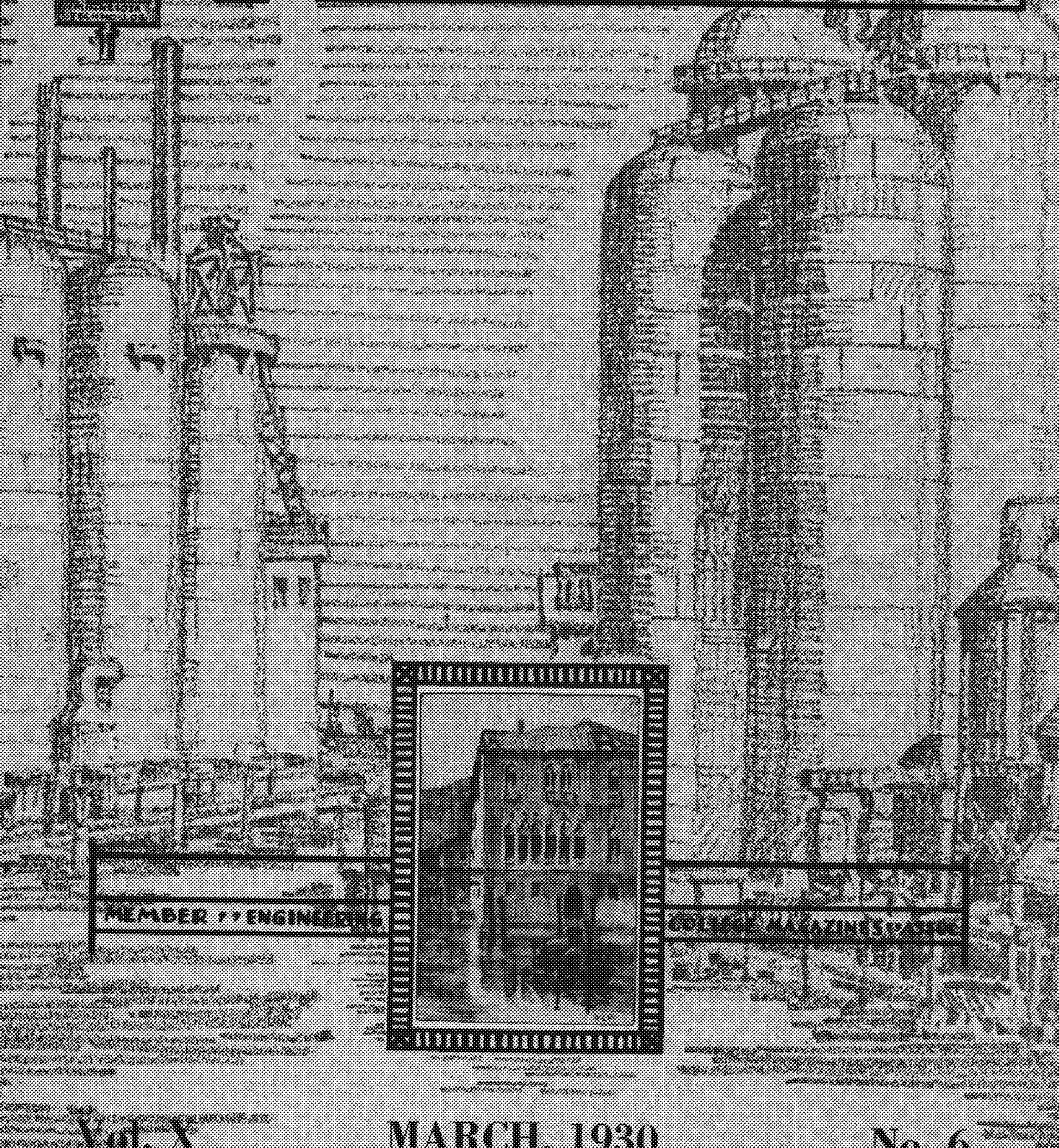


Of eminent importance to University officials is the recent perfection of a smoke detector. The uniformed attendants who now stand at attention in the Library may soon be abandoned and their places filled by the smoke detector.

A laboratory model recently exhibited consists of a long glass tube having a light source in one end and in the other a photoelectric or light sensitive tube. A small opening in the glass tube permits the operator to blow smoke inside the chamber. When the light intensity is dulled by the smoke, the photo-electric tube responds, throwing a relay which starts an exhaust fan. This could very easily be adapted for use in the entry to the library. The relay could also be connected to a buzzer or bell which would serve admirably to call the proper authorities to the scene. A photographic device could record pictures of the offenders, so that if they succeeded in disappearing before the arrival of the minions of the law,—their photographs would be on file for the delight of the dean's office.

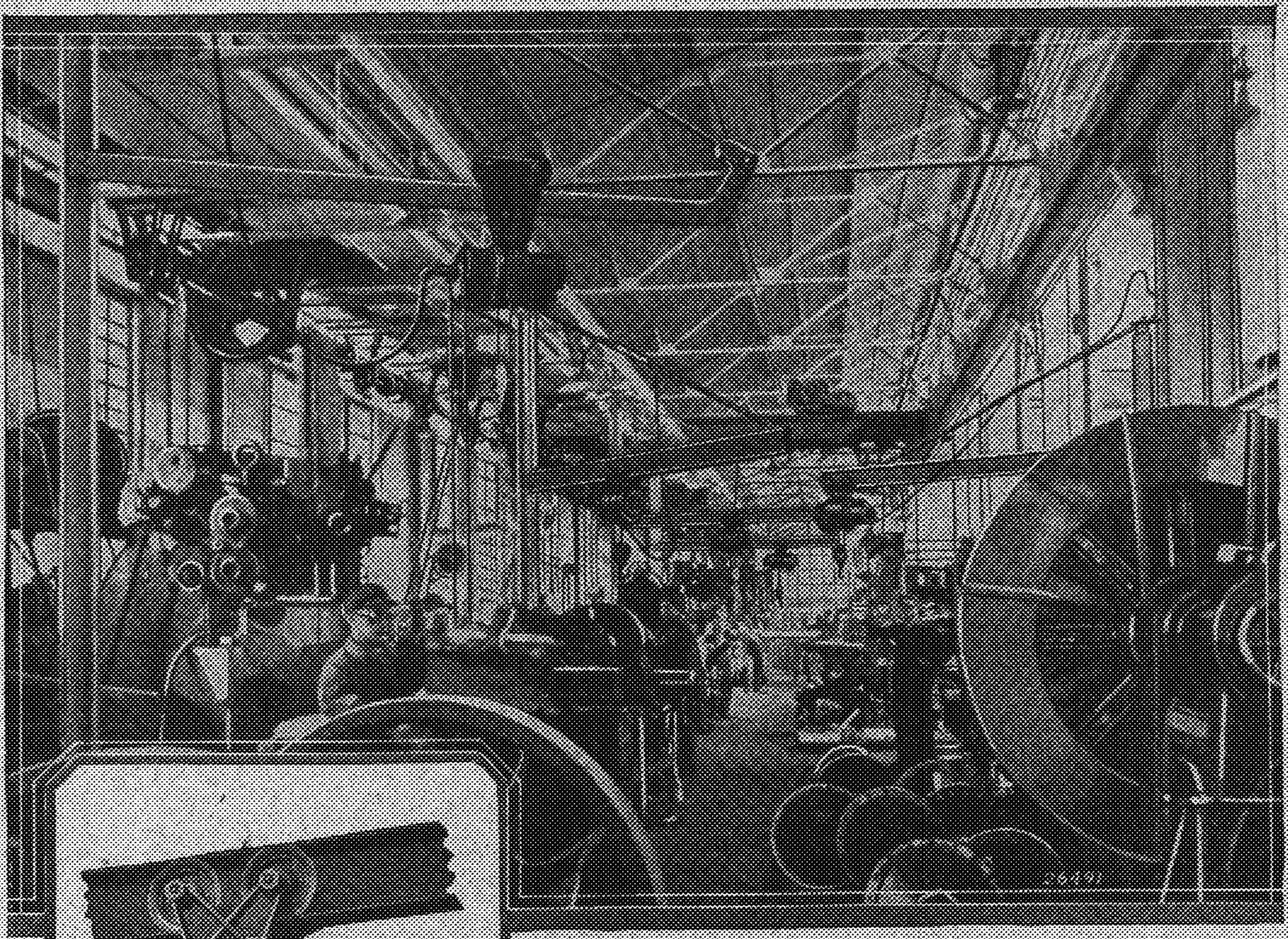
The Minnesota Techno-Log

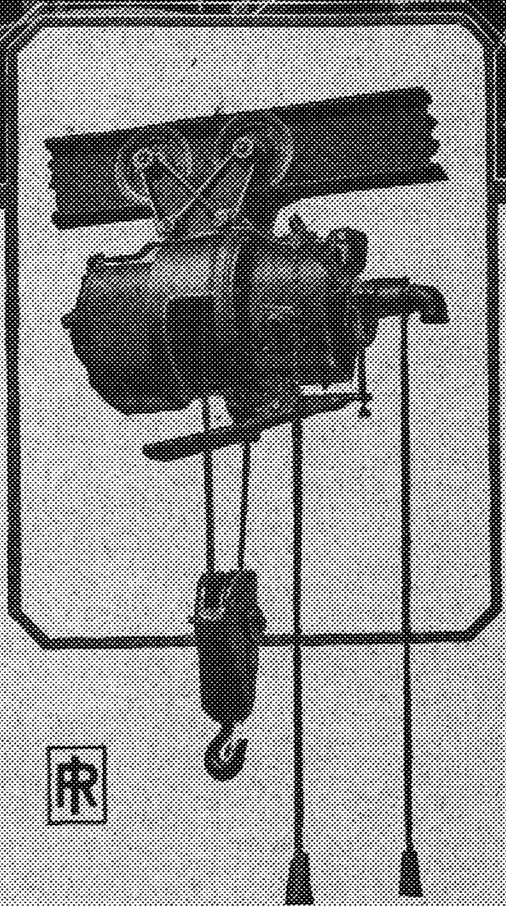
MONTHLY PUBLICATION OF THE TECHNICAL STUDENTS



MEMBER ENGINEERING COLLEGE MAGAZINES ASS'N

Vol. X MARCH, 1930 No. 6





A group of Ingersoll-Rand Air Motor Hoists in a railroad machine shop

I-R Air Motor Hoists Help Reduce Production Costs

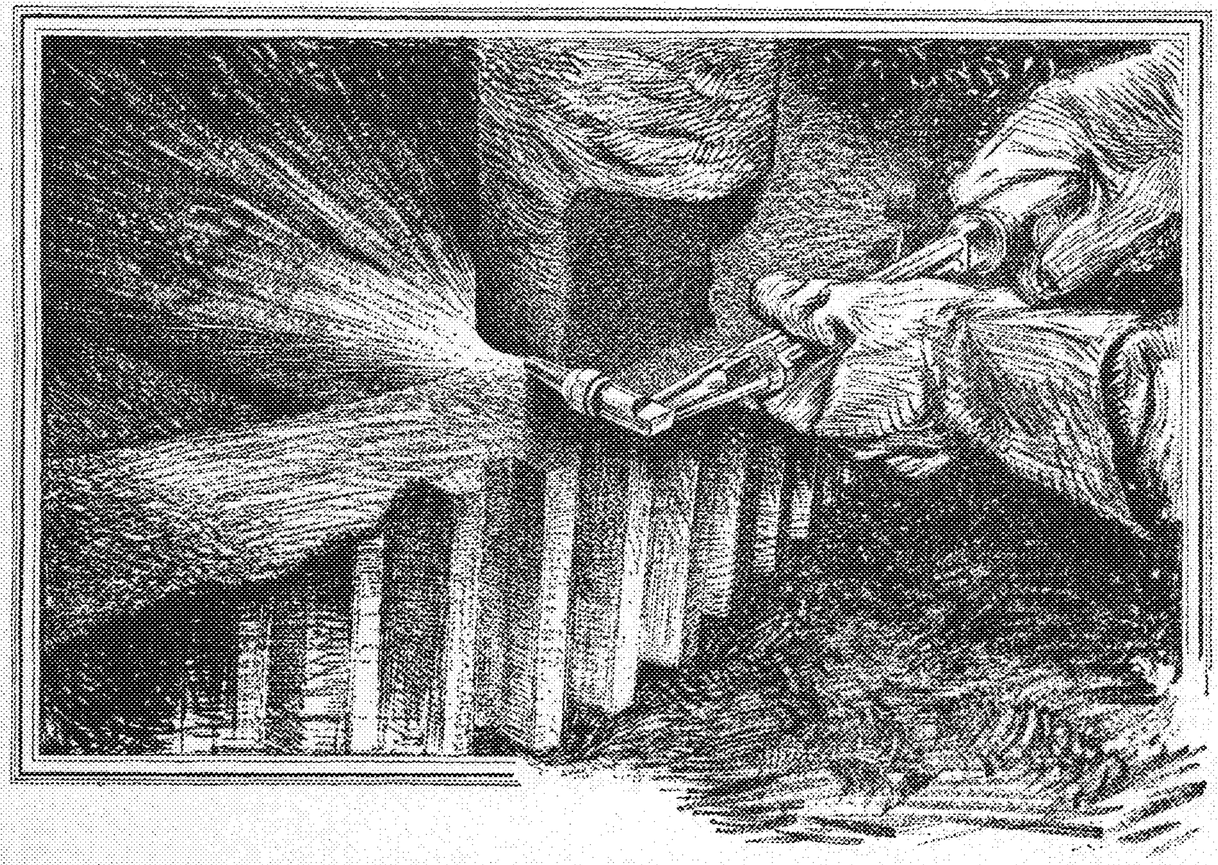
In numerous shops like that pictured above, Ingersoll-Rand air-operated hoists are saving the time of skilled laborers. They are used for quick lifting and lowering, and for the accurate placing of pieces on machines.

These hoists are but one of the many classes of compressed air tools and appliances manufactured by Ingersoll-Rand Company. Other types include chipping and riveting hammers, drills, grinders, woodborers, scaling hammers, sand rammers, and clay diggers.

INGERSOLL-RAND COMPANY

11 Broadway · · · New York City

Ingersoll-Rand



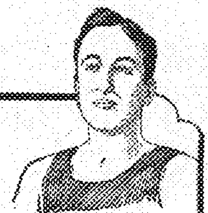
IN THE STEEL FOUNDRY

THE oxy-acetylene process is of particular importance to the foundry industry. Its use has enabled designers and makers of castings to accomplish results otherwise impossible.

Oxy-acetylene cutting is recognized by steel foundrymen as superior to all other methods of riser removal. It is fast and economical. In addition it reduces to a marked degree the amount of machining necessary to the casting after the risers are cut off.

Reclamation of castings by oxwelding is a natural adjunct to riser cutting. It has enabled foundry operators to reduce rejects to a minimum. Castings so reclaimed are in all respects equal to those accepted upon first inspection.

Oxy-acetylene cutting and welding are routine production steps in the modern foundry.



JOHN F. WILCOX

Leland Stanford University 1921

Crew Soccer

VINCENT DRADDY

Manhattan College 1929

Football 3 years
Captain, 1928

Class Officer

President Letter Club

From time to time the oxy-acetylene industry is in the market for technically trained men. It offers splendid opportunities for advancement.

[One of a series of advertisements featuring College men serving this industry.]

The Linde Air Products Company—The Prest-O-Lite Company, Inc.,—Oxweld Acetylene Company—Union Carbide Sales Company—Manufacturers of supplies and equipment for oxy-acetylene welding and cutting.

UNITS OF

UNION CARBIDE AND CARBON CORPORATION

30 East 42nd Street UCC New York, N. Y.

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

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

VOLUME X MINNEAPOLIS, MINN., MARCH, 1930 NUMBER 6

CONTENTS

PAGE

ONE WORD MORE - 181
Frank B. Lindsay

PORCELAIN INSULATORS - 182
J. Robert Ginnaty

MILITARY SCIENCE FOR ENGINEERS - 184
R. W. Siler

ENGINEERING REVIEW - 185

NEWS FROM THE TECHNICAL CAMPUS - 186

AROUND THE WORLD WITH OUR ALUMNI - 187

EDITORIALS - 188

CHARLES BOEHNLEIN—FACULTY SKETCH - 189

HOW TO GET A PATENT - 190
Ray Belmont Whitman

MEMBERS OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

Chairman: WILLARD V. MERRIHUE, 1 River Road, Schenectady, New York

Armour Engineer
Auburn Engineer
Colorado Engineer
The Cornell Civil Engineer
Illinois Technograph
Iowa Engineer
Iowa Transit
Kansas Engineer
Kansas State Engineer
Marquette Engineer
Michigan Technic
Minnesota Techno-Log
Nebraska Blue Print
Ohio State Engineer
Oregon State Technical Record
Penn State Engineer
The Pennsylvania Triangle
Princeton E. A. News Letter
Purdue Engineer
Rose Technic
Sibley Journal of Engineering
Tech Engineering News
Wisconsin Engineer

Entered as second-class matter April 9, 1925, at the post office at Minneapolis, Minnesota, under the Act of March 3, 1879. Office, 37 Electrical Building, University of Minnesota. Telephone, Dinsmore 2760. Contents copyrighted and permission must be secured for re-publication. Subscription rate, $1.50 a year. Single copies, 25 cents. Advertising rates upon application. Alumni Directory, 50 cents.

Old Tavern

Staten Island, N. Y.

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume X | MARCH 1930 | Number 6

ONE WORD MORE

By FRANK B. LINDSAY

Instructor in Mathematics.

AT a time peculiarly devoted to biography and true confession perchance a mathematics instructor may be allowed his contribution to the case histories accumulated by Freud and Bernarr MacFadden. When fifty million Frenchmen are suffering from repressions and twice as many Yankees suffer unrepressed, one may speak out as boldly as a Zonite "ad." If this be Œdipus complex, as Patrick Henry said, then let the reader make the most of it. In this article the writer, who often cannot add and who hates puzzles, both arithmetic and crossword, purposes to consider mathematics as play, as art, and as animal training. Should these turn out to be one and the same upon examination, it will not alter the author's set intent to discuss them.

For so long a time has play been associated with childhood that a generation which identifies immaturity with secret shame cannot abide the word. It must disguise its adult equivalents as business and sports. Nevertheless the child that is father of the man still cherishes its toys. The red wagon has been exchanged for a motor car and roller-skates only forgotten for the stock market. Yet the child still lives in every man to reappear when he recites his fishing or golf score. Just as boys find themselves with sandpiles and velocipedes, so young men profitably lose themselves in mathematics and science. The youngster plays with things to pit his muscles, eyes and ears against his backyard world. His hands crave the feel of a baseball bat; his toes rejoice to dig into the turf as he races to first-base. Arrived at his later teens he discovers a world of ideas. And happy is he who learns to play the game of mathematics.

Each of us is a citizen of four worlds. Truly satellites of earth as much as the moon, we pursue erratic and arrested orbits subject to the same gravitation and thermodynamics as the farthest star. We are animals, kin to the very vegetables in our gardens and maybe only poor fish twice removed. Four out of five, it is reported, harbor blood relations in their mouths. The colic flora are much at home with us. Then we are members of society. We may be gangsters or Rotarians, no matter, we all belong—hundred per cent Americans every one. And finally there is a world of mind within whose mansions we stumble clumsily and, painfully conscious of our hands and feet, we far from feel at home. It is a penalty for growing up

> *Frank B. Lindsay obtained his B. A. degree with highest distinction from Indiana University in 1921. After teaching for several years in Florida, Mr. Lindsay returned to Indiana to pursue graduate work which he continued during the years of 1925 and 1926. In the fall of the latter year, he became principal of Smithville High School at Smithville, Indiana. During the summer he entered the graduate school of Purdue University where he continued his studies in mathematics and physics until his appointment as an instructor in the department of mathematics and mechanics at Minnesota at the beginning of the winter quarter last year.*

that we must assume our civic duties in all departments of our fourfold universe.

If we are not to be alien in our own home, debarred from our rightful heritage, we must master the *open sesame* to our world and that is mathematics. Our foetal existence transformed us from blind worms, mostly gut, into passable mammals. Infancy found us anthropoid and left us almost human. Possibly degenerate from the ape, we may not rival him save with our minds. And to a method of sorting and controlling facts, to a habit of analysis and judgment, we have given the name mathematics. Is not mathematics then supremely a sport for early manhood?

The basketball aspirant does not begrudge incessant trials at shooting baskets if skill enables him to make the team. Nor will college undergraduates despise those problems that create the mental dexterity of a genuine engineer. Primitive man lacked claws so armed himself with clubs, then tools, now typewriters and precision instruments. His eyes were poor, so microscope and telescope have extended his vision. His voice would not carry so he created telephones and radio. But the most marvellous of his inventions was number and the subtlest tool he possesses is mathematics. We may never look upon electrons but we can count them and marshal them at our will. We may not swim in the ocean of air nor fly as the birds except as we apply mathematics to the design of airplanes and dirigibles.

But mathematics is more than play. It is a fine art. Human beings long to express themselves; primarily we are creatures of emotion. In our appreciation and enjoyment of various forms of art we evidence the embryo artist in us all. Yet painting and sculpture suffer the limitations of the material. The greatest artist is bound to his canvas and marble. Yet because the picture, the statue endures for a season we forget the soul of man cannot perfectly express itself in stone and oils.

Dancing is a subtler art; the artist here employs the medium of his own body. A lovely dancer holds us enthralled and we sigh that such beauty, such poetry of motion, is so fleeting. Drama gives us the art of gesture and words combined. Music is but artistry of sounds. And in mathematics the human soul is most free. It roams from the infinitely small to the unimaginably immense. It achieves symmetry impossible to the physical world. Like all true art, mathematics has its rigorous laws. Through it, our minds escape from space and time. Mathematics is the art of the human mind expressing itself through itself. With poet and musician, mathematician creates enduring beauty—verse for the one, musical score for the second, and equation and theorem for the last. The Parthenon and Forum are nearly dust; "The Last Supper" flakes into nothingness. But the masterpieces of a Homer and a Shakespeare, of a Beethoven and Wagner, of an Archimedes and Newton will sway men still when the glory that was Greece, the grandeur that was Rome, have met their ineluctable fate.

(Continued on page 204)

PORCELAIN INSULATORS

By J. ROBERT GINNATY, EE '29
Westinghouse Electric and Manufacturing Co.
Former Managing Editor of The Techno-Log

NEARLY 2000 years ago, the Chinese produced the first porcelains of which we have any definite knowledge. The ware of the best periods of Chinese production has never been equaled in form, color, or workmanship. History does not tell us definitely of the beginning of the manufacture of pottery. However, records show that about the year 206 B. C., the beginning of the dynasty of Han, some Chinese workers in earthenware set their pots in an oven to bake and then forgot them. When the ovens were finally opened, they found the pots showing shiny vitrified spots. In that way the process of enameling porcelain was discovered. The art of monochromatic glazing was discovered in the time of the dynasty of Sung (1280-960 B. C.); occasionally the action of fire separated the pigments and produced excessive richness of color.

The Mongol invasion checked this progress of ceramic art, yet in the year 1368 Tai-Tsu, son of a day laborer, dethroned the emperor and founded the dynasty of Ming, whose reign persisted until 1644. Tai-Tsu lost no time in restoring the imperial manufactories: under this new impetus all the ancient methods were revived and perfected. The system of three and five coloration after a preliminary firing dates from the renaissance of art under the Ming dynasty. The production of porcelain began in Europe in the latter part of the middle ages, but electrical porcelain is a development of the past two decades.

Clay ware in general may be divided into two classes. First, the ware is made entirely of one clay or of a combination of clays. Second, it is not, strictly speaking, made from a clay but from a paste containing clay, in combination with feldspar and flint. Very ancient pottery comes under the first class. Porcelains, including electrical porcelain, belong in the second class. Although of no importance except from a historical viewpoint, it is interesting to know that the ancient potter used the impure, low-fusing clay, and made his ware by one of two general methods. He either first batted out a roll of clay and then built it up by coiling the roll, or he batted out a flat slab and pressed it into shape. The potter's wheel came into use later, a lump of clay being thrown on the center of the horizontal wheel, fashioned and drawn into shape by the hands. A drawing from the tomb of Beni Hassan shows the wheel substantially as it exists in Asia today.

Modern methods and processes merely improved these same tools. Today the terra cotta munfacturers still use slabs of clay and press them into the desired shape by means of a mold, and the electrical porcelain manufacturer connects an electric motor to his potter's wheel instead of propelling it himself.

The advent of the present day alternating current transmission systems came at a time when insulators were designed with no fundamental principle. At this time a large surface, a huge mass of porcelain and a long leakage path constituted an insulator.

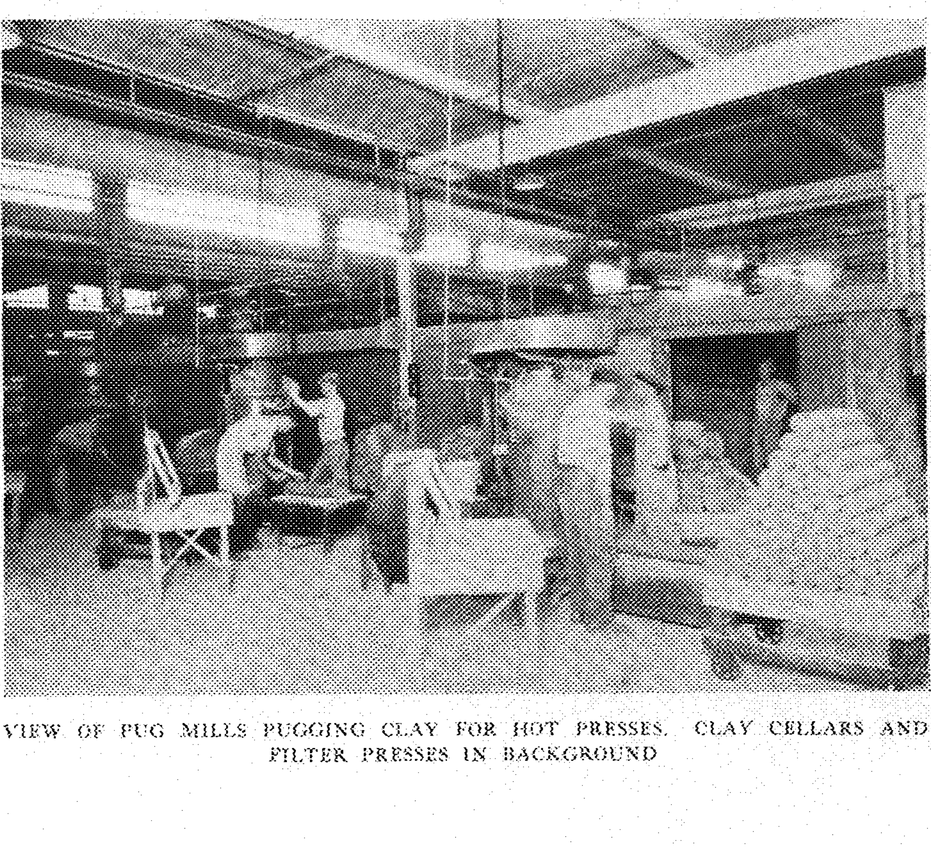
Twenty years ago the electrical industry was using insulator designs based on no recognized principle. As the transmision line voltages increased, the designers added more and more petticoats to their insulators. The result was a bulky design with many fragile rain sheds.

This condition has been overcome by applying known principles of electrical and mechanical engineering to the design of insulators. Among the first designs was the Faradoil pin type—an insulator whose design is based on a principle evolved by Faraday, and it is now the accepted design for all multi-part pin type insulators. Following this, the high strength cap and pin suspension type was developed through photo-elastic studies of stress conditions. In the production of clay for electrical porcelain insulators, flint and feldspar are used. After much research, American clays have been standardized.

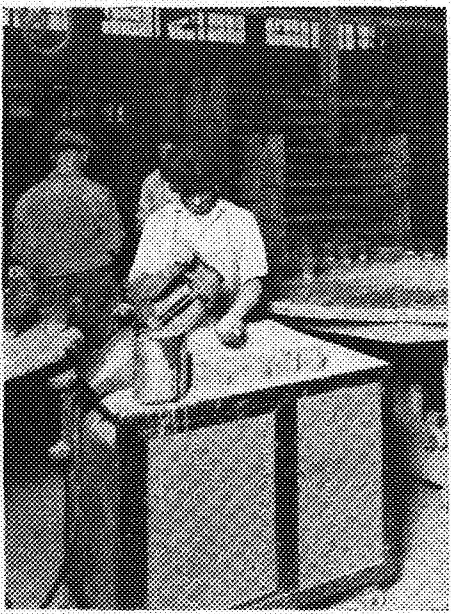
When a car of clay arrives at the works it is dumped into a disintegrator. From here it is carried by a drag type conveyor to storage bins where it is kept until needed. The flint and feldspar are distributed in the same manner, except that they do not pass through the disintegrator. Carefully weighted portions of flint and feldspar are placed in a ball mill and ground to a powder fineness. Corresponding weights of ball clay and china clay are placed in a blunging machine where they are thoroughly mixed with water. After about an hour of grinding, the flint and feldspar are pumped from the ball mill into the blunger where the entire mass is thoroughly blunged to obtain an intimate mechanical mixture. This mixture, now called the *slip*, is passed over a double set of screens and a magnetic field to take out all large particles and any small pieces of metal. After this cleaning process the slip is pumped into cisterns from which the air has been exhausted, where it is stored until needed.

True porcelain which is a real vitreous china, can be formed into desired shapes by any one of three different methods of manufacture. These three methods are the casting process, wet process and dry process.

When slip is used in the casting process, sodium silicate is added to give properties that will allow it to form more easily in the molds. To shape or



VIEW OF PUG MILLS PUGGING CLAY FOR HOT PRESSES. CLAY CELLARS AND FILTER PRESSES IN BACKGROUND



GLAZING INSULATORS. OPERATOR IN THE FOREGROUND IS APPLYING THE SANDED SURFACE

form a piece of ware by means of the casting method, the slip containing the sodium silicate is poured into a plaster of paris mold and allowed to remain there until it becomes solid. When strong enough to be handled, it is removed from the mold and placed in the drier. Four stages compose the process of drying. The first two are carried on with high relative humidity, which is built up by water and steam sprays. The high relative humidity is maintained so that the ware will be warmed to an even temperature and thus dry evenly. The last two states of drying are carried on with a dry bulb temperature, which is gradually increased toward the end of the drier, the temperature gradient beginning at 115° F. and ending at 145° F. The passage of the ware through the drier requires from 42 to 60 hours, the larger insulators requiring more time for drying. A mechanical pusher on the driers insures uniform passage through the drier as well as uniform drying in the shortest possible time. After this final drying the insulators are ready for final trimming. After trimming, they are glazed, sanded and fired.

In the wet process the slip is pumped from the cisterns into filters, where about 74 per cent of the moisture is removed. The clay is then a solid mass and is taken from the filter presses in cakes. These cakes are passed through pug mills and pugged out into the form of square bars. These bars are packed tightly into aging cellars where they are stored from four to seven days. At the end of this period the clay is again pugged to assure uniform moisture content and remove all air bubbles. The clay comes from this second pugging in the shape of long round bars and is now ready to be extruded, thrown, hot pressed, or jiggered into shape.

The hot press method is perhaps the one that is used most, and gets its name from the fact that the tool used to press the clay into shape is heated. In this process the clay is cut in chunks and placed in plaster of paris molds. The molds containing the clay are then placed in the press and the tool rapidly rotating is forced down, leaving the clay in the desired shape. The mold is removed from the press and placed in a mold release drier. This drier removes enough moisture that the clay may now be handled. The ware is then removed and placed in the preliminary drier where the moisture content of the ware is again reduced, this time to about 18 per cent. After the preliminary drying it is solid enough to be trimmed. Having been trimmed, the ware is placed in the final drier and dried to a bone dryness. It is then glazed, sanded, and fired.

Jiggering is a method of forming that is very similar to the hot press method. Instead of revolving the tool the clay is rotated and the tool, consisting of a piece of wood or metal cut to the correct shape, is forced down into the clay. This method is used only when a small number of pieces are ordered. After the clay has been shaped the mold is removed from the machine and the piece is handled the same as in the hot press method.

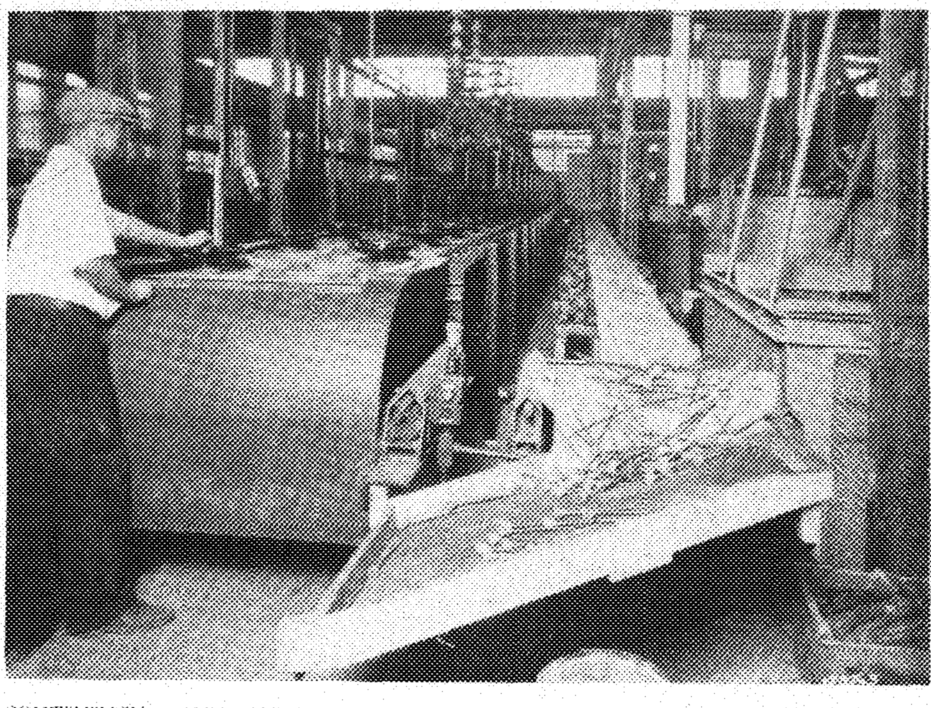
Extrusion is sometimes used in the forming of wet press porcelain. This method applies principally in the production of tubes and strain ball insulators. Here the clay is pugged and forced through dies which are then cut to the correct length and dried to a leather dryness. When this state of dryness has been reached the clay is trimmed on lathes or trimming machines and dried to a bone dry state. After this final drying it is glazed, sanded, and fired.

Throwing clay is one of the oldest methods of forming porcelain or clay ware. To shape the damp clay the operator throws it on the center of a rapidly revolving wheel and then shapes it into the desired form with his hands. The formed clay is then heated in the same manner as in the other processes.

The slip to be used in the dry process is pumped from the cisterns into filter presses where most of the moisture is removed. The clay cakes from the filter presses are placed in a dry storage room and when sufficiently dry are crushed and moistened down in a bin. The clay is again ground, this time into small pieces about the size of rice. When in this state, it is spongy and elastic. In the dry process this clay is placed in a steel die and molded in a press. The molded clay is removed from the die and completely dried, and then trimmed, with a moist sponge, glazed, sanded if necessary, and fired.

The glaze consists essentially of the same ingredients as the body of the insulator. However, some may be of a special type which is more vitreous than the clay used in the body of the insulator. This glazed nonporous surface of the insulator is necessary for two reasons. First, it betters the appearance of the finished product, and, second, it is easily kept clean. The necessity of a clean surface is important in maintaining a high dielectric strength. The ac-

(Continued on page 206)



CONTINUOUS CONVEYOR TYPE ELECTRICAL TESTING MACHINE SHOWING THE STARTING END. THE BELT CONVEYOR ON THE RIGHT RETURNS THE CONTACT PINS SET ON THE INSULATORS

MILITARY SCIENCE FOR ENGINEERS

By **R. W. SILER**
Department of Mathematics and Mechanics

TO drill or not to drill, that is the question. I have sometimes wondered, observing students sitting in classrooms on warm spring days wearing uniforms whose heat content an Eskimo might envy, whether the students had any idea of why they were called on to suffer so. Why should a man in a free country be taken to a parade ground, subjected to the agony of standing with chin in and chest out, made to walk from point to point in a straight line rather than by a more devious and natural route, and finally forced to describe himself as a mere numeral with a maximum value of 4? I realize that to justify such suffering to some of our students is very hard indeed. Yet I believe that in our educational program military science is of the utmost importance. Important in this way: that while most subjects of our curriculum simply involve questions of *how* we educate, a consideration of military science is a consideration of *why* we educate. In one case we are thinking chiefly of the means, in the other of the ends of education.

A student hiking to and fro over the parade ground and nursing thoughts of mutiny may finally conclude that he is manhandled thus that the army men in charge may have jobs; or that he is purposely being worn out in order that he cannot study and shock his "profs" into insensibility the next day with perfect recitations. Neither of these conclusions is quite right. The basic reason for military science, and indeed I think the only good reason, is national defense. This question of national defense should be for every man a very important question, no matter how he stands with regard to it. It should be of particular interest to those who drill.

People there are who insist that talk of the need of national defense is talk emanating from certain quarters with no more decent purpose than to give interested persons who manufacture battleships and firearms an opportunity to sell their product. Also it is maintained that, granting preparation for national defense to be necessary, national defense is not helped by anything that a course in military science at the university can do. Let every student ponder over these objections.

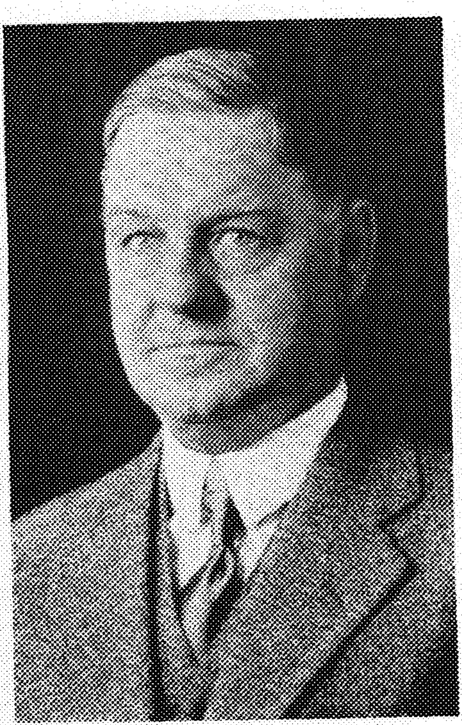
But before going further it might be well to say something of the obligation of an individual to do his part in any scheme of national defense which may be adopted. It seems almost inconceivable that there should be any doubt as to such an obligation. Without getting into an argument as to the ethics involved here, this may be said, that in this world it is impossible to get something for nothing. If an individual benefits by membership in a community he will have to make return to that community in service of some sort; and even though he may have some twisted views of life which persuades him that the community, the nation, should support, educate and protect him without asking anything in return he will find that the community will assert its power—even though he insist it has no right—and force service from him. In the final analysis the community is as subject to immutable law here as is the individual. A community, at least one that is civilized, is able to exist and function only because of the services of its individual members. No community can operate, can give the advantages of community and national life, without demanding and obtaining the services of its citizens. It is well nigh impossible for a man to escape this law while he remains on earth. Certainly it is impossible if a man lives with other men and does so in any degree of comfort and peace. I suppose one could, if one's soul insisted on it, still find localities in the world where social service would not be called for, but to find such one would have to go where social life did not exist. There still remain, for such an experiment, the polar regions and the Sahara desert; as far as climate goes there is still a variety of choice. But the seeker after individual freedom and expression would find the Sahara and the North Pole singularly alike in this, that while in them the advantages of civilized life were gone the disadvantages remained and were emphasized. Life in the Sahara, I fear, would be one long and unceasing existence of service; service in self defense against nature and human enemies. There is no escape from service in this world; there is only a difference in form! and most of us, I believe, are satisfied that we got more for our service in community and national life than we would elsewhere. As for the individual who elects to remain out of the Sahara and Arctic yet begrudgingly offers his service to the nation which entertains him, he has the questionable comfort of the man who cuts off his nose to spite his face. If the state suffers so does he. The individual is as inevitably affected by the national life and conditions about him as the leaf by the tree. Therefore, for one who objects to any phase of social service, as for instance a place in the national defense, the only sensible course is to work for the abolition of world conditions which make such service necessary. But, it may be added, it is well not to count one's chickens before they are hatched. It is well not to deny that conditions exist simply because they are unpleasant to contemplate. It is well not to talk of putting away all arrangement for national defense until it is certain that there will be no future need for national defense.

> *This is the third and last of a series of articles prepared for the* TECHNO-LOG *by Professor Siler. The first and second of this series were published in the January and February numbers of the* TECHNO-LOG.

As back of military science is the thought of national defense—so back of national defense is the possibility of war. Here, in the uncertainty of what the future holds, lies the only and complete justification of military science and of all preparation for national defense. We all, I think, hope for the day when such a thing as preparing for national defense will be unnecessary; but any unprejudiced consideration of the past must make one realize that in this, the elimination of war, is a problem more evident than certain of solution. The most casual reading of world history will convince that war, if not the greatest thing in history is the most striking, and in many respects the most significant. History is very largely a history of war. Call war abominable or call it holy—there have been wars called holy—regard it as ruinous to mankind or think it invigorating and necessary, have any imaginable opinion concerning it, yet the fact remains that war has always been with us. The classic definition in this country of war is that of General Sherman: "War is hell." But this definition, which in Sherman's day may have suffered because of people's clearer conception of hell at that time, is now more concise than complete. Actually, all that is to be gathered from Sherman's three words is that war seems, even to a general, extremely unpleasant. And the certain unpleasantness of it is one reason why men should consider it, prepare for it, with the thoroughness they never prepare for a picnic. The truth is that war, though so terrific and evident in all past history, yet remains for us today an enigma and a problem, in that we, not understanding the ultimate causes of it, have no certainty as

(Continued on page 200)

Engineering Review



CHARLES F. SHOOP

Mechanical Laboratory Practice

A new manual, *Mechanical Laboratory Practice*, a combination of experiments and text, written by Professor Charles F. Shoop of the University of Minnesota and Professor C. L. Tuve of Texas Technological College, for the use of engineers, especially mechanical, will be released by the publisher soon. This book should receive a hearty welcome mainly because at present there is no single reference available which the student may use to aid him in writing up his experiments. Bound in book form with the reference, the experiments can be more easily kept than is the case with the present system of mimeographed sheets, which, given out singly, are so easily misplaced.

The authors have done their best to arrange the manual systematically, appreciating the fact that the engineer just starting laboratory practice has but little initiative. For his benefit the experiments in the beginning of the book are quite simple, but they become more difficult as he gathers experience. Every effort has been made to illustrate to the student how he can use his time to the best advantage, especially emphasizing the most logical method of attack for that particular problem.

In addition to the elementary course for engineers in general and the mechanical second quarter work, the manual contains advanced work in steam power plant testing for seniors together with log tables, references, diagrams, etc., which are always useful to the engineer in college or in the commercial field. Also, there is a great variety of experiments supplementing the elementary courses, from which work which will be beneficial may be outlined by the instructor, depending on the field in which the student intends to specialize. Accompanying each experiment are precautions to warn the student of the possible sources of error and results taken from commercial tests with which the student may check the accuracy of his work. A list of references to outside texts and late technical papers has also been included to aid graduates in seeking further material on their commercial problems.

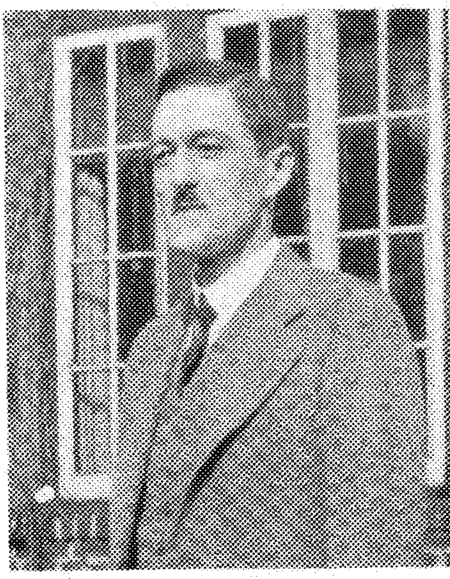
A prominent reviewer has said of the book:

"I like the plan of the book very much. Moreover, it is put up in simple easy style, and I have enjoyed reading it. The outstanding contribution of the book will be found to be, I think, in the excellent background of engineering usefulness and adaptation in which the laboratory of the student is set. I know of no other laboratory practice book that does this."

Design of Electrical Apparatus

The latest textbook on electrical design to appear on the market is "Design of Electrical Apparatus" by Professor J. H. Kuhlmann. The outstanding feature of this text, we believe, is the fact that it is the only book that can be used to advantage by a person who has had little or no training in design. As the average course in electrical engineering theory cannot give much of the procedure and methods of the procedure and methods of designing electrical apparatus, such a book must give a clear, simple, and logical order of the procedure necessary to calculate dimensions and characteristics of the apparatus. In accordance with this policy the book is divided into four sections covering direct current machinery, synchronous machinery, induction motors, and transformers. The method of treatment for these different headings is fundamentally the same. A discussion of the construction of the apparatus is presented with an explanation of the formulae and procedures. The design limit as established by practice is given and all of the material is well illustrated with sample illustrations.

The section on direct current includes the construction used for standard di-



JOHN H. KUHLMAN

rect current motors and generators and the voltage formula most convenient for use in design. The author presents a thorough discussion of the output equation and the factors controlling the armature dimensions together with the method of designing the pole shoe and the construction of the flux plot for determination of the no-load field form. In a further chapter the armature windings and the method of designing the armature core and windings are taken up. The new text contains a thorough discussion of the magnetic circuit for direct machines as well as the method of its calculation. A slight digression into the theoretical field occurs in the presentation of armature reaction and the design of the field windings. This section also explains very carefully the method of designing the shunt field rheostat for direct-current generators.

A discussion peculiar to direct-current machinery is the subject of commutation and the method of designing the commutating pole. This portion of the text closes with a presentation of the methods used to calculate the losses, efficiency and temperature rise and includes the usual efficiency obtained for standard commutating pole generators and motors. A section on sample design is included at end of each chapter and enables the student actually to practice the material given to him in the text.

The remaining sections of the text are prepared in a similar manner. The induction motors are presented in two designs, the type with a small air gap and large air gap density and that with a large air gap with a small air gap density. The portion on transformers is illustrated by four sample problems cover-

(Continued on page 210)

NEWS FROM THE TECHNICAL CAMPUS

Dean Leland Attends Conference in St. Louis

Dean O. M. Leland and John D. Akerman, associate professor in aeronautical engineering, were the delegates who represented Minnesota at the National Aeronautical Education Conference, held under the auspices of the Aeronautical Chamber of Commerce of America, with the co-operation of the Daniel Guggenheim fund committee in Elementary and Secondary Aeronautical Education, at St. Louis, Mo., February 17, 18, 19. Representatives of a large number of educational institutions, especially engineering schools, were present.

The conference was divided into three sections: College and University Aeronautical Education, Aeronautical Education in Public Schools, and Aviation Ground School Education. At the same time there was a meeting of the Society of Automotive Engineers, held in St. Louis, which was devoted principally to an aeronautical program. Both of the conventions were held in conjunction with the International Aircraft Exposition which was taking place the same week, at St. Louis.

Of especial interest at the convention, according to Dean Leland, was the Aircraft Exposition, where the large Aircraft companies displayed new planes and inventions relative to aeronautical engineering.

"I saw R. M. Hazen and G. O. Hoglund, former assistant professors in mechanical engineering at Minnesota, who, when they were at Minnesota were especially interested in aeronautical engineering," said Dean Leland. "Paul M. Boyd, mechanical engineer, 1924, was also at the Aircraft Exposition. He was in charge of the Curtiss Company's exhibit, which was made up of a large Curtiss *Condor*."

"This is the first time an educational convention of this kind has been held," said Dean Leland, "and it is most probable that it will be repeated annually."

It was brought out at the convention that courses in aeronautics are now being given at 60 universities and colleges throughout the country. The total enrollment was 2,406 students this year. Aeronautical training is also now offered in over 2,400 elementary schools, high schools, and vocational schools.

While at the convention, Dean Leland met William B. Stout, '03, who was much interested in the proposed plan to provide flight training for aeronautical engineering students at the University of Minnesota. The flight training course, according to the tentative plans, would be added to the recently established department of aeronautical engineering, and is planned to cover design, construction and operation of airplanes. According to Dean Leland, the course would be an elective, and not a requirement to the aeronautical engineering course. The instruction in flight would be given at the Minneapolis municipal airport. If the plans materialize Minnesota will be the first University to include a course of this nature in its curriculum.

The University has no funds to carry out this program, and has approached the Civic and Commerce Association of Minneapolis for assistance in securing about $7,000 for the purpose, according to J. S. Lincoln, secretary of the aviation committee of the association. It is believed that appropriations could be made for the course in future years, providing the training could be given this year.

Crump Gives Third Sigma Xi Lecture

The third of the scientific lectures sponsored by Sigma Xi was delivered by Professor C. C. Crump of the astronomy department. Dr. Crump traced the development of modern astronomy, beginning with the Polish astronomer, Copernicus, who was the first to proclaim that the earth moves. The advance was continued by Kepler, who stated the fundamental laws of planetary motion; by Galileo, who was the first to construct a telescope through which one "could see ships at sea after they had faded from sight;" and by Newton, who made the original reflecting telescope.

Parallax, commonly regarded as something to be avoided, is used as a basis for "plumbing the depths" of the universe; marvelously delicate instruments are used to measure this parallax of stars, which often is as small as a few tenths of a second; in such work, a single degree is a comparatively large unit. From such information one finds that there are very few stars closer to us than five hundred light years, a light year being the distance light travels in a year. The most distant object we know is a group of stars 140,000,000 light years away.

The brightness of the stars depends on their intrinsic brightness and the distance to them; in measuring the former, advantage is taken of the fact that calcium lines in the spectra lines of stars at high temperatures are weak while the strontium lines are strong.

Dr. Crump illustrated his lecture by a selection of lantern slides concerning the more unusual of the constellations.

Sixth Annual Architects' Banquet Held at Chalet

The Sixth Annual Architectural Engineers' Banquet was held Saturday, March first, at Glenwood Chalet. The event, as usual, was a stag, or as Professor R. T. Jones expressed it, "They were all ganders." Seventy-eight engineers and guests attended the dinner which was served at six-thirty. A program which followed included speeches by faculty members, music, skits by the students, and the performance of a magician. A humorous talk was given by Kenneth Cramsie, who represented the alumni.

The guests present were Professor F. M. Mann, Mr. D. J. Deneen, Professors J. A. Wise and J. I. Parcel, Mr. F. Lindsey, and Professor R. T. Jones, all of the college of Engineering. Each of these men was called on for a speech, the topic of which was given out for general discussion.

For the musical part of the program Jack Tews presented parodies on three popular numbers: "'Taint No Sin," "Bessie Couldn't Help It," and "If You Want It, You Got to Buy It Because I Ain't Givin' Nothin' Away." Reginald Ellefson also sang some solos and Dow Tinker officiated at the piano. Added amusement was given by George Laub in the form of a speech on "Sex," and by James McHugh and Milton Hoglund in a skit on Problem Judgment.

Lind and Tate Address Convocation

At the first scientific convocation of the year, Dr. S. C. Lind from chemistry and Dr. J. T. Tate of the physics department, presented their views on the nature of matter. Dr. Tate, speaking first, emphasized the point that the research physicist is driven on, not by mercenary motives, but rather by an impractical one, a desire to contribute to the world's knowledge—by a divine spark of intellectual curiosity. "Half the problem confronting the physicist," Dr. Tate declared, "is to determine the composition and the construction of matter; the other half is to discover the nature of radiation."

Dr. Lind, in his portion of the program, dated modern chemistry from the discovery of oxygen. He mentioned the contributions of several chemists since that time, especially in the fields of radioactivity and isotopes, physical chemistry, and the relation of electricity to matter. "The most important discovery since that of oxygen is that of radioactivity," Dr. Lind stated.

ABOUT THE WORLD WITH OUR ALUMNI

Architectural Engineering

'21—Milton L. Anderson, now in Los Angeles, has been visited by Albin R. Melander, '21.

'24—Emil Backstrom, who recently was awarded the LeBrun Traveling Scholarship, is somewhere in Europe.

'27—Porter W. Kilpatrick, who was St. Pat in 1927, is working for Theodore B. Wells, architect, in Grand Forks, North Dakota. He is also a part time instructor in freshman subjects at the University of North Dakota.

'27—Grace Cameron is with the firm of Stair and Andrew of New York City.

'28—Pang C. Loo sent the Architecture department a Christmas present of a box of candy. (It had to be kept a secret until all was consumed). Mr. Loo is now teaching at Tsing. Hua College, Peiping, China.

'29—Glanville Smith is back from a tour of the out-of-way places on the European continent.

'29—Dudley Bayliss, a recent winner of the Moorman Prize, is engaged to Rose Weston, '29Ed.

Silverman to Study in Paris

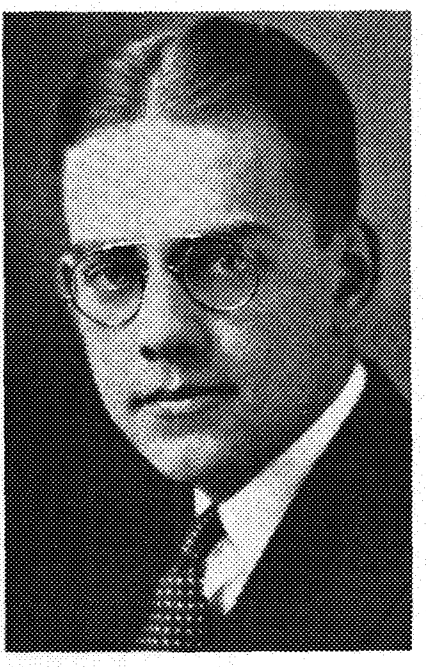
Invited by the French government to attend the Ecole des Beaux Arts, I. Woodner Silverman will sail sometime this month for Paris, France. Mr. Silverman is the first person to be elected to the Ecole des Beaux Arts without having actually won the Paris prize, a prize much sought after by architectural students.

With his election on February 8, Mr. Silverman may enter the first class of the School of Fine Arts of Paris as a guest of the French government. In the competition for the Paris prize, Mr. Silverman reached the final competition three times. In the final contest, which is limited to five men, he won second.

While attending the University of Minnesota, Mr. Silverman won several prizes, among them being the American Institute of Architects medal which is awarded to the student with the highest grade in his classes for the four-year period. After graduating from Minnesota, he accepted a scholarship at Harvard, where he continued his studies in architecture, finally taking his master's degree. While at Harvard he won several prizes, including the Sheldon fellowship, a prize of $1,500 for study and travel in Europe; and the Appleton fellowship, a $1,900 prize for the same purpose.

His invitation to come to Paris as a student followed his two years of study in Europe, during which time he attended the Madeline Defresse Atelier and the Ecole des Beaux Arts.

Mr. Silverman has worked in several architectural offices in Minneapolis, including the drafting rooms of Maguey and Tusler, and Hewitt and Brown. Recently he has been in the office of Norman bel Geddes, where he has been engaged in working on the illumination of the Chicago World's Fair.



Journeying through Canada's Rockies, along the western coast of that country, and finally arriving in Alaska, Carl M. Wise, '24, and Elmer E. Young, fine art instructor in the architecture department, recently visited that most northern portion of the United States. Spending several months in Alaska, the two men returned to their work shortly before the school year started. Mr. Young will describe their experiences in an article to appear in an early issue of the Techno-Log.

Mr. Wise was graduated from the University of Minnesota in 1924 with the degree of bachelor of interior decoration. He came here in 1920 from Lake City. After his graduation, Mr. Wise entered the employment of the W. A. French company of Minneapolis, where he remained until his appointment to the architecture department of the University of Minnesota on August 16, 1926. Mr. Wise was greatly interested in student activities and took part in them until his appointment as an assistant professor of architectural engineering at Iowa State University at Ames, Iowa. This position Mr. Wise accepted on his return from Alaska.

While on the campus as an instructor, Mr. Wise spent considerable time in student activities. He was especially interested in the work of the Arabs in which organization he had been an active member in his undergraduate days. He coached several productions including "Broadcast" and "High Pressure."

'29—Milton Melzian, last year's art editor of the Techno-Log, recently took unto himself a car and a wife and hied himself California-ward on a honeymoon. At present he is teaching at the University of Idaho at Moscow, Idaho. Mrs. Melzian was formerly Harriet Roberts.

'29—Glenn B. Youatt is now working for a contractor in Waupun, Wisconsin.

Chemical Engineering

'00—Gustav Bachman, a professor of pharmacy here, had charge of the program of Thursday, February 13, and Friday, February 14, of the Minnesota State Pharmacy association's convention at the Nicollet Hotel. The principal problem of the discussion was whether or not drug stores, pharmacies, and soda fountains would be incorporated into nation-wide chains. Professor Bachman, together with Rugnar Almin, an instructor, presented a discussion of prescription pricing.

'05—Francis C. Frary, director of research for the Aluminum Corporation of America, addressed a joint meeting of the New York sections of the American Chemical Society February 14, 1930, at the Chemists' Club in New York City. His lecture on "Present-Day Aspects of the Aluminum Industry" was illustrated with practical demonstrations of characteristics of aluminum and alloys. The remarkable properties of these metals recently obtained by new methods of heat treatment was especially stressed.

Mr. Frary was graduated from the University of Minnesota with the degree of Analytical Chemist in 1905. During his senior year he was a student assistant. Following his graduation, Mr. Frary studied for a year in Germany for the Aluminum Corporation of America. While there he patented an apparatus for electrolysis. The following year he returned here as an instructor, receiving his Ph.D. in 1912. After remaining a year as an assistant professor, he accepted a position with the Oldbury Electric company at Niagara. During the World War Mr. Frary served as a major in the Edgewood Arsenal receiving, after the armistice, his position as director of research for the Aluminum corporation. At present he is the national president of the American Electrochemical Society.

In the January lecture before the Philadelphia section of the American Chemical Society, Mr. Frary gave "A Bird's-Eye View of the Aluminum Industry." Steps by which aluminum metal is prepared from bauxite were discussed and the uses of the by-products, "red-mud" and monohydrate of aluminum, were indicated as heat insulating and dehydrating agents respectively. The American equivalent of duralumin (a copper-manganese-magnesium-alloy) finds use in airplanes and auto crankcase fabrication. When used in seaplanes, it is rolled with one side coated with aluminum to prevent corrosion. Other uses for the alloys are as shingles, cable, sheathing, base for nickel-chromium plating, and die cast pieces. Aluminum foil is used in coating oil tanks and underground pipe lines.

'09—Eva Dresser Alvas is waiting for the Minnesota-Stanford game. She wants to cheer again at a Minnesota football game. She now lives in San Francisco.

'29—Gust Erickson is working as a research assistant for a master's degree in chemical engineering at M. I. T.

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

Training for Leadership

MANY brilliant technically trained men fail to attain high executive rank because although they are specialists on engineering and similar problems, they fail in that they overlook the fact so ably expressed by Alexander Pope:

> "Know then thyself, presume not God to scan
> The proper study of mankind is Man."

They have become masters at handling machinery, materials, mechanics and mathematics, but they have not become masters at handling men.

A St. Paul corporation is loud in its cries for engineers who can co-operate and assist in organization; but they have no criticism to make of the scientific ability of the engineers they employ. Similar examples might be mentioned ad nauseam.

To quote C. E. Groesbeck, a graduate engineer who has developed into an all around executive of undoubted ability, and who speaks as a practical man, not merely as a theorist:

"One fact must never be forgotten. This, that the world of finance, while seeking the aid of the trained engineer, is looking for more than engineering knowledge, however profound. The men called to leadership in business and finance must have far more than technical equipment. They must have an appreciation of the springs of action of men and the power to direct and inspire them. The relations and interactions of men are a thousand times more complex than those of materials.

"This is strikingly exemplified among the large engineering and construction concerns of the country. Without proper administration and finance, these institutions cannot be successful. It follows that they must have capable business and financial leadership. Many of these posts are now filled by engineers. Where the engineering talent possessed of other requisites is available to fill these positions they should be so filled. But between a high-grade technical engineer without executive and business ability, and a high-grade executive without technical ability, the choice of an administrator, even for an engineering or construction organization, should fall to the latter."

When a position of monumental importance is to be filled, what qualities do boards of directors look for? The first test they apply to a man is, Has he the necessary ability? The second is, Does he know how to inspire loyalty and to handle men successfully? To fill these specifications, a man must be more than an expert engineer or an expert in production or an expert salesman. He must, as Mr. Groesbeck aptly expresses it, "have an appreciation of the springs of action of men and the power to direct and inspire them." In other words, "With all thy getting, get understanding."

If we only put the same zest into work that we put into play!

Industrial Research

IN the application of science to industry there are two problems which block the way to a closer co-ordination between the scientist and industry.

Scientific men protest against the slowness with which the industries assimilate laboratory results, and practical men protest the arrogant spirit with which scientific men have demanded that laboratory results be applied to industry, irrespective of the differences between the circumstances of industrial and laboratory work. To speak for the scientist it might be said that a large part of the more valuable results have to be obtained under laboratory conditions. Furthermore, for the greatest portion of them it cannot be known by what means they can be applied to industrial practice without making full-scale trials under industrial conditions. It must be admitted that the organizations for applying the results of research are much fewer than those for obtaining them, and most of those that have been established are not provided with sufficient resources to actually carry out their work on an adequate scale.

To speak for industry—the apparent remedy of providing full scale tests of laboratory experimentation is costly. Frequently this discloses the fact that the means for bridging the gap between experimental results and practical applications requires more capital than was originally required for the research work itself.

But, of what use is research to industry unless its findings be made practical? The results have proven time and again that there are enormous potential advantages to be obtained from research, and it may be hoped in view of recent surveys showing the benefits of research, that the difficulty of obtaining the essential larger sums may prove to be less than that of obtaining the resources required for organizing the research before such evidence was available.

A second need at the present time is to obtain an adequate supply of research workers. As an empirical result, the truth of which even now some people find difficult to believe and many more find still harder to understand, there is a remarkable correspondence between academic distinction, even in subjects remote from practical life, and efficiency in administrative work. Whether the academic training may have been a gymnastic that has developed students' abilities or whether the essential factors of administrative ability make those who possess them specially apt at academic gymnastics, experience has shown an astonishingly close correspondence between persons who excel in both.

The majority of engineering students who attain a good standard of scientific training pass into industrial life. This indeed is usually the object of their training. There can be little doubt, however, that those who so pass into industry must include a portion of the men who by temperament and ability would have been suited to become research workers of the type who might develop original conceptions and become pioneers in their subjects. At the present time, it cannot be doubted that the material prospects offered to men of this type, if they pursue their vocation for research, are much smaller, both in extent and in certainty, than those that are offered in administrative positions. Without doubt men with the vocation for research work are prepared to make some sacrifice in exchange for the means of being occupied in the work they like best. There are, however, limits to the sacrifice that can be expected of a man for such considerations, and these limits will restrict the supply of suitable men, all the more when, as at the present time, the assurance for continued employment is lacking. Doubtless, on the other hand, there are obvious difficulties in assuring continuity of employment on work in which no assurance can be given of continuous output. But in the later case, the individual is in a far better position to withstand the differences occasioned by irregular employment for he has been enabled to see the writing on the wall, and has taken the position with eyes and ears open.

These difficulties will be felt the more keenly in regard to those research workers who are wanted, not so much for their industry, accuracy, and even acuteness, all of which in some measure can be tested, as for their originality of thought, and their persistence in investigation—qualities that are more difficult to recognize and to measure in advance. Nevertheless, it is clear that as the application of scientific results to industrial purposes progresses, the need for a maintained supply of original workers must increase. The subject remains under the consideration of many eminent men of science and able teachers from all parts of the world. The difficulties admittedly are great, though they do not seem to be insuperable. In any case, it is clear, that for the assured maintenance of progress in scientific industry, it is indispensably necessary that they should be overcome.

Educators and executives must reach accord, must ascertain more accurately the underlying causes that have produced the existing difficulties. It is certainly a question of paramount importance and one that can not be settled by a superficial examination of cause and effect.

FACULTY SKETCH

CHARLES T. BOEHNLEIN

CHARLES T. BOEHNLEIN, assistant professor in Mathematics and Mechanics was born here in Minneapolis on September 1, 1893. His early life was spent in and around this city. He obtained his education here, attending West High School for three years and finishing his high school training at University High when that institution was still situated on Beacon Street.

The fall of 1913 Mr. Boehnlein entered the University of Minnesota registering in the College of Mechanical Engineering. He received his bachelor of science degree four years later. After graduation he obtained a position as aeronautical draftsman at Pensacola, Florida, where he spent almost a year. Becoming interested in aviation at the time of the World War, Mr. Boehnlein took advantage of the chance to become a pilot offered by the Government and enlisted in the Naval Air Service. He was sent to Massachusetts School of Technology for ground school training and remained there until the close of the war which came so shortly after his enlistment that he was not able to accumulate a great deal of flying experience.

Following the close of the war the Goverment began to discharge men as fast as possible since it was under an enormous expense to maintain such a large standing army. Of course, some were glad to go but others were not. The latter group included Mr. Boehnlein. Regardless of the fact that they wanted to remain until they "made their wings." Mr. Boehnlein and many others were relieved from active duty and forced to give up the anticipation of being a pilot from the time being at least.

Disappointed in that venture, Mr. Boehnlein returned to Minnesota and re-entered the University finishing his fifth year and receiving his master of arts degree. He accepted a position as instructor at the University in 1919 and not having given up the hope of flying yet, he took instruction at the local field and made his first flight sometime during the summer of that same year.

The year 1922 held two important incidents in the life of Mr. Boehnlein; he was married to Miss Luella Schultz on December 27, and it was during this year that he had his first class in aerodynamics, which subject he has been teaching ever since.

Desiring more knowledge on the subject of aerodynamics, Mr. Boehnlein went abroad in June, 1926 and attended the University of Goettingen for two semesters under Professor Prandtl, who has become internationally known because of his recent theories on air flow involving the source and sink principle. Mr. Boehnlein returned to this country in 1927 and continued teaching at the University.

Mr. Boehnlein has written several technical articles, among which are included his "Reactions of a Nozzle on a Flat Plane," which he wrote shortly before leaving for Germany. This paper was published in the A. S. M. E. Journal of 1927. His "Integration of the Theoretical Expression for Drag" appeared in a late issue of "Aviation."

For a hobby Mr. Boehnlein enjoys flying and belongs to one of the flying clubs of Minneapolis. He has recently been commissioned as a reserve officer in the U. S. Army.

Late Registration

IN a few weeks this quarter will have ended, and another, with its usual quota of late registration will be ushered in. As is customary, the usual facilities for taking care of the above will be provided in Room 106, Main Engineering building, under the supervision of Professor Herrick.

It has been our misfortune to be included among those in Room 106 every quarter. There are also some one hundred and fifty to two hundred other unfortunates in the same room. The general practice has been for each newcomer to write his name on the blackboard, and at frequent or rather infrequent intervals, five or more students were allowed to enter the inner sanctum. There another period of waiting generally ensued in which the student has nothing to do but shift his weight from one foot to the other, and gnaw feverishly on the worn end of a pencil in the hope that something, anything will happen and happen quickly.

The fly in the ointment, however lies in the fact that there are two types of students waiting to see Mr. Herrick.

There is the man who wants to see about a change in his program, and then there is the man who has paid his three-dollar late registration fee, been properly classified, and needs only to sign five or six pieces of yellow paper to complete his enrollment.

It is very obvious that the former student takes a very much longer time to transact his business than the latter.

It does not take a genius to perceive that the writer is of the latter type, and that he has had to wait from nine until five o'clock to complete an otherwise simple and routine transaction.

It seems only fair, that the students should be segregated according to their wants. This will not only result in a more expeditious handling of the matter, giving more time to Professor Herrick for advising on program changes, but will enable a greater number of students to be taken care of in a shorter time. In accordance with the present day cry for efficiency it is strange that the Administration has not seized upon this waste of time, to change loss to production.

As a parting suggestion the young man in Room 106, who checks names could very easily be utilized in taking care of giving out and taking in enrollment slips.

HOW TO GET A PATENT

By **RAY BELMONT WHITMAN**

NO class of people has done more for humanity than inventors. For the history of the world could easly be written in terms of its inventions, and the progress of every nation shown to depend largely upon its inventive genius.

Even during the present generation, inventors have practically revolutionized our lives. Most of us can remember the very start of the commercial progress of such inventions as the automobile, aeroplane, submarine, telegraph, telephone, phonograph, radio, and many popular improvements in labor-saving machines and merchandise, all of which enhance the pleasure and convenience of modern life.

The "Yankee ingenuity" of the American inventor has been responsible for a majority, at least, of all great inventions. Our Patent Office issues almost as many patents as all of the others combined. We have thousands of large industries founded originally on some of these patents.

The Fathers of our country were indeed wise men to encourage invention by putting into the Constitution, in 1790, that provision which now gives to the patentee of a new invention an exclusive monopoly to prevent others from making, using and selling it, for the first seventeen years after the issue of the patent, in return for its mere disclosure to the public and free use thereafter.

Our patent laws are the most liberal in the world. Nowhere else can a poor man with a good idea so easly acquire both fame and fortune as the result of protecting and marketing it.

There is now scarcely a town, village, or hamlet throughout our broad land but what has at least one prominent citizen living on Easy Street in a mansion purchased from the profits of a patented invention. In fact, some of our greatest fortunes have been made through the outright sale or royalty of these rights.

It has been well said that practically all of us are original enough to have conceived, sometime in our lives, at least one really valuable invention. The trouble usually is that we don't realize this, and therefore take no steps to patent and market it.

The information, advice, and working instructions which follow are the accepted methods of procedure and counsel followed by great corporation patent departments, by hundreds of reputable patent attorneys practicing throughout the country, and by many successful inventors, some of whom have become independently rich from such proper use of the patent monopoly.

The Real Nature of a Patent

In the beginning it is important to correct an almost universal misconception, which alone is responsible for many serious losses to the uninformed.

A patent does not, as many believe, give to its owner the right to make, use, and sell the invention. It merely gives the right to EXCLUDE OTHERS from making, using, and selling the invention as specifically covered in the claims of the patent.

The profession of a patent attorney holds out a very lucrative field for the engineering graduate since a knowledge of engineering is of, perhaps, even greater importance than a knowledge of law and since, moreover, law may be studied after an engineering degree to much better advantage than the reverse.

A knowledge of patents is important to all engineers, including those who intend to stay in the engineering profession, since the scientifically trained man is better able to get out important patentable improvements than is the layman, and some of our largest fortunes have been due to the income from the sale or license of such patents.

With this issue, therefore, we begin a series of articles on the subject by a well-known engineer-trained patent attorney of New York City, Mr. Ray Belmont Whitman. Mr. Whitman is a graduate of the University of Michigan, Class of 1913, and was for many years the Chief Patent Attorney and Consulting Engineer for one of America's largest corporations. He is now in private practice in New York City, and offers to advise our readers on any question in this field if they will address him in care of this magazine.

—Editor.

The inventor who has conceived an invention, *providing no one else has previously been granted a patent on it,* has already the right to make it, use it, or sell it as he chooses. This is his common law right! And everyone else, as well, has the same right! Our government, by enacting our patent laws, has sought to encourage invention by granting to every inventor who applies, an exclusive right for the first seventeen years to prevent others from making, using, or selling the invention claimed. If, however, this right has been previously granted to another on any part of the invention, then the later inventor is just as much estopped from using the previous invention as is the rest of the public.

Most inventors, and indeed many otherwise intelligent manufacturers and purchasers of patents, fail to grasp this situation. As a result, they proceed on the basis that the patent, having been granted by the government, gives them the right to *use* the invention. But as most patents are in the nature of improvements over older devices, it is frequently necessary for the inventor to employ also one or more of such older devices in order to make use of his own invention. And as it is sometimes happens that some such former device or method is already covered by a patent to a prior inventor, the later inventor then finds himself in the unfortunate position of not being able to use himself what he can prevent others from using!

This very important point should always be kept in mind when dealing with patents. Later, under the heading "Infringement Searches" it will be explained how to determine whether or not a patent owner has the right to use the invention without risk of infringing any such prior patents of others.

Who May Obtain a Patent

Our laws say that "any person" may obtain a patent in the United States. The person may be a foreigner or an American citizen, adult or minor, male or female, black or white, Jew or Gentile, a college graduate or educated in "the school of hard knocks." There are no exceptions. "Any person" means anybody and everybody who complies with the legal requirements.

The true inventor, if alive, must always sign the application for a patent. If any one else signs, the patent is invalid, and so of no value. There may be more than one inventor, in which case they are called "joint inventors," and each must sign the application papers as such. They then obtain a "joint patent." No one of them can obtain a patent for an invention jointly invented by all. Also, independent inventors of distinct and independent improvements in the same machine can not obtain a joint patent for their separate inventions.

When May a Patent Be Obtained, and on What?

Read the following paragraph carefully. It will answer many questions which are usually not understood.

"A patent may be obtained by any person who has *invented* any *new* and *useful* art, machine, manufacture, or composition of matter, or any new and use-

(Continued on page 196)

ABOUT THE WORLD WITH OUR ALUMNI

Civil Engineering

'24—Julian R. Garzon is living at 3240 Fremont Ave., Minneapolis. He is connected with a Minneapolis office equipment company.

'27—John E. Hoving is working for the Northern Pacific at Medoia, North Dakota. His work consists of drainage survey, bridge construction and channel stages.

'27—Floyd O. Borne and Russ Reidesel, assistant engineers for the Northern Pacific, are trying to replace bridge number 10 which washed out last June. This bridge, located near Glendive, Montana, was to be completed last fall but, when the connecting span was being lowered into place one of its supporting derricks slipped and the span lowered about eight inches, finally causing the second derrick to lose its hold. The span dropped into the river where it took the crew about five days to find it.

Electrical Engineering

'92—Edward P. Burch is now a consulting engineer and analyst with offices on the nineteenth floor of the Foshay Tower.

'01—Charles E. Tullar, according to the latest reports, is a grandfather. Congratulations. The last record of the TECHNO-LOG office has Mr. Tullar as the assistant manager for the patent department of the General Electric company at Schenectady, N. Y.

'06—Nathan Cohen is back in Washington, D. C., with the United States Patent Office as an assistant examiner.

'06—Otto B. Roepke says, "I visited the campus in July of this year ('29), and the reaction that continually stirred me was that I should have postponed my matriculation about twenty years. Wonderful progress, materially, has, and is being made. Let us hope the product is improved to the same degree."

'23—Harold W. Fischer is the proud father of a baby. They are living in Minneapolis at 4210 Dupont Ave.

'24—M. A. Anderson is studying special valuation of public utilities for the Northern States Power company. Anderson, a cost engineer for that company in Minneapolis, will be located in Chicago for about six months.

'25—Charles J. Cosandey has a daughter, Katherine Marie, who was born April 19, 1929. Mr. Cosandey is an instructor in the Duluth Junior College at Duluth, Minnesota.

'26—H. W. Lostrom was recently transferred from the western division of the Northern Pacific railway, and is now attached to the mechanical department of the St. Paul offices.

'27—A. J. Bezek is in Chicago in the manufacturing division of the Western Electric company. H. Barrett Rogers is also in Chicago with the same company. He is in the standards and planning division.

'27—A. Redding has moved his family of four to Omaha for the present where he has charge of the installation of several substations for the street railway system of that city. John, who is in the contract service organization of General Electric, has his headquarters in the Chicago office.

'27—H. A. Norberg is in Philadelphia with the department training plan of the General Electric company.

'27—Reynold O. Hortberg recently spent a short time vacationing in and about the Twin Cities, and visiting friends and relatives hereabouts. When on the job, he is engaged in the Distribution Division of the Commonwealth Edison company in Chicago. Ray maintains his residence at 7377 No. Damen avenue in that city.

> Max Latshaw, a member of the research staff of the Shell Development company, Emeryville, California, and a former member of the School of Chemistry staff, died January 23, 1930, at Berkeley, California.
>
> Mr. Latshaw, who was born in Pennsylvania in 1893, was graduated with a bachelor's degree from Stanford University in 1916. In 1924 he received his Ph.D. at Johns Hopkins. After his discharge from the army at the close of the war, he spent several years at the University of Minnesota. Before becoming connected with the Shell Development company, Mr. Latshaw was with the Silica Gel corporation of Curtis Bay, Maryland.
>
> Mr. Latshaw was recently described as being "a painstaking, accurate worker in the laboratory and equally reliable in his outside relations." He is survived by Mrs. Mabel W. Latshaw at Pasadena, Maryland.

'28—Glendon C. (Maj. Hoople) Brown paid a visit to the old haunts of his undergraduate days over the week-end of Washington's birthday. While in Minneapolis, he enjoyed the hospitality of an aunt living here, and was otherwise kept well in hand by his two sisters, who are now freshman students at the University.

After his graduation, "Glen" took the student test course given by the Cutler-Hammer manufacturing company, and is now on "regular" in the department engaged in vacuum tube development for control apparatus. He resides at 101 13th street in Milwaukee.

'29—Maurice Larson, having been graduated from the student course of Cutler-Hammer at Milwaukee, is now located in the experimental department. He is still in Milwaukee.

'29—J. C. Borden is now in the sales department of Cutler-Hammer. John always said he wanted to sell something, and now he has got his chance.

Mechanical Engineering

'18—Harold R. Peterson is returning to the Twin Cities for the Northern Pacific railroad. Harold, after several months in one of the company's hospitals at Missoula, Montana, is taking an indoor job in preference to his former one in the field.

'23—C. R. Marshall is co-author of an article, "Cinders—A Useful By-Product of the Power Plant," which appeared in an issue of Byllesby Management. The article explained how the Northern States Power company co-operates with the street departments of the Twin Cities by giving them their by-product cinders for use on slippery streets and sidewalks.

'26—Carl R. Liese, mine foreman for the Anglo-Chilean Consolidated Nitrate corporation, Casilla 17, Tocopilla, Chile, South America, has something else besides his address in a recent letter to the TECHNO-LOG. He says, "Left New York on August 29, 1929. On the way down I spent a day in Havana, Cuba; three hours at Cristobal; went through the Panama Canal; and spent six more hours at Balboa and Panama City. In one of the streets of Panama City I met F. V. Sullivan, '26. Besides spending thirty-six hours at Callao and Lima, Peru, we stopped for a short time at Salaverry, Talara, and Mollendo. Another place we visited was Arica where Pershing and the American delegation tried to patch up differences between Chile, Peru and Bolivia. After a short stay at Iquiqui we finally arrived at Tocopilla on September 15.

"We are now approximately forty miles inland and forty-five hundred feet up between the Coastal Range and the Andes. We live in a modern American camp containing 400 'gringos,' 12,000 Chileans, an American club, tennis courts, swimming pool, golf course, no trees, no grass, no rain, no snow, warm days and cool nights. The work done is the mining of caliche for sodium nitrate. I am here on a three-year contract. Am still single and there are no other Minnesota men here, but all the states and many nations are well represented.

"Perhaps my worst experience was trying to locate a comfort station in Lima without knowing the term and unable to speak Espanol. We saw two very different kinds of scenery on our way down. The best was that at Havana, Cuba; the worst, along the west coast of South America from Equador to Tocopilla. Crossing the equator and subsequent initiation into the 'Order of the Bath' as a subject of King Neptune was undoubtedly the most exciting happening on our way down here. Of course, our biggest thrill is the weekly mail from the States."

As a subnote Carl adds, "The worst smell I've ever smelt is that of the Guano bird deposits, especially near Arica. A new office larger than the present one, is to be opened near here soon. Its address will be the Anglo-Chilean Consolidated Nitrate corporation, 120 Broadway, New York

NEWS FROM THE TECHNICAL CAMPUS

(Continued from page 186)

FREDERICK M. MANN, head of the department of architecture, will leave about April first for a six months' tour of Europe. Professor Mann is making the trip for the purpose of collecting more material for his lectures on the history of architecture. He intends to visit the historic spots of Europe, inspecting materials and construction of European architecture, and will spend much of his time sketching and taking photographs.

Since this will be Professor Mann's third trip abroad, he has formulated definite plans on the places he wishes to visit and what he wants to see. He will start his travels in western France, going from there through the Loire River district to southern France, studying in these regions the Romanesque architecture of the eleventh and twelfth centuries. Leaving France, he will go into Italy, where he expects to find some picturesque, secluded spot on the Italian Riviera, where he will stop for a month to study and sketch. The next two weeks he will spend in and about Rome, studying especially the recent excavations under the Mussolini regime. He hopes to visit Naples and Pompei as well, to study the excavations which have been made in late years. In Paestum, in southern Italy, he will study the ruins of the Greek Basilica and the Temple of Poseidon. Then returning through Italy, he will stop only at places of major architectural importance, and from there make his way up into eastern France. Paris, and the surrounding territory, Isle de France, will hold his attention for several weeks. Isle de France is the center of Gothic development.

"There is a wonderful opportunity for photography in the well preserved Gothic churches and cathedrals. Commercial photographers focus their cameras on spots of beauty and pleasing compositions," said Professor Mann, "but these do not always illustrate the points of interest to the architect."

In Paris Professor Mann plans to spend considerable time studying in the libraries. Ecole des Beaux Arts of Paris, the leading school of architecture in the world, is where he plans to study the character of student work. In this work, according to Professor Mann, there has been quite a radical change in "architectural thinking" the last few years—modern architecture being based more on logic than on tradition.

England, which is next in his itinerary, he will spend some time in London, Oxford, and Cambridge, and some of the other major cathedral towns. In London, the mecca for students, is the Library of the British Museum.

"The average American," said Professor Mann, "covers Europe too hurriedly and so becomes too tired to appreciate what he is seeing. One must be at his best all the time if he is to get the most out of touring and sightseeing, and one of the best ways, I find, of resting is to sit down and leisurely sketch some object or scene of interest." As a result of some of his former travels, Professor Mann has quite a collection of water colors and sketches.

For photographic equipment, Professor Mann is taking two cameras. One of these takes a picture the size used in slides for the standard projector. These he will be able to use in his classes, because history courses in the School of Architecture consist almost wholly of illustrated lectures. The department now has about 2,000 slides, but these do not properly illustrate a great many subjects. The major purpose of the trip will be to improve this collection. The other camera which will be included in his equipment will take 50 exposures on one film. The picture is small, being the size of a moving picture film, but the camera has all the necessary adjustments in time, light, and focus, to make a negative which can be enlarged to any size. The camera itself is not much larger than the ordinary vest pocket size. This feature, according to Professor Mann, offers a distinct advantage since anyone carrying a large bulky camera about attracts attention, is immediately spotted as a tourist, and is treated as such by the natives. The school now has a special machine which will project these small prints on a screen for study by the history classes.

Professor Mann has appointed Professor Ray Childs Jones, of the department of architectural design, to take charge of the School of Architecture during his absence. Professor Jones will also take Mr. Mann's position as advisory architect for the buildings and grounds department. Charles R. Hamlen, graduate of Harvard University, will teach architectural history of the Middle Ages during Professor Mann's absence. Mr. Hamlen has had work under George H. Edgell, head of the graduate school in architecture of Harvard, and is prominent in the fields of history and archeology. Mr. Donald C. Heath, instructor in architecture, will teach the other course in history. Miss Esther Hargrave, instructor in architecture, will be in charge of Professor Mann's summer school course. Business relations outside of school will be attended to by Louis B. Bersback, architect, in Minneapolis.

Francis Mullen Named St. Patrick for 1930

In the recent Engineer's Day elections, Francis Mullen, senior in the College of Architecture was elected St. Patrick and Harland Harman, junior electrical, was chosen chairman of general arrangements.

The election for St. Pat was made by seniors in the College of Engineering and Architecture. Other candidates who filed for the honor are: William Thompson, electrical; Henry Conner, mechanical; Edwin Wilson, electrical; and Hubert Tierney, chemical. Mr. Mullen by winning the election will act as king of the engineers in their celebration on May 16.

The queen of the day will be chosen by St. Pat sometime before the ceremonies. After leading the parade on horseback, the reigning monarchs will knight the graduating engineers as they kiss the Blarney stone. On this day devoted to the patron saint of all engineers, the entire campus is turned over to the engineers.

Other men who ran for chairman of the day are: Arthur Garvey, chemical, and Loren Nichols, architecture.

Francis Mullen, the St. Pat for the year 1930 has been very active in extra-curricular activities on the campus. He is a member of the All-University council, a member of the Technical commission, head of the intra-mural sports in the College of Engineering, and chairman of the M banquet in 1929.

HOW TO GET A PATENT

(Continued from page 190)

ful improvement thereof. But it must not have been known or used by others in this country before his invention and not patented or described in any printed publication in this or any foreign country before his invention, or more than two years prior to his application. And it must not have been patented in a country foreign to the United States on an application filed by him or his legal representatives or assigns more than twelve months before his application, and not in public use or on sale in the United States for more than two years prior to his application, unless the same is proved to have been abandoned."

To be patentable, then, the idea must be "new." Of that, more later. Also, it must have been "invented"—that is, conceived by the inventor through exercise of the creative faculty, and not merely by imitation. Again, the idea must be "useful"—that is, applied to the production of a practical result. There is an exception to this last statement in "design" patents, which cover merely the aesthetic appearance or ornamentation of the article, and are not directed to a practical or "useful" function.

Now having found out just what a patent is, let us next consider, generally, the kind that fail and those that succeed.

Patent Failures

In the beginning, it must be admitted that the majority of patents issued to inventors, week in and week out, do not return to them even the cost of taking out these patents, not to mention the time and expense of developing the ideas to the point of filing the applications in Washington. There are many reasons for this unfortunate condition, some of which it is my purpose to explain, and to suggest means of correcting or largely eliminating. Other reasons exist which cannot be removed, and so they will be clearly pointed out, in the hope that many of these useless patents may in the future be eliminated.

Patent Successes

In spite of the many patent failures, it is nevertheless true that for every ten of then that result in a loss to the inventor, there is one, or possibly two, that returns a profit so great as to many times wipe out the combined loss from the failures, and leave a handsome surplus besides.

Newspaper accounts frequently attest to the more sensational of these successes. Only recently there was the report of a check for a million dollars having been drawn in favor of a Russian immigrant boy for his patent rights on an automatic photograph apparatus. A few years ago Major Armstrong, who invented the regenerative circuit for radio receivers, is said to have received for his patent rights a half million dollars from several large electrical companies. In this author's more recent personal experience, one inventor of a non-set automatic stop for phonographs was paid $125,000 in royalties by one large phonograph company, in less than three years, and for rights secondary to their own. During a recent investigation of the alien-owned patents taken over by the government in the name of the Chemical Foundation, it was revealed that a large camera company had long been paying one hundred thousand dollars a month in royalties for the use of a small group of German-owned patents.

> *In our next issue, Mr. Whitman will explain how to find a reliable patent attorney, and how to avoid the other kind; he will also explain about the patentability search, take up the proper cost of a patent, the writing of claims, drawings, etc.*

These only typify a few of many instances; for there are thousands of cases where the cash rewards from patented inventions have meant financial independence for their inventors and promoters.

But the inventor who seeks to profit under the patent laws must know *what to invent*, and also *what NOT to invent*. This is a very large question, but a little general advice will prove of value.

What to Invent and What Not to Invent

The inventor has the best chances of success who confines his inventive efforts to a field, or industry, about which he knows something; such, for instance, as the one in which he earns his livelihood. Many of the patent failures are due to the fact, as someone has facetiously remarked, that "the Iowa farmer attempts to invent a new form of submarine or the Cape Cod fisherman, a new threshing machine!"

Again, invent something in line with your mental capabilities and your financial station in life. For instance, if you are an average citizen without too much money or technical knowledge, don't try to invent anything too complicated, such as a new form of gas-turbine to drive an automobile; for the experimental work and the cost of the first model necessary to determine the practicability of such highly technical machines, runs into tens of thousands of dollars, and this burden must often first be shouldered by the inventor before he can hope to get anyone to finance him further. A well-to-do technician, such as John Hays Hammond, Jr., might well attack such a problem, but not a poor inventor.

Incidentally, this very condition is often the salvation of the poor inventor, since it forces him to invent in those more simple fields, where perhaps most of the great fortunes have been made in invention.

Speaking about the profits from simple inventions recalls the case of the Cedar Rapids, Iowa, inventor of Eskimo Pie, who is said to have realized a royalty of as much as $35,000 a week from merely putting a coating of chocolate on a piece of ice-cream. Then there was the shoe cobbler of Elyria, Ohio, with a fortune in seven figures, made in a few years, according to sworn testimony in court, from a rubber heel.

The cost of patenting and perfecting a similar invention is usually so little that any poor man can afford the risk, whereas with complicated and more technical conceptions, large sums must invariably be spent before even being able to determine if the subject-matter of the invention is of a useful or money-making character.

The Evidence of Conception

Having now conceived an idea which the inventor feels is valuable enough to go further with, he should, as the next step, protect himself against any one else, either unscrupulously or accidentally, proving priority of invention and the right to a patent. One way to do this is to prepare what is known as an "evidence of conception." The inventor writes a detailed description of the complete invention in his own words, on a typewriter or with pen and ink; and makes also any necessary rough sketches to illustrate the invention (unless it be a chemical process or like invention where this is impossible). On the last page he affixes his name and the date, either in the presence of two witnesses, preferably persons outside his family, or better, before a Notary Public, who will attest his signature as of that date, and affix the notary seal. This original document should always thereafter be retained by the inventor with other valuable papers. If it has been prepared on the typewriter, which is preferable, a carbon copy should be made and used to submit the invention to his attorney later.

By this simple means, the inventor is

(Continued on page 210)

NEWS FROM THE TECHNICAL CAMPUS

Todd Addresses Local Radio Engineer Group

The Dunwoody Industrial Institute was the scene of a lecture given on March the third by Professor M. E. Todd of the electrical engineering department of the University of Minnesota. The topic upon which he chose to speak was the application of electrical measuring instruments to radio testing and trouble shooting. Although the lecture was given primarily for radio engineers, it was attended by Dunwoody night school men enrolled in various branches of electrical work.

Professor Todd approached his subject by enumerating the types of measuring instruments, and discussed those most commonly used, the most important of which is the magnetic type, which involves the magnetic voltmeter and ammeter. Among the remaining classes the speaker listed the electro-chemical, electro-static, and ionization instruments, and also those which rely upon heating effects for their results. The entire group was outlined under the following headings: constituents, actuating force, controlling force, measures, and also gave a bit of history in connection with each machine, including the discoverer and date of discovery. Taking the electro-magnetic as the most important type, Professor Todd listed these under the following heads: direct-current, A. C. moderate frequency, and A. C. high frequency. Included in the direct-current machines were the milli-voltmeter and the milli-ammeter. The different varieties of shunts used with milli-ammeters were given in three classes; the series dependent, independent, and single, while the only voltmeter discussed was the series multiple. Under the heading of A. C. instruments, the magnetic vane principle was explained and demonstrated with miniature models. The dynamometer and thermo-couple type were also taken up and illustrated with working models. The methods of changing the ranges of the various instruments as well as the process of adding scales was also thoroughly discussed.

The lecture was followed by an informal discussion in which the members of the audience were permitted to present their views or to ask whatever questions they had in mind. All of the above material was well illustrated by means of working models and a large variety of slides.

Poore to Play in T. C. Handball Tournament

John Poore, E. '32, 1929 all-University handball champion will represent the University of Minnesota in the student competition at the Twin City handball tournament, which will be held at the Minneapolis Y. M. C. A., March 10 to 15, inclusive.

Otis C. McCreery, assistant dean of student affairs, is one of the men who will represent the faculty in the competition. Another faculty man who will enter, is M. Scherberg, of the mathematics and mechanics department in the College of Engineering.

Chemists Go on Trip

The senior class in chemical engineering will go on their annual inspection trip of northwest industrial plants, starting March 19.

The itinerary will cover plants in Appleton and Milwaukee, Wisconsin, Chicago, Illinois, and nearby towns. In all, about 20 plants will be visited by the 30 students and three instructors, who will make the trip. The group will return March 29.


TIME
TIME

MILITARY SCIENCE FOR ENGINEERS

(Continued from page 184)

to when or where it will next appear. It is quite right to say that wars seem to result from economic conditions due to disparities in national populations and wealths; but it is quite as true to assert that wars result from the ambition of men to subdue and govern and civilize their fellows. Truly the causes of war remain such a complex of economics and human emotions that no man has yet succeeded in making them clear. Perhaps war, in the final analysis, can be ascribed only to a blind chance or inscrutable fact which hurls men together just as it does stars and atoms. Whatever the causes may be, of the past and present existence of war we are as certain as we are of the tremendous part it has played in the affairs of men. Is it not ridiculous, then, to neglect all preparation to meet it? Is it not ridiculous to ignore it, to imagine that by ignoring an unpleasant possibility we can prevent the possibility from becoming a fact? To the man in college military science is the one subject which does give him, more or less directly, some actual evidence of war, does tie him up, to some extent at least, to the reality and possibility of the thing.

Undoubtedly the opposition of so many earnest and honest people to anything of a military nature, such as drilling and the wearing of uniforms, is due to a fear that it may lead to an excessive and costly feeling of nationality. But there is a sane course to pursue, and certainly there is nothing about military science as it is presented at the university which would incite a man to undue flag waving. Rather, if a man has any thought at all of why he drills, why there should be any consideration of such a thing as national defense, he must arrive at some realization of the contacts of this country with others, of the problems confronting this nation in its foreign relations, and of his own part in the national procedure. It is very likely that this will arouse in him some feeling of nationality, some wish to bring his own nation safely and creditably to equality with others. But that is desirable. Indeed it is in the effort of men to carry their nation forward that lies the urge to individual accomplishment properly tempered and guided by a thought for the universal good. Certainly the man who shows some willingness to study the nation's problems and meet them is he who has some inclination to accommodate his own peculiar preferences and crotchets to the general end. Perhaps it will be better when men, instead of thinking of these national objects, dedicate themselves to world objects. That time is not here, however, and if it ever comes it will only come when all nations are convinced that their neighbors are so capable of resistance, so capable in *national defense*, that there is far greater profit in living in amity than in conflict with them.

There remains the objection frequently heard that, granting the need of preparation for national defense, military science is of no use because of student indifference to it. To that it can be said there is not a subject taught in the university that a certain proportion of students are not indifferent to. And all such indifference is largely due to the same thing: a lack of comprehension of the value of such subjects to the man who is being offered them and declines. Military science does suffer in this respect. But this, too, is also true: that the value to the student of a course in military science is far from lying entirely in whatever data it may present. The greater value of military training is in what it suggests: it is one subject in modern college education that brings home to the student in a concrete way the fact that he owes something of service to the community and nation, and that the time may come when there must be a rendering of the bill. In putting the most indifferent student to the inconvenience of lugging a gun about for a few hours each week military training does, to some degree at least, impress upon that student's consciousness the fact that his education does not leave him entirely without obligation to others. There are some men who are impressed only as they are annoyed; so that even for them the purely physical process of picking up feet and planting them elsewhere with ordered celerity and precision at certain periods of drill is not entirely wasted. Those men who comprehend the necessity of drill will also comprehend that the intelligent thing is to feel annoyance and dislike, not for drill, but for those unsettled world conditions that justify drill. With this realization a student of any sanity must take drill with a considerable degree of interest even if with no particular love.

In concluding this article and looking back over it I find it contains considerably more mention of war than I had realized. Yet if we are to go to the bottom of things we cannot escape speaking of war when we consider the why and the wherefore of military science in the university. If one is optimist enough to believe that the day will come when injustice, crime, suffering, war will not be found on earth, his opinion should be respected, and certainly his efforts in attaining that which he foresees should be encouraged. But that day is not here yet. And it does no good to say it is—nor to think that war can be prevented by ridiculing the possibility of it. I imagine this last strange belief lies at the bottom of much of the wit that flows forth in print and otherwise concerning military science, the men who take the subject and the men who teach it. Probably no one is so profoundly ignorant of the history, causes, results and psychology of war as he who can be funny at the expense of what is being done to meet a possible visitation of it.

This Man  *who calls on you*

YOU like his quiet enthusiasm, but you like even more his complete and competent answers to your questions. And you admire his assurance in making equipment recommendations, in detailing performance characteristics, in quoting prices and deliveries, because he quite evidently *knows* his subject.

What is his authority so thoroughly to commit his house? What is the basis of his positive knowledge? Just this . . . he is a Worthington post-graduate.

He and his colleagues, in Worthington engineering, production and sales, were recruited from the graduates of representative technical schools. They doffed their caps and gowns for overalls, laid down their sheepskins for machinists' tools, and gladly spent many months in the Worthington plants at Harrison, Holyoke, Buffalo and Cincinnati. They took a thorough post-graduate course in Worthington Engineering. When they finished, they were Worthington men in fact as well as in name. It is significant that 76 out of every hundred of these candidates become permanent Worthington representatives.

* * *

. . . And it is important to you that the Worthington organization is inbued throughout with a spirit of precise engineering information, supplemented by a practical knowledge of exactly what Worthington products signify and what they are built to accomplish.

WORTHINGTON PRODUCTS

PUMPS
COMPRESSORS
CONDENSERS and Auxiliaries
DIESEL *and* GAS ENGINES
FEEDWATER HEATERS
WATER, OIL *and* GASOLINE METERS

Literature on Request

WORTHINGTON PUMP AND MACHINERY CORPORATION

Works: Harrison, N. J. Cincinnati, Ohio Buffalo, N. Y. Holyoke, Mass.

Executive Offices: 2 Park Avenue, New York, N. Y.

GENERAL OFFICES: HARRISON, N. J.

District Sales Offices:

ATLANTA, BOSTON, BUFFALO, CHICAGO, CINCINNATI, CLEVELAND, DALLAS, DENVER, DETROIT, EL PASO, HOUSTON, KANSAS CITY, LOS ANGELES, NEW ORLEANS, NEW YORK, PHILADELPHIA, PITTSBURGH, ST. LOUIS, ST. PAUL, SALT LAKE CITY, SAN FRANCISCO, SEATTLE, TULSA, WASHINGTON

Branch Offices or Representatives in Principal Cities of all Foreign Countries

WORTHINGTON

ABOUT THE WORLD WITH OUR ALUMNI

Chemical Engineering

'20—Dr. A. N. Parrett left the employ of the E. I. Dupont company and is now connected with the A. O. Smith company of Milwaukee, Wisconsin. Dr. Parrett recently visited the Chemical Engineering department for the purpose of interesting graduating students in employment with his company.

'21, '24—Ruth E. Elmquist is still located in Washington, D. C. Research work in the textile division of the Bureau of Home Economics is demanding her attention at present.

'27—W. Ohlweiler, who was formerly connected with Du Pont and later with the Universal Oil company, has been manufacturing soft drinks this last year in Rock Island, Illinois.

'29—L. P. Moore is doing research work for the Pulp and Paper Institute at McGill University under Professor Hibbert.

'29—W. Straub is a chemical engineer at the soda and alkali plant of the Pittsburg Plate Glass company at Barberton, Ohio.

'29—C. M. Linden and K. K. Kurtz are doing chemical research work for the Hercules Powder company at Kenvil, N. J.

'29—Clifford T. (Pat) Butler writes from Pennsylvania that "my duties are to analyze nitroglycerine, dynamite and dopes. The work is neither hard nor tiresome. I work from 7:30 till 4 with an hour out for lunch. I usually find an hour or two each day to spread the bull so I rather enjoy the work." During the winter Pat blossomed out as a basketball referee and also took part in a home talent play.

'29—George Holm was recently called from his work in Washington, D. C., by the death of his father.

'29—B. M. Berzelius is now in Sweden working for the Insulite company.

Mechanical Engineering

The city government of greater Shanghai is going to remodel Shanghai and Dayu Doon, '24, is going to help them do it. Dayu Doon is to be adviser of a city planning commission formed by the city.

Mr. Doon was graduated from Minnesota in '24 and received his master's degree here in the following year. He is now architectural adviser to the city planning bureau of Nankin. He was formerly with H. K. Murphy of New York City.

The commission has chosen the Kiangwan district, which is conveniently located between Woosung and the International Settlement, for this project.

According to the plan as made by Mr. Doon and his committeemen, the city will be centered on a civic center formed by the intersection of two avenues around which the streets will be built in a circular shape. The mayor's office, which is to be flanked by the other public buildings, will be in the center of the square formed by the intersection of these two axial avenues.

Shanghai's greatest asset, the Hoangho river, will be developed by improving the harbor facilities and building drives along its banks.

Modification of the existing railroad lines will improve their effectiveness. The city will also build an airport.

'26—Harold E. Rollin is working for the Pioneer Gravel Equipment company of Minneapolis as chief draftsman. Harold, who was formerly with the Proctor and Gamble company, has two other mechanical engineering graduates working under him. They are Donald Young, '29, and Dimon A. Roberts, '27.

'26—Clifford S. Nyvall, who is treasurer of P. J. Nyvall and Sons, Minneapolis contractors, recently married Lorraine C. Peterson, a graduate of '30. They are living in the Cliffwood Apartments which Mr. Nyvall built after finishing school.

Electrical Engineering

'21—Ralph W. Liddle is now editor of the Edison Round Table, published by and for the employees of the Commonwealth Edison company. The magazine appears twice a month.

It is interesting to know that Liddle started in the utility business while still a youngster. His father ran the local power and light plant in the small Dakota village where he was born. The whirr of the dynamos and the glitter of new copper wire fascinated him and so he studied engineering and business at the University.

'23, '25—Clifford L. Sampson is a transmission engineer in the chief engineer's office of the Iowa area of the Northwest Bell Telephone company at Des Moines, Iowa. Clif has been in charge of a transmission school for telephone engineers held in Minneapolis during the past year.

'23—James P. Johnson is a commercial engineer for the Northwest Bell Telephone company in Minneapolis. Jim was employed as district commercial engineer at Davenport, Iowa, for some time after he left Omaha. At present he lives at 1535 East River Terrace, Minneapolis.

'27—G. C. Hawkins has accepted a position with the Department of Commerce at Washington. Incidentally he is chief cook and bottle washer for Don Stevens.

'28—Glendon Brown is quite comfortably located in Milwaukee where he is working on tube development for Cutler-Hammer. He and another "Tau Bete" from Wisconsin have rented an apartment and are cooking their own meals. Glen expects to either hire a cook or a doctor soon.

'27—C. H. (Chuck) Burmeister, former campus politician and past president of the senior engineers, was a recent visitor in Minneapolis. Since his graduation, he has been affiliated with Redwood Falls Light & Power company of Redwood Falls, Minnesota.

ONE WORD MORE

(Continued from page 181)

Mathematics then challenges the best within us, our greatness and our perseverance. Are we imaginative? She strains the subtlest fancy of men to understand and appreciate her gifts. Are we adventurous? Columbus and Balboa did all their discovering in a three-dimensional world. Mathematics opens infinities of hyperspace. Do we crave mysteries? No Sherlock Holmes, no Philo Vance, moves more certainly and irresistibly toward a logical and true conclusion than does the mathematician solve the world's problems so utterly baffling to the untrained man. Only as mathematicians do we rise above whimpering beasts and make a habitat secure from torrid heat and arctic cold, from famine and disease, from human vice and social decay.

Nor is this the end to this question of mathematics. If art be creative, adequate self-expression of the entire man—and the by-product of art be beauty—mathematics supplies not only a medium for the soul but leaves a reflexive impress upon the personality. It is the marvel and glory of human living that nothing stops with its original and primitive use but is transfigured with meanings into spiritual splendor. Language originated as grunts of alarm, smacking of greasy lips over food, and growls of anger. Yet behold what lengths it reaches in verse, in textbooks and comic supplements! Food has become how much more than mere fuel for the body-engines: soft-drinks are indispensable in courtship and luncheon clubs are business institutions. Even sex functions less and less for the propagation of species. Likewise mathematics has long ceased to confine itself to counting and mensuration. Its present importance rests more with its service as animal training.

There was a time when Pharaoh could announce "I am God" and centuries later Roman emperors received divine honors even during their lives. Not so long ago the Stuarts reigned by the grace of God and "divine right" figured as late as the World War. But an Archimedes, a Kepler, and a Clerk-Maxwell have changed all that. The sons of heaven find themselves mere fungi of the surface scum as earth simmers into silence. And yet the instrument of our humbling is also the beginning of wisdom and deliverance. Our animal rages, cunning, and lusts have made bloody chronicles and fascinating literature from time immemorial. Only the wicked have loomed large in history, novel and on the stage. The classics of all times have centered in murder, theft, and rape. From Helen of Troy to Peggy Joyce, from the Borgias to Dr. Fu Manchu, the notables have been they who slipped a fast one past the psychic censor. Yet all this exercise of human passions has but demonstrated their futility. And mathematics shows us a more excellent way.

Ignorance, self-deception, and carelessness here are rebuked. And neither prayers nor prejudice avail to get the answer. Only as we imitate the universal mind do we obtain valid results. There used to be a lot of poppycock written about formal discipline. But the real discipline of mathematics has been overlooked. It takes a lazy, shiftless, lying human mind and instills habits of perseverance, of attention to detail, of truthfulness and explicitness until it becomes by that miracle the beginning of an engineer.

* *

Then there was the civil engineer who hung up his stocking last Christmas and all he got was a notice from the Health Department.

BAILEY METERS

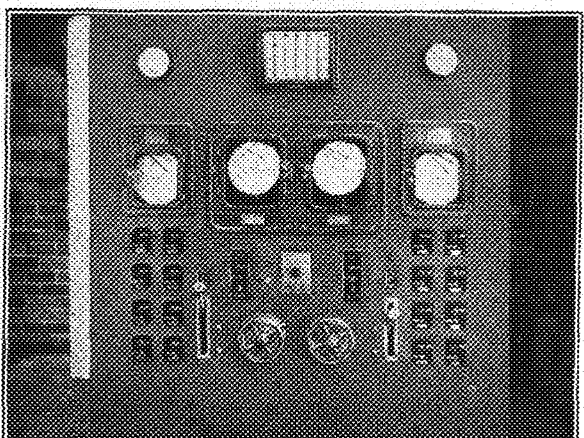
Serving Public Utilities

THE leading public service companies and industrial steam generating plants throughout the country use Bailey Meters because they are essential to the well-organized plant—the plant that accounts for its heat units as carefully as for its dollars.

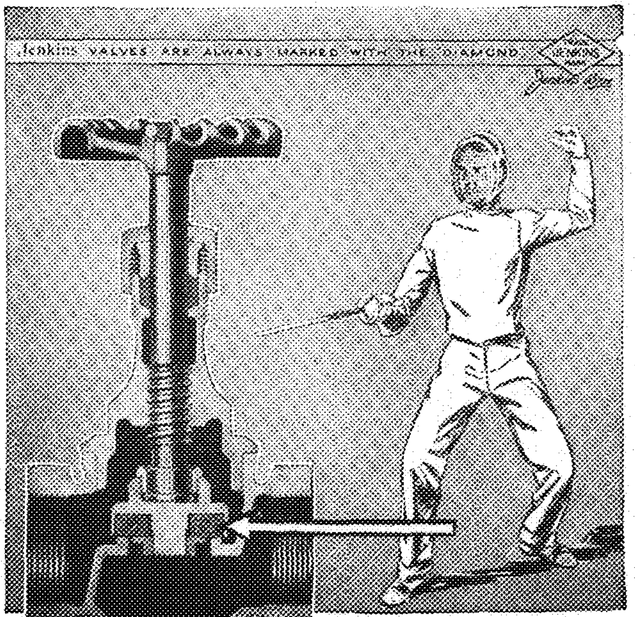
The high standards of efficiency that prevail in these modern power stations reflect the profitable operating economy assured by Bailey Meter Control.

Bailey Meters keep complete account of all important operating conditions. By their use, you can determine the fuel and stack losses, as well as check the fuel, steam and water consumption. These meters enable the operators to locate and determine the magnitude of the losses so they may be reduced to a minimum and the final results thereby improved. Bulletin No. 81B entitled, "The Heat Balance in Steam Power Plants" will show you how this can be done. Write for a free copy.

Bailey Meter Co.
Cleveland, Ohio



Bailey Meters on a Pulverized Coal Fired Boiler



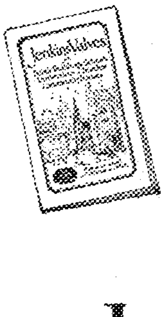
Sectional view, Fig. 106 Jenkins Standard Bronze Globe Valve. Arrow indicates renewable, resilient disc.

On guard!

A skillful fencer with a good blade presents an ever alert guard to every thrust of an adversary. It's the combination of expert fencer and good blade that wins.

Another winning combination . . . a combination that makes a trustworthy guard for every piping . . . is a Jenkins Valve with a Jenkins Disc. When a Jenkins Valve is closed, it's the specially compounded, renewable, resilient disc which presents an impassable guard to the flow of any fluid.

Jenkins Valves of the globe, angle, cross, check and "Y" types are fitted with a Jenkins Disc of the compound exactly suited to the service . . . whether hot or cold water, steam, solvents or process fluids.



Send for a booklet descriptive of Jenkins Valves for any type of building in which you may be interested.

JENKINS BROS.
80 White Street . . . New York, N.Y.
524 Atlantic Avenue . . . Boston, Mass.
133 No. Seventh Street . Philadelphia, Pa.
646 Washington Boulevard . Chicago, Ill.
JENKINS BROS., LIMITED
Montreal, Canada London, England

Jenkins
VALVES
Since 1864

PORCELAIN INSULATORS

(Continued from page 183)

cumulation of dirt on an insulator provides an excellent leakage path for the electrical current and frequent breakdowns occur by flashover.

The coloring matter in the glaze is produced by using various metallic oxides. For example: Fe_2O produces a brown color, Cu_2O_3 gives a green color, Co_3O causes the porcelain to be colored blue, and Ur_2O_3 and $Mn\,O_2$ produces brown and yellow. If a pure black glaze is desired, all of the metalic oxides mentioned are added. Flint, feldspar and Z_2O composes the body of the glaze and will produce a clear white glaze when used without any metalic oxide.

This mechanical mixture of materials constituting the glaze is mixed with the correct amount of water and applied to the ware by dipping, painting, or spraying. Dipping is most frequently used.

If the coefficient of expansion of the glaze is not nearly equal to the coefficient of expansion of the porcelain the glaze will chip and crack when heated or cooled. It is therefore of great importance that the glaze be made of materials having the same coefficient of expansion as the body of the porcelain.

The final operation in the manufacture of any porcelain ware is the firing. In the firing of porcelain ware the clay and the flint do not change either chemically or physically, whereas the feldspar does. The feldspar melts, flowing around both the flint and the clay, and takes them into solution. The material does not become liquid enough to flow but it does reach a rather soft melted state. When the firing has been completed, and the porcelain is cooling, the feldspar with the clay and the flint in solution solidifies into a completely vitrified mass, white in appearance and nonporous.

The firing may be carried on in any type of an oven or kiln which is heated to the required temperature and then slowly cooled. Most of the firing is done in one of three ways: The bee-hive kiln, the muffle kiln, and the continuous tunnel kiln. A further classification divides them into the periodic and continuous kilns. Both the bee-hive and muffle kilns are of the periodic type, meaning that they must be cooled between firings so that the ware may be removed and replaced by unfired ware. The continuous tunnel kiln is constructed so that the firing operation is continuous. The ware enters one end of the tunnel and advances toward the firing zone, its temperature increasing at each step until it arrives at the firing zone where it is hot enough for the firing operation. After passing through the firing zone, the ware recedes gradually from the heat and is gradually cooled to about 40° C., at which temperature it emerges from the oven.

The muffle kiln is so constructed that the flames of the heating fire are enclosed by a fire brick wall and the ware is heated by conduction and convection without coming in direct contact with the fire. The bee-hive kiln has the fires arranged in the open and the flames of the fire play directly upon the ware.

The periods required for the firing are from 6 to 7 days in the bee-hive kiln, 12 to 14 days in the muffle kiln, and about 90 hours or slightly less than 4 days in the continuous tunnel kiln. The temperature at which vitreous porcelain ware is fired is about 2400° F. as a maximum in the periodic kilns and 1350° C. in the tunnel kiln.

NEWS FROM THE TECHNICAL CAMPUS

Advanced Thinking

Instead of saying, "You're crazy!" an Engineer says "How?"

If, next week, some one comes to him and says he has discovered a way to jump to Mars and spend the week-end, the engineer will pack an overnight bag and get ready to go.

Why not? Is it any more than our fore-fathers were asked to accept on faith 100 years ago?

If you think so, read the records of the School board of Lancaster, Ohio, in 1828, about 100 years ago. It was desired that the "advanced thinkers" be permitted to use the school-room for public debate as to whether or not the railroads were practical. The minutes of the meeting read:

"You are welcome to use the school-room to debate all proper questions in, but such things as railroads and telegraph are impossibilities and rank infidelity. There is nothing in the Word of God about them. If God had designed that His intelligent creatures should travel at the frightful rate of fifteen miles an hour by steam He would have foretold it through His holy prophets. It is a device of Satan to lead immortal souls down to hell."

Bayliss Addresses Local A. C. S. on "Corrosion"

Dr. J. R. Bayliss, chief chemist of the Chicago water works, addressed the Minnesota section of the American Chemical Society at its meeting on February 21 in the auditorium of the School of Chemistry. "Corrosion" was the topic Dr. Bayliss chose to discuss with the group.

Dr. Bayliss, who is an authority on the purification and management of city water supplies, is the author of many papers on the subject and has contributed much to the knowledge of the properties of potable waters. In his lecture, he dealt with the aggressive power of water toward limestone and metals and explained the causes of the corrosive action of water.

A dinner in Dr. Bayliss' honor was given at the Campus Club preceding the meeting.

At the conclusion of Dr. Bayliss' lecture, the first of a series of group meetings was held. A series of short talks has been arranged for the group meetings which will be held in connection with the monthly meetings of the society, according to Dr. George Glockler, secretary of the Minnesota section.

Aeros Form Glider Club

The Aeronautical association, besides presenting two lecturers during the past month, held a dinner in the Minnesota union for the purpose of forming a new glider club.

The first lecture, by Doctor Herpolshein, was given on Wednesday, February 5. Doctor Herpolshein is flight physical inspector for the Department of Commerce and was therefore well qualified to speak on his subject, "Why the Physical Examination?"

Mr. R. M. Hazen stopped off on his way to North Dakota from the St. Louis Aircraft Show to speak before the club on February 25. Besides talking of the attractions of the show, Mr. Hazen described in considerable detail the new Fairchild motor.

The most significant of the club's projects for the month was the inauguration of the glider club. The plans for its organization were made at the dinner held on February 26. At that time Lloyd Kernkamp, president of the Minnesota chapter of the American Association of Aeronautical Engineers, appointed a committee with Franklin Vobeyda as its chairman, to draw up the rules and constitution for the new club.

PATENTS

(Continued from page 194)

always able to prove first conception of his invention at the date noted, and this is often of great importance, for many times others are inventing in the same field and without knowledge of their competitors' activities. Occasionally, too, where attempts are made to improperly appropriate the inventor's idea, he is able later on to substantiate his prior rights to the invention and a patent thereon. Such an instance as this last occured to a client of the author, who won a suit on a phonograph motor patent that went up to the Supreme Court, largely upon an evidence of conception which he had written informally on the back of a dance program, but which he had been careful to properly sign, date and witness.

It is highly important also that the inventor maintain a similar record in writing, properly dated and witnessed, giving other information which also may be needed later, including: (1) the date that the invention was first disclosed to others, with their names and the circumstances of the disclosures; (2) the date when the first sketches and working drawings were made—the drawings themselves to be suitably signed, dated and witnessed; (3) the date when the first operating model was made, together with information as to who made it, and the original bills for material, where obtainable; and (4) all the models themselves, made during the development of the idea, should be carefully preserved. All this data enters into a proper prosecution of what is called an "interference" in which the application for patent sometimes becomes involved.

The inventor having now established his or her "evidence of conception," may take the next step, which is finding a good patent attorney.

ENGINEERING REVIEW

(Continued from page 185)

ing the four different types of construction. The characteristics of the various types of apparatus are determined by both graphical and analytical methods. Numerous photographs and line drawings are given in the book to illustrate machine parts, type of construction, and method of assembly. The appendix includes a complete copper table covering dimensions and characteristics of wire.

The material in this text gives complete calculations for the design of two direct-current machines, two synchronous machines, two induction machines, and four transformers. While largely formalistic in treatment, in the main fundamental reasons are given for design principles and calculations.

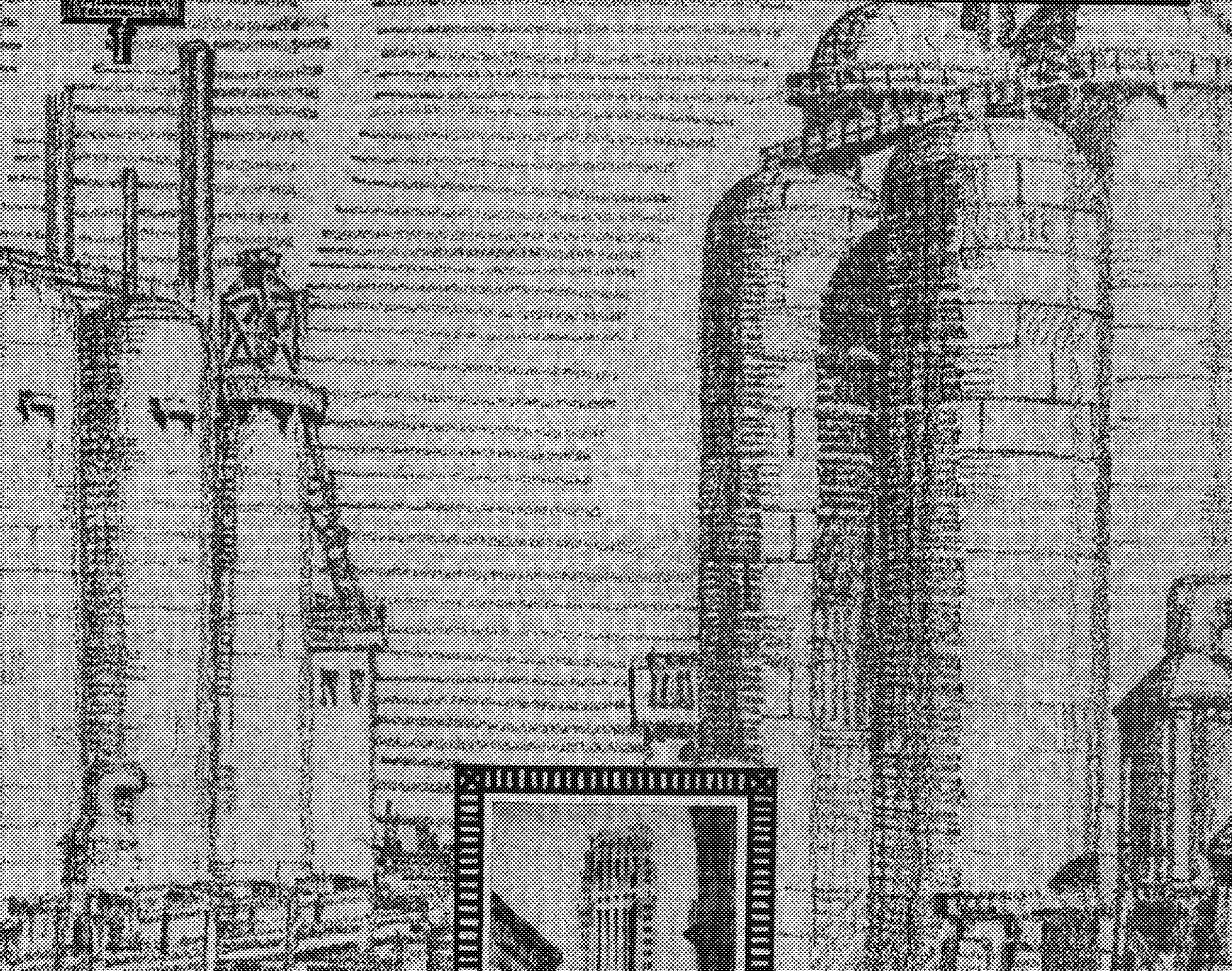
Bliss Talks On Campus

"The Mathematics of the new Quantum theory" was the subject of an address by Dr. G. A. Bliss, professor of mathematics at the University of Chicago. Dr. Bliss outlined and traced the mathematical development of the three major theories: the Bohr theory, formerly considered satisfying but now yielding place to the newer theories; the Schroedener theory, built upon a foundation of calculus of variation, which also happens to be Dr. Bliss' field of work; and the Heisenberg theory, derived from a rather limited knowledge of matrix algebra.

Dr. Bliss formerly taught at Minnesota and has held the presidency of the American Mathematical Society; he is one of the outstanding mathematicians of our time. In concluding, he stated that "mathematicians and physicists must work together to make progress in quantum theory work."

the Minnesota Techno-Log

MONTHLY PUBLICATION OF THE TECHNICAL STUDENTS



Vol. X APRIL, 1930 No. 7

THE UNIVERSITY OF MINNESOTA

THE MINNESOTA TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

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

VOLUME X — MINNEAPOLIS, MINN., APRIL, 1930 — NUMBER 7

CONTENTS

PAGE

RECENT THOUGHTS ON THE NATURE OF MATTER - - - - - - - 217
S. C. Lind

DULUTH'S NOVEL BRIDGE - - - - - - - - - - - - - 218
C. L. Ottinger

IRON MINING IN THE LAKE SUPERIOR DISTRICT - - - - - - - 220
R. O. Cash and T. H. Michell

NEWS FROM THE TECHNICAL CAMPUS - - - - - - - - - - 222

ABOUT THE WORLD WITH OUR ALUMNI - - - - - - - - - 226

EDITORIALS - - - - - - - - - - - - - - - - 224

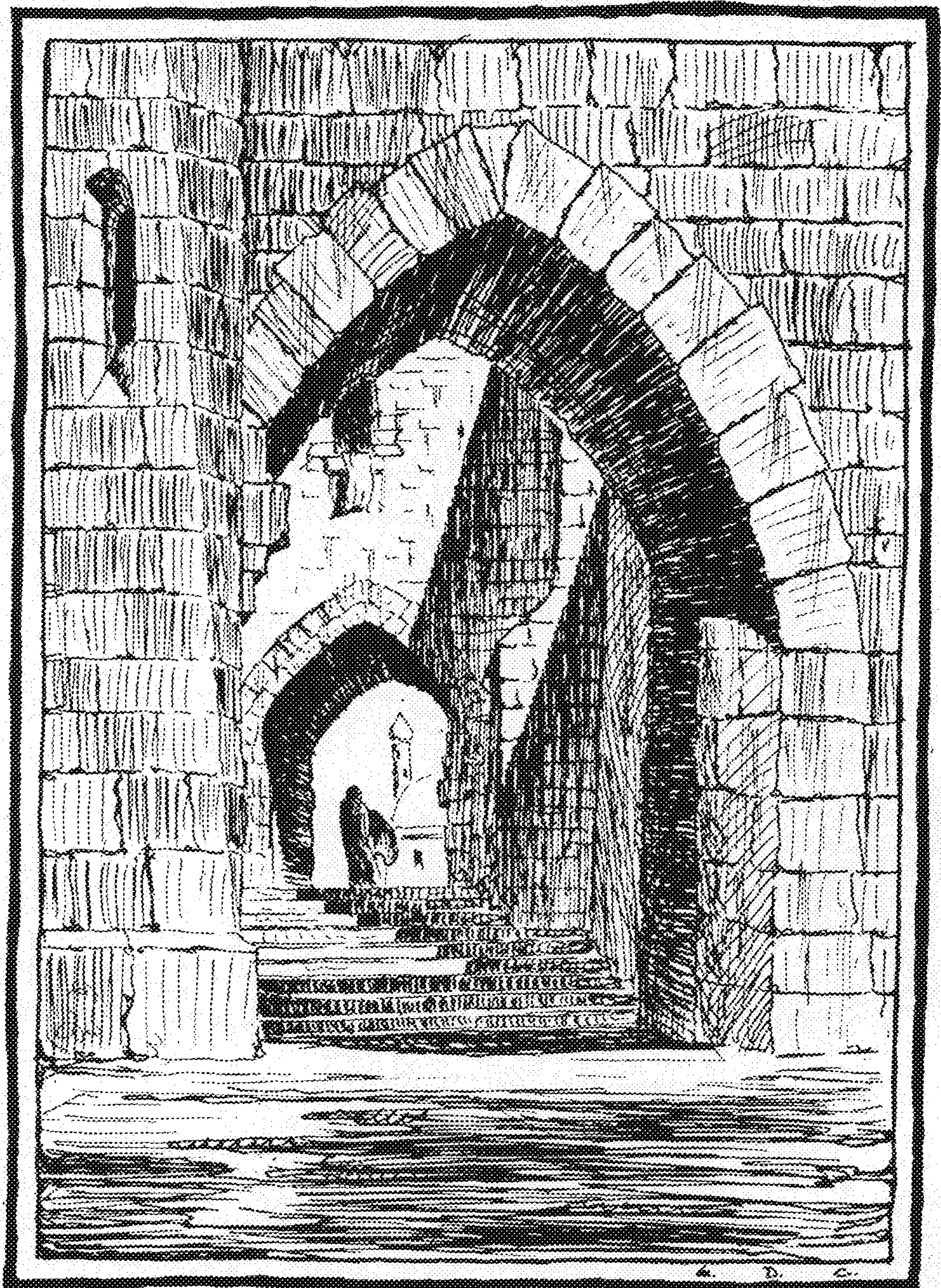
DRIPPINGS FROM THE OIL CAN - - - - - - - - - - - 226

MEMBERS OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

Chairman: WILLARD V. MERRIHUE, 1 River Road, Schenectady, New York

Armour Engineer
Auburn Engineer
Colorado Engineer
The Cornell Civil Engineer
Illinois Technograph
Iowa Engineer
Iowa Transit
Kansas Engineer
Kansas State Engineer
Marquette Engineer
Michigan Technic
Minnesota Techno-Log
Nebraska Blue Print
Ohio State Engineer
Oregon State Technical Record
Penn State Engineer
The Pennsylvania Triangle
Princeton E. A. News Letter
Purdue Engineer
Rose Technic
Sibley Journal of Engineering
Tech Engineering News
Wisconsin Engineer

Entered as second-class matter April 9, 1925, at the post office at Minneapolis, Minnesota, under the Act of March 3, 1879. Office, 37 Electrical Building, University of Minnesota. Telephone, Dinsmore 2760. Contents copyrighted and permission must be secured for re-publication. Subscription rate, $1.50 a year. Single copies, 25 cents. Advertising rates upon application. Alumni Directory, 50 cents.



An Old Street

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume X APRIL 1930 Number 7

RECENT THOUGHTS ON THE NATURE OF MATTER*

By S. C. LIND
Director of the School of Chemistry

AS far as we know at the present time, our material earth is composed of only about 90 elemental substances. They can be combined with each other, however, in different proportions and in various forms so as to compose several hundred thousand more complex substances which have been identified in nature or synthesized in the laboratory. Our knowledge of matter in other worlds as brought to us in meteorites, or even in other galaxies as we study the rays of the stars, indicates that the entire universe is composed of the same elements.

If we could communicate by radio with other planets, some of which must be inhabited by intelligent beings, one of the most tangible criteria of their stages of development in cultural life would be the degree of knowledge of their material world. Doubtless some would exhibit more primitive, others more advanced states of knowledge than our own.

Judging from our own experience, the curve of progress would always show a marked induction period—very long periods of time in the beginning to attain a certain state of progress—always shortening of the period or acceleration of the progress in each new advance.

From the rough to the polished stone age might be measured in hundreds of thousands of years, to the bronze age a few ten thousands, to the iron age perhaps ten thousand, to steel a thousand, to the modern Bessemer furnaces less than a hundred, to the electric furnace fifty, to the induction furnace 10-20 years more, and so forth,—each discovery hastening the next by making it easier.

In spectroscopy when lines fall successively closer and closer together, we say we have a converging series, and reach at the series limit a critical condition where something unusual happens. The atom or molecule breaks down. The rapid material progress of today has made some people wonder if we are not approaching such a breaking limit. Dr. Millikan in his lecture here last month referred to the view of the Bishop of Ripon who has called on scientists to cease activities for 10 years to give the world time to catch its breath.

But it is not my purpose to discuss the effects of the rapid development of science in recent times, but rather to point out that every period of rapid development always has its specific causes. It will be impossible in the time at our disposal to do more than select a few isolated instances.

Dr. Samuel Colville Lind, director of the School of Chemistry, is an internationally recognized authority on radium and radioactivity. Dr. Lind, whose life has been unusually eventful, graduated from Washington and Lee University, Massachusetts Institute of Technology, and the University of Leipzig, Germany, with degrees of A. B., B. S., and Ph. D.

Since 1921, Dr. Lind has been active in the publication of the JOURNAL OF AMERICAN CHEMICAL SOCIETY *and* CHEMICAL ABSTRACTS. *In addition to his other literary interests, he was made editor of the* INTERNATIONAL CRITICAL TABLES *in 1924. In the year 1926 he was made director of the School of Chemistry at the University of Minnesota and vice chairman of the division of Chemistry and Chemical Technology of the National Research Council.*

The modern science of chemistry began with the discovery of oxygen by Priestley in 1775 and the overthrow of the phlogiston theory. The controlling cause was the discovery of *gases*. Perhaps this is an exaggeration, for surely air had been known from the beginning. But the failure to recognize air as a ponderable mixture of gaseous elements had led to a singular confusion of ideas which permitted the false concept of phlogiston to dominate alchemy during the middle ages. Before the discovery of oxygen it was evidently impossible to get a correct conception of oxidation and reduction processes—hence the winning of metals by metallurgical reduction was confused with transmutation of elements, always the unattainable goal of alchemy. Based on the work of Priestley, Black and Cavendish, the brilliant young French chemist Lavoisier, who lost his life in the French Revolution, brought order out of confusion and founded the present principles of chemistry as a quantitative science.

The application of electricity to chemical investigation by Sir Humphrey Davy, ushered in another era of discovery by enabling the separation by electrolysis of some very basic metals from their oxides which had previously been thought to be the elements themselves. A little later his great pupil, Michael Faraday, took a great forward step in the disclosure of the relation of matter and electricity as embodied in the law known by his name, which states that in electrolysis one unit of electrical charge is associated with one chemical unit of matter, indicating a very fundamental relation between electricity and matter.

One hundred years after Priestley discovered oxygen, America made her first contribution of the first magnitude to physical chemistry, and in a very singular and non-spectacular manner. Josiah Willard Gibbs, a professor at Yale College, so retiring that we are assured he was almost unknown to his younger colleagues, worked alone and unheralded, without equipment or laboratory, in the application of thermodynamics to systems of chemical and physical equilibrium. He left behind at Yale little immediate trace of his ever having been there. He founded no school of thermodynamics and had no followers. His publications made in an obscure journal remained unknown for 25 years until two European chemists found them and brought them to light. Since that time the work of Gibbs has continued to dazzle the scientific world by its brilliance and profundity. He created a new tool, introducing an era of progress in heterogeneous equilibria by the application of Gibbs' famous phase rule—which, by the way, was only one of his many important contributions. Today phase rule diagrams are used in every plant in the world where steel or any other metallic alloy is made, wherever salts are sepa-

(Continued on page 232)

*An address delivered at the University of Minnesota Convocation, February 27, 1930.

DULUTH'S NOVEL BRIDGE

By C. L. OTTINGER, C. E. '31

DULUTH, situated at the head of the Great Lakes, is a natural point of transfer for many products of the great Northwest. Here many commodities used in the Eastern States are transferred from trains to lake freighters to be shipped to the large eastern cities. The cost of this mode of shipping is about 25 per cent of what it would be to ship the same produce by rail.

A sand-bar, known as Minnesota Point, extending pratically perpendicularly from the north shore of Lake Superior, forms a natural breakwater forming the Duluth-Superior harbor. This breakwater is about six miles long and between 300 and 400 feet wide, giving excellent protection from the frequent Lake Superior storms.

The Twin Ports, as Duluth and Superior are known, early realized the advantages of this natural harbor, and two points of entry were dug about 1870. The southerly one is known as the Superior Entry and the northerly one as the Duluth Ship Canal. The latter entry is the largest, being 250 feet wide.

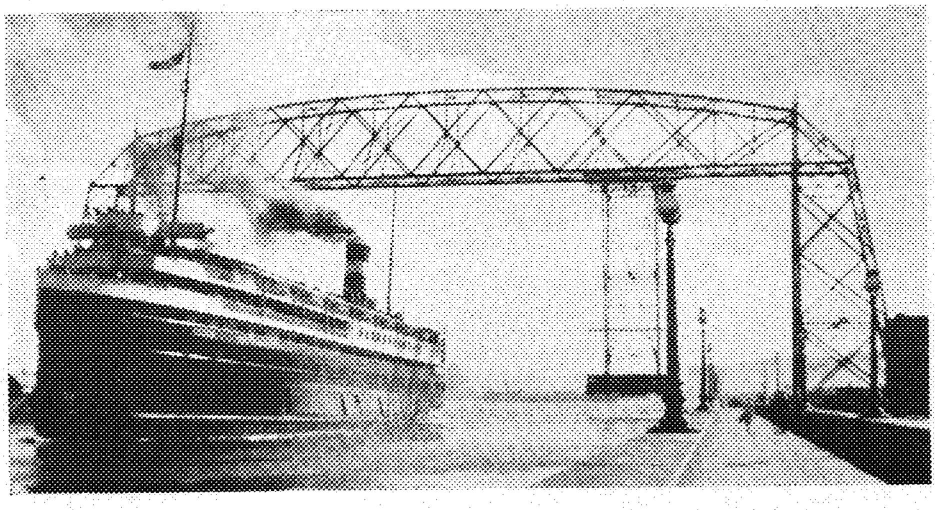
After the canal was dug, the only means of transportation to and from the mainland was by means of a rowboat provided by the city. A small part of the population still continued to live on the Point, and it was foreseen that in the years to come business developments on this small strip of land would make it imperative that a more practical and economical means of transportation would have to be devised.

The first attempt to provide a permanent crossing was made in 1890, according to Mr. C. A. P. Turner, the designer of the aerial bridge, when the services of A. P. Boller were secured to prepare plans for a bridge. Mr. Boller's plan was for a draw-bridge with a pivot span on the south side, that is, the Point side. This plan was finally rejected by the city. Many other plans followed, but they were all rejected by the city for various reasons.

Meanwhile, Mr. Thomas F. McGilvray suggested and prepared sketches of a bridge resembling the Anodin Bridge at Rouen, France. This plan aroused much interest. On the suggestion of Mr. Turner that a girder construction or span in place of a suspension bridge, and a stiff traveler in place of cable suspenders for the car would be safer and cheaper, Mr. McGilvray drew up the plans for the construction. After much controversy in congress and with certain contracting companies, the contract for the construction of the bridge was finally let to the Modern Steel Construction company of Waukesha, Wis., on their bid of $100,000. That was early in 1904 and the bridge was finally finished the following winter.

Here it might be well to give an account of the construction of the old aerial bridge, it being unique in that it was the only one of its kind in the United States. The somewhat peculiar and difficult conditions to be met were as follows: The canal points directly in the teeth of the prevailing winds and most severe storms of the locality, and hence vessels using it require an absolutely unimpeded passageway.

Any structure designed to move across the canal must have certainty of action and be under complete control at all times, owing to the large number of vessels arriving and departing. During the 1929 season there were 10,835 vessels arriving and departing, carrying 45,867,420 tons of freight, and 29,937 passengers. Any design for spanning the canal permanently must have a clear headroom of 135 feet, as masts of 125 feet are carried on some of the vessels. The car is required to clear the side of the canal when in the landing, and, for safety of operation, the method of suspension should be such as to limit to a minimum the lateral swing of the car under the heaviest wind.



The old aerial bridge as it was before the reconstruction. Note the position of the ferry car on the right to allow passage of a boat.

In order to reduce the span of the overhead truss to a minimum, the side of a tower facing the canal is open, forming a huge portal, 130 feet in height through which the car runs into the tower. The side posts forming this portal consists of twin columns, joined at the top, and spread 15 feet apart at the base, connected by suitable bracing, and anchored down by four 2½ inch bolts.

The desirable requirements to be met in the design of the truss are evidently stiffness, ease of erection, neatness of appearance, and economic form, combining concentric application of the vertical load to the truss, or uplift of the traveler from wind; application of the lateral bracing, and a rigid system of sway bracing to enable the four plans of bracing, viz., the two trusses and the top and bottom lateral systems, to act together in resisting the great twisting moment of the traveler caused by the wind.

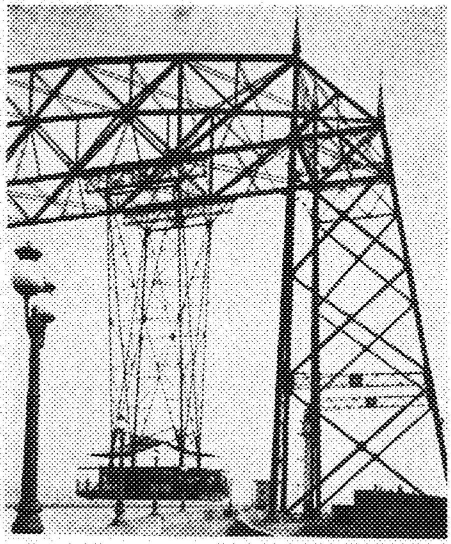
The double-system, Warren type of stiff-riveted construction throughout, was selected as best filling the above requirements, the bottom chord being of box form, open at the bottom, and carrying two lower rails and two upper rails to provide for uplift.

The further apart the trusses are placed the less the moment from the traveler affects the truss, but, beyond certain limits, the greater the weight of the bracing; and 34 feet was decided to be the desirable mean.

The load of the traveler is practically a concentrated one, hence stiff web bracing capable of taking tension or compression is evidently the economic type.

The arrangement of the tracks in the bottom chord secures concentric application of the load, both to the truss and to the bottom lateral system. The chord is prevented from spreading laterally by cast-steel yokes, or truss connections designed to act as yokes, at approximately 6 foot intervals. From the intersection of the web members two stiff hangers are dropped to the chord, supporting it at 13 foot intervals.

While the trusses are designed as simple trusses, they have an additional fac-



Close up view of car and supporting framework.

tor of strength and stiffness due to the rigid connection of both chords to the towers, causing them to act as trusses restrained at the ends.

Temperature stresses are provided for by placing one tower on rollers. An unusual roller nest is required under the front legs. One pair of rollers extends from the main column to the batter brace, acting as driving rollers, to insure the two nests under the outer and inner booms of the twin columns moving together.

The height in the clear of the old bridge was 135 feet. The clear span, that is, the distance from the pier on the mainland to the pier on the Point side, is 393.75 feet. The bridge itself stands on eight concrete piers which extend into the ground below the level of the lake. There are 730 tons of concrete in these eight piers. The bridge has a total height of 186 feet from the surface of the water. The height of the truss at the center is 51 feet and its width is 34 feet. The car had a load capacity of 125,000 pounds or 350 people. The normal speed of the car across the canal was four miles per hour, or a little over a minute per trip. The car had a deflection of 1 7-16 inches in a 60 mile gale. The cost of upkeep of the bridge to the city was $8,000 per annum.

Several years ago agitation became rife to remodel the old bridge. The campaign was led by the residents of Minnesota Point who had to travel over the canal several times a day. Many plans for the reconstruction of the old bridge were submitted to the city. Among these plans was one to raise the existing top span of the bridge and construct a lift span underneath which could be raised to a height of 135 feet in the clear for the passage of vessels, or lowered to the street level for traffic. This plan was submitted by the original designer of the bridge, Mr. C. A. P. Turner of Minneapolis. Finally, in the early spring of 1929 after many other plans had been submitted and rejected, Mr. Turner was ordered by the city to draw up plans for a lift bridge as suggested by him. The contract was let to the Kansas City Bridge Company of Kansas City on its low bid of $500,000. The consulting engineers were Harrington-Howard and Ash.

The contract called for the scrapping of the ferry; reinforcing of the original towers for the added load; and the lifting of the original top span 42 feet to make room for the new lift span that was to be constructed.

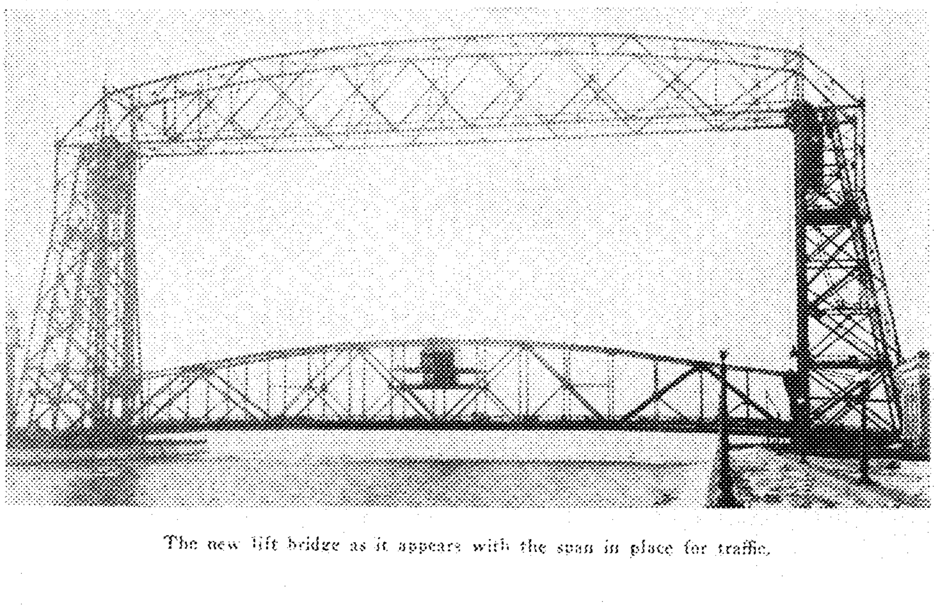
Work was started late in October with the removal of the old ferry car. After the car was removed and the two towers reinforced, the engineers undertook to perform one of the greatest feats in engineering history—the raising of the top span 42 feet. This was accomplished by means of jack-screws and a system of counter-balances which raised the span in the record time of 42 minutes. The original top span does not play any part in the strength of the new bridge, in fact, it hinders by placing an added load on the two towers; but was left for the purpose of carrying telephone, power, gas, and water lines.

The movable span was then constructed in the air, that is as it would be when the vessels are passing through. This was done so that the concrete counterweights could be built up to the proper weight down on the ground. Each counterweight weighs 200 tons. These weights are fastened to large drums in the center of the lift span by 24 cables at each end. These drums are driven by two direct current motors of 95 H. P. each. Each motor has an emergency motor with it in case the regular motor burns out. This makes a total of 190 H. P. at all times. The ferry car of the old bridge was propelled by two 40 H. P. motors or a total of 80 H. P. For the new bridge the ordinary city alternating current is sent through a rectifier where it is rectified to a direct current to be supplied to a direct current generator. This generates the current for the two motors on the movable span of the bridge. Current is also supplied to a battery of 153 storage cells that are kept fully charged at all times to be ready to supply current to the motors in the event that the city current fails.

The new bridge was opened for the use of pedestrians only on January 6, 1930. The span has a 4 foot sidewalk on each side and a 26 foot roadway between which contains a double street car track. Since the lake shipping season does not open until sometime in April or May, it cannot be said how the new bridge will work with traffic running both ways. But there is no doubt but what the bridge will prove successful.

Before the building of the old aerial bridge, several years were spent in deciding on the type of crossing to be used. In 1902 the city of Duluth offered a prize of 1,000 dollars for the best bridge designed for the crossing. The prize was awarded to a plan using a pivot span having two arms of different lengths. The shorter arm was to be on the point side. Counter balances were provided for to allow for dirt, water, and snow collecting on the roadway. This type seemed to be the most favored one before suggestion of the aerial bridge. Even then there was much opposition to the suggested type.

Several kinds of crossing were suggested from time to time. As the situation of the canal allowed the use of a long approach, it was felt that a pivoting span of unequal arms, or a suspension bridge would be the most economical and safest. Even at that time the construction of a bridge with a roadway to be lifted above the vessels was suggested.



The new lift bridge as it appears with the span in place for traffic.

IRON MINING IN THE LAKE SUPERIOR DISTRICT

By R. O. CASH and T. H. MICHELL*

THE terms Lake Superior district and the iron ore industry have become more or less synonymous as each passing year of the last half century has seen an ever-increasing percentage of our nation's iron ore supply mined and shipped from this section. We now find portions of Michigan, Minnesota and Wisconsin almost exclusively identified with this vast industry, the development of which presents an interesting and romantic narrative.

The ore deposits of the Lake Superior district are divided into six ranges—the Vermillion, Mesabi and Cuyuna in northern Minnesota, and the Marquette, Menominee and Gogebic in the upper peninsula of Michigan. The Menominee and Gogebic ranges also extend a short distance into northern Wisconsin. The characteristics of the ore and its formations vary materially on each of these ranges, and this phase alone affords a subject of deep interest for geological study.

Iron ore was first discovered in 1845, under the roots of an old stump on the Marquette range. This range was so named in honor of Father James Marquette, a Jesuit priest who had established missions in this section during the latter part of the seventeenth century. Today along the road between the cities of Ishpeming and Negaunee, Michigan, you will find the historic spot marked by an appropriate monument. Here the first ore was taken from shallow open pits and in 1852 the first shipment, consisting of a few tons, was packed in barrels for delivery to one of the lower lake ports.

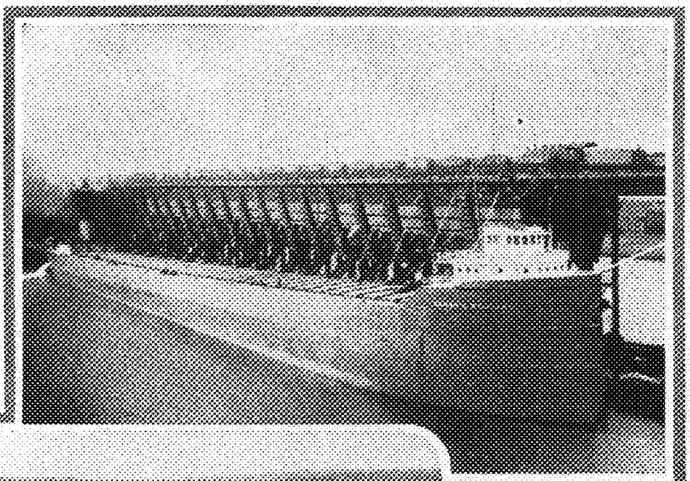
The country was undeveloped in these early days. It was necessary to transport the ore in wagons or sleds for fifteen miles through the woods to Marquette, Michigan; thence by boat to Sault Ste. Marie, where it was unloaded and hauled past the rapids that separates Lakes Superior and Michigan at this point. It was then loaded into boats and finally transported to those lower lake ports most accessible to the blast furnaces. Fortunately transportation facilities were rapidly improved. The construction of a canal at Sault Ste. Marie in 1855, followed by the building of a railroad between Ishpeming and Marquette in 1857, facilitated the early development of the industry.

The development of the Marquette range naturally led to further exploration in the Upper Peninsula and resulted in the discovery of iron ore on both the Menominee and Gogebic ranges. First shipments were made from the former in 1877 and from the latter in 1884. Since the majority of deposits in the Michigan ranges are covered to a great depth by overburden, most of the ore is removed by underground methods. However, there are some shallow deposits on both the Gogebic and Marquette ranges that are now the scene of open-pit operations.

Prior to 1884, all the iron ore shipped from the Lake Superior district had been mined in Michigan's three ranges, but in that year, with the initial shipment from Vermillion range, Michigan's prowess as an iron ore producer was first challenged. The finding of ore on this range was important, for it led eventually to the discovery of the large Mesabi range ore deposits in November, 1890. Minnesota soon gained supremacy as a producer of iron ore and its position has never since been disputed. The last range to be discovered was the Cuyuna, which derived its name from its discoverer, Cuyler Adams, and his faithful dog, Una, that had been his constant companion during his prospecting days. First shipments were made from this range in 1911. Development work followed and it now ranks with the other ranges as a steady producer of ore.

Ore deposits of the Vermillion range lie deep beneath the surface and are necessarily removed by underground methods. A majority of those on the Cuyuna and Mesabi ranges are comparatively shallow, and are easily accessible for economical stripping and open-pit operation, although there are several ore bodies that are more advantageously mined by underground methods. Both systems are in current use.

The Mesabi range, by virtue of its large yearly pro-



Above — Large fleets of boats, similar to the one illustrated, are kept busy throughout the shipping season transporting ore from the Lake Superior docks to ports located most advantageously to the blast furnaces.

Left — Looking down into the deepest open-pit iron mine in the Lake Superior district. At this distance the power shovel, right, and the train of cars in the background look small enough to be mere toys.

*Published through courtesy of the *DuPont Magazine.*

duction, its enormous reserves and magnificent civic improvements, is perhaps more popularly identified with the iron mining industry than any other. The name "Mesabi" originally came from the Ojibwa Indians and referred to a mythical giant, who, according to Indian legend, had his home in this long range of hills. The gigantic tonnage of ore, since found in its deposits, has proved that the original Indian name was an especially appropriate selection.

Since the discovery of ore on the Marquette range in 1845, including the shipments of 1928, records show that 1,398,478,044 tons of ore have been mined and shipped from the Lake Superior district. This enormous tonnage is divided among the various ranges approximately as follows: Mesabi, 816 millions; Gogebic, 174 millions; Marquette, 165 millions; Menominee, 163 millions; Vermillion, 55 millions; and Cuyuna, 27 millions. The 1928 shipments amounted to nearly fifty-five million tons, of which approximately thirty-five came from the Mesabi; seven from the Gogebic; five from the Menominee; four from the Marquette, and two each from the Cuyuna and Vermillion ranges. These figures will give the reader a basis upon which to determine the total production of the six ranges in this district at the present time.

The iron ore deposits of the Lake Superior district resulted from the disintegration of iron-bearing rocks and formations by erosion, folding, faulting, and other geological actions, which were then concentrated, by the circulation and filtering of underground waters, into small, enriched ore bodies, during the geological eras. Each range varies widely in geological formation and the ore bodies are correspondingly different, but for the most part the ores of this district are either a hard or soft hematite (Fe_2O_3) or magnetite (Fe_3O_4). Thus far production has been chiefly limited to hematite ores and will doubtless so continue as long as these deposits are available.

Exploration work, first carried on in shallow ore bodies by means of small shafts and test pits, soon gave way to diamond drilling as the search for ore extended to the deeper deposits. This work, in the deeper mines of Michigan, is largely executed by underground drifting, which operation is also supplemented by the use of diamond drills set up in underground locations. The churn drill has likewise been used in many of the Mesabi range properties, especially in surface and soft ores, where it has been found to give better results than the diamond drill.

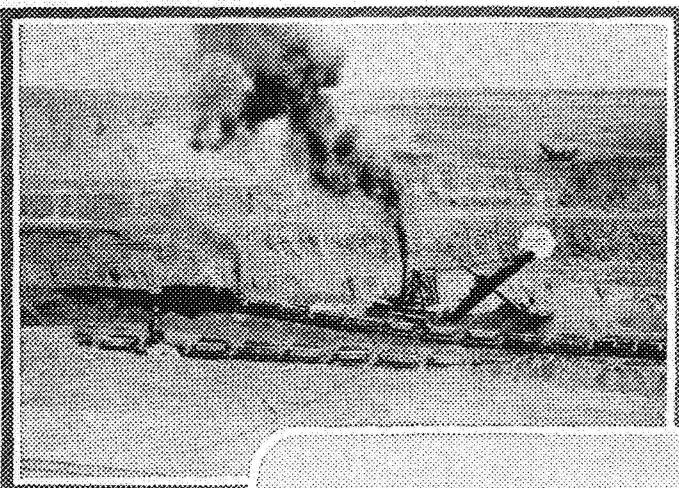
The results of exploration work not only define the limit and depth of the deposit, but also furnish accurate samples of the ore encountered, so that after the drilling and drifting have been completed, an estimate of the tonnage and grade of ore the property contains can be accurately computed. Such data and preliminary estimates govern the plan of operation and development. Whether the ore shall be won by underground or stripping methods depends upon the calculated ultimate cost per ton of ore recovered.

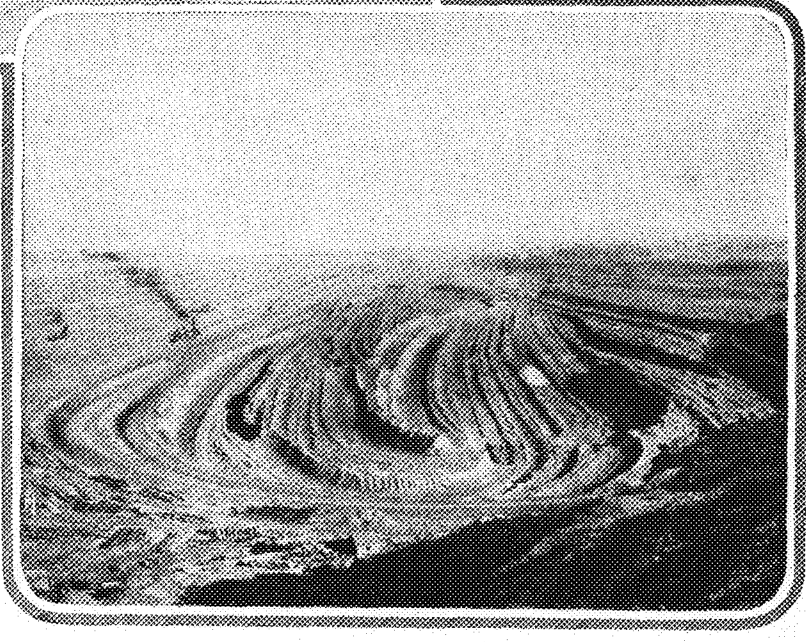
If the overburden is not too deep and the ore body large enough to warrant the removal of such surface yardage so as to obtain ultimately an economical tonnage of merchantable ore, then the open-pit system of mining is employed. This method offers the advantage of a large and flexible production with comparatively few employes; and in periods of depressions or inactivity it exacts relatively small maintenance charges. All surface material is first removed from the ore body by the use of power shovels, locomotives and dump cars; this waste material being transported to nearby ore-barren land. Then the ore is loaded direct into railroad cars by power shovels and hauled out of the pits with locomotives. It has become necessary, in later years, to crush and wash some of the open-pit ores before shipping them. In such cases the material is loaded into dump cars in the pits for transportation to the crushing or washing plants. After treatment, it is then loaded into railroad cars for shipment.

The development of this mining method has largely been a romance of mechanical progress. The first steam shovel, a small 35-ton model with half-yard dipper capacity, made its appearance on the Mesabi range in 1892, and other mechanical equipment such as locomotives and dump cars were likewise correspondingly small. Today, this early equipment has been supplanted, in some extreme instances, by 300-ton, full-revolving, caterpillar traction electric shovels with eight-cubic-yard dippers, and large-type locomotives weighing 125 tons on their drivers, as well as air-dump cars of 30 cubic yards capacity. Some of the mines recently stripped have installed large electric locomotives as regular equipment, and the loading of ore from such properties is almost completely a mechanical process.

Thus, despite a constant increase of wage and supply costs, and with fewer working hours, the operator has been able to keep the cost per ton at a satisfactory figure by the use of modern labor and time-saving machinery. Industry in other sections has greatly profited by mechanical improvements developed in open-pit iron mines. A specific example is the modern

(Continued on page 238)





Above—This picture shows a 300-ton power shovel loading ore from the open pit at Hibbing. This view also gives some idea of the size of this mining operation.

Right — Looking toward the Hull-Rust-Mahoning mines at Hibbing, the largest open-pit operations of their kind in the world. Millions of tons of ore are removed annually from this pit, which is approximately one mile wide, three miles long and three hundred feet deep.

NEWS FROM THE TECHNICAL CAMPUS

Todd Directs Short Course

The General Extension Division of the University of Minnesota, co-operating with the Electrical Engineering Department and the North Central Electric Association, offered the fifth short course for electric metermen during the week of March 24-28. This short course, which was under the direction of M. E. Todd, professor of electric engineering, had for its purpose the presentation to users of electric meters the latest, safest, and most economic method of installing and calibrating meter devices, test switches, meter blocks, laboratory meter testing devices, and the necessary equipment and accessories for making installations. The total attendance of 70, of which 33 were regularly enrolled in the course, and the remainder were manufacturers representatives and visitors from the League of Municipalities, was drawn largely from Minnesota, Wisconsin, and North Dakota.

Those enrolled in the course were divided into two groups, according to previous experience, one group being lectured by Professor M. E. Todd, of the Electrical Engineering Department, and the other by Mr. K. J. Mertz, superintendent of meters, Northern States Power company, St. Paul.

On Wednesday evening a dinner meeting was held in the Minnesota Union. Short talks were given by Mr. W. L. Wadsworth, of the Northern States States Power company, Minneapolis, Mr. J. O. McElroy, of the Minnesota Light and Power company, Duluth, and Mr. L. B. Johnson, from the Lincoln Meter Company. Mr. Johnson gave a talk on the "Life in Japan". The group joined the American Institute of Electrical Engineers after the dinner.

Chemist Wins Scholarship

The Johns Hopkins University scholarship for the State of Minnesota was awarded recently to Walter O. Lundberg, a University sophomore majoring in chemistry. Thirty students throughout the state applied for the award.

The purpose of this scholarship was to shorten the time required to obtain a doctor's degree in some branch of chemistry. Under the plan adopted, the winning students, one from each state, take a specially arranged course of studies which leads to the degree in one or two years less than usual methods. Once a month some well known scientist will spend the entire day with this group of students so they will know many of the scientific leaders personally when they finish the course.

JOHN BELLAMY TAYLOR

"Visible Sound" Explained by Research Expert

Mr. John Bellamy Taylor, consulting engineer of the General Electric company, recently addressed the Minnesota Branch and the Minnesota section of the American Institute of Electrical Engineers on the subject of "Audible Light."

Mr. Taylor is a graduate of the Massachusetts Institute of Technology where he received a B. S. degree in engineering in 1897. He is a member of several engineering and technical societies, a lecturer on acoustics and music at Union College, and was formerly a vice-president of the American Institute of Electrical Engineers.

For his demonstration, he used a "narrow casting" station, as distinguished from a broadcasting station from which he transmitted a beam of light which was translated into sound. In the course of the demonstration, the audience hear the burning of a match, the sound of various types of flash lights, the English word spoken backwards and speeded-up to such an extent that the sound could not be distinguished as speech.

"The study of sound, as distinct from the art of music," according to Mr. Taylor, "has long been of interest to a comparatively small number of specialists, but within recent years the development and increasing popularity of telephones, photographs, radio broadcasting equipment, and the like, have brought the same and related questions within the every-day field of work of the engineer and the manufacturer.

"While much can be learned and many questions may lead to improvements as a result of experimental observations on sound where the set-up is such that the ear alone is affected, it is well known that certain devices and forms of apparatus can present or record the sound so that they may be sensed at the time or studied later by the eye.

"Still later development than means for obtaining a visual record of sound vibrations is the reproduction of sound from the record which has been made, and besides the cylinder or disc record, quite distinct forms of sound record adapted for reproduction are possible. The latest of these methods to become of practical application is a photographic one in which sound is recorded on a strip of motion picture film and reproduced as the film is moved between a source of light and photo-electric tube. This tube when backed up by amplifiers and loud speaker, makes the beam of light audible."

A. I. E. E. Revises By-Laws

The Minnesota Branch of the A. I. E. E. called a special meeting for the purpose of the revision of the by-laws. The following changes were made:

Section 1 of article 2 was changed to allow for the provision of article 5, section 4, which reads: "The vice-chairman shall be a sophomore at time of election and is to be elected by active associate members."

Section 1 of article 5 was revised in order to make the transfer of the office of secretary-treasurer cancelling the office of vice-chairman-treasurer and making one office of vice-chairman.

Section 2 of article 7 automatically makes the vice-chairman a member of the meetings and papers committee.

Section 3 of article 7 added. It reads "When the executive board deems it advisable to send a junior representative to the district convention that representative shall be the vice-chairman."

A great deal of discussion arose from the last named revision. The discussion was centered on the fact that if the vice-chairman should attend the convention and the following year become chairman, he might be allowed to take two trips. The revision, however, was accepted.

Two new amendments were proposed and accepted. They were as follows:

1—That the junior representative to the convention shall present a paper on the convention.

2—Vice-chairman shall appoint men to present papers at following meetings.

Papers were presented at the next meeting by Mr. Campbell and Mr. Swanson as provided in the new ruling.

HOW TO GET A PATENT

By **RAY BELMONT WHITMAN**

THERE are some 12,000 or more patent attorneys registered to practice in the United States Patent Office, and of these probably 2,000 get most of their income from the preparation and prosecution of patent applications, and their exploitation and litigation. These men are all professionally-trained men, and, with perhaps some rare exceptions, honest and ethical in all their dealings. However, they, like doctors, dentists, or other professional men, vary in their degree of ability or skill.

Patent Attorneys to Avoid

Some attorneys are too young and with too limited experience or education to understand fully how to properly protect a valuable invention. Others are too old to be at the height of their mental power, or not aggressive enough in combating the Examiner's objections, during prosecution of the case, to obtain all the protection that the inventor is entitled to.

Some attorneys get their clients through advertising methods, and instead of conducting a professional practice, work on the "once only" plan, getting the maximum possible fees from the inventor for the minimum allowable work. Needless to say, this latter class of attorneys do their work so poorly that their patents are usually of little or no practical value.

Other patent attorneys devote most of their time to court litigation, and very little to Patent Office practice, or the preparation and prosecution of patent applications into patents. So they have little real skill in such work, and especially in the drafting of the "claims" in patents, which is the important and really protective part of these legal documents, of which more hereafter.

Again, many patent attorneys are merely lawyers, with but little knowledge of the sciences or engineering, and so are seriously handicapped in patenting inventions, especially if they are very technical.

The Ideal Patent Attorney

The ideal patent attorney is one who not only has a thorough working knowledge of patent law and procedure, and especially Patent Office practice, by virtue of a proper education and long experience in the work, but who is also a graduate engineer and with a successful experience in that profession. Such a man, whose mind is trained both logically and analytically, is best able to properly represent an inventor.

(The Patent Office, in fact, requires each of its Examiners, who examine all inventions before deciding to grant the patents, to be technical graduates, trained in scientific subjects. And the time is not far off when this same requirement will be made to apply to patent attorneys, for they are required to do not only everything the Examiner must do, but many things also which are far more technical. At present, however, any young law student who has completed a course of study in general law and been admitted to the bar, can present his certificate and become registered to practice as a full-fledged patent attorney!)

This is the second of a series of four articles on patents by the well known engineer-trained Patent Attorney, Mr. Ray Belmont Whitman. Mr. Whitman was for many years the chief patent attorney and consulting engineer for one of America's largest corporations. He is now in private practice in New York City, and offers to advise our readers on any question in this field if they will address him in care of this magazine.—Editor.

If the inventor does not know of a really able attorney with a record for taking out good patents, he should try to locate some inventor who has made a monetary success from his patents, and find out whom he employed. Where, however, this is impossible, then engage some well-known attorney who represents, or has represented, some large corporation—which would ordinarily be real proof of his ability—and who may be located in one of the large cities.

Another test in determining a good patent attorney, and perhaps the best of all, since it is one that almost never fails, is to *check up some past work of the attorney before you engage him.* This may be done by asking the one whom you may be considering hiring to loan you, say, eight or ten copies of patents, chosen at random which he has prepared, as evidenced by his signature on their drawings. Then put these patents through the method of analysis explained later under the heading "How to Analyze the Real Protection in Your Patents." If the results show that the particular attorney's work is not considerably above the average, based upon this analysis, consult someone else, and repeat the test until you finally locate one whose work does measure up to these requirements.

Since your attorney's skill and knowledge of patenting is going to have much to do with your success with your inventions in future, you should leave nothing undone to get a very good one in the beginning; for having once found such a man, you will probably want to retain him on all such matters in the future, and this association will, as the years go by, become increasingly valuable, and you will learn more and more how to cooperate with him and he with you. It is by such coordination of effort between attorney and client that the best successes come. Having once chosen your attorney, you should put your complete trust in him, and follow his advice, although there is no harm done in checking up his work from time to time to see that it is kept up to par.

If you follow this careful and painstaking method of choosing and retaining your attorney, you will be saved many of the most serious pitfalls which beset the inventor, such for instance as serious loss of your rights due to the attorney's inability to properly understand or claim your invention, necessitating additional expense of reissuing the patent to correct it, and even, in many instances, inability to do so, after the time has expired: or, loss of a profitable sale or license through not having an attorney who is well regarded by the prospective purchaser.

The Patentability Search

Although, as the next step, it is usually desirable to have your attorney immediately prepare and file your application for patent on your invention, it sometimes saves expense to instruct him to have a thorough search made through all the issued patents in the class of your invention, to determine its extent of patentability. For you are entitled to a patent only on what is really new. And yet it is often amazing how much is old among patents that is yet apparently novel because never put on the market.

The cost of such a preliminary patentability search is usually from ten to twenty-five dollars. It is never quite complete, since it does not include (because too costly) a search among foreign patents, which may also be cited by the Examiner against the allowance of a patent. Neither does it include pending applications, which are always retained in secrecy, and are only examinable after your application has been filed, and then only by the Examiner in his final search for prospective interferences.

Notwithstanding, a patentability search conscientiously made and reported to the inventor by a reputable attorney, will, in most cases where little or no patent protection of value is possible, bring that fact out, and so save the in-

(Continued on page 228)

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

Learn to Write

SEVERAL articles in current newspapers and magazines have shown the crying need for technical men who can write. Reports such as a writeup purporting to tell about "a $30,000 machine at the University, requiring thirty-five men to operate, run only once a year, etc.," create a bad impression concerning University research activities; the facts in the case cited are that the machine, a double effect evaporator, cost only $3,000, requires only a few men to operate, and is run quite frequently during the year. Numerous other articles equally garbled have appeared in print in spite of attempts at correction by various means such as agreements to have stories OK'd by responsible scientific men. Since this method of supervision has been not more than partially successful, the conclusion staring us in the face is that technical men, engineers, and chemists, must learn to write.

Some of the most humorous stories we have read are the serious, matter-of-fact reports submitted by students and by men already out in their field of endeavor; such impossible, not to mention unintelligible combinations of English are scarcely imaginable—all because scientific students have not availed themselves of opportunities to master the intricacies of their language as they progressed in their technical training. The vast majority are incapable of explaining their results to men not similarly trained.

This unfortunate circumstance is especially lamentable in this day and age when everyone from the tinkering mechanic to the largest executive desires at least a smattering of knowledge concerning many phases of human endeavor. It is useless to attempt to explain on the basis of ions and electrons when one's hearers scarcely comprehend the meaning of molecules. Hence the urging to write. One could do far worse than to become a technical reporter or writer of scientific articles in everyday, generally understood language. And certainly everyone will be glad to make intelligently written, informative reports to the "men higher up." Such ability is valuable. Cultivate it!

Training for Leadership

COLLEGE halls seem to have a decided edge on the little red school house as a training ground for industrial leadership, according to the facts just compiled by the Sherman Corporation. The careers of one hundred men who direct the destinies of many of the richest industrial corporations in the United States were studied as, presumably being typical of the careers of executives in places of leadership. Only twenty-two received a formal education limited by the walls of the red schoolhouse. Fourteen went to secondary schools but did not go to college. Sixty-four attended college and three out of this number took advanced degrees. The ages of the men studied indicate that from fifty to seventy are the years when large leadership capacities come to fruition. Only two men of the group are in the 30-40 year decade, further age grouping being, by decades—40-50, 13 men; 50-60, 34 men; 60-70, 35 men; 70-80, 14 men, and over 80 years of age two men.

An analysis of the first jobs indicates that white collar beginnings just about break even with "blue shirt" beginnings. The largest number, in any one class of first jobs, is represented by clerking. One out of ten of the men rose in a direct line, that is, their positions today are the direct results of humble beginnings in the same company or in an allied line. Law and teaching have contributed several leaders to industry according to the study.

Self Expression

THAT it is essential for the engineer to be well versed in the art of public speaking should become evident in this day of radio broadcasting, financial drives, and verbal reports to city councils and boards of directors. Even the young engineer in presenting an idea to the head of his drafting room needs to be skilled in marshalling his ideas if he would be convincing.

With the desire of fostering public speaking among engineers, the educational committee of the Associated Technical Societies of Detroit has assisted in forming an intercollegiate debating society. Seventy engineering students at the University of Michigan debate or "wrangle" once a week, under competent guidance. Debates are also held with other institutions. Engineering students at the Detroit Institute of Technology, Northwestern, Michigan State College, Ohio State University and Purdue University have also become interested in the movement with the prospect of a series of debates on engineering subjects lying in the future.

When advancement comes, can Minnesota be far behind?

As has been said before, the time when the engineer was employed merely to compile statistics and juggle figures belongs to the decade of the hoop skirt and wasp waist. Engineers of today are specifically trained for leadership,—yet how can there be true leadership, when graduate engineers are lacking in those fundamentals of self-expression without which there can be no verbal transmission of ideas or stimulation of action. The Techno-Log has bemoaned this state of affairs in the past, has deprecated the abundance of Tongue-tied Technicians that issue from these halls of learning stamped as engineers. In fact, a survey was made of the public-speaking courses offered in the College of Engineering. The classes were found to be poorly attended, and what is more, poorly conducted.

Yet the Powers have failed to act.

There is no doubt but that engineers are woefully lacking in the fundamentals of self-expression. And there is no doubt but that it is possible to improve the engineering curriculum at Minnesota by offering more and better courses in public speaking. Now with the formation of intercollegiate debating societies, a new field has been opened which is probably more certain to develop the powers of oral expression than any other educational method. Let the College of Engineering and Architecture and the School of Chemistry be not backward in following the example of other engineering institutions; let them not hesitate to be known as pioneers.

FACULTY SKETCH

CLIFFORD I. HAGA

CLIFFORD I. HAGA, instructor in the Department of Engineering English, was born at Granite Falls, Minnesota on November 11, 1902. Mr. Haga, of pure Norwegian ancestry, spent his grade school and high school years in a rural school. Two years after he graduated from high school, he entered the University of Minnesota, graduating in 1925. Mr. Haga spent a year in New York, N. Y., immediately after his graduation. From New York he went to take a position in the department of English at the University of Illinois, where he taught for two years before coming to the University of Minnesota. This is his second year here.

He expresses himself as greatly interested in the special problems met with in Engineering English and is sufficiently optimistic to think that they can be solved by the magic formula of "More English—if possible," rather than by the other: "Less English."

The summer of 1926, Mr. Haga traveled in Norway. This summer he will return to Norway, where he and his wife will make an extended tour of the country on their wedding trip. Besides making it his honeymoon, he has other reasons for the trip. He intends to get to Norway in time for the 900th anniversary of the death of St. Olaf, who christianized the country, and was killed in a battle at Stiklestad about one mile from Haga, Verdalen, Norway. Mr. Haga also plans to be present at the rededication of the cathedral at Trondhjem, one of the best examples of English Gothic in Europe, construction of which was begun early in the Thirteenth Century.

Mr. Haga and his wife will go on a two week's walking trip through the mountains of Western Norway, crossing the Jostedalsbrae, the largest glacier in Europe, and climbing the two highest mountain peaks in Norway.

Mr. Haga is very much interested in Scandinavian literature and history. He has had some training in Scandinavian philology. He is also interested in writing. However, so far most of his literary works, in print since his leaving college have been written in Norwegian. Last summer he worked in New York, on the Encyclopedia of the Social Sciences in the capacity of editorial assistant. He has also done some translating from the Norwegian language.

Let's Go!

FOUR years of hard work, to some of us it is more, with a few good times as our inducement to withstand the strain. We feel we have done our best in accumulating a smattering of technical knowledge, perhaps gotten an idea of how to make engineers of ourselves if given time and then it is all over and we are thrust out into the world. All the outside evidence of having attended an up-to-date university we can show is a sheepskin the size of a calling card and if we are fortunate a few keys to dangle on our watch chain. We will aways contend it has been worth it even though we have felt discouraged at times when we saw our grades posted for other eyes as well as our own but even at that, we maintain that there are worse things than being socalled "dumb." Even if we do feel as if we have committed a crime when called before the committee, the penalty of being forced to drop connections with the Alma Mater would hurt us far more than having to serve three months of our "time" to find if we were worthy of "parole"; we usually are, and then it is much to our interests to get back into good standing. But along with our interest in studies should come interest in other things, for it has often been said that education is a broadening in more ways than one. Our chance to broaden ourselves is in taking part in campus activities.

If we have never taken an interest in what was going on outside of the regular curriculum we have certainly missed something—we may never know what we missed but just the same we will have that guilty feeling that we did not do our part in making the doings of the Engineers the talk of the campus. We overheard a senior civil talking about the Arabs. He said, "I never had so much fun as I did when we were getting the last production worked into shape." And other Arabs will give similar answers when asked in what activities they enjoy participating. The date of the Arabs next production is not far off. Why not try out and get in on some of the fun?

Engineers Day is one of the big events of the year. Every Engineer knows about the legends of St. Patrick and the Blarney Stone, two splendid traditions to be carried out annually, but alone, without backing, they are mere figures. St. Pat, his queen and the Stone must have a big parade displaying plenty of that engineering originality and to make the day a snappy turnout for the dance that marks the end of their reign. Engineers of the past have made this a day closely watched by the whole campus. The Administration has given us a holiday; it is up to us to fill it with enough excitement to last for a whole year. Let's turn out Engineers, one year, two years, or just three months left, compared to the time after we graduate, none of us have long to contribute to the old school spirit.

Machines

EDUCATION has become the watchword of the present generation, much like freedom was the continuous cry of our forefathers. Each succeeding year has seen the number of students in secondary and higher educational institutions increase by leaps and bounds. The rise of trade schools, correspondence courses and even the use of the radio have altered the educational program of the twentieth century from that of previous years. The last decade has developed the radio from a child's toy until today it is considered a potent means for disseminating knowledge. With all due regard to the radio, it must be remember that knowledge is short of true wisdom. Knowledge must be digested before it is of benefit to the human system. The present certainty finds us with a greater quantity of knowledge, but has our capacity for digestion been increased? It is doubtful.

The signs of the times,—the machine-like precision which characterizes modern America, the "high pressure," and all the dirty grime of this struggle for efficiency, where is it leading us? And what of individuality?

ABOUT THE WORLD WITH OUR ALUMNI

Architectural Engineering

'23—John M. Newman is now living in Milwaukee. He is a member of the board of directors of the Minnesota alumni organization of that city.

'26—W. Dewey Gerlach, who is now located in Mankato, Minnesota, is to build a million dollar canning factory in Russia.

'28—John Davidson is building a bridge across Susanbay for the Southern Pacific Railway.

Chemical Engineering

'24—Karl F. Paul now lives in Niagara Falls, New York, where he is working for the Roessler and Hasslacher Chemical company. Four other Minnesota graduates, Frank J. Dobrovolny, Theodore T. Brudow, Roscoe E. Jackman, and Oscar C. Schermer, are also working for that company.

'27—Marjory Crawford will be an assistant professor next year at Vassar College.

'27—Bernard M. Marks is installing a new research laboratory at Arlington, New Jersey, a suburb of Newark, for the DuPont Viscoloid company. This laboratory will re-establish the company's research headquarters at Arlington.

B. Bren, an undergraduate here who finished his course at the University of Iowa, is to be in charge of the laboratory.

Civil Engineering

'08—Henry K. Dougan is now executive assistant of the Great Northern Railway company. After his graduation, Mr. Dougan served the Great Northern Railway. About a year later he resigned to accept a position with the Idaho and Washington Northern Railway company. In August he was appointed assistant engineer for the Great Northern and since then has continued with this road and has successfully moved from that position to the positions of assistant valuation engineer, assistant statistician and assistant general auditor.

'11—G. C. Mattison will soon arrive in the Philippine Islands to take command of one of the ships of the United States Coast and Geodetic Survey.

'23—Carl E. Aslakson and his wife and his son left the Philippine Islands last month to return to the United States by way of Europe. Mr. Aslakson is completing his tour of duty as executive officer on one of the United States Coast and Geodetic Survey ships.

'27—George E. Morris recently helped rescue the entire crew from a sinking Japanese steamer. The United States Coast and Geodetic Survey ship on which he is working picked up the SOS while along the southern Palawan coast.

Mr. Morris, who is stationed at Manila, Philippine Islands, has been working on a survey of the east coast of Luzon. The boat has touched at places where very few white people have been. During the season they were caught in a typhoon and lost two small boats, although no other damage was done.

'29—I. E. Anderson, Carl Eyberg, David Erickson, Edward Post, F. S. Anderson, and W. W. Anderson are in Washington, D. C., as junior engineers with the Interstate Commerce Commission. They expect to be transferred within a year to other departments.

'29—Melvin Eck is with the DuPont company in Charleston. He drove home last month in his new Ford.

'29—Kenneth Melin has been overworked as a foreman for the J. J. Shirley Readymix Concrete plant and is now in California looking for a job. A. A. Anderson is with him, also looking.

'29—J. Grant Waits is living in Duluth where he is working as a supervising engineer for the Duluth and Iron Range Railway. He is married and has a daughter.

Karl Eggen is also in Duluth with the United States Engineers.

'29—Abner Bjork and Cecil Burch are in Milwaukee with the United States Engineers.

'29—Delbert Heath is finishing his aviation training at Pensacola, Florida.

'29—James Hartigan has been forced to leave the United States Engineers and is trying to regain his health.

'29—Bob Lohn is with the Joliet and Eastern Railway at Joliet, Illinois.

'29—Nordahl Rykken was recently seen by Dean Leland while on a trip through the University of Arkansas. Nordahl expects to return to Minnesota next fall for graduate work with a fellowship in civil engineering.

Electrical Engineering

'03—I. A. Rosok has again been elected president of the Bisbee, Arizona, Y. M. C. A.

'04—V. E. Goodwin was recently appointed managing engineer of the lightning arrester, cutout and capacitor department of the Pittsfield Works of the General Electric company. Mr. Goodwin, who has been with the General Electric company since his graduation, was formerly with the test and power and mining department. He holds several patents, is a member of committees of several national electrical organizations, and has published several articles.

'20—C. R. Price and John M. Newman, '23, are living in Milwaukee. Mr. Price was formerly president of the Milwaukee alumni unit and Mr. Newman is a newly appointed member of the board of directors.

'23—Roy Olson is now an attorney and counselor at law specializing in patent, trade mark, and copyright cases. He has offices in 1133 Monadnock building, Chicago. Mr. Olson was formerly a patent attorney for the Western Electric company.

'24—B. C. Treka is now at 22 West Monroe, Chicago, with the Federal Service Corporation, a part of the United Power Corporation.

'24—Archie McCready is now patent attorney for the Western Electric company, Hawthorne plant, at Chicago. He succeeded Roy Olson.

'25—Clarence W. Thyberg, now at 195 Broadway, New York City, is in the office of the vice-president in charge of the traffic of the Western Union Telegraph company. Enan C. Johnson is also somewhere in New York City.

'25—Joe Meagher is growing gray hairs down along the Gulf coast. He is with the Curtiss Flying Service and has been down south "trying to induce natives and visiting Chicagoans to 'take the air.'" The weather is great but the fogs are very nice for aviators' gray hairs.

'26—R. A. Beveridge is in Fort Wayne, Indiana. He is a commercial engineer for the General Electric company. Mrs. Beveridge, a University of Minnesota graduate of '27, is assistant librarian in the business and technical departments of the Fort Wayne and Allen County Public Library.

'26—Paul Nelson is living an exciting life in Chicago according to a letter of his appearing in the Alumni Weekly. Here it is:

"Bombing: We live in a rather peaceful part of Chicago on the near North Side. After midnight the noise of traffic dies down, and when Lake Michigan's fog horns shut up, nothing can disturb our sleep.

"But of late, a harsh note has disturbed our peace—a cab starter's whistle, blown persistently from two to six in the morning. This was the doorman at 'Algiers,' a new night club housed in a one-time stable on St. Clair street. Very elaborate it was, with a complete bar in the basement and a negro orchestra in the old hayloft. Membership cards were required for admittance.

"Last Friday evening, reading in the lounge, the copy of Time was nearly blown out of my hands by a blast that shook the building. Out went the windows for a block. Out came a dozen fire engines. And out into the rain I ran, along with hundreds of other northsiders.

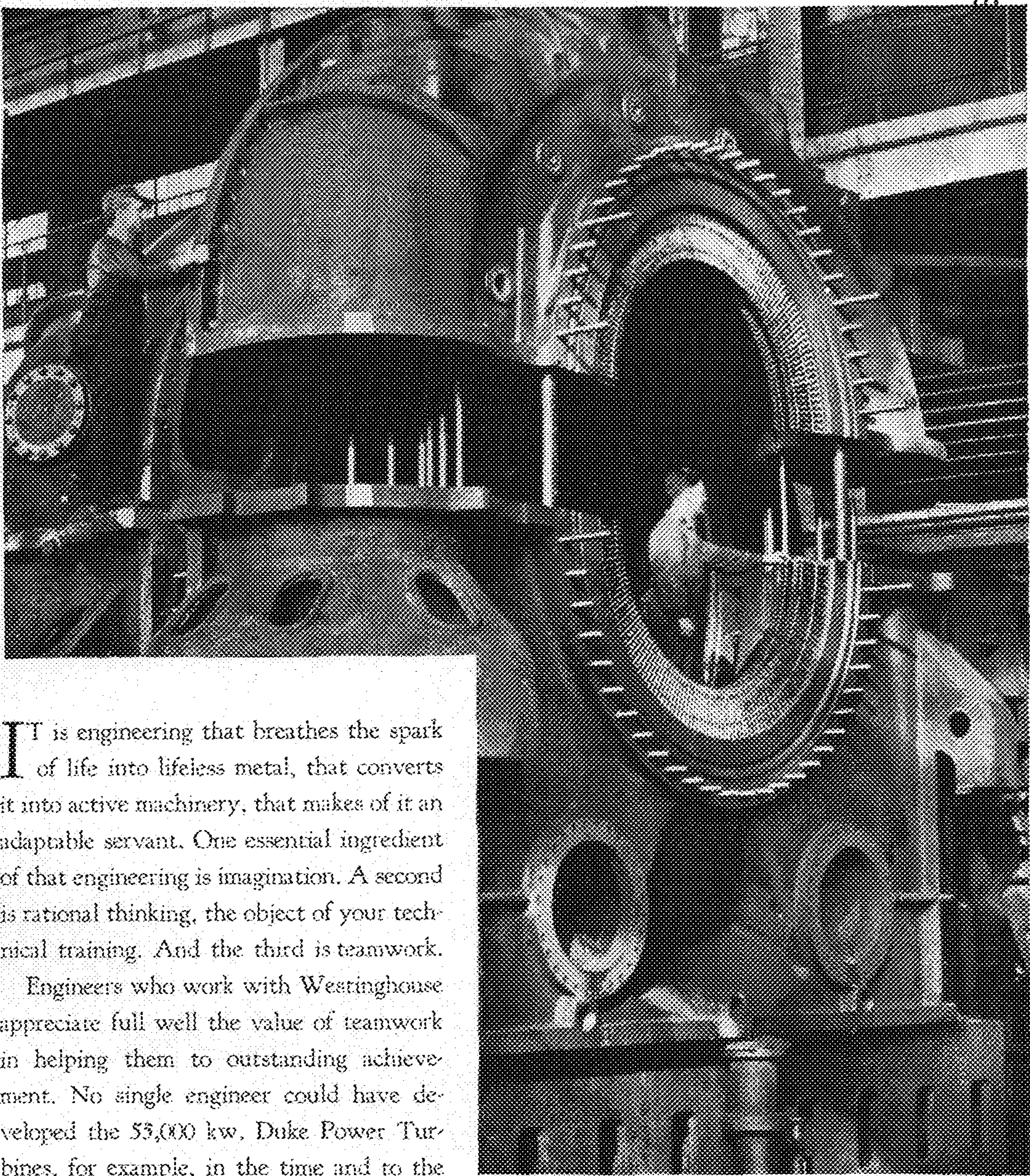
"It was the Algiers all right—bombed in the rear—right near the orchestra loft. This was to be Algiers' last night with an opening in the loop Saturday. And this bomb was a gentle reminder from a rival gang of racketeers for the management to stay out of their territory.

"News photographers appeared, methodically puffed their flashlights and beat it back to their offices to await another call. A black and yellow squad car appeared and then went back towards Lincoln Park. Firemen finished breaking windows in neighboring loft buildings. It was all over.

"With typical exaggeration, the local Hearst papers faked a few facts—'Subdeb Injured—Piano Hurled Ten Feet—Flying Splinters,' etc., etc., and carried a three inch headline (instead of the usual two inch). The other papers merely chronicled it as our nineteenth bombing for this year.

"I repeat—a great place—Chicago."

DEAD METAL LEAPS TO LIFE
at the hands of Westinghouse engineers



The 55,000 kw. turbine-generator units that Westinghouse built for the River Bend station of Duke Power Company are the largest in the South.

IT is engineering that breathes the spark of life into lifeless metal, that converts it into active machinery, that makes of it an adaptable servant. One essential ingredient of that engineering is imagination. A second is rational thinking, the object of your technical training. And the third is teamwork.

Engineers who work with Westinghouse appreciate full well the value of teamwork in helping them to outstanding achievement. No single engineer could have developed the 55,000 kw. Duke Power Turbines, for example, in the time and to the degree of perfection that the Westinghouse organization did.

Here teamwork extended back to the date when George Westinghouse brought the steam turbine to America. It included men who have made life studies of vibration, of blade design, of the effects of superheated steam on metals. It embraced the foundrymen who made the huge castings required, and the packers who have mastered the science of shipping giant machinery. And it took in also the business men who create a market for such machinery and who cement together the many-fold activities of the Westinghouse institution.

Westinghouse

WHAT YOUNGER COLLEGE MEN ARE DOING WITH WESTINGHOUSE

W. F. BOYLE
Pratt Institute, '27
Turbine Sales

R. H. HANNEY
Tuft's, '26
Condenser Sales

R. S. THATCHER
Drexel Institute, '27
Production Department

H. B. RASMUSSEN
Copenhagen (Denmark) Institute of Technology, '20
M. I. T., '22
Turbine Engineering

J. C. HARPER
Lafayette College '29
Turbine Sales

HOW TO GET A PATENT

(Continued from page 223)

ventor the needless greater expense of filing the application for patent. In such instances, the attorney will explain in detail the nature of the prior patents found, and just why and to what extent they will limit you in getting a good patent, so you can decide for yourself whether or not you want to proceed, in spite of such prior art.

Even Weak Patents Are Sometimes Profitable

It is sometimes wise to take out a patent, even if you know it's going to be a weak one; since any patent may be said to have, besides its real or *protective* value, also both an *advertising* value, and a *restraining* value. Its advertising value is its effect, from an advertising viewpoint, on the public mind, which dignifies and elevates the importance of an invention which is patented, by virtue of its having passed a certain government test, the exact nature of which is little known to the public, and its value often over-estimated. And its restraining value is the *presumption of validity and strength* assumed to be in every issued patent, rightfully or wrongfully, by this same unlearned public. For if a patent, no matter how weak, frightens a competitor from infringing it because ignorant of its weakness, it accomplishes the same purpose in that instance as though strong enough to stand up in a court contest. In fact, it is astonishing how often shrewd business men will contract to pay for the rights under patents which are of so little value as to be easily avoided, and so open to public use without charge.

If the preliminary search reveals nothing published like your invention, or if for some such other reason as the above you decide to file an application, you should next have a clear understanding with the attorney as to the cost of doing the work. It will be fair to both of you if he sets a definite sum merely to prepare and file the application (because he can gauge that far the extent of his service needed), and an additional sum for each amendment which it may later be necessary to prepare during the prosecution of the application into a patent. In this way, you have the ultimate cost largely in your own hands, and you prevent him from charging a too high fee for contingencies which may not happen in your case.

> *In our next issue, Mr. Whitman will explain further the importance of many broad claims to give a patent proper protection, show how the application is completed and filed and afterwards prosecuted by amendments to allowance, advise on certain patent office complications which sometimes arise, such as interferences and the requirement for division; he will discuss the advantages of keeping patent applications pending, tell us about how to correct a defective patent by re-issue, and also how to avoid risk of abandonment of one's patent rights.*

The Cost of a Patent

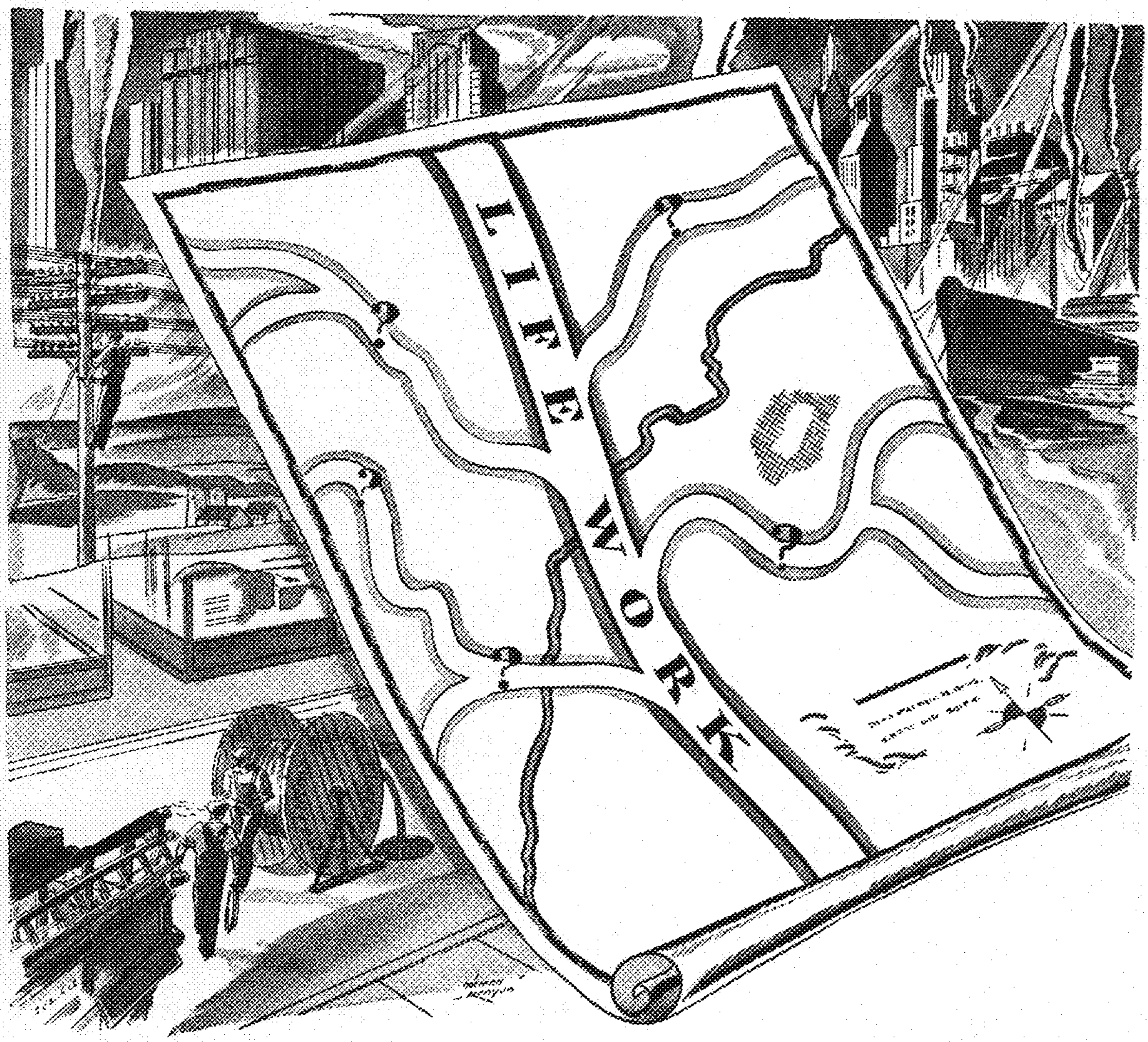
The cost of preparing and filing a patent application on a simple invention involving not more than one sheet of drawings, should be in the neighborhood of $125, but it may be more or less depending upon the skill and reputation of the attorney. This amount includes the government filing fee of $20, the draftsman's charge for the drawing, and the fees and other expenses of the attorney. More complicated cases are, of course, correspondingly more expensive. And where the attorney has to leave his office, as to inspect a machine in some shop, he of course must charge you extra for his time and traveling expenses.

The attorney's charge for each amendment, while the case is being "prosecuted" or contested with the Patent Office, before allowance, is often about $25, where there are no unusual complications. Sometimes only one amendment is necessary in order to get all the protection to which the inventor is entitled. More frequently, however, two or three amendments are made, and in very important cases, especially if the invention is at all technical, five or six, or even more, may really be necessary. It all depends upon the state of the prior art, the thoroughness with which the invention has been claimed in the application, and the skill and aggressiveness of the attorney who prosecutes it.

This is the hardest part of the work, and requires the greatest skill. *Also, it is usually the part that is badly neglected, and responsible for the greatest loss of rights to the inventor.* Therefore, you should here cooperate with your attorney in every way, and provide him with sufficient funds to do the work properly.

The definite amounts stated above as

(Continued on page 230)


LIFE WORK

HOW TO GET A PATENT

(Continued from page 228)

being the usual cost of a patent, are merely representative, and to help the inventor gauge in a general way whether he is paying too little or too much. And of the two, shun the first as you would the plague. Nowhere is the old adage, "You can't get something for nothing," more true than in patent service. Trying to save a few dollars here may mean a loss of thousands later on, through your patent being worthless. The skill of an attorney is as vital to an inventor's success, as a doctor's skill in a serious illness may be to his life.

Cooperating with the Attorney

The inventor should now take a keen interest in the preparation and prosecution of his case. He should possess sufficient fundamental knowledge of the work to be done to have an intelligent appreciation of his attorney's work: know when to leave him alone and when, perhaps, to offer some constructive suggestion; and when to tell, in plenty of time to correct the situation, if the attorney's work is not up to standard, and ought therefore to be augmented by some other counsel, or in extreme cases, substituted for.

Remember always that the law permits you to substitute another attorney at any time. You have merely to consult the new attorney, and request him to prepare a new "power of attorney" in his favor, so worded that all former powers are revoked. You then sign this paper, which he forwards to Washington, and the former attorney is notified by the Patent Office that he no longer represents you. That is all there is to it.

The inventor should begin by frankly disclosing to his counsel every portion of his invention, for the disclosure must be complete if the patent is to be valid. If any necessary part of the invention is omitted from both drawings and description when the case is filed, it becomes "new matter," which cannot thereafter be included, resulting either in total loss of rights, or at least in needless expense for filing another application on the omitted part.

The more, then, that the inventor knows about the attorney's work, the better off he is. These following facts should therefore be carefully noted.

The Complete Disclosure

The attorney first has a drawing made of the invention, if it is mechanical in character. This should cover every essential detail, as conceived by the inventor. Any attempt to limit the disclosure to the part of the inventor's idea which it is thought represents invention may be responsible for great loss to the inventor later on. Fortunately, no really reputable attorney will risk being a judge in such matters. That is solely the function of the Patent Office Examiner. The attorney's is, properly, always constructive, never destructive. And even the Examiner is never properly antagonistic to the inventor's just rights, but instead resolves all doubts in his favor, and aids with constructive suggestions when possible.

Acting upon this idea, then, the skilled attorney will have the draftsman put into the patent drawings every essential detail of the invention as conceived by the inventor; for later on, it might well happen that some such apparently inconsequential detail is the really valuable part of the invention.

Clear, understandable drawings, well executed, showing not only the essential features of the invention but the necessary details as well, are a great aid in getting a good patent. They help the Examiner to a rapid and clear understanding of the nature of the invention, and leave his mind free to determine those features which are patentable by comparison with the prior art.

Good drafting work, also, helps the attorney to prepare a better case. And finally, it makes the patent more salable after it issues, by making it more understandable to most manufacturers and investors.

The best patent draftsman combines the skill of the mechanical draftsman and the freehand artist. Particularly in complicated mechanical cases, he is able, by the use of perspective views, partly cut out, or "in phantom," to show clearly in a few figures on one or two sheets, what could only be shown dimly in many figures on many sheets, when using flat plane views, such as side and top elevations.

One of the figures of the drawings should, by disclosing the most essential feature of the invention, be made adaptable for illustration in the Official Patent Office Gazette, where it appears the week the patent issues.

Preparing the Specification

When the drawings have been prepared, the attorney then begins work on

(Continued on page 234)

THOUGHTS ON THE NATURE OF MATTER

(Continued from page 217)

rated from solutions or from each other. Even the great chemist Van t' Hoff spent his entire last years in Berlin, employing Gibbs' phase rule to unravel the mysteries of the great natural Stasfurt salt deposits in Germany.

In 1894 Ramsay and Rayleigh discovered argon in the atmosphere. It had previously escaped observation on account of its chemical inertness. Following the property of inertness and using the methods of fractional distillation, Ramsay quickly brought to light the rare elements in air,—helium, neon, krypon and xenon, thus completing the work begun by Priestley 120 years before. Today we have helium filled air ships, argon-filled electric lamps, and neon-filled electric advertisements.

In 1896-8 the most startling discovery was made in chemistry since the discovery of oxygen, namely that many of the heavy elements are not stable—but decompose spontaneously, with emission of energy, into lighter elements and helium. This is, of course, the property which we call *radioactivity*. Its discovery and early development is associated with the names of Becquerel, Pierre and Marie Curie, Rutherford, and Soddy. Its investigation quickly gave us 35 or 40 new elements, which have not only been successfully fitted into the Periodic System but have given to it a new importance and a genetic law bringing the radioactive elements into conformity with all its previously known principles and thus establishing a law of evolution in inanimate matter.

In order to bring all of the forty radioactive elements into the twelve available places in the periodic system, it was necessary to put more than one element into the same place. Soddy therefore called them *isotopes*. Their identity in all chemical and most physical properties was previously known from the failure of Boltwood to separate thorium from ionium and of Soddy and others to separate radium from mesothorium. This new principle of isotopism led Thompson and Aston to seek isotopes or new species of elements among the ordinary non-radioactive elements. They separated and weighed the species differing from each other only in mass—not in a gravity field but in balanced electrical and magnetic fields. This method so far has disclosed that more than half of the sixty or more elements that have been examined are composed of two or more isotopic species, some of as many as eleven.

Quite recently a still more refined method of weighing isotopes has been discovered, namely, by means of the vibrational band spectrum of some compound of the element in question. By this means it is found that oxygen in the atmosphere is composed not of O^{16} atoms alone but of 1 part in 650 of O^{18} and of 1 part in 10,000 of O^{17} atoms. A few years ago it was a question whether isotopes of the same element would exhibit any spectral differences. Only the most delicate interference methods then available disclosed them. Today such differences are being used to discover new isotopes.

Besides the different *atomic* species of many of the elements, a new type of kinetic isomerism in *molecules* was predicted by Dennison in 1927. In 1928 Giauque and Johnston partially confirmed the prediction in the case of the hydrogen molecule and in 1929 Bonhoeffer and Harteck gave a complete confirmation of the theory and prepared para-hydrogen practically free from the

(Continued on page 240)

HOW TO GET A PATENT

(Continued from page 230)

the "specification." This is a description, in detail, of the construction and operation of the invention. It should begin with a few paragraphs broadly stating what the invention is, and what it seeks to accomplish, and also how it compares with the prior art.

As regards this last, however, care should be taken to make no negative statements regarding the extent of the invention. When this is neglected, the inventor sometimes finds himself in the position of having disclaimed an essential part of his invention, through such limiting or negative statements made by his attorney in these opening paragraphs. It is a frequent point of attack by opposing interests during patent infringement suits.

Next in order in writing the specification is a statement describing what each view of the drawing is and what it is intended to show. After that a complete detailed description is given of the parts or "elements" of the invention, each element being referred to by a different number on the drawings, the same numerals being used throughout the several views. Then follows an explanation of the exact operation of the invention.

Throughout the whole description the skilled attorney will be careful to use various broadening statements and alternative words, when describing the different parts, to show clearly that the inventor's conception is not limited strictly to the particular disclosure, but contemplates broadly any equivalent which will act in lieu of the various elements to perform the real invention which the patent seeks to protect.

The Claims Are the Most Important Part of the Patent

Now follows the very vital part of the patent, namely, the "claims." These are a series of paragraphs, numbered consecutively, each containing a statement of one or more of the elements in combination, together with certain limiting or descriptive expressions modifying them. These claims are by far the most difficult part of the patent to write, and require the highest skill in an attorney to completely protect the invention. For he must so thoroughly claim all of the invention as to prevent a competitor from making or selling not only the complete device disclosed in the patent, but every essential part in its various patentable combinations with other parts.

The greater the attorney's ability to state the broad invention in inclusive language, and which will yet fall within the disclosure, the more valuable the patent will be. The rare knack of disregarding details, and getting at the real kernel of the invention is here practically indispensable. It is through lack of such ability that many patents, otherwise sound, are vitally defective, and often in such manner as renders them uncorrectable later on. For when the patent issues, the inventor is presumed to have dedicated to the public every part and combination of the disclosure which he might have claimed as his own, but which were either claimed in more specific combinations, or not at all.

Writing the claims to fully protect an invention calls for super-inventive ability of a high order. In addition, the attorney must have an absolutely accurate and complete vocabulary of technical terms, a thorough knowledge of the sciences, such as physics, chemistry and mechanics, and be must be fully versed in the intricate and voluminous decisions bearing upon claim construction in patents. For instance, he must fully understand that phase of the law called the "Doctrine of Equivalents."

(Continued on page 236)

HOW TO GET A PATENT

(Continued from page 234)

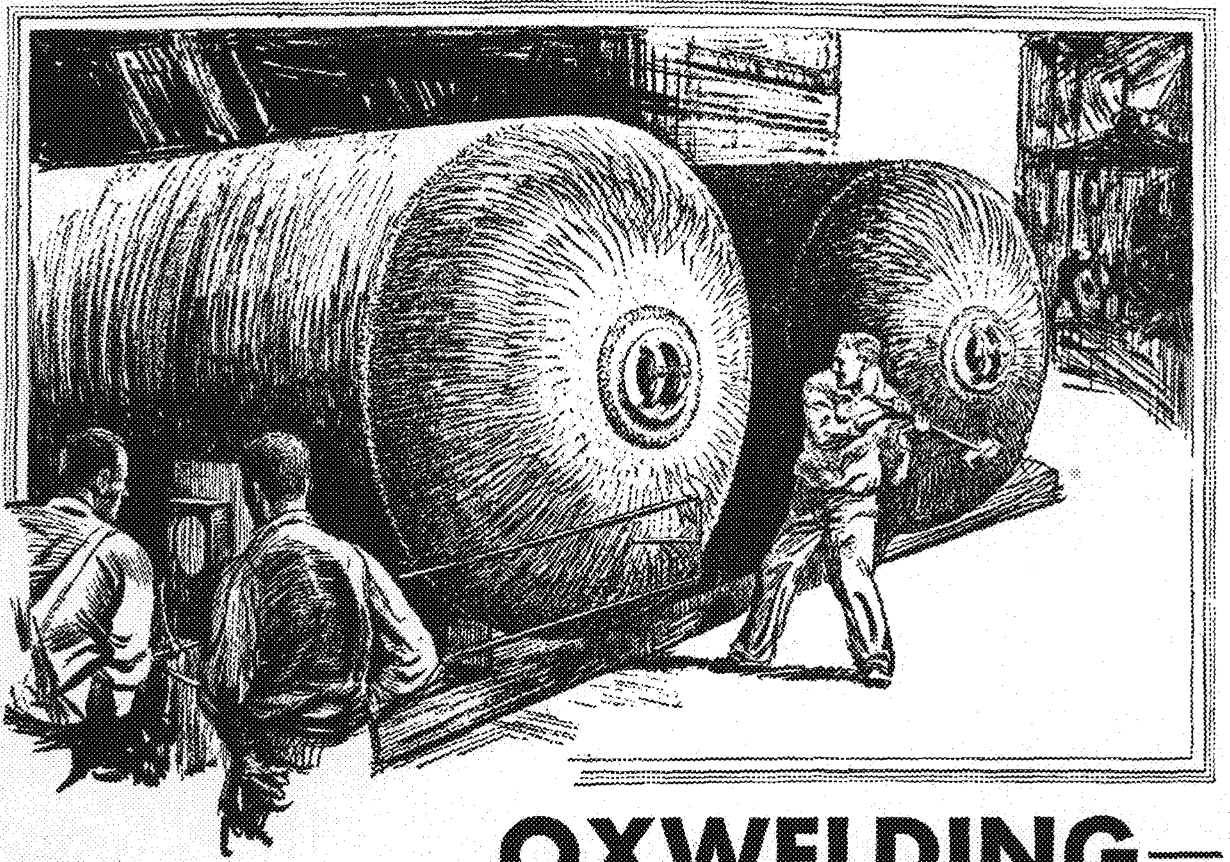
This doctrine gives the inventor certain additional protection over the exact wording of his claims, should they later come up in court for adjudication as to their scope, or inclusiveness. Its extent is in proportion to the inventor's advance in the art—that is, how basic or how specific an improvement his invention is, when compared with what has gone before. If his concept is far ahead of all others, and so quite basic, the wording of his claims, even if somewhat specific, may be held to extend considerably beyond their exact meaning, and so sometimes catch an infringer whose device may not exactly fit the claims as worded. If, on the other hand, as is usually the case, the inventor's concept is a minor improvement over the prior art, the Doctrine of Equivalents operates in his favor almost not at all, and he is held to be limited practically to the exact wording used in the claims.

Certainly, the safest plan to follow when writing claims, is to disregard any possible later help from this doctrine, and instead claim the invention as broadly as possible.

It is well to repeat that the whole protection of a patent resides in the claims, and almost wholly without regard to what the description and drawings show, notwithstanding these last make up the bulk of the patent. But if this disclosure is not complete, or is found later to be inoperative, the patent is held to be invalid.

Another, but rarer, use of this disclosure, is as an adjunct to the claims. It helps to interpret and clarify them, particularly where there appears to be ambiguity or indefiniteness in their wording. Sometimes when such a patent is being litigated in the courts, it is nec-

(Continued on page 242)



IRON MINING IN THE LAKE DISTRICT

(Continued from page 221)

steam or electric shovel, which has been developed and improved almost entirely as a result of its extensive use in these mines.

Iron ore that cannot be recovered economically by open-pit operations is mined by underground methods, of which there are many different systems in use, since each ore body offers its own particular mining problems and difficulties. Perhaps the most common method employed is that of top-slicing, in which a shaft is sunk just outside of and to the bottom of the ore body. At the bottom of the shaft a main haulage drift or level is driven and developed. Raises are then put up from this main level to the top of the ore body, and from them subdrifts and levels are driven and developed at vertical intervals of from twelve to fourteen feet. The ore in the top sublevel is mined first, being removed in horizontal slices after the subdrifts have been driven to the property line or ore limits. Then the surface is caved, after which the next lower sublevel is mined and so on until the main level is reached. Such ore, mined in slices, is trammed through the subdrifts and dumped into a nearby raise. It is collected at the bottom by cars and motors on the main level and is then transported to a shaft pocket and hoisted in skips to the surface. During the summer months the ore is loaded direct into railroad cars. In winter, when navigation is closed, it is stock-piled to be reloaded into railroad cars with the opening of the shipping season.

The increased cost of labor and supplies has likewise made it necessary to turn to mechanical and labor-saving equipment in underground mines. In drifting work where mucking was formerly done by hand, mechanical loaders or scrapers are now used; modern high-speed drills are in action where formerly the slow, laborious hand-augers were employed; and in the slices and sublevels where ore was previously hand mucked into small cars which were hand trammed and dumped into raises, electric double-drum scrapers now convey the ore direct from the blasted pile into the raise. Such advancement is only logical, for underground costs must relatively keep pace with those of open-pit operations.

Since the ore varies in natural iron and other mineral values, depending upon the composition, it is sampled and analyzed before shipment. Each operator is allotted a number of pockets in the ore docks, into which ores of similar analysis or desired grade are dumped and stored until tonnage sufficient for a cargo has accumulated. Then it is loaded into a boat and transported to a lower lake port.

Railway and lake transportation equipment has developed hand in hand with that used in the mines. Wooden cars of thirty tons capacity once served to haul ore from the mines to the docks, but they have given way to all-steel cars of fifty and seventy-five tons capacity at the present time. Huge modern locomotives can now pull, in most instances, a sufficient tonnage of ore from mine to dock in one train load to completely fill an ore boat of average size.

Large fleets of boats, maintained by various steel companies and independent interests, are kept busy throughout the shipping season transporting ore from the Lake Superior docks to those lower lake ports located most advantageously to the blast furnaces. Some idea of the magnitude of this lake carrier industry alone may be gained from the fact that approximately 350 vessels with a total trip capacity of almost three millions of tons of ore will be in operation during

(Continued on page 240)

NATURE OF MATTER

(Continued from page 232)

orthoform. They found that ordinary hydrogen is composed of about 75 per cent of one and 25 per cent of the other form. It is not improbable that similar isomeric forms of other molecules will be discovered in the near future.

Rutherford first found that when gaseous nitrogen is bombarded by alpha particles from radioactive material that very rarely one strikes the nitrogen nucleus so directly that a swift proton is ejected. By using a moving picture camera to photograph the fog tracks of the particles in nitrogen it was found by several observers that the alpha particle which is a helium nucleus sticks in the nitrogen nucleus when expelling a proton. The resulting nucleus should have three more units of atomic mass and one more unit of positive charge. It is therefore no longer an atom of nitrogen but an isotope of oxygen of mass 17 instead of the usual 16. We may express the reaction as:

$$N^{14}+He^{4}=O^{17}+H^{1}$$

Since O^{17}, as we have seen, has been found in the earth's atmosphere to the extent of 1 part in 10,000 of the O^{16} atoms, it is interesting to calculate from the known amount of radium emanation (gas) in air (10^{-10} curies per cubic meter) whether its alpha radiation could within a reasonable geological period have generated the amount of O^{17} which we find now in air. The result is 10^{14} years, a period much longer than we can allow. It seems, therefore, if O^{17} was ever generated at all by this process, that it was mostly not in our atmosphere, but either elsewhere in the universe and came to earth as primordial gas, or else it has been generated in the earth's crust and reached the atmosphere by diffusion. It would lead too far to discuss the latter possibility.

From having had 90 elements we are now reduced to two, the electron and the proton—even fewer than the five which the ancients had. The electron is the atom of negative electricity, and the proton the nucleus of the hydrogen atom and apparently the atom of positive electricity. Even these two may mutually destroy each other with the generation of energy. Of the degradation of matter to lower forms, we can have no doubt; of the building up we have no evidence on the earth, except in a very exceptional case to be mentioned again. But Millikan has interpreted the cosmic rays as the energy emission accompanying the building of atoms out in space, or as the newspapers have vividly put it, "the birth pains of matter."

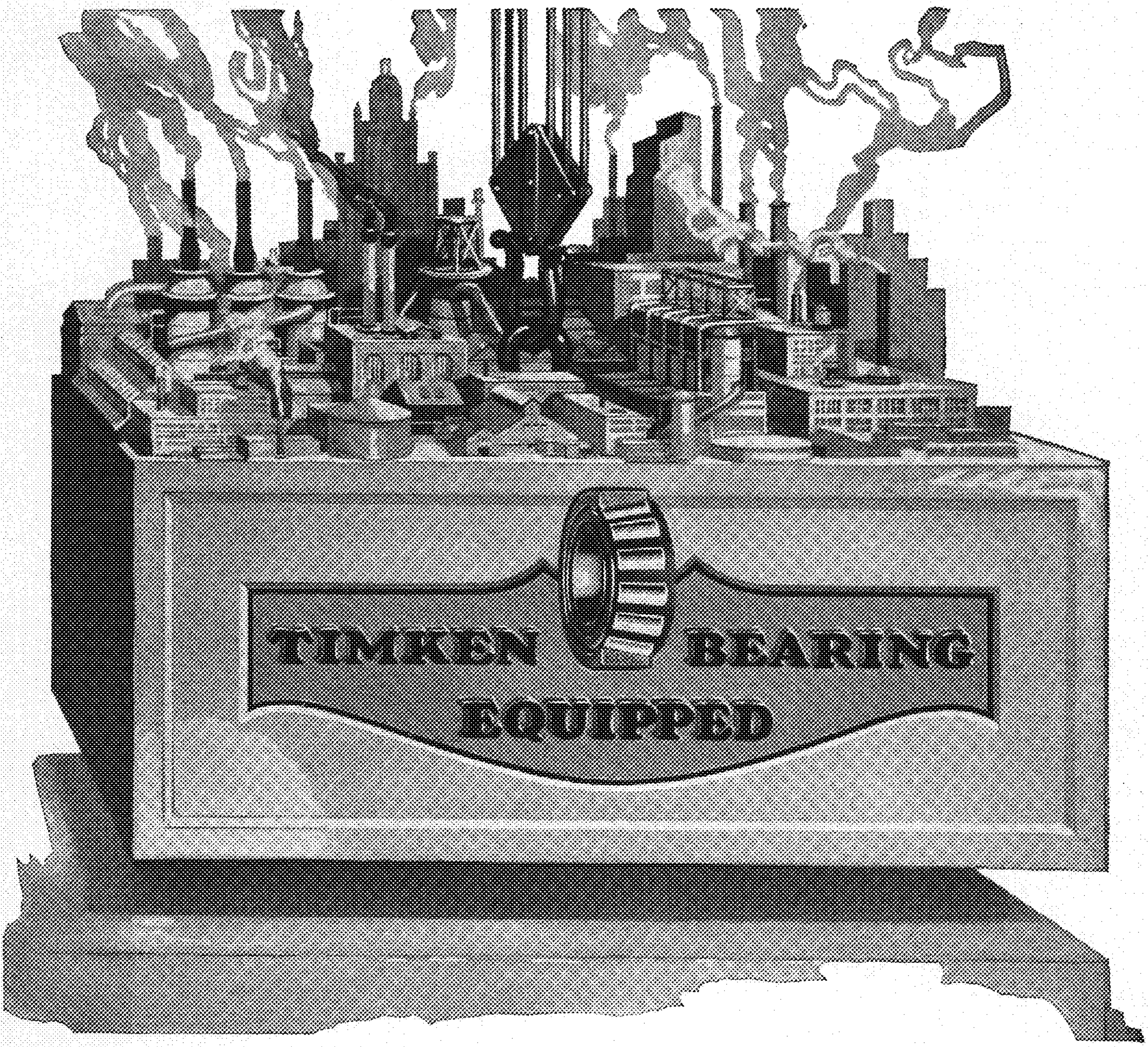
MINING IN THE LAKE DISTRICT

(Continued from page 238)

the present season. Lake Superior has long been noted, among vessel men and shippers, for its severe storms and dangerous channels. Navigation is especially treacherous in the early spring and late fall months because of bad weather and ice conditions. Often, at these times, large fleets of ore boats are caught in the ice and delayed for days.

Within recent years, blast furnaces and steel mills have been constructed at Duluth, Minnesota, mainly for the manufacture of wire and nail products. This within a radius of seventy miles from the city of Duluth, one can see the raw iron ore taken from the earth, converted into pig iron, steel and various finished products.

Living and working conditions have long been recognized as vital to the progress of the industry, and they have steadily improved. Each employe's health and welfare while at work is guarded by the most rigid enforcement of modern measures of safety and sanitation, while company dwellings, and in some instances company schools and hospitals, are well maintained for the use of employes and their families.



The Corner Stone of Industry

Friction or anti-friction is the difference between building upon a *sand* foundation or upon a *sound* foundation . . . "Timken Bearing Equipped."

Industry either lays itself wide open to Waste and pays a heavy friction-tax . . . or sets up a safeguard and reaps the resulting profits.

The kind of anti-friction protection is important . . . to select the bearing that carries *all* burdens, whether the load is all radial, all thrust, or both in any combination . . . and student engineers will do well to remember that full protection is based squarely upon Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken-made steel.

This group of exclusive Timken advantages puts production on a modern basis. Machine life becomes self-perpetuating. Power loss, lubricant and maintenance costs lose their significance and dwindle to decimals.

In lathe spindles or rolling mills; in steam shovels or mine cars or railroad trains—a wave of replacement surges over the nation—a protest against Waste—headed by the national symbol and safeguard—"Timken Bearing Equipped," the Corner Stone of Industry.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**

HOW TO GET A PATENT

(Continued from page 236)

essary to refer to the description or drawings to determine just what the claims are intended to cover, and whether the patent is infringed.

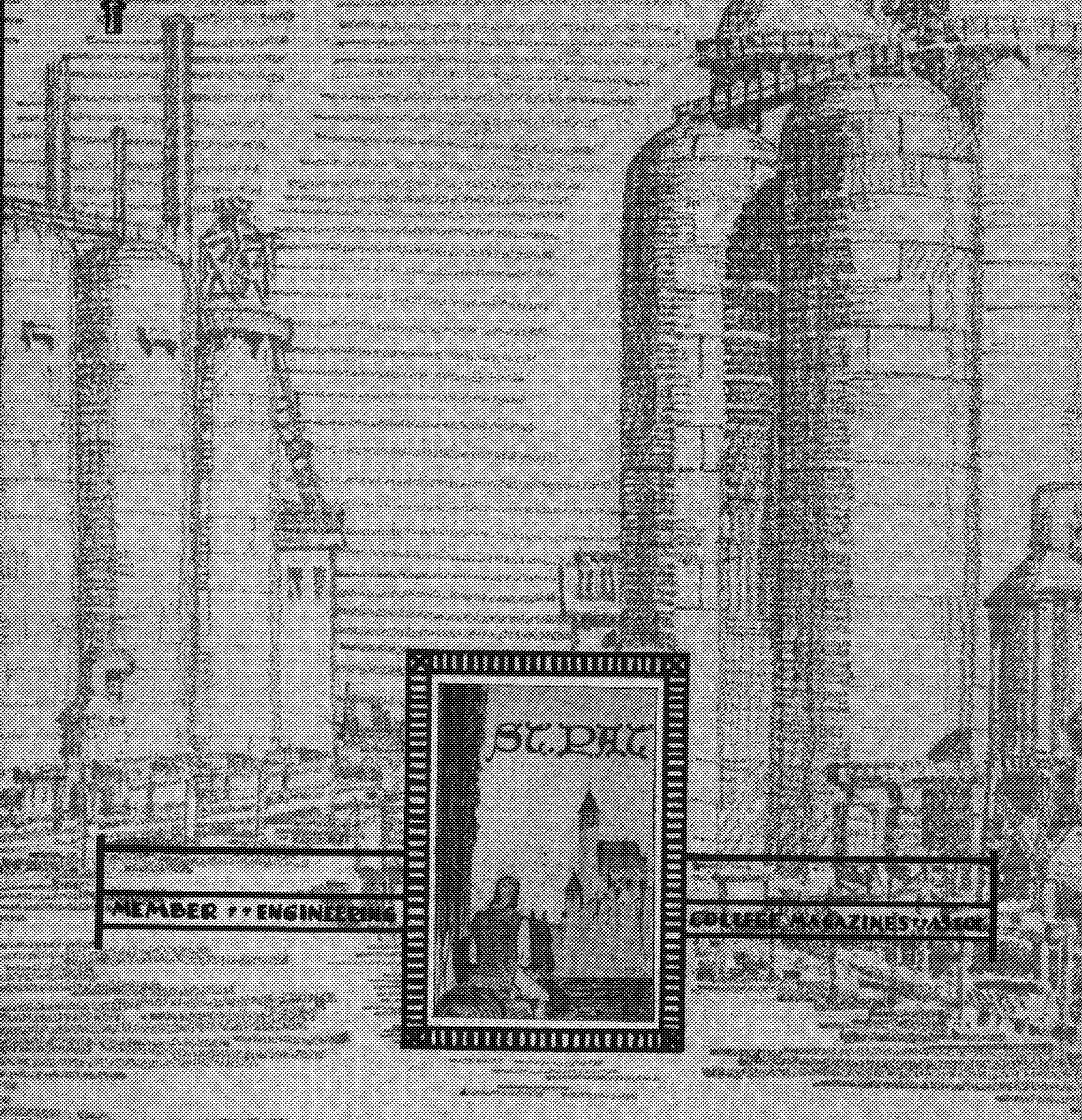
Mostly, however, the claims must stand or fall alone; so, the broader and more inclusive the wording, consistent of course with the real invention, and the greater the number of patentable combinations there are, each covered by a separate claim, the more protection does the inventor enjoy. If, for example, there are six elements, the combination of any two or more of them might support a claim. Thus, let us refer to the elements by numbers. The combination of elements 1 and 2 may be one claim, elements 1 and 3 another, elements 1 and 4 another, elements 1, 2, and 3 another, elements 2, 3, and 4 another, elements 2, 3, 4, and 6 another, and so on. Where these various combinations represent a patentable combination, as distinguished from a mere aggregation, each is entitled to a claim. It is evident that the possible number of such combinations, even for a comparatively simple invention, might run into several hundreds. It is the duty of the attorney to choose from among these, the patentable ones that are really important, based upon his practical knowledge of what a competitor might seek to appropriate.

As to the wording of each claim, care should be taken by the attorney not merely to describe the detailed construction as shown, but rather to conceive a series of broad combinations in words which will cover it in a general or inclusive way. Thus, if an essential element of the combination is embodied in a lever, instead of using that word in the claim, the attorney might write "means for," and then follow with the particular basic function that such lever really performs, this function being essential to make the invention operate.

The broadest, or shortest, claims are better written first, and each should include only the essential combinations of a few different elements which do co-act to make a patentable combination vital to the success of the invention. Then to these same combinations are added additional elements which also co-act into a new patentable combination, and so on, until all the claims have been prepared.

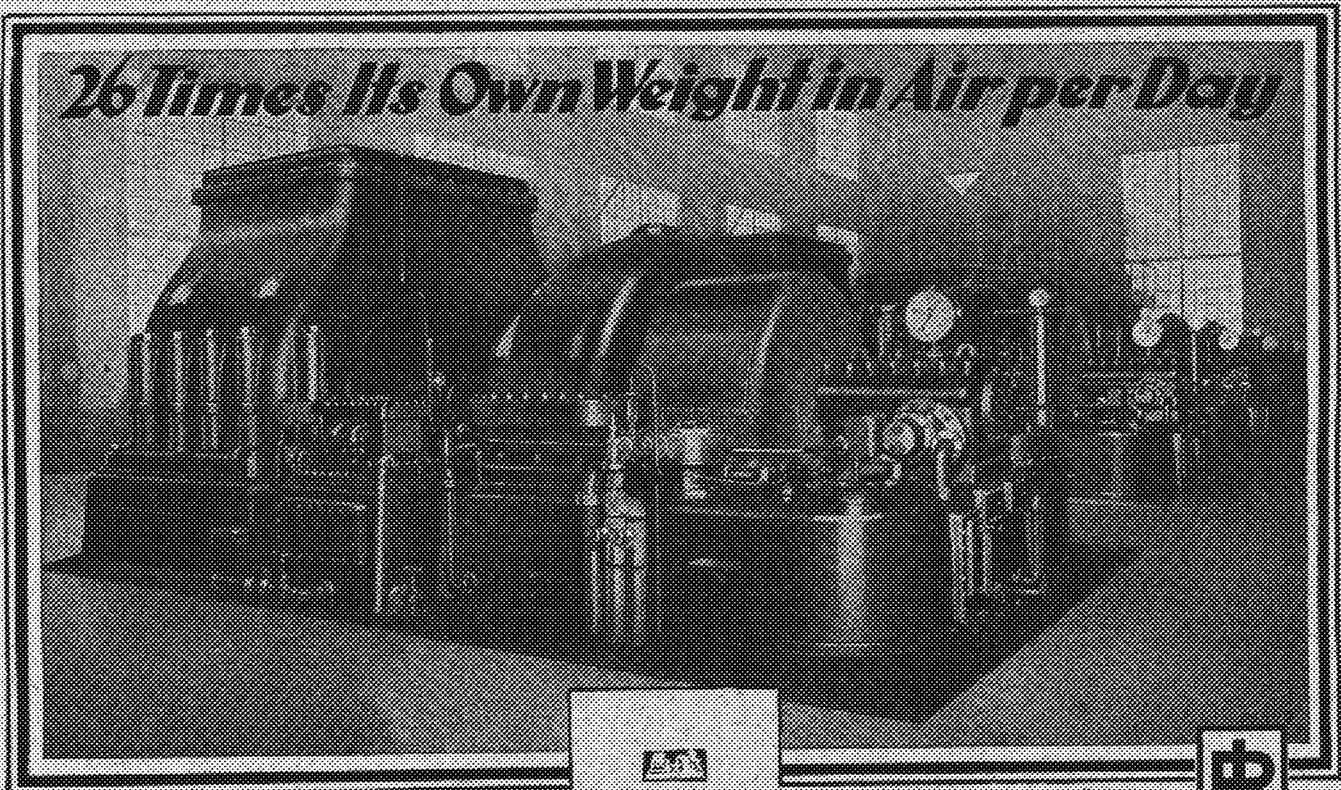
The Minnesota Techno-Log

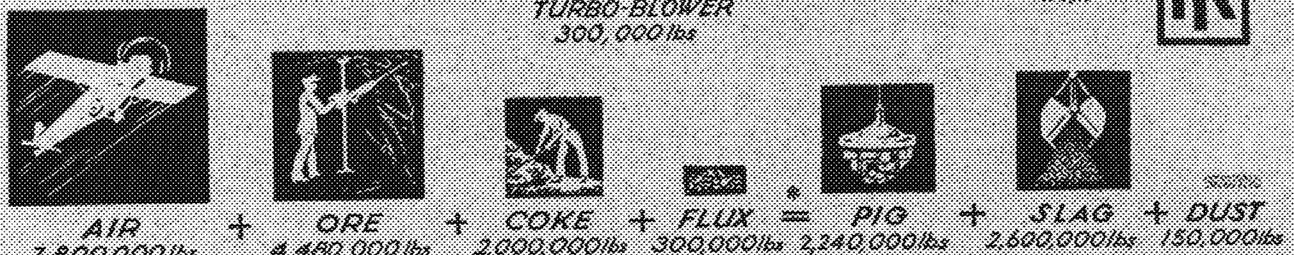
MONTHLY PUBLICATION OF THE TECHNICAL STUDENTS



MEMBER ENGINEERING COLLEGE MAGAZINES ASSOC.

Vol. X MAY, 1930 No. 8





An Ingersoll-Rand turbo blower serving an average 1000-ton blast furnace handles approximately 26 times its own weight in air each 24 hours. More air is used than the combined weight of all other ingredients. This relationship is shown clearly by the above diagram, which picturizes the approximate daily consumption of a 1000-ton furnace.

*Balance of this equation is blast furnace gas

INGERSOLL-RAND CO. · 11 Broadway · New York City

Branches or distributors in principal cities the world over

For Canada Refer—Canadian Ingersoll-Rand Co., Limited, 10 Phillips Square, Montreal, Quebec

Ingersoll-Rand


Wherever, whatever men build
—giant dams, great reservoirs, towering skyscrapers, city streets, cross-country highways, long bridges and massive viaducts—in fact, wherever construction work is in progress, you will find the products of N. E. C.—National Equipment Corporation.
N. E. C., the greater name in construction equipment, now unites great names which have long stood for quality and integrity—Koehring, Insley, T. L. Smith, Parsons, C. H. & E. and Kwik-Mix—for greater engineering, greater service and greater realization of quality.
KOEHRING
Pavers, Mixers; Power Shovels, Pull Shovels, Cranes, Draglines; Dumptors.
INSLEY
Excavators; Concrete Placing Equipment: Cars, Buckets, Derricks.
T. L. SMITH
Tilting and Non-tilting Mixers, Pavers, Weigh-Mix.
PARSONS
Trench Excavators, Backfillers.
C. H. & E.
Portable Saw Rigs, Pumps, Hoists, Material Elevators.
KWIK-MIX
Mixers — Concrete, Plaster and Mortar.
Pardee Dam, California. Four 56-S Smith Tilters poured the 600,000 cubic yards of concrete shown here.
NEC
National Equipment Corporation Milwaukee Wisconsin

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

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

VOLUME X — MINNEAPOLIS, MINN., MAY, 1930 — NUMBER 8

CONTENTS

PAGE

TUTSHI: FROM AN ADVENTURE OF YOUNG AND WISE, TRAVELERS - 249

WHO SAYS WE CAN'T GET JOBS? - 252
Marion Petri, '23

CHEMISTS TAKE SPRING TRIP - 253

ESQUISSES AND RENDUES - 254
E. R. Cone, Arch. '31

CLOUD FORMATIONS - 256
Hal B. Pittlekow, Aero '31

EDITORIALS - 258

THE RUSHMORE MEMORIAL - 260
Steve Gadler, EE '32

ABOUT THE WORLD WITH OUR ALUMNI - 261

NEWS FROM THE TECHNICAL CAMPUS - 262

Entered as second-class matter April 9, 1925, at the post office at Minneapolis, Minnesota, under the Act of March 3, 1879. Office, 37 Electrical Building, University of Minnesota. Telephone, Dinsmore 2760. Contents copyrighted and permission must be secured for re-publication. Subscription rate, $1.50 a year. Single copies, 25 cents. Advertising rates upon application. Alumni Directory, 50 cents.

The MINNESOTA TECHNO-LOG
University of Minnesota

Volume X | MAY 1930 | Number 8

TUTSHI

From an Adventure of Young and Wise, Travelers

To the reader, an Alaskan trip offers little that is new; for that part of this country has been recorded by historians, commercialized by journalists, and photographed by the National Geographical Society. And so, in impression, spontaneity must depend not upon form, but upon an individual's personal reactions to certain fresh, vital, vivid circumstances. Such limitations would not grant that I ransack my memory for disconnected details; therefore, I have submitted this series of word pictures—the impersonal ones—from my journal.

* * *

July 28, 1929. For three days a most persistent bug has been biting me. Although it has not been captured by zoologists, nor been examined by entomologists, it carries a deadly disease. That bug is "Ennui." The ordeal, that prelude to all journeys, is over.

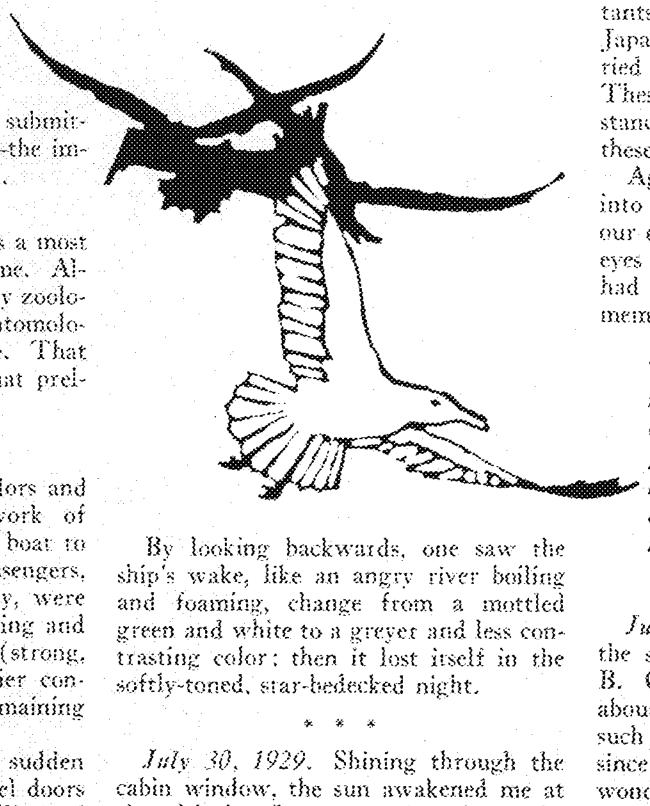
* * *

July 29, 1929. Amid dock odors and rugged noise, a brilliant network of streamers seemed to harness the boat to the Vancouver wharf. While passengers, warmed by the sun to sociability, were leaning over the ship's rail chatting and gossiping with friends, stevedors (strong, sullen dock-hands of the Meunier conception) were heaving the remaining cargo aboard.

At the sound of the whistle, a sudden change of activities was felt. Steel doors clanked into position. The milling of the crowd reminded one of mass pugilism. A belated passenger forced through the crowd as did Napoleon in his early campaigns.

Excitement was at its peak. On shore, pallid faces registered vague signs of envy. Under such circumstances, the gangplank "just disappeared." The propellors churned, and a tremendous power took hold of the ship. Like a groggy fighter, uselessly swinging his arms before action, the boat remained in a sort of tension, until the imposed difficulties were overcome. Suddenly, it coughed up some water, and then silently glided out into the bay.

Far ahead, two fantastic arms of land held the sun in a weird embrace. A few moments later, as that great ball of fire sank into the golden sea, the two headlands seemed to float apart, and our ship majestically steamed into more open waters. During these few minutes, breezes, the most refreshing influence of a voyage, caressed our faces.



By looking backwards, one saw the ship's wake, like an angry river boiling and foaming, change from a mottled green and white to a greyer and less contrasting color; then it lost itself in the softly-toned, star-bedecked night.

* * *

July 30, 1929. Shining through the cabin window, the sun awakened me at six o'clock. Its companion from the north blew with its sure, heavy, devouring, breath. Yes, it covered the prow with a salty spray, and moaned through the cordage of the ship. After a few minutes on deck, my cheeks tingled; I was exhilarated, happy.

The day has shown me brilliant sky scenes covered with ragged, ravelled clouds; I thought of them as beggars of the air. Color pictures of heavily timbered forests on mountainous islands appeared frequently. It was like this all along.

I have a constant desire to go farther north. Why are one's thoughts always so wistfully attracted to the sea?

In the distance, I can see an industrious solitude. On the hillside, rows of houses are perched one above the other in zigzag fashion. The arrangement reminds me of its name: Ocean Falls, B. C.

The arrival of our boat was a sign of rest and entertainment for its inhabitants. Canadians, Hindoos, Chinese, Japanese, chattering and gesturing, hurried toward the snug little harbor. These experiences have, in most instances, formed the only real contact for these people with the outside world.

Again we sailed; this time we slipped into the night, that calming influence of our daily existence, and I contrasted the eyes I had seen. That association alone had been inspiring. It recalled to my memory Emerson's observation:

> *"Eyes speak all languages; wait for no introductions, they ask no leave of age or rank; they respect neither poverty nor riches, neither learning, nor power, nor virtue, nor sex, but intrude and come again and go through you in a moment of time."*

* * *

July 31, 1929. We are steaming into the sheltered harbor of Prince Rupert, B. C. Industries of the coast type abound here. A revival of interest in such marked versatility should be taught, since it it instructs one in the value and wonder of work.

How well Joseph Pennell captured the spirit of industry.

Ketchikan is in view. Conversation has become more simple. In fact, people are showing an unusual interest in all their luggage. It is not exactly a panic, but a readjustment.

The immigration officials have departed. Some look wise; others disappointed.

Ketchikan, Alaska. Here the harbor presents a queer spectacle. Masts protrude in confused hosts. In the background, both the bushes and trees are scrubby. On one side, the trees, for over six feet from the top, have no foliage. If one could cut twelve years from

one's life, the scene of a bombed territory would be similar. The contrast is touching: there, man's war; here, nature's.

There is no doubt about it! Modern man's culture is a matter of geography. Although the fishing equipment used by these people is of the popular type, including boats, nets, and bait, the atmosphere appeals to one's primitive sensations. I feel like a savage. I should like to fish in that style.

The collective interests, commercially, point toward sturdy, compact industries. Nevertheless, the main district has a Washington avenue aspect; the shop keepers are catering to the tourists with curios, novelties, and trinkets.

* * *

August 1, 1929. "What's in a name?" Wrangell, Alaska, has a quiet tone about it. The only genuine native arts of any value (and this is true of the whole trip) are to be found here in numerous quantities, and in the original settings. Totems, or Indian coats of arms are as interesting and fascinating to view as a tablet containing the earliest known laws: Babylon. In a design, the laws, passions, hates, and loves of a family or a race are concealed. Symbols carry a man forward and unite his hopes and interests.

Totems: some interpretations.

"The Indians here in this part of America differ from the red man of the United States in appearance, habits, and customs. They seem to have a mongolian cast of features, and unlike our Indians, are naturally intelligent, with industrious habits, keen in trade, good mechanical ideas, quick to learn, while some are very skillful in carving wood, bone, and metal."

"The Thlingits of the mainland and the larger islands from Yakutat to the Canadian border divide themselves into two main tribes; the Raven and the Wolf families. The two main tribes are subdivided into many clans. Each clan has adopted for its crest or the family coat of arms a certain bird, fish, animal, or insect. In the primitive mythology, we see the Raven and the Wolf having families. For want of proper names, the heads of these families named their children for animals, birds, fishes, and insects. These names in later years gave rise to the legends of animals as pictured in the totems. In this way, the animal came to be respected, and finally revered."

"The totem has no religious significance, and is not an object of idolatrous worship. Its heraldic designs and quarterings are displayed in the same way and for the same reason that the European parades his crest and escutcheon."

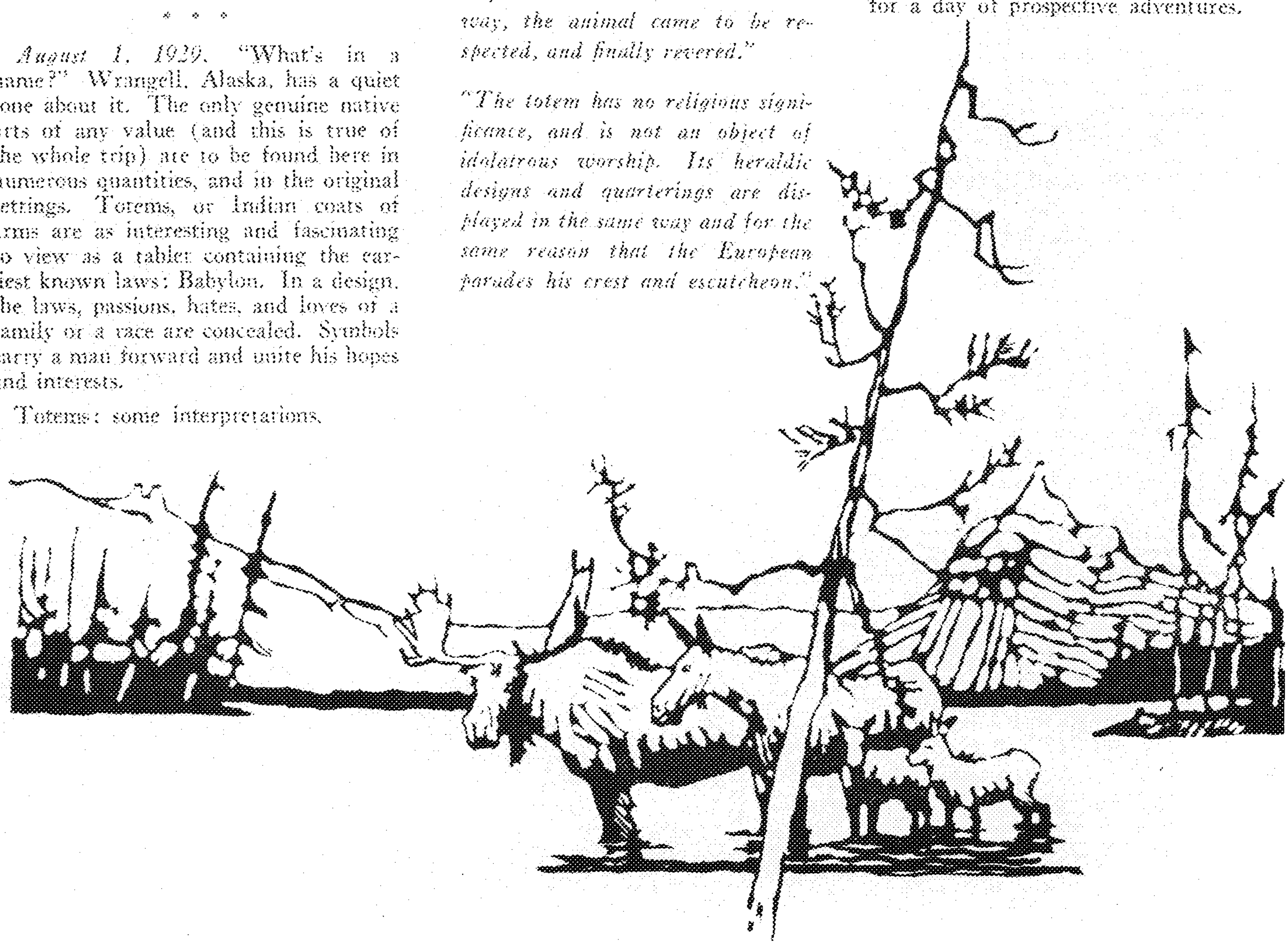
In Juneau, Alaska, the capital city, one hears stories about Dick Harris and Joe Juneau, the original "Gold getters." Gold! Gold! Gold! It is a remarkable subject for conversation, and is even incorporated in names: "Gold Mine," "Gold Creek," and "Goldstein." In this era of prohibition, however, a gilded stein is not extraordinary.

There is a museum of natural history at Juneau. The collection fully illustrates the life, customs, habits, art, social regulations, beliefs, and ceremonies of an Eskimo's life. There are, however, neither divorce certificates, nor alimony checks. Among the tools, are knives, interesting knives, sharp enough to cut clay. Being of a practical turn of mind now and then, I am thinking of my sculpture friends.

It is late at night, and we about to sail in water covered by the silver rays of the moon. My preference is a canoe, for I should like to force my way through these waters by tremendous, renewed efforts. Such a course would enrich one's languorous moments.

* * *

August 2, 1929. What an exhilarating morning! A light, crisp breeze is rising, and a few, fleecy clouds are traveling across the clear, blue sky. The air seems full of energy, and arouses in one a new vigor. It is a delightful beginning for a day of prospective adventures.



We are entering a channel and, nestling picturesquely among firs, poplars, and birches, far below the snow-capped mountains, is Skagway—"Skagua" or "Home of the North Wind."

Few people live here, yet within is another city which is famous for the grave of "Soapy" Smith, bandit. "Soapy," that slippery, show-boat reality, adds phantom blossoms of glamor to his grave each year.

There are beautiful flower gardens to be viewed. Heaps of lovely sweetpeas, dahlias, asters, snapdragons, gladioli, daisies, petunias, pansies, violets are sending their fertile sweetness into the air. Solid walls of these colors, punctuated here and there by spots of rich green foliage, remind one of Monet's charming "Garden at Giverny."

Bridal Veil Falls. (Thought) a white veil behind palms. A silver cascade among green trees.

Old White Pass City————?————!

Tragedy! Some men are driven to the stock market. The footing is insecure. Alas!

Dead Horse Gulch, twenty-four hundred feet of granite, was erected by nature to baffle men and trap beasts.

Today, science is master.

The train passed through long snowsheds a few minutes ago. When the air, set in motion by our speed, whistled, I thought of the severe, raw, biting winters those people endured. On our way to Carcross, the wheels ground and polished the rails; the arrival was heralded by a shower of sparks.

Many foxes may be observed here in cages. They, too, feed on fish.

Tutshi is waiting for us. Her voice is alluringly mellow. She is dressed like a sturdy, companionable girl of a summer's outing, in white with contrasting colors of blue and grey. But one piece of jewelry is seen: a golden bar bearing the letters of her name. When we sail, she will teach us to dream and then to forget.

We are sailing. Nearby, not so far from the harbor, is the old ship, "Australia," a "Skeleton in Armour." An old man, when peering into the past, uses his hand to cast a shadow over his wall of memories. Well, that is the way the broken inner structure of wood is peeping over its iron hull. Each new season destroys vitality; it is wasting away.

For some time I thought about this quaint old vessel. I gambled with myself; I wagered that the birds used it during the nesting seasons of the past. I was certain that more fortunate adventurers had found within its walls straw and horsehair and spider's webs with enough feathers to make a bed. How many birds must have hissed a warning, the challenge of a viper, to unwelcome intruders.

Majestic mountains are in view. The more imposing ones are clothed, like the kings of a continent, in ermine. Nature is not impartial; for these monarchs are eternal.

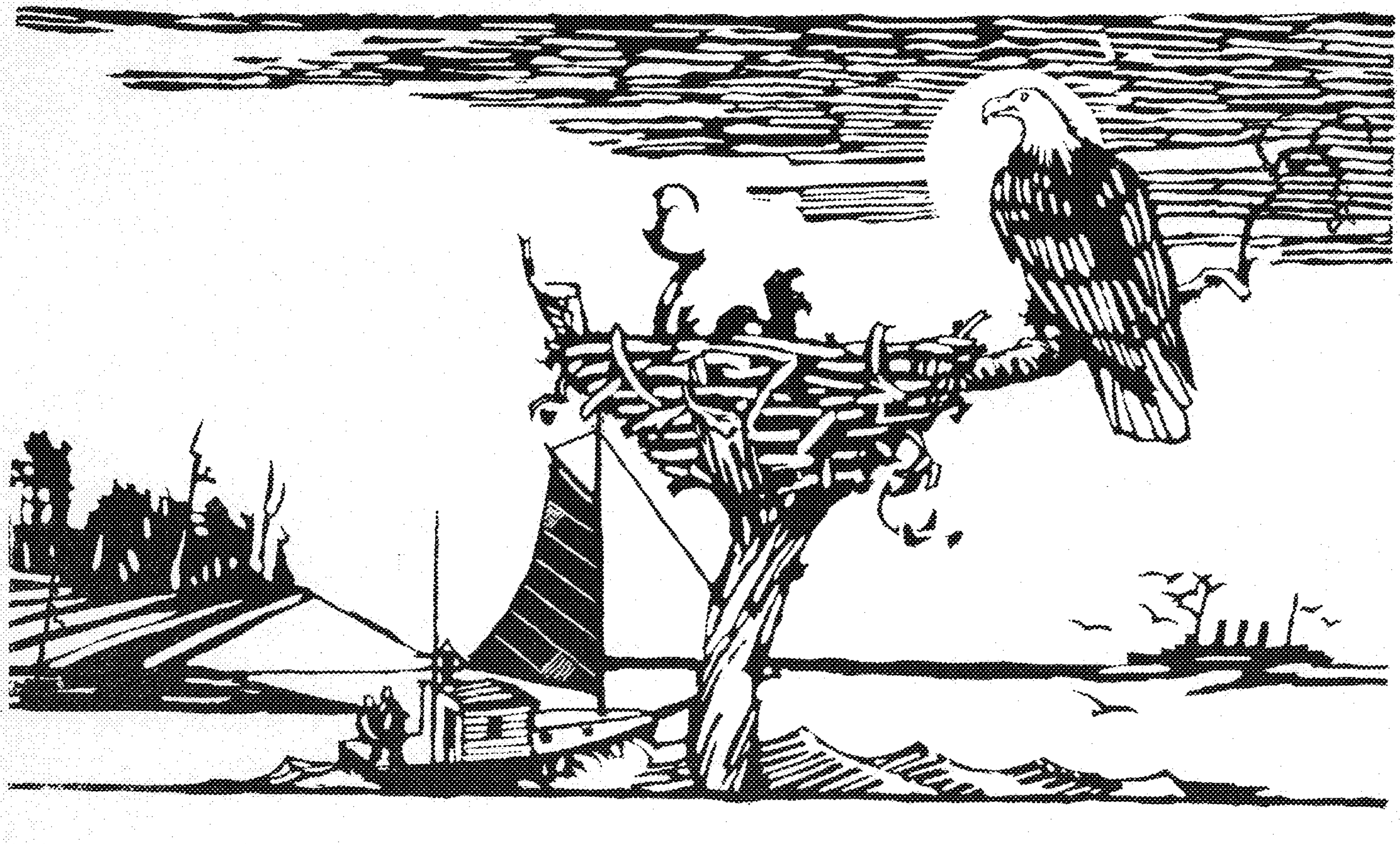
In a valley, ahead of us, is Conrad. Follies, it seems, exist in all times and places. This locality has old cabins, a theatre, and public institutions. It is a mining town. Where is the "Joker"? There is no mine.

What kind of barbers do they have here? Where British Columbia joins the Yukon, is a wonderful growth of trees through which some gigantic monster has run his clippers. Hmph! This, it appears, is the way a parallel is marked, the sixtieth in this instance. It is a warning to the adjoining locations that the laws differ for not only hunting, but also mining.

We are in the country of short, cool nights, and long, warm days. The atmosphere breathes of activity. Beautiful flowers are in a hurry, and the vegetation is growing without pause.

Solitude has a strong appeal. Its symbol is before me. Beyond a path, not the cultivated type, is a little log cabin with trees for companions. Within double rooms, divided by two stairs and a quaint archway, are the comforts associated with seclusion. To one wall, a section of shelves is attached. Pride and feeling are suggested by the fact that these cases were made not to house merely purchases, but to protect the books and add to their originality. Among the Greek and Roman classics, I can see a volume about the Wagnerian operas. And, what should accompany these? Well, they, too, are here. A

(Continued on page 276)



WHO SAYS WE CAN'T GET JOBS?

By **MARION PETRI, '23**

DOUBTING friends, informed that you are taking a course in interior architecture—for their benefit you call it interior decorating—are polite enough to put it in the form of a question, "Can you?" (Unsympathetic male architectural students of 1922 and 1923—made it a definite statement, "You can't.") Timid but aspiring decorators need encouragement. And so a little broadcasting will not come amiss.

For the fact remains that we have got jobs, are getting them, and will, we are optimistic enough to believe, continue to get them. Getting them and keeping them on the strength of our years of training in the School of Architecture.

Some of these girls merely majored in architecture, some took a full architectural course, but the greater number are graduates of the course in interior architecture, one far more thorough than the usual interior decorating course. We begin with the earlier classes and work down.

One of the first was Helen Barker, who left the University in '21. Information about her is not complete, but we know that she went to New York City, where she took some further work in interior decoration, won a scholarship which took her abroad to study, and is now the interior architect for a New York firm of architects.

Gertrude Quinn Brennan, '21, was employed as artist and draftsman for Thompson Yards, Inc., upon completion of her course.

Alice Little, '21, was first a draftsman in the office of Frederick M. Mann, head of the School of Architecture, then turned to teaching mathematics for a time; but she did not stray entirely from the fold, as she afterwards studied at Columbia University, and, we believe, received a degree, and she is now teaching art at the College of Applied Arts in Cincinnati, Ohio.

Edna Croft, '22, has been, since graduation, a draftsman in the office of Croft & Boerner, architects and engineers of Minneapolis. (These one-job people make poor copy, but it speaks well for their ability.)

Eunice Nielsen, '23, is another who has held one position since her graduation, that of draftsman in the office of Lang, Raugland & Lewis of Minneapolis, who specialize in ecclesiastical architecture. In the course of her work Eunice says she has done such things as carved Gothic chancel furniture, tracery windows, marble altars and the like, exotic things which sound as though they might have been assigned as problems in design class.

Gladys Brouillard Hammett, '23, was designer in the interior decoration studio at the Dayton Company in Minneapolis for two years. She then worked for William A. French & Company for a short time. Later, in Chicago, she was in the studio at Mandel's as assistant buyer of lamps and decorative articles.

Catherine Howard, '23, and a partner have had their own decorating shop in Brooklyn, New York, for a little over a year. A letter from her written in response to a request for an autobiography might well be used as a testimonial for the Interior Architecture course. She writes in part as follows: "I feel extremely indebted to my own training at Minnesota, and as yet have never heard of another school which gives a similar course. When I reached New York I took a summer course at the New York School of Fine Arts (Parsons), in order to gain a little confidence in myself and learn 'city ways,' but I learned nothing that I had not had drilled into me twice as forcibly at Minnesota. When I started to look for a position in interior decorating, I found even a little B. A. degree in decorating almost an open sesame. I had no trouble in getting a position, and later I joined the Decorators' Club. Mrs. Ackerman [lecturer at Columbia and the Metropolitan Museum and a decorator] was especially nice to me because I came from Minnesota and the best school of decorating in the country. . . . The field is still full of badly prepared girls who are looking for work without experience, and the club is making a serious effort to raise the standards of a professional decorator so that a three months' course in an art school does not constitute a finished training. . . ."

> *Male architects once scoffed when interior decorators spoke of getting work, for jobs in that line were few and far between.*
>
> *Now, however, according to the accompanying chronicle of the past seven years, the interior decorator enjoys as favorable a market for her training as does her brother architect.*

Olive Prescott Diggs, '23, started a lamp shade "atelier" immediately upon her return to her home in Washington, D. C., designing original shades for large clubs, hotels, apartment buildings, and homes. She also made water color renderings for firms to use when submitting bids to furnish many of these buildings. She designed the cottages for an eastern summer resort, and, as an example of the widely varied positions for which this training prepares a girl, she is at present a senior draftsman in the United States War Department, making topographical maps to be used in the Congressional Record this fall.

Marion Petri, '23, is with the Architects' Small House Service Bureau. One of the privileges of the position is the writing of plan descriptions to be used in their publicity. When endeavoring to write one which will convince the general public that the design in question is the architectural profession's greatest gift to humanity, an acquaintance with architectural design and construction is a decided convenience. She also writes articles for the Bureau's magazine, "The Small Home."

Tressa Snure Root, '23 was employed at Yungbauer's in St. Paul, for two years. This position might also be called a habit with the girls from our department, for Rhoda Coté Barton, '25, succeeded to it next, then Edith McElroy Huchthausen. Now, after a lapse of several years, Rosabelle Grahek, '29, is filling it very competently.

Dorothy Brink Ingeman, '25, is a practicing architect in St. Paul, in partnership with her husband. Entering a national small house design competition, Dorothy won first prize in her district.

Helen McGregor Lyman, '25, after some time in New York City, was employed by William A. French & Company, and at the time she left was in charge of the Chintz Shop.

Helen Perker Backstrom, '25, was for several years an artist in the laboratory of the Zoology department at the University. This same position is now held by Grace Jones, '28.

Dorothy Mann, '25, after graduation was at Weber-Werness Studios for about a year, and also did some independent work in interior decoration. Later she studied painting at the Minneapolis School of Art, as well as teaching some classes there and teaching art at Central High School. For the last year she has been traveling in Europe and studying at the Hoffman School of Painting at Munich.

Ruth Danielson, '25, holds a different sort of position, the only one of the girls we know who is in a landscape architect's office. She is both stenographer and draftsman for Morell & Nichols, Minneapolis.

Marie Guesmer, '26, has been for several years employed in art work in a stained glass studio in this city.

Dorothy Snyder, '26, has occupied herself in a number of ways since graduation: as draftsman for a Minneapolis architect, as artist for A. Loria, the decorator, and as artist and designer in the interior decorating studio of the Dayton company here.

Murier Ehrenberg, '26, was another graduate of the interior architecture course who spent some years at French's selling in various departments.

Geneva Grafslund, '27, is in New York, at the Hale Desk company. She writes, "It takes me about a day to do a full perspective of a room in pencil now. . . I love doing perspectives. . . . I have also gotten to like furniture sketching, and can scratch one off in about two minutes. One is given about that much time to do things in business—'Must have it right away,' and there they stand over your shoulder while you're trying to make something that looks like a table, desk, or chair by the time they say Jack Robinson. But it is all in the game, and I love it."

Grace Cameron, '27, is also in New York, with Stair & Andrews, interior decorators, as artist and designer, and this summer is being sent abroad for two months with all expenses paid by her firm, which gives other aspiring decorators a mark to shoot at!

Gladness Wilkinson, '27, was employed in the studio of Weber-Werness, decorators, for some time.

Esther Hargrave, '27, has so far employed her talents in teaching, both at the School of Architecture at the University, where she has the senior classes in furniture and decoration and allied arts, and at the Minneapolis School of Art, where she has classes in design and interior decoration.

Elizabeth Flather, '27, after some time spent abroad, is with some decorating establishment in New York.

Ruth von Sien, '28, for some time in the studio at the Golden Rule, St. Paul, is now employed in a decorating establishment in Fargo, North Dakota.

Florence Berman Rakov, '28, for a time at the Dayton Company's studio, is now in Boston, Massachusetts, working at the Fetva Goodroff Art Studios, where she arranges her own hours as designer and draftsman. She has recently made the designs for a hotel dining room in the Adam style, also designing the full-sized ceiling details, and the designs for redecorating a theatre from the preliminary studies on to the final ones.

Margaret Bradbury, '28, is now an artist at Harrison & Smith, an engraving and printing company, doing sketches which range from lovely interiors to adorn a booklet for William A. French & Company to advertisements for "Wheaties."

Jane West and Ruth Carter, both '28, are in Chicago, Jane in the W. P. Nelson company's studio, Ruth in the studio at Mandel Brothers. Jane's letter supplies a wealth of information so we quote it extensively: "Both Ruth and I are designers. I make a point of this because in most decorating firms there's a vast difference between the so-called designer and decorator.

"The designer's work is to make the sketches the decorator uses in selling the job to the client, so that often we never even see the client at all. The sketches are for two types of jobs; those for new buildings in which we work from the architect's blue prints and are concerned principally with the color scheme, draperies, furniture, and minor decorative detail, and those for remodelling old buildings, where we work from the old blue prints and sketches and notes made on the spot by the decorator and are concerned with alterations in the architecture of the interiors as well as the details mentioned above.

"For minor jobs such as residences, apartments, tea rooms, railway coaches, shops, window displays, etc., elevation drawings at ½" or ¾" are generally sufficient. But for important jobs such as theaters, hotels, churches, banks, clubs, lodges, restaurants, and large residences, perspectives are required.

"In addition there are many smaller sketches, furniture layouts, pencil sketches of furniture, and tracing paper studies of detail of the whole or part of a room which are to be blue printed. Often, too, it is necessary to make colored cartoons for the murals indicated on the walls and ceilings in the sketches mentioned; and wherever the decorative motives shown are to be applied by stencil, these have to be drawn and cut. Since the sketches aim to reproduce actual colors and textures of the fabrics, plaster, wood, etc., from the samples furnished by the decorator, and since they must be turned out quickly, opaque water color plays an important part in the technique used.

". . . . Of course as beginners we get the smaller jobs; elevations and small perspectives, and in addition to having to please the decorator for whom we're doing the job, we get much valuable criticism from the head designer."

Janet Lieb, '29, was for a time at Lord & Taylor studios in New York, but is now at the Virginia Hammil studio, and has lately designed a show room and show cases for the International Silver company.

Lucene Breding, '29, is also in New York and has been working on interior church designs.

After considering this imposing array —and we make no pretense that it is complete, and seeing that now in seven small years the he's of the drafting room no longer say "You can't," but find the prospect no more uncertain than their own hoped-for jobs, who can say that girls taking these courses, particularly that in interior architecture, will be unable to find a place in the sun?

CHEMISTS TAKE SPRING TRIP

During spring vacation, when other University students were resting, the senior chemical engineers made their annual inspection trip through several large manufacturing concerns in the Middle West. The trip was made in a bus chartered for this purpose and began Wednesday of examination week.

The first stop was Appleton, Wisconsin. After spending the night there, the group went through the paper mills, following the paper from timber to the numerous finished products. That noon the men were the guests of the company for lunch.

Friday morning was spent in visiting the Milwaukee sewage disposal plant. This remarkable plant, which represents a million dollar investment, removes 98 per cent of the bacteria in sewage, yet uses no chemical action except that of the air—the resulting liquid is as clear and clean as drinking water. Friday afternoon was occupied with inspection of the Pittsburgh plate glass company's plant and a large glue factory. The latter, it was learned, uses enough water daily to supply a city of one hundred thousand people.

After passing through a leather factory, a coke and gas plant, and a linseed oil concern, the group motored to Chicago. The chemists report that they heard no bullets, saw no racketeers in action, and were disappointed generally. Saturday evening and Sunday they were "out." 'Nuf sed!

Bright and early Monday morning they started out again (only two of the seniors missed the bus at 7:00 o'clock) and visited a large paint company. What surprised them most (by this time they no longer regarded with awe the immensity of the concerns) was to learn that the white lead used for paints is still produced by the Dutch process, which is hundreds of years old, but hasn't been improved upon.

The next plant visited was the largest cement company in the United States. This concern generates its own power, using the waste heat from the kilns to generate steam. Sixty million bags of cement are produced here annually.

Little thought was given to the cold wind which had blown all Monday

(Continued on page 272)

ESQUISSES AND RENDUES

By E. R. CONE, Arch. '31

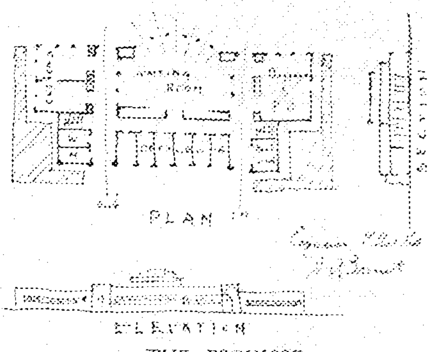
HOW many of you Engineers have wandered down the corridor on the third floor of Main Engineering and have seen all the "pretty pictures" with funny marks scribbled down in the lower right hand corners? How many of you have stood there looking at a prettily painted plan of "A Circus Group" and wondered why architectural students didn't plan houses instead of circuses. Why are these students always working on such improbable edifices—monumental airports, archeological museums, aquariums, or perhaps great monuments to "The Spirit of the West"? These and other questions are common among outsiders visiting the school and we propose to answer some of them in this article.

First, let us consider another question. Is it not rather remarkable that one can walk down a city street and distinguish between a bank and a post office, a hotel and an office building, a church and a theater, or a garage and a fire station without ever seeing the name? Perhaps you will say that it is not remarkable but natural. Yes, it is natural, but how much training and study there is behind that natural result! These buildings,—the ones we admire—are not just screen facades plastered over the front of a building and covered with decoration peculiar to that type of building. That isn't architecture. Architecture is planning logically each type of building to suit its needs and purposes. The plan precedes, and determines to a great extent, the elevation. Logical planning, then, is one of the first big steps in architectural design. This is what the architectural students seek after when they draw all those "pretty pictures" of improbable buildings. The pictures and types of buildings are only incidental, although an attractive presentation, of course, is valuable, especially if it portrays the spirit of the problem. The types of buildings must of necessity cover a wide range since such a great number of problems are given. We speak of "problems." Let us see what these problems are, how they are given, and how the students go about solving them.

The Beaux Arts System

Any advanced architectural student will tell you that mathematics, physics, history, and English are very incidental to the course in architectural design. If tied down, he will admit that they are more or less necessary, but very inconvenient. Design is the most important course, but why is it that students place so much more emphasis on it than does the curriculum? They work in the drafting rooms mornings, afternoons, and evenings—until the janitor goes his rounds calling, "Closing oop time." Saturday afternoons, even during the football season, find a large number of students bending over their drafting boards. They even pack these huge 32 by 54 inch boards home or to some fraternity house and work all night on a problem. The entire senior class one night, not long ago, migrated to one of the fraternity houses so that they might work steadily from Friday morning to Saturday noon. This certainly is a phenomenon which needs explaining. What method is used to produce so much enthusiasm and intensive work?

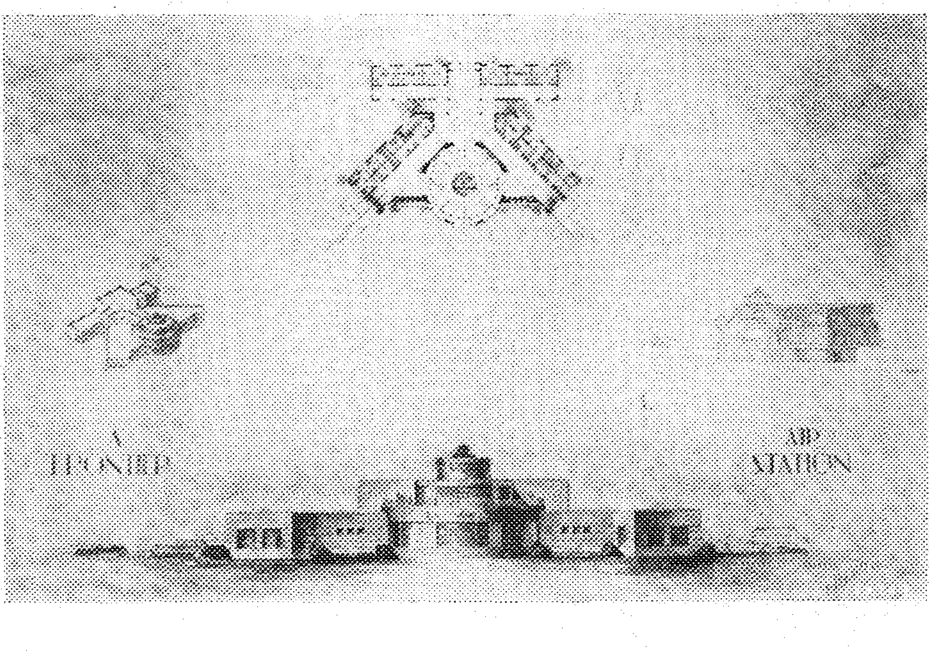
The Beaux Arts system, as the name would imply, grew up in France. The École des Beaux Arts, a government school in Paris, was founded back in 1648. It is not a school or college as we think of them. The school consists of an



THE ESQUISSE

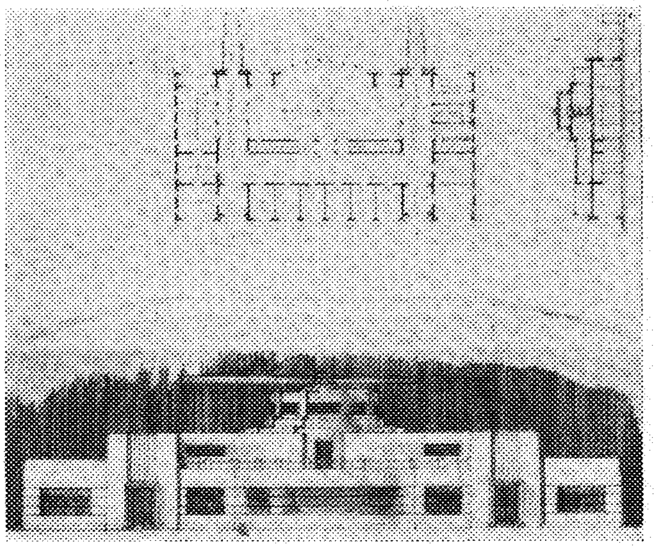
administration building with offices, class rooms and chambers for judging the problems or *projets*, but the work is not done here. The work is done in the private offices or rooms of different *Ateliers* in charge of men of pronounced architectural ability, called *patrons*, who give the *logist* help and criticism. The problems, when finished, are taken to the École, and judged in competition. Those worthy of the grades are marked "1st Mention" and "Mention," and the authors of these receive a certain number of points toward the sum required for graduation. The others are marked "H.C." (Hors de Councours) and the authors of these might just as well have spent the previous six weeks sitting in the middle of the Salon floor playing tiddledy-winks as far as points or credit is concerned. This, although a little discouraging if the H. C's are too repetitious, is conducive to hard work, and the students continue to take the problems until, after a period of years, they have their quota of points.

The universities in this country which use this system modify it somewhat, the course being more elemental. The problems in the Mention Class are not the only ones to receive points, the marks "Credit" and "Conditional Credit" with their lesser number of points being added. (It is the abbreviations of these gradings, i.e. 1st Ment., Ment., Cred. and Con. C., which you see scribbled down in the lower right hand corner. Those receiving no points are designated by the letter "X.") Instead of Patrons, we have our professors, and the work is carried on in the drafting rooms instead of in outside ateliers. The same spirit, however, is present. It is partly the spirit of competition the same as you would have in field sports—all trying to place first, or at least high, in the judgment, and partly the spirit of an aggregate of artistic temperaments, for architecture is an art. There is no faculty supervision of the drafting rooms. The professors make their rounds on designated afternoons, giving each student in his turn a period of criticism. The rest of the time, with the exception of an out-



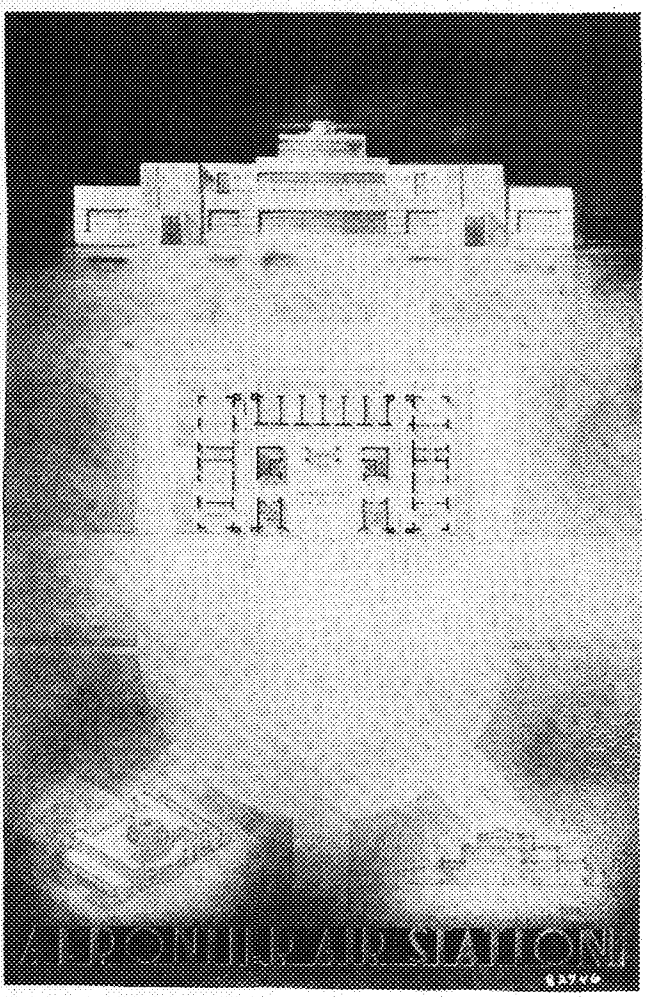
burst in the spirit of fun, the "logists" work on, with nothing but the desire to place high as an inducement. These "outbursts in the spirit of fun" are not a result of lack of discipline. They have their place in the student's routine, for the continuous close and tense work must be relieved at intervals and a little costume parade or a few male chorus selections accomplish this.

But to get back to the details of the Beaux Arts System, let us see how the students handle these problems. There are three kinds of problems: Long Problems, Short Problems; and esquisse-esquisses, often called Sketch Problems. The time given on these is about five weeks, two weeks, and nine to twenty-four hours, respectively. The first two of these require an "esquisse," the last is, as its name implies, an esquisse itself. An esquisse, in short, is an idea on paper. In this school the programs for a problem are given out at one-thirty in the afternoon and the esquisse is due at ten-thirty that evening. Since the esquisse must be followed in its main points through all the future development, the student in this first eight hours must find a solution to the problem which will bear two and five weeks of development. If he makes a bad mistake or a poor solution, he is just "in a bad way." This, then, means nine hours of intense work, and it must be done without the aid of books or personal help. After the esquisse is in, the student proceeds by making studies for criticism. Study after study is made during the following weeks, each one an improvement over the one before and with added detail, until the final rendering or *Rendu* of the projet is made. Now let us follow thru the development of one of these problems. The only problem with its early stages available is not a perfect illustration, but it will serve the purpose. The following is a program for a Grade III (Senior) projet.



A Frontier Air Station

A frontier airport has sprung into prominence because of its favorable position and convenience to several large transport companies operating to and from foreign countries. Due to the increase of mail and passenger traffic, a syndicate proposes to erect a building in keeping with the advance of aviation.



The site is on the north side of a flying field within a marginal strip 100 feet wide, which has been set aside for hangars and other airport necessities. A main highway parallels this strip. The terrain is very flat in all directions.

The building is to contain on the ground floor:

(a) Entrance from the highway and vestibule.
(b) Waiting room of 2000 square feet overlooking the field.
(c) Customs and Health Inspector's offices controlling baggage and passengers.
(c) Six private offices approximately 12 by 16 feet for executives of the transport companies.

Other required services on the ground floor are: ticket office, baggage checking room, news stand, telephones and telegraph, men's and women's toilets, small lunch room for about thirty people, a post office which is also a sorting room between mail truck and plane, and stairs to the floor above.

The main element above the main floor is the control room for the Chief Dispatcher, affording perfect observation in all directions. A radio room and several small offices are also necessary. The greatest height of the building shall not exceed thirty-five feet and the greatest horizontal dimension shall not exceed 150 feet.

Provisions must be made to handle arriving and departing plane passengers simultaneously, and spectators shall be separated from passengers to eliminate congestion.

It is called to the competitor's attention that trees or high obstructions are a hazard to flying.

You will notice on the esquisse (Figure 1) that although there is very little drawing, the result of a lot of thought and reasoning is indicated. The plan is well organized into a pleasing as well as practical shape. Good circulation is provided between all rooms and entrances are in their proper places. Each room is provided with proper light and ventilation. Finally, there is a possibility of getting in all the little incidental things which did not have to be shown on the esquisse. Forethought in all these matters made it possible for this competitor to turn in an idea which could be developed into a Mention Rendu. You will notice that the elevation is very sketchy. This was permissible here since the plan and section determine the shape of the elevation and there was nothing left to indicate except the shapes of openings and the general mass of the building. This illustrates the point made above—the importance of the plan with respect to the elevation.

Next, examine the intermediate study. The similarity between this and the final

(Continued on page 276)

CLOUD FORMATIONS

THE WHY AND WHEREFORE

By **HAL B. PITTLEKOW, Aero. '31**

INASMUCH as the weather plays such a conspicuous part in our every day life, especially in our transportation life, and particularly in flying transportation, it is highly desirable for us to acquaint ourselves with the mysteries of the various appliances and methods that we have of ascertaining intelligently, which among all sorts of weather conditions are the best suited for our particular activity.

Of these various methods, two stand out sharply. One, namely the weather map, offering specific and accurate knowledge, and the other, the clouds, offering general and to the uninitiated, meaningless knowledge.

The weather map, of course, is by far the more accurate and better authority, providing it can be obtained readily. Here in the United States, it is, in most parts, very easy to obtain for the transportation companies, and for the individual also, if he will only take the trouble to request the daily weather maps issued by the United States Department of Agriculture; but, in out of the way districts, in Canada, in Mexico, and in Alaska, where these weather maps are not so readily available, the pilot, speaking now solely of flying transportation, must forecast and decide for himself on the weather conditions as he sees them. Thus we come back to that oldest and still reliable means of forecast, namely, the clouds.

Clouds, as M. Luchiesh, in one of his numerous articles on cloud formations, has so aptly said, are the sign posts on the highways of the winds.

The clouds make the air currents above us visible. They are formed from invisible water vapor sometimes forming before our very eyes and then disappearing again in the same mysterious fashion. The shapes and forms of these clouds tell those of us who are any way cloud-wise, much in regard to wind and weather conditions about them. In other words, as every pilot knows, they tell us when to fly and when not to. The sky is indeed the countenance of Nature, and the clouds fleeting thereon, besides signalling up their information, inspire us to our various moods. Take, for instance, a clear, deep blue sky, and what do you think of? Why, of course, calm, peace, and serenity. Now think of a dull, completely overcast, gray, and turbulent sky, and what are your reactions? Discontent, depression, and irritableness, surely.

If one studies the clouds carefully he will soon note that he can divide them into three general divisions, centering each division on certain characteristics that are definitely associated with altitude. These divisions can be simply stated as, the high region, the intermediate or middle region, and the low region.

In the high region, we have, of course, the high, thinner clouds. Their individual forms, however, vary from thin, delicate, loosely scattered flakes, to fleecy, globular, and closely packed rolls. They are visible from the ground chiefly through openings in the heavy layers of clouds of the lower region, and because of this are not fully appreciated until one travels among them. The clouds of this middle region, as I have said, vary from thin flakes to rolls of globular masses. However, as one might expect, these are not the only formations, for in this middle district, we also have the less variable but more popular stratus formations, which produce the corona around the sun. The mackerel and billowed clouds of this middle region, besides the cumulus, are the ones that the casual observer more readily remembers, and they are probably the only ones he can describe from memory. These clouds often evaporate or grow denser quickly and with this action of the beautiful coloring and formation, produce one of the marvelous sights of the world.

THE clouds of the lower region, excepting the ground hugging fog, that are more obvious are the cumulus formations. These cumulus clouds rest on flat, shadowed bases and rear themselves in almighty crests. The crests appear as domes, and resemble cauliflower heads when the up-draft is strong and loosely combed wool when the up-draft is light. Cumulus clouds are usually at about a mile in altitude, but in flying through them, we notice more often that their bases are around 4,000 feet and that their crests sometimes rise to 7,500 feet although the average is about 7,000 feet. Thus it is logical that the wind velocity at the crest should be different from that at the base. This is often noticeable for the velocity at the crest is generally about 50 miles per hour in winter and 40 miles per hour in summer to that of 25 miles per hour at the base in winter and 20 miles per hour at the base in summer and consequently, we see the crests strain forward and seemingly drag the resisting bases along. The cumulus formations occupy to a great extent the lower region and so we may take our lower region to extend upward to 12,000 feet. This leaves the middle region as the space between 10,000 feet and 20,000 feet which is entirely logical.

So much for the general regions of the clouds, and let us proceed now to specific formations.

Each cloud, individually, is of interest, is necessary in the scheme of things, is worthy of attention and thought for it has a cause behind its existence and as such must be carefully studied and analyzed in order that we may know how to read and to interpret its signals. Consequently, let us inquire informally into the origin of the clouds and in so doing read their individual stories.

The vast area above and surrounding our earth extends outwards hundreds, even thousands of miles. The pressure, density, and temperature of the substance filling this area varies, or I should say, decreases rapidly as we leave the earth and at 45,000 feet, so I am informed by a competent physician, the present limit of man's endurance, with necessary apparatus, is reached. This, however, I am informed also, should not be taken as the definite limit because even at the present time scientists are working on and perfecting a system whereby internal pressure and external pressure may be equiponderant and flying to any sane altitude may be accomplished.

It is this above named variation then that has so much to do with the formation, existence, and meaning of clouds. The temperature of the atmosphere decreases with altitude at the rate of approximately 17° Fahrenheit per mile until a minimum of 67° (below zero) is reached at about 7 miles. The atmosphere above this, at least up to about 25 miles, seems to beat the same temperature although no definite data above the 25 mile line has at present been obtained. Along with this decrease in temperature is an accompanying decrease in density and consequently, the pressure at, say 7 miles, is only about a fifth that at sea level.

THE atmosphere, as we all know, is made up of many gases, chief among them, nitrogen about 78 per cent, and oxygen 21 per cent and water vapor. Of all these gases, which are practically constant up to 7 miles, the water vapor is the only one that varies with the altitude. At sea level, the water vapor averages slightly more than one per cent of the atmosphere, at 3 miles it averages about .33 per cent by volume, and at 7 miles, only about .01 per cent. The amount of water vapor that the air can hold depends primarily upon the temperature, and decreases as the temperature decreases. Thus we see why there is less water vapor in the air at 7 miles than there is at sea level. We see why clouds are usually found under 8 miles and why the clouds become thinner and more tenuous as we increase the altitude.

Clouds are formed when the temperature and pressure of the atmosphere are such that the water vapor can no longer be retained. The atmosphere is saturated when it contains for a certain temperature and pressure all the water vapor that it can retain. Under such conditions it has 100 per cent humidity. Consequently, when the air contains only 80 per cent as much moisture as it can retain it has a humidity of only 80 per cent. Thus it is seen that in order to produce a cloud, the retained water vapor must exceed 100 per cent humidity for that temperature and pressure and the water vapor will then condense out and become visible as a cloud.

In general, clouds are formed by the cooling of the atmosphere. The cooling is accomplished in a myriad of ways. Take for instance, cumulus cloud at an altitude of roughly a mile. It does not come to us from some other part of the sky. It is formed before your eyes. The day is warm and clear. The moisture laden air at the ground is heated by the sun's rays on the earth, the air becomes lighter by heating and expansion and rises. Thus a convection air current is produced and normally this current rises to the height of the aforesaid mile. On rising, the air expands due to the decrease in pressure. Thus, as the moisture laden air expands it cools. If it cools to the saturation point so that all of the water vapor cannot be retained, some of the water vapor condenses out. This is now no longer invisible as a gas, but is a visible droplet of water, which scatters the light rays on it and when joined by innumerable other droplets produces the cloud.

Now again, a layer of moisture laden air may be cooled by a layer of colder air above or below it. Such a layer cools of its own accord by dissipating its heat to the surrounding layer and if it cools enough as before, some of the water vapor may condense out and we will then have a layer of cloud, usually fog at the earth's surface or at higher altitudes a stratus cloud. This is fundamentally the situation on ocean fronts and lake shores, as, for instance, the Newfoundland coast where fog has caused so many Trans-Atlantic flyers to disappear. The warm moisture laden air from the south following the Gulf Stream meets the cold air from the Arctic and condensation takes place with the resultant fog formation that causes the pilots of these Trans-Atlantic planes to go "blind." The same fundamental phenomena applies to the upper regions of the sky as well.

Cirrus clouds show the effects of the winds of the high altitudes in which they float. They are almost always born in a cyclonic area that is in an area of low pressure and their formation may be easily explained by reference to the theory of liquids. The atmosphere consists of high and low areas of pressure with the resultant cyclonic and anti-cyclonic areas. Now the pressure tends to become uniform and air will flow from the barometric high to the barometric low. The air flowing from all directions into a cyclonic or low pressure area causes an upheaval at the center. The upward action is tremendous and the up-draft may reach altitudes of several miles. The air thus thrown up carries water vapor with it. This condenses out and cirrus clouds are formed. The high winds of the region then take the cirrus clouds and carry them along usually far out in advance of the moving barometric low. This explains the action of the mare's tail and also indicates why the cirrus formations herald stormy weather.

Now for the individual clouds. Stratus or layer formations are common to all clouds. Clouds that are fractured, that are broken, appear as fractuc clouds and therefore the term fracto is also common to several clouds.

The clouds of the high region are chiefly cirrus and cino-stratus. Their altitude vary any way from 15,000 feet to 45,000, but average about 28,000 feet. Cirrus clouds are detached clouds of delicate, fibrous appearance and are seen more often in dry weather than in wet weather. Cino-stratus, 22,000 to 25,000 feet and are known as the mackerel sky, are predominantly wet weather clouds.

The clouds of the middle region are chiefly cino-cumulus, alto-cumulus and alto-stratus. Cino-cumulus clouds are small globular masses or white flakes, without shadows, generally at an altitude between 20,000 feet and 25,000 feet and are known as the mackerel sky. They are often arranged in more or less regular lines and are usually due to local convection currents. Alto-cumulus clouds are rather large globular masses, white or grayish and are also arranged in lines or groups, but these groupings are sometimes confused by close packing. They are commonly known as the Great Waves and average about 13,500 feet in altitude. They are usually prevalent in calm summer weather when the humidity is low. Alto-stratus clouds are, as the name implies, a thick sheet of blue-gray clouds at an altitude between 15,000 and 20,000 feet.

The clouds of the lower region, below 10,000 feet, can be divided easily into two groups, namely the dry weather clouds and the wet weather clouds. In the former group, we have the strato-cumulus and cumulus and in the latter group we have the nimbus, fracto-nimbus, stratus, and fracto-stratus.

Cumulus clouds are perhaps the most generally observed of all clouds. Overhead they appear like fleecy masses, hence the sobriquet "Wool pack clouds." They are slightly grayed by shadows, have horizontal bases, and are not very interesting except that they lend variety to the blue sky. The more interesting cumulus formations are those seen nearer the horizon. At the oblique angle thus obtained, their crests are visible and it is in this position that we can best see their dome like tops.

Stratus clouds are merely horizontal sheets of fog at an altitude of less than 3,000 feet. Sometimes they are only a sea fog drifting inland and then again they are clouds formed by the passing of a cold layer of air underneath a warm moisture laden sheet as explained above.

A nimbus, as "Rain Cloud," is a thick, dark, extensive layer of flat cloud without shape and with ragged edges from which rain or snow is falling. The average height is about 3,000 feet although it is often lower and sometimes higher. Through openings in it, a layer of cirro-stratus or alto-stratus may often be seen. Fracto-nimbus formations are merely detached fragments of nimbus clouds, but because they are slightly lower, 300-1,000 feet, and show light against the darker true nimbus, they are commonly called "scud." Scud moves quickly and seemingly forms only when a strong wind is blowing. The cumulo-nimbus-thunderhead is a heavy mass rising in the form of turrets, mountains, anvils, and various other formations. It is usually surmounted by a screen of sibrous appearances (false cirrus) and has at its base a mass of cloud similar to nimbus.

These are the primary clouds. However, there are many special formations on which I shall not touch at this time for each is peculiar to a certain district or location as the line squalls of the Ohio and Mississippi rivers and the typhoons of the south seas.

Clouds are funny things; watch them as you go about; watch their beginnings; and then, if possible and the conditions are right, watch a cloud floating inland over a stretch of open water. Perhaps you shall see it start gently over the land, and then jump and rend violently upwards. If you do, you will marvel and begin to wonder if you are so almighty as you think you are and finally you'll come to the conclusion as so many have already done that the clouds are indeed a marvelous film on the screen of the sky.

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

Graduate Engineers in Industry

IT may safely be stated that there are very few students who elect to take four years of technical training without having a real interest in the knowledge they expect to acquire. It is also true that there are even less who undertake a technical course purely from motives of interest in the abstract knowledge they may obtain in the classrooms. Thus it is evident that the major inducement is the job which is supposedly waiting just behind the sheepskin. A quick survey of the possibilities confronting the graduate will indicate that all is not as it might be.

There are as many attitudes toward graduate engineers as there are personnel heads and employment managers. Certain large companies have a well developed and systematic routine which every new engineer must go through. This routine consists of such things as shop training, training schools and probation periods. These companies differ greatly in their respective inducements. Other smaller industrial concerns do not have an elaborate system for breaking in the new engineer, but depend more on the man finding himself when on the job. There are also many concerns who are antagonistic toward technical graduates. Further, there are personnel heads who believe that there is no need of, or room for, any new beginners in their concern.

Likewise there are as many attitudes toward the prospective job as there are applicants. To some of the new engineers, the job offered seems worthwhile and interesting, the recompense ample, and the future outlook rosy. Many more, however, are considering the first job only as a stepping stone to a better position. Unless it speedily improves, they intend to leave it at the first opportunity. Such an attitude is hardly conducive to good work and real effort. Lastly, come those who were unable to obtain a position. They have serious doubts as to the wisdom of anyone making a large expenditure to acquire a technical training.

The objections raised against technical graduates by industrial heads are many and varied. A common one is that the training is too abstract, and the young engineer is not versed in applying his knowledge to the problems on the job. Other frequent complaints are, lack of interest, and lack of cooperation. A common complaint is that technical graduates are too much centered in their work, and do not have a background of interest in other lines, neither do they have the ability to speak or write clearly and forcefully. Another objection is that new engineers are so called "formula hounds," that is, they are prone to use a formula for any unusual problem which may arise, without a thorough knowledge of its derivation and application. There are some captains of industry who may have no objections to an embryo engineer but who feel that they have no need of any influx of new technical knowledge into their staff, and that to employ one would be to incur an expense which could not be justified on the basis of lowered costs or improved product.

The new engineer, too, has many faults to find with the situation. He believes that many concerns offer too low a salary at the start. He also objects to being obliged to put in a long apprenticeship period over a drawing board or in the shop before being given a responsible position. He fears that his hard-won technical knowledge will have seeped away by the time he has passed this probationary period. There are many concerns in which promotion is slow and uncertain, and even the tenure of the job is unstable. The young engineer also feels that it is unnecessarily difficult to get in contact with certain employers, said contact to be of such nature that a real consideration will be given to an applicant's qualifications. Too often an application blank filled out may as well have remained blank for all the consideration given to it.

It is an old maxim that with much smoke there must be some fire. That there are real difficulties in the path of the young engineer is not to be denied; any steps which would help remove some of these should be taken. The responsibility lies jointly with employers, students and the schools. With better application by the students, many of the objections to a technical graduate would disappear. Engineering is a fast changing science, and the curricula of the engineering colleges must keep in step with the latest developments, if they are to be of maximum value and service. With a proper attitude on the part of employers, and proper recognition of the contribution which the graduate engineers make to the progress of industry, there will be a greater inducement for every student to put forth his best efforts.

The Alumni Service Fund

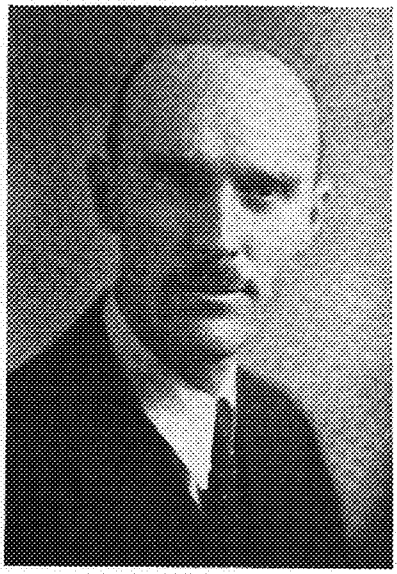
GRADUATES of the year 1930 in the College of Engineering and Architecture and the School of Chemistry are offered a rare opportunity to inaugurate a fund, which can work only for a better Minnesota and greater success among Minnesota engineers.

The year 1930 makes the establishment of the Alumni Service Fund. This fund has been conceived for the purposes of first maintaining an employment bureau for graduate engineers, and second, creating a higher degree of cooperation among graduates of the technical schools. But over and above these concrete examples of its actions, the fund will serve to weld alumni into a homogeneous body which can bring matters of interest to Minnesota engineers to the attention of the proper authorities. It is difficult to say just what action will result from this closer union of engineering alumni. But the fact remains that the faculty are interested in what the alumni think. But the idea that the faculty is sufficient by itself, is erroneous. Graduates who have gone through the Minnesota mill, and tested the efficacy of its education in the world of practical experience are the ones who will best be able to supplement the knowledge and skill of the faculty in order to develop a better Minnesota.

Let us now turn to a consideration of the Employment Bureau which is to be established. On first leaving these halls of learning the graduate engineer finds little difficulty in obtaining a job—they are offered to him on every side. But when he has profitted by his first contact with experience, and found time to acclimatize himself with the world of business—then his search for a position to suit his desires and ambition becomes a different story. And the search is most difficult as will be attested to by countless alumni. There is a crying need for this employment bureau which will not only be able to ascertain the wants of employers, but also the capabilities and experience of applicants.

And the part of the TECHNO-LOG in the establishment of the fund? The TECHNO-LOG contributes by offering a four year subscription to every supporter of the service fund. The $5.00 is given to the alumni service fund in toto, the TECHNO-LOG therefore offers its four year subscription free of charge. And why? First, because the TECHNO-LOG endorses whole-heartedly any plan that promises to be of such great benefit to the Engineering Schools and Minnesota Engineers. Secondly, because there is need of a binding matrix, and of this there is the utmost need. It is useless to say that so and so many members or twice that many can establish an effective alumni fund. It is like saying that since a house is made of 7,000 bricks, that 7,000 bricks make a house. They do not. There has to be a plan as well, and timbers and girders and mortar. There has to be, in short, a unifying principle. The TECHNO-LOG is this unifying principle—for the Alumni Service Fund. It is the means for linking graduates into a homogeneous body.

But in the final analysis, it is impossible that the alumni service fund be successful unless it receives the support of the entire graduating class. Let every senior show his gratitude to Minnesota by assisting in the establishment of a fund which can work only for his individual benefit in the years after graduation.



F. B. LINDSAY

FACULTY SKETCH

FRANK B. LINDSAY, instructor of mathematics, was born in St. Louis, Missouri, on the sixteenth of October, 1895. When he was still quite young, his family moved to Bloomington, Indiana where he attended high school for four years. Following his graduation, he matriculated at the University of Indiana, where he majored in mathematics and minored in physics. Although he was graduated with Phi Beta Kappa honors, Mr. Lindsay found time to establish a fine record in extra-curricular activities. The members of Phi Delta Kappa, an educational fraternity, gave him the presidency of that organization for two successive years. Mr. Lindsay represented the fraternity at two national councils held in Chicago in 1920 and 1921. He was also president of Kappa Delta Rho, a national academic fraternity.

At the conclusion of his university work, Mr. Lindsay was given a position as principal of the Hastings High School at Hastings, Florida. There he remained for five years during which time, in addition to his professional activities, he occupied himself with his pet hobby, the study of nature. For many years, he carried on a correspondence with John Burroughs, the famous naturalist.

During his stay in Florida, Mr. Lindsay wrote extensively for the Country Gentleman and contributed numerous editorials to "Sunniland," a Florida publication. Upon leaving the state, he returned to Indiana, to pursue graduate work at thee University of Purdue. In January 1929, he came to the University of Minnesota where he has since held the position of instructor in mathematics and technical mechanics. His natural ability as an instructor coupled with his clever humor has succeeded in making him a great favorite with his students.

Some idiosyncracies:

Likes to raise vegetables, poultry, and hell, but finds the opportunities for gardening and poultrying restricted in Minneapolis.

Pet aversion: cross-word puzzles.

Chief recreation: hiking.

Admitted vices: Reading in bed; Scotch jokes.

Additional honors: Member of the Indiana Academy of Sciences; two years service in the U. S. Marine Corps during the World War.

Engineers' Homecoming

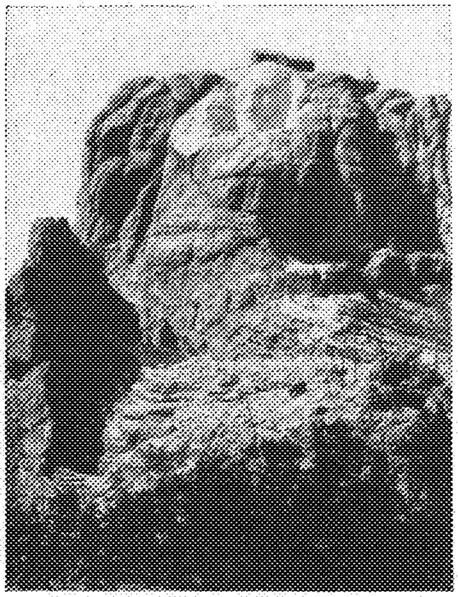
MAY SIXTEENTH—Engineers' Day. Again the great army of graduated engineers, architects, and miners follow the well-known trail back to the campus where the good old school days were spent. Little wonder that the eyes of the old "alums" sparkle with pleasure at the thought of renewing old friendships and making new acquaintances.

There is probably no sensation so pleasurable as that which comes with the clasp of an old comrade's hand. Little groups congregate here and there, boasting of old accomplishments and bragging of new conquests. The former classmates stroll about, glancing at this new building and that latest improvement. Above the whole scene hangs a spirit of good fellowship seldom seen outside a college campus. Here is Smith, back from the Philippines; next to him stands Parker of the same class, the man in charge of that new high-line going up in Argentina. Countless others from all parts of the civilized and savage world stand together, one telling of the latest laboratory discovery, the other relating a tale of a hairbreadth escape in the African jungles. Separated for years they have lost none of the carefree spirit which forever characterizes every engineer.

One and all, the "grads" never fail to visit the instructors, who in years past were the guiding lights through the pitfalls of undergraduate work. It is a real pleasure to hear the lusty shouts which arise as some favorite of days gone by hastens from the same old classroom to greet the arrivals. The jokes and pranks of years past are all discussed anew, and the grads are treated to incidents of interest which have occurred in their absence. Throughout the day, which is all too short, the newcomers visit the various exhibits scattered about the engineering campus, all recalling the days when they too supervised the parade, open house, and the "Brawl."

The close of the day comes all too soon. The visitors, having finished with the most pleasant day of the year, must return to the pressure of business. Taking one last glance at the scene of the happiest days of their lives, they return to the problems of the hydro-electric dam and the power plant.

The worth of such a day undoubtedly lies chiefly in its ability to bring old classmates together and to acquaint the alumni with new conditions at the university.



MOUNT RUSHMORE

THE RUSHMORE MEMORIAL

AN AMERICAN EPIC

By STEVE GADLER, EE '32

IN the summer of 1927, President Coolidge, while vacationing in the Black Hills of South Dakota, was called upon to dedicate Mount Rushmore, which was to be sculptured into a great memorial.

Mount Rushmore is situated in the Black Hills about three and a half miles from Keystone and twenty miles from Rapid City. The mountain itself is in the shape of a sugar loaf, rising more than 900 feet above the surrounding plateau. Mount Harney, which may be compared with Mount Rushmore, is 7200 feet above sea level and is the highest point in the United States east of the Rockies, while Mount Rushmore is 6100 feet above sea level.

The memorial will portray Jefferson, Washington, Lincoln, and Roosevelt, arrayed in the order named, facing south and a little east. The rising sun will light up the group, and bathe all the faces in its full light until about two in the afternoon when only the profiles will be visible because of the lowered position of the sun. Washington's face is placed higher than the others and so will be lighted for a longer time by the rays of the setting sun.

The very inspirational effect of the monument can have a profound effect on all those who contemplate it with sympathy and, perhaps strive to emulate the characters portrayed there in such noble proportions.

Egypt may have its pyramids, Rome its Coliseum, and Pisa its leaning tower, but it is doubtful whether these monuments will have the significance to the people of these various lands as our monument on Mount Rushmore will have to the American people far into the future.

The monument in itself is like a legend retold, because the sound of these names, Washington, Jefferson, Lincoln, and Roosevelt echo and recho in the Hall of Fame. The very fame of these men represents something attainable by the American of today and of tomorrow.

The great of a great nation are displayed to the eye in such proportions which can fittingly represent the nation which they helped to build—a mighty nation among nations.

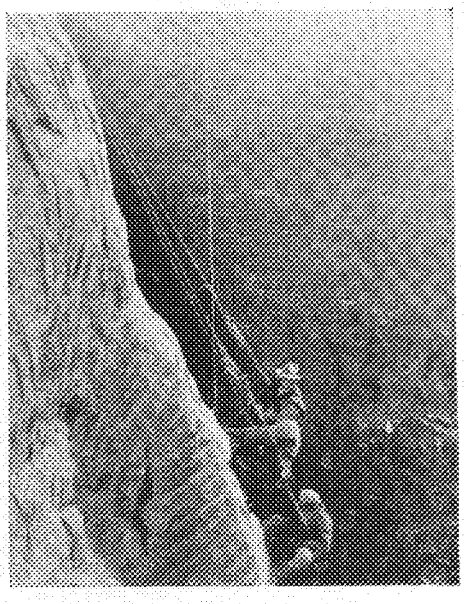
This monument now being carved from the mountain is significant from an engineering point of view, for after all, it is only by the aid of these sciences that it is possible to fashion a mountain into the likeness of man.

The statues are scaled to the proportions of men 465 feet high, the heads being 60 feet high and 40 feet wide. We may compare them to the great Egyptian Sphinx which is 66 feet high and to the Colossus of Rhodes which is 96 feet high. When completed this monument will be eight times greater than the Sphinx, four times larger than the Bartholdi Statue of Liberty and five times greater than the Colossus of Rhodes.

The meaning of the great memorial can best be understood from the words of the sculptor Gutzon Borglum, "In the national memorial on Mount Rushmore, which we are now carving in the mountains to the west of the continent we are not dealing with personalities except as they emphasize in themselves some crucial moment in the nation's life. We are building the memorial as a national record of the conception of our liberty, the forming of our nation and finally the completion of its economic structure by the cutting of the Panama canal.

"In the sculptured work we shall concede Jefferson as the leading figure in the Declaration of Independence. His position on the memorial is inevitable. Washington is the guiding genius from the time of our national conception through its struggle for life and the completion of its constitution and becomes the central part of the great group. To these we will add Lincoln, who saved the union they had created and Roosevelt, who joins the trio by the cutting of the Isthmus of Panama and so after four hundred years, the dream that led Columbus westward on his quest for a way to India.

"So we shall place the Father of the Republic in the center somewhat above the others, silent as the Sphinx, because his far-seeing character suggests that. But we mean to give him feeling that will indicate his broad world purpose. It was because of these qualities that he compelled the great above him, Jefferson, Franklin, Mason and Hamilton to build something that has in the brief life of less than a hundred and fifty years, freed a world, changed the political philosophy of civilization and in the meantime given a haven to the homeless, unwanted of the older world, where they and their children have built even better than Washington and his great associates dreamed. I believe, yes, I know, these records which are our nation's records, there with the Gods, above the meddling hand of man, to remain for aeons, where wind and rain alone may wear them away. Science tells us an inch in a hundred thousand years! So our message to posterity will linger in the granite of the Rockies in the backbone of our continent, for a million years or more, and there bear witness that here passed the sons of the old world, that here they sought and found freedom and happiness, peopled a continent and that their leader was Washington."



WORKING ON WASHINGTON'S NOSE

ABOUT THE WORLD WITH OUR ALUMNI

Architects

'92—George Taylor Plowman, etcher and author, is again in London where, for the last year, he has managed to spend the summer.

Besides making a splendid record in etching, which he started in 1910, Mr. Plowman has written two books, "Etching and Graphic Arts" and "Manual of Etching." He travels much as a lecturer and etching exhibitor.

Mr. Plowman, who lives at 9½ Madison Street, Cambridge, Massachusetts, has three sons, one of whom will be a professor in Denver University next year.

'17—Floyd W. Brown is working with A. R. Van Dyke in the First National Soo Line Building.

'17—Donald H. Buckhout is living at 446 W. Front street, Perrysburg, Ohio. His office address is 1505 Nicholas building, Toledo, Ohio.

H. Lee Burton, who was in school here in 1918, has established an office for himself in Seattle, Wash.

'21—Milton L. Anderson, 2880 Edgehill Drive, Los Angeles, California, is now with the firm of Norstrom and Anderson, 1104 W. M. Garland building, Los Angeles.

'22—Catherine Smit is living at 320 Embarcado Road, Palo Alto, California.

'23—Clarence H. Luedeman as district manager for the Genfire Steel Co. has offices at 1012 Waldheim building, Kansas City, Missouri.

'23—Miner J. Markuson, now an assistant professor of agricultural engineering in the Massachusetts Agricultural College, is enjoying life. He writes, "Enjoying life at work. Started a modest practice which has kept me extremely busy outside of college work."

'24—Otto C. Person, still a structural engineer for the Schuett-Meier Co., Consulting Engineers, is living in Minneapolis. His address is 5508 1st Ave. So.

'24—In the Australian Competition for the Anzac War Memorial I. Woodner Silverman, now at the Beaux-Arts Institute, Paris, has been selected as one of six competitors to submit designs for the final competition.

'25—C. P. Erickson has a son who is ten months old and can whistle. Maybe he'll be a second whistler.

Mr. Erickson is an architectural draftsman for the Great Northern Railroad, 1450 Van Buren street, St. Paul, being his home address.

'25—A. Gordon Lumm's home address is 1729 12th avenue, Seattle, Washington.

'27—Winston Close, who has been working for Ellerbe and company, is now planning a trip to Europe.

'28—Vere Broderick has just returned from a two and one-half years stay in Europe.

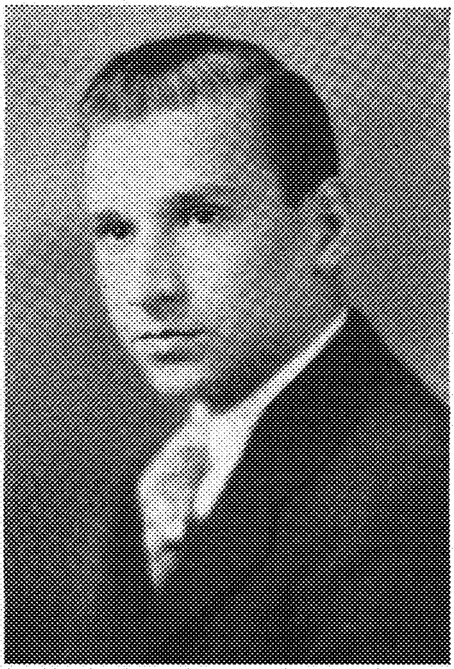
'28—Walter J. Huchthausen, now at Harvard, has recently been awarded two prizes: $1,500 from the Frederick Sheldon Traveling Fellowship Fund, and half the Robinson Fellowship, amounting to $1,100.

'29—Lawrence Hovik has left Ekman-Holm, Architects, and is now with Ellerbe and company.

'29—Glynne Shifflet has been working in Minneapolis since his graduation last summer with Paul Jones '28 over in Europe where they will study at the Fountainbleau School of Fine Arts, where Roy Thorsov, '27, and Nathan Juran, '28, studied last summer.

'29—Lyle Nelson, who has been spending most of his time since graduation last June out in Spokane, has just returned to his home in Albert Lea.

'29—"Dud" Bayliss is now teaching in the Architectural Department of the State College at Fargo, North Dakota.



Wesley Gray

Starting a year's active service as naval aviator, Wesley Gray, E. E. '29, will soon join the naval fleet air base at San Diego, California. Mr. Gray has just returned from Pensacola, Florida, where he has been training since his graduation for a commission as an ensign.

Imediately after being graduated Mr. Gray left for Great Lakes, Illinois, for a month of preliminary training consisting of 18 hours flying in seaplanes.

Leaving the Great Lakes in July, he went to the Naval Air Station at Pensacola, Florida, to begin an eight months' course in aeronautics. The course included both practical flying and ground school training.

Finishing his course in April, Mr. Gray took his examination for a commission and was designated as a naval aviator. He recently received his commission as ensign in the United States Naval Reserve.

Speaking of his training course, Mr. Gray said, "The station is situated near the mouth of Pensacola bay and encompasses about four square miles of land.

"The bay holds a squadron of 50 NR-2 seaplanes for primary seaplane train'ng. In addition the station has two fields for land plane training. They are Corey field, consisting of approximately a square mile of land lying five miles north of the station, and a field at the station.

"Corey field, which has a squadron of 50 NR-1 planes, is used for primary land training while the other is a training field for combat and observation training.

"The equipment of the station field consists of 20 Curtiss Hawks, and a squadron of twenty-five 02-V1, Vought Corsairs, which are used for observation training in spotting corrections for target gunfire, communication between planes and ground being kept by radio.

"Blind flying is taught in a squadron of 02-V seaplanes in which the student, in a covered cockpit, is guided entirely by instruments."

Mr. Gray was advertising manager of The Techno-Log last year, and was active in campus affairs during his four years here.

Chemical Engineering

'10—G. H. Woolett, professor of chemistry at the University of Mississippi, has a future engineer in his family.

'10—Farrington Daniels is vice chairman of the Physics & Inorganic Section of the American Chemical Society.

'13—J. D. Edwards, assistant research director of the Aluminum Corporation of America, has a two volume book on chemistry on the press.

'21—Morris L. Boxwell, foreman for the Asphalt and Lubricant plant of the Union Oil company, Oleum, California, says, "You will find Stanford a powerful team to beat and that Minnesota gains considerable prestige here by the relation. Dare you to bring the 'Jug'."

'21—Oscar Schmerer is connected as chemical engineer with the Roessler and Hasslacher Chemical company.

'21—Carl L. Walford has left the ore-testing laboratory at the University of Minnesota to fill a position with the A. O. Smith company in Milwaukee, Wisconsin.

'22—Carl E. Lager has left the employ of the Aluminum corporation of America.

'22—Betty Sullivan is still a chemist for the Russell-Miller Milling company, Minneapolis. She lives at 43 Dell Place, Minneapolis.

'23—Richard L. Rademacher, chemical engineer for the Republic Creosoting company of St. Louis Park, Minnesota, is living at 3844 22½ avenue South, Minneapolis.

'24—Alvin O. Fuhrman, 565 Portland avenue, St. Paul, is working for the National Lead Battery company.

'25—Norman Bekkedahl, 3943 Connecticut avenue, Washington, D. C., is doing research work for the International Association of Electrotypers, Bureau of Standards, Washington.

'25—Harold Bunger, who has been at the Georgia School of Technology, has recently been promoted to an assistant pro-

(Continued on page 268)

NEWS FROM THE TECHNICAL CAMPUS

Emmons Gives Fourth Sigma Xi Lecture

The fourth of the Sigma Xi lectures on science was delivered by Dr. W. H. Emmons of the geology department. "The earth is believed to be two billion years old," he stated, "although we know little of the first billion and a half.

"Man knows quite definitely the ten mile crust of the earth; the density of this surface is 2.5. But by means of a pendulum, the density of the entire earth is shown to be 5.5! The prevailing explanation is that the core of the earth consists of a molten nickel-steel alloy; this accounts for the great density and for the increase of temperature as one approaches the center of the earth, this increase amounting to one degree Centrigrade per hundred feet or one degree Fahrenheit per sixty feet.

"Since the interior is warmer and the sun keeps the surface at a constant temperature, the earth shrinks. This contraction, very similar to the shrinking of the skin on an apple, produces mountains and valleys.

"A range of mountains extending half way across the United States lies buried only a comparatively few hundred feet below the surface. Oil has been obtained from the peaks of these mountains, the largest well being that one which recently burned so fiercely without control near Norman, Oklahoma.

"Centuries ago Chinamen drilled four thousand feet by hand, using a simple churn drill. In spite of the unusually favorable conditions they encountered, one must respect these men who pioneered so far in advance of us.

"Indeed, until twenty-five years ago, geology was not appreciated to any large extent. The rise of large oil and mining companies was coincident with the appreciation and utilization of geology and the work of the geologist."

Dr. Emmons also discussed the simpler earth formations, using diagrams to clarify the details. He concluded the lecture with a series of slides.

Freezers Used in Test

Apparatus to test the effects of freezing and thawing on clay and concrete has been installed in the experimental engineering department. Permeability tests at pressures up to two hundred pounds per square inch are carried out after a certain number of cycles of freezing and thawing.

The freezing apparatus consists of two Nizer ice cream freezers, of the compressor type, each equipped with its own power unit, and capable of holding sixteen test cylinders at a temperature of forty degrees below zero Fahrenheit. Thawing is brought about in water baths.

The apparatus is being used by students in Structural Engineering 150, and it is also being used on an extensive program of research on clay substitution for concrete. Freezing and thawing are more important than crystallization as a cause of disintegration in northern zones, according to C. A. Hughes, of the department of structural engineering.

Four sizes of clay and concrete blocks are used. At the present there are two hundred and forty 6x12 inch test cylinders and one hundred and sixty 4x6 inch test cylinders under test. Tests of fifteen cycles of freezing and thawing require sixty days; thirty cycles, six months; forty-five cycles, one year, and sixty cycles, two years.

Alumni to Banquet on Engineers' Day

Along with the 1930 festivals of St. Pat comes the Engineering alumni-faculty gathering in form of a banquet to be held at the Minnesota Union between the hours of six and nine P. M. Alumni galore will be there. The sixteenth will see engineers from Minnesota and surrounding states back on the campus shaking hands with old friends and talking over old times. In general, Engineers Day will also be an Engineers Homecoming, full of excitement from morning till night. At eleven the student engineers parade down University, at twelve thirty St. Pat dubs his knights, and from three to five the Architects entertain with a tea dansante in the Engineering auditorium. The alumni and faculty take control from six to nine, then they in turn make room for the big dance.

An excellent program of entertainment has been arranged for the dinner by the committee. President Coffman and Dean Leland will be ready with talks on the progress of the University and the changes that have taken place. Mr. Royden V. Wright of New York, graduate of 1898 and editor of *Railway Age* and *The Railway Mechanical Engineer* will talk on "Transportation." Mr. Wright is an authority on the subject having had many years of experience in that field.

Says Mr. Ryan of the Electrical Engineering department, chairman of the committee, "Having this first banquet on Engineers Day is a matter of experiment but we hope to make it an annual function to be held in combination with the regular festivities."

Inventor of Nichrome Adrresses Local A.C.S.

Dr. William Hoskins, consulting chemist of Chicago, Ilinois, spoke before the local section of the American Chemical Society on April 16. The subject of his address was "The Genesis of Industry." He described in a most vivid and human manner the early struggles of his career.

One of his early inventions was the hydrocarbon blow pipe and the hydrocarbon furnaces. His story of how, with the aid of Mr. A. L. Marsh, Nichrome metal was invented and developed was an inspiration to all of his hearers. Mr. Marsh had come to Dr. Hoskins' laboratory with some ideas about thermocouples and nickel-chromium alloys for such use. He worked in Hoskin's laboratory and under Hoskins' supervision. At first they planned to light farm-houses by placing thermo-couples in the cook stove, and later they proposed to supply electrical current to the automobile, which at that time was just being developed. However, the high electrical resistance of the alloys made their use in the farm or auto impossible. This same property that balked them in their original plans was made use of, however, and today we have the electric furnaces as the result.

Dr. Hoskins stressed particularly the point that all of the great enterprises of today have had a small beginning and that opportunities similar to his exist today, waiting only to be developed by those who have sufficient insight and perseverance.

Montillon to Return

George H. Montillon, Associate Professor of Chemical Engineering, is working while on sabbatical leave with the department of engineering research of the University of Michigan. This department is affiliated with the Utilities Research Commission of Chicago, Illinois.

Professor Montillon is studying the fundamental theory of heat transfer in viscous substances, such as tars and asphalts. He is using a diphenol boiler in place of a mercury boiler in an attempt to do away with the poisonous mercury gases. By using the vapor of diphenol, a study of the nature of the film resistance of the viscous substances may be made. The results of his research will be made use of by the Utilities Research Commission.

Professor Montillon expects to conclude his experiments by the middle of July, and he will teach during the second summer session at the University of Minnesota.

Faculty Men Attend Chemical Meeting

The use of organic fluorides as refrigerants discussed at A.C.S. Convention.

THE meeting of the American Chemical Society held in Atlanta, Georgia, during the week of April 7 was a great success, according to reports brought back by several members of the faculty who attended. Many subjects of importance in the chemical world were discussed, and several interesting demonstrations were given.

During the first part of the week, the members were entertained each night at dinners followed by short programs and dancing. On Thursday, at noon, they were treated to a barbecue. Pigskin billfolds were presented to members by the Coca-Cola company, and music was furnished by a negro orchestra. In the afternoon, trips were made to Stone Mountain, where the sculptor, Borglum, is hewing great figures of Confederate war heroes. They went also to Agnes Scott College, and to the Atlanta State prison. On Friday the party visited many of the nearby industrial concerns, including cotton, oil, and chemical factories, and the Coca-Cola plant.

The ladies' section of the program consisted of luncheons on Monday, Tuesday, and Wednesday, followed by drives through Atlanta's residential district. The luncheon on Tuesday was with the compliments of J. E. F. Herreshoff, one of the two surviving founders of the society. The luncheon was followed by a drive and tea at the home of Dr. and Mrs. J. Samuel Guy.

Among the topics discussed was the problem of illegal distilleries and their control. The society favors putting the enforcement of the prohibition law under the jurisdiction of the Judicial department. The reorganization of the society was a point of paramount interest.

The winners in the prize essay contest for college freshmen and normal school students were announced.

A highlight in the program was the presentation of a paper, "Organic Fluorides as Refrigerants" by Thomas Midgley, Jr., of General Motors Corporation. He has developed an absolutely safe gaseous refrigerant which has properties that make it preferable to any of the substances in use at the present time.

The qualifications of an ideal refrigerating gas, Mr. Midgley declared, are that it must have a low boiling point, must be non-inflammable, non-toxic, and non-corrosive toward metals. The commonly used gases, ammonia, carbon dioxide, sulfur dioxide, and methyl chloride all have the first indispensable quality, but each lacks one or more of the others.

When Mr. Midgley started on his search, he tried methyl chloride, a very low boiling gas, as his starting point. He substituted atoms of fluorine for chlorine, but found that the boiling point went up tremendously. He then chose a very high boiling liquid, carbon tetrachloride, and substituted two atoms of fluorine for two of chlorine and found that it had a satisfactorily low boiling point. The first qualification was satisfied. He found the gas to be non-corrosive toward metals used in refrigerators, a quality which sulfur dioxide and ammonia do not have. He then sent samples to skilled toxicologists for exhaustive tests. They found that animals may live for an hour in 80% concentrations of the gas and that life was possible for indefinite periods in a 40% concentration. In smaller amounts, the gas apparently had no effect on the creatures. In contrast with this, any of the other gases will kill in a very short time in concentrations of 20% or more. Sulfur dioxide, ammonia, and methyl chloride are actively toxic, while carbon dioxide kills by suffocation.

Mr. Midgley's test for inflammability was highly interesting. Into a two liter beaker, he poured enough of the liquid gas so that the low temperature caused by evaporation formed a thick layer of frost around the beaker and kept the gas in the liquid state. He then placed a lighted candle in another two liter beaker. Taking a long glass tube, he exhaled slowly through it near the bottom of the flame. A flickering caused by the air currents was the only result. He then bent over the beaker of gas and filled his lungs. He breathed the vapor for a full minute and again blew through the tube at the candle. The flame went out. Here was the ideal refrigerating gas.

The formula for the new gas is CCl_2F_2. It is made by heating together carbon tetrachloride (CCl_4) and antimony fluoride (SbF_3). Its technical name is chloro-fluoro-methane. An important possibility of the gas will be for cooling the bottoms of very deep mines where because the temperature is very high (90° to 100° F.) and the humidity is 100%, men are able to work only a very short time. It has heretofore been impossible to cool the mines mechanically because of the dangerous nature of the gases which would have to be used.

The substance, it is expected, will also be of great value for cooling submarines and sick rooms.

Zelner to Direct State School Music Contest

Professor Otto S. Zelner of the department of civil engineering is the manager of the sixth Minnesota State High School Music contest, which will be held at the University of Minnesota, May 15, 16 and 17. Professor Zelner, who is widely known in music circles, will be in charge of the entire contest which will bring approximately 1,400 high school students to the Minnesota campus.

Professor Zelner is planning a new system of judging all entries in the contest with a view towards rating teams and individuals so that they can compare one year's performance with that of another.

"It often happens that a good organization fails to win first place in its class," explained Professor Zelner, "because it is up against better ones, and it happens also that mediocre groups sometimes win prizes because there are so few entries in the given class. While our new system will not be able to eliminate entirely such a condition, it will show a team just where it stands with reference to past years and with reference to a 100 per cent standard."

Last years' contest was under the direction of Abe Pepinsky, of the department of music, who is now on sabbatical leave in Berlin.

Iowa Man Takes Drawing Post Here

There is quite a difference in the methods of education at the Iowa State College at Ames from that at Minnesota, according to J. George Dean, instructor in the department of drawing and descriptive geometry. "The difference, I think, can be attributed to the fact that there is a much larger enrollment at Minnesota than at at Ames," said Mr. Dean.

Mr. Dean was recently appointed to the department of drawing and descriptive geometry at the University of Minnesota. He is a graduate of the Iowa State College at Ames, Iowa, with the class of civil engineers of 1918. After his graduation, he spent about a year and a half in the United States Army, during the World War. Following his return from the war, he spent eight years in county highway work, city work, with the city of Nevada, Iowa, and private practice. Since that time, he has spent approximately two years in managing his farm in Nevada, Iowa. He was appointed as instructor shortly after mid-quarters of the winter quarter.

Mr. Dean has now moved with his wife and three children to Minneapolis. He is a member of the Ames chapter of Delta Chi.

FRANCIS E. MULLEN, *St. Pat*

Program of the Day

MORNING

9:30-12:00—All of the laboratories, shops and all departments conduct open house for the visitors and alums. Souvenirs are given out.

11:00—Loyal sons of St. Pat parade through the campus district, displaying many floats depicting the engineer's view of the campus. The Blarney Stone always rides in the parade on its way to the Knighting ceremony.

AFTERNOON

12:30—Senior engineers are knighted on the campus knoll by their royal St. Patrick. Announcement is made of members of Plumb Bob.

3:30—Dansant held in the Main Engineering auditorium. Green Tea is served in the Architectural Library.

6:30—Alumni-Faculty Banquet.

9:00—The Brawl! The biggest party of the year. St. Pat and his queen lead the Grand March. Minnesota Union Ballroom.

ST. PAT R

By His Irish Majesty fo

WHEN I learned that one of my duties as patron saint of Engineer's Day was to prepare an article for the MINNESOTA TECHNOLOG, I was so distracted that I wandered about for three whole days in the Main Engineering Building, and finally about sundown, found myself in Professor Zelner's office. "Professor," I said, as I sank into a chair beside his desk, "It is one thing to be elected Saint Pat and it's an entirely different thing to write about it."

"Yes, yes," he regarded me quizzically, "but that shouldn't be so terribly hard—what with traditions and the Blarney stone and all."

"That is just it," I cried. "Can't you see that everybody is sick and tired of reading the same old stuff year after year. Even the *Daily* says so. Who was this Saint Pat anyhow, that he should bring sorrow and grief upon me in my last quarter in college?"

"There are several stories as to that," Mr. Zelner reflected aloud, "but perhaps this will help you." He reached behind his desk and brought out a twisted club of peculiar appearance. I took it and glanced inquiringly at him.

"The black thorn shillelagh," he explained. "Tradition has it that Saint Patrick himself wielded it in his celebrated worm drive . . ."

"Bologna," I exploded wearily. "This stick may serve to keep off Miners and Foresters, but how can it help me to write?"

"There have been queer tales of its powers . . ." but the story Mr. Zelner was settling himself to tell was interrupted. I had impatiently pounded three times upon the floor with the butt of the old shillelagh.

"And who would be after calling me?" inquired a strange voice from the doorway. We whirled to face the intruder. In the twilight everything was dusky and indistinct, but I made out a tall form, lean face beneath a mop of reddish hair with keen, twinkling eyes and a winning, twisty smile.

"Who are you?" I blurted out. "We weren't calling anybody."

"Indade, and ye don't say," continued the friendly voice. "But who else could be thumping with me auld stick that I see in yer hand there?"

"Your stick?" I looked at it in surprise. "How do you get that way? Don't you know this is the shillelagh Saint Pat carries on Engineer's Day?"

"So ye don't think the auld thorn is for the likes of me, eh?" and the newcomer, said he strode into the office and took it out of my hands. "Faith and begorra," he exclaimed as he twirled it above his head. "'Tis the devil of a while since I've felt the heft of it, but I'll be after telling ye me right arm still lay it about with power, glo to God."

"Won't you sit down?" invited Zelner who had recovered himself quickly than I—for I was still ga at the apparition. "The club brings old times?" suggested the Profe "Won't you tell us about the old da I suppose we may call you Saint

"Pat to the likes of ye," offered visitor graciously as he leaned bac a chair, "though the Britons called *Sucat* which means warlike and the great Irish *Cothraige*."

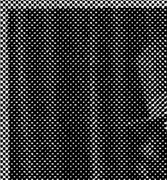
"That stick must have come in h back in those times," I said. "Did always have it with you in Ireland

"I cut this shillelagh from the that grew in the midst of the ga of Erin before auld Mither Eve too draping herself with shamrocks."

"Hold on," interrupted Mr. Ze hastily, "what are you saying? Are talking of the Garden of Eden?"

"Erin, not Eden," Saint Pat corre him patiently, "'tis happy I'll be t ye right, seeing how many folks mis and mispronounce it."

ENGINEERS DAY



CHEMISTS TRIP

(Continued from page 253)

afternoon, but that night the storm came —and what a storm it was—twenty inches of snow.

Tuesday the engineers wallowed through the snow to visit a corn products plant covering two hundred acres and consuming one-eighteenth of the total corn produced in the United States. The various processes require twenty million gallons of water a day, which is supplied from a source hundreds of feet below the surface of Lake Michigan. In this factory all of the kernel is used—if corn had a squeal like a hog, that would probably be used also.

The itinerary also included inspection of the largest Standard Oil plant in the country, and a trip through the Western Electric company, manufacturers of telephone and Vitaphone equipment, and employer of thirty-five thousand men.

In a lead refining plant that produces lead 99.8% pure, the students saw huge piles of silver. The guide offered them all they could carry but no one brought back any of the huge bricks as souvenirs.

Dante's inferno, or its equivalent enlarged and improved, was the description given of a large steel plant visited. See the seniors for unprintable details.

More than the usual interest was shown in a visit next day to a large bottle company where each of fifty machines produces from twenty to sixty bottles a minute. This factory is located near one of the largest and best beds of pure sand in the country.

After spending the night in the more or less conventional manner, the seniors climbed into their bus for the last time on their thirteen hundred mile ride. At five o'clock Saturday they arrived in Minneapolis, weary but happy and already looking back with pleasure to the interesting and sociable trip they made together.

ENGINEERS GIVEN ATHLETIC AWARDS

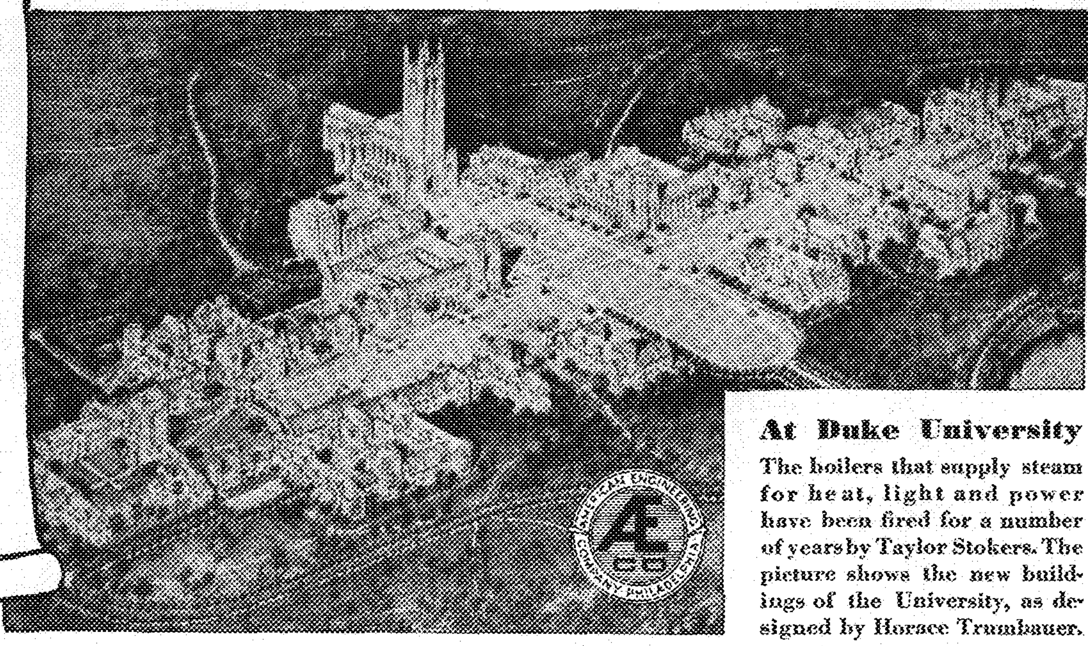
(Continued from page 266)

awarded to Roy Kinzie as All-U wrestling champion in the 145-pound class. Seven gold keys went also to graduating varsity letter men. In football to Fred Hovde, Lawrence E. Johnson, and Fabian Redmond. In basketball to Glenn Williams. In hockey to Lloyd Russ. In baseball to W. E. Hinderman, and in wrestling to Louis Tiller.

Seven silver keys were awarded to M. Jensen, F. Seibolds, H. Mikkelson, D. Scheffel, D. Dols, E. Fremo, and O. N. Felt. As an independent team of engineers, these men defeated all other teams in the basketball league.

One silver key was awarded to W. R. Strand, the college champion in the spring 1929 tennis tournament, and Arne Wick, champion in the fall of 1928. One silver key was awarded Lester Borchardt, engineering champion in the spring tennis doubles. His partner, Hendrickson, as a member of the all-university diamondball team, had a gold key awarded him. J. P. Shirley and J. G. Poore were each awarded silver keys for engineering handball championship. S. E. Farin and Jewell Nienaber were each awarded a silver key for having taken second place in the 155-pound and 165-pound class in the all-university wrestling tournament.

The presentation of the twenty gold keys and fourteen silver keys completes all 1928-'29 awards for engineering and chemistry intramural athletics.



ABOUT THE WORLD WITH OUR ALUMNI

(Continued from page 268)

fall quarter. The school has a Junior class of thirteen, two of whom are going with Westinghouse this summer.

Mr. Swenson, living at 135 Agate street, Houghton, Michigan, planned to visit the Minnesota campus the last of April.

'06—L. A. Strenger, 840 So. Clarkson, Denver, Colorado, writes:

"It may be of interest to some of your readers to know of the class letter of the E. E.'s of 1906. This letter has been circulated to class members practically since our graduation, making a welcome visit to each of us about once a year, thus keeping us in touch with each other.

"We have an interesting group of Minnesota alumni here. We have monthly meetings and, in proper season, picnics in the mountains. There are about thirty active members. We are looking forward to meeting President Coffman next June when he comes to make the commencement address at Denver University.

"My son, Vernon A. Strenger, expects to begin work at Minnesota for his doctor's degree in Chemical Engineering next September.

"As both his mother (Effie Dahlberg '07) and father are Minnesota graduates, we think heredity must have some influence in his case."

'19—Frank W. Jordan, 205 Virginia Apartments, Butte, Montana, is "married, but has no fence around the house yet." Mr. Jordan is a sales engineer for the Westinghouse Electric and Manufacturing company at Butte, Montana.

'21—Norman S. McVean recently turned poet. He wrote the TECHNO-LOG saying, "I miss the Mississippi."

Mr. McVean, living at 149 Shore Drive, Winthrop, Mass., is doing "just ordinary work" as an engineer in the Central Office Equipment Engineering department of the Metropolitan Division, New England Telephone and Telegraph Co., Boston, Mass.

'21—L. S. McKibben, consulting engineer for the Electrical Research Products, Inc., of Hollywood, California, has two co-workers and former classmates. They are D. P. Love and E. C. Mandersfield, who are in the Recording Engineering department of the Western Electric Sound System.

Mr. McKibben's home address is 3508 Manhattan avenue, Manhattan Beach, California.

'23—Henry Lieberman, technical employee for the Long Lines department of the American Telephone and Telegraph company, has been engaged in training work since July, 1929. His home is at 1414 West 78th street, Chicago, Illinois.

'24—A. T. Miller will be married to Esther L. Lubman of Wabash, Indiana, the last of June. The couple will be at home after July 1st at 526 W. Broadway, Winona, Minnesota. Mr. Miller is purchasing agent for the Union Fibre company of Winona.

'24—E. J. Mabbott, sales manager for the Faribault division of the Northern States Power company, was married October 21, 1929 to Miss Blanche Dusseau of Monroe, Michigan. He is living at 846 7th avenue S. W., Faribault, Minnesota.

'25—H. J. Winslow, now instructor of mathematics in the U. S. Naval Academy at Annapolis, Maryland, was married June 18, 1929 to Miss Pearl M. Shirley, a graduate of the University of Iowa and a member of Kappa Delta sorority. They are living at 106 High street, Annapolis, Maryland.

'25—Manley B. Monsen, assistant general superintendent of the Wisconsin Division of the Northern States Power company, is living in Eau Claire, Wisconsin. He writes:

"Now I am studying (besides the power business) all the information and books I can absorb on good philosophy, but unfortunately (or consequently maybe not) I am not yet married. Eau Claire is not 'out in the sticks,' friends; it has a population of 30,000."

'26-'27—R. E. Willey, a former instructor in the electrical department, recently visited the campus. He left a note in the office: "It seems good to be back. The school is progressing in fine shape."

'27—Paul R. Lee, 51½ Columbia avenue, Mansfield, Ohio, says he is "unmarried but not given up." Mr. Lee is in the Thermostat Engineering department of the Westinghouse Electric and Manufacturing company.

'28—Arthur M. Braaten has decided to double up on expenses. He will be married to Miss Louise F. Herman of New York City about the last of June.

Mr. Braaten, engineer in the design division of the RCA Communications, Inc., of Riverhead, New York, has "been working on a piezo-electric frequency standard, and am now working on a system for using harmonics from this standard to measure the frequencies of short-wave transmitters."

'28—K. K. Klammer, now a student engineer with the Illinois Bell Telephone company, 215 Market street, Alton, Illinois, writes that he would like to hear from everyone. Let's swamp him!

Mr. Klammer, whose home address is 302 E. 13th street, Alton, Illinois, will be in Chicago during June at the Illinois Division Engineer's office of the Illinois Bell Telephone company.

Mechanical Engineering

'83—John H. Barr, 505 East Seneca street, Ithaca, New York, is vice-president of the Barr-Morse corporation, makers of the Barr typewriter.

'96—Chas. D. Hilferty's new business address is the Superheater Company, 42nd floor, 603 42nd street, New York City. He is living at 647 Prospect street, Westfield, New Jersey.

'98—Roy V. Wright was one of the three honorary editors of the reports on technical developments since 1890 prepared by the professional division of the American Society of Mechanical Engineers in connection with the recent celebration of the fiftieth anniversary of the founding of the society. Mr. Wright prepared the foreword to the section on transportation, briefly reviewing the growth of transportation in this country, drawing attention to the social and economic benefits and the still greater problems which will confront us in the future.

These reports have been published in the *Mechanical Engineering* for April, 1930.

'07—M. D. Bell, general superintendent of the Washburn-Crosby company, extends a welcome for "us engineers" to visit the "A" mill, now reconstructed since the fire of last year. His address is 1416 West 26th street, Minneapolis, Minnesota.

'09—Frank L. Nemec, Hopkins, Minnesota, is chief engineer for the Fegles Construction company, 711 Wesley Temple, Minneapolis.

'09—Wilbur S. Williams writes: "Would like to receive a letter from every member of the Mechanical class of 1909, bind them all together, and send all the letters to each member."

Mr. Williams' address is 2901 Jennings avenue, Sioux City, Iowa. He is president of the Williams-Minnick Motor company of Sioux City.

'10—Browning Nichols, now with the Manganese Steel company of Chicago Heights, Illinois, is looking forward. He has a family of twin girl and boy and two boys of eight and twelve. Mr. Nichols' home address is 1546 Euclid avenue, Chicago Heights, Illinois.

'11—L. E. Owens, 683 Summit avenue, St. Paul, Minnesota, is still publishing the St. Paul Dispatch and the St. Paul Pioneer Press.

'12—William P. Brown, 680 Mandana boulevard, Oakland, California, is a partner in the Brown Brothers Welding company, a company of welding engineers specializing in marine work, welded buildings, and manufacture of welding equipment. His business address is 223 Main street, San Francisco.

'13—Eugene C. Crane, 29729 Foote Road, Bay Village, Ohio, is an engineer for the waste disposal department of the C. O. Bartlett and Snow company of Cleveland, Ohio.

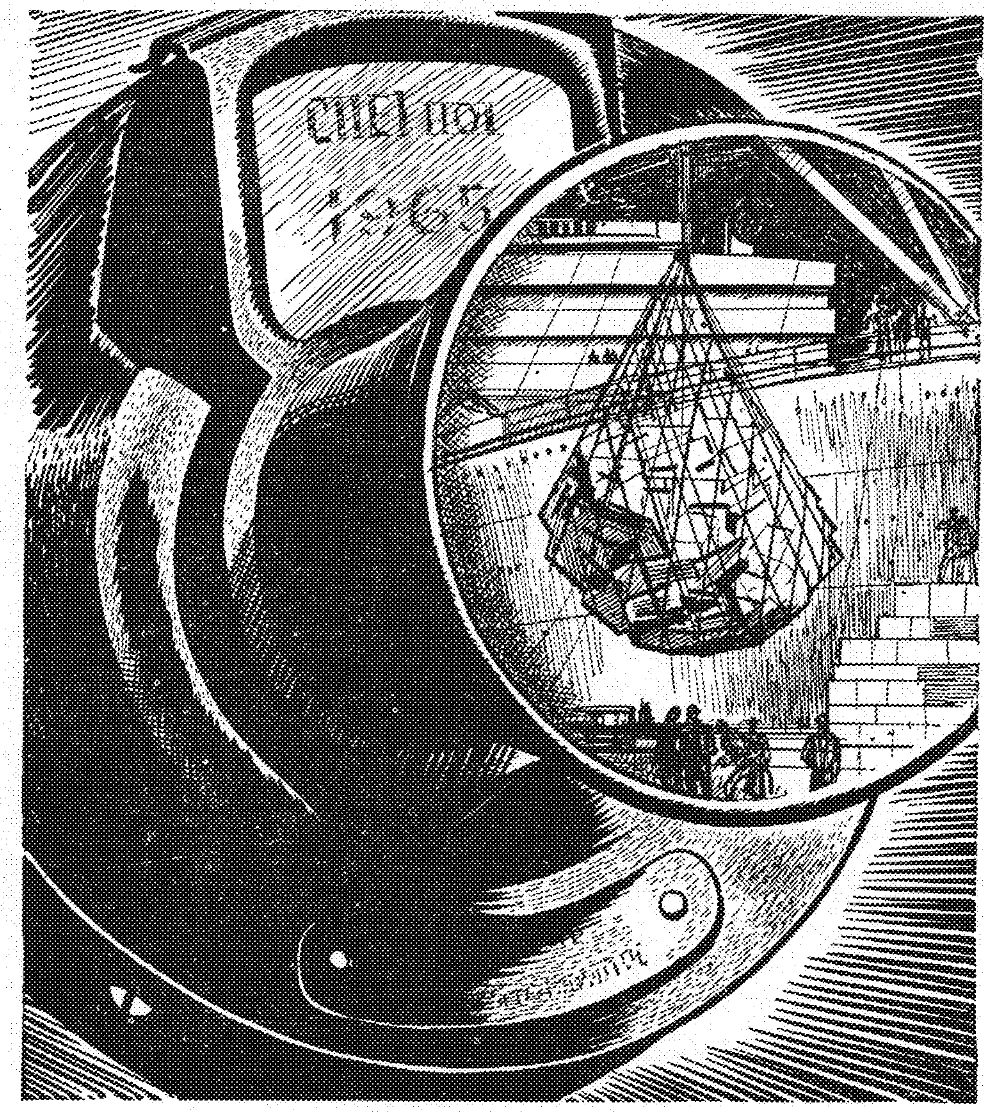
'14—John S. Peoples, formerly at Chicago with the Western Electric company, is now manager of the West Suburban branch of the Winslow Boiler and Engineering company at 506 Washington Boulevard, Maywood, Illinois. Mr. Peoples writes:

"My older daughter, Mary, may become an engineer some day. She makes the honor roll at Oak Park high school every month." His home address is 134 North Lombard avenue, Oak Park, Ill.

'15—George Milton Orr, president of the G. M. Orr and company at 408 Baker building, Minneapolis, writes an interesting letter. He says: "The heads of all departments must be graduate engineers. Three Minnesota men are with us." Mr. Orr's address is 2223 Emerson avenue North, Minneapolis.

'16—David Murray Gultinan is president and general manager of Eskew, Smith and Cannon, Charleston, West Virginia.

(Continued on page 274)



ABOUT THE WORLD WITH OUR ALUMNI

(Continued from page 261)

fessorship. He will have charge of courses in Chemical Engineering. Mr. Bunger expects to attend the University of Minnesota this summer to work for his Ph.D. degree.

'26—Lloyd E. Swearington of the University of Alabama is now Professor of Physical Chemistry at that institution.

'27—Franz Rathman, a former assistant in chemistry at the University of Illinois, is now teaching chemistry at the John Millikan University, Decatur, Illinois.

'28—Percy A. Wells has joined the Color and Farm Waste Division of the Bureau of Chemistry & Soils in Washington, D. C., as a research chemist.

'29—Alice Duschak is teaching Chemistry in Montevallo college in Montevallo, Alabama.

Civil Engineering

'01—T. H. Strafe, 6246 Greenview avenue, Chicago, Illinois, is "with the Milwaukee Road on track elevation projects and general maintenance of way and structures."

'07—H. F. Blomquist, superintendent of the city waterworks at Cedar Rapids, Iowa, is building a new "twelve million gallon daily" water purification and softening plant for Cedar Rapids. His address is 1837 7th avenue East, Cedar Rapids, Iowa.

'07—James A. Grant writes, "Now engaged in a study of the Susquehanna river system in interest of water power and flood control. Mrs. Grant, formerly Miss Kate Wyman '10, is continuing her scientific readings and our son is completing his second year in Johns Hopkins University. He expects to take his Ph.D. in chemistry from that institution. Our daughter is entering Goucher college here."

Mr. Grant, who is principal electric engineer for the U. S. Engineering department, 300 Custom House, Baltimore, Maryland, lives at 434 Kenneth Square, Baltimore.

'08—A. P. Hustad, 4132 Aldrich avenue South, Minneapolis, is president of the Hustad company, consulting engineers. His business address is 529 7th street South, Minneapolis.

'15—Herman Neerland is the first Minnesota graduate to run for the office of Surveyor in Hennepin County. Mr. Neerland has been with the state highway department of Minnesota for nine years as resident engineer. During the war he served two years with the Army Engineering Corps. Mr. Neerland is married and has three children. He is living at 3849 3rd Ave. South, Minneapolis, Minnesota.

'15—Olaf L. Oustad, junior civil engineer for the Bureau of Engineering, City of Los Angeles, says he was "back to Minneapolis during the Christmas holidays. Visit the campus but didn't see any of the faculty as the dump was closed. I hardly knew the school since construction of the stadium, auditorium, electrical engineering building and others." His address is box 1395, Van Nuys, California.

'20—D. J. Bleifuss, 1507 Rockland avenue, Pittsburgh, Pennsylvania, is an assistant hydraulic engineer for the Aluminum Corporation of America at Pittsburgh.

'20—Edmond C. O'Hanrahan, patent attorney at 338 Old Southern railway building, Washington, D. C., writes, "Not married, no prospects, no intentions—not rich, famous, or disillusioned, and NOT in favor of prohibition." His address is 736 22nd street, Washington, D. C.

'20—Arnold Pless, 409 Albert Lea avenue, Albert Lea, Minnesota, is building county roads around his home town.

'21—J. H. Werdenhoff, 200 Groveland avenue, Minneapolis, is an assistant engineer with the International Milling company, 1100 Flour Exchange, Minneapolis, Minnesota.

'22—A. Dean White writes, "Have been having a lot of fun playing with boats along the coast and around Catalina Island. Sold my last boat which was only a 25 foot cabin cruiser with accommodations for my wife and me. Am now completing a new cruiser with accommodations for six and a cruising radius of about 350 miles." Mr. White, a partner in Miller and White, civil engineers and surveyors, lives at 3404 West 79th street, Inglewood, California.

'22—George R. Bailey has written a book, "The Red Mesabi," a novel of love and adventure of the Mesabi iron range. The book has been published by Houghton Mifflin Company, Boston.

Mr. Bailey, whose address is 1219 Hull Street, Evanston, Illinois, is a project engineer for Albert H. Wetten and Company of Chicago, Illinois.

'24—Clifford M. Stoner, engineer for the Griffin Wheel company and Griffin Engineering company of Chicago, writes, "Have been in Chicago for three years now. My work is mostly in connection with making modern foundries out of ordinary ones for the Griffin Wheel company and others. It's the changing from manual to mechanical operation in which the foundry industry has lagged 'way behind the others."

Mr. Stoner's address is 3440 Franklin avenue, Chicago, Illinois.

'24—Roscoe W. Bauer is lost. The last record the TECHNO-LOG has of him is with the Great Lake Dredge and Dock company. But where is he now?

'25—John H. Swanberg is now living at 2910 Voelkel avenue, Dormont, Pennsylvania. Mr. Swanberg was formerly at the University of Minnesota on a research fellowship in civil engineering.

'25—W. C. Brose, salesman for the Marion Steam Shovel company of Marion, Ohio, is "still trying to sell the 'World's Greatest Shovels'—but am wondering what has become of the '25 civil class members and the annual news letter which was published several times."

Mr. Brose's address is 4032 Herschell, Dallas, Texas.

'25—Frank E. Nichol, district engineer for the Truscon Steel company, 311 Seaboard building, Seattle, Washington, was married October 11, 1929, to Miss Ruth E. Hill of Ipswich, South Dakota. They are at home at 325 North Summit avenue, Seattle.

'26—R. R. Kelly has turned pessimist. He says, "James R. Kelly, our youngest, will be two years old in June. May he never be an engineer."

Mr. Kelly, in sales promotion work for the Western Lime and Cement company, is living at 723 Monroe street, Evanston, Illinois.

'26—P. C. Fenton is now living at 314 Ballengee street, Hinton, West Virginia. He is working for the New-Kanawha power company.

'28—Percy H. Flatten, 1728 West Lake street, Minneapolis, Minnesota, is now district commercial engineer for the Northwest Bell Telephone company.

Mr. Flatten spent three years in the Duluth commercial office. May, 1929, he was transferred to the Minnesota Area office as assistant to the commercial engineer, being given his present position in November, 1929.

'28—C. H. Prior, still with the U. S. Geological Survey as a junior hydraulic engineer, is in Tuscaloosa, Alabama.

Electrical Engineering

'93—George H. Morse, 610 No. 2nd St., Harrisburg, Pennsylvania, is still a consulting engineer for the Department of Welfare, Commonwealth of Pennsylvania. In 1917 he was called to Pennsylvania by Governor Pinchot to serve as electrical engineer of his Giant Power Survey.

Mary L. Morse, his daughter, now teaching chemistry at the University of Nebraska, received her Ph.D at the University of Minnesota in '15.

'98—Adolph Wagner, 5757 Washington Boulevard, Indianapolis, Indiana, is president of the H. T. Electric company and of the Wagner Radio company, both of Indianapolis.

'03—J. H. Schumacher is doing things. He is the Western Canadian Committeeman on the Association of Electragists-International, member of the Canadian Electrical Code Committee, examiner for the Manitoba Electricians License Board, and vice-president of the Winnipeg Builder's Exchange.

Mr. Schumacher's address is 373 Oxford street, Winnipeg, Manitoba.

'05—Emil Anderson and his family of a wife and two children have lived almost continually in Minneapolis since his graduation. He writes: "Get on the camuus enough to know my way around. Went up for the twenty-fifth anniversary."

Mr. Anderson's address is 5235 Upton avenue South, Minneapolis.

'10—E. E. Skytte is an electrical instrument engineer for the Esterline and Angus Graphic Electrical Instrument Co., of Speedway, Indiana. He has been with this firm thirteen years.

'17—George Warner Swenson, Professor and head of the electrical engineering department of the Michigan College of Mining and Technology, expects to be in their new building by the beginning of the

(Continued on page 270)

WHAT YOUNGER COLLEGE MEN ARE DOING WITH WESTINGHOUSE

Equipping A Cathedral of Learning for the University of Pittsburgh

Nine years ago the University of Pittsburgh, then a hundred and thirty-six years old, faced an urgent need for larger quarters. To extend its restricted campus was almost out of the question, for a city had built up around it. The logical direction for expansion was into the air.

American business had long before faced the same situation, and met it with the skyscraper. But no conventional business building would satisfy here. Chancellor John Gabbert Bowman envisioned a Cathedral of Learning, an edifice that would express the essential self of the steel center of the world, a structure with more power, more spirit of achievement and reverence in it than had ever before been attempted. A great architect put his soul into the making of the plans. Leading suppliers were called on for the materials for the realization of Chancellor Bowman's dream.

To Westinghouse engineers came the assignment of providing the electrical and elevator equipment for this great structure. Recognized as a great clearing house for electrical development, the Westinghouse organization draws interesting assignments in every field of human activity.

H. O. KOEHLER
University of Illinois, '22
Application Engineer

H. J. PETERSON
University of Washington, '26
Control Engineer

E. N. BALDWIN
Purdue University, '22
Engineer of Mechanical Design

R. A. GAUT
Pennsylvania State College, '25
Field Engineer

C. F. CARNEY
University of California, '26
Control Engineer

Westinghouse

Engineers Receive Athletic Awards

The annual convocation of the School of Chemistry and College of Engineering and Architecture took place on April 24. In addition to addresses by Dean O. M. Leland of the technical schools and Prof. H. O. Crisler, Director of Athletics, and others closely associated with campus and athletic activities.

The occasion was marked by the presentation of trophies to students of the two schools who have been outstanding in the field of athletics—Varsity, Intramural, and Independent.

Professor O. S. Zelner, chairman of the University eligibility committee had charge of the meeting, and after briefly outlining its purpose, presented the different speakers. Mr. W. R. Smith of the department of intramural athletics paid graceful compliments to the assemblage on the sportsmanship of its competitors and presented medals to the members of the championship teams in basketball and touchball for the preceding year.

Dean Leland spoke briefly on the value of athletic activities and expressed himself as greatly pleased with the prowess shown by the students from the two colleges.

Mr. Crisler took for his theme the vital importance of athletics in the affairs of a nation which hoped to endure and remain a compelling force for good. He cited ancient Rome and Greece as striking examples of political disintegration following closely on the heels of loss of athletic supremacy.

At the conclusion of his address Mr. Crisler made the presentations of the Engineers Bookstore gold and silver keys. These are trophies awarded for championships in any branch of sports—gold for All-U, and silver for College competitions. Gold keys are also given to graduating letter men.

With the well conceived idea of developing sports over and above what is done by societies and fraternities, the Engineers Bookstore adopted this plan back in 1925. That the judgment of its directors, and its capable manager, Mr. H. D. Smith, was sound in this commendable and generous enterprise is attested by the enviable positions the technical schools hold in every branch of campus athletics. In addition to the gift of these attractive mementos the Bookstore also supplies gratis the various equipment for athletic play.

At the conclusion of the enthusiastic exercise, Mr. Francis E. Mullen of the School of Architecture, student manager of athletics for the technical schools, was presented and sincerely praised for his untiring efforts.

Awards were made as follows:

Eleven gold keys to the All-U Diamondball championship team consisting of A. B. Johnson, B. J. Kalt, L. M. Schellenberger, W. W. Ralphs, M. G. Schumacher, L. Kloki, C. Kocian, C. Hendrickson, E. Hanlon, T. Sandler, and H. Clausen.

Hubert Tierney as all-U golf champion received a gold key. Another was

(Continued on page 272)

THE LAND OF IND

Being a Tale of the Architects Jubilee

Guided by the noise of tom-toms and whining of musettes, we were gradually led into the land of strange faces, costumes and manners. For here was a riot of colors, sounds, gay jewels, somber demeanors, scent of incense and smells of strange oriental herbs—and all encased in a setting which seemed to have been transported from the banks of the sacred Ganges.

We went farther, saw more and more beturbaned men and comely damsels in their resplendent saris. The throb of tom-toms became incessant, urging, until we came to an open court seemingly of the great Taj Mahal or was it the Great Mosque of Delhi—that most sacred of buildings! But hark! The tom-toms increase their pace and what weird instrument is that?—the wailing saxophone! with their cries echoed by the shuffling feet of the multitude—where are we? Why, it's the Architects Jubilee!

Such sensations await all who will attend the annual celebration of the architects, for elaborate plans have been laid to transport a resplendent piece of the fabled land of Ind to our shores, and yea, even unto the third story of our own Engineering Building. In such a setting the days given over to the jubilation will be held. Festivities lasting a week will reach their climax on Friday, May 23, when the entire day will be open house for the University with the architects as hosts, with a whirlwind finish at the grand costume ball to be held amid the glitter and splendor of far-famed Ind on the same evening.

During the day will be on view the best efforts in all media of the hard working architects. When the visitor tires of viewing the splendid achievements and numerous art works of the faculty and students, then may retire to the Rajah's harem and be entertained with divertissements of a social nature and be regaled with tea. After such soothing treatment—who would want to miss the ball in the evening?

Rajah Ed Hanson and his councilors of general arrangements, Leonard Melkus, Gerhard Peterson and Helen Thian, have organized committees, plans and theories which will result in the greatest jubilee of the Architectural Department. Here are the committees and their chairmen:

Decorations: James Bonner
Construction: Hans Wessel
Exhibition: Jack Crimmins
Tea: Norma Edwards
Publicity: Gerhard Peterson
Programs: Bruce Wallace
Refreshments: Helen Thian
Freshmen Play: Harold Fridlund, LeRoy O. Anderson
Tickets: Sherman McMahon

So hark to the Muezzin's call to the open house and in placid contemplation gaze at the results of the storms and strifes of the architect, and sip tea with oriental placidity, yet reserve enough occidental energy to out-whirl the royal dervishes when the climatic whirl is held that evening. Live up to and dress up to that far-famed land of India for a gay, joyous, and perfect good time in the Maharajah's company.

EMINISCES

30, Francis E. Mullen, E. '30

"Surely you are not trying to say our first parents lived in Ireland? I have always thought the Good Book located them in Mesopotamia."

"And where else but on the auld sod would God be after planting man to make him happy and kape him dacint?" Saint Pat retorted. "Such ignorance in a college professor is beyont imagining."

"But shamrocks—" protested Mr. Zelner perplexedly. "I have always heard Eve wore fig-leaves."

Saint Patrick regarded us sternly. "Whist, aint yiz a stiffbacked and rebellious generation. Ye put me in mind of the days before the flood whin the blessed Lord fair repented of his handiwork. The folks thin laughed whin I spit on me hands and built me an ark of gopher wood—Cothrige's Folly—the lads called it."

"You don't mean to say you were Noah?" I feared Mr. Zelner would burst with the violence of his emotions.

"'Tis the Ulsterites misnamed me, Noah, what with trying to say Cothrige through their noses."

"And then in the seventh month, on the 17th day of the month?" I ventured.

"I was that glad to see dry land," cried the Saint, "even if it was but a bit of rock sticking out I grabbed it and kissed it."

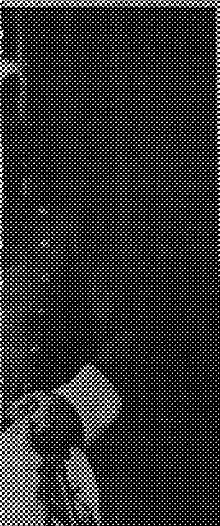
"I'll bet that was the first kiss the blarney stone ever got," I added, and Saint Patrick beamed upon me.

"You seem to have lived quite a life," Mr. Zelner remarked.

"Quite a number of lives," confided the Saint. "I mind me the day Hiram of County Tyrone sez to me, 'Sweat me lad,' sez he, 'tis a timple will do the trick.' 'What trick?' sez I just like that. 'Kaping them contented,' sez he. 'Yer sivin hundred ladies and their maids. Give 'em a timple,' he sez, 'And ye'll have pace.' 'For why?' I asks. 'They'll be that busy thrying on Easter hats and dresses,' he sez, 'they'll forgit all about yiz, and you and me'll be able to have our drop and a smoke together without any interruption at all.' Faith, and Hiram was a grand king. 'Twas himself furnished the ships to bring the ivory and apes and paycocks to kape me wives happy."

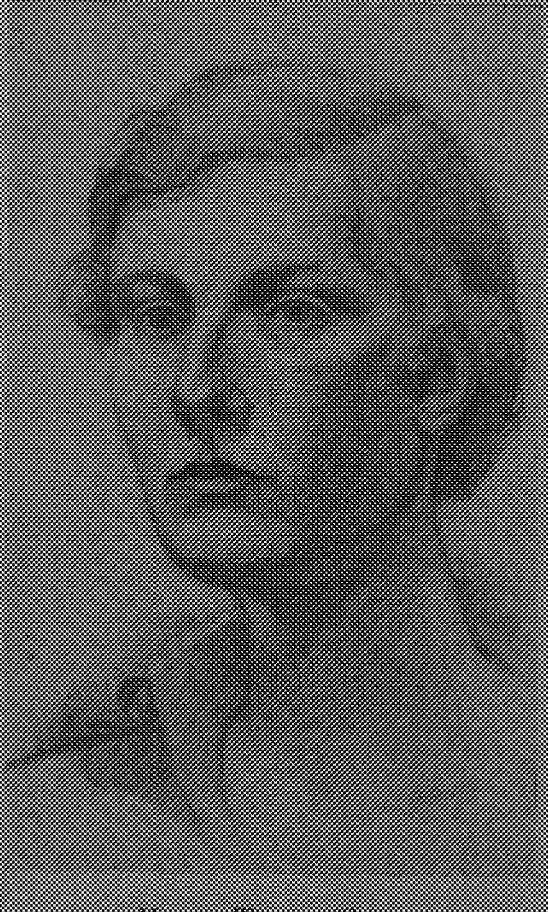
I did not dare to look at Mr. Zelner, but we both sat in the darkening office and gazed at the shadowy figure in the other chair. I had heard of the nine lives of a cat, but the reincarnations of a Saint were new. However, he started out and in whatever age he became some sort of an engineer. Of the intervals between appearances he had no notion. One vision persisted as a forerunner to his return to earth. He would be in a desert place and a voice would call him, "We pray thee come and walk amongst us as before." Then he would find himself again with men. Always he embodied the aspirations of the age. Once he lived in Rome he was a builder, but this time in stone, and a dreamer whose reveries still last in the dome and frescoes of St. Peters. A little over a century ago he came to himself as he stared at a kettle boiling on the hearth. "Bedad," he exclaimed to himself on that occasion, "if steam can raise the lid of this kettle, why can't it lift the drudgery from the backs of men and women?" And then, if our strange companion is to be believed, he stood in East Orange but fifty years ago beside a man whose deafness did not prevent him from listening to Saint Pat as he clapped him on the shoulder, saying, "Thomas lad, ye've done it—brought light to this blind black world of ours. I fale as happy as the time I drove the snakes out of Ireland."

Just then somebody switched on the lights in the hall and Mr. Zelner and I jumped out of our chairs. We turned to the Saint, but there was nobody in his chair. Only a gnarled and carved shilelagh lay upon the seat.



...TRICK

MAY · 16 · 1930



Helen Thian, *Queen*

Announcements

The prizes in the Techni-Log Article Contest have been awarded as follows:

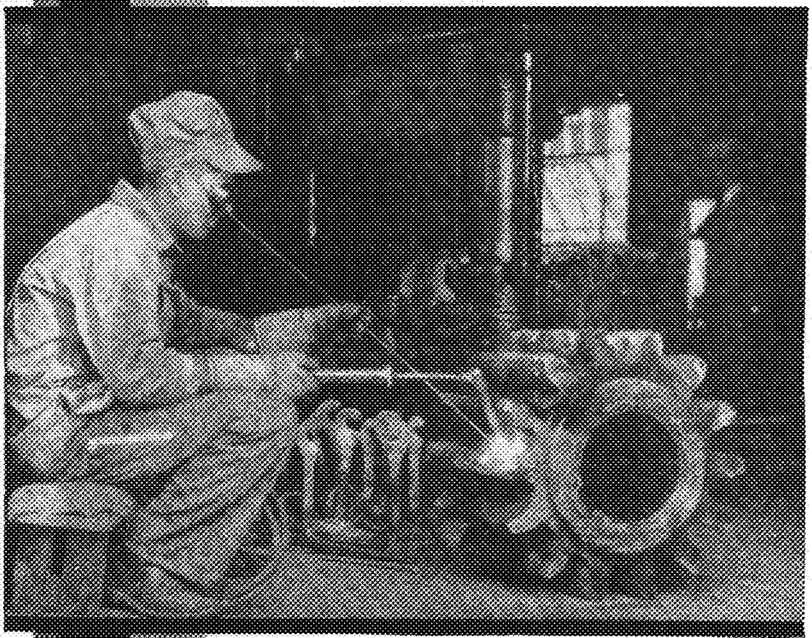
First Prize: J. D. Jacobs for the story, "Engineering in Grain Handling," which will be published in the June issue.

Second Prize: Hal H. Pittelkow for the story, "Cloud Formations," published in this issue.

Plumb Bob, senior honorary society, announces the election of the following men:

Russel Cheney
C. E. Crippen
C. E. Elliott
R. F. Fenton
Richard Gapps
Roy Higgins
W. C. Kay
G. H. Meffert
F. E. Mullen
Adolph Ringer
John Skidmore
W. G. Warrington

OXWELDING



• • THE FOE OF FRICTION

INDUSTRY no longer scraps metal parts that have become badly worn. By oxy-acetylene welding such parts are readily built up to size and returned to service as good as new.

Often wear indicates the desirability of special qualities in the wearing surfaces. Oxwelding provides a rapid and effective means of applying bronze as well as abrasion resisting materials such as Haynes Stellite, thus minimizing the necessity for further renewal.

Millions of dollars a year are saved in American industry by oxwelding — the foe of friction.

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

Units of UNION CARBIDE AND CARBON CORPORATION

General Offices . . . 30 E. 42nd St., N. Y. UCC Sales Offices . . . in the Principal Cities

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

ABOUT THE WORLD WITH OUR ALUMNI

(Continued from page 270)

Married since 1921, he now has a family of three children. Mr. Gultinan writes:

"Have gotten rather far from 'pure' engineering, but have never had reason to regret my engineering training. I occasionally hear from E. H. Roberts ('16) but no one else of that year."

Mr. Gultinan is living at 1223 Virginia street, Charleston.

'10—Wallace H. Martin, professor of heat engineering at the Oregon State Agricultural College, Corvallis, Oregon, has a family of two boys and one girl.

Mr. Martin taught mechanical engineering here for 6 years. After leaving here he taught at Penn State College until 1920 when he entered the Oregon State College as professor of heat engineering.

Mr. Martin's father died recently at Willmar, Minnesota.

'17—Joel Hektner, 1703 Fulton Road, Canton, Ohio, is assistant engineer for the railway division of the Timken Roller Bearing, Canton, Ohio.

'18—R. C. Kively started with the Western Electric company at their Hawthorne Plant located in Chicago, Illinois, in June, 1921. Taking the training course provided for college graduates, "Kive," as he was known at Minnesota, passed from the period of study in a year's time, and received his first permanent assignment with the company. His mechanical engineering training proved very valuable to him as his new work demanded a knowledge of the kinematics of the various types of machinery.

Within less than six months he was placed in charge of a section of machine planning engineers. A section chief is the first step in supervisory responsibility at the Western Electric company and being in charge of a small number of men.

Working at this for approximately a year, Mr. Kively was selected as department chief for the development of equipment necessary for the manufacture of rubber covered wire. He remained in charge of this work for four years, and during this time he gained considerable experience in designing and laying out shop equipment. With this experience he was given an opportunity to supervise the ordering of the standard machinery of the company. Although he was successful at machinery ordering, he was soon taken back to the research department to originate designs for new manufacturing equipment, used in production of pole line hardware. After a period of a few months he was promoted to his present position of development engineer in charge of equipment studies, production, inspection, clerical, operating, process development, and accounting in the manufacture of pole line hardware.

'19—Archie J. Dowd, 112 Westfield avenue, Elizabeth, New Jersey, is a de-

(Continued on page 278)

ESQUISSES and RENDUES

(Continued from page 255)

indicates that this was done in the last stages of development. The plan is almost exactly the same as that shown on the esquisse except the rooms have been developed, better proportions effected, and most details decided upon. The elevation has taken shape—with modern detail to work out the mass indicated by the esquisse. The arrangement of rooms in plan has made it possible to create a very interesting elevation.

And then the Rendu. The only change of note is in the stairways, still in the same position but more accessible to the floor above. Notice how the rendering is in perfect character with the type of building. But this is not the only solution to the problem, as you will see by examining the cut on the opposite page. In a general way, they have many things in common—those things which are essential to this particular building. In other respects they differ, the circulation being one of the main differences. Both schemes work; both were in the Mention class. Now imagine this to be a square box of a building with a series of equal-sized openings across the front. Would that be architecture?

The object, then, of this whose procedure is to train a student first, to analyze a problem immediately so that no time will be lost in trying to develop a poor solution, and then to develop his solution and present a rendering which increases the readibility of the plans and is at the same time very attractive. During the development he does a great deal of research on the type of architecture he is using. By making immediate use of the results of this research, he is able to retain much more than would otherwise be the case. In turning out a great number of studies he trains himself both in draftsmanship and sketching.

Thus all phases of architectural design are included with proper emphasis on each in this system.

TUTSHI

(Continued from page 251)

chair, built for reading, sits beside a window. Directly in front, but on top of a sand-box base is a stove which I am sure has the requisite heat possibilities and good regulators. This place possesses the true compensation of solitude; and appreciative family.

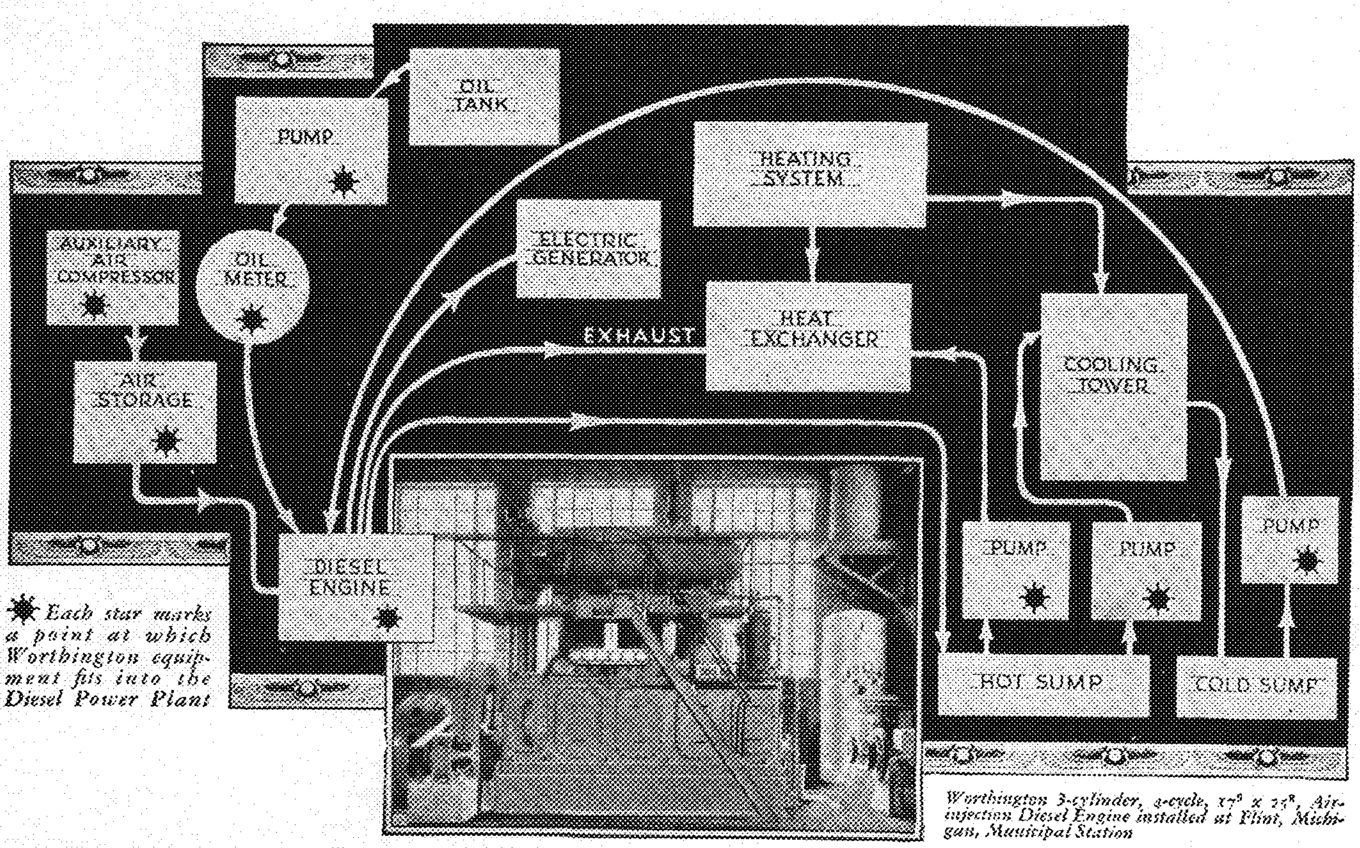
Although we were noisy, speculative intruders, courtesy, entertainment, and refreshments were extended to us. We sang "God Save the King," then we followed with the "Star Spangled Banner." Rhubarb wine was served and we departed cheerfully.

The water pounds steadily on the sides of the boat. Out in the black curtain, I can see some devilish eyes blinking at me. A flare interrupts this to reveal "Engineer's Mine," a property located in British Columbia.

Screeching like the shrill cry of a saw, an eagle, most noble of birds, was startled. I looked in that direction and saw the moon pushed from the trees in slow-motion. After resting for a moment on the peak of a mountain, it rolled slowly down, down into the valley. Only the stars were left. I asked my friend why they took a shape so different from that of other planets. He smiled and intimated that a camera did not register them in points. I am interested in this secret.

* * *

August 2, 1929. "Think, my journal, we have been on deck all night. The morning light has individualized each tree we saw in those masses. They were the past and future too; for several hours ago, I saw by the schedule we were homeward bound."



✸ *Each star marks a point at which Worthington equipment fits into the Diesel Power Plant*

Worthington 3-cylinder, 4-cycle, 17" x 25", Air-injection Diesel Engine installed at Flint, Michigan, Municipal Station

Flint wanted dependable lighting
. . . *and got it*

PUMPS
COMPRESSORS
Stationary and Portable
CONDENSERS
and Auxiliaries
DIESEL ENGINES
GAS ENGINES
FEEDWATER HEATERS
WATER, OIL and GASOLINE METERS
MULTI-V-DRIVES
CHROMIUM PLATING
Literature on request

WHEN Mr. Consumer quits for the day, he wants to relax. If he's a radio fan, he wants freedom from line voltage fluctuation; if he reads, he wants steady light; if movies are his weakness, he wants them flickerless.

In Flint, Michigan . . . city of automobile manufacture . . . they have to relax. But they are wide awake on the subject of lighting.

They wanted dependable low-cost power for their lighting system, and they got it . . . with a modern Worthington 3-cylinder 4-cycle Diesel Engine direct-connected to an a. c. generator.

Now in its third year of service, this unit is rendering steady, dependable service . . . representative of the performance promised for and delivered by *every* Worthington Diesel Engine. *Write for information on this type of equipment.*

WORTHINGTON

60-10

WORTHINGTON PUMP AND MACHINERY CORPORATION
Works: Harrison, N. J. Cincinnati, Ohio Buffalo, N.Y. Holyoke, Mass.
Executive Offices: 2 Park Avenue, New York, N.Y.
GENERAL OFFICES: HARRISON, N. J.
District Sales Offices and Representatives:
ATLANTA BOSTON BUFFALO CHICAGO CINCINNATI CLEVELAND DALLAS DENVER DETROIT EL PASO HOUSTON KANSAS CITY LOS ANGELES NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH ST. LOUIS ST. PAUL SALT LAKE CITY SAN FRANCISCO SEATTLE TULSA WASHINGTON
Branch Offices or Representatives in Principal Cities of all Foreign Countries

ABOUT THE WORLD WITH OUR ALUMNI

(Continued from page 274)

velopment engineer for the Western Electric company in Kearny, New Jersey.

'19—Ross M. Foltz was recently elected president of the Milwaukee alumni unit. He succeeded C. R. Price, an electrical engineering graduate of 1920.

Other mechanical engineers living in Milwaukee are Folmer Bjere, Edwin T. Hutchins, E. L. Ludvigson, and Earl H. Roberts.

'20—Helmer N. Anderson, 1757 Capitol avenue, St. Paul, Minnesota, is manager of the diesel engineering department of Fairbanks Morse and company.

'20—Harold T. Odegaard, 908 South Main street, Aberdeen, South Dakota, is roundhouse foreman for the C. M. St. P. & P. railroad.

'20—Knox A. Powell, cost reduction engineer for the Marine and Industrial Turbine division of the Westinghouse Electric and Manufacturing company, Lester, Pennsylvania, is "single, but busy anyway. Still like to write and sometimes in verse in memory of Dr. Skinner's class." His home address is 903 Lafayette avenue, Moore, Pennsylvania.

'20—H. T. Odegaard, formerly a foreman at Portage, Wisconsin, for the C. M. St. P. & P. railway, is now living in Aberdeen, South Dakota. His address is 908 South Main street.

'21—M. S. Gjesdahl, assistant professor of mechanical engineering at Pennsylvania State College, State College, Pennsylvania, appears to be progressing. He writes:

"Like it fine here. Most important item during the year was the arrival of a little daughter on December 16. Hope to see some news in the TECHNO-LOG about the 1921 graduates."

'22—Victor T. Holmsten, estimator for the Alphons Custodis Chimney Construction company, Marquette building, Chicago, Illinois, is living at 165 North Elm street, Hinsdale, Illinois.

'23—E. H. Eige started with the Western Electric Company on July 16, 1923, in the capacity of a manufacturing student. This course of training covered a period of one year after which Mr. Eige was given an opportunity to apply himself as a piece work rate setter. The work involved studies pertaining to originating piece rates from labor grades together with actual time studies and piece rate standards. Within three years, he had gained a very broad knowledge of piece work rates, as he was frequently rotated from work on one class of rates to another. Consequently he was able to get a complete picture of the company's policy with regard to paying shop employees on a piece work basis.

During the early part of 1927, the company began a development project on time standardization labor grades and wage incentive methods. Having had such valu-

(Continued on page 282)

Committees—Engineers' Day

General Arrangements
Harland Harmer, *Chairman*
Loren Nichols, *Secretary*
Duncan Watson, *Treasurer*
Wesley Taylor
Paul Honey
Frank Laska
Richard Cady
Arthur Garvey
Francis Biltz

Open House
Stanley Furber, *Chairman*
Roy Grover
Martin Swanson
Irving Grant
James Dickey
Oswald Williams

Knighting
Robert Rice, *Chairman*
Ralph Sprungman
Clarence Ottinger
Stanley Amren
Ralph Blyberg
Walter Bowker

Parade
Paul Staffeld, *Chairman*
Martin Agather
Adrian Wrucke
Milton Hoglund
Gerhard Quamrud
Winfield Foster
Frank Whaley
John Conroy

Alumni
Graydon Hoskins, *Chairman*
John Bachmann
Paul Markson
Carl Christenson

Green Tea
Margaret McVey, *Chairman*
Beatrice Johnson
Margaret Ebeling
Jane Fish
Helen Thian
Chaffee Marx

Dansant
W. McGregor Beadie, *Chairman*
Roger Hayes
Howard Harvey
John Byrne
Paul Salo

Brawl
Rolland Stoebe, *Chairman*
Elmer Ahlstrom
Harold Kindseth
Ray Kullberg
Roy Wiprud
Cedric Cowan

Buttons
Steve Gadler, *Chairman*
Sheridan Farin
Oscar Swenson
A. W. Lindert
Gordon Bowers
Zenas Havstad
Robert Lommen

Posters
John Bailey, *Chairman*
LeRoy Anderson
James DeVolis
James McHugh

Broadcasting
Lyman Swendson, *Chairman*
Fred Shidell
Webster Soules
John Wilson

Publicity
Charles Winding, *Chairman*
Guy Arthur
George Taft
George Doleman
Alder Elstrom

Decorations
Lloyd Knutsen, *Chairman*
Henri Brunet
Sherman McMahon
John Cary
Edward Bradbury

Program
Howard Nichols, *Chairman*
Stanley Watkins
Rudolph Hanson
William Allen
Steiner Doos

Finance
Charles Hearn, *Chairman*
W. Gerald Shepherd
Harold Stanley

ALUMNI

(Continued from page 278)

able experience in actually setting piece rates, Mr. Eige was selected to take charge of a section of a few industrial engineers in the new organization. Continued progress in this line of work rewarded him with the position of department chief within one year. He had charge of several sections that were originating time standards and comparing these standards with the actual piece work rates already being used in the shops. Standards were set up to eliminate the necessity of repetition in figuring individual rates for similar operations and also to save much monetary expenditures in the organization which applies piece work rates.

As the Time Standardization Organization expanded, Mr. Eige grew with it and during the latter part of 1929 was made chief of the Time Standardization Division. A position of this rank carries great responsibilities and is given only to those who are leaders and who have a number of years of company experience plus a broad knowledge of the company's business and policies. Being in such a new field of the company's business, Mr. Eige has an added responsibility as the results of the endeavors of his organization must of necessity be carefully scrutinized before the final policy with regard to paying employees according to the new time standards may be adopted.

'24—Harley R. Langman, production supervisor for the Procter and Gamble Manufacturing company, is living at 109 South 15th street, Kansas City, Kansas.

'24—George A. Rathbun is a patient at the Glen Lake Sanatorium, Oak Terrace, Minnesota.

'24—Stuart V. Willson, now in the sales department of the Northern States Power company at LaCrosse, Wisconsin, is married and has a family of two girls. He swears the next will be an "All American." Mr. Willson's home is at 1706 State street.

'26—C. E. Comfort has moved to 1704 Pinehurst avenue, St. Paul, Minnesota.

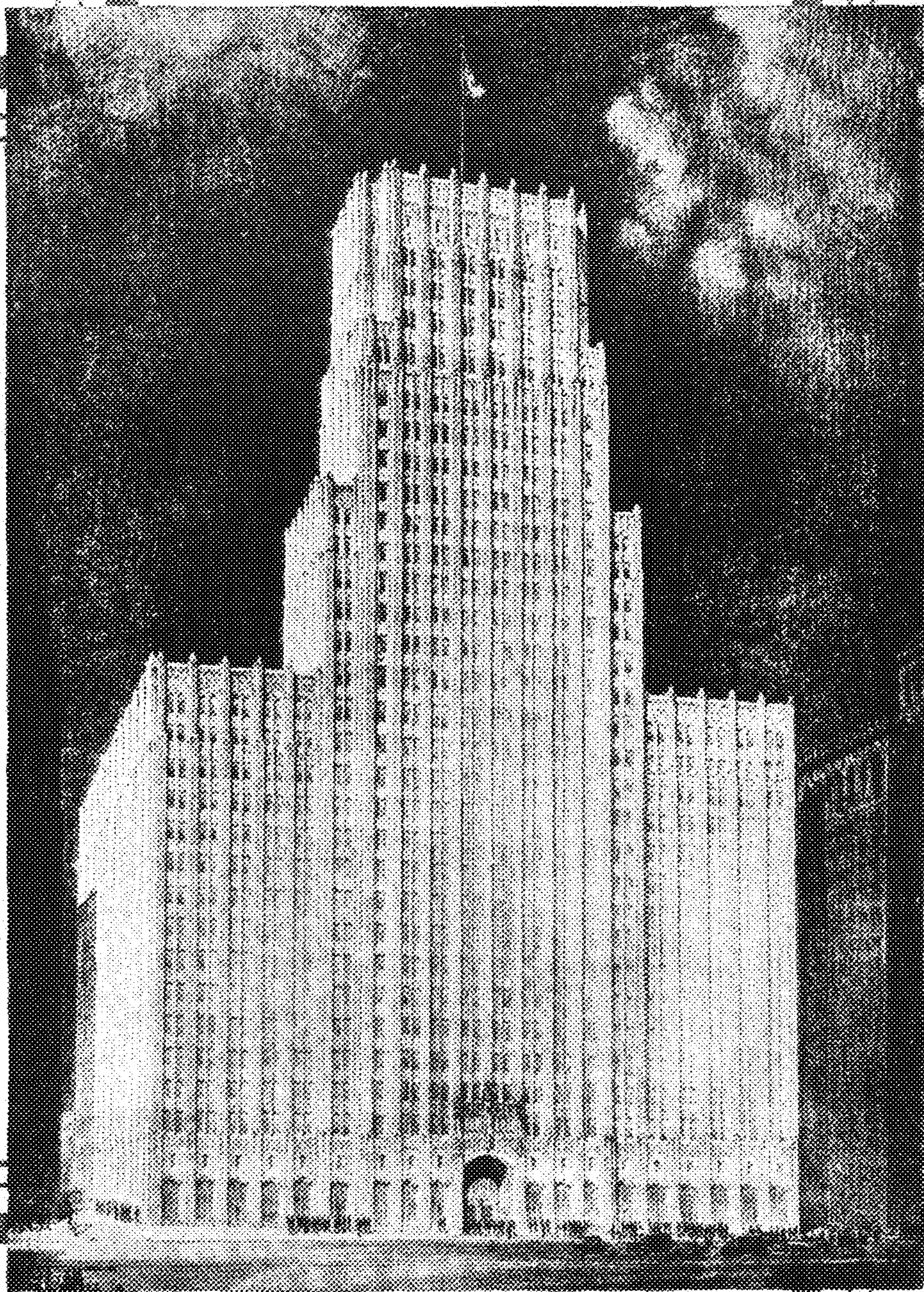
'28—Marvel P. Miller, who is stationed at Langley Field, Virginia, is a member of the National Advisory committee on Aeronautics.

'28—C. T. Skanse has left the Ingersoll Rand company and is now with the Insulite company, Backus-Brooke company, Minneapolis.

'29—Roy M. Johnson is taking the special training course with the Bucyrus Erie company at South Milwaukee, Wisconsin. He has been having practical experience at the South Milwaukee, Erie, Pennsylvania, and Evansville, Indiana, shops.

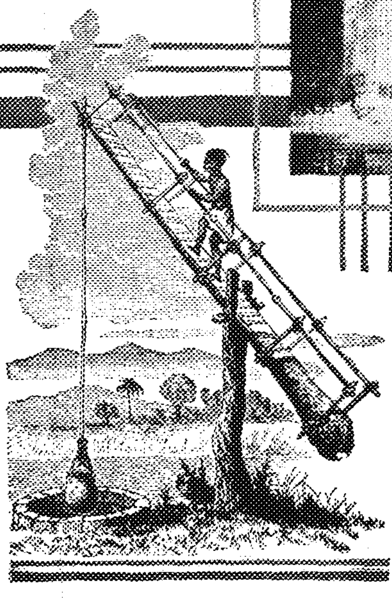
'29—Harold R. Shannon writes: "Not married yet, so am feeling great. Fort Wayne is a great city. If you have an opportunity to come here, don't pass it up. Am writing textbooks on and teaching courses in refrigeration."

Mr. Shannon, who is in the refrigeration department of the General Electric company, Fort Wayne, is living at 530 West Berry street.



Russ Building, San Francisco, Cal. Geo. H. Kelham, Architect
Equipped with Otis Signal Control Elevators

One of the early phases of Vertical Transportation.

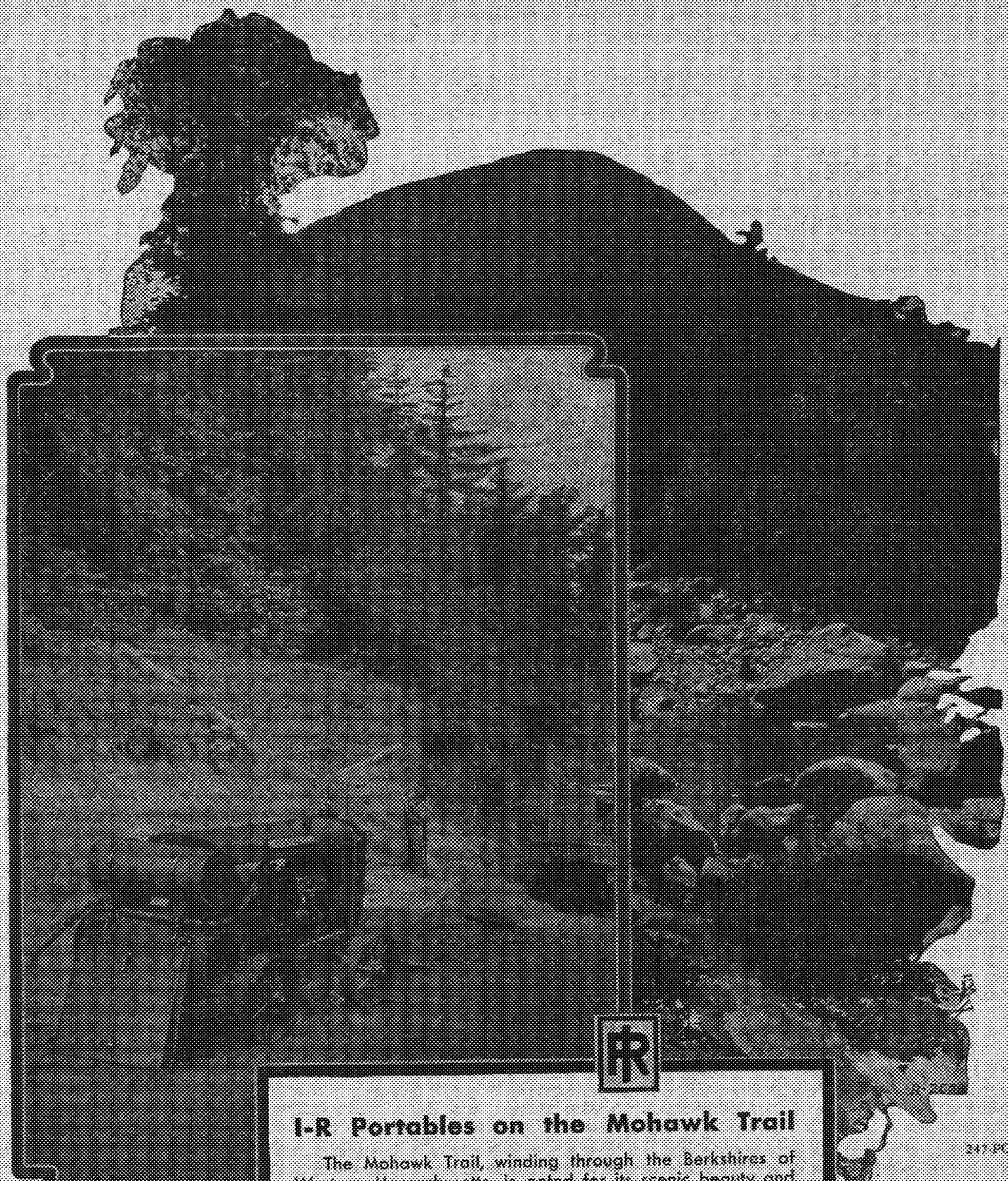


The Minnesota Techno-Log

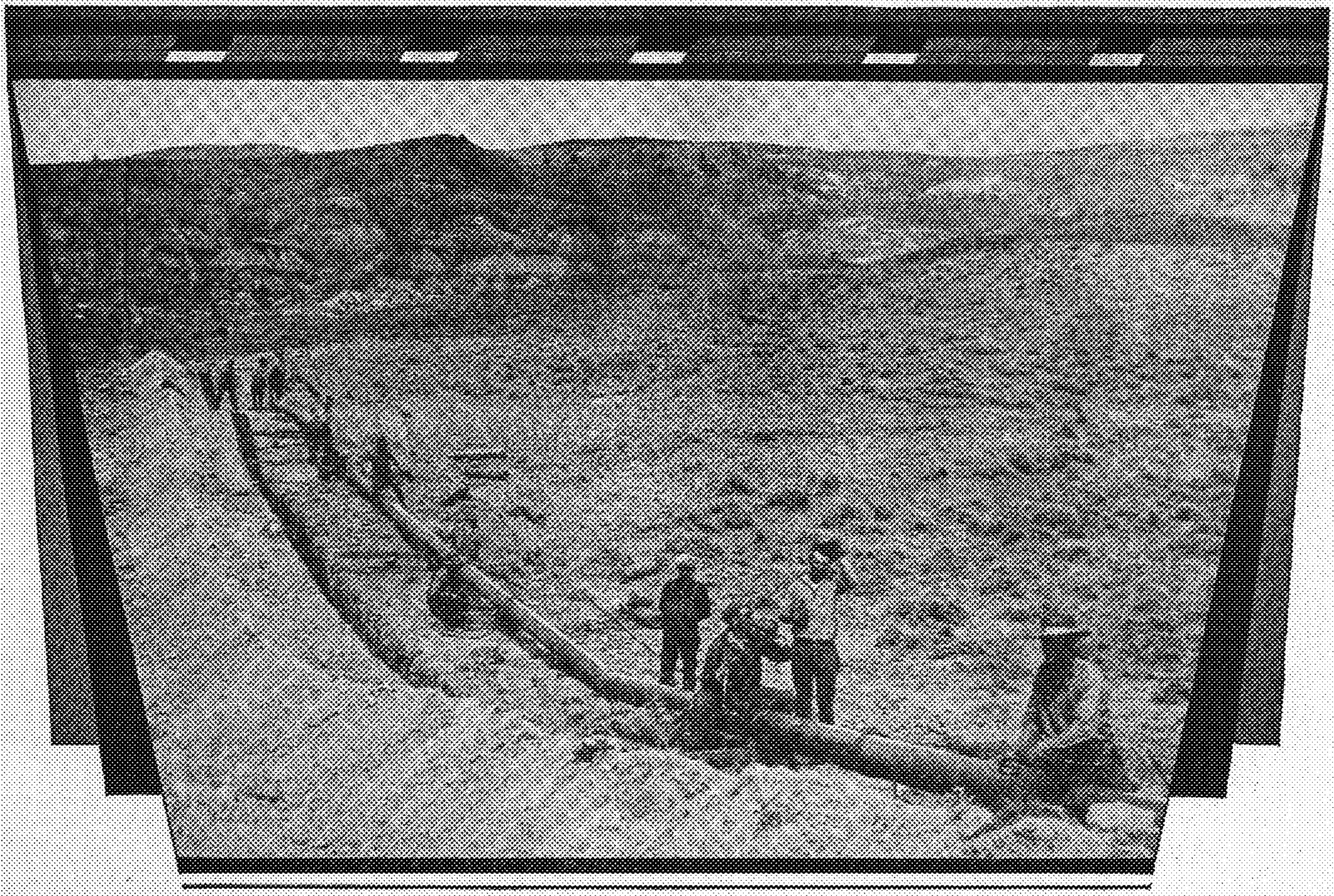
MONTHLY PUBLICATION OF THE TECHNICAL STUDENTS

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOC.

Vol. X JUNE, 1930 No. 9



Widening the roadway along the Mohawk Trail. The machines pictured above are 3½ x 5 Portables and S-49 "Jackhamer" Drills.



Building America's Skyline

Six great names in the manufacture of construction equipment — Koehring, Insley, T. L. Smith, Parsons, C. H. & E. and Kwik-Mix—have become well and favorably known wherever construction projects are going forward.

These names represent leaders in their types of machinery—they are recognized by engineers and builders from coast to coast in America and in many foreign countries.

Now united in National Equipment Corporation these leaders are building a greater name in construction equipment. They have become one—for greater engineering, greater service, and greater realization of quality.

N. E. C. builds America's skyline, — as well as America's highways and notable engineering achievements.

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

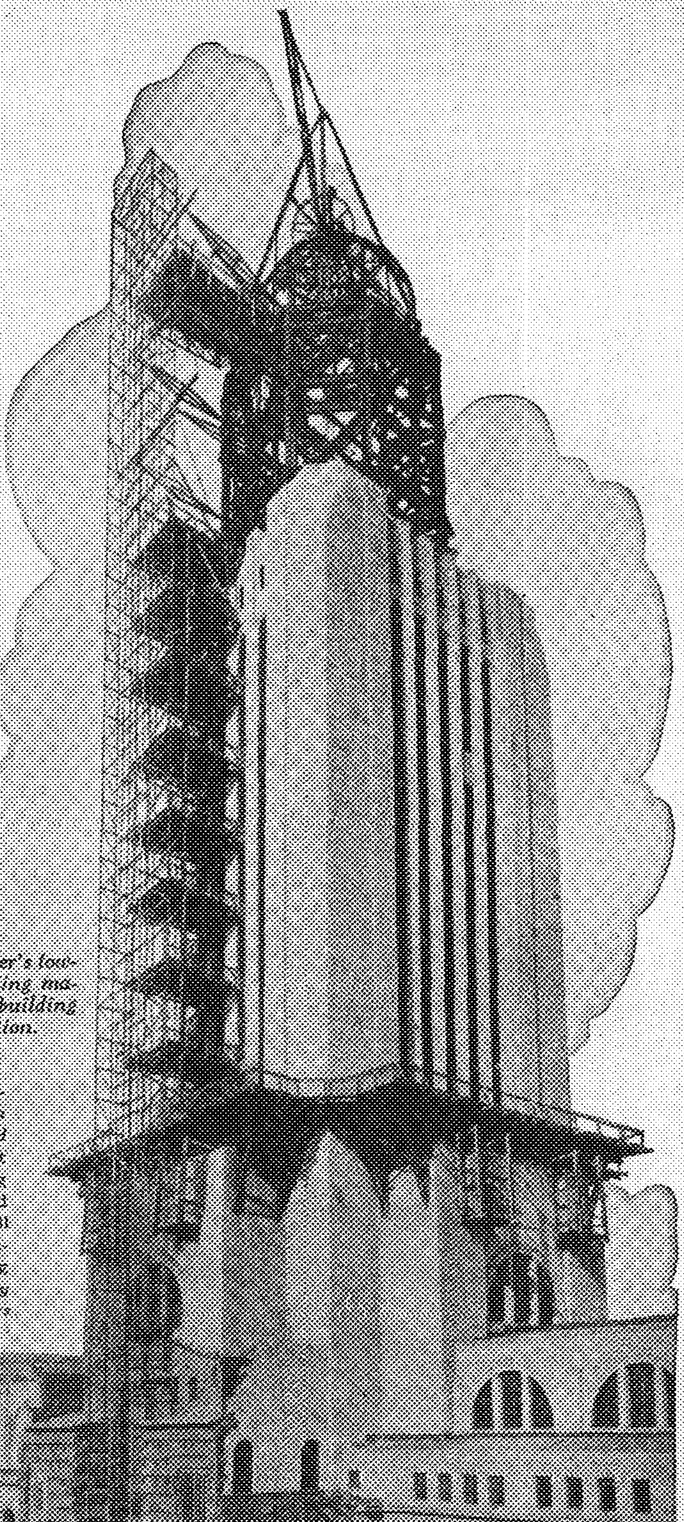
INSLEY
Excavators; Concrete Placing Equipment; Cars, Buckets, Derricks.

T. L. SMITH
Tilting and Non-tilting Mixers, Pavers, Weigh-Mix.

PARSONS
Trench Excavators, Backfillers.

C. H. & E.
Portable Saw Rigs, Pumps, Hoists, Material Elevators.

KWIK-MIX
Mixers — Concrete, Plaster and Mortar.



Insley builder's tower for elevating materials in building construction.

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

NEC

National Equipment Corporation Milwaukee Wisconsin

THE MINNESOTA

TECHNO-LOG

MONTHLY PUBLICATION OF THE TECHNICAL COLLEGES OF THE UNIVERSITY OF MINNESOTA

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

VOLUME X — MINNEAPOLIS, MINN., JUNE, 1930 — NUMBER 9

CONTENTS

	PAGE
COVER INSERT—OLD DUTCH FARMHOUSE *G. C. Peterson*	288
PROFESSOR SPRINGER AND PATENTS *Harmond Grabert EE '30*	289
ENGINEERING IN GRAIN HANDLING *J. Donovan Jacobs '31*	290
HEALTH PROTECTION IN INDUSTRY AND LABORATORY *Dr. G. Schultze*	292
NEWS FROM THE TECHNICAL CAMPUS	294
THOSE HONORED	297
EDITORIALS	298
THE 1930 DIRECTORY	299

Entered as second-class matter April 9, 1923, at the post office at Minneapolis, Minnesota, under the Act of March 3, 1879. Office, 37 Electrical Building, University of Minnesota. Telephone, Dinsmore 2760. Contents copyrighted and permission must be secured for re-publication. Subscription rate, $1.50 a year. Single copies, 25 cents. Advertising rates upon application. Alumni Directory, 50 cents.

Old Dutch Farmhouse

The MINNESOTA TECHNO-LOG

University of Minnesota

Volume X — JUNE 1930 — Number 9

Professor Springer and Patents

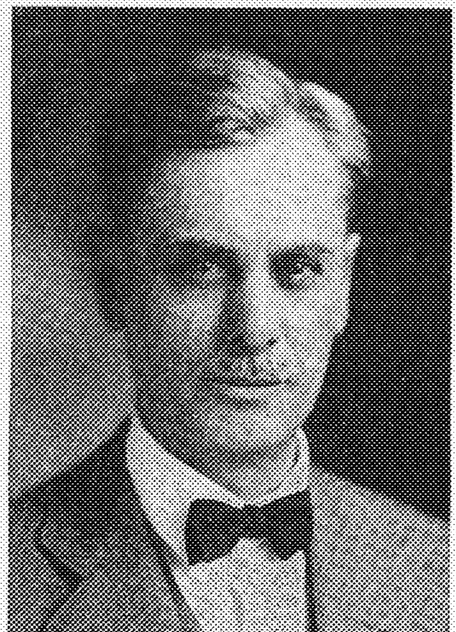
By HARMOND T. GRABERT, EE '30

PROFESSOR F. W. SPRINGER has been connected with the University of Minnesota for a period of thirty years. In that time he has served in almost every division of the staff even acting as head of the department for some time (in the Electrical Engineering College). Aside from his duties as an instructor, Professor Springer has taken an unusually active part in the constructive and administrative building up of the Electrical College.

During the construction of the new Electrical Building his efforts were expended toward the establishment of a most efficient system of construction and administration. His accomplishments during this period may be classified into two main divisions: (1) functional plans and (2) service plans. These two items involved a great deal of exhaustive study and observation. Professor Springer before arriving at any definite conclusion of plans, studied the various systems of Europe and America. He obtained his information through actual visits to the laboratories and study rooms, profiting by the errors and accomplishments of others.

The functional plans involve the actual construction details such as grouping of departments and isolation of the laboratory system proper from the recitation section. The service plans, on the other hand, involve the establishment of an efficient system for the distribution of service with a minimum of unnecessary expenditure of effort. This may be most easily illustrated by the following example. In student experimental work, Professor Springer established the present system of instrument distribution. The instruments are placed in cases and the student is allowed to sign them out on his own initiative reporting to the instructor all damage incurred. This article cannot cover fully these plans but a very clear and concise conception may be obtained from Professor Springer's explanatory articles in the March, 1924, and the March, 1925, issues of the MINNESOTA TECHNO-LOG.

Along with this work, he has been active in the field of invention. It has been his practice to perfect at least one new idea during each summer vacation. This inventive work from his own standpoint is more or less of a hobby rather than an intensive application of the research laboratory. He has at present some twenty patents as well as several that are pending. Some of those he holds



PROF. F. W. SPRINGER

at present may be listed as follows: high tension insulator, automobile dash thermal indicator, three phase induction regulator and numerous automobile electrical regulating devices. His most recent contribution to patents appears under the title of Electrical systems and involves the experimental work of two summers. It consists in the perfection of the third brush generator for automotive purposes, incorporating a translating device for increasing the output with special cut-off facilities. This involves the principle of a cut-off relay to reduce the charging capacity of the generator when the battery has reached a nominal potential.

An interesting feature of this particular patent is the fact that it was obtained through a Minnesota graduate of the class of 1906, Mr. Albrecht. He obtained his electrical degree at Minnesota and later received an LLB from the University of Washington.

Referring to the patent situation, or rather the actual methods employed in obtaining monetary return on patents, there are several general methods of procedure. They are as follows:

(1) After the patent is obtained the owner may merely await further developments in the hope that some individual may become interested in his invention and open negotiations.

(2) The patent may be manufactured through the individual resources of the owner.

(3) A company may be organized, stock sold, and the patent manufactured.

(4) The patent may be placed in the hands of a manufacturing concern, which will attend to all the details of manufacturing and selling the patent, reimbursing the owner on a royalty basis.

(5) The patent may be sold outright.

Mr. Springer has so far always employed the first named procedure. When negotiations are first opened, a nominal offer of say $200 is made to the owner of the patent by the attorney of the prospective purchaser. This offer is merely a "feeler," or an invitation for discussion, and is not taken as a binding contract. In case arrangements are not completed the initial offer is returned to the would-be purchaser, and again the owner of the patent resorts to the process of waiting.

The actual value of a patent varies enormously—from that of a decided liability, to an asset of untold worth. All of which makes the patent game anything but an easy one, for it is a decided gamble. It involves a long and tedious process, punctuated by long dashes of technical and political red tape. For not only must the aforementioned difficulties be encountered, but also another, which is rather explicitly mentioned in the preface to the patent. The preface opens in the following manner: "Presented to the Commissions of patents, a petition praying for—," and according to Professor Springer there is plenty of accent on the praying.

Engineering in Grain Handling

By J. DONOVAN JACOBS, '31

THE average man knows little, perhaps cares less, about the travels and wanderings of a grain of wheat from the time it leaves the harvest field until it reaches his dinner table in the form of bread and pastry. Mild interest is aroused in him by the sight of a new grain elevator under the process of construction. He is surprised at the seemingly phenomenal rate at which its concrete walls creep skyward as the work progresses and he pauses for a moment on his way to work to gaze on the efforts of the laborers. When the building is completed his interest dies. True it is, that the plain grey concrete walls and the towering head house may lack the architectural attractiveness which to the layman lends a certain enchantment and romance to such engineering endeavors as a bridge or a skyscraper.

Also, it can justly be said that one notices least, that which is nearest him in his every day suroundings. Grain elevators are certainly commonplace in the city of Minneapolis. The leading grain milling city of the world is also the world's greatest inland grain terminal. Mills and grain storage houses are, to Minneapolitans, a part of their environment and as such retain their places unnoticed by the populace.

However true this may be the place of the grain elevator in the world's industry must not be underrated. Since the dawn of history the human race has depended upon wheat flour as a principal food. Nor does the demand for this commodity give any indications of decreasing after some six thousand years. In the United States nearly a billion bushels of wheat are produced in one season. Before this vast quantity of grain reaches the flour mill it must be transported, stored, and perhaps rehandled many times. The railroads and steamship lines take care of the transportation and the terminal elevators handle and store the grain.

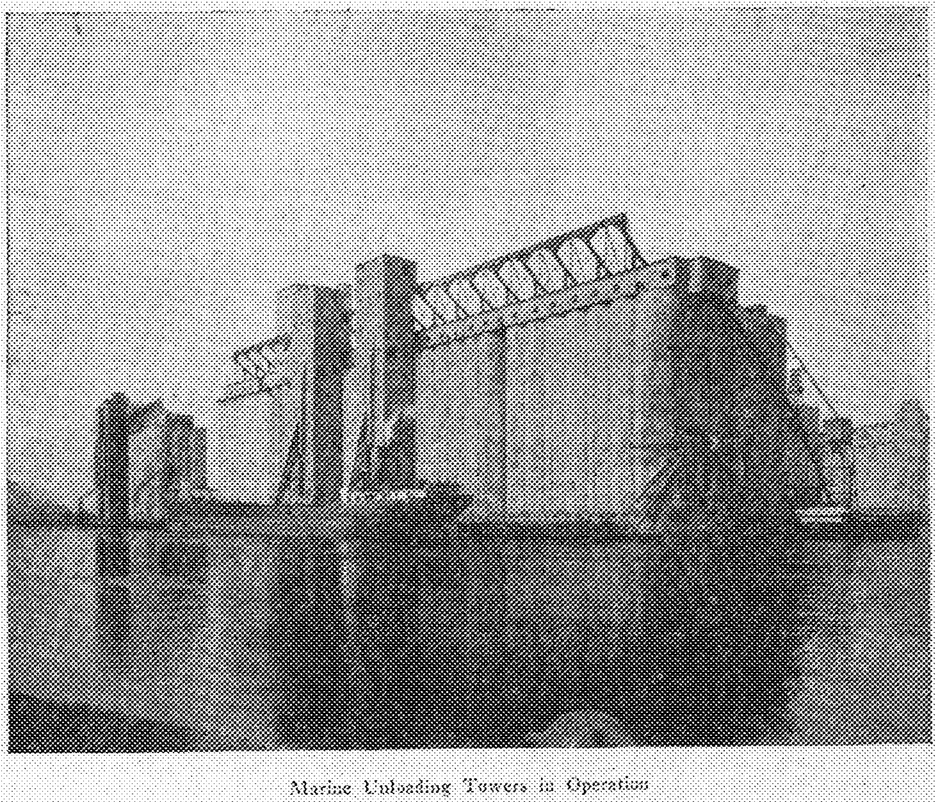
The modern grain terminal is in every respect a masterpiece of engineering design. "Efficiency," and "speed," the two watchwords of present day industry, are emphasized in it to the highest degree through contributions from all branches of the engineering profession. Structurally and mechanically the modern grain handling plant is the result of years of research and development toward a definite objective. In the milling business, as in other fields today competition is at its peak with the result that capital has called upon engineering for an assisting hand.

Minneapolis has played an important part in the early development of the grain elevator. In and about this city stand a number of old houses as monuments to the achievements of pioneers. These old buildings, with their wooden grain bins of laminated planking and their sheet metal exteriors are indeed a far cry from the modern concrete structure. Although a number of these old houses still stand, scarcely a season passes that one or more of the old landmarks is not wiped out by fire or razed to make way for a new unit of fireproof storage. The constant increase in insurance rates is doing much toward their extinction.

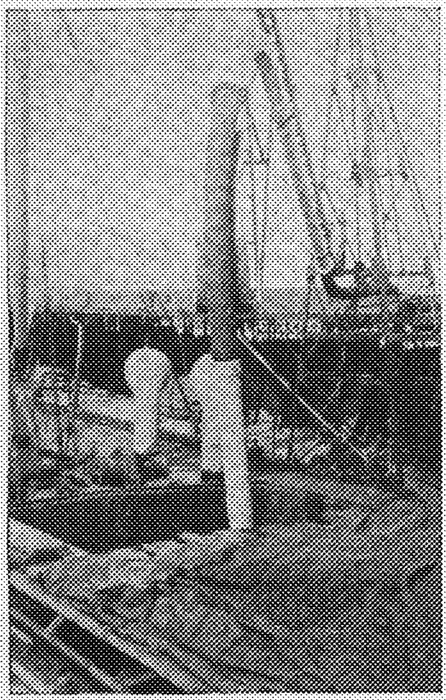
Among the pioneers in this vicinity is the old Interior Elevator in St. Louis Park, just beyond the Minneapolis city limits. Built nearly a half century ago by the late F. H. Peavey, founder of the grain company which bears his name, it was for years the largest grain house in the world. Until the dismantling of one of its units during a period of business depression twenty years ago its storage capacity was three million bushels of wheat.

Not only was this house important due to its size, but it and its builder have contributed much toward the engineering development of the modern elevator. Mr. Peavey, a business man of prominence, was also well versed in the field of engineering. During the early years of the Interior, he carried on many experiments and much research toward the scientific development of grain handling and conditioning. On a hill adjacent to the present elevator stands a round concrete grain tank which is said to be the first reinforced concrete grain tank ever built. It was erected as an unique experiment in the early nineties and its original height was 100 feet. One of the features is that it contains no vertical reinforcing rods. In spite of this it successfully underwent all tests and still is apparently sound after thirty years. A year or so after the completion of the first 100 foot section the originator desired to experiment with greater grain pressures so he extended his tank upwards another 25 feet. In this top section he used copper reinforcing instead of steel. Although this may be quite contrary to modern practice, the present condition of the tank gives evidence to the fact that the experiment was successful.

The modern reinforced concrete terminal elevator consists primarily of two general divisions: the elevator proper, and the grain storage. The elevating equipment, together with machinery for weighing, cleaning, and conditioning the grain, is housed in the cupola or head house which usually towers a hundred feet or more above the top of the grain storage tanks. All grain handled in the house is elevated from ground level to the top of the head house by means of bucket elevator lofting legs.



Marine Unloading Towers in Operation



Unloading Grain With Pneumatic Tubes

From the head house it is distributed to the various bins on belt conveyors. Trippers located at the desired points above the bins remove the grain from the conveyor belts and deliver it to its proper tank or bin.

The storage section of the elevator consists of a series of round concrete bins varying in size from 16 feet to as large as 28 feet in diameter. These large round tanks will hold as much as 40,000 bushels of grain. Between these major tanks are the smaller odd-shaped interstice bins, the walls of which are formed by the surrounding round bins. The reason for the round tank type of construction is based on several well-known scientific facts. One is the principle that a circle is a figure containing the greatest area for the least circumference. This tends toward economy in wall construction. Another reason for the circular walls is that the outward pressure within a round bin is resolved into tensile stress in the walls, which is easier to take care of than moments. The circular walls of the large tanks also act as arches in withstanding the pressures in the surrounding interstices.

The bottoms of all tanks are hoppered and the grain is drawn out through control valves onto conveyor belts in the basement which transport it to the head house where it is re-elevated for distribution to cars, boats, or flour mill.

The complete elevator, however, consists of much more than concrete tanks and elevating equipment. One feature of interest which is included in practically every large elevator erected at the present time is the electric thermo-couple thermometer system by which the temperature of the grain within the bins is observed. It is a commonly known fact that if grain has been received slightly damp or before it has become thoroughly ripe, it is liable to heat within the bin. This heating is the result of a chemical action commonly known as spontaneous combustion and results in very serious consequences if allowed to continue. The temperature of the grain in each bin throughout the house must therefore be checked daily to guard against "hot spots."

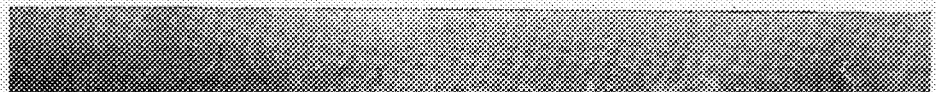
This observation is effected by means of the thermocouple thermometer, commonly known as the Zeleny system. The principle of the thermocouple is that heat applied at the junction of two unlike metals will cause a small electric current to flow between the metals. In the grain elevator a series of these junctions or thermocouples is located down the center of each bin at intervals of five feet throughout its height. The wires from these thermocouples are carried within conduits to a switchboard in a small heat-insulated thermometer room where they terminate in a series of contacts on a switchboard. Each grain tank has its set of switch points on the board by means of which each five foot station in the tank can be read on a galvanometer.

The registering device consists of a sensitive galvanometer of the swinging mirror type which casts a beam of reflected light on a scale in front. The scale is graduated in degrees fahrenheit. To standardize the galvanometer the instrument is first connected to a thermocouple within the thermometer room and the scale adjusted until the light beam indicates the temperature of the room as registered by a mercury thermometer near at hand. The galvanometer can then be connected to the switchboard and the temperature at any point in any bin read accurately to a degree. If a hot spot develops in any bin the grain in that bin is drawn off, run through drying equipment in the head house, and returned to the bin. The thermometer system often saves many times its initial cost in one season.

It may be interesting to observe the manner in which cars of grain are unloaded at a large elevator. In the older or smaller houses the unloading is performed by means of power shovels consisting of an automatic electric winch connected by cables to a wooden scoop or drag which is operated by a man in much the same manner as a hand scraper is used in moving earth. Two drags are usually used, one in either end of the car, and two men can thus shovel out a car in from five to ten minutes. Several minutes is then required to sweep the car clean of the small remainder of grain which can not be pushed out with the drags. The grain which is removed from the car drops through a grating beneath the door of the car into a receiving hopper under the track from whence it is carried by conveyor belts to the lofting legs.

In the more modern of the larger houses the power shovel method has been superseded by the car dumper. The car dumper consists essentially of a movable platform upon which the car is run. After the car trucks have been clamped to this platform, the car and platform are bodily lifted and the car is tilted sideways, pouring the grain out the car door with as much comparative

(*Continued on page 362*)



Modern Milling Plant at Buffalo, N. Y.

Health Protection in Industry and Laboratory

By **DR. GEORGE SCHULTZE**

MILLIONS of dollars are spent every year to safeguard life and health in industrial plants, and yet the number of accidents is not decreasing, for increased production has brought with it increased danger.

A detailed study shows that in countries with highly developed industries, for example, the United States or Germany, in almost every case not insufficient precautions and safety devices but rather ignorance, carelessness, and negligence are responsible for accidents.

In this way our problem becomes more or less a question of education, instruction, and information. This fact should be noted especially from the point of view that—as far as I know—in no country in the world do the universities offer to their chemical and engineering students an official course dealing with "health protection."

The subject is so broad that we can not hope to deal with all its phases. Those who are interested in a detailed study of this problem are referred to the extensive literature on this subject. The "National Safety Council of America" or the "United States Bureau of Labor Statistics" or the "United States Public Health Service" or the management of the "Arbeiterschutz-museum" in Berlin are without any doubt glad to supply references to the literature for any special phase of the problem.

There are two factors which make the question of safety in the laboratory (we here consider only those laboratories used for the education of the rising generation) quite different from that in industry: 1. The investigations in the laboratory are mostly carried out on a small scale. This fact involves arrangements which are not always economical and not even feasible for the large scale of industry. 2. Industry necessarily exposes its employees to the same substances during a great many years. These may not be poisonous when they attack the human body only for a short time but by accumulation they may give rise to those occupational diseases which are especially feared because a complete recovery is generally impossible.

The small scale of the experiments and the short time of handling such substances in the laboratory do not require the great carefulness which is necessary in manufacturing them. Both factors make the problem of safety essentially more difficult for industry than for the laboratory. In a modern laboratory the possibilities of health protection are almost exhausted by preventing typical accidents which may be caused by ignorance and negligence of the young students. What can be done in the laboratory to impress upon the student the necessity for carefulness? First, the equipment for safety should be in line with the most recent knowledge and modern standards of health protection.

> *Dr. George Schultze is the recipient of the American Petroleum Institute Research Fellowship and is working on the transformation of lighter hydrocarbons into heavier molecules. He was born in Germany and attended what corresponds to high school there; such schools have a nine year curriculum and are otherwise considerably different from American schools. The examinations taken at the end of the nine years are rigorous indeed, being considered more difficult even than examinations for advanced degrees; the subject matter includes more advanced mathematics than is given in the regular four-year courses taken by most engineers in this country.*
>
> *After successfully completing this preliminary part of his education, he attended the University of Halle, one of the oldest German universities; later he transferred to the University of Berlin, recognized as probably the best in the world, and continued his work. While here, he had the privilege of studying under Prof. Max Bodenstein, one of the leading physical chemists of the world; Dr. Einstein, of relativity fame, and other truly outstanding scientists of our times.*
>
> *Dr. Schultze received the coveted Doctor's degree less than three years ago and is one of the youngest men on the University staff. He speaks good English, although he came to America for the first time last fall.*

It is certainly true that this cannot be accomplished in a day but efforts should be made in this direction insofar as they are felt to be necessary. In the second place, the instructors must be especially attentive in supervising the student and his attitude toward handling dangerous substances.

Only one very characteristic example: a student was handling an ether solution in a separatory funnel. Not knowing that the ether in almost every case develops more than atmospheric pressure, he took no notice of a flame burning on his desk. Suddenly the glass stopper came off and immediately the ether explosion destroyed the funnel and ignited a bottle of ether which stood nearby, and set fire to his clothing, burning his face and chest. The student tried to extinguish the fire with his hands; other students noticing that his efforts were in vain, drew him under the shower. Finally the fire was put out, but the student died several days later in the hospital. An example of how not to act from the first to the last word!

Some precautions which should be observed are:

1. If you work with inflammable substances keep them away from flames.

2. Bottles of explosive substances, especially metallic alkalies, should never be allowed to be kept on shelves on top of the working desk. (But look around, you find that in every laboratory!)

3. Dangerous substances should never be handled at the height of the upper part of the body; and certainly never in front of the face.

4. If you are burning, first, take your smock off. The best and easiest way to extinguish fire in a laboratory is always to smother it by using rags. In the second place, use fire extinguishers, which, together with asbestos rags and a shower, should be located near the door of the room. Never use water for extinguishing ether, benzene, or burning alkalies.

5. Showers should have one ordinary valve such as everyone knows how to use. Special contrivances are often subject to rust and are difficult for the individual to use, particularly in excitement. They should be placed so that they are easily reached at any time from the research rooms as well as from the large laboratories.

6. Hurry if you hear some suspicious noise, even if you think it might be unnecessary.

7. Become used to wearing glasses, especially in working with high vacuum, corrosive or inflammable materials, and even with ammonia, which as a liquid is harmful to the eyes.

8. Have working clothes which can easily be taken off (with snaps, not ordinary buttons). Overalls are better than an apron or a smock which may be caught in gears or belts.

9. Know always what to do first in case of an accident. Never be nervous in a laboratory but keep your wits about you.

10. Cleanliness particularly in handling mercury and alkali wastes, and

order, especially in labelling all bottles and containers, are the most common and important factors for safety in a laboratory.

A cupboard containing the ordinary articles for first aid should be a requirement in every laboratory. The kit should contain, among other things:

1. A good string for tying up a cut artery;
2. For burns contracted by
   a. Acids: a big bottle of saturated sodium bicarbonate solution;
   b. Alkalies: acetic or citric acid solution;
   c. Heat or cold; picrate ointments or carbolic acid;
   d. Solution of ferric chloride for stopping blood;
3. Tincture of iodine (5%) for disinfection;
4. Gas masks, especially for halogens and carbon monoxide.

A table of instructions should give simple suggestions for special cases, e. g. internal poisoning. Everybody should know that eggwhite, milk or charcoal are excellent antidotes for poisons; that in the case of corrosive poisoning it is very dangerous to attempt forced vomiting because of the danger of rupturing the damaged tissues of the stomach; that among the laxatives which are rapid in action, those which are solvents for the poison must be avoided, for example, castor oil in the case of phosphorus poisoning. For lung poisoning fresh air is the most important factor of first aid.

On the outside of the first aid kit should be the name and telephone number of the nearest doctor as well as that of the nearest fire station. It is absolutely essential that this cupboard be easily accessible at all times, even though there may be suspicion of unauthorized usage.

In industry the problem is much more complicated, not only for the reasons mentioned already, but also because of the greater ignorance about safety measures on the part of the people involved, and because of some almost incalculable factors: the static electricity of belts may give rise to dust explosions which could not be expected, or important tubes which are subject to vibrations may break and cause a terrible gas explosion.

From the tremendous statistical material, only the following three facts are given, which show the importance and multiplicity of our problem.

1. The first one deals with Germany which I know from my own experience to be essentially well equipped with all safety devices, and yet the records show that every hour there is one fatal, every six and one-half minutes one serious case, and every minute one minor injury from industrial accidents.

2. Another example: during one season more than five hundred dust explosions occurred in agricultural operations in the Northwest. The damage from these amounted to a million dollars.

3. It is not the purpose of this article to deal in detail with all the questions involved. However, some of the more important phases should be considered. Whereas for prevention of typical accidents in industrial life the same general ideas are of value which are given for the laboratory, the necessity of avoiding possibilities of occupational diseases complicates the problem. Of greatest importance is the fight against all kinds of dust and vapors. If one has had the opportunity of seeing the lung of a human being who has lived in a large city, one gets an impressive idea about what quantities of dust this organ is able to absorb without especial harm; the lung looks not red but dark grey or black.

It is evident that industries which have appreciably larger amounts of dust per cubic-foot than the air in large cities, require special precautions, particularly if the dust is poisonous or if it is organic in nature. It is not necessary that such dust be a real poison from a toxicological standpoint; it is only of importance when it becomes toxic by accumulation. For example, the dust of silica is not poisonous itself, but it gives rise to a disease by being distributed as socalled colloidal lung silicose. Chronium, lead, barium and many other materials which may be handled quite carelessly in the laboratory, demand greatest caution in the process of manufacture.

Even the public is interested in the question because the whole surrounding territory may be poisoned both by bad air from the waste gases and by liquids and solids from the sewers. Therefore the question of ventilation and disposal of all waste material in industrial plants is nearly as important as the problem of preventing fire.

As to ventilation, good architectural regulations are the cheapest and best factors but nowhere are so many mistakes made as in working out a reasonable plan. Incidentally it must be mentioned that a plan should, from the standpoint of our problem, also consider the question of transportation; nearly 60% of all accidents happen in transporting materials. A proper construction of the buildings keeps accidents down and saves time and money. Since ventilation is a subject by itself and is well covered in numerous books on the subject, we may omit a study of the various methods of purifying the air.

More difficulties are involved in using up all wastes which leave the plants and poison the neighborhood. In contrast to Germany, for instance, this question is of great importance for America where the regulations governing the location and operation of factories often come too late, and where the abundance of resources does not make profitable a recovery and working up of all different kinds of wastes.

Finally a few examples of particular importance for safety in industrial plants may be briefly mentioned inasmuch as one does not find sufficient consideration of them.

1. Sprinklers should have two conducting lines, one on each end. In installing such a sprinkler system the dimensions of the tubes should really be calculated, not merely estimated, according to the best available data on such factors as decrease in pressure when the sprinklers are open, length of the tubes, number of taps, etc. Water meters very often have a large internal resistance which also decreases the quantity of water supplied. The main tubes should be covered so that they cannot be burned through by pointed flames.

2. Belts should never be connected by metal clamps which may fatally injure somebody, but should be sewn.

3. Tell your successor when he starts his shift about even the smallest irregularity you may have noticed.

4. Never use force in turning stopcocks or loosening screws. In high pressure tubes, stopcocks should be turned very slowly.

5. Be careful in handling tanks, particularly if they are filled with inflammable gases. Valves which have contact with pure oxygen must not be greased. Hydrogen and acetylene may even be ignited by too rapid escape from the tank.

6. Advise your employees to wear a cap suitable for protection of head and eyes.

7. Be acquainted with the use of all equipment for health protection. You have no time to learn it in the moment of accident. Know also where the most important electrical, steam, water, and gas pipes may be shut off.

8. Keep dust away from electrical lights. It may be ignited by the heat of the light.

9. All "horseplay," as you find it very often among young people in plants, should be strictly forbidden.

10. Make your knowledge about your special field and your experience on improvements openly available to the public in favor of the lives of thousands of people who may derive benefit from each bit of progress made in the broad field of health protection in industrial life.

NEWS FROM THE TECHNICAL CAMPUS

Architects Revel in Hindoo Jubilee

White-turbaned Hindoos with flowing pantaloons and colored sashes and Englishmen with tropical hats danced with their ladies in the light of the blue moon and under the watchful eye of Buddha on the night of May 23 in the Engineering Auditorium. Blue sky, palm trees, Royal Gardens, temples, clever light effects; all gave the atmosphere of far-off India. The Architects deserve credit for their realistic oriental night.

Under the guidance of Ed Hanson everything was ready at nine-thirty, punch and orchestra included. Dave Fleckenstein and his Tinker Town Band furnished the music. Among the patrons present were Professor H. C. Richardson of the English Department and Professor Leon Arnal of Architecture. During intermission Professor Arnal gave a clever impromptu talk and presented the winners of scholastic honors with prizes. Bruce Wallace and Kenneth Newton, graduating seniors, received awards. Freshman architects presented "What's Got India," a play of two scenes laid in the Royal Gardens of Half Skail, the ruler. The skit was written and dramatized by the Freshmen. Dancing was resumed and not until the last strains of the Minnesota Rouser had died away were the Hindoos troubled about removing their make-up and becoming architects again.

Mystery Tea Parties Held for Engineers

Shrouded in secrecy are recent afternoon tea parties held by a certain group of fair damsels in honor of the book store boys. Techno-Log news noses have searched and hunted, have questioned and queried but have met only with non-commital replies and chit-chat. But Techno-Log noses are not satisfied,—they demand more information. Facts that have come to hand at present are as follows: first, on several occasions the faint aroma of boiling coffee has been detected; second, furtive individuals have been seen scurrying along the corridors of Main Engineering, carrying cream bottles and large mysterious sacks.

To aid in the solution of the mystery, the Techno-Log appeals to all engineers that may feel themselves gifted with the powers of a Sherlock Holmes or a Philo Vance. A big reward is offered to any individual who detects or apprehends the mystery makers.

Doctor Fajans Gives Series of Lectures

Dr. Fajans of the University of Munich, Germany, recently gave a series of four lectures before various scientific groups at Minnesota. He is one of the leading scholars in modern physical chemistry and is an authority on atomic structure and radioactivity; lately, he has been specializing in the deformation of ions. Together with Soddy, he is coauthor of what is now known as the Fajans-Soddy displacement law.

During the course of his lectures which followed a sequence from introductory to more detailed studies, he explained and discussed the results of his experiments with an impersonal attitude. He is introducing a new manner of studying the behavior of strong electrolytes in solution, by the use of highly refined refractive methods. He has also added to the knowledge of quantitative analysis in the line of absorption on heavy molecules, such as dyes.

Techno-Log Board Elects Officers

At the last regular meeting of the Techno-Log Board held in the Minnesota Union, officers were elected for the coming year.

Charles A. Hearn of the mechanical engineering department was chosen president and Cedric L. Cowan was elected vice-president. John T. Huchthausen of the architectural department was elected secretary. Professor A. S. Cutler was again chosen to fulfill the duties of treasurer.

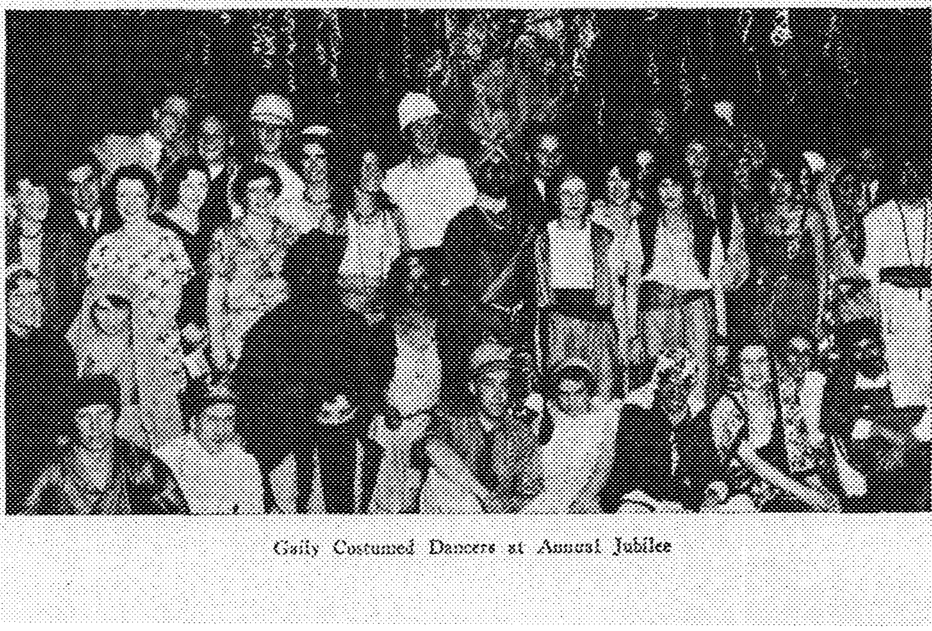
Other members of the Board are: Paul Salo, Chemistry; Robert E. Rice, Electrical, and Dean O. M. Leland, faculty representative from the School of Chemistry.

Physics Department Offers Survey Course

The physics department has inaugurated a new course this quarter which is a survey of the general principles of physics treated from a philosophical standpoint. It is a three credit course meeting three times a week, and is open to anyone who has a desire to take it. There are no prerequisites.

The course is planned to consist of thirty lectures for the quarter, the lectures being arranged so that each phase of physics will be studied for a period of two weeks. The various divisions of physics that will be studied are as follows: Mechanics, acoustics, heat, electricity, and optics. Each division has a special lecturer who will give six lectures. H. A. Erickson will lecture on mechanics, J. W. Buchta will speak on acoustics, and L. F. Miller will talk on heat. Professors Anthony Zeleny and Joseph Valasek will lecture on electricity and optics. This arrangement enables the student to receive instruction in all of the major branches of physics in one course. However, because of limited time, only the high points of each branch can be taken up.

Professor Erickson, who is chairman of the physics department, outlines the object of the course with this statement, "This course is not intended to count as a requirement in the professional schools, but is intended for those students who, on account of other interests, cannot devote the time necessary to a more complete course but do wish a general view of the field of physics. It is evident that such a course will meet the approval of a large number of nonprofessional students who have not the time to spend in the more complete courses in the major branches of physics."



Gaily Costumed Dancers at Annual Jubilee

Dean Leland Addresses Arkansas Engineers

Ora M. Leland, dean of the College of Engineering and Architecture, was the principal speaker at the University of Arkansas' annual Engineers' Day convocation, held recently.

The knighting of 33 engineering seniors was part of the convocation. St. Pat called each of the men to the stage by name, adding a humorous personal anecdote, or remark as the man came forward to kiss the Blarney stone and become a full fledged knight of St. Pat.

A program of displays and exhibitions of phenomena was featured by the various departments of engineering during the afternoon. The civil engineers sponsored a guessing contest on the strength of a wooden beam, which was later broken in a large testing machine. In the road laboratory a rock crusher and a brick polisher were demonstrated.

The chemists also contributed some unique stunts during open house. By mystic writing, past and future, was revealed to the visitors. Pharaoh serpents, a perpetual stream of water, and the solidifying of carbon dioxide were among the interesting experiments. Green lemonade, made in the laboratory, was served in beakers.

Engineers' Day has become a fixed custom at the University of Arkansas. It originated in 1909 when, as W. N. Gladson, dean of the College of Engineering at Arkansas, said, "The engineers' fife and drum corps marched about the campus and the town advertising the fact and incidentally incurring the displeasure of professors in latin and mathematics by disturbing the serenity of their classes." In the development of the celebration a part of the famous Blarney stone from the ruins of old Blarney Castle was brought over to the state of the razorbacks, through the efforts of a faculty member.

"The University of Arkansas' Engineers' Day differs from Minnesota's, in that they have no parade, but they have many more exhibits," said Dean Leland.

According to Dean Gladson, "Engineer's Day is a real opportunity to show the public something of the great service the engineering profession as a whole has rendered, and is rendering, to humanity."

Arabs Elect Officers for Coming Year

Officers of Arabs, engineering dramatic organization, for the coming year were recently named at the club's final meeting. James Dennerly was elected president; Kenneth Knox, vice-president, Arthur McCracken, secretary, and Henry Frommelt, treasurer.

HARLAND HARMER
Who Directed Activities of Engineers' Day this Year

Chemical Engineers Obtain Positions

Representatives of some of the larger chemical companies of the United States have come to Minnesota during the month of February for the purpose of interviewing students in Chemical Engineering for positions after graduation.

The men who have accepted positions to date, are as follows: W. Eaton, who will receive his M. A. degree this spring, will go with the Eastman Kodak company, at Rochester, New York; Kenneth Kobe, who will receive his Ph.D. degree this spring has accepted an offer of the Dupont company of Charleston, West Virginia; R. B. Selund, '30, will go with the Standard Oil company of Whiting, Indiana; John McConnell, '30, will be connected with the LaZote corporation of the Dupont company; T. A. Petry, '30, will be employed by the Willhelm Oil Company of Minneapolis, Minnesota, and Bruce Strain, '30, will be at Ivorydale, Ohio, with the Procter and Gamble company.

The companies who sent representatives to Minnesota during the month are: the Procter and Gamble company, the Union Carbide company, Frigidaire, E. I. Dupont de Nemours company, Grasselli company, A. O. Smith corporation, American Telephone and Telegraph company, General Electric, Pittsburgh Plate Glass company, Roesler-Haslacher company, Northern States Power company, and the Balkite corporation. There are several more companies who plan to send representatives here early in March.

Techno-Log Board Makes Appointments

At the last meeting of the MINNESOTA TECHNO-LOG BOARD, J. P. Shirley was re-elected to the position of managing editor for the year 1930-1931. The business manager elected by the Board upon the recommendation of Mr. Shirley is Steve Gadler.

Both men have been active in many engineering functions. Mr. Shirley has been connected with the TECHNO-LOG for two years. He is a member of the Arabs, having worked during the production of "Enginferno," last year's show. He is also a member of Sigma Delta Chi, professional journalistic fraternity and Alpha Tau Sigma, honorary engineering journalistic fraternity.

Mr. Gadler is president of the North Dakota Club, and has been on the staff of the MINNESOTA TECHNO-LOG for the last three years working in various positions on the business staff. He was also Button Chairman of Engineer's Day for this year.

At the annual dinner of the TECHNO-LOG Board keys for meritorious service were awarded to members of this year's staff. Gold keys were awarded to Morris Hauge, business associate, Harold Wang, Circulation Manager, and Gerhard C. Peterson, art editor. Silver keys were awarded to John Madden, advertising manager, James Spicola, collection manager, George Taft, alumni editor, O. Reginald Lindstrom and John Skidmore.

Hughes Experiments With Steel Strains

With a gauge of his own invention, Chester A. Hughes, assistant professor of structural engineering at the University of Minnesota, is attempting to find out what stresses and strains do to the steel used in the construction of bridges and buildings.

He is using in his experiment a testing apparatus capable of producing a pressure of 400,000 pounds, and the U-shaped instrument which he invented to measure the strain. The gauge can measure within 1-600 the diameter of a hair. The steel on which the tests will be made are H-beams and I-columns, which weigh approximately 1,100 pounds. Pressure is applied to the beams and from the resulting gauge readings, Mr. Hughes determines how far out of place rivets have been forced.

One of the difficulties encountered in making the necessarily minutely accurate readings is the problem of constant temperature conditions. Any sudden change in temperature, as the opening of a door in cold weather, or a ray of sunlight falling on the beam, would disrupt calculations.

The Curtiss-Wright College Air Tour As Told to the Techno-Log by Lloyd Kernkamp

At 3:30 p. m., May 10, eight Curtis Robins, small cabin airplanes, landed at the Valley Stream airport on Long Island. As the planes stopped, one by one, in front of the Curtiss-Wright hangars and the passengers and pilots stepped out, a pandemonium of greetings and introductions arose. The Curtiss-Wright College Air Tour had arrived in New York exactly on the scheduled time.

The passengers, two students from each of the nine Universities represented, gathered in a group to exchange opinions and impressions of the trip. The Harvard students were the only ones who flew their own plane on the tour, as their flying club owns and operates a Travel-Aire. The University of New York, Carnegie Tech, and the Universities of Detroit, Michigan, Ohio, Illinois, Kansas, and Minnesota each had a plane and pilot sent to carry its delegates on the tour.

The Minnesota men had the longest trip of any of the delegates, covering a distance of approximately twenty-four hundred miles. As the distance was made in twenty-seven hours and thirty minutes of flying time, the average speed that the plane maintained was 88 miles per hour.

The plane carrying the Minnesota delegates, Albert Wettles and Lloyd Kernkamp, and piloted by Joseph Meagher, a graduate of engineering at Minnesota in 1925, took off from Minneapolis airport at 8:30 A. M. May 8 and arrived in Chicago before lunch time, where they were joined by the plane from Illinois. In the afternoon the two ships flew to Detroit, where two more planes, one from the University of Detroit and the other from the University of Michigan, joined them. The following day the four planes left the Grosse Isle airport, Detroit, and flew in formation to Pittsburg, where they met planes from Kansas, Ohio, and Carnegie Tech. After being royally entertained in Pittsburg Friday evening by the Carnegie Tech delegation the tour again took to the air Saturday morning. There were now seven planes flying in formation over the Alleghany Mountains enroute to New York, via Baltimore, where a short stop was made for lunch.

Saturday evening in New York the students and pilots were guests of the Curtiss-Wright Flying Service at a dinner held in the Hotel Roosevelt where plans for financing college club air ships were discussed. After dinner the men were taken to the New York Aviation Show at Madison Square Garden. Here the latest developments in ship and engine design were observed which served as a very interesting and fitting climax to the tour.

Sunday and Monday were spent sight-seeing in New York, and on Tuesday morning the planes again took to the air, each plane heading directly toward its respective goal. The Minnesota plane arrived in Chicago Tuesday afternoon traveling via Cleveland and South Bend.

The weather had been perfect until Tuesday afternoon when it was necessary to alter the course several times to avoid running directly into rain storms. On several occasions small showers were encountered, but the discomfiture of passing through them was well worth while, for when the plane was again in the sunshine the perfect circle of a rainbow was visible around the tail.

The rainy weather prevailed around Chicago Wednesday morning and it was some time after noon before the final leg of the return trip to Minneapolis could be attempted. Clear weather was not encountered again until the Wisconsin hills were passed, where some interesting maneuvering was necessary between the hills because of the extremely low service ceiling. Not much time was lost, however, for the plane settled into the Minneapolis Municipal Airport at 6:30 P. M., thus successfully completing the first college safety air tour.

Dougan Goes to Russia With Ralph Budd Party

Henry L. Dougan, of St. Paul, a member of the staff of railway technicians which Ralph Budd, president of the Great Northern railway, is taking to Russia with him to assist in a survey of the Russian Siberian railways for the Soviet Government, studied engineering at the University of Minnesota. He entered the employ of the Great Northern railway in June 1906. For eight years he was resident engineer on various improvement projects, then he was brought into the valuation department of the railway at St. Paul as draftsman engineer; in 1918, he was made assistant valuation engineer; in 1925, assistant general auditor in the comptroller's office; and on January 1, 1930, executive assistant to the president.

In addition to his experience as an engineer, Mr. Dougan is recognized as an outstanding statistician in railway matters. He has appeared several times before the Interstate Commerce Commission as an expert on statistical matters.

One of his most important assignments with the Budd party will be the making of studies of traffic density upon which Mr. Budd can make his recommendations for increasing the capacity and efficiency of the Russian-Siberian transportation systems.

Chemical Engineers Hold Spring Smoker

The A. I. Ch. E. held their spring smoker recently in the Chemistry building. The features of the meeting were a guessing contest, which began the meeting, and an illustrated lecture given by Dr. Halvorson of the Farm School. He discussed the various methods of sewage disposal and gave a short history of the field. He illustrated his talk with a motion picture of the kinds of bacteria.

Plans were discussed for a Chemistry Day similar to Engineers' Day, to be held next year. After the meeting an executive conference was held, which the officers and others interested attended.

Faculty-Alumni Dinner Held in Union

The faculty and alumni of the College of Engineering and Architecture and the School of Chemistry held their annual banquet in the Minnesota Union on Engineer's Day. About two hundred attended the banquet which is the first of its kind to be held for ten years.

President Coffman, Roy V. Wright '28 M and Dean Leland were the speakers of the evening. President Coffman and Dean Leland both stressed the rapid expansion of the technical school in recent years. President Coffman suggested three mean for dealing with the increased enrollment; first obtain larger appropriations; second, cut down on the existing requirements for graduation; third, make the scholastic requirements more strict.

Mr. Wright, who is managing editor of *Railway Age* spoke on the subject of Transportation.

Dr. Klein Speaks On Obsolescence

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

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

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

THOSE HONORED

Many technical students are included in the annual announcement of prizes, awards and elections to scholastic fraternities

Alpha Tau Sigma

Alpha Tau Sigma, honorary engineering journalistic fraternity, has elected Theodore Corbett and Harlow C. Richardson faculty members, M. V. Bergstedt, R. H. Comstock, Winfield Foster, Francis J. Fox, Steve Gadler, J. Robert Ginnaty, Harmond Grabert, Morris J. Hauge, O. R. Lindstrom, Howard H. Lowe, A. E. McCracken, John S. Madden, Wesley Gray, Albert W. Morse, Gerhard C. Peterson, J. Rex Severson, John P. Shirley, Jr., R. N. Soufal, James Spicola, George H. Taft, Harold S. Wang, J. L. Warrington, and W. G. Warrington.

Chemistry Faculty Prize

W. Cameron Kay has won the School of Chemistry Faculty prize. The prize is awarded to the student maintaining the highest average in the work of the sophomore and junior years and the first two quarters of the senior year.

Alpha Chi Sigma Prize

The Alpha Chi Sigma prize, awarded each year to the male sophomore in the School of Chemistry having the highest scholastic average at the end of the winter quarter, has been won by Winfield W. Foster.

The Dupont Fellowship

The Dupont fellowship in Chemistry has been awarded this year to Charles Rosenbloom.

The Shevlin Fellowship

Grant W. Smith has been awarded the Shevlin fellowship in Chemistry.

Architectural Awards

Harold W. Fridlund and Erwin W. Bingham have been awarded the Magney and Tusler prize.

The American Institute of Architects medal has been awarded to Bruce V. Wallace.

Bruce V. Wallace and Gerhard C. Peterson have won first and second, respectively, for the prizes awarded by the Minnesota chapter of the American Institute of Architects.

The School of Architecture faculty prizes have been awarded to Milton L. Hoglund and Lenwood J. Brighthill.

Dudley C. Bayliss has won the Moorman Prize.

The Scarab prize has been awarded to Kenneth H. Newton.

The Alpha Alpha Gamma prize has been awarded to Rogert C. Cerny.

Norma Edwards and Marjorie Maitland have been awarded the French prizes in interior decorating.

Raymond B. Hertel and Erwin W. Bingham have won the Northwest Section of American Institute of Architects prizes.

Chi Epsilon

New members initiated during the past year in Chi Epsilon, honorary Civil Engineering fraternity, are: Cedric L. Cowan, W. Stanley Ekern, Sheridan E. Faring, Willard W. Fryhoffer, Wendell E. Johnson, Kenneth McGhie, Earl Porter, George F. Snodgrass, and John A. Swanson.

Pi Tau Sigma

Pi Tau Sigma, honorary society in the department of mechanical engineering, elected the following men: Ralph J. Baskerville, Albert E. Bauer, William A. Eckley, Edward E. Bjorklund, Richard E. Hayden, and Paul K. Honey.

Iota Sigma Pi

A national honorary chemical society for women has elected the following members: Alice Jean Bacon, Nyiene Eolds, Anna Gillig, Hortense Honey, Myrna Hovlid, Inez Mason, Lillian Merrick, and Marjorie Saunders.

Phi Lambda Upsilon

New members elected to Phi Lambda Upsilon, honorary chemical society, are: Walter M. Buehl, William Filbert, Winfield W. Foster, K. J. Goldner, Gordon H. Guest, H. W. Hellmann, Q. Cameron Kay, Donald E. Kvalness, C. E. Maugels, Elmer A. Pearson, Earl Verner Peterson, Marvin H. Roepke, James R. Sanford, Robert B. Selund, Marvin A. Spielman, Frank H. Stodola, Hans B. Stromberg, Oscar J. Swenson, Fred C. Ward, Harold O. Wiles, and Samuel Yuster.

Phi Lambda Upsilon Prize

The Phi Lambda Upsilon prize was awarded this year to Winfield W. Foster.

Pi Tau Sigma Prize

The Pi Tau Sigma Prize was awarded to Forton A. Christoffer.

Plumb Bob

Plumb Bob is an organization of senior men in the technical colleges who have assisted in the promotion of the general welfare of the university. The following men have been elected: Dean O. M. Leland, Honorary, Russell Cheney, C. E. Crippen, C. L. Elliott, R. F. Fenton, Richard Guppy, Roy Higgins, W. C. Kay, G. H. Meffert, F. E. Mullen, Adolph Ringer, John Skidmore and W. G. Warrington.

Techno-Log Prize

The prizes in the Techno-Log Article Contest were awarded as follows:

First Prize: J. D. Jacobs for the story, "Engineering in Grain Handling."

Second Prize: Hal B. Pittlekow for the story, "Cloud Formations."

Tau Sigma Delta

Tau Sigma Delta, national honorary fraternity in architecture, elected the following men: Earle R. Cone, Milton L. Hoglund, Arthur E. Monthey, and Howard F. Woo.

Eta Kappa Nu

Elections to Eta Kappa Nu, honorary electrical engineering fraternity included: Donald Kendall, Onni Lindfors, H. Punkari, Milo Rollins, Rudolph Hansen, Andrew Hustrulid, William Kinsell, Morris Newman, Alfred Nier, Oscar Norgorden, Gordon Small, and Lyman Swenson.

Board of Publications

Harland Harmer has been elected to represent the College of Engineering and Architecture and the School of Chemistry on the board in control of student publications for next year.

All-University Council

Oscar Swenson and Frank Laska were elected to represent the School of Chemistry and the College of Engineering and Architecture respectively on the All-University Council.

Alpha Delta Sigma

Francis J. Fox and J. Lamont Warrington were elected to Alpha Delta Sigma, honorary advertising fraternity.

Bookstore Board

Engineers who have been elected to the Bookstore Board for the coming year are Paul Staffeld, Civil; H. Duncan Watson, Mechanical; Clarence Olsen, Architecture; Harold Graves, Chemistry, and Richard Cady, Electrical.

A. S. C. E. Prizes

The northwestern section of the American Society of Civil Engineers offers annually to the members of the student chapter submitting the best prizes. They were won by Raymond T. Hertel and Lyell R. Shellenbarger.

The Tau Beta Pi Prize

The Tau Beta Pi Prize awarded on the basis of high scholarship and merit to a freshman in the College of Engineering and Architecture, the School of Chemistry or the School of Mines and Metallurgy was given to Stephen E. Erickson.

Grey Friars

Grey Friars, senior men's honorary organization, have elected George H. Meffert, William H. Painter, and W. Gerald Warrington.

Iron Wedge

Iron Wedge, a senior honorary organization, has elected Donald S. Burris, Curtiss E. Crippen, and Hubert J. Tierney.

Silver Spur

Richard Jones, George Minder and Charles Winding have been elected to Silver Spur, a junior men's organization.

Tau Beta Pi

Tau Beta Pi, all engineering honorary fraternity, has elected the following men, during the last year: William B. Stout as an honorary member, Onni Lindsors, Alfred O. Nier, Zenas H. Haustad, Rudolph M. Hanson, Arthur E. Monthey, Sheridan K. Farin, Paul K. Honey, Wendell E. Johnson, Andrew Hustrulid, Milton L. Hoglund, Oscar Norgorden, Gustave M. Carlson, Gordon J. Small, Heinrich W. Rathman, Robert E. Samuelson and E. W. Christoferson.

THE MINNESOTA TECHNO-LOG

UNIVERSITY OF MINNESOTA

Alumni Service Fund in Brief

1. To support alumni activities in the Technical Schools—Engineering, Architecture and Chemistry.
2. To maintain a system of professional records of alumni employment for use in recommending alumni for special positions. This will contain:
   (a) Classification of alumni by nature of experience and preparation.
   (b) Classification of employers.
   (c) List of employers of alumni with names of alumni employed by each.
3. To facilitate and co-ordinate contacts between representatives of employers and seniors in the various departments, so as to avoid errors and omissions and bring available openings to the attention of seniors who may be interested and qualified in whatever departments they may be,—the actual contacts to be handled by the departments primarily as at present.
4. To maintain contacts with alumni through correspondence.
5. To organize technical alumni groups in various cities, as is now done in a few places informally.
6. To expand the Alumni News section of the Techno-Log by a systematic plan of obtaining such information.
7. To develop continuous relations with the alumni by special 4-year subscriptions to the Techno-Log immediately after graduation.

Vacation!

STUDENTS in the College of Engineering and Architecture and the School of Chemistry will soon leave the halls of Minnesota, some to vacation during the summer months, others to gain practical experience along various engineering lines. The Techno-Log extends a cordial invitation to every student and graduate to contribute articles about the summer's experiences. It has always been the policy of the magazine to print as many student articles as possible, but in the past there has been but little material dealing with vacation time experiences that has come to the office.

There are certainly a great number of students who will be engaged in some occupation during the summer months that will prove of interest to the undergraduates, as well as the alumni and faculty. Don't feel hesitant about letting us know your plans and activities, and remember that the Techno-Log is published by technical students and for technical students. Do your bit!

An Engineer's Public Service

THE quality of our municipal governments depends upon the collective efforts of the individual. It is good or poor depending upon whether the majority of those who direct its affairs are well trained or are uneducated in such matters.

Civil engineers by their training are peculiarly fitted to advise cities upon many municipal matters and to take part in the direction of city affairs. But few of them do.

The late Louis R. Ash was a splendid example of how effective engineers can become in municipal affairs if they make it their business to take more than a passive interest in civic problems. Of him the Kansas City *Star* said at the time of his death:

"Louis R. Ash was a type of citizen that every city needs. His profession of engineering may have had something to do with his high regard for system, efficiency and order and with his intolerance toward things haphazard, including city government. He was assertively public-spirited. He recognized the obstructive effect of pernicious partisanship in city affairs. He helped to procure the adoption of the new charter after he had helped to frame it.

"Every genuine movement for municipal progress had his support. Some have been successful and some have failed, but Mr. Ash never lost his zeal for better standards of government. In his death the city loses an individual factor in courageous civic effort. Even those who disagreed with him or lacked his faith in ultimate accomplishments acknowledged his sincerity and respected his motives."

This country needs more such engineers. They may not be right at all times; they are sure to be misunderstood and abused frequently; but in the long run they will make an impression that will be felt and will be appreciated as Mr. Ash's service to Kansas City is appreciated.

—*Engineering News-Record.*

Swan

AS the year draws to a close there is an interlude between the last final rush and the examination period in which we may give thanks for assistance rendered during the year. Especially to the Faculty and the student body do we owe thanks for their constant cooperation and frequent contributions. Among others who should be listed as having assisted throughout the year are: the Dean's offices and especially Miss Roskilly, Miss Johnson and Margaret. Then there are "Sunny" from Electrical and Martin and Bill from Lund's and Haskins from Weston's, and countless scores of others.

Our appreciation is sincere though brief.

THE 1929 ALUMNI DIRECTORY

of the

Technical Colleges *of the* University *of* Minnesota

ABBREVIATIONS

Courses

A, Architecture; AE, Architectural Engineering; ID, Interior Decoration; IA, Interior Architecture; C, Civil Engineering; E, Electrical Engineering; M, Mechanical Engineering; G, General Engineering; Ch, Chemistry; Ch. E., Chemical Engineering.

Advanced Degrees

CE, Civil Engineer; EE, Electrical Engineer; ME, Mechanical Engineer; MS, Master of Science; MS (Arch), Master of Science in Architecture; MS(CE), Master of Science in Civil Engineering; MS(EE), Master of Science in Electrical Engineering; MS(ME), Master of Science in Mechanical Engineering; Ch.E., Chemical Engineer.

*Deceased

CHRONOLOGICAL DIRECTORY

College of Engineering and Architecture

FROM 1875 to 1896 inclusive, the first degrees awarded for the regular four-year courses were Bachelor of Civil Engineering (1875), Bachelor of Architecture (1877), Bachelor of Mechanical Engineering (1878), and Bachelor of Electrical Engineering (1891). In this period, also, a few professional advanced degrees were given, as Civil Engineer in 1888, Mechanical Engineer in 1894, and Electrical Engineer in 1896.

From 1897 to 1911 inclusive, the degrees of Civil Engineer, Electrical Engineer, and Mechanical Engineer were regularly awarded at the close of the four-year courses, and a few were given in 1912 and 1913. In 1908, however, five-year courses were established and at the end of the first four years, the degree of Bachelor of Science in Engineering was awarded for each of the three courses, civil, electrical, and mechanical, and also for a general course in engineering, which last had begun in 1900. Upon completion of the fifth year's work the professional degrees, Civil Engineer, Electrical Engineer, and Mechanical Engineer were given, the first being awarded in 1913.

In 1921, the first degree became Bachelor of Science in Civil Engineering, Electrical Engineering, or Mechanical Engineering. The degree of Bachelor of Science in Architecture was established in 1916. The general engineering course was discontinued in 1923. The new requirements for the professional degrees of Civil Engineer, Mechanical Engineer, and Electrical Engineer were adopted in 1921 and these degrees were placed in the Graduate School.

In 1928, the form of the Bachelor's degree in this college was changed to the original one used prior to 1878, namely, Bachelor of Architecture, Bachelor of Civil Engineering, etc., and this form was used in June, 1928, and thereafter. Similar action was taken in the School of Chemistry.

New Courses were established as follows: Agricultural Engineering in 1926; and Aeronautical Engineering and Landscape Architecture in 1928. In 1929 the course in Interior Decoration was changed to that of Interior Architecture.

1875

Bachelor of Civil Engineering

*Leonard, Henry C. (B. S. 1878)
Rank, Samuel A. (B. S. 1875)
*Stewart, Clark

1876

Bachelor of Civil Engineering

*Gillette, Lewis S. (B. S. 1877, C. E. 1898)
*Hendrickson, Eugene A.
Thayer, Charles E.

1877

Bachelor of Architecture

*Pardee, Walter S.

1878

Bachelor of Mechanical Engineering

Bushnell, Charles S.

1879

Bachelor of Civil Engineering

*Dawley, William S. *Furber, Pierce P., Sr.

1883

Bachelor of Civil Engineering

Peters, William G. *Smith, Louis O.

Certificate in Civil Engineering

Holcomb, Alexander M.

Bachelor of Mechanical Engineering

Barr, John H. (M. S. 1888)

1884

Bachelor of Civil Engineering

Hoag, William R. (C. E. 1888) *Loy, George J.
*Matthews, Irving W.

1885

Bachelor of Civil Engineering

*Fitzgerald, Patrick T. Reed, Albert I.

Bachelor of Mechanical Engineering

Bushnell, Elbert E.

1886

Bachelor of Architecture

*Woodmansee, Charles C.

1887

Bachelor of Mechanical Engineering

Crane, Fremont (B. S. 1886, C. E. 1893)

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.
Dunn, 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. (C. E. 1898)
Hoyt, Hiram P.
Mann, Fred M.

Bachelor of Electrical Engineering

Chase, Arthur W.
Dewey, William H.
Guthrie, John D. (M. D. 1897)
Morse, George H. (E. E. 1911)
Reidhead, Frank E. (E. E. 1898)
Springer, Franklin W. (E. E. 1898)

Bachelor of Mechanical Engineering

Anderson, Ole A. (M. E. 1908)
Avery, Henry B. (M. E. 1898)
Couper, George B. (M. E. 1902)

1894

Bachelor of Civil Engineering

*Cunningham, Andrew O.
Gilman, James B.
Johnson, Noah
Weeks, William C.

Bachelor of Electrical Engineering

Chalmers, Charles H. (E. E. 1903)

Bachelor of Mechanical Engineering

*Bray, George E. (M. E. 1904)

ADVANCED DEGREES

Civil Engineer

Trask, Birney E. (B. C. E. 1890)

Mechanical Engineer

Gill, James H. (B. M. E. 1892)

1895

Bachelor of Civil Engineering

Bohland, John A.
*Casseday, George A.
Chapman, Leslie H.
Shenehon, Francis C. (C. E. 1900)

Bachelor of Electrical Engineering

Adams, George F.
*Eishman, Adam E.
Eddy, Horace T. (E. E. 1896)
Ford, Robert E. (E. E. 1903)
Rounds, Fred M.
*Tanner, Harry L.
Von Schlegell, Frederick

Bachelor of Mechanical Engineering

Shepherd, Burchard F.
*Tilderquist, William M.
Weaver, Albert C.

1896

Bachelor of Civil Engineering

*Beyer, Adam C.
Burch, Albert M.
*Jones, C. Paul
Long, Fred W. (C. E. 1898)

Bachelor of Electrical Engineering

Erikson, Henry A. (Ph. D. 1908)
Magnuson, Carl E. (M. S. 1897, E. E. 1905)
*Wheeler, Herbert M.

Bachelor of Mechanical Engineering

Hastings, Clive
Hilferty, Charles D.
*Hugo, Victor
Lang, James S. (E. E. 1897, M. E. 1899)

Bachelor of Science (in Engineering)

Hickok, Jessie E. S. (M. S. 1904)

ADVANCED DEGREE

Electrical Engineer

Eddy, Horace T. (B. E. E. 1895)

1897

Civil Engineer

*Hewett, Frank M.
Lee, Engbret A.
Walker, Frank B.
Woodman, Howard H.

Electrical Engineer

Abbott, Arthur L.
Chestnut, George L.
Hibbard, Truman
Lang, James S. (B. M. E. 1896, M. E. 1899)
Markhus, Olaf G. F.
Miller, William L.
Myers, Mortimer

Mechanical Engineer

Blake, Robert P.
Craig, Robert E.
Cross, Charles H.
Lunie, James H.
Savage, Edward S.
Silliman, Henry D.

ADVANCED DEGREE

Master of Science

Magnuson, C. E. (B. E. E. 1896, E. E. 1905)

1898

Civil Engineer

Glass, Clifton A.
Taylor, Edward W. D.

Electrical Engineer

*Dahl, Hans F. M.
Gilchrist, Charles C.
McKellip, Frank W.
Wagner, Adolph W.

Mechanical Engineer

O'Brien, John E.
Willson, Manton F.
Wright, Roydon V.
Zeleny, Frank

ADVANCED DEGREES

Civil Engineer

Crane, Fremont (B. S. 1886, B. C. E. 1887)
*Gillette, Lewis S. (B. C. E. 1876, B. S. 1877)
Hoyt, William H. (B. C. E. 1890)
Long, Fred W. (B. C. E. 1896)
Mann, Fred M. (B. C. E. 1893)

Electrical Engineer

Burch, Edward P. (B. E. E. 1892)
Gray, William I. (B. E. E. 1892)
Reidhead, Frank E. (B. E. E. 1893)
Springer, Franklin W. (B. E. E. 1893)

Mechanical Engineer

Avery, Henry B. (B. M. E. 1893)

1899

Civil Engineer

Anderson, John G.

Electrical Engineer

Artz, Emmanuel A. (B. S. 1897)
Graling, Verney
Hildebrandt, Henry A.
Huntoon, Milton B.
MacKusick, Elwood M.
Pratt, Arthur K.

Mechanical Engineer

Bayless, Harry C.
Richardson, Wilbur P.
Wennerlund, Elias C.

ADVANCED DEGREES

Civil Engineer

Douglas, Fred L. (B. C. E. 1891)

Electrical Engineer

Huntoon, Milton B.

Mechanical Engineer

Lang, James S. (B. M. E. 1896, E. E. 1897)

1900

Civil Engineer

Grime, Edwin N.
*Prendergast, Paul S.
Whitman, Edward A.

Electrical Engineer

Dow, James C.
*Johnson, Frank E.
Kinsell, William L.
Parkhurst, Harleigh
Shumway, Ernest J.
Stussy, William T.
Thaler, James A.
Thompson, Roy E.
*Tracy, Fred G.
Wiltgen, Edward

Mechanical Engineer

Ashbaugh, Lewis E. (C. E. 1907)
Daniel, T. Lester
*Higgins, Charles C.
Johnston, William W.
Newhall, William B.

ADVANCED DEGREE

Civil Engineer

Shenehon, Francis C. (B. C. E. 1895)

1901

Civil Engineer

Everington, James W.
Gunstad, Paul I.
Klemer, Frank H.
McKittrick, James
Quense, John H. (M. E. 1902)
Strate, Thomas H.

Electrical Engineer

Anderson, Martin E.
Blake, Henry B.
Danner, Jake
Houlton, Amos D.
Houts, Guy J.
Reque, Styrk G.
Tuller, Chas. E.

Mechanical Engineer

Robertson, Philip W.
Wilson, Eliel F. (E. E. 1902)

Bachelor of Science (in Engineering)

Groat, Ben. F. (L. L. B. 1908, L. L. M. 1911)

1902

Civil Engineer

Allee, David A.
Beaulieu, Richard L.
Hallan, Christian
Houston, George S.
*Knowlton, Warren C.
Lambert, Fred T.
McClelland, Claude L.
Shepley, Charles R.
Weston, William S.

Electrical Engineer

Burns, Harvey L.
French, Edwin L.
McPherson, William B.
Nilson, Wilhelm
Spence, William J.
Wilson, Eliel F. (M. E. 1901)

Mechanical Engineer

Acomb, William E.
Bean, William L.
Cook, Robertson
Grimshaw, William E.
Herrick, Carl A.
Quense, John H. (E. E. 1901)
Ramstad, Edward C.
Stone, Melvin O.
*Sudheimer, Edwin L.
Taylor, Ralph G.

Bachelor of Science (in Engineering)

Graham, Eugene C.

ADVANCED DEGREES

Mechanical Engineer

Couper, George B. (B. M. E. 1893)
Quense, John (C. E. 1901)

1903

Civil Engineer

Barlow, Harry E.
Bennett, Walter J.
Beyer, Theodore A.
Carr, Harvey C.
Davison, Joseph H.
Grow, Harry A.
Madden, Francis
*Novig, Ole S.
Oltman, Charles A.
Prendergast, Arthur A.
Robbins, Orison B.
Smith, Leighton H.
Smith, Paul S. (B. S. 1901)
Stewart, Clarence H.

Electrical Engineer

Benedict, George F.
Dibble, Barry
Eberhardt, Otto L.
Erickson, Carl G.
Ireland, Roy R. (B. S. 1901)
Laird, Lee R.
*Miller, Lucius W.
Page, Mark L.
Rask, Louis G.
Rosok, Ingwald A.
Schumacher, John H.
Vincent, Jay C.

Mechanical Engineer

Hughes, Frank C.
Kjosness, Ingram G.
Williams, Edward H.

Bachelor of Science (in Engineering)

Crounse, Avery F.
Whitney, Alfred C.

ADVANCED DEGREES

Electrical Engineer

Chalmers, Charles H. (B. E. E. 1894)
Ford, Robert E. (B. E. E. 1895)

Mechanical Engineer

Morris, John O. (B. M. E. 1888)

1904

Civil Engineer

Bouge, Nathan H.
Downing, Frank E.
Fernald, Frank O.
*Holland, Jay C.
Nelson, Nels B.
Rothi, Paul

Electrical Engineer

Bouman, Bernhard M.
Cheney, Edward J.
Crabbe, George
Goodwin, Victor E.
*Helms, Frank C.
Hewitt, John
Morton, Harry G.
Otto, Frederick A.
*Rosok, Peter A. M.
Taplin, Robert B.
Tomlinson, L. C.
Wicks, John

Mechanical Engineer

Fager, Simon R.
Otto, Robert W.
Stanton, Raymond E.
Davis, Gilbert N.

Bachelor of Science (in Engineering)

Collins, Stewart G.

ADVANCED DEGREES

Mechanical Engineer

*Bray, George E. (B. M. E. 1894)

Master of Science

Hickok, Jessie E. S. (B. S. 1896)

1905

Civil Engineer

Bisbee, Elmer
Brockway, Royden R.
Burke, Roy L.
Cutler, Alvin S.
Feyder, William H.
Finley, Joseph E.
Gillette, George L.
Hopeman, Albert M.
Jensen, John A.
Johnson, Nels
King, Wesley E.
McMillan, Franklin R.
Mattison, Oliver
*Mueller, Henry J.
Nelson, Oscar B.
Smith, Donald T.

Electrical Engineer

Adams, William C.
Anderson, Emil
Billan, Louis S.
Boman, Carl E.
Coleman, Frank D.
Davis, Charles A.
Ely, Irving R.
Frankoviz, John J.
Gibson, Charles B.
Jackson, Earl D.
Jones, Raymond L.
Kochendorfer, Milton J.
LeBlond, Edmond J.
LeTourneau, Edward H.
Lundquist, Reuben A.
Morris, Robert
Ryan, William T.
Simmon, Karl A., Jr.
*Smith, Clinton B.
Wood, John W.

Mechanical Engineer

Andrews, George L.
Bates, Albert H.
Clipfell, Carroll D.
Cutter, Francis C.
Gerrish, Harry E.
Harris, Sigmund
Johnson, Austin G.
*Johnson, Ernest P.
Lewis, Edward B.
*Pancratz, Alexander J.
Rydeen, Francis G. A.
Sperry, Leonard B. (E. E. 1908)
Tuck, George A.

Bachelor of Science (in Engineering)

Gregg, Treshame D. (C. E. 1906)

ADVANCED DEGREE

Electrical Engineer

Magnuson, C. E. (B. E. E. 1896, M. S. 1897)

1906

Civil Engineer

Adams, Elmer E.	Hayward, George I.
Alrick, Bannona G.	Malley, Charles J.
Alsop, Ernest B.	*Murphy, John G.
Bowen, Fred P.	Norelius, Lewis M.
Childs, Hervey B.	Reed, Arthur L.
Childs, John C.	Wiesner, Frederick E.
Hanauer, Monroe H.	

Electrical Engineer

Albrecht, George M.	Lang, Charles A.
Bunce, Paul F.	Mowry, Harry W.
Calmeyer, John P.	Payne, Harold G.
Cohen, Nathan	Roepke, Otto B.
Cooper, Leo H.	*Schow, Harry A.
Cornelius, Martin	Schwedes, Walter F.
Dunn, Andrew P.	Shuck, Gordon R.
Englin, Charles F.	Stenger, Laurence A.
Finchy, Jacob O.	(M. S. 1916)
Glascock, Henry H.	Stone, Harris G.
*Gunther, Albert N.	Ungerman, Carl M.
Haeberle, Elmer H.	Weber, Erwin L. F.
Hoff, Christopher	(M. E. 1908)
Hokanson, Clarence E.	Wiggins, Gerald G.
Hubbard, Robert T.	Zimmer, William A.

Mechanical Engineer

Armstrong, Thomas S.	*Matteson, Frank E.
Crawford, Wallace T.	Ringsred, Arthur C.
Garber, Gabriel E.	Rose, Norman W.
Loye, Benjamin W.	

Bachelor of Science (in Engineering)

Swensen, Karl F. (M. S. 1907)

ADVANCED DEGREE

Civil Engineer

Gregg, Tresham D. (B. S. Eng. 1905)

1907

Civil Engineer

Batson, Charles D.	Hobart, Walter B.
Blomquist, Hjalmer F.	Huston, David B.
Cram, Clyde M.	Jones, Lewis A.
*Dougherty, Joe	Kelly, Earl W.
Dunham, John A.	Swenson, Charles A.
Grant, James A.	(L. L. B. 1910)
Green, Fred H.	Tondell, Mandel G.
Haverson, Henry D.	VanCleve, Horatio P.
Hawley, Harry G.	Yager, Louis

Electrical Engineer

Alton, Herbert D.	Pearce, John H.
Andrus, Raymond J.	Rezab, John J.
Baer, Louis E.	Schow, William P.
Countryman, Peter F.	Smith, Byron E.
Eddy, Lynne W.	Smithson, John E.
Fairchild, Albert R.	Sternberg, Carl
Kerns, Ralph W.	Uxzell, George W.
Norcross, Arthur F.	Woehler, William L.

Mechanical Engineer

Bell, Maurice D.	Meany, James M.
Bjorge, Oscar B.	Nekola, John W.
*Brown, Oliver L.	Rawson, Ralph H.
Buhl, Paul S.	Spring, Willis W.
Burwell, Loring D.	*Stacy, Elmer N.
Fee, E. Franklin	Stephenson, Oliver H.
Gessert, George R.	Tubby, Oliver G.
Gilman, Nicholas A.	Wagner, Otto H.
Krag, Walter C.	

ADVANCED DEGREES

Civil Engineer

Ashbaugh, Lewis E. (B. S. in Eng. 1900)

Master of Science

Swensen, Karl F. (B. S. in Eng. 1906)

1908

Civil Engineer

Ash, James W.	Hustad, Andrew P.
Bergquist, Oscar J.	Knowlton, Herbert H.
Borrowman, LeRoy F.	Krauch, William L.
Brenchley, Harry E.	Lang, Fred C.
Comstock, John W.	Longfellow, Dwight W.
Dallimore, Arthur N.	McCall, Harry J.
Doeltz, William F., Jr.	McCree, Andrew A.
Dougan, Henry K.	Mowery, Clarence W.
Fleming, Douglas R.	Norelius, Lewis M.
Furber, Pierce P., Jr.	Okes, Day I.
Gage, Hugh N.	Olson, Melvin S.
Quinn, John I.	Widell, Gustaf F.
Robertson, Charles N.	Willis, Roy
Schlattman, Edward C.	Woodrich, Oscar F.
Walker, George W.	

Electrical Engineer

Anderson, Frank A.	Peterson, Clarence A.
Bachrach, Alfred	Prentice, Robert S.
Brown, George J.	Schildt, William F. H.
Carter, Robert J. S.	Schoepf, Alfred W.
Casberg, James W.	Scobie, Francis G.
Currie, Neill, Jr.	Sperry, Leonard B.
Frahm, Alfred R.	(M. E. 1905)
Hoppin, Glenn H.	Sturtevant, Percy G.
*Hovelson, Henry	Svendsen, George P.
Kauffman, Roy	Swanstrom, Frank N.
King, Alfred B.	Sweningsen, Oliver
McAfee, Allan L.	Weibeler, William M.
Pancratz, Frank J.	Zimmerman, Louis P.

Mechanical Engineer

Anderson, Ole A.	Hetherton, Percival
Bingham, Stanley E.	Morris, Thomas C.
Councilman, Halstad P.	Norelius, Emil F.
(B. S. Eng. 1909)	Norton, Clyde W.
Cox, Richard F.	(M. E. 1909)
Estep, Harvey C.	Peterson, George T.
Fleming, Frank R.	Priedeman, George W.
(E. E. 1909)	Walsh, James
*Frary, Hobart D.	(E. E. 1909)
(M. S. 1909)	Weber, Erwin L. F.
Harwood, Stanley G.	(E. E. 1906)

Bachelor of Science (in Engineering)

Clarke, Charles P. (C. E. 1909)
Fruen, Arthur B. (C. E. 1909)
King, Robert N.
McKeehan, Louis W. (M. S. '09, Ph. D. '11)
Rowe, Harry B.
Schmid, Robert J.

1909

Civil Engineer

Childs, James A.	King, Lawrence W.
Ellison, Jay T.	Mitchell, John B.
Ellsberg, N. W.	Nelson, Edward S.
Esser, Frank F.	Okes, Sidney R.
Fiske, F. William, Jr.	Paul, Frederick T.
Houston, Cecil C.	Sheffield, Fred W.
Hubbard, Fred A.	Shepard, George M.
Hubbard, Henry A.	Siverts, Samuel A., Jr.
Ingberg, Simon	Torrance, Eli
Jaques, Robert	

Electrical Engineer

Beckjord, Walter C.	Johnson, Herman R.
Brockway, Alvah E.	Kristy, George A.
Cobban, Rollo J.	Lindelef, Charles G.
Converse, Clovis M.	McKenzie, Lauren F.
Davies, Ralph M.	Murrish, Frederic E.
Fitts, Joel A.	Poore, Orson B.
Fleming, Frank R.	Robison, Archer R.
(M. E. 1908)	Stillman, Marcus H.
Gadsby, Lester H.	Todd, Milo E.
Grant, Fred R.	Turner, Leslie E.
Harris, Clayton	Vita, Theodore
*Hitzker, Albert J.	Walling, Benjamin R.
Hopkins, Mark L.	Walsh, James
Hornibrook, James W.	(M. E. 1908)
Japs, Bernard G.	Williams, Fred M.
	(B. A. 1905)

Mechanical Engineer

Beery, Charles B.	Mark, Walter J.
*Bieri, John B.	Morris, John E.
Birnberg, Zingel C. J.	Moyer, Malcolm B.
Buck, Frederick W.	Nemec, Frank L.
Buhl, John E.	Shippam, Willis
Forfar, Donald M.	Souba, William H.
Holmgren, Charles E.	Starrett, Howard M.
Kircher, Frank J.	Udell, Carl D.
Kircher, George A.	Williams, Wilbur S.
Knopp, William R.	Wright, Harris H.
Lambert, Edwin M.	

Bachelor of Science (in Engineering)

Curtiss, Lindsley B.
Councilman, Halstad P. (M. E. 1908)
Norton, Clyde W. (M. E. 1908)

ADVANCED DEGREES

Civil Engineer

Anderson, Ole A. (B. S. M. E. 1893)
Clarke, Chas. P. (B. S. Eng. 1908)
Fruen, Arthur B. (B. S. Eng. 1908)

Master of Science

*Frary, Hobart D. (M. E. 1908)
McKeehan, L. W. (B. S. Eng. '08, Ph. D. '11)

1910

Civil Engineer

Adams, Benjamin W.	Jevne, George W.
Asleson, Hans	Leach, Edward W.
Bolme, Ole M.	Meyer, Carl F.
Boyum, Benjamin C.	Motl, Charles L.
Brownell, Otto E.	Nason, George L.
Chapman, Burton L.	Olson, Arthur O.
Dahlquist, Philip L.	Overholt, Harley G.
Ekman, Claes T.	Sawyer, Emerson D.
Garen, George M.	Sommerfeld, Adolph A.
Godward, Alfred C.	Timperley, William D.

Electrical Engineer

Anderson, Oscar F.	Jesperson, Clarence M.
Anderson, Oscar V.	Johnson, Leonard T.
Beck, Vernon S.	Josephson, Eliot B.
Conley, Wilfred E.	Landeen, Arvid G.
Dahlstrom, Raymond E.	Nelson, Carl H.
Fiske, Walter J.	Phelps, Ray R.
*Hagstrom, Herbert E.	Powles, James W.
Hansen, Christian	Reid, Harry A.
Hustad, Byron P.	Skytte, Ernest E.

Mechanical Engineer

*Atkinson, William B.	Martin, Wallace H.
Comb, Fred R.	Meixner, Bernard A.
Cook, Harry C.	Moyer, Amos F.
DuToit, George A., Jr.	Nichols, Browning, Jr.
Fleming, Laurence T.	Pease, Maynard W.
Frear, Jenness B.	Wesbrook, Donald M.
Kaplan, Eugene V.	

Bachelor of Science (in Engineering)

Salisbury, Willis R.

1911

Civil Engineer

Ainslie, Arthur F.	Maney, George A.
Arnesen, Herbert P.	Mark, Reuben A.
Boerner, Francis C.	Mattison, George C.
Cottingham, William P.	Methven, Clyde L.
Craft, Ernest B.	Miller, Erwin J.
Elfstrum, Axel E.	Orbeck, Martin J.
Enger, Edward H.	Roth, Lewis M.
Fieldman, David P.	Siverson, Sigvel J.
Hodnett, Ralph M.	Smith, Sydney H.
Hoffman, Michael J.	Swedberg, M. Ray
Johnson, Carl A.	Walby, Arthur C.
Kvitrud, Ingvald	

Electrical Engineer

Ashworth, Roy H.	Lyford, Dartt H.
Blossom, George W.	McCoy, Ira C.
Burrows, Robert P.	McQuillin, Raymond E.
Butterworth, Allan C.	Markuson, Oscar S.
Chapman, Arthur G.	Mittag, Albert H.
Demarest, Charles S.	Nebel, Walter H.
Drinkall, Leon R.	O'Brien, Raymond J.
Emerson, Lynn A.	Pengilly, Joseph H.
Forsberg, William P.	Riegel, Louis F.
Fredrickson, Harry B.	Shepard, Donald D.
Hansen, Maurice J.	Soulek, Joseph H.
James, Henry C., Jr.	*Stinson, Will V.
Johnson, Edward J.	Walker, William A.
Jones, Watkin W.	Wilson, Glenn W.

Mechanical Engineer

Barnum, Marvin C.	Olstad, Oscar A.
Bishop, Ira L.	Orom, Robert C.
Farnam, Julian P.	Owens, Leo E.
Kasper, Walter F.	Sneve, Jack S.
Larson, Martin S.	Woodman, Joseph C.

Bachelor of Science in Science and Technology

Hoffman, Ralph M.
Klopsteg, Paul E. (M. A. 1913, Ph. D. 1916)

ADVANCED DEGREE

Electrical Engineer

Morse, George H. (B. E. E. 1893)

1912

Civil Engineer

Adams, John W., Jr.	Hosfield, Raleigh W.
Curtis, Thomas H.	West, Robert W.
Flygare, August L.	

Bachelor of Science in Engineering (Civil)

Anderson, Harvey B. (C. E. 1913)
*Bailey, William H. (C. E. 1913)
Bingen, William J. (C. E. 1913)
Cummings, Elmer F. (C. E. 1913)
Diamond, Grover W.
Giertsen, Marcus O. (C. E. 1913)
Haberle, Edward L. (C. E. 1913)
Jorgens, Charles R. Danevin (C. E. 1913)
Kapphahn, Raymond J. (C. E. 1913)

Bachelor of Science in Engineering (Civil)

King, Forest V. (C. E. 1913)
Kriz, Joseph J. (C. E. 1913)
Pagenhart, Clarence C.
Pease, Raymond A. (C. E. 1913)
Peterson, Barney J. (C. E. 1913)
Ryan, Loiel S. (C. E. 1913)
South, Willard A. (C. E. 1913)
Souther, Morton E. (C. E. 1913)
Swenson, Hjalmer S. (C. E. 1913)
Torgerson, Irving E. (C. E. 1913)
Wangaard, Oscar H. (C. E. 1913)
Welin, Arthur G. (C. E. 1913)
Wolff, Henry E. (C. E. 1913)

Electrical Engineer

Anderson, Arthur R. — *Purves, Leland E.
Bill, Earl McM. — Streich, Harry C.
Dorrance, Albert P. — Young, Charles N.

Bachelor of Science in Engineering (Electrical)

*Avis, Samuel L. (E. E. 1913)
Benham, Claude F. (E. E. 1913)
Brewster, William E. (E. E. 1913)
Daum, H. Arno
Hedenstrom, Ernest A.
Herrmann, Raymond R. (E. E. 1913)
Hillman, Charles K.
Hoorn, Frederick W. (E. E. 1914)
Hovden, Conrad D. (E. E. 1913)
Knapp, Lester H.
Mathes, Robert C. (E. E. 1913)
Merriell, Elmer W. (E. E. 1913)
*Nelson, George A. (E. E. 1913)
Pardee, Charles A. (E. E. 1913)
Ringstrom, Ivan G. (E. E. 1913)
Swenson, Theodore J. M.
Thuras, Albert L. (E. E. 1913)
Towle, Neal C. (E. E. 1913)

Mechanical Engineer

Boyce, Leonard F. — Markoe, James C. P.
Brown, William P. — Thompson, Herbert L.
*Johnson, Frank

Bachelor of Science in Engineering (Mechanical)

Chapin, Harold S. (M. E. 1913)
Clark, William G. (M. E. 1913)
Crane, Eugene C. (M. E. 1913)
Crawford, Allen S.
Dinsmore, Arthur T. (M. E. 1913)
Donaldson, Frank A.
Hirleman, Clark W. (M. E. 1913)
Mikesh, Martin A. (M. E. 1913)
Morton, Harold S. (M. E. 1913)

Bachelor of Science in Engineering (Mechanical)

Rand, Lars (M. E. 1913)
Ruemmele, Albert E. (M. E. 1913)

Bachelor of Science in Science and Technology

Johnson, Paul A. (Lawrence)

1913

Bachelor of Science in Engineering (Civil)

Bergquist, John E.
Bradley, Byron H. (C. E. 1914)
Chilton, Edward G. (C. E. 1914)
Curtis, Benjamin J. (C. E. 1914)
Hewett, Maurice W. (C. E. 1914)
Koepke, Walter E. (C. E. 1914)
Kruse, Helmer V. (C. E. 1914)
Lovering, Harry D. (C. E. 1914)
Montgomery, Albertus
Morse, George A. (C. E. 1914)
Quiggle, Arthur W. (C. E. 1914)
Rolfe, West A.
Thurston, Harold H. (C. E. 1914)
Webster, Donald W. (C. E. 1914)
Wilk, Benjamin (C. E. 1914)

Electrical Engineer

White, Charles W.

Bachelor of Science in Engineering (Electrical)

Dewars, Allen G. (E. E. 1914)
Dow, Clarence A. (E. E. 1914)
Everett, William R. (E. E. 1915)
Goebel, Rudolph C. (E. E. 1914)
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 R. (B. S. Eng. 1912)
*Bailey, William H. (B. S. Eng. 1912)
Bingen, Wm. J. (B. S. Eng. 1912)
Cummings, Elmer F. (B. S. Eng. 1912)
Giertsen, Marcus O. (B. S. Eng. 1912)
Haberle, Edward L. (B. S. Eng. 1912)
Jorgens, Charles R. D. (B. S. Eng. 1912)
Kapphahn, Raymond J. (B. S. Eng. 1912)
King, Forest V. (B. S. Eng. 1912)
Kriz, Joseph J. (B. S. Eng. 1912)
Pease, Raymond A. (B. S. Eng. 1912)
Peterson, Barney J. (B. S. Eng. 1912)
Ryan, Loiel S. (B. S. Eng. 1912)
South, Willard A. (B. S. Eng. 1912)
Souther, Morton E. (B. S. Eng. 1912)
Swenson, H. Seymour (B. S. Eng. 1912)
Torgerson, Irving E. (B. S. Eng. 1912)
Wangaard, Oscar H. (B. S. Eng. 1912)
Welin, Arthur G. (B. S. Eng. 1912)
Wolff, Henry E. (B. S. Eng. 1912)

Electrical Engineer

*Avis, Samuel L. (B. S. Eng. 1912)
Benham, Claude F. (B. S. Eng. 1912)
Brewster, Wm. E. (B. S. Eng. 1912)
Herrmann, Raymond R. (B. S. Eng. 1912)
Hovden, Conrad D. (B. S. Eng. 1912)
Mathes, Robert C. (B. S. Eng. 1912)
Merriell, Elmer W. (B. S. Eng. 1912)
*Nelson, George A. (B. S. Eng. 1912)
Pardee, Charles A. (B. S. Eng. 1912)
Ringstrom, Ivan G. (B. S. Eng. 1912)
Thuras, Albert L. (B. S. Eng. 1912)
Towle, Neal C. (B. S. Eng. 1912)

Mechanical Engineer

Chapin, Harold S. (B. S. Eng. 1912)
Clark, Wm. G. (B. S. Eng. 1912)
Crane, Eugene C. (B. S. Eng. 1912)
Dinsmore, Arthur T. (B. S. Eng. 1912)
Hirleman, Clark W. (B. S. Eng. 1912)
Mikesh, Martin A. (B. S. Eng. 1912)
Morton, Harold S. (B. S. Eng. 1912)
Rand, Lars (B. S. Eng. 1912)
Ruemmele, Albert E. (B. S. Eng. 1912)

1914

Civil Engineer

Larson, Albin

Bachelor of Science in Engineering (Civil)

Brenchley, Walter C. (C. E. 1915)
Burnett, Harold V.
Dimond, Harvey G.
Doolittle, William Y.
Ekberg, Carl E. (C. E. 1915)
Hustad, John C. (C. E. 1915)
Johnson, Edgar W. (C. E. 1915)
Lagaard, Maurice B. (C. E. 1915)
Larson, Louis (C. E. 1915)
Mitchell, Lester M. (C. E. 1915)
Nordstrom, Carl T.
Ott, Leonard E. (C. E. 1915)
Price, John R.
Rankin, Renville S.
Rockwell, Harvard S.
Sears, Dow I.
Weatherill, Cedric S. (C. E. 1915)
Weigel, Howard N. (C. E. 1915)

Bachelor of Science in Engineering (Electrical)

Adler, Eugene H. (E. E. 1915)
Bisek, Peter P.
Chapman, Wendell P.
Dunham, Roy O. (E. E. 1915)
Elliott, A. Douglass (E. E. 1915)
Fallon, Eugene L. (E. E. 1915)
*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.
Handahu, 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)
Onstad, Olaf L.
Pratt, Benjamin A.
Ruisvold, Olav M. (C. E. 1916)
Scott, Elmer C. (C. E. 1916)
Skurdalsvold, Peter (C. E. 1916)
Swenson, Oscar E. (C. E. 1916)
West, John C.
Wild, Carl D. (C. E. 1916)
Withee, Warren

Bachelor of Science in Engineering (Electrical)

Anderson, Joseph W.
Eggers, Henry C. T. (E. E. 1916)
*Garvey, Walter S. (E. E. 1916)
Hjermstad, Harry M. (Webster)
*Houghtaling, Elting W. (E. E. 1916, B. S. 1916)
Jones, Robert A. (E. E. 1916)
Lawrence, Scott W. (E. E. 1916)
Lutz, Richard E.
Olaison, Clifford E. (E. E. 1916)
Skagerberg, Rutcher (E. E. 1916)

Bachelor of Science in Engineering (Electrical)

Thompson, Harry T. (E. E. 1916)
Turner, Roy H. (E. E. 1916)
Wilcox, Halsey H.

Bachelor of Science in Engineering (Mechanical)

Boyles, Ralph R. (M. E. 1916)
Crosby, Milton E.
Giltinan, David M. (M. E. 1916)
Holmberg, Abner W. (M. E. 1916)
Kerns, Clinton B.
Orr, George M.
Roberts, Earl H. (M. E. 1916)
Skon, Herman W. (M. E. 1916)
Tupper, Charles E.
Wolff, William S. (M. E. 1916)

ADVANCED DEGREES

Civil Engineer

Brenchley, Walter C. (B. S. Eng. 1914)
Ekberg, Carl E. (B. S. Eng. 1914)
Hustad, John C. (B. S. Eng. 1914)
Johnson, Edgar W. (B. S. Eng. 1914)
Lagaard, Maurice B. (B. S. Eng. 1914)
Larson, Louis J. (B. S. Eng. 1914)
Mitchell, Lester M. (B. S. Eng. 1914)
Ott, Leonard E. (B. S. Eng. 1914)
Weatherill, Cedric S. (B. S. Eng. 1914)
Weigel, Howard N. (B. S. Eng. 1914)

Electrical Engineer

Adler, Eugene H. (B. S. Eng. 1914)
Dunham, Roy O. (B. S. Eng. 1914)
Elliott, A. Douglass (B. S. Eng. 1914)
Everett, William R. (B. S. Eng. 1913)
Fallon, Eugene L. (B. S. Eng. 1914)
Harris, Harold R. (B. S. Eng. 1914)
Jackson, Otto E. (B. S. Eng. 1914)
Johnson, Carl J. (B. S. Eng. 1914)
Johnson, Elmer W. (B. S. Eng. 1914)
Jones, George B. (B. S. Eng. 1914)
Loeffler, Henry S. (B. S. Eng. 1914)
Putz, John H. (B. S. Eng. 1914)
Robertson, Burton J. (B. S. Eng. 1914)
Schroeder, Carl W. (B. S. Eng. 1914)
Tallmadge, Everett S. (B. S. Eng. 1914)
*Wuest, Karl F. (B. S. Eng. 1914)

Mechanical Engineer

Colvin, James A. (B. S. Eng. 1914)
Gemmell, John H. (B. S. Eng. 1914, B. S. 1918, M. B. 1919, M. D. 1920)
Hammond, Laurence D. (B. S. Eng. 1914, B. S. 1918, M. B. 1919, M. D. 1920)
Hartney, James L. (B. S. Eng. 1914)
Hubbell, Arthur C. (B. S. Eng. 1914)
Mayer, Harris J. (B. S. Eng. 1914)
Peterson, Albert L. (B. S. Eng. 1914)
Rockwood, Fletcher (B. S. Eng. 1914)
Snow, Clarence J. (B. S. Eng. 1914)
Thayer, Paul Wm. (B. S. Eng. 1914)

1916

Bachelor of Science in Architecture

*Albee, Pierce
Heath, Donald C.
Liebenberg, Jacob J.
Tannehill, Louis Wm.

Bachelor of Science in Engineering (Civil)

Askew, Thomas A., Jr.
Biskup, William F.
Bruce, 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)
Cavell, Russell O.
Creswell, Daniel R.
Dow, William G. (E. E. 1917)
Edelman, Philip (E. E. 1917)
Ellefson, Selmer
Fastenau, Karl DeV.
Gannett, Danforth K. (E. E. 1917)
Hult, George A.
Irwin, Frank H. (E. E 1917)
Loye, Donald P. (E. E. 1917)
Russell, Carl A.
Schulz, Elton A.
Simons, Walter W.
Tallmadge, Hiram (E. E. 1917)
Teberg, Ernest J. (E. E. 1917)
Thompson, Jesse L. (E. E. 1917)
Turnquist, Axel A. (E. E. 1917)

Bachelor of Science in Engineering (Mechanical)

Corser, John
Dresser, Harry S.
Johnson, Ira L. (M. E. 1917)
*Mason, Arthur P.
Miller, William C.
Moody, Chester S. (M. E. 1917)
Ritchie, John R. (M. E. 1917)
Smart, George A.
Stone, Charles W. (M. E. 1917, M. S. 1919)

ADVANCED DEGREES

Civil Engineer

Cuddy, William A. (B. S. Eng. 1915)
Leonard, Thomas K. (B. S. Eng. 1915)
McKay, Earle D. (B. S. Eng. 1915)
Ruisvold, Olav M. (B. S. Eng. 1916)
Scott, Elmer (B. S. Eng. 1915)
Skurdalsvold, Peter (B. S. Eng. 1915)
Swenson, Oscar E. (B. S. Eng. 1915)
Wild, Carl D. (B. S. Eng. 1915)

Electrical Engineer

Eggers, Henry C. T. (B. S. Eng. 1915)
*Garvey, Walter S. (B. S. Eng. 1915)
*Houghtaling Elting W. (B. S. Eng. 1915, B. S. 1916)
Jones, Robert A. (B. S. Eng. 1915)
Lawrence, Scott (B. S. Eng. 1915)
Olaison, Clifford E. (B. S. Eng. 1915)
Scott, Walter L. (B. S. Eng. 1915)
Skagerberg, Rutcher (B. S. Eng. 1915)
Taylor, Lyman D. (B. S. Eng. 1913)
Thompson, Harry T. (B. S. Eng. 1915)
Turner, Roy H. (B. S. Eng. 1915)
Wentz, Walter W. (B. S. Eng. 1915)

Mechanical Engineer

Boyles, Ralph R. (B. S. Eng. 1915)
Giltinan, David M. (B. S. Eng. 1915)
Holmberg, Abner W. (B. S. Eng. 1915)
Kopper, Edward, Jr. (B. S. Eng. 1914)
Roberts, Earl H. (B. S. Eng. 1915)
Skon, Herman W. (B. S. Eng. 1915)
Wolff, William S. (B. S. Eng. 1915)
Wang, Jee K. (B. S. Armour Institute)

Master of Science

Stenger, Lawrence A. (E. E. 1906)
Wilcox, Hugh B. (E. E. 1914)

1917

Bachelor of Science in Architecture

Brown, Floyd W.
Buckhout, Donald H.
Gilman, Howard B.
Kreinkamp, Linton H.
Mixer, Walter R.
Poulsen, George P.
Prudden, George H., Jr.
Riedesel, George M.

Bachelor of Science in Engineering (Civil)

Boyce, Ellsworth R.
Brataas, Mark G.
Douglass, Addison H. (C. E. 1920)
Fossen, George
Linden, Henning
Luplow, Walter D.
Luxford, Ronald F.
Rader, Clarence McK. (C. E. 1917)
Rickman, Herman W.
Tryon, Philip D.
Wolfangle, Raymond J.

Bachelor of Science in Engineering (Electrical)

Becker, Ward E.
Boyum, Irvin L.
Carlson, Chauncy M.
Dunlap, Lemuel J.
*Ebert, Solomon R.
Eckenbeck, Everett E.
Jacobs, Arthur R.
Juvrud, Edwin C.
Lilly, Clarence W.
Malmstrom, Axel L.
*McKibbin, Ray (E. E. 1918)
*Melby, Einar C.
Scott, Willard W.
Swenson, George W. (E. E. 1921)
Thomas, William A.
Wheeler, Herbert H.
Williams, Frederick J.
Willis, Benjamin S.

Bachelor of Science in Engineering (Mechanical)

Andersen, Edward I. (M. E. 1919)
Boehnlein, Charles (M. E. 1919)
Bros, Ernest T.
Brown, Homer L.
Carlson, Arvid P.
Ek, Gustav A.
Eustis, Irving N. (M. E. 1918)
Gerlach, Arthur C.
Guggisberg, Charles F.
Hektner, Joel
Holmstine, Arthur G.
Hvoslef, Frederik W. (M. S. 1919)
Jones, Edwin F.
Knutson, Harry
Larson, Victor F.
Murray, John H.
Nelson, Otis S.
Romero, Cirilo L. P. Y. (M. E. 1918)
Rosenbloom, Abraham E.
Swenson, Clarence Q. (M. E. 1920)
Taylor, Duane L.

ADVANCED DEGREES

Civil Engineer

Bruce, Hjalmar N. (B. S. Eng. 1916)
Carlson, Anders J. (B. S. Eng. 1916)
Doell, Charles E. (B. S. Eng. 1916)
*Johnston, Ralph E. (B. S. Eng. 1916)
Knauss, Archibald C. (B. S. Eng. 1916)
Peterson, Harold L. (B. S. Eng. 1916)
Rader, Clarence McK. (B. S. Eng. 1917)
Weinke, Ernest (B. S. Eng. 1916)

Electrical Engineer

Abbott, Amos H. (B. S. Eng. 1916)
Blomberg, Evar H. (B. S. Eng. 1916)
Butterworth, Russell I. (B. S. Eng. 1916)
Dow, William G. (B. S. Eng. 1916)
Edelman, Philip (B. S. Eng. 1916)
Gannett, Danforth K. (B. S. Eng. 1916)
Irwin, Frank H. (B. S. Eng. 1916)
Loye, Donald P. (B. S. Eng. 1916)
Muri, Nathaniel R. (B. S. Eng. 1915, University of Washington)
Tallmadge, Hiram (B. S. Eng. 1916)
Teberg, Ernest J (B. S. Eng. 1916)
Thompson, Jesse L. (B. S. Eng. 1916)
Turnquist, Axel A. (B. S. Eng. 1916)

Mechanical Engineer

Johnson, Ira L. (B. S. Eng. 1916)
Moody, Chester S. (B. S. Eng. 1916)
Ritchie, John R. (B. S. Eng. 1916)
Stone, Charles W. (B. S. Eng. 1916, M. S. 1919)

1918

Bachelor of Science in Architecture

Forsberg, Enock E.
Kaplan, Seeman
King, Harvey M.
Moorman, Albert J.

Bachelor of Science in Engineering (Civil)

Battles, Leon E.
*Chamberlain, Herbert D.
Deutsch, Richard E.
Eliassen, Sigurd
*Gould, Reed D.
Konstantinopoulos, Nicholas (Konstants)
Nickerson, Neal C.
Smith, Cedric B. (B. A. 1914)
Smolensky, Martinian G.

Bachelor of Science in Engineering (Electrical)

Brooke, Harold L.
Gibbs, Clayton T.
Hartig, Henry E.
Hotchkiss, Fred W.
Levin, Jake M.
Ross, Russell H.
Schlenk, Hugo, Jr.
Smith, Donald C.
Smith, Hugh A.
Talbot, Thomas F.

Bachelor of Science in Engineering (Mechanical)

Abrahamson, Howard B.
Anderson, Hilder A.
Bierman, George H. (M. E. 1919)
Francis, Paul E.
Greenberg, Morris
Hagerman, Oliver S.
Kivley, Ray C.
Muller, Carl C.

Bachelor of Science in Engineering

Peterson, Harold R.
Putman, George W.

ADVANCED DEGREES

Electrical Engineer

*McKibben, Ray (B. S. Eng. 1917)

Mechanical Engineer

Eustis, Irving N. (B. S. Eng. 1917)
Romero, Cirilo L. P. Y. (B. S. Eng. 1917)

1919

Bachelor of Science in Architecture

Buenger, Edgar
Deane, George B.
Denern, David J.
Emery, George C.
Fraser, George
Hamilton, Jefferson M.
Hammett, Ralph W.
Schwartz, John S.
Wright, Stewart V.

Bachelor of Science in Engineering (Civil)

Coe, Edward H.
Elstad, Rudolph T.
Hawlick, Henry I.
Rosenthal, Oscar L.
Sushan, Harry M.

Bachelor of Science in Engineering (Electrical)

Christensen, Edgar W.
Cotton, Ernest H.
Drinkall, John F.
Duncan, George R.
Grimes, David
Hartman, Walter K.
Heinemann, John R.
Jordan, Frank W.
Klass, Frederick
Langland, Harold S.
Lee, Oscar C.
Marshall, Donald E.
Nelson, Gustav A.
Olson, Richard H.
Peterson, Albert E.
Peterson, Arthur P.
Pettich, Alfred C.
Pierson, Joe W.
Reeve, Charles H.
Sander, Theodore, Jr.
Swanson, Edwin W.

Bachelor of Science in Engineering (Mechanical)

Baker, Arthur W.
Bros, Raymond J. (M. E. 1920)
Cosh, Richard A.
Dowd, Archie J.
Elliot, Harry C.
Feltz, Russ M.
Hartzberg, Edward M.
Moffat, George N. (M. E. 1920)
Pavek, William J. (M. E. 1920)
Williams, Arthur H.
Wunderlich, Milton S. (M. E. 1920)

Bachelor of Science in Engineering

Briggs, Hiram K.
Gee, Harry J.
Kapphahn, Ernest H.
Kroeze, Herbert A.
Lewis, Carroll E.
Lilly, Eugene

ADVANCED DEGREES

Mechanical Engineer

Andersen, Edward I. (B. S. Eng. 1917)
Bierman, George H. (B. S. Eng. 1918)
Boehnlein, Charles (B. S. Eng. 1917)
Hvoslef, Fredrik W. (B. S. M. E. 1917)

Master of Science

Stone, Charles W. (B. S. Eng. 1916, M. E. 1917)

1920

Bachelor of Science in Architecture

Anderson, Milton J.
Kleinschmidt, Florian A.
Korslund, Harry J.
Lin, Shu M.
Loye, Edwin M.
Lyon, Glenn H.
Raugland, Arnold I.

Bachelor of Science in Engineering (Civil)

Alexander, George D.
Beneke, Walter E.
Berg, Karl A. E.
Bernt, Hans E.
Bleifuss, Donald J.
Dever, Francis A.
Fitzgerald, William J.
Frias, Floyd M.
Gilbert, Roy
Gould, Edward S.
Hanke, Carl C.
Hansen, Carlos C.
Holm, Edwin R.
Johnson, Byron F.
Larson, Amandus C.
Lebeck, Carl E.
Lende, Henry M.
Malmberg, Victor A.
Nelson, Donald O.
Neville, Earle L.
Piess, Arnold G. M.
Purdy, Irving B.
Seemann, Ernest W.
Sherwood, Edward B.
Staehle, Gilbert C. (M. S. Eng. 1922)

Bachelor of Science in Engineering (Electrical)

Aske, Irving E.
Bauer, Ruben B.
Carlson, Victor H.
Ellsworth, Charles D.
Engquist, Victor E.
Goss, Harold R.
Groth, Arthur W.
Hunt, Gates E.
Janzen, William H.
Jules, Harold A.
Kingsley, Norman W.
Knowles, Everett H.
Kruse, Orlin O.
Larson, Walter J.
Lee, Walter J.
Lockwood, Raymond A.
McKenzie, Leonard F.
Mayer, Albert F.
Miller, George W.
Mitchell, Alexander C.
Molskness, Nels S.
Nelson, Clarence L.
Noel, Clay W.
Peterson, Peter I.
Peterson, Richard M.
Peterson, Vance C.
Price, Clarence R.
Siegmann, Chester W.
Strothman, Russell A.
Triem, Ralph H.
Waldron, Ralph E.
Westberg, Russell E.

Bachelor of Science in Engineering (Mechanical)

Anderson, Helmer N.
Ball, Hampton R.
Cerney, Glen C.
Curry, Ezra B. (M. E. 1921)
Czuck, Jacob H.
Egilsrud, Fridtjof S.
Fortune, Harry G.
Gerow, Theron G.
Hayes, Edward J. (M. E. 1921)
Joachim, William F. (M. E. 1921)
Merrill, Lewis E. (M. E. 1921)
Odegaard, Harold T.
Powell, Knox A.
*Reasoner, Clayton M. (M. E. 1921)
Rhame, Paul W. (M. E. 1921)
Shellenberger, Hiram R.
Tuve, George L. (M. E. 1921)
Wallfred, John E.
Waterous, Fred A.
William, Myrl J.

Bachelor of Science in Engineering

Didriksen, Philip H.
Hanrahan, Edmund C.
Harris, Nathan
Madsen, Olav
Moore, Clarence F.
Swenson, Gustav A.
Vallacher, Theodore L.
Wyly, Lawrence T.

ADVANCED DEGREES

Civil Engineer

Douglass, Addison H. (B. S. 1917)

Mechanical Engineer

Bros, Raymond J. (B. S. 1919)
Moffat, George N. (B. S. 1919)
Pavek, William J. (B. S. 1919)
Swenson, Clarence Q. (B. S. 1917)
Wunderlich, Milton S. (B. S. 1919)

1921

Bachelor of Science in Architecture

Anderson, Milton L.
Dahl, George L.
Damberg, Rheuben P.
Gewalt, Carl H.
Larson, Edwin
Melander, Albin R.
*Thorshov, Olaf
Wills, Arthur D.

Bachelor of Science in Civil Engineering

Barber, Harold A.
Carpenter, Hugh W.
Christilaw, George M.
Daly, Richard T., Jr.
Dehn, Eltor A.
Del Plaine, Carlos W. (C. E. 1922)
Enke, Fred A.
Grochau, Earl H.
Hallady, Leslie L.
Hanson, Edwin L.
Henry, Burt C.
Jensen, Cyril D.
Johnson, Alphonse N.
Johnson, Carl S.
McCubrey, Everett J.
Mackintosh, William S.
Muessel, Robert W.
Simmonds, Richard R.
Sverdrup, Leif J.
Weis, Wallace D.
Werdenhoff, James H.

Bachelor of Science in Electrical Engineering

Anderson, Edward S.
Austin, Paul D.
Barger, Harold L.
Barnes, Dean M.
Beardmore, Albert E.
Berg, Samuel A. (B. A. 1921) (E. E. 1922)
Briggs, William G.
Carlson, Carl P.
Colson, Lauren G.
Donahoe, Robert E.
Hammerstrom, Aleck A.
Hayward, Laurence W.
Hougan, Sander
Johnson, Edgar F.
Johnston, Charles K.
Larson, Ludvig C. (E. E. 1923)
Loye, Percival E.
McKibben, Lloyd S.
McVean, Norman S.
Maine, Basil C.
Manderfeld, Emanuel C.
Mangney, Elmer J.
Miller, Andrew L.
Nelson, Richard L.
Palmer, Roy A.
Pearson, Charles W.
Peterson, Harold W.
Podosin, John
Satori, Roy H.
Shuirman, Gabe
Stanius, Godfrey
Sweet, Ray R.
Wahlquist, Hugo W.
Wessale, George
Wilson, Paul R.

Bachelor of Science in Mechanical Engineering

Arneson, Lloyd O.
Elmer, Lloyd A.
Farmer, John W.
Forsberg, Elmer J. (M. E. 1922)
Gjesdahl, Maurice S.
Hamlin, Lehan H.
Johnson, Carl A. (M. E. 1922)
Lewis, George R.
Luce, Alexander W. (M. E. 1923)
Reuter, Peter T.
Roe, Milo C.
Umbehocker, Frank
Vaule, Sven A.
von Rohr, Herbert H.

Bachelor of Science in Engineering

Beeman, Harry J.
Carlton, Richard P.
Cowin, Clifford C.
Dills, Lyle A.
Godwin, Kenneth A.
Jacobson, Howard C.
Liddle, Ralph W.
McLean, Milton D.
McMeekin, Glenn D.
Martin, Curtis R.
Noble, John F.
Papenthien, Roy O.
Young, Joseph E.

ADVANCED DEGREES

Electrical Engineer

Swenson, George W. (B. S. Eng. 1917)

Mechanical Engineer

Curry, Ezra B. (B. S. Eng. 1920)
Hayes, Edward J. (B. S. Eng. 1920)
Joachim, William F. (B. S. Eng. 1920)
Merrill, Lewis E. (B. S. Eng. 1920)
*Reasoner, Clayton M. (B. S. Eng. 1920)
Rhame, Paul W. (B. S. Eng. 1920)
Tuve, George L. (B. S. Eng. 1920)

1922

Bachelor of Science in Architecture

Bakken, Laurence H.
Croft, Edna K.
Damberg, Paul S.
Dawson, John W.
Gerlach, Henry C.
Graf, Donald T.
Hahn, Stanley W.
Haines, Howard N.
Kreinkamp, Herbert A.
Little, Alice V.
Moorman, Frank S.
Smit, Catherine
Stewart, George A.
Willner, William E.

Bachelor of Science in Civil Engineering

Anderson, Nels S.
Andrus, Harry J.
Bailey, George B.
Berdan, Hubert J
Chernus, Maurice
Cook, Walter K.
Cray, Seymour R. (C. E. 1923)
Erickson, Edwin C. O.
Espenett, Edward L.
Feder, Max
Fraser, Carlisle G.
Frost, Herbert J.
Greenberg, Jack
Hortskotte, Arthur E.
Johnson, Ellsworth
Keeler, Jasper F.
Kelley, William
Levens, Alexander S. (M. S. in C. E. 1924) (C. E. 1927)
Lund, Earl H. (C. E. 1923)
Markson, Christian O.
Mattson, Dewey F.
Morrison, John E.
Newberry, Lester W.
Ost, Roland E.
Paida, Chas. H.
Palmer, Howard B.
Paulson, Thorwald S.
Peterson, Neander E.
Pinska, Lawrence F.
Reardon, John M.
Rosenthal, Paul
Silverman, Emil M.
Slade, Loring
Sochnik, Edward J.
Stoutland, Oliver A.
Swanson, Clifford L.
Tarbell, William F.
Teberg, Lawrence E.
Thompson, Claudius A.
Tierney, Festus F.
White, Arden D.
Wilson, Charles A.
Wood, Victor R.

Bachelor of Science in Electrical Engineering

Aultfather, David H.
Bergstrom, Marlow B.
Bisbee, Bertin A.
Bjonerud, Earl S.
Bochus, Gerald H.
Bosshardt, Wilmert C.
Carlson, Richard E.
Cooley, Gilbert
Dahl, Hjalmer A.
Downie, John M.
Drost, Henry F.
Dunnum, Orney E.
Ellestad, Irwin M.
Enger, Arne
Fiske, Harold C.
Forbes, Henry C.
Hagelin, Lawrence W.
Heidelberger, Roy J.
Hendrickson, Arnold B.
King, John E.
Linhoff, Carl H.
McEachin, John
McMillen, James S.
Magnuson, John E.
Mentzer, Clarence A.
Merritt, Alva W.
Mintz, Nathaniel
Nielsen, Walter M.
Nordlien, Berger W.
Olson, Arnim G.
Oscarson, Gerhard L.
Pangburn, Carroll G.
Plank, Howard G.
Ransom, Glen B.
Rome, Robert C.
Rood, Arnold E.
Sannicolo, Joseph F.
Selander, Karl W.
Sorensen, John E.
Steffens, Robert A.
Tuve, Merle A.
Wickman, Martin F.
Willard, Arthur C.
Williams, Percival H.
Wilson, Abner W.

Bachelor of Science in Mechanical Engineering

Aure, Roy
Bros, Chester W. (M. S. in M. E. 1924)
Carlson, Ernest F.
Clark, John S.
Curtis, Verne F.
Eddy, Clarence
Fabiand, Frank, Jr.
Hemsey, Clayton E.
Hilgedick, Ralph V.
Hoffman, Richard H.
Holmsten, Victor T.
Kutter, Calvin K.
Katter, Reuben L.
Kelsey, Howard C.
Kleinschmidt, Armin R.
Kumm, Arthur W.
Mikesh, Edward S.
Nordenson, Arnold
Nordstrom, Ernest A.
Olmstead, Charles F. (M. E. 1923)
Peters, Walter C.
*Reed, Olaf T. (M. E. 1923)
Rosendahl, Harold R.

Bachelor of Science in Engineering

Adams, Edward H.
Brown, Harry
Capstick, Donald
Dock, Chester
Forssell, William
Hayes, Harold
Meili, Rudolph E., Jr.
Olson, Clarence

ADVANCED DEGREES

Civil Engineer

Del Plaine, Carlos W.

Electrical Engineer

Berg, Samuel A. (B. S. Eng. 1921, B. A. 1921)

Mechanical Engineer

Forsberg, Elmer J. (B. S. Eng. 1921)
Johnson, Carl A. (B. S. Eng. 1921)

Master of Science in Engineering

Stehle, Gilbert C. (B. S. 1920)

1923

Bachelor of Science in Architecture

Backstrom, W. A.
Holien, Edward O.
Johnson, Elving L.
Markuson, Miner J.
Nielsen, Eunice V.
Sime, Theodore L.
Strom, Arthur
Walquist, John A.

Bachelor of Science in Architectural Engineering

Luedeman, Clarence H.
Sutherland, Samuel J.

Bachelor of Science in Civil Engineering

Aasland, Arne
Abramson, Harry W.
Aldrich, Louis W.
Aslakson, Carl I.
Berg, Swan P.
Bergford, Lester M.
Bergford, Rolf E.
Buhr, Leo
Christlieb, Frank R.
Cribbs, Harry E.
Curry, Byron K.
Darrell, James B.

Bachelor of Science in Civil Engineering

DeFreece, Paul R.	Nelson, Elmer A.
Dindorf, Edward C.	Nelson, Glenn
Flindt, Richard H.	Odquist, Carl
Hill, Hibbert M.	Olson, Elmer J. E.
Hiner, Walter G.	Peck, Lloyd A.
Hosmer, Orville H.	Sauer, Arthur A.
Johnson, Albert W.	Schaller, George C.
Johnson, Nels	Schienk, John J.
Judd, Maurice D.	Sclarow, Abraham M.
Kotz, Walter E.	Spencer, Raymond D.
Lazarus, Morris W.	Stephans, Clifford S.
Leonard, Aubrey C.	Swanson, Paul H.
Maiser, Walter L.	Tennstrom, Carl H.
Manger, Henry J.	Thompson, Everett
Meskal, George A.	Villaume, Walter F.
Mitchell, Lloyd S.	Zimmerman, Arthur C.

Bachelor of Science in Electrical Engineering

Babcock, Vernon M.	McCullough, Robert T.
Bouquet, Otto T.	Meserve, Ralph H.
Braden, Rene A.	Moreno, Gerardo
(M. S. 1925)	Nash, Russell O.
Bumgardner, Louis T.	Newman, John M.
Burrill, Charles M.	Nordvall, Glenn W.
Case, Gerald F.	Olin, Henry A.
Clausen, Elmer W.	Olson, Roy H.
Dunnavan, Ralph B.	Pause, Harold A.
Elwood, Daniel H.	Pulver, Richard F.
Engstrom, Elmer W.	Rath, Harvey C.
Fairbanks, George W.	Reeve, Howard E.
Feeney, Wayne I.	Russell, Winfred W.
Fischer, Harold W.	Ryan, Robert M.
Friedman, Edwin A.	Sampson, Clifford L.
Goldberg, Maurice G.	(M. S. 1925)
Grettum, LeRoy Atwood	Schottler, George J.
Hargraves, Robert A.	Schweiss, Clifford C.
Hawkins, Harvey C.	Scott, Herbert L.
Heidelberger, Otto F.	Sickel, Edwin C.
(M. S. 1925)	Swift, George E.
Helwig, William F.	Thorne, Donald E.
Johnson, Gustaf A.	Trask, Alfred S.
Johnson, James P.	Ward, Alvin C.
Kannenberg, Walter F.	Wellisch, Walton
(M. S. 1925)	Wiggins, John B.
Kearney, Adrian A.	Williams, Roy N.
Koch, Karl L.	Wills, David C.
Lambie, Horace H.	Wilson, Frank W.
Lieberman, Henry	Zimmerschied, Clarence R.
Lundquist, John V.	

Bachelor of Science in Mechanical Engineering

Acker, Sidney H.	*Keiser, Karl W.
Amidon, Lee L.	(M. S. in M. E. 1924)
Ascher, Raymond C.	Kuhlman, Rudolph H.
Bachmann, Graydon A.	Larson, Glen M.
Bergsland, Grant C.	Lindelien, Engen
Bros, Bernard M.	Marshall, Chester R.
Brossard, Edward V.	Messer, Harold D.
Copeland, Floyd E.	Parkin, Orrin G.
Cross, Roland E.	Peckham, Harold E.
Eige, Elmer H.	Ransom, Ralph W.
Gilstad, Arthur	Sear, Arthur W.
Halden, Herbert O.	Swanson, Philip G.
Hibbard, Shelden S.	Waby, Delton T.

ADVANCED DEGREES

Civil Engineer

Cray, Seymour E. (C. E. 1922)
Lund, Earl H. (C. E. 1922)

Electrical Engineer

Larson, Conrad L. (B. S. E. E. 1922)

Mechanical Engineer

Luce, Alexander W. (B. S. M. E. 1921)
Olmstead, Charles F. (B. S. M. E. 1922)
*Rool, Olaf T. (B. S. M. E. 1922)

1924

Bachelor of Science in Architecture

Backstrom, Emil F.	Kraft, Edwin W.
Barnum, Charles R.	Magoon, Herbert A.
Bonsall, Wallace C.	Nelson, Mark L.
Hawkins, Edward W.	Nystrom, Paul E.
Hinman, Charles H.	Rosenberg, Rahil A.
Johnson, Anton A.	Silverman, Isadore W.

Bachelor of Science in Architectural Engineering

Person, Otto C.	Tvedt, Lawrence A.
Root, Frank R.	

Bachelor of Science in Civil Engineering

Bachelder, William H.	Bevan, R. Louis
Bauer, Roscoe W.	Braddock, Edward
Bergquist, Edwin T.	Brody, Mace F.
Bergquist, Philip L.	Bullis, Everard J.
Bestor, George C.	Chapin, S. Caryl
Dedic, Richard J.	McCrady, Archie R.
Erickson, Carl E.	Nelson, Martin E.
Garzon, Julian R.	Normann, Rolf A.
Gillard, Herbert W.	Olson, C. Milford
Grant, Elberth R.	Parker, Robert M.
Guerin, George V., Jr.	Peterson, Lloyd L. H.
Gusmer, George O.	Powell, Louis H.
Gustafson, Reuben W.	Ranger, Donald R.
Hankins, Nathaniel R.	Roos, Frank T. W.
Harrington, Marry V.	Somero, Waino M.
Hayden, Claude E.	Sprehn, George H.
Herberg, Sanford	Stoddart, Hugh A.
Holder, Laurance E.	Stoner, Clifford M.
Johnson, Raymond V.	Tews, Arthur W.
Kaufman, Morris B.	Thompson, Theodore S.
Larson, Peter L.	Veix, Clarence J.
Liese, Herbert W.	Wilson, Walter E.
Lund, Roy V.	

Bachelor of Science in Electrical Engineering

Anderson, Emil G.	Little, LeRoy C.
Anderson, Fayette C.	McConnell, E. S.
Anderson, Matthew A.	McGregor, F. A.
Appleman, Frank C.	McLeland, Lyle K.
Arstad, Leonard O.	Mabbott, Leonard E.
Carlson, Warren E.	Mangney, Hilding O.
Cass, Hoyt R.	Marcroft, Harold C.
Cassidy, Walter J.	Marshman, Irving C.
Dahl, Harold W.	Mathes, Richard E.
Diment, J. Morton	Mayer, Joseph S.
Dunlap, George M.	Miller, Archibald T.
Eckberg, Curtis R.	Miller, William J.
Frazee, Leonard M.	Monsen, Manley A. B.
Furber, John R.	Mouseth, Ingwald T.
Garthus, Ira R.	Morton, Lysle W.
Greene, Alfred R.	Nee, Harold E.
Greene, Chauncey L.	Nelson, Edgar M.
Greiner, Harry S.	Pelley, Lloyd L.
Grettum, Walter A.	Schilling, Theodore F.
Harrington, Russell A.	Schow, Garfield G.
Hecht, Henry W.	Sheckman, Harvey Z.
Heggen, Reuben	Skarolid, Charles T.
Holbeck, John I.	Stimart, Elwood L.
Huseby, Gisle E.	Strege, Henry W.
Jacobson, Frank H.	Swift, Donald C.
Johnson, Iver W.	Taplin, George C.
Juran, Joseph M.	Teal, Clarence W.
Kapple, Frederick R.	Treka, Benjamin C.
Katur, Jozef J.	Tunell, Robert H.
Kline, Frank W.	Tyvand, James A.
Krause, Fred E.	Waligoski, Adam A.
Lampher, Murray N.	Warren, Laurence C.
Lauritzen, Carl W.	Weber, Hanard F.
Lebeck, Torarin E.	Wolfe, George E.
Lewis, John G.	

Bachelor of Science in Mechanical Engineering

Anderson, Joseph A.	Moore, John H.
Berry, George F.	Morris, Frank A.
Blodgett, Charles R.	(M. S. M. E. 1925)
Borst, Wellington L.	Nelson, Edward K.
Boyd, Paul M.	Nelson, Einer
Collis, Norman S.	*Olien, Hamlet C.
Dale, Dallas W.	Olson, Arthur L.
Darmody, William J.	Peterson, Arthur S.
Earl, Donald F.	Rathburn, George A.
(M. S. M. E. 1925)	Ross, Kenneth R.
Engh, Harris S.	Rosseau, Clifton C.
Erskine, Robert K.	Saltwick, Andrew
Estabrooks, Clyde F.	Sartell, Page M.
Grobel, Lloyd P.	Sebo, Arthur O.
Hiers, Charles R.	Seaseng, Gunnar
Holmstine, Ralph D.	Simms, Charles G.
Kiesner, Frank C.	Stachle, Haswell E.
Koehler, Edwin F.	Stauffacher, Edward L.
Langford, George, Jr.	Thomas, W. Alan
Langman, Harley R.	Tuttle, Stanley B.
Logue, John F.	Wagner, John W.
Mehandru, Behari L.	Willison, Stuart V.
Montgomery, Ralph M.	Woolman, Harry D.

ADVANCED DEGREES

Master of Science in Civil Engineering

Levens, Alexander S. (B. S. C. E. 1922)

Master of Science in Mechanical Engineering

Bros, Chester W. (B. S. M. E. 1922)
*Keiser, Karl W. (B. S. M. E. 1923)

1925

Bachelor of Science in Architecture

Bross, Peter P.	Lumm, Allan G.
Erickson, Clarence P.	Molander, Edwin W.
Freeberg, George	Olson, Edwin E.
Kendall, Walter A.	Peterson, Everett L.
Lantz, Reuben S.	Rigg, Alwin E.

Bachelor of Science in Architectural Engineering

Brimeyer, Ferdinand J.	Pesek, Cyril P.
Elmburg, LeRoy M.	Vaudreuil, Lionel H.
Grisson, Aubrey H.	Rankin, Dean W.
Larson, Emil L.	Wicklund, Paul E.

Bachelor of Science in Interior Decoration

Cote, Rhoda H.	Slocumb, Mary G.
MacGregor, Helen J.	Smith, Verna G.
Parker, Helen R.	

Bachelor of Science in Civil Engineering

Auzer, William L.	Kroll, Arthur J.
Banovetz, John A.	LaBonte, Anton E.
Bartholomew, Neal W.	Larson, Fred H.
Beese, Harold U.	Lushene, Joseph P.
Berg, Thorsten H.	McAndrews, Harry N.
Bertossi, Clarence F.	Macgowen, Irvin S.
Bird, Harold E.	Mark, Max B.
Blue, Clarence W.	Moore, Norman R.
Bonner, Donald E.	Morris, Russell F.
Brose, William C.	Nelson, Edwin W.
Burns, Dwight T.	Nelson, George A.
Carlbom, Leonard H.	Nichol, Frank E.
Cornell, George M.	Nordstrom, Milton E.
Craig, Hamilton S.	Nutting, Horace W.
Donahue, Stephen	O'Brien, Thomas E.
Dungay, Herbert F.	Olson, Kenneth M.
Duval, Arndt J.	Olson, Vernon H.
Elers, Baldwin C.	Peterson, Clarence R.
Frantz, Willard F.	Peterson, Harold C. E.
Fulton, Edwin G.	Prichard, Charles E.
Galanter, Samuel S.	Quinn, Edward I.
Gerdes, Carl H.	Quinn, Ursula R.
Gobeli, Arthur W.	Schmidt, Roland L.
Haims, Mark	Skrukrud, Odean M.
Hansen, Arthur A.	Sullivan, Frederick V.
Hartmann, Philip F.	Swanberg, John H.
Hendricks, Clifford L.	Thompson, Clarence W.
Hendrickson, C. Edward	Walder, N. T.
Imsande, Fred L. C.	Ward, John, Jr.
Jones, Harold W.	Wold, Milton C.
Knudsen, Esther M.	Youngquist, Eder B.

Bachelor of Science in Electrical Engineering

Albrecht, Ernest G.	Ludlum, Robert V.
Albrecht, Karl J.	Lund, Jeffery L.
Anderson, Arthur P.	McClung, Karl R.
Benson, Ikel C.	McCully, James F.
(M. S. E. E. 1927)	McEwen, Alexander D.
Boe, Lester L.	Malmgren, Richard V.
Borchert, Oscar H.	Meagher, Joseph E.
Bordeau, Sanford P.	Nelson, Carl C.
Brossard, Henry F.	Nelson, Clarence H.
Burlingame, Robert E.	Nickerson, Edward
Cameron, Harry D.	Nierling, Grant C.
Childs, Morris F.	Parsons, Sidney A.
Christensen, Arthur L.	Peterson, Lewis E.
Cosandey, Charles J.	Postma, John
Countryman, M. Alden	Reed, Henry R.
Cousins, Van M.	(M. S. E. E. 1927)
Edwards, Richard G.	Richardson, Philip E.
Ellis, Carl E.	Robertson, Kenrick
Franzen, Roy O.	Schenckieth, Harry H.
Gilman, Gaylord	Schuck, Roy D.
Hammer, Harold E.	Shaver, George J.
Hanft, Hugo H.	Smith, Harold D.
Heins, Harold H.	Solomonson, Lawrence D.
Hill, Edward L.	Steinert, Emil
Holmes, Raymond H.	Taylor, Richard G.
Hussey, Norman W.	Thomas, Richard L.
Jacobsen, Arthur C.	Thomson, Andrew
Johnson, Enan C.	Thyberg, Clarence W.
Johnson, Robertson B.	Tunell, Clement R.
Kauppinen, Heino	Untinen, August L.
Keller, Raymond W.	Upton, Albert P.
Knoll, Franklin O.	Westigard, Glenn A.
(B. S. C. E. 1922)	Wieland, Willard W.
(St. Thomas)	Winslow, Harry J.
Koch, Winfield R.	Wurzbach, Henry A.
Lewis, Berkeley R., Jr.	

Bachelor of Science in Mechanical Engineering

Algren, Axel R.	Jacobi, Alfred J.
Backstrom, Russell E.	Jacobson, Reuben A.
(M. S. M. E. 1927)	Jenkins, Clifford H.
Beseler, Herman F.	Ludvigsen, Elliot L.
Bjerre, Folmar I.	Lundquist, C. D. Vernon
Boss, Ronald W.	Martino, Anthony D.
Caswell, Thomas R.	Mills, Hartzel
Donnelly, William H.	Pendergast, Webster G.
Eggleston, Smith	Peterson, Laurence L.
Erskine, Lawrence F.	Robinson, Parke D.
Forseth, George O.	Souba, John I.
French, William O.	Stevens, Everett B.
Heath, Arthur C., Jr.	Whitten, Robert C.
Heisveen, Leonard F.	Wilson, Roy A.
Holmes, Roland W.	

ADVANCED DEGREES

Master of Science in Architecture

Dayu, Doon (B. S. 1924)

Master of Science in Electrical Engineering

Braden, Rene A. (B. S. E. E. 1923)
Heidelberger, Otto F. (B. S. E. E. 1923)
Kannenberg, Walter F. (B. S. E. E. 1923)
Sampson, Clifford L. (B. S. E. E. 1923)

Master of Science in Mechanical Engineering

Earl, Donald E. (B. S. M. E. 1924)
Morrill, Raleigh D. (B. S. M. E. 1909, E. E. 1922, Maine)
Morris, Frank A. (B. S. M. E. 1924)

1926

Bachelor of Science in Architecture

Frenzel, Herman	Naslund, Gustave A.
Kronick, T. Gerald	Potter, Robert P.
Lighter, Clyde W.	Stageberg, Oswald C. R.

Bachelor of Science in Architectural Engineering

Kranzfelder, Robert H.	Redin, R. Kenneth
Rasey, Raymond F.	

Bachelor of Science in Interior Decoration

Ehrenberg, Muriel L.	Snyder, Dorothy E.
Guesmer, Marie W.	

Bachelor of Science in Civil Engineering

Balkin, Samuel W.	Juell, Barton
Bolstad, Roswell C.	Kelly, Raymond R.
Breeden, James R.	Kreiting, Arthur S.
Bunnell, Charles W.	Lewin, Sherman W.
Comfort, Thomas H.	Liese, Carl R.
Cooper, R. Conrad	Lindstedt, Philip C. A.
Croswell, Leslie D.	Lipchick, Alex A.
Deegan, Raymond C.	Lorens, Edward R.
Drdla, Robert L.	Lund, Clarence V.
Fenton, Paul C.	Manson, Philip G.
Flaaten, Percy H.	Meyerdick, Clarence E.
Foster, Kenneth W.	Nasvik, Adolph C.
Gould, Edward C.	Neubauer, Loren W.
Haakensen, N. Theodore	Nyvall, Clifton S.
Halbkat, Frankam J.	Ohman, Uno G.
Hoffman, John R.	Peterson, Garvin E.
Jakkula, Arne A.	Sandberg, Clifford H.
(M. S. C. E. 1927)	Schulz, Alex A.
Johnson, Clifford S.	Young, Edward F.
Johnson, James R.	Young, Truman P.
Johnson, Raymond A.	

Bachelor of Science in Electrical Engineering

Ageton, Edwin O., Jr.	Johnson, Clarence A.
Anderson, Lowell W.	Johnson, Welton V.
Ayshford, Loren C.	Jones, Richard W.
Barron, John H.	Kelly, William J.
Berghs, Charles J.	Larsen, Einar H.
Bergman, Hilder W.	Lee, Albert A.
Beveridge, Robert A.	LeVescomte, Lester B.
Bullard, Henry M.	Levy, Max L.
Carman, Willard J.	Lindquist, Oliver J.
Christen, Ray L.	Lostrom, Herbert W.
Coon, Lawrence C.	Lyberg, Verele C.
Dahl, Merle G.	Lynskey, Joseph F.
Deinema, George R.	Mackay, Donald H.
Deterling, Edward A.	Mahachek, Ross
Dimmick, Merton A.	Mann, Alvin K.
Etem, Victor	Meader, Glenn S.
Faulkner, Louis L.	Mindrum, Arthur I.
Feldman, Carl B. H.	Murdoch, George B.
Ferguson, Kenneth R.	Nelson, Paul B.
Fiene, Marcus	Nelson, Robert B. D.
Forsmark, Ulrik E.	Nimmer, Walter B.
Gaalaas, George L.	Orning, Harold
Gemmell, Robert W.	Parry, John E.
Getchell, Earl	Quine, William M.
Graf, Alois W.	Rhoades, Herbert F.
Gross, Leon A.	Robinson, Lawrence T.
Haedecke, August D.	Salstrom, Paul S.
Hafstad, Lawrence R.	Schroeder, Clarence A.
Hammond, Joseph A.	Schweppe, Walter A.
Hargrave, William A.	Scott, Franklin B.
Hart, Maurice W.	Sjoberg, Roy H.
Hartley, Lowell J.	Slaggie, Eucharius L.
Hilgedick, Winfred C.	Tholstrup, Henry L.
Holcomb, Harry S.	Tighe, James S.
Hummel, Carl	Walters, Robert P.
Irons, George R.	Wenrich, James R.
Jensen, Otto L. (B. A.)	Wentz, Edward C.
Joesting, Frederick D.	Williams, William R.

Bachelor of Science in Mechanical Engineering

Anderson, Wesley J.	Bennett, John C.
Bancroft, Henry K.	(M. S. M. E.)
Beek, Hiram D.	Bohannon, George W.
Burt, Paul R.	Maney, James E.
Cole, Ernest C.	Mork, George W.
Comfort, Clifford E.	Norrbom, Oscar E.
Corbett, Theodore R.	Nordenson, Willard H.
Dewaji, Gunaker	O'Donnell, Lawrence
DuBois, N. Warren	Pierce, Walter H.
Fornfeist, Carl H.	Pike, Jay B.
Grant, Russell S.	(M. S. M. E. 1927)
Hanna, Cyril C.	Roberts, Norman A.
Hass, Paul O.	Rollin, Harold E.
Kleinfeld, Leonard S.	Slaby, Louis J.
Letson, Donald E.	Tucker, Carl W.
Lundgren, Carl W.	

ADVANCED DEGREES

Civil Engineer

Coe, Edward H. (B. S. C. E. 1919)
Luxford, Ronald F. (C. E. 1917, M. S. 1925, Wisconsin)

Master of Science in Civil Engineering

Nichol, Frank E. (B. S. C. E. 1925)

1927

Bachelor of Science in Architecture

Anderson, Lawrence B.	Flegal, Al Claude
Backstrom, K. A. W.	Gustafson, Robert F.
Broderick, Vere H.	Havens, Paul Maynard
Cameron, Lester W.	Kastner, Arthur Henry
Close, Winston A.	Kilpatrick, Porter Warren
Eaton, Paul Frederick	McCan, Realino Vincent
Edwards, William H.	Melius, Arnold A.

Bachelor of Science in Architectural Engineering

Bull, Alvah Stanley	Nyquist, Roy L.
Davidson, Henry A.	Park, James Injun
Gilfillan, Donald Wm.	Sorenson, Russell L.
Nelson, Neal N.	Stolte, Sidney L.

Bachelor of Science in Interior Decoration

Cameron, Grace	Grafslund, Geneva Louise
Wilkinson, Gladness B.	

Bachelor of Science in Civil Engineering

Bolnick, Harry Wm.	Lund, Stanley D.
Borne, Floyd O.	Marcroft, John Clifford
Borrowman, John Keeley	Morris, George Edward
Brattlof, Clifford	Murray, Harold E.
Briggs, Lucrd E.	Norman, Henry Robert
Brohaugh, Gustave C.	Pajari, Tauno
Campbell, Douglas M.	Paulson, Joseph Bernard
Carlson, Elmer W.	Pearson, Einar Otto
Christianson, Elmer John	Pearson, Harold Theodore
Clark, Kenneth Miles	Peterson, Frederick G.
Crowell, Sidney Howe	Platzer, George John
Engler, Myer	Pohl, Loren Frank
Edlund, Ray Clinton	Preus, Christian K.
Gehring, Lester George	Riedesel, Russell Irving
Hagman, Walter Fred	Rosing, Donald Clay
Hoving, John E.	Ruth, Fred Louis
How, Francis Waldo	Santelman, Ralph Henry
Johnsen, Kenneth A.	Sperling, Abe J.
Johnson, Laurence Victor	Teske, Frederick Carl
Castner, Roy W.	Turrittin, Hugh Lonsdale
Lande, Clarence C.	Wentz, Clarence Arthur
Luethi, Carl Francis	Witt, Edward John
Loucks, Roger Brown	Youngquist, C. Vernon
Lundsten, Frank Rueben	Zuckman, George J.

Bachelor of Science in Electrical Engineering

Anders, Milton F.	Lange, George M.
Anderson, Henry Alvin	Lee, Albert Christian
Asphalt, Filip Johanson	Lee, Paul Raymond
Bailey, Stuart Lawrence	Leider, Albert E.
Barton, James Parker	Lewis, Lloyd W.
Beach, George	McDonnell, Lawrence P.
Berglund, Erick Bernard	McKesson, Lewis James
Berkner, Lloyd Biel	Miller, William S. E.
Byer, Randall R.	Moore, Gordon B.
Berck, Albert	Moosbrugger, Frank John
Bonner, Arthur Lee	Moses, Marlowe Grant
Bottemiller, Edward L.	Nelson, Clarence Enoch
Boyce, Harold J.	Nergaard, Leon Severin
Brandt, Clifford Alois	Nielsen, Andres H.
Brayden, Giles William	Nolan, George Charles
Brightfelt, John Charles	Norberg, Hans A.
Buccowich, Paul	Ofelt, George R.
Burmeister, Charles H.	Osburn, Roy Wesley
Clark, Charles Stevens	Peters, Charles Max
DuBois, John Harry	Pilger, Clarence L.
Edgar, Robert Ferguson	Preho, Victor Nicholas
Farmer, Herbert Fred	Rauscher, Paul Frank
Gibson, Robert	Redding, James A.
Heimer, Amos Kingsley	Ringstrom, George H.
Hortberg, Reynold Olof	Robinson, Richard Burton
Hovey, Bertram Kelsey	Rogers, H. Barrett
Johnson, Gustave F.	Scholz, Edmund Henry
Schultz, Albert W.	Ward, Stanley A.
Schulze, LeRoy Edward	Weber, Clyde
Smith, Jerome Conrad	Weeks, Leonard H.
Speer, Paul B.	Wehlitz, Hubert Frank
Sunblad, Everts William	Weum, Laurel Allan
Swanson, Carl Everett	Whiteley, Howard Orville
Thompson, Niles J.	Witts, Seth Newton
Volkenant, Gordon W.	Woloshin, Boris
Wald, Joseph Harold	

Bachelor of Science in Mechanical Engineering

Akins, Clifford Miller	Little, Fred Wellington
Bliven, Paul	Loo, Yusen
Boyce, Norman Elliott	Lowther, Wilfred Wesley
Bros, Kenneth Donald	McNeill, Lyle D.
Carlson, Clifton Conrade	MacDonald, George A.
Chapman, Wilbur J.	Mongren, Richard Vern
Coates, Joseph Edwin	Munger, Maurice
Cook, Lyle M.	Parten, Carl Darius
Dacanay, Lino P.	Richardson, Ralph Arthur
Dixon, Donald Kenneth	Roberts, Dimon Albert
Evans, Ralph B.	Schneider, Frank Mahlon
Giessel, Paul Albin	Spehr, Peter Eldon
Hall, John Whitmore	Spencer, John Boyd
Hutchinson, Edwin T.	Trexler, Richard Rollo
Irons, Roy Cecil	Tubbesing, Norman F.
Isaacson, Arthur M.	Vye, George Parks
Lamson, Harold Joseph	

ADVANCED DEGREES

Civil Engineer

Levens, Alexander Sander (B. S. C. E. 1922, M. S. C. E. 1924)

Master of Science in Civil Engineering

Jakkula, Arne Arthur (B. S. C. E. 1926)

Master of Science in Electrical Engineering

Benson, Ikel (B. S. E. E. 1925)
Reed, Henry Rouse (B. S. E. E. 1925)

Master of Science in Mechanical Engineering

Pike, Jay Becker (B. S. M. E. 1926)

1928

Bachelor of Architecture

Carjola, Chester L.	Huchthausen, Walter J.
Church, Bruce R.	Jones, Paul W.
Ekman, Harold	Rakov, Avner
Grossman, Frederic R.	Thorshov, Roy N.
Holien, Gilman C.	Witt, Edward H.

Bachelor of Architectural Engineering

Affleck, Dean H.	McGinnity, William J.
Davidson, John E.	Meyers, Clare F.
Jerabek, Daniel A.	Pearson, George O.
Jones, Gordon W.	Ramey, John M.
Loo, Pang Chieh	Roston, Rees E.

Bachelor of Interior Decoration

Berman, Florence C.	von Sien, Ruth E.

Bachelor of Civil Engineering

Amidon, Roger E.	Kreger, Lynn S.
Beaudin, Lawrence A.	Lexau, Ole H.
Benson, Mons H.	McDanield, Laren A.
Bergford, John F.	McNally, Lee D.
Bolton, John M.	Maturi, Rudolph
Daly, Frank A.	Meyeron, Ben
Dreveskracht, Wallace W.	Normann, Olav. K.
	Olson, Clarence C.
Engstrom, LeRoy	Parker, Clyde H.
Erickson, Hugo G.	Prior, Charles H.
Erickson, Lloyd R.	Rinell, Eric A.
Ferguson, George E.	Ringwood, James R.
Frank, Carl W.	Rydeen, James P.
Gard, Donald L.	Schroepfer, George J.
Goldberg, Hymen	Silliman, Paul D.
Gustafson, J. Melvin	Tauber, Joseph H.
Johnson, Ralph P.	Tebo, Frank A.
Knox, Charles E.	Thwing, George Jr.
Kopp, David C.	Verizek, Jerry J.
Kopplin, Charles D.	Wieide, John A.

Bachelor of Electrical Engineering

Ackermann, Robert W.	Corlies, Charles V.
Anderson, Elwood C.	Dahl, Paul E.
Barnes, James C.	Elmburg, John C. W.
Benezovitz, Abe	Engquist, Emil B.
Brasten, Arthur M.	Fisher, George L.
Brown, Glendon C.	Fogelholm, Edward G.
Burris, Arthur F.	Frankovich, John J.
Christopherson, Arnold J.	Fredrickson, Edwin W.
Clousing, Lawrence A.	Froberg, Harold E.
Compton, Milton E.	Furber, Richard D.
Cook, J. Marvin	Grimm, Raymond E.
Cooper, Jack L.	Gustafson, Thor A.

Bachelor of Electrical Engineering

Hamilton, Sam R.
Harwick, Henry C.
Hawkins, George C.
Heywood, George L.
Holt, Gunnard T.
Holt, Leo G.
Hoover, Lloyd H.
Jarchow, Theodore L.
Johnson, Douglas O.
Johnson, Sheldon F.
Klammer, Kalmer K.
Koerner, Allen M.
Kotchevar, Joseph F.
Kriechbaum, John F.
Krieger, Keith M.
Kritzer, Louis W.
Larson, Seymour R.
Lende, Willard H.
Lee, Alfred H.
McCrea, John A.
*McIntire, Elmer E.
Neill, Clarence L.
Nogueria, Frederico P.
Ohman, Leo S.
Peterson, Randall J.
Peterson, Valgar N.
Riddell, Donald J.
Schvone, Anthony P.
Schliep, Carl J.
Seeger, Franklin H.
Sharpless, William M.
Sheire, James B.
Smeby, Lynne C.
Soderholm, Lauren V.
Stevens, Donald T.
Stevens, Bruce E.
Stuart, Donald M.
Swanson, Carl E.
Sweeney, Frank C.
Thelin, Ruben E.
Towey, James M.
Young, Clifford L.

Bachelor of Mechanical Engineering

Angell, Glenn H.
Arko, Frank W.
Barthelemy, Carl R.
Blackmore, Frank E.
Blackshaw, Joe L.
Bowers, Raymond
Boyce, John
Burke, James J.
Dunning, Robert M.
Elliott, Merle B.
Fritzberg, L. Hilding
Gustafson, Hugo F.
Hathaway, Herbert F.
Hemenway, Edward L., Jr.
Japs, Wilbur H.
Knutson, Melvin I.
Kusnerek, Clement J.
Larson, Werner L.
Libby, Calvin R.
Lundquist, Wilton G. C.
McGladrey, Lyle L.
Mayhugh, Benjamin F.
Miller, Marvel P.
Nelson, Arthur
Osrowske, Arthur B.
Pettersen, Wilber E.
Roberts, Henry M.
Robertson, Haney M.
Spotts, Herbert J.
Von Stecker, Selmer G.
Wood, Leslie L.

ADVANCED DEGREES

Master of Science in Civil Engineering

McKay, Earle Douglas (B. S. 1915, C. E. 1916)

Master of Science in Electrical Engineering

Bailey, Stuart Lawrence (B. S. E. E. 1927)
Feldman, Carl Brandt (B. S. E. E. 1927)
Fiene, Marcus Ernest (B. S. E. E. 1926)
Schweppe, Walter August (B. S. E. E. 1926)
Tholstrup, Henry Leo (B. S. E. E. 1926)

Electrical Engineer

Kannenberg, Walter Frederick (B. S. 1923, M. S. 1925)

1929

Bachelor of Architecture

Bayliss, Dudley C.
Ben-Ora, Samuel
Hakenjos, Frederick M.
Hovik, Lawrence E.
Juran, Nathan
Leach, Stowell D.
Melzian, Milton W.
Nelson, Erling W.
Nelson, Lyle
Redmond, Fabian
Santo, Louis
Shiffett, Glynne W.

Bachelor of Architectural Engineering

Amundson, Leland R.
Anway, Fred L.
Berzelius, Carl E.
Cramsie, Kenneth J.
Dutcher, Lloyd L.
Fergestad, Marvin L.
Hansen, Oliver S.
Johnson, Laurence E.
Kline, Marvin L.
Poss, John A.
Schilken, Donald R.
Youatt, Glen B.

Bachelor of Interior Architecture

Bradbury, Margaret B.
Breding, Lucene A.
Carter, Ruth
Grabek, Rosabelle
Lieb, Janet
Undine, Eugene A.
West, Jane

Bachelor of Civil Engineering

Alderson, Donald A.
Anderson, Frederick S.
Anderson, Irving E.
Anderson, Walter W.
Bernick, Leslie L.
Borne, Floyd Orville
Burch, Cecil J.
Eck, Melvin C.
Eggen, Karl M.
Erickson, David W.
Eyberg, Carl J.
Fredrickson, Fred C.
Grant, John W.
Gunnarson, Jon
Hanson, James B.
Hartigan, James J.
Heath, Delbert W.
Helseth, Paul A.
Hinderman, Winfred
Jenson, Theodore B.
Kingston, Paul S.
Lohn, Robert N.
McCauley, John S.
Melin, Kenneth R.
Onstad, Carl B.
Post, Edward
Rykken, Nordahl T.
Schaller, Louis M.
Shoemaker, Douglas H.
Waits, J. Grant
Wallin, Stanton E.
Zeuthen, Victor E.

Bachelor of Electrical Engineering

Abrahamson, Arthur L.
Abrahamson, LeRoy M.
Anderson, Arnold O.
Anderson, Merle W.
Bailey, John T.
Bierwagen, Rudolph W.
Bohrer, Donald M.
Borchardt, Lester F.
Borden, John C.
Brauch, Harold N.
Braum, Cyril M.
Briggs, Maynard R.
Cahn, Harold
Clark, Charles J.
Cutliffe, Wendell W.
DeVoy, William T.
Dybvig, Edwin S.
Edey, Francis E.
Finnell, Thomas C.
Fisher, Addison M.
Fox, C. Clair
Franks, George E.
Freeman, Raymond C.
Gill, Roscoe L.
Gille, Willis H.
Ginnaty, J. Robert
Goodner, Theodore C.
Gran, Conrad L.
Graubois, Kenneth J.
Gray, Wesley
Halverson, Vernon E.
Harris, Gordon C.
Healey, Joseph M.
Heidmann, Karl R.
Holmstrom, George
Jacobson, Carl Arnold
Johnston, Clinton J.
Korba, Anton A.
Krueger, Walter R.
Kuefler, Edward L.
Larson, Harold Oscar
Larson, Maurice C.
Liu, Maoling
Locklin, Robert B.
Loudon, William
McIlvaine, Wm. D., Jr.
Mayer, Francis L.
Meeks, Edwin D.
Millunchick, John W.
Mueller, Robert
Newhouse, John C.
Nissenson, Phineas
Oman, Lloyd L.
Owens, Remus R.
Perotti, John J.
Raney, Donald G.
Russ, Lloyd A.
Saxhaug, Erling B.
Saxon, Paul M.
Specht, James E.
Stark, John X.
Steiner, Edmund F.
Suhr, Frederick W.
Vardal, Victor K.
Vigness, Carl I.
Warneke, Roman C.
Williams, W. Glenn

Bachelor of Mechanical Engineering

Baldock, Frederick C.
Brewer, Carlos W.
Bruess, Edward C.
Cederstrom, Curtiss
Cherne, Realto
Deschner, Richard E.
Dey, Philip S.
Doepke, Christoph
Fedders, Melvin P.
Feithouse, Donald G.
Foss, Arbie
Freeman, Frank S.
Hanson, Manford P.
Heath, Owen M.
Heyer, Robert H.
Hoffman, Walwin H.
Ives, Kenneth S.
Johnson, Roy M.
Kuempel, Leon L.
Leegard, Clifford
Lockhart, Harold A.
Matzke, Walter W.
Moisesku, William
Nelson, Chester L.
Nickey, William E.
Norley, William H.
Peterson, Roy C.
Pfeifer, Otto J., Jr.
Read, Leland R.
Reed, Gordon
Reutiman, F. Rudolph
Rollin, Vern G.
Rowell, Lester J.
Sanders, Paul
Shannon, Harold R.
Sinnott, Irvine G.
Skanse, C. Theodore
Smilow, Leo
Smith, Rolf M.
Swanstrom, Carl Wm.
Tanner, Ela C.
TenBrook, Charles S.
Tiller, Louis
Watland, Maynard B.
Young, Donald

ADVANCED DEGREES

Master of Science in Chemical Engineering

Beal, John Linden (B. S. 1927)
Kurtz, Kerwin Kenton (B. S. in Ch. E. 1928)
Lauer, Byron Elmer (B. S. 1927 Oregon State)

Master of Science in Civil Engineering

Sandberg, Clifford Helmer (B. S. in C. E. 1927)
Swanberg, John Howard (B. S. in C. E. 1925)

Master of Science in Electrical Engineering

Edgar, Robert Ferguson (B. S. in E. E. 1927)
Pregel, Alexander Julius (B. S. in E. E. 1928, Robert College, Constantinople)

Master of Science in Mechanical Engineering

Carlson, Clifton Conrad (B. S. in M. E. 1927)

School of Chemistry

THE first degree was that of Chemical Engineer, granted in 1897, at the close of the regular four-year course. In 1902, the present degree of Bachelor of Science in Chemistry was conferred and has continued except for the two years, 1905 and 1906, when the degree was Analytical Chemist. For the course in chemical engineering, the corresponding degree of Bachelor of Science in Chemical Engineering was used.

In 1912, the degree of Chemical Engineer was granted at the close of the four-year course, as had been the custom for several years in the College of Engineering and Architecture, but in 1913 the new plan in that college was followed in the School of Chemistry as far as chemical engineering was concerned, and the degree of Chemical Engineer was granted at the end of the fifth year's work after the Bachelor of Science in Chemical Engineering had been obtained for the four-year course.

The present plan of conferring the professional degree of Chemical Engineer as a graduate degree based upon graduate study, experience, and a thesis was established in 1923.

In 1928 the form of the Bachelor's degree was changed to Bachelor of Chemistry and Bachelor of Chemical Engineering, taking effect in June, 1928. Similar action was taken at the same time by the College of Engineering and Architecture.

1897

Chemical Engineer

*Chapin, Lewis P.
Hamilton, Herbert C.
Linton, James H.
Webber, Frederick W.

1902

Bachelor of Science in Chemistry

Benner, Raymond C.
*Lando, Maximillian N.
Rice, Edgar W.

1903

Bachelor of Science in Chemistry

Bakke, Oliver M.

1904

Bachelor of Science

Grout, Frank F.
Gutsche, Edward J.
Hopkins, Joseph I.
Rose, Anton R.

1905

Analytical Chemist

Borrowman, George L.
Dahlberg, Arnold V.
Frary, Francis C. (M. S. 1906, Ph. D. 1912)
Jackson, Myron B.
Longworth, Fred J.
Pennock, Edward M.
Foote, 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.
Manuel, Earle V.
Von Kuster, Edith I. (Mrs. W. Johnson)

Bachelor of Science in Chemical Engineering

Davies, Edwin T.

1908

Bachelor of Science in Chemistry

Anderson, Edward X. (M. S. 1909)
Badger, Walter L. (B. A. 1907, M. S. 1909)
*Cressy, Charles R. (M. S. 1913)
Lowe, John M.
McBride, Russell S.
Porter, Allen H.
Whited, Orie O.

1909

Bachelor of Science in Chemistry

Bacon, Charles B.
Dresser, Eva L. (Alves)
Kueffner, Otto K.
Selvig, Walter
Sterling, Faith (Sterling)
Walker, George W.

Bachelor of Science in Chemical Engineering

Barnaby, William E.
Morey, George W.
Roehrich, Victor H. (M. S. 1910)

Bachelor of Science in Chemistry

Anderson, Edward X. (B. S. 1908)
Badger, Walter L. (B. A. 1907, B. S. 1908)

1910

Bachelor of Science in Chemical Engineering

Bicknell, Henry R.
Daniels, Farrington (M. S. 1911)
De Witt, Joseph Henri
Dietrichson, Gerhard
Finke, Wilbur W. M.
*Peterson, Andrew P. (M. S. 1911)
*Smith, Carolyn H.
*Stone, George H.
Taylor, Carl A.
Tronson, Carl A.
Woolett, Guy H. (M. S. 1916, Ph. D. 1918)

Bachelor of Science in Chemical Engineering

Dahlberg, Henry W.
Gutsche, Frank Carl
Smith, Sheldon H.

Master of Arts in Chemistry

Nye, Lillian L. (B. A. 1909)

Master of Science in Chemistry

Pitchford, G. Leonard (B. S. 1907, Nebraska)
Roehrich, Victor H. (B. S. 1909)

1911

Bachelor of Science in Chemistry

Cantwell, William F.
Halverson, Henry A.
Hartnett, John G.
Hennessey, Hugh J.
Johnson, Einer (M. S. 1912)
Leavenworth, Francis M.
McMiller, Paul R.
Olson, Arthur O.
Pettijohn, Earl (M. S. 1912, Ph. D. 1918)
Stoppel, Ernest A.

Bachelor of Science in Chemical Engineering

Baker, Russell E.
*Bolton, John B.
Callaway, Roy S.

Master of Science in Chemistry

Bell, Grace M. (B. A. 1909)
Daniels, Farrington (B. S. 1910)

Master of Science in Chemistry

Kepner, Ben-Hur (B. A. 1910)
Peterson, Andrew P. (B. A. 1910)
Poppe, Frederick W. (B. A. 1910, Lawrence)

1912

Bachelor of Science in Chemistry

Brinton, Paul H. M.-P. (M. S. 1913, Ph.D. 1916)
Daniels, Elmer A. (M. S. 1913, Ph.D. 1917)
Hoffman, Henry J. (M. S. 1914)
Karatz, Lucian
*McLeod, John B.
Mitchell, Ralph W.
Nease, Charles O.
Parkin, Guy G. (M. S. 1913)
Robinson, Rhea B.
Rockwood, Ralph H.
Schmidt, George H.
*Spriestersbach, David O. (M. S. 1915)
Wanless, Lynn A.

Bachelor of Science in Chemical Engineering

Edwards, Junius D. (Ch. E. 1913)
Goldstein, Milton M. (Ch. E. 1913)
Harshaw, John R.

Chemical Engineer

Brunkow, Herbert E.
Martin, Edmund W.

Master of Science in Chemistry

Johnson, Einer (B. S. 1911)
Pettijohn, Earl (B. S. 1911, Ph. D. 1918)

Doctor of Philosophy

Frary, Francis C. (A. C. 1905, M. S. 1906)

1913

Bachelor of Science in Chemistry

Felton, Arthur J.
Martin, Marion G.
Miller, Ralph H.
O'Connell, Thomas C. (M. S. 1914)
Otterstein, Earl F.
Sutter, Hedwig M. (Mrs. R. Wilson)
Taylor, Cyril Stead
Yngve, Victor

Bachelor of Science in Chemical Engineering

Anderson, Fredolf T. (Ch. E. 1914)
Katz-Nelson, William
Kern, Herbert A. (Ch. E. 1914)
Peterson, Henry (Ch. E. 1914)
Porter, Ralph E. (Ch. E. 1914)

Chemical Engineer

Edwards, Junius D. (B. S. 1912)
Goldstein, Milton M. (B. S. 1912)

Master of Arts in Chemistry

Beck, Maud G. (B. A. 1905)
Skartvedt, Peter M. (B. A. 1906, St. Olaf)

Master of Science in Chemistry

Brinton, Paul H. M.-P. (B. S. 1912, Ph.D. 1916)
Cressy, Charles R. (B. S. 1908)
Daniels, Elmer A. (B. S. 1912)
Parkin, Guy G. (B. S. 1912)

Doctor of Philosophy

Cohen, Lillian (B. S. 1900, M. S. 1901)

1914

Bachelor of Science in Chemistry

Gauger, A. W.
Juvrud, Ingvald O.
Merton, Howard V.
Tibbling, Ernest F.

Chemical Engineer

Anderson, Fredolf T. (B. S. 1913)
Bierman, Harry C. (B. S. 1914)
Kern, Herbert A. (B. S. 1913)
May, Darwin R. (B. S. 1914, Ch. E. 1915)
Peterson, Henry (B. S. 1913)
Porter, Ralph E. (B. S. 1913)
Tinkham, Willis M. (B. S. 1914)

Bachelor of Science in Chemistry

Bray, Mark W. (B. A. 1912, Lawrence)
Hoffmann, Henry J. (B. S. 1912)
Kokatnur, Vaman R. (B. A. 1912, Bombay India, Ph. D., 1916)
Yngve, Victor (B. S. 1913)

Doctor of Philosophy

Brown, Harold H. (B. A. 1909, M. A. 1910, Syracuse)

1915

Bachelor of Science in Chemistry

Fegan, Elmer T. (M. S. 1916)
Olsen, Leslie R.
Ringstrom, Hugo (M. S. 1917)
Toncheff, Stanil

Bachelor of Science in Chemical Engineering

Morse, Guilford A. (Ch. E. 1915)

Master of Science in Chemistry

Nietz, Adolph (B. A. 1913)
*Spriestersbach, David O. (B. S. 1912)
Ziegler, Mildred R. (B. A. 1914)

Doctor of Philosophy

Temple, Sterling N.
(Ph. D. 1905, M. A. 1906, Hamline)

1916

Bachelor of Science in Chemistry

Dunningham, Merton
Souther, Benjamin L.
Morrow, Leon W.

Bachelor of Science in Chemical Engineering

Bell, Alexander D. (Ch. E. 1917)

Master of Science in Chemistry

Fegan, Elmer T. (B. S. 1915)
May, Darwin (B. S. Ch. Eng. '14, Ch. E. '15)
Newman, Allen T. (B. S. 1912, Nebraska)
Stenger, Lawrence A. (B. S. E. E. 1906)
Woolett, Guy H. (B. S. 1910, Ph. D. 1918)

Doctor of Philosophy

Brinton, Paul H. M.-P. (B. S. 1912, M. S. 1913)
Kokatnur, Vaman R.
(B. S. 1912, Bombay, M. S. 1914)

1917

Bachelor of Science in Chemistry

Carson, Benjamin I. Marr, Horace S.
Durham, Samuel W. Marshall, Olive W.
*Eckman, Lawrence R. Owens, Jay C.
*Egge, Walter Rask, Olaf S.
Markus, Benjamin

Bachelor of Science in Chemical Engineering

Burningham, Foster A. Luft, Oscar W.
(Ch. E. 1918) Strong, Frank D.
Domovsky, Aaron Washburn, Frederick M.
Higburg, William Widell, Gideon
Kuentzel, Ward E.

Chemical Engineer

Bell, Alexander D. (B. S. 1916)

Master of Science in Chemistry

Barrows, Vera (B. A. 1906)
Cade, Arthur R.
(B. S. Worcester Polytechnic Inst. 1915)
Joyce, Floyd E. (B. S. 1912, Iowa)
Lauer, Walter M.
(B. S. 1913, Ursinus College, Ph. D. 1924)
Ringstrom, Hugo (B. S. 1914, B. S. 1915)
Seyfried, Lillian M. (B. A. 1915)

Doctor of Philosophy

Daniels, Elmer A. (B. S. 1912, M. S. 1913)

1918

Bachelor of Science in Chemistry

Joselowitz, Goodwin Nelson, Harry G.
Kesselman, Leo Pan, Wen Ping

Bachelor of Science in Chemical Engineering

Donauer, Max (Ch. E. 1925)
Hognes, Thorfin (Ch. E. 1919)
Johnson, Donald L. (Ch. E. 1919)
Kessel, Herbert (Ch. E. 1919)
Neilsen, Chris

Chemical Engineer

Burningham, Foster A. (B. S. 1917)

Master of Science in Chemistry

Schultz, Peter D. (B. A. 1914, Bethel College)

Doctor of Philisophy

Pettijohn, Earl
(B. A. 1906, B. S. 1911, M. S. 1912)
Sternberg, Woldemar M.
(B. S. 1908, Petrograd, Russia)
Woollett, Guy H. (B. S. 1910, M. S. 1916)

1919

Bachelor of Science in Chemistry

Beckel, Arthur C. Heck, Frank J.
Brooks, Leslie C. Thorson, Stuart J.
Engstrom, Leslie G.

Bachelor of Science in Chemical Engineering

Fischer, Earl B. (Ch. E. 1923)
Greenlaw, Charles E.
Hawkey, Harold K. (Ch. E. 1919)
Koch, Arthur
Reu, Albrecht H. (Ch. E. 1920)
Winslow, Raymond (Ch. E. 1920)

Chemical Engineer

Hognes, Thorfin R. (B. S. 1918)
Hawkey, Harold K. (B. S. 1919)
Johnson, Donald Lee (B. S. 1918)

1920

Bachelor of Science in Chemistry

Hoff, John E.
Korfhage, Roy F.
Matthews, Glenn E. (M. S. 1921)
Moe, Claude P.
Pippel, Herbert A.

Bachelor of Science in Chemical Engineering

Anderson, Minton M. (Ch. E. 1921)
Busch, John S.
Fieger, Ernest A. (Ch. E. 1921)
Hammer, George E.
Jones, Ernest J. (Ch. E. 1921)
Kracek, Frank C. (Ph. D. 1924)
Mitchell, Donald F. (Ch. E. 1921)
Parrett, Arthur N. (Ch. E. 1921)
Pearson, Elmer A. (Ch. E. 1921)
Reck, Robert C. (Ch. E. 1921)
Sternberg, Heime A. (Ch. E. 1921)
Stoppel, Arthur E. (Ch. E. 1921, Ph. D. 1924)
Wallfred, Carl L. (Ch. E. 1921)
Weber, Ludwig J. (Ch. E. 1921, Ph. D. 1924)

Chemical Engineer

Reu, Albrecht H. (B. S. 1919)
Winslow, Raymond M. (B. S. 1919)

Master of Science in Chemistry

Morse, Minerva (B. A. 1915, Ph. D. 1925)
Plummer, Clayton E.
(B. C. E. 1914, Michigan)

1921

Bachelor of Science in Chemistry

Corl, Cady S. Riley, Philip J.
Epstein, Hymen (M. S. 1924)
Kryger, Edward R. Seymour, Merrill W.
Nygard, Edwin M. Westerberg, Carl G.

Bachelor of Science in Chemical Engineering

Aronovsky, Samuel I. (Ch. E. 1922)
Boxell, Morris L.
Cornell, Reuben W. (Ch. E. 1922)
Lee, Melville R. (Ch. E. 1922)
Leerskov, Gerhard W.
Nicholson, Harry G.
Peterson, Marshall A. (Ch. E. 1922)
Ramsey, Selmer
Riddington, Frederick W. (Ch. E. 1922)
Roberts, Wesley J. (Ch. E. 1922)
Ruchhoft, Clarence
Schermer, Oscar C. (Ch. E. 1922)
Swart, Richard H.

Chemical Engineer

Anderson, Minton M. (B. S. 1920)
Fieger, Ernest A. (B. S. 1920)
Jones, Ernest J. (B. S. 1920)
Mitchell, Donald F. (B. S. 1920)
Nicholson, Harry G. (B. S. 1921)
Parrett, Arthur N. (B. S. 1920)
Pearson, Elmer A. (B. S. 1920)
Reck, Robert C. (B. S. 1921)
Sternberg, Heime A. (B. S. 1920)
Stoppel, Arthur E. (B. S. 1920, Ph. D. 1924)
Wallfred, Carl L. (B. S. 1920)
Weber, Ludwig J. (B. S. 1920, Ph. D. 1924)

Master of Science in Chemistry

Hauge, Sigfred M. (B. A. 1918, St. Olaf)
Hovland, Clifton R. (B. A. 1919, St. Olaf)
Kohlhase, Arthur H.
(B. S. 1919, Hamline, Ph. D. 1924)
Matthews, Glenn E. (B. S. 1920)

1922

Bachelor of Science in Chemistry

Darling, Stephen F. (M. S. 1924)
Ellestad, Reuben (M. S. 1924)
Hammond, Kathryn D. (Mrs. K. E. Kelley)
Sullivan, Betty
Tappan, Ruth W. (Mrs. Joseph Dowling)

Bachelor of Science in Chemical Engineering

Barrett, Joseph O. (Ch. E. 1923)
Busch, William A.
Cassel, Norman S. (Ch. E. 1923)
Chadbourne, L. Rodney (Ch. E. 1923)
Halvorson, Halvor O. (Ch. E. 1923)
Langseth, Axel O. (Ch. E. 1923)
Livermore, Harvey J.
Luger, Karl E.
Manuel, Douglas R.
Morin, William T. (Ch. E. 1923)
Morken, Carl H.

Bachelor of Science in Chemical Engineering

Schwartz, Marcel M.
Stone, Leslie F. (Ch. E. 1923)
Wyman, LeRoy L. (Ch. E. 1923)

Chemical Engineer

Aronovsky, Samuel I. (B. S. 1921)
Cornell, Reuben W. (B. S. 1921)
Lee, Melville R. (B. S. 1921)
Peterson, Marshall A. (B. S. 1921)
Riddington, Frederick W. (B. S. 1921)
Roberts, Wesley J. (B. S. 1921)
Schermer, Oscar C. (B. S. 1921)

Master of Science in Chemistry

Fulermer, Jervis M.
(B. S. 1920, Washington State College)
Harris, Elmin E. (B. S. 1921, Hamline)
Heisig, Lucille Krantz (B. A. 1919)

Doctor of Philosophy

Hartshorn, Elden B. (B. S. 1912, Dartmouth)

1923

Bachelor of Science in Chemistry

Kampa, Edmund Webster, Cora H.

Bachelor of Science in Chemical Engineering

Bostwick, Ross D.
Bruce, G. Norman
Eck, Lester J. (M. S. 1924)
Edgar, Donald E. (M. S. 1925)
Firth, Charles V.
Frederickson, Hubert M.
Hatch, Lloyd
McMillen, Elliott L. (M. S. 1927)
Paulson, Paul M. (M. S. 1924)
Peterson, Clifford E.
Rademacher, Richard L. (M. S. 1924)
Sorenson, Ben. E. (M. S. 1924, Ph. D. 1927)
Thordarson, William (M. S. 1924)
White, Robert H. (M. S. 1924)

Chemical Engineer

Barrett, Joseph O. (B. S. 1922)
Cassel, Norman S. (B. S. 1922)

Chemical Engineer

Chadbourne, L. Rodney (B. S. 1922)
Halverson, Halvor O. (B. S. 1922)
Langseth, Axel O. (B. S. 1922)
Morin, William T. (B. S. 1922)
Stone, Leslie F. (B. S. 1922, Ph.D. 1927)
Wyman, LeRoy L. (B. S. 1922)

Master of Science in Chemistry

Anderson, Winslow S. (B. S. 1921, Bates College)
Bakken, Adolph C. (B. A. 1919, St. Olaf)
Pagel, Herbert A. (B. A. 1922)

Bachelor of Science in Chemical Engineering

Ernst, Robert C.
(B. S. 1921, N. C. State College)
Kester, Ernest B. (B. A. 1922)

Doctor of Philosophy

Levine, Arthur (B. A. 1916, Augustana College)

1924

Bachelor of Science in Chemistry

Fredrickson, Edna M. Ludwig, Llewellyn G.
Humphrey, Gertrude J.

Bachelor of Science in Chemical Engineering

Bache, Edmund
Dahlen, Miles A.
Fuhrman, Alvin O.
Glenn, Harry W.
Krantz, Rudolph W. (B. A. 1923, M. S. 1925)
Lavine, Irvin
Luft, Hans L. (M. S. 1924)
Paul, Karl F.
Roque, Feliciano T.
Zims, Albert G.

Master of Science in Chemistry

Bauer, Esther E. (B. A. 1921)
Darling, Stephen F. (B. S. 1922)
Dobrovolny, Frank J.
(B. A. 1920, Dakota Wesleyan)
Ellestad, Reuben B. (B. S. 1922)
Elmquist, Ruth E. (B. A. 1921)
Riley, Philip J. (B. S. 1921)

Master of Science in Chemical Engineering

Eck, Lester J. (B. S. 1923)
Hartkemeier, Leonard (B. S. 1921, Louisville)
Luft, Hans L. (B. S. 1924)
Nelson, Ernest W. (B. A. 1920)
Paulson, Paul M. (B. S. 1923)
Rademacher, Richard L. (B. S. 1923)
Sorenson, Ben E. (B. S. 1923, Ph. D. 1927)
Thordarson, William (B. S. 1923)
White, Robert H. (B. S. 1923)

Doctor of Philosophy

Fuson, Reynold C. (B. A. 1920, Montana, M. A. 1921, Calif.)
Kohlhase, Arthur H. (B. S. 1919, Hamline, M. S. 1921)
Kracek, Frank C. (B. S. 1920)
Lauer, Walter M. (B. A. 1913, Ursinus College, M. S. 1917)
Sarver, Landon E. (B. A. 1915, Randolph Macon, M. A. 1919, Lafayette)
Stoppel, Arthur E. (B. S. 1920, Ch. E. 1921)
Weber, Ludwig J. (B. S. 1920, Ch. E. 1921)

1925

Bachelor of Science in Chemistry

Anderson, Alvin F.
Ayers, Ellsworth B.
Brinker, Howard C.
Galvez, Nicolas L.
Gilman, Hyam
Hamm, Homer A.
Vievering, William A.

Bachelor of Science in Chemical Engineering

Bekkedahl, Norman P.
Coult, Lyman H.
Covell, Paul L.
Edmunds, Alvin M.
Jewett, Ernest E. (M. S. 1926)
Johnson, Lester L. (M. S. 1927)
Johnston, Charles L.
McKee, John B. (M. S. 1926)
Reiter, Alfred A.
Scandling, Joseph E.
Sprung, Murray M.
Stier, Ruth I. (Mrs. Cecil Mayo)
Zeidlik, William J. (M. S. 1926)

Chemical Engineer

Donauer, Max (B. S. 1918)

Master of Science in Chemistry

Chaney, Albert L. (B. A. 1920, Washington Missionary College)
Freche, Hertha R. (B. A. 1919)
Underhill, Editha (B. A. 1916, Vassar)

Master of Science in Chemical Engineering

Edgar, Donald E. (B. S. 1923)
Krantz, Rudolph W. (B. A. 1923, B. S. 1924)

Doctor of Philosophy

Morse, Minerva (B. A. 1915, M. S. 1920)

1926

Bachelor of Science in Chemistry

DeVaney, Grace M.
Dysterheft, George A.
Johnson, Waldo C.
Thompson, Warren L.
Westman, Bruce

Bachelor of Science in Chemical Engineering

Bunger, Harold A.
Haugsrud, Parmalee S.
Jersbek, Henry S.
Kobe, Kenneth A.
Kugler, Joseph H.
Lewenstein, Abraham
Murray, Robert
Reiter, Alfred A. (M. S. 1926)
Rogers, Marvin
Schlafge, William H. (M. S. 1927)
Shirk, Loren H. (M. S. 1926)
Smith, Allen S.
Sverdrup, Edward F. (M. S. 1927)
Tronson, John L.
Rauen, Theodore
Jordan, Wallace E.

Master of Science in Chemical Engineering

Jewett, Ernest E. (B. S. 1925)
Kameda, Tohru (1923, Tokio Technical School)
McKee, John B. (B. S. 1925)
Pagnucco, John W. (B. A. '23 U. of Minn.; M. S. '26)
Reiter, Alfred A. (B. S. 1926)
Shirk, Loren H. (B. S. 1926)
Tindall, Jesse E. (B. A. 1919, Denver)
Zeidlik, William J. (B. S. 1925)

Doctor of Philosophy

Barber, Hervey H. (B. A. 1918)
Dobrovolny, Frank J. (A. B. 1920 Dakota Wesleyan; M. S. 1924)
Morris, Vlon N. (B. S. 1922; M. S. 1924, Purdue)
Sweazingen, Lloyd E. (B. S. 1920; M. S. 1921, Oklahoma)

1927

Bachelor of Science in Chemistry

Anderson, Edgar G.
Dumke, Walter H.
Lux, Lester

Bachelor of Science in Chemical Engineering

Arnold, Jerome H.
Beal, John L.
Bercovitz, Henry
Cornell, L. Wallace
Elston, Arthur A.
Gerlicher, Harold W.
Holst, James E.
Languth, Karl H.
Maehl, Kenneth A.
Moffat, Harold A.
Murray, Robert C.
Ohlweiler, William
Wheeler, Roger B.

Master of Science in Chemistry

Kilburn, Elsie I. (B. A. 1924)
Lampert, Kenneth C. (B. S. '25)
Lohman, Anne L. (B. A. 1922)
Wernlund, Christian J. (Ph. B. 1913, Hamline; M. S. 1916, Northwestern)
Willman, August (B. A. Rude College)

Master of Science in Chemical Engineering

Johnson, Lester L. (B. S. '25)
McMillen, Elliot L. (B. S. 1923)
Schlafge, William H. (B. S. '26, M. S. '27)
Sverdrup, Edward F. (B. S. '26)

Doctor of Philosophy

Crawford, H. Marjorie (B. A. '20, Miami; M. S. '22, Iowa)
Edgar, Donald E. ('23 B. S., '27 Ph. D.)
Pugel, Herbert A. (B. A. '22; M. S. '23)
Sly, Caryl (B. S. '23; M. S. '24, Nebraska)
Sorenson, Ben E. (B. S. '23, M. S. '24)
Stone, Leslie F. (B. S. '22, ChE. '24)
Whitney, Robert B. (B. A. '24)

1928

Bachelor of Science in Chemistry

Blosio, Herbert Helmer
Goldberg, Will Mordecai
Hansen, Theodore Bruce
Hargrave, Lorin Donald
Knutson, Reuben W.
Robinson, Helen M.
Silverman, Reuben
Sandell, Ernest B.
Wells, Percy Albert

Bachelor of Science in Chemical Engineering

Kurtz, Kerwin K.
Fawcett, Robert B.
Foker, Leslie Warren
Gehrenbeck, Gilbert B.
Gerlicher, Robert A.
Hella, Roy Paul
Jallings, Kenneth R.
Merrill, Grant S.
Seestrom, Hjalmer E.
Stodola, Frank Harold
Swenson, George W.
Van Duzee, Edward M.

Master of Science in Chemistry

Bull, Henry R. (B. S. '27 U. of So. Carolina)

Master of Science in Chemical Engineering

Buzzell, Maurice E. (B. A. '26 Macalester Col.)
Kobe, Kenneth Albert (B. S. '26 U. of Minn.)
Tronson, John Laurence (B. S. '26 U. of Minn.)
Rohrman, Frederick A. (B. S. '26 Oregon Agri. Col.)

Doctor of Philosophy

Beard, Ralph Finney (B. S. '17)
Dahlen, Miles A. (B. S. '24)
Brewer, Ralph Emmett (B. A. '17; M. S. '20)

1929

Bachelor of Science in Chemical Engineering

Baker, Lawrence G.
Butler, Clifford Thomas
Clark, Carroll
Draper, Howard Clinton
Eaton, Wentworth Ch.
Erickson, Gust Erick
Fuller, Donald Leask
Glaser, David Walter
Gordon, Moses
Heinemann, Gustave
Hill, Donald Paul
Hovde, Frederick L.
Kanter, Max
Langkammerer, Carl M.
Linden, Carlyle Maurice
Lyden, Arvid E.
McConnell, John R.
Micks, Kerwin
Mitchell, William James
Mohrenweiser, Elmer H.
Moore, Leonard P.
Nelson, Lawrence Wm.
Netherly, George F.
Otis, Lawrence Bradley
Parkin, Fremont Peter
Petry, Theodor Arthur
Rehfeld, Harold
Rolwes, Edward A.
Shabaker, Hubert A.
Shoup, Geo. L., Jr.
Straub, Wm. Sanford
Stromberg, Hans Bernhard Severin
Thompson, Boyd Alpha

Bachelor of Science in Chemistry

Brick, Bayard R.
Ramsden, Allyn M.
Sperry, Wilbur
Roe, Charles P.
Shields, Charles Dohm
Wolk, Isadore

ADVANCED DEGREES

Master of Science in Chemical Engineering

Beal, John Linden (B. S. 1927)
Kurtz, Kurwin Kenton (B. S. in Ch. E. 1928)
Lauer, Byron E. (B. S. '27, Oregon State Ag. Col.)
Holst, James E. (B. S. '27, Univ. of Minn.)

Doctors of Philosophy

Aronovsky, Samuel I. (B. S. in Ch. E., '21, Ch. E. '22, Univ. of Minn.)
Marks, Barnard M. (B. S. '26, Ch. E. '27, Univ. of Mo.)

Masters of Science in Chemistry

Lux, Albert R. (B. A. '26, Univ. of Minn.)
Sandell, Ernest B. (B. S. '28, Univ. of Minn.)

ALPHABETICAL DIRECTORY

College of Engineering and Architecture

Alumni, help us keep these lists correct. In spite of our efforts we realize that there are errors and old and incorrect addresses. Those graduates whom we have not heard from have been listed with their addresses the same as last year. We would appreciate having corrections sent to the Dean's Office.

AASLAND, ARNE '23 C
620 S. 9th St., Minneapolis.
Estimator and Salesman, Harrison & Smith Co.

AASLAND, CHRISTOPHER '15 C
1406 Thomas Ave. N., Minneapolis,
Resident Engineer,
Minnesota Highway Department.

ABBOTT, AMOS H. '16 E '17 EE
1854 Grand Ave., St. Paul.
Northern States Power Co., Minneapolis,
Asst. Gas Engr.

ABBOTT, ARTHUR L. '97 E
420 Lexington Ave., New York City.
Business Engineer, Society for Elect. Develop., Inc.

ABRAHAMSON, ARTHUR L. '29 EE
Pittsburg, Pa.
Westinghouse Elect. Co.

ABRAHAMSON, HOWARD B. '18 M
St. Paul, Minn.
Northern States Power Co., Engineering Department.

ABRAHAMSON, LEROY M. '29 EE
950 Edison Bldg., Chicago, Ill.
Chicago Central Station Institute.

ABRAMSON, HARRY W. '23 C
923 Fremont Ave., Minneapolis.

ACKER, SIDNEY H. '23 M
314 Frisco Bldg.
St. Louis and San Francisco Ry.,
Springfield, Mo.
Assistant Engineer of Tests.

ACKERMAN, ROBERT '28 E
208 West Washington Ave., Chicago, Ill.
A. T. & T. Co., Cable Const.

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.
Insurance.

ADAMS, EDWARD H. '22 G
1004 Marquette Ave., Minneapolis.
Owner of E. H. Adams Construction Co.

ADAMS, ELMER E. '06 C
112 E. 22nd Ave., 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
201 Eustis Bldg., Minneapolis, Minn.
Realtor.

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., Manager.

AFFLECK, DEAN H. '28 AE
317 Union St. S. E., Minneapolis, Minn.
Medical Student, U. of M.

AGETON, EDWIN O. '26 E
Stillwater, Minn.
Asst. Supt. Northern States Power.

AINSLIE, ARTHUR F. '11 C
Staples, Minn.
Asst. Engineer, N. P. R. R.

AKINS, CLIFFORD M. '27 M
2840 Garfield Ave. S., Mpls.

ALBRECHT, ERNEST G. '25 E
St. Paul, Minn.
Tri-State Tel. and Telg. Co.
Trans. Inspr.

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.
Patent Attorney.

ALDERSON, ANTHONY D. '29 C
Rochester, Minn.

ALDRICH, LOUIS W. '23 C

ALEXANDER, GEORGE D. '20 C
916 New York Life Bldg., Minneapolis.
J. W. Stoffer Co.

ALGREN, AXEL B. '23 M
3049 10th Ave. S., Minneapolis.
Instructor in Engineering at U. of M.

*ALLBEE, PIERCE '16 A

ALLEE, DAVID A. '02 C
Room 643, Schenectady, N. Y.
General Elec. Co.

ALRICK, BANNONA G. '06 C
2746 13th Ave. S., Minneapolis.
Asst. Engineer, C. A. P. Turner Co.

ALSOP, ERNEST B. '06 C
Arling, Idaho.
Morrison-Knudsen Co., Engr. and Supt.

ALTON, HERBERT D. '07 E
2804 Sprague St., Spokane, Wash.
Electrical Contractor.

AMIDON, LEE L. '23 M
Morgantown, W. Va.
Instructor, Dept. Steam and Exp. Eng'g. W. Va. University.

AMIDON, ROGER '28 C
1502 Chelmsford St., St. Paul, Minn.

AMUNDSON, LELAND R. '29 AE
1227 4th St., Minneapolis, Minn.

ANDERS, MILTON '27 E
420 N. 8th St., Brainerd, Minn.
Eng. Dept., Northern Pacific R. R.

ANDERSEN, CHRISTIAN '88 C
New Post Office Bldg., Portland, Ore.
Engineer, Bureau of Public Roads.

ANDERSEN, EDWARD I. '17 M '19 ME
35 North View Park, Attica, N. Y.
Asst. Works Mgr., Westinghouse Elect. Co.

ANDERSON, ARNOLD O. '29 E
Pittsburgh, Pa.
Westinghouse Elect. Co.

ANDERSON, ARTHUR P. '25 E
102 W. 19th St., Chicago Heights, Ill.
Ill. Public Service Co. of N. 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, ELWOOD C. '28 E
Hazen, Arkansas.

ANDERSON, EMIL '05 E
Langford Electric Co.,
511 S. 3rd St., Minneapolis, Minn.

ANDERSON, EMIL G. '24 E
Bureau of Standards, Washington, D. C.

ANDERSON, FAYETTE C. '24 E
510 W. 123rd St., New York City.

ANDERSON, FRANK A. '08 E
935 Sandy Blvd., Portland, Ore.
National Appliance Co. Manager.

ANDERSON, FRANK L. '16 E
Minneapolis, Minn.
Testing Department, Elec. Machinery and Manufacturing Co.

ANDERSON, FRED S. '29 C
Hillsboro, N. D.

ANDERSON, GEORGE T. '15 C
City Engineer, Chisholm, Minn.

ANDERSON, HARVEY B. '12 C '13 CE
Hopkins, Minn.

ANDERSON, HELMER N. '20 M
220 E. 5th St., St. Paul, Minn.
Fairbanks-Morse & Co.,
Mgr. Diesel Engine Dept.

ANDERSON, HENRY A. '27 E
75 N. 4th, Easton, Pa.

ANDERSON, HILDER A. '18 M
2835 E. Hennepin Ave., Minneapolis, Minn.
Johnston Mfg. Co.

ANDERSON, IRVING E.
1482 Blair St., St. Paul, Minn.

ANDERSON, JOHN G. '99 C
Minneapolis, Minn., M. St. P. & S. Ste. M. R. R., Asst. Engr., Structural Design.

ANDERSON, JOSEPH A. '24 M
Flint, Mich.
A. C. Spark Plug Co., Chief Inspector, Speedometers.

ANDERSON, JOSEPH W. '15 E
517 Plymouth Bldg., Minneapolis.

ANDERSON, LAWRENCE B. '27 A
Instructor, University of Virginia,
University, Virginia.

ANDERSON, LOWELL W. '26 E
Schenectady, New York. General Electric Co.

ANDERSON, MARTIN E. '01 E
601-610 Interstate Trust Bldg.,
Denver, Colo.
c-o A. J. O'Brien, Patent Attorney.

ANDERSON, MATTHEW '24 E
N. S. Power Co., Special Const. Dept.,
308 Lincoln Bank Bldg., Minneapolis, Minn.
Cost Engineer.

ANDERSON, MERLE W. '29 E
15 S. 5th St., Minneapolis.
Northern States Power Co.

ANDERSON, MILTON J. '20 A
421-422 Bradley Bldg., Duluth, Minn.
c-o W. C. Agnew, Architect.
Draftsman.

ANDERSON, MILTON L. '21 A
1104 W. M. Garland Bldg., Los Angeles, Calif.
Architect, Nordstrom & Anderson.

ANDERSON, NELS S. '22 C
N. P. R. R., St. Paul (Main office),
Computor, Valuation Dept.

ANDERSON, OLE A. '93 M '08 ME
Box 263, Buhl, Minnesota.
Instructor in Machine Shop Practice.

*ANDERSON, OLE J. '93 C

ANDERSON, OSCAR P. '10 E
Harrison, N. J.
Edison Lamp Works, Mgr. Commercial Engraving Section.

ANDERSON, OSCAR V. '10 E
Toronto, Ontario, Canada.
Duncan and Nelson,
Toronto Hydro Electric System.

ANDERSON, WALTER W. '29 C
1390 Sherburn Ave., St. Paul.

ANDERSON, WESLEY J. '26 M
1841 S. Euclid, Berwyn, Ill.

*ANDREWS, GEORGE C. '87 M

ANDREWS, GEORGE L. '05 M
1901 Roblyn Ave., St. Paul, Minn.
Draftsman, American Hoist and D. Co.

ANDRUS, HARRY J. '22 C
Columbus, Ga.
Stone & Webster, Inc.

ANDRUS, RAYMOND J. '07 E
Foshay Bldg., Minneapolis, Minn.
Pres. Public Utilities Consolidated Corp.

ANGELL, GLENN H. '28 M
Austin, Minn.

ANWAY, FRED L. '29 AE
Bureau of Public Roads, Washington, D. C.

APPLEMAN, FRANK C. '24 E
Room 1404, 212 W. Wash. St., Chicago, Ill.
Engineer, Ill. Bell Telephone Co.

ARENSON, TIMOTHY G. '16 E

ARKO, FRANK W. '28 M
Chisholm, Minn.

ARMSTRONG, THOMAS S. '06 M

ARNESEN, HERBERT P. '11 C
Teltz, King & Day, St. Paul, Minn.
1418 Pioneer Bldg.,
Office Engineer.

ARNESON, LLOYD O. '21 M
Bailey Meter Co., Cleveland, Ohio.
Engineer.

ARSTAD, LEONARD O. '24 E
420 3rd Ave. S., Minneapolis.
Northwestern Bell Tel. Co., Engineer.

ARZT, EMMANUEL A. '97 BS '99 E
211 5th St., Sioux City, Ia.
Electrical Contractor.

ASCHER, RAYMOND C. '23 M
3-138 Gen. Motors Bldg., Detroit, Mich.
Republic Flow Meters Co., Sales Agent.

ASPALT, FILIP J. '27 E
Distribution Dept., Northern States Power Co.,
Minneapolis, Minn.

ASH, JAMES W. '08 C
206 E. Grand Ave., Des Moines, Ia.
American Horticulture Co.
Landscape Arch.

ASHBAUGH, LEWIS E. '00 M '07 CE
1427 N. Dearborn St., Chicago.

ASHWORTH, ROY H. '11 E
618 Kearns Bldg., Salt Lake City, Utah.
Utah Power and Light Co.

ASKE, IRVING E. '20 E
2921 Stevens Ave., Minneapolis, Minn.
Pres.-Gen'l. Mgr., Aske-Fuemer Co.

ASKEW, THOMAS A., JR. '16 C
Plainview, Minn.
Thomas Askew Co., General Merchandise
Manager.

ASLAKSON, BAXTER M. '91 M
53 W. Jackson Blvd.
Intercontinent Motor Corp.

ASLAKSON, CARL I. '23 C
U. S. C. & G. S. Ship, Manila, P. I.

ASLESON, HANS J. '10 C
Engineer and Contractor.
526 Sexton Bldg., Minneapolis, Minn.

*ATKINSON, WILLIAM B. '10 M

AULTFATHER, DAVID H. '22 E
431 Flowerdale Ave., Owatonna, Minn.

AURE, ROY '22 M
St. Paul, Minn. N. P. Ry., General Office
Bldg., Draftsman.

AUSTIN, PAUL D. '21 E
15 S. Fifth St., Minneapolis, Minn.
N. S. P. Co., Sales Dept.

AUXER, WILLIAM L. '25 C
Davenport, Iowa.
Iowa State Highway Commission.

*AVERY, HENRY B. '93 M '98 ME

*AVIS, S. L. '12 E '13 EE

AYSHFORD, LOREN C. '26 E
Chicago, Ill.
Western Electric Company.

BABCOCK, VERNON M. '23 E
14-230 General Motors Bldg.,
Detroit, Mich., General Motors Corp.

BACHELDER, WILLIAM H. '24 C
Exp. Eng. Building, Univ. of Minn.
Minn. Dept. of Highways.

BACHMANN, GRAYDON A. '23 M
382 Herschel Ave., St. Paul
Computer, Legal Valuation Dept., G.N.R.R.

BACHRACH, ALFRED '08 E
5201 Santa Fe Ave., Los Angeles, Calif.
General Elec. Co.

BACKSTROM, EMIL F. '24 A
415 Lexington Ave., Halins & Collins,
New York, N. Y.

BACKSTROM, KENNETH A. '27 A
3959 Snelling Ave., Minneapolis, Minn.

BACKSTROM, RUSSELL E. '25 M
Cloquet, Minn.
Wood Conversion Co.

BACKSTROM, WILBURG A. '23 A

BAER, LOUIS E. '07 E
Farming, Humbolt, Minn.

BAILEY, GEORGE R. '22 C
1219 Hull St., Evanston, Ill.
A. H. Wetten & Co., Chief Engineer.

BAILEY, JOHN T. '29 E
1725 Univ. Ave. S. E.
Soph. Arch. Eng. U. of M.

BAILEY, STUART L. '27 E
U. S. Engineers Radio Station, 3760 Jefferson, E., Detroit, Mich.

*BAILEY, WILLIAM H. '12 C '12 CE

BAKER, ARTHUR W. '19 M
Deerlodge, Montana.

BAKKEN, LAWRENCE H. '22 A

BALDOCK, FRED C. '29 M
4650 Xerxes Ave. S., Minneapolis.

BALKIN, SAMUEL W. '26 C
243 Loeb Arcade, Minneapolis, Minn.
Balkin Construction Co.

BALL, HAMPTON B. '20 M
Troy, Mo.
Farmer and Poultryman.

BALTON, JOHN M. '28 C
Elk River, Minn.

BANCROFT, HENRY K. '26 M
5417 Dupont S., Minneapolis.
Wm. Bros Boiler & Mfg. Co.

BANOVETZ, JOHN A. '25 C
St. Paul, Minn.
Engr. Dept., N. P. R. R. Co.

BARBER, HAROLD A. '21 C
Box 172, Big Creek, Calif.
Southern Calif. Edison Co.

BARGER, HAROLD L. '21 E
601 Monadnoch Bldg., Chicago.
Lab. Elect. Co.

BARLOW, HARRY E. '03 C
275 E. Fourth St., St. Paul, Minn.
Chief Engineer, C. St. P. M. & O. Ry.

BARNES, DEAN M. '21 E
San Bernardino, Calif.
Associated Telephone Co., Plant Supt.

BARNES, JAMES C. '28 E
212 Walnut St. S. E., Minneapolis, Minn.

BARNUM, CHARLES R. '24 A
University of Mich., Ann Arbor, Mich.
Instructor in Arch.

BARNUM, MARVIN C. '11 M
1900 James Ave. S., Minneapolis, Minn.

BARR, JOHN H. '83 M '88 MS
Ithaca, New York.
Vice-President, Barr-Morse Corp.

BARRON, JOHN H. '26 E
Marion, Ohio.
Engineering Dept., Marion Steam Shovel Co.

BARTHELEMY, CARL R. '28 M
1779 Wellesley Ave., St. Paul, Minn.

BARTHOLOMEW, NEAL W. '25 C
Asst. Office Engineer, C.M.St.P.&P.R.R.
Milwaukee, Wis.

BARTON, JAMES P. '27
Radio Engineering Dept.,
Chicopee Falls Plant, Mass.
Radio Engr. Westinghouse Elec. & Mfg. Co.

*BATCHELDER, FRANK L. '93 C

BATES, ALBERT H. '05 M

BATSON, CHARLES D. '07 C
202 Masonic Bldg., Mobile, Ala.
Manager for Republic Creosoting Co.

BATTLES, LEON E. '18 C
Coleraine, Minn.
Oliver Iron Mining Co., Mining Engineer.

BAUER, ROSCOE W. '24 C
Albany, N. Y.
Great Lakes Dredge & Dock Co.

BAUER, RUBEN B. '20 E
195 Broadway, New York.
American Tel. & Tel. Co., Engineer.

*BAXTER, WILMA K.
Certificate of Proficiency in Drawing and Design.

BAYLISS, DUDLEY C. '29 A
315 19th Ave. S. E., Minneapolis.

BAYLESS, HARRY C. '99 M
35 E. Wacker Drive.
West. Mngr. Business Training Corp.

BEACH, GEORGE H. '27 E
Stewartville, Minn.

BEAN, WILLIAM L. '02 M
610 N. Crescent Hgts. Blvd., Los Angeles, Calif.

BEARDMORE, ALBERT E. '21 E
Schenectady, New York.
General Electric Co.
Industrial Engineering Dept.

BEAUDEN, LAWRENCE '28 C
654 Aurora Ave., St. Paul, Minn.

BEAULIEU, RICHARD L. '02 C
Marlborough Apts., Everett, Wash.
Manager, Am. Pile Driving Company.

BECK, VERNON S. '10 E
1011 E. 7th Ave., Winfield, Kansas.
Chief Engr. of Winfield.

BECKER, WARD E. '17 E
Hqts., 9th Corp Area, U. S. Army,
San Francisco, Calif.
Captain, Ordnance Dept., U. S. Army.

BECKJORD, WALTER C. '09 E
100 Arlington St., Boston, Mass.
Boston Consolidated Gas Co., Vice-Pres.

BEEK, HIRAM D. '26 M
791 Forest, St. Paul.
Minn. Mining & Mfg. Co., Engineering Dept.

BEEMAN, HARRY J. '21 G
337 N. Menard Ave., Chicago, Ill.
John R. Magill Co.

BEERY, CHARLES B. '09 M
1700 Portland Ave., Minneapolis, Minn.
Pres. Prudential Co. of Minn.

BEESE, HAROLD U. '25 C
St. Paul, Minn.
Bridge Dept., G. N. R. R.

BEIGFORD, ROLFE
Standard Oil Co.
1918 Russell Ave. N., Minneapolis, Minn.

BELL, MAURICE D. '07 M
Minneapolis, Minn.
Washburn-Crosby Co., "A" Mill Office
General Superintendent.

BENEDICT, GEORGE F. '03 E
U. S. Navy Yards, Puget Sound, Wash.
Mechanical Engr.

BENEKE, WALTER E. '20 C

BENESOVITZ, A. '28 E
Water and Light Dept., Hibbing, Minn.

BENHAM, CLAUDE F. '12 E '13 EE
530 Bush St., San Francisco, Calif.
Great Western Power Co.

BENNETT, JOHN C. '26 M
South St. Paul, Minn.
Power Plant, Armour & Company.

BENNETT, WALTER J. '03 C
Great Northern Ry., St. Paul, Minn.

BEN-ORA, SAMUEL '29 A
1426 Barnes Place N., Minneapolis.

BENSON, IREL C. '25 E
Engr., Elect. Mach. Mfg. Co., Minneapolis, Minn.
1331 Tyler St. N. E., Minneapolis, Minn.

BENSON, MONS '28 C
U. S. Engineer's Office, Grand Rapids, Mich.

BERDAN, HUBERT J. '22 C
Chippewa Falls, Wis.
N. S. P. Co., Hydro Development.

BERG, KARL A. E. '20 C
235 Clark Ave., Billings, Mont.
N. P. R. R. Co., Geologist.

BERG, SAMUEL A. '21 BA '21 E '22 EE
1211 Times Bldg., New York.
Caxton Inst. of Extension Ed.

BERG, SWAN P. '23 C
1520 Soo Line Bldg., Minneapolis, Minn.
Asst. Engr., M. St. P. and S. Ste. M. Ry.

BERG, THORSTEN H. '25 C

BERGFORD, JOHN '28 C
645 11th St., Eau Claire, Wis.

Bergford, Lester M. '23 C
556 Builders Exchange, Minneapolis, Minn.
Cutler-Magner Co.

Bergford, Rolf E. '23 C
309 Oak St. S. E., Minneapolis.
Standard Oil Co.

Berghs, Charles J. '26 C
214 Julian St., Waukegan, Ill.

Berglund, Erick B. '27 E
Camden, N. J.
R. C. A. Victor Co., Eng. Dept.

Bergman, Hilder W. '26 E
3445 Wisconsin Avenue, Berwyn, Ill.

Bergoust, Oscar J. '08 C

Berquist, Edwin T. '24 C
360 N. Michigan Ave., Chicago.
Sales, Wood Conversion Co.

Bergquist, John E. '13 C
1210 W. California, Urbana, Illinois.

Bergquist, Philip L. '24 C
Wood Conversion Co.
360 N. Michigan Ave., Chicago.

Bergsland, Grant C. '23 M
1501 Vine St., La Crosse, Wis.
Supt. Street Railway, La Crosse, Wis.

Bergstrom, Marlow B. '22 E
517 Security Bldg., Elec. Engr.
J. E. Sumpter Co.

Berkner, Lloyd V. '27 E
Washington, D. C.
Radio Div., U. S. Bureau of Standards.

Berman, Florence '28 ID
644 Elwood Ave. N., Minneapolis, Minn.

Bernt, Hans E. '20 C
210 S. LaSalle St., Chicago, Ill.
Field Engr., Universal Portland Cement Co.

Berry, George F. '24 M
4036 2nd St., Wabasha, Minn.
N. S. P. Co.

Bertossi, Clarence F. '25 C
1019 First Ave. S., Fargo, N. D.
N. P. Ry.

Berzelius, Carl E. '29 AE
1150 Terminal Tower, Cleveland, Ohio.
Sales Engineer, The Insulite Co.

Beseler, Herman F. '25 M
Hoyt and Hamline Aves., St. Paul.
Hoyt Landscape Nursery.

Bestor, George C. '24 C
818 Univ. Ave. S. E., Mpls. Standard Oil Co.

Bevan, R. Louis '24 C
4017 Washburn Ave. S., Minneapolis, Minn.

Beveridge, Robert A. '26 E
1122 Ewing St., Fort Wayne, Ind.,
Gen'l Elec. Co.
Motor Specialist.

*Beyer, Adam C. '96 C

Beyer, Randall R. '27 E
7270 Sherbrook St., W., Montreal, Que.
Northern Elect. Co., Ltd.

Beyer, Theodore A. '03 C
405 Kearns Bldg., Salt Lake City, Utah.
Vice President, James J. Burke & Co., Inc.

Bezek, Albert J. '27 E
Chicago, Ill.
Engineer of Mfg. Organization, Western Elect. Co.

*Bieri, John B. '09 M

Bierman, George H. '18 M '19 ME
White Motor Co., Cleveland, Ohio.
842 E. 79th St., Cleveland, Ohio.
General Foreman, Dept. 351M.

Bierwagen, Rudolph W. '29 E
818 South Ave., Wilkinsburg, Pa.
Westinghouse Elect. Co., Pittsburgh.

Bill, Earl M. '12 E
Erie, Penn.
General Electric Co.
Tr. Eng. Dept.

Billau, Lewis S. '05 E
Baltimore, Maryland.
Baltimore and Ohio Ry.
Asst. Elec. Eng.

Bingen, William J. '12 C '13 CE
Pacific Northwest, Keewatin, Minn.
Salesman.

Bingham, Stanley E. '08 M
881 St. Clair St., St. Paul, Minn.
Bingham & Norton, Inc., Motor Cars.

Bird, Harold E. '25 C
St. Paul, Minn.
Minn. State Highway Dept.

Birnberg, Zingel C. J. '09 M
Youngstown, Ohio.
Carnegie Steel Co.
Machine Designer.

Bisbee, Bertin A. '22 E
1451 Capitol Ave., St. Paul, Minn.
Minn. By-Products Coke Co.

Bisbee, Elmer '05 C

Bisek, Peter P. '14 E
Baxter Springs, Kansas.

*Bishman, Adam E. '95 E

Bishop, Ira L. '11 M
Duluth, Minn.
Clyde Iron Works. General Supt.

Biskup, William F. '16 C
2091 Princeton Ave., St. Paul, Minn.
Minneapolis Steel and Machinery Co.

Bjerre, Folmar I. '25 M
2530 Highland Blvd., Milwaukee, Wis.

Bjonerud, Earl S. '22 E
Russ Bldg., 235 Montgomery St.,
San Francisco, Cal.
Gen. Elect. Co.

Bjorge, Oscar B. '07 M
Portland, Ore.
Secy and Gen. Mgr., Clyde Equipment Co.

Blackmore, Frank E. '28 M
Westinghouse Elec. & Mfg. Co.,
East Pittsburgh, Pa.

Blackshaw, Joe L. '28 M
1888 Feronia Ave., St. Paul, Minn.
Research Engineer, A. S. H. V. E.

Blake, Henry B. '01 E
Lightcap, South Dakota.
Rancher.

Blake, Robert P. '97 M
N. P. Ry., Tacoma, Wash.
Master Mechanic, Tacoma Div.

Bleecker, George W. '16 E
1331 Tyler St. N. E., Minneapolis, Minn.
Salesman, Electric Mach. Mfg. Co.

Bleifuss, Donald J. '20 C
Oliver Bldg., Pittsburgh, Pa.
Hydraulic Eng., Aluminum Co. of America.

Bliven, Paul '27 M
2812 Fremont Ave. S., Minneapolis.

Blodgett, Charles R. '24 M
828 W. North St., Kalamazoo, Mich.
American Sign Corp. Head of Order Dept.

Blomberg, Evar H. '16 E '17 EE
Hibbing, Minn.
Pentecostal Evangelist.

Blomquist, Hjalmer F. '07 C
Cedar Rapids, Iowa.
City Water Works, Supt.

Blossom, George W. '11 E
3113 Goldsmith St., Loma Portal, San Diego, Calif.

Blue, Clarence W. '25 C
204 S. 9th St., Minneapolis.
A. C. Ochs Brick & Tile Co., Sales Dept.

Bockus, Gerald H. '22 E
New Ulm Wholesale Grocery Co.,
New Ulm, Minn.
Secretary.

Boe, Lester L. '25 E
General Electric Co., Schenectady, N. Y.

Boehnlein, Charles '17 M '19 ME
Univ. of Minn., Minneapolis, Minn.
College of Engineering, Asst. Prof.

Boerner, Francis C. '11 C
1006 Marquette Ave., Minneapolis, Minn.
Croft and Boerner Co.

Bogue, Nathan H. '04 C
Box 185, Merril, Ore.

Bohannon, George W. '28 M
Proctor, Minn.
Duluth, Missabe and Northern Railway.

Bohland, John A. '95 C
G. N. Railway, St. Paul, Minn.
Office Engineer.

Bohrer, Donald M. '29 EE
Sales Engineer, Westinghouse Elect.,
East Pittsburgh, Penn.

Bolme, Ole M. '10 C
15 Park Row, New York, N. Y.
Robins Conv. Belt Co.

Bolnick, Harry W. '27 C
Amarillo, Texas.
Valuation Dept., A. T. & S. F. Ry.

Bolstad, Roswell C. '26 C
U. S. C. & G. S., Washington, D. C.

Bolton, John Merriot '28 C
Elk River, Minn.

Boman, Carl E. '05 E
463 West St., New York City, N. Y.
Bell Telephone Laboratories, Inc.

Bonner, Arthur L. '27
Bell Telephone Labs., 463 West St., New York.
Elec. Engr. Development Dept.

Bonner, Donald E. '25 C

Bonsall, Wallace C. '24 A
Apt. 407, 511 Melrose St., Chicago, Ill.

Borchardt, Lester F. '29 E
East Pittsburgh, Pa.
Westinghouse Elect. Co.

Borchert, Oscar H. '25 E
Mapleton, Minnesota.

Bordeau, Sanford P. '25 E
1331 Tyler St. N. E., Minneapolis, Minn.
Elec. Machinery Manufacturing Co.

Borden, John C. '29 E
Milwaukee, Wis., Cutler-Hammer, Inc.

Borne, Floyd O. '27 C
St. Paul, Minn.
Eng. Dept., N. P. R. R.

Borrowman, John K. '27 C
406 Federal Bldg., Milwaukee, Wis.
Jr. Eng. U. S. Eng. Office.

Borrowman, Leroy F. '08 C
Sutherland Construction Co.,
Winnipeg, Canada.

Borst, Wellington L. '24 M
St. Paul, Minn.
Donovan Construction Co.
Supt. of Construction.

Boss, Ronald W. '25 M
University and Raymond Aves., St. Paul, Minn.
The Specialty Mfg. Co., Gen'l Manager.

Bosshardt, Willmert C. '22 E
615 W. 43rd St., New York City.
Aldrich and Montgomery,
C-o Gentlewomen Magazine.

Bottemiller, Edward L. '27 E
Electrical Engineer
Gen. Elec. Co., Schenectady, N. Y.

Bouman, Bernard M. '04 E
463 West St., New York City,
Bell Telephone Laboratories, Inc.
Equipment Engineer

Bouquet, Otto T. '23 E
231 So. La Salle St., Chicago, Ill.
Rate Engineer, Byllesby Eng. & Mang't. Co.

Bowen, Fred P. '06 C
City Engineer's Office, Seattle, Wash.
Structural Draftsman.

Bowers, Raymond J. '28 M
Como Station, R 3, St. Paul, Minn.

Boyce, Ellsworth R. '17 C
Box 442, Rochester, Minn.
County Engineer, Olmsted County.

Boyce, Harold J. '27 E
3356 36th Ave. S., Minneapolis, Minn.
With Northern States Power Co.

Boyce, John '28 M
Minnesota Soldiers Home, Minneapolis, Minn.

Boyce, Leonard F. '12 M
1307 Center Ave., Sioux Falls, S. D.
Sioux Falls Construction Co., Pres.

Boyce, Norman E. '27 E
3356 36th Ave. S., Minneapolis, Minn.
With Northern States Power Co.

Boyd, Paul M. '24 M
Garden City, L. I., New York.
Curtiss Airplane & Motor Co.
Project Engineer.

Boyles, Ralph R. '15 M '16 ME
St. Paul, Minn.
American Hoist and Derrick Co.,
Designer.

Boyum, Benjamin O. '10 C
117 W. 3rd St., Winona, Minn.
Boyum, Schubert & Sorensen, Archs. & Eng.

Boyum, Irvin '17 E
2303 Kennedy St. N. E., Minneapolis, Minn.
Westinghouse Elec. & Mfg. Co.
Supt. Switchboard Div.

BRAATEN, ARTHUR '28 E
Box 979, Riverhead, New York.
R. C. A. Communications, Inc.
BRADBURY, MARGARET B. '29 IA
1724 E. 3rd St., Duluth, Minn.
BRADDOCK, EDWARD '24 C
3200 Garfield Ave. S.
Minneapolis, Minn.
BRADEN, RENE A. '23 E '25 MS (EE)
3620 Iron St., Chicago, Ill.
Research Eng., Zenith Radio Corp.
BRADLEY, BYRON H. '13 C '14 CE
3829 24th Ave. S., Alexander & Bradley.
Minneapolis, Minn.
BRANDT, CLIFFORD A.
15 S. 5th St., Minneapolis, Minn.
Rate Eng., N. S. P. Co.
BRATAAS, MARK G. '17 C
Breckenridge, Minn.
Highway Engineer.
BRATTLOF, CLIFFORD
466 Lexington Ave., New York, N. Y.
Engr. Drftsm., N. Y. Central R. R., Grand Cent. Terminal.
BRAUCH, HAROLD N. '29 E
419 Rebecca St., Wilkinsburg, Pa.
Westinghouse Elect. Co.
BRAUM, CYRIL M. '29 E
3832 Elliot Ave., Minneapolis, Minn. (res.)
Install. Eng., Western Elec. Sound Eq'pt. Co.
*BRAY, GEORGE E. '94 M '04 ME
BRAYDEN, GILES W. '27 E
11 Broadway, N. Y. City.
Ingersoll-Rand Co.
BREDING, LUCENE A. '29 IA
739 Metropolitan Nat'l Bank Bldg.
Minneapolis, Minn.
BREEDEN, JAMES R. '26 C
BRENCHLEY, HARRY E. '08 C
Minneapolis, Minn.
Minneapolis Steel and Machinery Co.
Manager, Structural Sales.
BRENCHLEY, WALTER C. '14 C '15 CE
4063 Liberty Blvd., Southgate, Cal.
Sale Eng. Union Iron Works of Los Angeles.
BREWER, CARLOS W. '29 M
BREWSTER, WILLIAM E. '12 E '13 EE
101 General Motors Bldg., Detroit, Mich.
The Christian Science Monitor.
BRIGGS, HIRAM K. '19 G
19213 Winslow Rd., Cleveland, Ohio
Asst. Ex. Secy., Amer. Soc. for Steel Treating.
BRIGGS, LUARD E. '27 C
332 Academy St., Williamsport, Pa.
Jr. Eng., U. S. Geological Survey.
BRIGGS, MAYNARD R. '29 E
East Pittsburgh, Pa., Westinghouse Electric Company.
BRIGGS, WILLIAM G. '21 E
Consumers Power Bld., Jackson, Mich.
Allied Engineers, Inc.
BRIGHTFELT, JOHN C. '29 E
Erie, Pa.
Gen. Elect. Co.
BRIMEYER, FERDINAND J. '25 AE
1300 Empire Bldg., Milwaukee, Wis.
Structural Engineer.
BROCKWAY, ALVAH E. '09 E
Rte. 1, Box 18, Medford, Oregon.
BROCKWAY, ROYDON R. '05 C
5th and Jackson Sts., St. Paul, Minn.
Chief Draftsman, Bridge Engr.
Office of N. P. Ry.
BRODERICK, VERE H. '27 A
BRODY, MACE J. '24 C
6032 Eberhard Avenue, Chicago, Ill.
BROHAUGH, GUSTAVE C. '27 C
1727 Laurel Ave., St. Paul, Minn.
Bridge Draftsman, Minn. Highway Dept.
BROOKE, HAROLD L. '18 E
2660 Grand Blvd., Detroit, Mich.
The C. G. Spring and Bumper Co.
BROS, BERNARD M. '23 M
Minneapolis, Minn.
William Bros Boiler & Mfg. Co.
BROS, CHESTER W. '22 M
Minneapolis, Minn.
William Bros Boiler & Mfg. Co.
BROS, KENNETH D. '27 M
Wm. Bros Boiler Co., Minneapolis, Minn.

BROS, ERNEST T. '17 M
Minneapolis, Minn.
Vice-Pres., William Bros Boiler & Mfg. Co.
BROS, RAYMOND J. '19 M '20 ME
Nicollet Island, Minneapolis, Minn.
Wm. Bros Boiler & Mfg. Co.
BROSE, WILLIAM C. '25 C
Marion Steam Shovel Co., Marion, Ohio
Salesman
BROSS, PETER P. '25 A
Rochester, Minn.
With I. M. Miller, Architect.
BROSSARD, EDWARD V. '23 M
Farmington, Minnesota.
BROSSARD, HENRY F. '25 E
Mantorville, Minn.
Rural Electrification Dept., N. S. P. Co.
BROWN, FLOYD W. '17 A
831 1st Natl.-Soo Line Bldg., Minneapolis, Minn.
Assoc. Arch., A. R. Van Dyck, Architects.
BROWN, GEORGE J. '08 E
27 New Parliament Bldg., Winnipeg, Man., Can.
BROWN, GLENDON '28 E
Cutler-Hammer Mfg. Co., Milwaukee, Wis.
BROWN, HARRY E. '22 G
310 2nd St. N. E., Watertown, S. D.
BROWN, HOMER L. '17 M
Aurora, Ill.
C. B. & Q. R. R.
BROWN, LOUIS M. '16 E
Pittsburgh, Pa.
Westinghouse Elec. & Mfg. Co.
*BROWN, OLIVER L. '07 M
BROWN, WILLIAM P. '12 M
223 Main Street, San Francisco, Calif.
Brown Bros. Welding Co.
BROWNELL, EDWARD '26 C
Bruce, Wis.
N. S. P. Co.
BROWNELL, OTTO E. '10 C
University of Minnesota, Minneapolis, Minn.
Div. of Sanitation, Minn. Dept. of Health.
BRUCE, HJALMER N. '16 C '17 CE
3431 11th Ave. S., Minneapolis.
Manager, A. M. Chesher Printing Co.
BRUESS, ED. C. '29 M
1110 Rice St., St. Paul.
BUCCOWICH, PAUL '27 E
P. O. Box 462, Ely, Minn.
BUCK, FREDERICK W. '09 M
205 Lonsdale Bldg., Duluth, Minn.
BUCKHOUT, DONALD H. '17 A
446 W. Front St., Perrysburg, Ohio (res.).
Architect, Nicholas Bldg., Toledo, Ohio.
BUENGER, ALBERT '13 M '14 ME
360 Robert St., St. Paul, Minn.
C. H. Johnston, Arch., Mechanical Engineer.
BUENGER, EDGAR '19 A
Rochester, Minnesota.
BUHL, JOHN E. '09 M
Turner Const. Co., 244 Madison Ave., New York.
BUHL, PAUL S. '07 M
532 W. Evergreen Ave., Youngstown, O.
Eng., Republic Iron & Steel Co.
BUHR, LEO '23 C
Bruce, Wis. N. S. P. Co.
BULL, ALVAH STANLEY '27 AE
c-o The Insulite Co., 7-219 General Motors Bldg., Detroit, Mich.
BULLARD, HENRY M. '26 C
1314 Wood St., Wilkinsburg, Pa.
Westinghouse Elec. and Mfg. Co.
BULLIS, EVERARD J. '24 C
808 Metro. Life Bldg., Woodrich Const. Co., Minneapolis, Minn.
BUMGARDNER, LOUIS T. '23 E
J. H. A. Bratz Co.
St. Paul, Minn.
BUNCE, PAUL F. '06 E
Omaha, Nebraska.
N. W. Bell Tel. Co., Gen. Traffic Mgr.
BUNNELL, CHARLES W. '26 C
720 36th St., Milwaukee, Wis.
Metr., Sewerage Commission
BURCH, ALBERT M. '96 C
Manager in charge of field construction, Minn. S. & M. Co.
Minneapolis, Minnesota.

BURCH, CECIL J. '29 C
1174 S. Robert St., St. Paul.
BURCH, EDWARD P. '92 E, '98 EE
1729 James Ave. S., Minneapolis, Minn.
Consulting Engineer, Foshay Tower.
BURKE, JAMES J. '28 M
850 Frelinghuysen Ave., Newark, N. J.
The Carrier Eng. Corp.
BURKE, ROY L. '05 C
515 Sellwood Bldg., Duluth, Minn.
Bowe and Burker.
BURLINGAME, ROBERT E. '25 E
15 S. Fifth Street, Minneapolis, Minn.
Electrical Section, N. S. P. Co.
BURMEISTER, CHARLES '27 E
Redwood Falls, Minn.
Redwood Falls Light & Power Co.
BURNETT, H. V. '14 C
Hampshire Arms, Minneapolis, Minn.
BURNS, DWIGHT T. '25 C
A. T. & S. F. R. R., Fairfax, Okla.
BURNS, HARVEY L. '02 E
149 Fulton St., New York, N. Y.
Methods & Planning Engrs.,
Installation Dept., Western Elec. Co.
BURRILL, CHARLES M. '23 E
RCA Victor Co., Inc., Camden, N. J.
BURRIS, ARTHUR '28 E
Westinghouse Elec. & Mfg. Co.,
Pittsburgh, Pa.
BURROWS, ROBERT P. '11 E
357 Palm Ave., Oakland, Calif.
Gen. Mgr., Nat'l Lamp Works of G. E. Co.
BURT, FRED R. '16 E
East Pittsburgh, Pa.
Gen. Engr., Westinghouse Elec. and Mfg. Co.
BURT, JOHN L. '90 C
Guadalajara, Jalisco, Mexico.
Owner of sugar estate.
BURT, PAUL R. '26 M
4112 Chicago Ave., Minneapolis, Minn.
BURTIS, WILLIAM H. '92 E
2216 Garfield Ave. S., Minneapolis, Minn. (res.)
U. S. Blower & Heating Corp.
*BURWELL, LORING D. '07 M
BUSHNELL, CHARLES S. '78 M
91 Spring St., Seattle, Wash.
Mfg. of typewriter parts.
BUSHNELL, ELBERT E. '85 M
1251½ 3rd St., Los Angeles, Calif.
Mfg. Typewriter Supplies.
BUTTERWORTH, ALLAN C. '11 E
700 Sellwood Bldg., Duluth, Minn.
Elec. Eng., Pickands, Mather & Co.
BUTTERWORTH, RUSSELL I. '16 E '17 EE
Bristol, Tenn., Gen. Supt., Tenn. Central Service Co.
CAHN, HAROLD '29 E
1367 E. 53 St., Chicago, Ill.
CALMEYER, JOHN P. '06 E
CAMERON, GRACE '27 I
344 E. 48th St., New York, N. Y. (res.)
Draftsman, Stair & Andrew
CAMERON, HARRY D. '25 E
Long Beach, Calif.
CAMERON, LESTER W. '27 A
1118 5th St. S. E., Minneapolis, Minn.
CAMPBELL, DOUGLAS M. '27 C
40 Squadron 5 S, Naval Aviator, Naval Air Station, Hampton Roads, Va.
CAPSTICK, DONALD W. '22 G
808 LaSalle Ave., Minneapolis, Minn.
c-o Morgan Gerrish Co.
CARJOLA, CHESTER L. '28 A
CARLBOM, LEONARD H. '25 C
4400 3rd Ave. S., Minneapolis.
Computer, Minn. State Hiway Dept.
CARLSON, ANDERS J. '16 C '17 CE
College of Mining, Univ. of Calif., Berkeley, Calif.
CARLSON, ARVID P. '17 M
St. Paul, Minn.
Elec. Distr. Engr., N. States Power Co.
CARLSON, C. PHILIP '21 E
Chuquicamata, Chile, South America.
Electrical Dept., Chile Exploration Co.
CARLSON, CHAUNCY M. '17 E
Albert Lea, Minn.
Supt. Operations, N. Division,
Interstate Power Co.

Carlson, Clifton C. '27 M
3529 Humboldt Ave. N., Minneapolis, Minn.
Carlson, Elner W. '27 C
Comfrey, Minn.
Carlson, Ernest F. '22 M
St. Paul Minn.
High Bridge Steam Plant, N. S. P. Co.
Carlson, Richard E. '22 E
Chicago, Ill.
Western Electric Co.
Carlson, Victor H. '20 E
Chile Exploration Co., Tocopilla, Chile, S. A.
Carlson, Warren E. '24 E
Carlton, Richard P. '21 G
791 Forest St., St. Paul, Minn.
Minn. Mining and Mfg. Co.
Carman, Willard J. '26 E
Chicago, Ill.
Ill. Bell Telephone Co.
Carpenter, Hugh W. '21 C
Asst. City Eng., Compton, Calif.
Carr, Harvey C. '03 C
Wells-Dickey Company, Minneapolis, Minn.
Carter, Robert J. '08 E
655 19th Ave. N. E., Minneapolis, Minn.
Carter, Mayhew Mfg. Co.
President.
Carter, Ruth '29 IA
217 Walnut St. S. E., Minneapolis, Minn.
Casberg, James W. '08 E
Weyburn, Sask., Canada.
Case, Gerald F. '23 E
536 W. 114th St. N. Y.
New York Edison Co.
Foreman, Test Dept.
Cass, Hoyt R. '24 E
430 Rasberry St., Erie, Pa. (res.)
General Electric Co., Transformer Engr.
*Casseday, George A. '95 C
Cassiday, Walter J. '24 E
6841 Stony Island Ave., Chicago, Ill.
Caswell, Thomas B. '25 M
638 Soo Line Bldg.,
Salesman, G. Elec. Co., Minneapolis.
Cayola, Chester L. '28 A
319 19th Ave. S. E., Minneapolis, Minn.
Cederstrom, C. M. '29 M
General Electric Co., Pittsfield, Mass.
Cerney, Glen G. '20 M
723 Fulton St. S. E. (res.)
Noble Realty Co., Minneapolis.
Chalmers, Charles H. '94 E '03 EE
1234 Central Ave. N. E., Minneapolis, Minn.
Chalmers Oil Burner Co.
*Chamberlain, Herbert D. '18 C
Chapin, S. Caryl '24 C
Three Rivers, Michigan.
City Manager.
Chapin, Harold S. '12 M '13 ME
445 Milwaukee St., Milwaukee, Wis.
Dist. Mgr., Concrete Engineering Co.
Chapman, Arthur G. '11 E
77 South Munn St., East Orange, N. J.
Chapman, Burton L. '10 C
Gasconade, Missouri.
Draftsman for U. S. Engineers.
Chapman, Leslie H. '95 C
996 St. Clair, St. Paul, Minn.
Draftsman, N. P. R. R.
*Chapman, Wendell P. '14 E
Chapman, Wilbur J. '27 M
1705 Hague Ave., St. Paul, Minn.
Chase, Arthur W. '93 E
Red Rock Bldg., Atlanta, Ga.
Cotton Merchant.
Cheney, Edward J. '04 E
61 Broadway, New York City.
Consulting Engineer.
Cherne, Realto '29 M
830 Frelinghuysen Ave., Newark, N. J.
Carrier Eng. Corp.
Chernus, Maurice C. '22 C
443 Wrigley Bldg., Chicago, Ill.
Bridge Contractor.
Chestnut, George L. '97 E
Dallas, Texas.
Sales Engineer, Graybar Electric Co.
Childs, Hervey B. '06 C
Childs, James A. '09 C
Univ. of Minn., Minneapolis, Minn.
Engr., Div. of Sanitation, State Board of Health.
Childs, John C. '06 C
Bulletin Bldg., Philadelphia, Pa.
The Austin Co.
Childs, Morris P. '25 E
4606 N. Robey St., Chicago, Ill.
Chilton, Edward G. '13 C '14 CE
Frazee, Minnesota.
Farmer.
Chowen, Walter A. '91 C
216 Pine Street, San Francisco, Calif.
California Inspection Rating Bureau, Manager.
Christen, Ray L. '26 E
Humbolt, Iowa.
Christensen, Arthur L. '25 E
15 S. Fifth St., Minneapolis, Minn.
N. S. P. Co.
Christensen, Edgar W. '19 E
Omaha, Nebraska.
Equipment Engineer, N. W. Bell Tel. Co.
Christenson, Elmer J. '27 C
Hastings, Minn.
U. S. Corps Engrs., Jr. Engr.
Christianson, Hilmar B. '15 C
Marion, Iowa. C. M. & St. P. R. R.
Christilaw, George M. '21 C
Lake City, Minn.
Resident Engr. Minnesota Dept. of Highways.
Christlieb, Frank B. '23 C
Minn. Highway Dept., St. Paul, Minn.
Christopherson, Arnold '28 E
Fergus Falls, Minn.
Church, Bruce R. '28 A
1112 W. Johnson St., Madison, Wis. (res.)
Law, Law & Potter, Archt's.
Clark, Charles J. '29 E
11 Broadway, N. Y. City.
Ingersoll-Rand Co.
Clark, Fred S. '27 E
Milwaukee Elec. Ry. Co., Milwaukee, Wis.
Clark, John S. '22 M
N. W. Bell Telephone Co., Minneapolis, Minn.
Supervisor of Motor Equipment.
Clark, Kenneth M. '27 C
Penn. R. R., Chicago,
179 1st St., Hinsdale, Ill.
Clark, William G. '12 M '13 ME
35 E. Wacker Drive, Chicago, Ill.
Pure Oil Co., Chief Automotive Engineer.
Clarke, Charles P. '08 C '09 CE
234 Oakland Ave., Milwaukee, Wis.
Draftsman, Warden-Allen Co.
Clausen, Elmer W. '23 E
Madison, Minn.
Clipfell, Carrol D. '05 M
Redwood Falls, Minn.
Teaching Industrial Arts in local high school.
Close, Winston A. '27 A
1617 Univ. Ave. S. E., Minneapolis, Minn.
Clousing, Lawrence '28 E
VJ1B Squadron, Fleet Air Base, San Diego, Cal.
Coates, J. Edwin '27 M
205 Oaks Ave., Dayton, Ohio.
Jr. M. E. Propeller Test Unit, McCook Field.
Cobban, Rollo J. '09 E
901 Porter Bldg., Portland, Ore.
Special Representative, Westinghouse Elec. & Mfg. Co.
Coe, Clarence S. '89 C
251 Charlotte Street, St. Augustine, Fla.
Consulting Engineer.
Coe, Edward H. '19 C '26 CE
Lieut., 3 Engineers U. S. A., Fort Shafter, T. H.
Cohen, Nathan '06 E
U. S. Patent Office, Washington, D. C.
Cole, Ernest C. '26 M
Fairbanks-Morse & Co., Beloit, Wis.
Engineering Department.
Coleman, Frank D. '05 E
Billings, Montana.
District Manager, Montana Power Co.
Collins, Stewart G. '04 G
1352 W. Minnehaha Pkwy., Mpls., Minn.
Building Contractor.
Collis, N. Stuart '24 M
1068 St. Clair St., St. Paul, Minn.
Colson, Lauren G. '21 E
7678 Rogers Ave., Chicago, Ill.
Colvin, James A. '14 M '15 ME
15 South Fifth St., Minneapolis, Minn.
Northern States Power Co., Supt. of Generation.
Comb, Fred R. '10 M
2113 Chicago Ave., Minneapolis, Minn.
Comfort, Clifford E. '26 M
1704 Pinehurst Ave., St. Paul, Minn.
Comfort, Thomas H. '26 C
York and Agate Streets, St. Paul, Minn.
St. Paul Structural Steel Co.
Compton, Milton '28 E
Maple Plain, Minn.
Comstock, John W. '08 C
Conley, Wilfred E. '10 E
543 Terminal Tower Bldg., Cleveland, Ohio
Illuminating Engr., Nat'l Lamp Works of G. E. Co., Buckeye Division.
Converse, Clovis M. '09 E
7780 Dante Ave., Chicago.
Sales Engr., G & W Elec. Spec. Company.
Cook, Harry C. '10 M
Red Wing Iron Works, Red Wing, Minn.
Manager.
Cook, J. M. '28 E
Cutler-Hammer Company, Milwaukee, Wis.
Cook, Lyle M. '27 M
7136 Cyril Ave., Chicago, Ill.
Cook, Robertson '02 M
Portland Gas & Coke Co., Portland, Ore.
Service Engineer.
Cook, Walter K. '22 C
Bankers Bldg., Chicago, Ill.
Structural Eng., Byllesby Eng. & Man. Corp.
Cooley, Gilbert '22 E
Northern States Power Co., St. Paul, Minn.
District Engineer.
Coon, Lawrence C. '26 E
Bridger, Mont.
Cooper, J. '28 E
2321 Boulder St., Los Angeles, Calif.
Cooper, Leo H. '06 E
442 Builders Exchange, Minneapolis, Minn.
Frank Adam Electric Co., District Manager.
Cooper, R. Conrad '26 C
Minneapolis, Minn.
Field Engineer, Universal Portland Cement Co.
Copeland, Floyd E. '23 M
72 W. Adams St., Chicago, Ill.
Public Service Co. of Ill.
Electric League Representative.
Corbett, Theodore R. '26 M
Minneapolis, Minn., Univ. of Minn.
Curliss, C. V. '28 E
Madison, Minn.
Cornelius, Martin '06 E
20 N. Wacker Drive,
Westinghouse Elec. Co., Chicago, Ill.
Cornell, George M. '25 C
90 Bristol St., New Haven, Conn.
Corser, John '16 M
Minneapolis, Minn.
Mech. Draftsman, Caterpillar Tractor Co.
Cosandey, Charles J. '25 E
Instructor Duluth Jun. College, Duluth, Minn.
Cosh, Richard A. '19 M
Machine and Eng. Dept. Supt.
Illinois Glass Co., Alton, Ill.
Cote, Rhoda H. '25 ID
Mrs. J. P. Barton
Springfield, Mass.
Cottingham, Geo., Jr. '15 C
303 Harrison St., Oak Park, Ill.
Cottingham, William P. '11 C
7th Ave. and Mass. Street, Gary Ind.
City Hall, City Engineer.
Cotton, Ernest H. '19 E
Eau Claire, Wis.
Asst. Genl. Supt., Wisconsin Div.,
Northern States Power Co.
Councilman, Halstad P. '08 M '09 ME
Fresno, Calif.
Rosenberg Bros. & Co., Mechanical Supervisor.
Countryman, M. Alden '25 E
Sioux Falls, S. D.
Western Material Co.
Countryman, Peter F. '07 E
R. R. 1, Ontario, Ore.
Rancher.

COUPER, GEORGE B. '93 M '02 ME
636 Railway Exchange, Portland, Ore.
Standard Appraisal Co., Office Engr.

COUSINS, VAN METER '25 E
463 West Street, N. Y. City.
Eng., Bell Telephone Lab., Inc.

COVELL, RUSSELL O. '16 E
463 West Street, New York City
Patent Attorney

COWIN, CLIFFORD C. '21 G
16161 Euclid Ave., Cleveland, Ohio.

COX, RICHARD F. '08 M
Ft. Mills, Corregidor, Cavite, P. I. Major Coast Artillery.

CRABBE, GEORGE N. '04 E
250 11th Ave., New York City.
Otis Elevator Co., Elec. Engineer.

CRAIG, HAMILTON S. '25 C
202 Union Station, Chicago.
B. & B. Dept., C. M. St. P. & P. R. R.

CRAIG, ROBERT '97 M
42 Broadway, New York City.
Consulting Engineer and Patent Attorney.

CRAM, CLYDE M. '07 C
1821 S. 6th St., Alhambra, Calif.

CRAMSIE, KENNETH J. '29 AE
2428 E. 22nd St., Minneapolis, Minn.

CRANE, EUGENE C. '12 M '13 ME
Bartlett & Snow Co. of Cleveland, Ohio

CRANE, FREMONT '86 BS '87 C '98 CE
Supt. of Const. Quartermaster Corp.,
Fort Sam Houston, Texas.

CRAWFORD, ALLEN S. '12 M
St. Paul, Minn.
Webb Publishing Co.
Circulation Mngr.

CRAWFORD, WALLACE T. '06 M
Faribault, Minn.
Crawford Bros. Garage and Welding Shop.

CRAY, SEYMOUR R. '22 C '23 CE
Chippewa Falls, Wis.
City Engineer

CRIBBS, HARRY E. '23 C
Eldora Iowa.
Res. Eng., Iowa State Highway Commission.

CRITCHETT, EDWARD F. '13 M '14 ME
4012 Vincent Ave. S., Minneapolis, Minn. (res.)
Sales Promotion Dept., Standard Oil Co., Ind.

CROFT, EDNA K. (MISS) '22 A
600 15th St. S. E. (res.
Minneapolis.
Croft & Boerner.

CROFT, ERNEST B. '11 C
1004 Marquette Ave., Minneapolis, Minn.
Croft & Boerner.

CROSBY, MILTON E. '15 M
4536 Lincoln St., Chicago, Ill.

CROSS, CHARLES H. '97 M
284 Wisconsin Ave., Milwaukee, Wis., and Wauwatosa, Wis. Real Estate Broker.

CROSS, ROLAND E. '23 M
5117 Springfield Ave., Philadelphia, Pa.

CROSSWELL, DANIEL R. '16 E
Croswell Power Co., Twin Valley, Minn.

CROSSWELL, THOMAS L. '15 C
President, Croswell Power Co.
Twin Valley, Minn.

CROSSWELL, LESLIE D. '26 C
Brainerd, Minn.

CROUNSE, AVERY F. '03 G
3050 South Fourth Ave., Minneapolis, Minn.
President and Mgr., Industrial Contracting Co.

CROWELL, SIDNEY H. '27
Minn. Highway Dept., LeSueur, Minn.

*CUDDY, WILLIAM A. '15 C '16 CE

CUMMINGS, ELMER F. '12 C '13 CE

*CUNNINGHAM, ANDREW O. '94 C

CURRIE, NEIL, JR. '08 E
6901 Elmwood Ave., Philadelphia, Pa.
Works Mgr., General Electric Co.

CURRY, BYRON K. '23 C
Barranquilla, Columbia, S. A.
Fegles Construction Co.

CURRY, EZRA B. '20 M '21 ME
1263 Laurel Ave., St. Paul,
C. M. & St. P. R. R.

CURTIS, BENJAMIN J. '13 C '14 CE
910 S. Michigan, Chicago, Ill.
Sanitary Dist. of Chicago.

CURTIS, THOMAS H. '12 C
Fairmount, Minn.
Civil Engineer.

CURTIS, VERNE F. '12 M
601 Yuster Bldg., Columbus, Ohio.
C. C. & T. Rep., Dodge Bros., Inc.

CURTISS, LINDSLEY B. '09 G
918 Smith Tower, Seattle, Wash.
Asst. Eng., W. P. Ry.

CUTCLIFFE, W. W. '29 E
208 W. Washington St., Chicago, Ill.
A. T. & T. Co.

CUTLER, ALVIN S. '05 C
College of Engineering & Architecture, U. of M., Professor of R. R. Eng.

CUTTER, FRANCIS C. '05 M
Lima Locomotive Works, Inc., Lima, Ohio
Asst. to Vice President.

CZOCK, JACOB H. '20 M
Buffalo, N. Y., Snow-Holly Works, Worthington Pump & Mach. Corp. Asst. Chief Eng.

DACANAY, LINO P. '27 M

DAHL, GEORGE '21 A
805 Santa Fe Bldg., Dallas, Tex.

*DAHL, HANS F. M. '98 E

DAHL, HAROLD W. '24 E
Electric Machinery Company, New York City.

DAHL, HJALMER A. '22 E
General Engr., Westinghouse Elec. & Mfg. Co.
Wilkinsburg, Pa.

DAHL, MERLE G. '26 E
208 W. Washington St., Chicago, Ill.
American Tel. and Tel. Co.

DAHL, PAUL '28 E
Sharon, Pa.

DAHLQUIST, PHILIP L. '10 C
517 Monadnock Bldg., Chicago, Ill.
Scherzer Rolling Lift Bridge Co., Asst. Eng.

DAHLSTROM, RAYMOND E. '10 E
101 Valley View Place, Minneapolis, Minn.
N. W. Bell Telephone Co.

DALE, DALLAS W. '24 M
Mechanical Engineer, Office of City Engr.
Detroit, Mich.

DALLIMORE, ARTHUR N. '08 C
447 Thatcher Bldg., Pueblo, Colo.
Cole Brothers.

DALY, FRANK A. '28 C
Joliet, Ill.
Designing Draftsman, E. J. & E. Ry. Co.

DALY, RICHARD T. '21 C
650 E. 29th St., Brooklyn, N. Y.
Kalman Steel Co.

DAMBERG, PAUL S. '22 A
4129 2nd Ave. S., Minneapolis, Minn.
Draftsman, Lang, Raugland & Lewis, Archts.

DAMBERG, RHEUBEN P. '21 A
20 Newbury St., Boston, Mass.
Architect.

DANIEL, THOMAS L. '00 M

DANN, WILBUR W. '90 C
San Diego, Calif., Insp. Public Works.

DANNER, JAKE '01 E
Washington St., Chicago.
Gen. Supt. of Installation,
Western Elec. Co., Inc.

DARMODY, WILLIAM J. '24 M
U. S. Bureau of Standards, Washington, D. C.

DARRELL, JAMES E. '23 C
St. Paul, Minn.
Asst. Eng., Highway Dept.

DAUM, HENRY A. '12 E
Webb Publishing Co., St. Paul, Minn.
Circulation Manager, The Farmer.

DAVIDSON, HENRY A. '27 AE
Experimental Engineer, U. of M.

DAVIDSON, JOHN E. '28 AE
1841 Sargent Ave., St. Paul, Minn.

DAVIES, RALPH M. '09 E
4304 Lyndale Ave. S., Minneapolis, Minn.
F. M. Davies Co., Grain Salesman.
1031 Chamber of Commerce.

DAVIS, CHARLES A. '05 E
207 Richard St., Apt. E-2,
Joliet, Ill. Joliet Herald.

DAVIS, GILBERT N. '04 M
Dispatch & Pioneer Press, St. Paul, Minn.
Pressman.

DAVISON, JOSEPH H. '03 C
M. & I. Ry. Co., Bemidji, Minn.
Engineer of Maintenance.

*DAWLEY, WILLIAM S. '79 C

DAWSON, JOHN W. '22 A
525 Minnesota Bldg., St. Paul, Minn.
Chief Draftsman, Ellerbe & Co.

DEANE, GEORGE B. '19 A
4033 Ewing Ave. S., Minneapolis, Minn. (res.)
Larson & McLaren Co., 308 Baker Bldg., Draftsman.

DEDIC, RICHARD J. '24 C
Detroit, Mich., Concrete Detailer.
Concrete Steel Fireproofing Co.

DEEGAN, RAYMOND C. '26 C
1246 University Ave., St. Paul, Minn.
Minn. Highway Department.

*DEFREECE, PAUL R. '23 C

DEHN, ELTOR A. '21 C
718 Commerce Bldg., St. Paul, Minn.
Asst. C. E., City of St. Paul
Bureau of Valuations and Assessments.

DEINEMA, GEORGE R. '26 E
Melvin, Iowa.

DEL PLAINE, CARLOS W. '21 C '22 CE
University of Minnesota, Minneapolis, Minn.
Medical Student.

DEMAREST, CHARLES S. '11 E
195 Broadway, New York City.
Electrical Engr., A. T. & T. Co.

DENEEN, DAVIS J. '19 A
University of Minnesota. Instr. Arch.

DESCHNER, RICHARD E. '29 M
820 N. Snelling, St. Paul.

DETERLING, EDWARD W. '26 E
Gaylord, Minn.

DEUTSCHE, RICHARD E. '18 C
382 S. Warwick, St. Paul, Minn.

DEVER, FRANCIS A. '20 C
Cleveland, Ohio.
Supervisor of Track, Pa. R. R.

DEVOY, WM. T. '29 E
2706 W. Lake of Isles Blvd., Minneapolis.

DEWAJI, GUNAKER '26 M
Berhampore, Bengal, India.
Berhampore Tech. School.

DEWARS, ALLEN G. '13 E '14 EE
Minneapolis, Minn.
Asst. Elec. Supt., N. States Power Co.

DEWEY, WILLIAM H. '93 E

DEY, PHILLIP S. '29 M
Phillipsburg, N. J., Ingersoll-Rand Co.

DIBBLE, BARRY '03 E
Redlands, Calif.
Consulting Engineer.

DIDRIKSEN, PHILIP H. '20 E
6655 E. 37th St., Kansas City, Mo.
Chevrolet Motor Co.

DILLS, LYLE A. '21 G
Minnesota Highway Dept., St. Paul, Minn.
Structural Steel Inspector.

DIMENT, J. MORTON
Minnesota Loan & Trust Co. Tax Expert.
2621 15th Ave. S., Minneapolis, Minn.

DIMMICK, MERTON A. '26 C
S. D. State School of Mines, Rapid City, S. D.
Inst. Physics and E. E.

DIMOND, GROVER W. '12 C
St. Paul, Minn.
St. Paul Foundry Co., Estimator.

DIMOND, HARVEY G. '14 C
G. N. Ry. Bldg., St. Paul, Minn.
Engineering Department.

DINDORF, EDWARD '23 C
Billman & Purdy Co.,
106 Bryant Bldg., Lakeland, Fla.

DINSMORE, ARTHUR T. '12 M '13 ME
507 1st National Bank Bldg.
Duluth, Minn.
General Contractor.

DIXON, DONALD K. '27 M
Union Station, Chicago, Ill.
Engr. Dept. C. M. St. P. & P. Ry.

DOCK, CHESTER '22 G
146 Bridge St., Albert Lea, Minn.

DOELL, CHARLES E. '16 C '17 CE
325 City Hall, Minneapolis, Minn.
Secretary, Board of Park Commissioners.

DOELTZ, WILLIAM F. '08 C
616 E. 11th St., Portland, Ore.

DOEPKE, CHRIS '29 M
N. W. Terminal Bldg., Minneapolis, Minn.
U. S. Blower Co.
DONAHOE, ROBERT E. '21 E
Minnesota Power & Light Co.,
Little Falls, Minn.
Division Engineer.
DONAHUE, STEPHEN '25 C
Dublin, Ky.
I. C. R. R.
Engineering Department.
DONALDSON, FRANK A. '12 M
4613 Emerson Ave. S., Minneapolis.
President of Donaldson Co.
DONNELLY, WILLIAM H. '25 M
1946 Riverside Drive, Los Angeles, Calif.
DOOLITTLE, WILLIAM K. '14 C
712 W. 39th St., Minneapolis, Minn.
Wm. Bros Boiler Co., Nicollet Island,
Minneapolis, Minn.
DORR, WILIAM R. '14 M
4348 West Third St., Los Angeles, Calif.
Hall Organ Company of West Haven, Conn.
S. W. Representative.
DORRANCE, ALBERT P. '12 E
2824 University Ave., Minneapolis, Minn.
White Company, Mgr. White Co.
DORSEY, JOHN G. '15 C
Pastoret Const. Co., Duluth, Minn.
Contractor.
DOUGAN, HENRY K. '08 C
1315 N. Cleveland Ave., Assist. Auditor Great
North. R. R.
*DOUGHERTY, JOE '07 C
DOUGLAS, ADDISON H. '17 C '20 CE
300 Oneida Bldg., Minneapolis, Minn.
Northwestern Terminal Co.
Sales Manager.
DOUGLASS, FRED L. '91 BCE '99 C
Covina, California.
Civil Engineer and Orange Grower.
DOW, CLARENCE A. '13 E '14 EE
N. S. P. Co., Eau Claire, Wis.
Assistant to Manager.
DOW, JAMES C. '00 E
Great Falls, Mont.
The Montana Power Co.
Operating Engineer.
DOW, WILLIAM G. '16 E '17 EE
Ann Arbor, Mich.
College of Engineering, University of Michigan.
Asst. Prof., Electrical Engineering.
DOWD, ARCHIE J. '19 M
Kearny, N. J.
Development Engineer, Western Electric Co.
DOWNIE, JOHN M. '22 E
242 Union St., Schenectady, N. Y.
General Electric Co.
DOWNING, FRANK E. '04 C
905 Trurillo Ave., Houston, Texas.
DRDLA, ROBERT '26 C
Byllesby Eng. & Mgt. Corp.
DRESSER, HARRY S. '16 M
405 Plymouth Bldg., Minneapolis, Minn.
LaCrosse Dredging Co.
DREVESKRACHT, WALLACE '28 C
Mpls. St. Ry. Co., 1 So. 11th St.
Minneapolis, Minn.
DRINKALL, JOHN F. '19 E
Nela Park, Cleveland, Ohio
National Lamp Works.
DRINKALL, LEON R. '11 E
Minneapolis, Minn.
Head of Electrical Department,
Dunwoody Institute.
DROST, HENRY F. '22 E
2333 S. Throop St., Chicago, Ill.
Engr., Commonwealth Edison Co.
DUBOIS, JOHN H. '27 E
1401 Hudson Ave., Chicago, Ill. (res.)
Gen. Elec.
DUBOIS, N. WARREN '26 M
Northern Light & Pr. Co.,
Mgr., Indian Head, Sask., Canada.
DUNCAN, GEORGE R. '19 E
88 Tenth St., Oakland, Calif.
Sales Engr., Pacific Electric Motor Co.
DUNGAY, HERBERT F. '25 C
Minn. Highway Dept., St. Paul, Minn.
Field Draftsman.
DUNHAM, JOHN A. '07 C

DUNHAM, ROY O. '14 E '15 EE
Gen'l Electric Co., Schenectady, N. Y.
Aero & Marine Dept.
DUNLAP, GEORGE M. '24 E
Independence, Iowa.
DUNLAP, LEMUEL J. '17 E
Room 2133, 111 W. Washington,
Chicago, Ill.
DUNN, ANDREW P. '06 E
Contractor, 1334 N. Orange Grove Ave.,
Los Angeles, Calif.
DUNNAVAN, RALPH B. '23 E
15 S. 5th St., Minneapolis, Minn.
Minneapolis General Electric Co.
DUNNING, ROBERT M. '28 M
1768 Wellesley Ave., St. Paul, Minn.
DUNNUM, ORNEY E. '22 E
604 Witherspoon Bldg., Philadelphia, Pa.
The Ideal Electric and Mfg. Co.
District Sales Manager.
DUTCHER, LLOYD L. '29 AE
DU TOIT, GEORGE A. '10 M
4115 Dupont Ave. S., Minneapolis.
Mpls. Heat Regulator Co. (Purchasing Agent).
DUVALL, ARNDT J., JR. '25 C
250 So. Syndicate, St. Paul, Minn. (res.)
Toltz, King & Day, Inc.
St. Paul.
DYBVIG, EDWIN S. '29 E
Gen. Elec. Co., Schenectady, N. Y.
EARL, DONALD E. '24 M '25 MS (ME)
U. S. Patent Office, Washington, D. C.
Examiner.
EATON, PAUL F. '27 A
4719 Gladstone St., Duluth, Minn.
EBERHARDT, OTTO I. '03 E
316 Spruce St., Scranton, Pa.
Pres., Eberhardt Elec. Co.
*EBERT, SOLOMON B. '17 E
ECK, MELVIN C. '29 C
312 Elm St., Charleston, W. Va. (res.)
Gas Eng., Du Pont Ammonia Corp.
ECKBERG, CURTIS R. '24 E
436 West St., New York City.
Bell Telephone Laboratories.
ECKENBECK, EVERETT E. '17 E
2730 Thayer St., Evanston, Ill. (res.)
Western Mgr. Whitacre-Grier Co.
EDDY, CLARENCE J. '22 M
EDDY, HORACE T. '95 E '96 EE
Omaha Technical High School, Omaha, Neb.
Instructor in Mathematics.
EDDY, LYNNE W. '07 E
Chicago, Ill. Western Electric Co.
EDELMAN, PHILLIP '16 E '17 EE
7255 Yates Ave., Chicago, Ill.
Development Engineer.
EDEY, FRANCIS E. '29 E
Wagner Elec. Corp. Kansas City, Mo.
EDGAR, ROBERT F. '26 EE
Gen. Elec. Co., Schenectady, N. Y.
EDLUND, RAY C. '27 C
Truscon Steel Co., 611 Metro. Bank Bldg.
Minneapolis, Minn.
EDWARDS, RICHARD G. '25 E
1201 W. Second Street, Los Angeles, Calif.
S. Calif. Edison Co.
Substation Designer.
EDWARDS, WILLIAM H. '27A
Thomas Ellerbe & Co., Arch's.,
St. Paul, Minn.
EGGEN, CARL M. '29 C
U. S. Engineers, Duluth, Minn.
EGGERS, HENRY C. T. '15 E '16 EE
U. of M., Minneapolis, Minn.
Asst. Prof., College of Eng. and Arch.
EGGLESTON, SMITH '25 M
North St. Paul, Minn.
Standard Conveyor Co.
EGILSRUD, F. S. '20 M
EHRENBERG, MURIEL L. '26 ID
5036 Bryant Avenue S., Minneapolis, Minn.
Wm. A. French Co.
EIGE, ELMER H. '23 M
Berwyn, Ill.
Western Electric Co. Planning Engineer.
EILERS, BALDWIN C. '23 C
Chicago, Ill.
Office of Roadmaster, I. C. R. R.

EK, GUSTAF A. '17 M
2322 E. 24th, Minneapolis, Minn.
EKBERG, CARL E. '14 C '15 CE
Minneapolis, Minn.
Bridge Dept., N. P. Ry.
EKMAN, CLAES T. '10 C
601 Phoenix Bldg., Minneapolis, Minn.
Engineer and Architect.
EKMAN, HAROLD '28 A
914 W. Portland St., Phoenix, Ariz.
ELFSTRUM, AXEL E. '11 C
Oakland, Calif.
Building Inspector.
ELLEFSON, SELMER '16 E
425 N. 17th Ave. E., Duluth, Minn.,
Salesman, Graybar Electric.
ELLESTAD, IRWIN M. '22 E
195 Broadway, New York.
Dept. of Operation and Engr.,
Amer. Tel. & Tel. Co.
ELIASSEN, SIGURD '18 C
Chili River Commission, Tientsin, China.
Acting Engineer in Charge, Survey Dept.
ELLINGSON, ELMER '16 C
ELLIOT, HARRY C. '19 M
ELLIOTT, A. DOUGLASS '14 E '15 EE
708 6th Ave. S., Minneapolis, Minn.
Mgr. Elliott Equipment Co.
ELLIOTT, MERLE B. '28 M
Western Elec. Co., Hawthorne Station,
Chicago, Ill.
ELLIS, CARL E. '25 E
Fort Wayne, Indiana.
Instructor, General Electric Co.
ELLISON, JAY T. '09 C
Minn. Highway Dept., 1246 University Ave.,
St. Paul, Minn.
Chief Engr.
ELLSWORTH, CHARLES D. '20 E
Century Electric Co. of St. Louis,
(Minneapolis Office), Sales Engineer.
ELMBURG, JOHN C. '28 E
Westinghouse Elec. & Mfg. Co.,
Pittsburgh, Pa.
ELMBURG, LEROY M. '25 AE
Truscon Steel Co., Youngstown, Ohio.
ELMER, LLOYD A. '21 M
102 Riggs Place, West Orange, N. J. (res.)
Design Engr., Bell Telephone Lab., N. Y. City.
ELSBERG, NELS W. '09 C
City Hall, Minneapolis, Minn.
City Engineer.
ELSTAD, RUDOLPH T. '10 C
Chisholm, Minn.
Oliver Iron Mining Co.
ELWOOD, DANIEL H. '23 E
Decatur, Ill.
ELY, IRVING R. '05 E
U. S. Navy Yard, Brooklyn, N. Y.
Engineer.
EMERSON, LYNN A. '11 E
420 Lexington Ave., Director Guidance &
Employment, Y. M. C. A., New York City.
EMERY, GEORGE C. '19 A
Boston, Massachusetts.
Frohman, Robb and Little, Architects.
ENGER, ARNE '22 E
ENGER, EDWARD H. '11 C
245 Ninth Ave. N., Minneapolis, Minn.
Architectural Engineer, Board of Education.
ENGH, HARRIS S. '24 M
Rushford, Minn.
ENGLER, MYER '27 C
Barker, Flavin, Sheets & Wallace, 35 E.
Wacker Drive.
Chicago, Ill.
ENGLIN, CHARLES F. '06 E
Connolly Shoe Company, Stillwater, Minn.
Sales and Credit Manager.
ENGQUIST, EMIL '28 E
717 South Blvd., Evanston, Ill. (res.)
Commonwealth Edison Co., Chicago.
ENGQUIST, VICTOR E. '20 E
Elec. Eng., Northern States Power Co.,
Rice and Atwater Sts., St. Paul, Minn.
ENGSTROM, ELMER W. '23 E
Schenectady, N. Y., G. E. Co.

Enostrom, LeRoy '28 C
404 Eng. Exp. Station.
Ohio State Univ., Columbus, Ohio.

Enke, Fred A. '21 C
University of Arizona, Tuscon, Ariz.

*Erf, John W. '93 C

Erickson, Carl E. '24 C

Erickson, Carl G. '03 E
6325 39th St. S. W., Seattle, Wash.

Erickson, Clarence P. '25 A
G. N. R. R., St. Paul, Minn.

Erickson, David W. '29 C
Jr. Eng., I. C. C., Washington, D. C.

Erickson, Edwin C. O. '22 C
Appleton, Wis., Engineer for Kimberly-Clark Corp.

Erikson, Henry A. '96 EE '08 PhD
U. of M., Minneapolis, Minn.
Professor and Chairman of Dept. of Physics.

Erickson, Hugo '28 C
Minesota Highway Dept., St. Paul, Minn.

Erickson, Lloyd '28 C
393 Cedar Ave., Minneapolis, Minn.

Erskine, Lawrence F. '25 M
3411 Hennepin Ave., Minneapolis, Minn.
Engineering Dept., Waldorf Paper Products Co., St. Paul, Minn.

Erskine, Robert K. '24 M
1780 Goodrich Ave., St. Paul, Minn.
Asst. to Production Manager,
Minneapolis Heat Regulator Co.

Espenett, Edward L. '22 C
Jefferson City, Mo.
Mo. State Highway Department.

Esser, Frank F. '09 C

Estabrooks, Clyde F. '24 M
Minneapolis, Minn.
James Leck Company.

Estep, Harvey C. '08 M
Cleveland, Ohio.
The Penton Publishing Co., Vice President.

Etem, Victor '26 E
Cleveland, Ohio.
Ingersoll-Rand Company.

Eustis, Irving N. '17 M, '18 ME
Fairmont, Minn.
Fairmont Railway Motors, Inc.

Evans, Ralph B. '27 M

Everett, William R. '13 E '15 EE
415 S. Fifth St., Minneapolis, Minn.
Minneapolis Trust Company.

Everington, James W. '01 C
531 N. Louis St., Glendale, Calif.

Eyberg, C. J. '29 C
Junior Engineer, I. C. C., Washington, D. C.

Fager, Simon R. '04 M
13 E. 36th St., Minneapolis, Minn.
Western Heating Company.

Fahland, Frank, Jr. '22 M
Roanoke, Va.
Norfolk and Western Ry.

Fairbanks, Geo. W. '23 E
326 Fourth Ave., Eau Claire, Wis.
Sales Engineer, N. S. P. Co.

Fairchild, Albert R. '07 E
30th & Walnut St., Philadelphia, Pa.
Westinghouse Elec. & Mfg. Co.
Central Station Engineer.

Fallon, Eugene L. '14 E '15 EE
Schenectady, N. Y.
Adirondack Power and Light Corp.

Farmer, Herbert F. '27 E
Westinghouse Elect. Co., E. Pittsburgh, Pa.

Farmer, John W. '21 M
Minneapolis, Minn.
W. S. Nott Co.

Farnam, Julian P. '11 M
1000 Plymouth Bldg., Minneapolis, Minn.
Architect.

Fastenau, Karl D. '16 E

Faulkner, Louis L. '26 E

Feder, Max '22 C

Fedders, Melvin P. '29 M
2747 Fourth Ave. S., Minneapolis, Minn.
Minneapolis-Honeywell Co.

Fee, Ernest F. '07 M
Duluth, Minn.
Secretary and Treasurer, Zenith Cedar Co.

Feeney, Wayne I. '23 E
Hixon-Peterson Lbr. Co.
12th and Madison, Toledo, Ohio.

Feldman, Carl B. H. '26 E, '28 MS
Bell Laboratories,
Phoenixville, Pa.

Felthous, Donald G. '29 M
210 Thompson St., Portland, Ore.

Felton, Ralph P. '92 M
1755 W. Adams St., Los Angeles, Cal.

Fenton, Paul C. '26 C
Hinton, W. Va., New Kanowah Power Co.

Fergestad, Marvin L. '29 AE
3515 Colfax Ave. S., Minneapolis, Minn.

Ferguson, George '28 C
c/o U. S. G. S., Austin, Texas.

Ferguson, Kenneth R. '26 C
115 High St., Portland, Maine.
Asst. Mgr., Curtiss Wright Flying Service.

Fernald, Frank O. '04 C
308 Union Terminal Station Bldg.,
Operating Dept. The Pullman Co.
Dallas, Texas.

Feyder, William H. '05 C
St. Paul, Minn.
Asst. Engineer, N. P. Ry. Co.

Fieldman, David P. '11 C

Fiene, Marcus '26 E
Research Dept., General Elec. Co.
Schenectady, N. Y.

*Finchy, Jacob O. '06 E

Finke, Walter J. '10 E

Finley, Joseph E. '05 C
514 Globe Bldg., St. Paul, Minn.
R. R. and Gen'l Contr.

Finnell, Thomas C. '29 E
Westinghouse Elect. Co., E. Pittsburgh, Pa.

Fisher, George '28 E
G. E. Co., Fort Wayne, Ind.

Fischer, Harold W. '23 E
4210 Dupont Ave. N., Minneapolis, Minn.
Eqpt. Eng., Northwestern Bell Tel. Co.

Fisher, Addison M. '29 E
Westinghouse Elec. Co., E. Pittsburgh, Pa.

Fiske, Frederick W. '09 C
Engr., George Grant Construction Co.
904 New York Bldg., St. Paul, Minn.

Fiske, Harold C. '22 E
Chic. Dist. Repr., James R. Kearney Corp'n.

Fitts, Joel A. '09 E
Chicago, Ill.
Engr., Electric Storage Battery Co.

*Fitzgerald, Patrick T. '85 C

Fitzgerald, William J. '20 C
601 Metropolitan Bank Bldg., Minneapolis, Minn.
Truscon Steel Company.

Flaaten, Percy H. '26 C
Minneapolis, Minn.
Northwestern Bell Telephone Co.

Flegal, A. I. '27 A
596 Oakland Apt. 21,
Milwaukee, Wisconsin.

Fleming, Douglas R. '08 C
Marreho, La.
Land and Cattle Business.

Fleming, Frank R. '08 ME '09 EE
St. Paul, Minn.
Valuation Engineer, N. P. Ry.

Fleming, Laurence T. '10 M

Flindt, Richard H. '23 C
Minneapolis, Minn.
Asst. Engr., Croft and Boerner.

Flygare, August L. '12 C
1246 University Ave., St. Paul, Minn.
Minnesota Highway Department.

Fogelholm, Ed. G. '28 E
Prod. Dept., Public Service Co.,
Edison Bldg., Chicago, Ill.

Foltz, Ross M. '19 M
West Allis, Wis.
Obenberger Forge Co. General Manager.

Forbes, Henry C. '22 E
Chicopee Falls, Mass.
Westinghouse Elec. & Mfg. Co.
Section Engineer.

Ford, Robert E. '95 E '03 EE
100 North Seventh St., Minneapolis, Minn.
Luther Ford and Company.

Forfar, Donald M. '09 M
240 7th Ave. S., Minneapolis.
Grinnell Co., Sales Dept.

Fornfeist, Carl H. '26 M
1225 S. Michigan, Chicago.
Peoples Gas, Light & Coke Co.

Forsberg, Elmer J. '21 M '22 ME
St. Paul, Minn.
Overhead Engr., Northern States Power Co.

Forsberg, Enock '18 A
Liebenberg & Kaplan, Minneapolis.

Forsberg, William P. '11 E
Schenectady, N. Y.
Eng. Dept., General Electric Co.

Forseth, George O. '25 M
Halstad, Minn.

Forsmark, Ulrik E. '26 E
304 N. Maple Ave., Oak Park, Ill.

Forssell, William O. '22 G
Walpole, Mass.
Lewis Mfg. Co., Sales.

Fortune, Harry G. '20 M
Odessa, Texas.
Engr., Texas Elec. Service Co.

Foss, Abbie '29 M
655 19th Ave. N. E., Minneapolis, Minn.
Hart-Carter Co.

Fossen, George '17 C
905 Lumber Exchange, Minneapolis, Minn.
J. and W. A. Elliot Co.
Estimator.

Foster, Kenneth W. '26 C
3500 34th Ave. S., Minneapolis, Minn. (res.)
N. P. R. R.

Fox, Clair C. '29 E
67 Broad St., N. Y. City, I. T. & T. Corp.

Frahm, Alfred R. '08 E
2-4 D. Barstow, Eau Claire, Wis.
N. S. P. Company. General Superintendent.

Francis, Paul E. '18 M
St. Paul, Minn.
Northwestern Fuel Company.

Frank, Carl '28 C
53 W. Jackson Blvd., Chicago, Soo Line R. R.

Frankoviz, John J. '05 E
Frankoviz Hardware Company.
Fergus Falls, Minn.

Frankovich, John J. '28 E
Illinois Bell Tel. Co., Chicago, Ill.

Franks, George E. '29 E
Rock Island Mfg. Co., Rock Island, Ill.

Frantz, Willard F. '25 C
Constr. Eng., Morell and Nichols, Mpls.

Franzen, Roy O. '25 E
100 Central Ave., Kearny, N. J.
Engr. Investigator, Western Elec. Co.

*Frary, Hobart D. '08 M '09 MS (ME)

Fraser, Carlisle G. '22 C
810 Guardian Life Building, St. Paul, Minn.
Engineer with William C. Fraser.

Fraser, George '19 A
Cornell University, Ithaca, N. Y.
Department of Architecture.

Frazer, Leonard M. '24 E
70 Schly Ave., Pittsburgh, Pa.
Supt. of Power Department.

Frear, J. B. '10 M
609 N. LaSalle St., Chicago, Ill.
Design. and Testing Eng., Don L. Quinn Co.

Fredrickson, Edwin '28 E
205 Cecil St. S. E., Minneapolis, Minn.

Fredricksen, Fred C. '29 C
1003 N. 37th Ave. W., Duluth, Minn.

Frederickson, Harry B. '11 E
80 Park Place, Newark, N. J.
Public Service Electric Co.

Freeberg, George '25 A
1843 E. 28th St., Mpls.
Draftsman for J. C. Pendergast.

Freeman, Frank S. '29 M
Commercial Trust Bldg., Philadelphia, Pa.
Ingersoll-Rand Co.

Freeman, Raymond C. '29
Gen. Elec. Co., Schenectady, N. Y.

French, Edwin L. '02
4120 Washington St.,
Niagara Falls, N. Y.

French, William O. '25 M
Winona, Minn.
Mississippi Valley Public Service Co.
Engineering Department.

Get every issue for 100% more Alumni News.

FRENZEL, HERMAN '26 A
450 Fuller Avenue, St. Paul, Minn.
FRIAR, FLOYD M. '20 C
FRIEDMAN, EDWIN A. '23 E
Hibbing, Minn.
Oliver Iron Mining Co.
Assistant Electrical Superintendent.
FRITZBERG, HILDING L. '28 M
Carrier Eng. Corp.
Newark, New Jersey.
FROBERG, HAROLD '28 E
4044 N. Keystone Ave., Chicago.
FROST, HERBERT J. '22 C
FRUEN, ARTHUR B. '08 E '09 C
Glenwood & Thomas Ave., Minneapolis, Minn.
President, Fruen Milling Company.
FULTON, EDWIN G. '23 C
722 Insurance Exchange Bldg., Montreal, Can.
Roger Miller & Son, Ltd.
FURBER, RICHARD '28 E
Northern States Power Co., 15 S. Fifth St.,
Minneapolis, Minn.
FURBER, J. ROSCOE '24 E
15 S. 5th St., Minneapolis.
Sales Engr., Northern States Power Co.
FURBER, PIERCE P. '08 C
112 N. Broad St., Philadelphia, Pa.
*FURBER, PIERCE P., SR. '79 C
GAALAAS, GEORGE L. '26 E
Mansfield, Ohio.
Ideal Electric & Mfg. Co.
GADSBY, LESTER H. '09 E
Vizalia, California. City Engineer.
GAGE, HUGH N. '08 C
920 Guardian Life Bldg., St. Paul, Minn.
Engr., State Highway Dept.
GALANTER, SAMUEL S. '25 C
513 W. Jackson Blvd., Chicago, Ill.
Burrell Engineering and Construction Co.
GAMMELL, JOHN H.
'14 BS '15 ME '18 BS '19 MB '20 MD
805 Yeates Bldg., Minneapolis.
GANNETT, DANFORTH K. '16 E '17 EE
195 Broadway, New York City.
A. T. and T. Co.
GARBER, GABRIEL E. '06 M
4201 Colfax Ave. S., Minneapolis, Minn.
GARB, DONALD '28 C
Fergus Falls, Minn.
GAREN, GEORGE M. '10 C
Asst. Supt. of Constr.,
Dept. of Public Works, St. Paul, Minn.
GARTHUS, IRA B. '24 E
Minneapolis, Minn.
N. S. P. Co.
*GARVEY, WALTER S. '15 E '16 EE
GARZON, JULIAN R. '24 C
4421 Vincent Ave. S., Minneapolis, Minn.
GEE, HARRY J. '19 G
1308 Foshay Tower, Minneapolis, Minn.
J. K. Raglan & Co. Accountant.
GEHRING, LESTER G. '27 C
Minn. Highway Dept.
Litchfield, Minn.
GEMMELL, ROBERT W. '26 E
E. Pittsburgh, Pa.
Westinghouse Elec. Mfg. Co.
GERDES, CARL H. '25 C
Apartado 85, Maracaibo, Ven.
Standard Oil of Venezuela.
GERLACH, ARTHUR C. '17 M
Landisburg, Pa.
Mountain Brook Farm (Poultry).
GERLACH, HENRY C. '22 A
33 E. 22nd St., New York City.
Architect.
GERLACH, W. DEWEY '26 A
414 N. 4th St., Mankato, Minn.
GEROW, THERON G. '20 M
Velva, N. D.
GERRISH, HARRY E. '05 M
808 LaSalle Ave., Minneapolis, Minn.
Pres., Morgan-Gerrish Co.
GERRY, MARTIN H. '90 ME '91 EE
1107 Hobart Building, San Francisco, Calif.
Consulting Engineer.
GESSERT, GEORGE R. '07 M
St. Paul, Minn.
Estimator, Dept. of Public Works.

GETCHELL, EARL '26 E
Chicago, Ill.
Commonwealth Edison Co.
GEWALT, CARL H. '21 A
2464 S. Loomis St., Chicago, Ill.
Lake Superior Piling Co.
GIBBS, CLAYTON T. '18 E
912 Black Building, Los Angeles, Calif.
Holmes and Sanborn, Consulting Engrs.
GIBSON, CHARLES B. '05 E
East Pittsburgh, Pa.
Westinghouse Elec. & Mfg. Co.
GIBSON, ROBERT '27 E
Western Elec. & Mfg. Co.
East Pittsburgh, Pa.
GIERTSEN, MARCUS O. '12 C '13 CE
1246 University Avenue, St. Paul, Minn.
Minnesota Highway Commission.
GIESSEL, PAUL A. '27 M
GILBERT, ROY '20 C
Seaside Hospital, Long Beach, Calif.
Physician and Surgeon.
GILCHRIST, CHARLES C. '98 E
Chicago, Ill.
Asst. Supt. Planning Dept.
Western Electric Co., Hawthorne Station.
GILFILLAN, DONALD W. '27 AE
Insulite Co.
Builders Exchange, Minneapolis, Minn.
GILL, JAMES H. '92 BME '94 ME
W. Va. Univ., Morgantown, W. Va.
Engineering College.
GILL, ROSCOE L. '29 E
309 Franklin St., Waukegan, Ill.
Public Service Co. of No. Ill.
GILLARD, HERBERT W. '24 C
2528 West Madison St., Chicago, Ill.
Simplex Ejector Co.
GILLE, WILLIS H. '29 E
671 S. Roy Street, St. Paul, Minn.
GILLETTE, GEORGE L. '05 C
Minneapolis Steel & Machinery Co.,
Minneapolis, Minn. Vice President.
*GILLETTE, LEWIS S.
'76 BCE '77 BS '98 CE
*GILMAN, FRED H. '90 C
GILMAN, GAYLORD '25 E
Oak Forest Sanitarium,
Oak Forest, Ill.
GILMAN, HOWARD B. '17 A
Cleveland, Ohio.
Phillip Lindsley Small, Architect.
GILMAN, JAMES B. '94 C
Minneapolis, Minn.
Chief Eng., Mpls. Steel & Machinery Co.
GILMAN, NICHOLAS A. '07 M
North Yakima, Wash.
Yakima Valley Transportation Company.
GILSTAD, ARTHUR '23 M
N. St. Paul, Minn.
Sales Eng., Standard Conveyor Co.
GILTINAN, DAVID M. '15 M, '16 ME
Charleston, W. Va.
Eskew, Smith & Cannon.
Pres. & Gen. Mgr.
GINNATY, J. ROBERT '29 E
Westinghouse Elec. & Mfg. Co.
Mansfield, Ohio
GJESDAHL, MAURICE S. '21 M
State College, Pa.
Asst. Prof. of M. E., Pa. State College.
GLASCOCK, HENRY H. '06 E
New London, Mo.
New London Tel. Co.
GLASS, CLIFTON A. '98 C
Dwight Building, Kansas City, Mo.
Consulting Engineer, Steel Structures.
GOBELI, ARTHUR W. '25 C
Fairfax, Oklahoma.
Engineering Dept., A. T. and S. Fe Ry.
GODWARD, ALFRED C. '10 C
Minneapolis, Minnesota.
Consulting Engr., City Planning Commission.
GODWIN, KENNETH A. '21 G
244 Kearney St., San Francisco, Calif.
Estimator and purchaser Austin Co. of California.
GOEBEL, RUDOLPH C. '13 E, '14 EE
M. & St. L. R. R. Co., St. Paul.

GOETZENBERGER, RALPH L. '13 E '14 EE
2747 4th Ave. S., Minneapolis, Minn.
Mgr., Indus. Dept., Minneapolis Honeywell Co.
GOLDBERG, HYMEN '28 C
712 Elwood Ave. N., Minneapolis, Minn. (res.)
M. S. P. & S. St. M. Ry. Co.
GOLDBERG, MAURICE G. '23 E
376 Robert St., St. Paul, Minn.
Beacon Radio Service.
GOODNER, THEODORE C. '29 E
Electrical Research Products Co., N. Y. City.
GOODKIND, LEO '92 A
Treas., Schunemans & Mannheimers,
St. Paul, Minn.
GOODWIN, VICTOR E. '04 E
Pittsfield, Mass.
Chief Engr., Lightning Arrester Dept.,
General Electric Co.
GOSS, HAROLD R. '20 E
East Pittsburgh, Pa.
Design Engr., Westinghouse Elec. & Mfg. Co.
GOULD, EDWARD C. '26 C
GOULD, EDWARD S. '20 C
500 Delaware St. S. E., Minneapolis, Minn.
Real Estate.
*GOULD, REED D. '18 C
GRAF, ALOIS W. '26 E
Washington, D. C.
1036 National Press Bldg.
GRAF, DONALD T. '22 A
305 Grove Ave., Tampa, Fla.
GRAFSLAND, GENEVA L. '27 I
Drapery Dept. at Herbst, Fargo, N. D.
GRAHAM, EUGENE C. '02 G
Manhattan, Kans.
Kansas State Agricultural College, Asso. Prof.,
Shop Practice.
GRAHEK, ROSABELLE K. '29 IA
Box 274, Duluth, Minn.
GRALING, VERNEY '99 E
Niagara Falls, N. Y.
N. F. P. Co.
GRAN, CONRAD L. '29 E
Campbell, Minn.
GRANBOIS, KENNETH J. '29 E
Westinghouse, Mfg. Co., Sharon, Pa.
GRANT, ELBERTH R. '24 C
St. Joseph, Mo.
Asst. Bridge Eng., Dept. of Parks.
GRANT, FRED R. '09 E
Schenectady, N. Y.
General Electric Co. Ind. Engr. Dept.
GRANT, JAMES A. '07 C
300 Custom House, Baltimore, Md.
Hydro-Elec. Engineer, U. S. Eng. Dept.
GRANT, RUSSELL S. '26 M
72 West Adams St., Chicago, Ill.
Telephone Engr., Chicago Rapid Transit Co.
GRANT, JOHN W. '29 C
812 Summer St. N. E., Minneapolis.
GRAY, WILLIAM I. '92 E '98 EE
209 Globe Bldg., Minneapolis, Minn.
GRAY, WESLEY '29 E
Marine-on-St. Croix, Minn.
GREENE, ALFRED B. '24 E
X-Ray Technician, Glen Lake Sanatorium,
Oak Terrace, Minn.
GREENE, CHAUNCEY L. '24 E
Projectionist, Hennepin-Orpheum,
Minneapolis, Minn.
GREEN, FRED H. '07 C
344 Santa Clara Ave., San Francisco, Calif.
GREENBERG, JACK '22 C
2047 Palm Grove, Calif.
J. M. Cooper Co., Contractors.
GREENBERG, MORRIS '18 M
Bailey Meter Co., 908 Pioneer Bldg., St. Paul.
*GREENWOOD, WILLISTON W. '90 C
GREGG, TRESHAME D. '05 C
165 Broadway, New York.
Gregg and Company.
GREINER, HARRY S. '24 E
5628 Blaisdell Ave., Minneapolis, Minn.
GRETTUM, LEROY A. '23 E
Winona, Minn.
Mississippi Valley Public Service Co.
Electrical Engineering Department.
GRETTUM, WALTER A. '24 E
Little Falls, Minn.
Minn. Power & Light Co. Engr.

Grime, Edwin N. '00 C
St. Paul, Minn. N. Pacific Ry. Co.
Engr., Water Service.

Grimes, David '19 E
Staten Island, N. Y.
Grimes Radio Engr. Co.

Grimm, Raymond E. '28 E
Grand Meadow, Minn.

Grimshaw, William E. '02 M
914 Securities Bldg., Seattle, Wash.
Real Estate and Investments.

Grisson, Aubrey H. '25 AE
127 W. Mt. Palm St., Detroit, Mich.

Groat, Benjamin F. '08 LLB '11 LLM '01 G
137 Audubon Road, Boston, Mass.
Consulting Engineer.

Grobel, Lloyd P. '24 M
Schenectady, N. Y.
General Electric Co.
Research Engr.

Grochau, Earl H. '21 C
Martin Bldg., Birmingham, Ala.
Dist. Mgr., E. G. Holladay Const. Co.

Gross, Leon A. '26 E
Sauk Rapids, Minn.

Grossman, Frederic R. '28 A
123 W. Madison Ave., Chicago, Ill.

Groth, Arthur W. '20 E
Belle Plaine, Minn., Retail Hardware.

Grow, Harry A. '03 C
1416 First National Bank Bldg., Chicago, Ill.
McClintic-Marshall Co.
Asst. Chief Engineer.

Grow, Robert W. '16 C
Fort Brown, Texas.
Major of Cavalry, U. S. Army.

Guerin, George V. '24 C
St. Paul, Minn.
Asst. Bridge Eng. for Great Northern.

Guesmer, George O. '24 C
3011 3rd St. N., Minneapolis, Minn. (Res.)
Asst. Eng., U. S. Engineer's Office, St. Paul.

Guesmer, Marie W. '26 ID
U. S. Engineer's Office, St. Paul, Minn.

Guggisberg, Charles F. '17 M
Minneapolis, Minn.
M. St. P. and S. Ste. M. Ry.

*Gunnarson, Carl A. '14 E

Gunnarsson, Jon '29 C
Reykjavik, Iceland.

*Gunstad, Paul I. '01 C

*Gunther, August N. '06 E

Gustafson, Hugo '28 M
Goodrich Rubber Co., Akron, Ohio.

Gustafson, J. M. '28 C
N. P. Ry. Gen. Office, St. Paul, Minn.

Gustafson, Reuben W. '24 C
627 S. Bernard St., Spokane, Wash.
G. N. Ry. Co.

Gustafson, Robert F. '27 A
830 Central Ave., Red Wing, Minn.

Gustafson, Thor '28 E
4729 W. Michigan Ave., Duluth, Minn.

Guthrie, J. DeMott '93 E
3669 Interlake St., Seattle, Wash.
Physician.

Haakensen, N. Theodore '26 C
Lieut., U. S. Army.
Fort Shafter, Honolulu, Hawaii.

Haberle, Edward L. '12 BS '13C
St. Paul, Minn.
Great Northern Ry. Co.
Structural Engr. Bridge Dept.

Haeberle, Elmer H. '06 E
Bridge Dept., G. N. R. R., St. Paul, Minn.

Haedicke, August D. '26 E
19 Governor's Lane, Schenectady, N. Y.
General Electric Co. Test Man.

Hafstad, Lawrence R. '26 E
Physicist, Carnegie Inst. of Wash.
Washington, D. C.

Hagelin, Lawrence W. '22 E
2915 Vincent Ave. No., Mpls.
Musical Inst. Supply Co.

Hagerman, Oliver S. '18 M
105 W. Adams St., Chicago, Ill.
American Light and Traction Co.

*Hagstrom, Herbert E. '10 E

Hahn, Stanley W. '22 A

Haima, Mark '25 C
Raymond, Minn.

Haines, Allen K. '13 E
3974 Olive St., St. Louis, Mo.
President, The Dick X Ray Co.

Haines, Howard N. '22 A
117 East Duke Bldg., Duke Univ., N. C.
Arch., M. E. Church Board.

Hakenjos, Fred M. '29 A
Student of Arch., Columbia Univ., N. Y. City.

Halbkat, Franklin J. '26 C
2000 Second Ave., Detroit, Mich.
Estimator, Detroit Edison Co.

Halden, Herbert O. '23 M
347 Mfg's Exchange, Kansas City, Mo.
Fuel Economy Engineering Co. of Missouri.

Hall, John W. '27 M
4001 10th Ave. S., Minneapolis, Minn.

Halladay, Leslie L. '21 C
720 G. St. N. E., Brainerd, Minn.

Hallan, Christian '02 C

Halverson, Vernon E. '29 E
Westinghouse Elec., E. Pittsburgh, Pa.

Hamilton, Jefferson M. '19 A
5103½ Franklin St., Tampa, Fla.
Partner, Franklin O. Adams, Jr.
Architects.

Hamilton, Sam '28 E
1083 Geranium St., St. Paul, Minn.

Hamlin, Lehan H. '21 M
Ivorydale, Ohio.
Procter & Gamble Co.
Engineer, M. and M.'s Office.

Hammer, Harold E. '25 E
3225 23rd Ave. S., Minneapolis, Minn.

Hammerstrom, Aleck '21 E
Chisholm, Minn.
Bruce Mine.
Mining Engineer.

Hammett, Ralph W. '19 A
133 W. Madison Ave., Chicago, Ill.

Hammond, Joseph A. '26 E
3434 Franklin Blvd.
Garfield Park Station, Chicago.
Commonwealth Edison Co.

Hammond, Laurence D. '14 M '15 ME '19 MB '20 MD
5600 Clinton Ave. S., Minneapolis.
Hammond Plumbing & Heating Co.

Hanauer, Monroe H. '06 C
815 Chapman Bldg., Los Angeles, Calif.
Minneapolis Steel & Machy. Co.

Handschu, C. E. '15 C
Moose Lake, Minn.

Hanft, Hugo H. '25 E
East Pittsburgh, Pa., Westinghouse Elec. Co.

Hanke, Carl C. '20 C
910 Michigan Ave. S., Chicago, Ill.
Sanitary District of Chicago.

Hankenson, John J. '92 C
Glencoe, Minn.
Contractor, Ajax Dredge Co.

Hankins, Nathaniel R. '24 C
823 Palace Bldg., Minneapolis, Minn.
Abbott and Hankins.

Hanna, Cyril C. '26 M
R. R. No. 3, Mora, Minn.

Hanrahan, Edmond C. '20 G
336 Old Southern Ry. Bldg., Washington, D. C.

Hansen, Arthur A. '25 C
504 American Trust Bldg., Nashville, Tenn.
Hartford Accident & Indemnity Co.

Hansen, Carlos C. '20 C
State Highway Dept., St. Paul, Minn.
Sub. resident Engineer.

Hansen, Christian '10 E
N. S. P. Co., St. Paul, Minn.
Auditor, Accounts Receivable.

Hansen, Edwin L. '21 C
1630 S. Alameda St., Los Angeles, Calif.
Blue Diamond Co.

Hansen, Maurice J. '11 E
425 East Waters St., Milwaukee, Wis.

Hanson, James B. '29 C
Cass Lake, Minn.

Hanson, Manford P. '29 M
Sales Eng., Frigidaire Corp, Dayton, Ohio.

Hargraves, Robert A. '23 E
1731 E. 3rd St., Minneapolis.
Assist. Eng. D. M. & N. R. R.

Hargrave, William A. '26 E
RCA Victor Co., Camden, N. J.
Radio Eng., Photophone Div.

Harrington, Marzy V. '24 C
Big Four Ry. Bldg., Cincinnati, Ohio.
Bridge Designer.

Harrington, Russell A. '24 E
327 Rose St., La Crosse, Wis.
C. M. and St. P. R. R.

Harris, Clayton '09 E
Dayton, Iowa.

Harris, Gordon C. '29 E
Student General Elec. Co., Schenectady, N. Y.

Harris, Harold R. '14 E '15 EE
2153 Stanford Ave., St. Paul.

Harris, Nathan '20 G
City Hall, Minneapolis, Minn.
Engineer, Board of Estimate & Taxation.

Harris, Sigmund '05 M
Harris Liquidator Co., University Ave.
Minneapolis, Minn.

Hart, Maurice W. '26 E
400 W. Madison St.
Sales Engr., Cutler Hammer Mfg. Co.

Hartig, Henry E. '18 E
U. of M., Minneapolis, Minn.
College of Eng. and Arch.
Dept. of E. E., Asst. Prof.

Hartigan, James J. '29 C
535 Capitol Blvd., St. Paul.

Hartley, Lowell J. '26 E
Schenectady, N. Y.
General Electric Company.

Hartman, Philip F. '25 C
1903 W. Pershing Road, Chicago, Ill.
Goodyear Tire and Rubber Co.

Hartman, Walter K. '19 E
822 Standard Oil Building, Los Angeles, Calif.
Century Electric Co.

Hartney, James L. '14 M '15 ME
823 Dousman St., Green Bay, Wis.

Hartzberg, Edward M. '19 M
1300 Quincy St. N. E., Mpls.
Estimator Engr., C. W. Olson Mfg. Co.

Harwick, Henry C. '28 E
Illinois Bell Telephone Co., Chicago, Ill.

Harwood, Stanley G. '08 M

Hass, Paul O. '26 M
Fort Frances, Ont., Can.
Maintenance Engr., Backus Brooks Co.,
c-o F. Frances Pulp & Paper Co.

Hastings, Clive '96 M
Atchison, Kansas.
Pres., the Railway Specialty Co.

Hathaway, Herbert F. '28 M
General Elec. Co., Philadelphia, Pa.

Havens, Paul M. '27 A
1290 Grand Ave., St. Paul, Minn. (res.)
Instructor, Univ. of Minn.

Haverson, Henry D. '07 C
Havre, Montana, G. N. R. R.

Hawkins, Edward W. '24 A
Geo. W. Stiles Co.
139 E. Ontario St., Chicago, Ill.

Hawkins, G. C. '28 E
KGCR, Watertown, S. Dak.

Hawkins, Harvey C. '23 E
601 3rd Ave. S., Minneapolis, Minn.
Plant Engr., N. W. Bell Tel. Co.

Hawlek, Henry I. '19 C
1203 E. Juniper, Crete, Nebr.

Hawley, Harry G. '07 C
Los Angeles, Calif.
Metropolitan Water District of
Southern California.

Hayden, Claude E. '24 C
St. Paul, Minnesota.
Instrument Man, Minn. Highway Dept.

Hayden, John F. '90 C
1011 Lumber Exchange, Minneapolis.
Mgr., Mississippi Valley Lumberman.

*Hayes, Edward J. '20 M '21 ME

Hayes, Harold '22 G
Chicago, Ill. U. S. Gypsum Co.

*Haynes, S. H. '15 G

Hayward, George I. '06 C
917 L. C. Smith Bldg., Seattle, Washington.
Dist. Engr., N. P. Ry.

HAYWARD, LAWRENCE W. '21 E
4425 Cambell Ave., Kansas City, Mo. (res.)
Dist. Supt. Combustion Eng. Corp.

HEALY, JOE M. '29 E
Western Elec. Co., Chicago, Ill.

HEATH, ARTHUR C. '25 M
U. S. Aluminum Co., Massena, N. Y.

HEATH, DELBERT W. '29 C
Aviation Training Schools, Pensacola, Fla.

HEATH, DONALD C. '16 A
U. of M., Minneapolis, Minn.
Instructor in Architecture, College of Engineering and Architecture.

HEATH, OWEN M. '29 M
4507 Drexel Ave., Minneapolis.

HECHT, HENRY W. '24 E
Gaylord, Minn.

HEDENSTROM, ERNEST A. '12 E
1441 Van Buren, St. Paul, Minn.

HEGGEN, REUBEN '24 E
Wheaton, Minnesota.

HEIDELBERGER, OTTO F. '23 E '24 MS (EE)
1331 Tyler St. N. E., Mpls. Elec. Designer, Elec. Mach. Mfg. Co.

HEIDELBERGER, ROY J. '22 E
15 South 5th St., Minneapolis.
N. S. P. Co.

HEDMANN, KARL R. '29 E
East Pittsburgh, Pa.
Westinghouse Elec. Co.

HEIMER, AMOS K. '27 E
72 W. Adams St. Chicago, Illinois.

HEINEMAN, JOHN R. '19 E
General Electric Co., Schenectady, N. Y.

HEINS, HAROLD H. '25 E
150 Broadway, N. Y. City.
Westinghouse Elec. & Mfg. Co.
Traction Apparatus Sales Dept.

HEKTNER, JOEL '17 M
Canton, Ohio, Asst. Engr. Ry. Division
Timken Roller Bearing Co.

HELMICK, DAN S. '15 C
1200 Second Ave. S. Minneapolis, Minn.
Assoc. of Ralp D. Thomas, Consulting Engr.

*HELMS, FRANK C. '04 E

HELSETH, PAUL A. '29 C
264 Taney St., Gary, Ind.
Designer, Am. Bridge Co.

HELWIG, WILLIAM F. '23 E
Univ. of Texas, Austin, Texas.
Instructor in Electrical Engineering.

HEMENWAY, ED. L. '28 M
2115 E. Third St., Duluth, Minn.

HEMSEY, CLAYTON E. '22 M
86 44th St., Milwaukee, Wis.
Designer.

HENDRICKS, CLIFFORD L. '25 C
699 Lincoln Ave., St. Paul, Minn.
Tri-State Tel. Co.

HENDRICKSON, ARNOLD B. '22 E
611 New Orpheum Bldg., Los Angeles, Calif.
Calif. State Mining Bureau, Petroleum Engr.

HENDRICKSON, C. EDWARD '25 C
1609 Norwood St., Brainerd, Minn. (res.)

*HENDRICKSON, EUGENE A. '76 C

HENDRICKSON, NORMAN E. '16 C
Kalman Steel Co., 1112 Builders Exchange, St. Paul, Minn. District Manager.

HENRY, BURT C. '21 C
Gen. Delivery, Harlingen, Texas. Contractor.

HERBERG, SANFORD '24 C
3305 Grand Ave., Minneapolis, Minn.
General Inspection Co.

HERRICK, CARL A. '02 M
Ass. Pro., Mathematics and Mechanics,
U. of M., Minneapolis, Minn.

HERRMANN, RAYMOND R. '12 E '13 EE
Asst. Prof., Mathematics and Mechanics,
U. of M., Minneapolis, Minn.

HETHERTON, PERCIVAL '08 M
Longview, Wash., The Longview Co.
Manager, Industrial Div., Real Estate Dept.

*HEWETT, FRANK M. '97 C

HEWETT, MAURICE W. '13 C '14 CE
St. Paul, Minn.
Dept. of Public Works, Senior Asst. Civil Engr.

HEYER, ROBERT H. '29 M
3950 Oakland Ave., Minneapolis, Minn.
Grad. Student, Univ. of Minn.

HEYWOOD, GEORGE L. '28 E

HIBBARD, SHELDON S. '23 M
Duluth, Minn.
Clyde Iron Company.

HIBBARD, TRUMAN '97 E
14th Ave. N. E. and Tyler St., Minneapolis, Minn. Elec. Machinery Mfg. Co.
Secretary and Chief Engineer.

HICKOK, JESSIE E. S. '96 G '04 MS
1219 Flour Exchange, Minneapolis, Minn.
Treasurer, Hickok Construction Co.

HIERS, CHARLES R. '24 M
81 Fletcher Ave., Mt. Vernon, New York.
U. S. Radiator Co., New Haven, Conn.

*HIGGINS, CHARLES C. '00 M

HIGGINS, ELVIN L. '92 C
Hutchinson, Minn.
City Eng. and Chief Eng., Minn. Western R. R.

HIGGINS, JOHN T. '90 BCE '94 MD
Box 22, Watsonville, Calif.

HILDEBRANDT, HENRY A. G. '99 E
323 Church St. S. E., Minneapolis.

HILFERTY, CHARLES D. '96 M
60 E. 42nd St., New York City.
The Superheater Co.

HILGEDICK, WINFRED C. '26 E
New Orleans, La., Western Union Tel. Co.

HILL, EDWARD L. '25 E
Physics Department, U. of M.
Minneapolis, Minn.

HILL, HIBBERT M. '23 C
St. Paul, Minnesota,
U. S. Engineer's Office.

HILLMAN, CHARLES K. '12 E
2601 No. Broadway.
Seattle, Wash.
C. Kirk Hillman Co., Manager and Owner.

HINER, WALTER G. '23 C
1759 Van Buren St., St. Paul, Minn.
Minnesota Highway Dept.

HINMAN, CHARLES H. '24 A
P. L. Small, Inc., Archts.
Cleveland, Ohio.

HIRLEMAN, CLARK W. '12 M '13 ME
4424 Washburn Ave. S., Minneapolis, Minn.
Andrews Heating Co.

*HITZKER, ALBERT J. '09 E

HJERMSTAD, HARRY M. '15 E
(See Harry Merle Webster)

HOAG, WILLIAM R. '84 C '88 CE
Box 837, Lakworth, Fla.

HOBART, WALTER B. '07 C
2103 Colfax Ave. South,
Minneapolis, Minnesota.

HODNETT, RALPH M. '11 C
R. 700, 650 S. Clark St., Chicago, Ill.
Bureau of Architecture, Board of Education.

HOFF, CHRISTOPHER '06 E
St. Paul, Minn.
Lee-Hoff Mfg. Co., Vice-president.

HOFFMAN, JOHN R. '26 C
C. M. St. P. & P. R. R., Lanark, Ill.

HOFFMAN, RALPH M. S. & T. '11 C
State Highway Dept., St. Paul, Minn.
Bridge Engineer.

HOFFMAN, RALPH M. S. & T. '11
3315 Hunter Blvd., Seattle, Wash.
Link Belt Co.
Manger, Pacific Div.

HOFFMAN, RICHARD H. '22 M
2545 A St., San Diego, Cal.
Engineer Sprekels Companies.

HOFFMAN, WALLWIN H. '29 M
Bessemer, Michigan.

HOISVEEN, LEONARD F. '25 M
791 Holly Ave., St. Paul, Minn. (res.)

*HOKANSON, CLARENCE E. '06 E

HOLBECK, JOHN I. '24 E
32 W. Superior St., Duluth, Minn.
Minn. Power and Light Co.

HOLCOMB, HARRY S. '26 E
Minneapolis, Minn.
Switchboard drafting,
Electric Machinery Mfg. Co.

HOLDER, LAURENCE E. '24 C
Como Blvd. at N. P. Tracks, St. Paul, Minn.
Grant Construction Co.

HOLIEN, EDWARD O. '23 A
Allerton Club, New York City.

HOLIEN, GILMAN '28 A
Coffin & Holien, 400 Sexton Bldg., Minneapolis.

*HOLLAND, JAY C. '04 C

HOLM, EDWIN R. '20 C
213 S. Barstow St., Eau Claire, Wis.
Ass. Div. Engineer.
Div. No. 6, Wisconsin Highway Dept.

HOLMBERG, ABNER W. '15 M '16 ME
Gogbic Nat'l Bank Bldg., Ironwood, Mich.
Partner—Erickson-Holmberg Agency.

HOLMES, RAYMOND H. '25 E
Duluth, Minn.
Minn. Power and Light Co., Asst. Div. Engr.

HOLMES, ROLAND W. '25 M
Wilmerding, Pa.
Westinghouse Airbrake Co., Engineering Dept.

HOLMGREN, CHARLES E. '09 M
Breckenridge, Minn., Oil Company.

HOLMSTEN, VICTOR T. '22 M
Marquette Bldg., Chicago, Ill.
Alphons Custodis Chimney Const. Co.
Estimator.

HOLMSTINE, ARTHUR G. '17 M
Design Draftsman, Plant Engineer's Office,
N. N. S. and D. D. Co., Newport, Virginia.

HOLMSTINE, RALPH D. '24 M
Cicero, Ill.
Western Electric Co., Inc.

HOLMSTROM, GEORGE '29 E
224 3rd Ave., Two Harbors, Michigan.

HOLT, GUNNARD T. '28 E
University of Cincinnati, Cincinnati, Ohio.

HOLT, LEO '28 E
4512 Magnolia Ave., Chicago, Ill.

HOORN, FREDERICK W. '12 E '14 EE
Captain, Signal Corps, Fort Monmouth, N. J.

HOOVER, LLOYD '28 E
Northwestern Bell Tel. Co., Minneapolis, Minn.

HOPEMAN, ALBERT M. '05 C
Moorhead, Minn.
Hopeman Material Co., President.

HOPKINS, MARK L. '09 E
430 Oak Grove St., Minneapolis, Minn.
Jacobson Engineering Company.

HOPPIN, GLENN H. '08 E
Dearborn, Michigan, Secy. Stout Air Services, Inc.

HORNIBROOK, JAMES W. '09 E
622 Carney Blvd., Marinette, Wis.

HORSTKOTTE, ARTHUR E. '22 C
Burns, Oregon.

HORTBERG, REYNOLD O. '27 E
Chicago Central Stations, Chicago, Ill.

HOSFIELD, RALEIGH W. '12 C
Owatonna, Minn.
County Highway Engineer.

HOSMER, ORVILLE H. '23 C
City Planning Dept., St. Paul, Minn.
Asst. Civil Engr.

HOTCHKISS, FRED W. '18 E
1331 Tyler St. N. E., Minneapolis, Minn.
Elec. Machinery Mfg. Co., Treasurer.

HOUGAN, SANDER '21 E
1304 7th Ave. N., Great Falls, Mont.

*HOUGHTALING, ELTING W. '15 E '16 EE

HOULTON, AMOS D. '01 E
Minneapolis Tribune, Minneapolis, Minn.
Plating and Grinding Cylinders for Roto Dept.

HOUSTON, CECIL C. '09 C
400 W. Madison, Chicago, Ill.
Office of the President, C. & N. W. Ry.
Chief Clerk.

HOUSTON, GEORGE S. '02 C
1008 Roanoke Bldg. Minneapolis, Minn.
Houston-Christensen Co.

HOUTS, GUY J. '01 E
149 Fulton St., New York City.
Telephone Engineer, Western Electric.

HOVDEN, CONRAD D. '12 E '13 EE
South St. Paul, Minn.
Asst. Chief Engineer, Swift Co.

*HOVELSON, HENRY '08 E

HOVEY, BERTRAM K. '27 E
Sharon, Pa.
Transformer Eng. Dept., Westinghouse Elec. & Mfg. Co.

HOVING, JOHN E. '27 C
St. Paul, Minn.
Engr. Dept. Inspr., N. Pacific Ry.,
General Office Bldg.

HOVIK, LAWRENCE E. '29 A
525 Minnesota Bldg., St. Paul.
Ellerbe & Co., Architects.

HOW, FRANCIS W. '27 C
1246 University Ave.
St. Paul, Minn. (Minn. State Highway Dept.)

HOWARD, MONROE SHERMAN '92 E
1041 North Formosa Ave., Hollywood, Calif.
Sound Dept., United Artists Studio.

HOWATT, JOHN '04 E
650 S. Clark St., Chicago, Ill.
Board of Education, Chief Engineer.

HOYT, HIRAM P. '93 C
Monadnock Bldg., San Francisco, Calif.
Contracting Engineer.

*HOYT, WILLIAM H. '90 C '98 CE

HUBBARD, FRED A. '09 C
Portland, Ore.
Oregon, Washington R. R. and Navigation Co.
Valuation Dept.

HUBBARD, HENRY A. '09 C
420 Lexington Ave., N. Y. City.
Credit Man, Pure Oil Co.

HUBBARD, ROBERT T. '06 E
Bank of Wisconsin Bldg., Madison, Wis.
Ross W. Harris, Consulting Engr.

HUBBELL, ARTHUR C. '14 M '15 ME
3951 Canal St., Chicago, Ill.
American Can Co., Supt.

HUCHTHAUSEN, WALTER '28 A
93 Prescott St., Cambridge, Mass.

HUGHES, FRANK C. '03 M
900 The Rookery, N. W. Mutual Life Ins. Co.
Chicago, Ill.

*HUGO, VICTOR '96 M

HUHN, GEORGE P. '91 E
R. R. No. 3, Excelsior, Minn. (res.)
Secy., Turners' Bldg. Asso., Mpls.

HULT, GEORGE A. '16 E
315 S. Philips Ave., Sioux Falls, S. D.
N. S. P. Co., General Superintendent.

HUMMEL, CARL A. '26 E
Mo. Elec. Power Co., Mt. Grove, Mo.
Resident Engr.

HUNT, GATES E. '20 E
Commonwealth Bldg., Philadelphia, Pa.
Cutler-Hammer Mfg. Co., Merchandising Sales Div.

HUNTOON, MILTON B. '99 E
1365 Cass Ave., Detroit, Mich.
Telephone Eng.

HUSEBY, GISLE E. '24 E
212 W. Wash. St., Chicago, Ill.
Ill. Bell Tel. Co.

HUSSEY, NORMAN W. '25 E
Westinghouse Elec. Co., East Pittsburgh, Pa.

HUSTAD, ANDREW P. '08 C
529 7th St. South, Mpls.
Pres. Hustad Co.

HUSTAD, BYRON P. '10 E
300 First National Bank Bldg., Duluth, Minn.
Klippen and Hustad, General Contractors.

HUSTAD, JOHN C. '14 C '15 CE
560 Sexton Bldg., Minneapolis, Minn.
Sec. and Treas., The Hustad Co.

HUSTON, DAVID B. '07 C
Minot, N. D.
Huston-Kemper Construction Co.

HUTCHINSON, EDWIN T. '27 M
671 Franklin Place, Milwaukee, Wis.

HVOSLEF, FREDERICK W. '17 M '19 MS
Kohler Co., Kohler, Wis.
Heat Equipment Dept.

IMSANDE, FRED L. C. '25 C
Wadena, Minn., N. P. Ry.

INGBERG, SIMON '09 C
Washington, D. C.,
Bureau of Standards, U. S. Dept. of Commerce,
Chief Fire Resistance Section.

IRELAND, ROY R. '01 BS '03 E
463 West St., New York City, N. Y.
Asst. Apparatus Devl. Eng.,
Bell Telephone Lab., Inc.

IRONS, GEORGE '26 E
1771 Princeton Ave., St. Paul, Minn.

IRONS, ROY C. '27 M
300 W. Adams St., Box 725, Chicago, Ill.
Sales Engr., Shaffer Oil and Refining Co.

IRWIN, FRANK H. '16 E '17 EE
Guild, Tennessee.

IRWIN, VINCENT H. '13 E '14 EE
112 North Broad St., Philadelphia, Pa.
United Engineers & Constructors.

ISAACSON, ARTHUR M. '27 M
501 North Central Ave.
Chicago, Ill.

IVES, KENNETH S. '29 M
General Electric, Schenectady, N. Y.

JACKSON, EARL D. '05 E

JACKSON, OTTO E. '14 E '15 EE
26 East Lake St., Minneapolis, Minn.
Sec. and Mgr., Sterling Oil Co.

JACOBI, ALFRED J. '25 M
U. S. Patent Office, Washington, D. C.

JACOBS, ARTHUR R. '17 E

JACOBSON, ARTHUR C. '25 E
Century Electric Co., Minneapolis, Minn.

JACOBSON, CARL A. '29 E
2625 E. 24th St., Minneapolis, Minn.

JACOBSON, FRANK H. '24 E
1090 Tenth Ave. S. E., Minneapolis, Minn.
A. E. Jacobson Machine Works.
Vice President and Treasurer.

JACOBSON, HOWARD C. '21 G
1454 Branston St., St. Paul, Minn. (res.)
A. E. Jacobson Machine Works, Minneapolis.
President.

JACOBSON, RUBEN A. '25 M
G. N. Bldg., St. Paul, Minn.

JAKKULA, ARNE A. '26 C
University of Minnesota, Engineering Experiment Station, Research Fellow.

JAMES, HENRY C. '11 E
Assist. Division Supt.,
N. P. R. R., Seattle, Wash.

JANZEN, WILLIAM H. '20 E
C. M. & St. P. R. R., Avery, Idaho.
Foreman.

JAPS, BARNEY G. '09 E
522 West 21st St., University Place, Neb.
Poultry Business.

JAPS, WILBUR H. '28 M
E. I. duPont deNemours & Co.,
Wilmington, Delaware.

JAQUES, ROBERT '09 C
411 Lonsdale Bldg., Duluth, Minn.
Attorney at Law.

JARCHOW, THEO. '28 E
331 Walnut St., Minneapolis, Minn.
Distribution Dept., Northern States Power Co.

JENKINS, CLIFFORD H. '25 M
Boeing Airplane Co., Seattle, Wash.

JENSEN, CYRIL D. '21 C
Lehigh University, Bethlehem, Pa.
Asst. Professor of C. E.

JENSEN, JOHN A. '05 C
231 City Hall, Minneapolis, Minn.
Supervisor, City Water Dept.

JENSEN, OTTO L. '26 E
911 Church St., Evanston, Ill.
Public Service Co. of No. Ill.

JENSON, THEODORE B. '29 C
Experimental Eng., Univ. of Minn.

JERABEK, DANIEL '28 AE

JESPERSON, CLARENCE M. '10 E
The Swann Corp., Anniston, Ala.

JEVNE, GEORGE W. '10 C
Los Angeles, Calif.
Bldg. Supt., c/o Walker and Esen.

JOACHIM, WILLIAM F. '20 M '21 ME
Langley Field, Hampton, Va.
Assoc. Mech. Engr., National Advisory Committee for Aeronautics.

JOESTING, FREDERICK D. '26 E
1032 Mifflin Ave., Wilkinsburg Sta.,
Pittsburg, Pa., Westinghouse Elec. & Mfg. Co.

JOHNSEN, KENNETH A. '27 C
Ill. State Highway Dept.,
Courier News Bldg., Elgin, Ill.

JOHNSON, ALBERT W. '23 C
1725 Wilson Ave., Chicago, Ill.

JOHNSON, ALEXANDER B. '15 C
Maynard, Minn.

JOHNSON, ALPHONSE N. '21 C
15 S. Fifth St., Minneapolis, Minn.
N. S. P. Co.

JOHNSON, ANTON A. '24 A
Tyler, Minn.

JOHNSON, AUSTIN G. '05 M
D. & I. Range R. R. Co., Two Harbors, Minn.
Mechanical Engineer.

JOHNSON, BYRON F. '20 C
Managua, Nicaragua,
First Lieut. Air Squadron of Marine Corps.

JOHNSON, CARL ALBERT '21 M '22 ME
83 Como Ave., St. Paul, Minn.

JOHNSON, CARL ARTHUR '11 C
Ill. State Highway Dept., Elgin, Ill.

JOHNSON, CARL J. '14 E '15 EE
Fergus Falls, Minn.
Director of Sales, Otter Tail Power Co.

JOHNSON, CARL S. '21 C
Box 951, Buffalo, N. Y.
Lackawanna Steel Construction Corporation.
Engineering Department.

JOHNSON, CLARENCE C. A. '26 E
Boonville, Ind.

*JOHNSON, CLIFFORD S. '26 C

JOHNSON, DOUGLAS O. '28 E
437 Rebecca Ave., Wilkinsburg, Pa.
Westinghouse Electric Co.

JOHNSON, EDGAR F. '21 E
Waseca, Minn.
c/o E. F. Johnson Co., Radio Supplies.

JOHNSON, EDGAR W. '14 C '15 CE
209 City Hall, Minneapolis, Minn.
Engineer, Water Works Dept.

JOHNSON, ELLSWORTH '22 C
Los Angeles, Cal.
Western Pipe and Steel Co.

JOHNSON, ELMER W. '14 E '15 EE
U. of M., Minneapolis, Minn.
Asst. Prof. of Electric Power.

JOHNSON, ELVING L. 23 A
145 W. 84th St., New York City.
York and Sawyer Co.

JOHNSON, ENAN C. '25 E
Minneapolis, Minn.
Interference Engr. N. W. Bell Tel. Co.

*JOHNSON, FRANK E. '00 E

JOHNSON, GUSTAV A. '25 E
19th and Douglas, Omaha, Nebr.
N. W. Bell Telephone Co.

JOHNSON, GUSTAVE F. '27 E
15 S. 5th St., Minneapolis.
Rate Engr., N. S. P. Co.

JOHNSON, HERMAN R. '09 E
425 E. Water St., Milwaukee, Wis.
Westinghouse Elec. and Mfg. Co., Sales Engr.

JOHNSON, IRA L. '16 M '17 ME
Minneapolis, Minn.
2334 Minnehaha Ave., Minneapolis, Minn.
Experimental Eng.

JOHNSON, IVAR W. '24 E
709 East 29th N., Portland, Ore.

JOHNSON, JAMES P. '23 E
4309 Dupont Ave. S., Minneapolis, Minn.
N. W. Bell Telephone Co.

JOHNSON, JAMES R. '26 C
Bowlus, Minn.

JOHNSON, JOHN E. '11 E
463 West St., New York City.
Bell Telephone Lab.

JOHNSON, LAURENCE V. '27 C
110 7th Ave. South, St. Paul, Minn.
N. P. Railway Co.

JOHNSON, LAURENCE E. '29 AE
Wm. Bros Boiler & Mfg. Co., Minneapolis

JOHNSON, LEONARD T. '10 E
1400 Guardian Bldg., Cleveland, Ohio.
Asst. Steam Engr., Grasselli Chemical Co.

JOHNSON, LESTER L. Ex '2

28 Mooney Place, Rahway, N. J.

JOHNSON, NELS '05 C
1246 Univ. Ave., St. Paul, Minn.
Res. Eng., Minn. Highway Dept.

JOHNSON, NELS '23 C
Chaska, Minn.

JOHNSON, NOAH '94 C
St. Louis, Mo.
Valuation Engineer, Wabash Ry.

JOHNSON, PAUL SC. AND TECH. '1
(Laurence, Paul A.)
Paul A. Laurence Co., Minneapolis, Minn.

JOHNSON, RALPH '28 C
Bowlus, Minn.

Get every issue for 100% more Alumni News.

JOHNSON, RAYMOND V. '24 C
Thetford Mines, Quebec, Canada.
Night Supt., Roger Miller & Sons, Ltd.
JOHNSON, ROBERTSON B. '25 E
Minneapolis, Minn.
N. S. P. Co.
JOHNSON, RAYMOND A. '26 C
6708 Merrill Ave. N. W., Chicago, Ill.
JOHNSON, ROY M. '29 M
South Milwaukee, Wis.
Bucyrus-Erie Co.
JOHNSON, SHELDON '28 E
437 Rebecca Ave., Wilkinsburg, Pa.
Westinghouse Elec. & Mfg. Co.
E. Pittsburgh, Pa.
JOHNSON, WELTON V. '26 E
Newark, N. J.
Relay Engr., Westinghouse Elec. & Mfg. Co.
JOHNSTON, CHARLES K. '21 E
4816 Garfield Ave., Mpls.
Kinsell Auto Sales.
JOHNSTON, CLINTON J. '29 E
531 Walnut St. S. E., Minneapolis, Minn.
*JOHNSTON, RALPH E. '16 C '17 CE
JOHNSTON, WILLIAM W. '00 M
*JONES, C. PAUL '96 C
JONES, EDWIN F. '17 M
116 East 4th St., St. Paul, Minn.
Consulting Engineer.
JONES, GEORGE R. '14 E '15 EE
510 Third Ave. S., Minneapolis, Minn.
Industrial Electric Co., Vice President.
JONES, GURDON '28 AE
99 Crocus Place, St. Paul, Minn. (res.)
Des. Eng., McKenzie Hague Co., Inc.
JONES, HAROLD W. '25 C
417 4th No. Brainerd, Minn.
Eng. Dept., N. P. R. R., St. Paul, Minn.
JONES, IDRIS V. '15 C
2636 16th Ave. S., Minneapolis, Minn.
JONES, IVOR V. '15 C
P. O. Box 308, Bryn Mawr, Pa.
Stone & Webster, Inc.
JONES, LEWIS A. '07 C
U. S. Dept. of Agriculture, Washington, D. C.
Senior Drainage Engineer.
JONES, PAUL W. '28 A
Agricultural School, Fargo, N. Dak.
JONES, RAYMOND L. '05 E
140 New Montgomery St., San Francisco, Calif.
Pac. Tel. and Tel. Co. Engr.
JONES, RICHARD W. '26 E
East Pittsburgh, Pa.
Control Eng., Westinghouse Elec. & Mfg. Co.
JONES, ROBERT A. '15 E '16 EE
113 S. Salina St., Syracuse, N. Y.
Engr. Gen. Elec. Co.
JONES, WATKIN W. '11 E
81 Navajo St., Salt Lake City, Utah.
Mgr. Salt Lake Radio & Mfg. Co.
JORDAN, FRANK W. '19 E
52 East Broadway, Butte, Mont.
Westinghouse Elec. & Mfg. Co., Sales Engineer.
JORGENS, C. R. D. '12 C '13 CE
Minn. Highway Dept., Court House, St. Cloud, Minn. Maintenance Supt.
JOSEPHSON, ELIOT B. '10 E
215-219 Bush St., Red Wing, Minn.
JUDD, MAURICE D. '23 C
544-46 Builders Exch., Minneapolis, Minn.
Mgr., Mason City Brick & Tile Co.
JUELL, A. BARTON '26 C
Room 1815, 20 N. Wacker Drive, Chicago
JULES, HAROLD A. '20 E
295 Main St., Buffalo, N. Y.
Cutler-Hammer Manufacturing Co.
JURAN, JOSEPH M. '24 E
Hawthorne Station, Chicago, Ill.
Inspection Engineer, Western Electric Co.
JURAN, NATHAN H. '29 A
Room 541, 3120 Bwdy., New York City.
JUVRUD, EDWIN C. '17 E
Fargo, N. D.
N. W. Bell Telephone Co.
KANNENBERG, WALTER F. '23 E
463 West St., New York City.
Bell Telephone Laboratories, Inc.
Telephone Engineer.
KAPLAN, EUGENE V. '10 M
East Pittsburgh, Pa.
Westinghouse Elec. and Mfg. Co.

KAPLAN, SEEMAN '18 A
617 McKnight Bldg., Minneapolis, Minn.
KAPPEL, FREDERICK R. '24 E
420 Third Ave. S., Minneapolis, Minn.
N. W. Bell Tel. Co., Interference Engr.
KAPPHAHN, ERNEST H. '19 G
Geneva, Ill.
Wells Engineering Company.
KAPPHAHN, RAYMOND J. '12 C '13 CE
R. J. Kapphahn Cont. Co., Duluth, Minn.
KASPER, WALTER F. '11 M
Fairmont, Minn.
Fairmont Ry. Motor, Inc.
KASTNER, ARTHUR H. '27 A
1340 W. Como Ave., St. Paul, Minn.
Student, Univ. of Minn.
KASTNER, ROY W. '27 C
702 N. Monroe St., Peoria, Ill.
Ill. Highway Dept.
KATER, JOZEF J. '24 E
31st and Western Ave., Chicago, Ill.
Jr. Elec. Engr.
Sanitary District of Chicago.
KATTER, CALVIN K. '22 M
4216 Washburn Ave. S., Minneapolis. Salesman.
KATTER, REUBEN L. '22 M
E. E. Atkinson Co., Minneapolis, Minn.
Asst. Credit Manager.
KAUFMAN, MORRIS B. '24 C
KAUFFMAN, ROY '08 E
1041 West 98th St., Los Angeles, Calif.
KAUPPINEN, HEINO '23 E
Box 616, Ely, Minn.
KEARNEY, ADRIAN A. '23 E
2143 Grand Ave., St. Paul.
Northern States Power Co.
KEELER, JASPER F. '22 C
G. N. Ry. Co., St. Paul, Minn.
Bridge Department.
*KEISER, KARL W. '23 M '24 MS (ME)
KELLER, RAYMOND W. '25 E
37 E. Cassilly, Springfield, Ohio.
Ohio Edison Co.
KELLEY, WILLIAM '22 C
Long Lake, Minn.
Kelley and Kelley, Landscape Engineers.
KELLY, EARL W. '07 C
414 W. First St., Duluth, Minn.
Mgr. Water and Light Dept.
KELLY, RAYMOND R. '26 C
303 N. Grove Ave., Oak Park, Ill.
Sales & Mkt. Research for Western Lime & Cement Co.
KELLY, WILLIAM J. '26 E
Elkton, N. D.
KELSEY, HOWARD C. '22 M
Box 996, Buffalo, N. Y.
Jos. T. Ryerson & Son, Inc.
KENDALL, WALTER A. '25 A
200 3rd St., Milwaukee, Wis.,
c-o Dick & Bauer Archs.
KERNS, CLINTON B. '15 M
U. S. Metals Refining Co., Carteret, N. J.
Engineer.
KERNS, RALPH W. '07 E
Box 1912 Globe, Ariz.
Inspiration Consolidated Copper Co.
KIESNER, FRANK C. '24 M
3828 Harrison, Kansas City, Mo.
KILPATRICK, PORTER W. '27 A
Grand Forks, N. Dak.
T. B. Wells Co., Arch. Designer.
KING, ALFRED B. '08 E
99 Water St., New Haven, Conn.
Pres., Arthur C. Morse Co.
KING, F. V. '12 C '13 CE
Los Angeles, Calif.
Engineering Dept., City Hall.
KING, HARVEY M. '18 A
1115 S. 4th St., Louisville, Ky.
Architectural Secy., Board of Church Extension, M. E. Church.
KING, JOHN E. '22 E
212 West Washington St., Chicago, Ill.
Ill. Bell Telephone Co., Equipment Engr.
KING, LAWRENCE W. '09 C
111 W. 5th St., St. Paul.
St. Paul Fire & Marine Insurance Co., St. Paul, Minn. Ass't Secretary.

*KING, ROBERT E. '08 G
KING, WESLEY E. '05 C
Toltz King & Day, Inc., St. Paul, Minn.
KINGSLEY, NORMAN W. '20 E
Des Moines, Iowa.
Asst. to General Manager.
N. W. Bell Tel. Co.
KINGSTON, SAMUEL P. '29 C
410 Customs House, Detroit, Mich.
KINSELL, WILLIAM L. '00 E
4223 Garfield Ave., Minneapolis, Minn.
KIRCHER, FRANK J. '09 M
President, Citizens' Nat'l Bank of Olivia, Minn.
KIRCHER, GEORGE A. '09 M
Kircher Bros., Olivia, Minn.
KIVLEY, RAY C. '18 M
Western Electric Co., Hawthorne Station, Chicago, Ill. Development Engineer.
KIVLEY, WARREN O. '16 C
Helena, Mont.
State Highway Commission.
KJOSNESS, INGRAHAM G. '03 M
Lewiston, Idaho, Pres. Madison Lumber Mill Co.
KLAMMER, K. K. '28 E
Illinois Bell Telephone Co., Alton, Ill.
KLASS, FREDERICK '19 E
630 Soo Line Bldg., Minneapolis, Minn.
General Electric Co., Salesman.
KLEINFELD, LEONARD S. '26 M
1400 Wrightwood Ave., Chicago.
Research Engineer, Patents.
KLEINSCHMIDT, ARMIN R. '22 M
1026 LeSueur St., Mankato, Minn.
Contractor and Builder-Designer.
KLEINSCHMIDT, FLORIAN A. '20 A
Texas Technological College, Lubbock, Texas.
Head of Dept. of Arch.
KLEMER, FRANK H. '01 C
Faribault, Minn.
Faribault Woolen Mill Co., President.
KLINE, FRANK W. '24 E
4429 2nd Ave. S., Minneapolis.
Electrician, Mpls. Gen. Elec. Co.
KLINE, MARVIN L. '29 AE
4429 2nd Ave. S., Minneapolis, Minn.
KLOPSTEG, PAUL E.
'11 BS '13 MA '16 PH. D
(Science and Tech.)
460 E. Ohio St., Chicago, Ill.
Central Scientific Co.
KNAPP, LESTER H. '12 E
Paducah Electric Co., Paducah, Ky.
Sales Manager.
KNAUSS, ARCHIBALD C. '16 C '17 CE
Oregon-American Lumber Co., Vernonia, Ore.
Dry Kiln Supt.
KNIGHT, RALPH J. '15 C
Newport, Minn., Contractor.
KNOLL, FRANKLIN O. '25 E
N. S. P. Co., Minneapolis, Minn.
KNOPP, WILLIAM R. '09 M
KNOWLES, EVERETT H. '20 E
Chile Exploration Co., Chuquicamata, Chile, S. A., via Antofagasta, Jr. Elec. Engr.
KNOWLTON, HERBERT H. '08 C
Motor Route "A," Fowler, Colorado.
Supt., Apishapa Irrigation Project.
*KNOWLTON, WARREN C. '02 C
KNOX, CHARLES '28 C
630 Power Building, Chattanooga, Tenn.
KNUDSEN, ESTHER M. '25 C
State Capitol Annex, Madison, Wis.
Wis. Highway Com.
KNUTSON, HARRY '17 M
Clyde Iron Works, Duluth, Minn.
Chief Draftsman.
KNUTSON, MELVIN I. '28 M
3147 28th Ave. S., Minneapolis, Minn.
KOCH, KARL L. '23 E
St. Paul, Minn.
Northern States Power Co.
KOCH, WINFIELD R. '25 E
Westinghouse Elec. & Mfg. Co.
East Pittsburgh, Pa.
KOCHENDORFER, MILTON J. '05 E
St. Paul, Minn.
Andrew Schoch Grocery Co.
KOEHLER, EDWIN F. '24 M
688 Lawrence, Detroit, Mich.
Safety Eng., Standard Acc. Ins. Co.

Koepke, Walter E. '13 C '14 CE
1950 Andrews Ave., New York City.
Eastern Sales Mgr., Nat'l Concrete Metal Forms Corp.

Koerner, A. M. '28 E
Bell Telephone Company,
463 W. St., New York City.

Konstant, Nicholas '18 C
6248 Wayne Ave., Chicago, Ill., Dept. of Public Works.

Kopf, David '28 C
Great Northern R. R. Bridge Dept.,
St. Paul, Minn.

Kopper, Edward '14 BME '16 M
318 Endicott Bldg., St. Paul, Minn.
Mfrs. Agent for Railway & Mill Supplies.

Kopplen, C. Donald '28 C
1609 University Ave. S. E., Minneapolis, Minn.

Korba, Anton '29 E
Westinghouse Elec. Co., E. Pittsburgh, Pa.

Korslund, Harry J. '20 A
Norwood, Mass., Bigelow Bldg.
Arch. Designer for W. G. Upham.

Kotchevar, Joseph F. '28 E
Ideal Elec. & Mfg. Co., Mansfield, Ohio.

Kotz, Walter E. '23 C
Fairmont, Minn., Minn. State Highway.

Krafft, Edwin W. '24 A
2d Ave. S. and 9th St., Minneapolis, Minn.
Magney and Tusler.

Krag, Walter G. '07 M

Kranzfelder, Robert H. '26 AE
836 Security Bldg., Minneapolis, Minn.
Technical Service Engineer.
Universal Atlas Cement Co.

Krauch, William L. '08 C
893 Como Blvd., St. Paul, Minn.
Chief Engr., Geo. J. Grant Const. Co.

Krause, Fred E. '24 E
72 W. Adams St., Chicago, Ill.
Public Service Co. of Northern Illinois.

Krefting, Arthur S. '26 C
4851 Lyndale Ave. N., Minneapolis, Minn.
1st Nat'l. Bank Soo Line Bldg., Mpls.
Structural Design, Bridge Dept., Soo Line R. R.

Kreger, Stuart S. '28 C

Kreinkamp, Herbert A. '22 A
Los Angeles, Calif.
802 Architects Bldg.

Kreinkamp, Linton H. '17 A
Los Angeles, Calif.
Draftsman, Walker and Eisen.

Kriechbaum, John P. '28 E
2528 Portland Ave., Minneapolis, Minn.

Krieger, Keith M. '28 E
Glenwood, Minn.

Kristy, George A. '09 E
508 S. Dearborn St., Chicago, Ill.
Brilliant Search Light Mfg. Co., Manager.

Kritzer, Louis M. '28 E
205 Cecil St. S. E., Minneapolis, Minn.

Kriz, Joseph J. '12 C '13 CE

Kroeze, Herbert A. '19 G
Jackson, Miss.
Chief State Sanitary Engineer.

Kroll, Arthur J. '25 C
Chicago, Ill.
I. C. R. R. Bldg.

Kronick, T. Gerald '26 A
1135 Irving Ave. N., Minneapolis, Minn.

Krueger, Walter R. '29 E
New York City Bell Tel. Lab.

Kruse, Helmer V. '13 C '14 CE
United Verde Copper Co., Jerome, Ariz.
Construction Engineer.

Kruse, Orlin C. '20 E
11th Ave. and St. Charles Rd., Maywood, Ill.
American Can Co.

Kuebler, E. L. '29 E
Westinghouse Elec. & Mfg. Co.,
E. Pittsburgh, Pa.

Kuempel, John L. '29 M
Minneapolis-Honeywell Reg. Co., Minneapolis.

Kuhlman, Rudolph H. '23 M
101 Park Ave., New York City.
Pres. Thermo-Service Inc.

Kumm, Arthur W. '22 M
1117 Union Oil Bldg., Los Angeles, Calif.
Designing Engr., Union Oil Co. of California.

Kusnierek, Clemet J. '28 M
2117 W. Sixth St., Duluth, Minn.

Kvitrud, Ingwald '11 C
113 S. Tenth St., Minneapolis, Minn.
Sec'y-Treas., Reese Metal Weather Strip Co.

LaBonte, Anton E. '25 C
Bridge Draftsman, Minn. State Highway Dept., St. Paul.

Lagaard, Alex S. T. '13 E '14 E E
1437 Northwestern Bank Bldg., Minneapolis, Minn. Patent Attorney.

Lagaard, Maurice B. '14 C '15 CE
Portland Cement Association, Chicago, Ill.
Associate Engineer.

Laird, Leo R. '03 E
463 West St., New York City.
Bell Telephone Laboratories, Inc.

Lambert, Edwin M. '09 M
U. of M., Minneapolis, Minn.
Professor, School of Mines.

Lambert, Fred T. '02 C
Minn. State Highway Dept., St. Paul, Minn.
Resident Bridge Engineer.

Lambie, Horace H. '23 E
Ill. Bell Telephone Co., 212 W. Washington St., Chicago, Ill. Toll Engr., Suburban Plant.

Lamon, Harold J. '27
Buick Motor Co., Flint, Mich.

Lande, Clarence C. '27 C
Neenah, Wisconsin. Kimberly-Clark Co.

Landeen, Arvid G. '10 E
463 West St., New York City, N. Y.
Western Electric Co.

Lang, Charles A. '06 E
2011 James Ave. S., Minneapolis.

Lang, Fred C. '08 C
1246 University Ave., St. Paul.
Minn. Highway Dept., Dept., Eng. Tests and Inspection.

Lange, George M. '27 E
1429 Harrison Ave. S., Canton, Ohio.

*Lang, James S. '96 M, '97 EE, '99 ME

Langford, George, Jr. '24 M

Langland, Harold S. '19 E
3713 Minnehaha Ave., Minneapolis, Minn.
Stanley Iron Works, Sec'y-Treas.

Langman, Harley R. '24 M
Kansas City, Kansas.
Production Supervisor, Procter & Gamble Co.

Lanpher, Murray N. '24 E
Westinghouse Elec. & Mfg. Co., Davenport, Ia.

Lantz, Reuben S. '25 A
120 Story St., Boone Ia.

Larson, Albin '14 C
University Farm, St. Paul, Minn.
Assistant Professor of Ag. Botany.

Larson, Amandus C. '20 C
Morell & Nichols, Landscape Architects, Minneapolis, Minn. Engineer. 723 Superior St. S.E., Minneapolis.

Larson, Carl '16 C
1521 Soo Line Bldg., Minneapolis, Minn.
Soo R. R. Co., Structural Draftsman.

Larson, Edwin '21 A
314 W. Hanna, Tampa, Florida.

Larsen, Einar H. '26 E
Public Service Co. of N. Ill., Pontiac, Ill.

Larson, Emil L. '25 AE

Larson, Fred H. '25 C
Albuquerque, New Mexico.
Middle Rio Grande Conservancy Dist.

Larson, Glen M. '23 M
5412 Virginia Ave., Los Angeles, Cal.
Associated Oil Co.

Larson, Harold O. '29 E
215 Midland Ave., Arlington, N. Y.

Larson, Louis J. '14 C, '15 CE
A. O. Smith Corp., Keefe & 27th Ave., Milwaukee, Wis.

Larson, Ludvig C. '21 E, '23 EE
University of Wisconsin, Madison, Wis.
Instructor, Electrical Engineering.

Larson, Martin S. '11 M
Hampden & Wabash Ave., St. Paul, Minn.
Mechanical Engineer, Flaxlinum Insulating Co.

Larson, Maurice C. '29 E
Hendricks, Minn.

Larson, Peter L. '24 C
Deem and Yarbrough, Winter Haven, Fla.

Larson, Seymour R. '28 E
General Electric Company, Fort Wayne, Ind.

Larson, Victor F. '17 M
National Iron Company, W. Duluth, Minn.
Mech. Draftsman.

Larson, Walter J. '20 E
1816 E. 45th St., Cleveland, Ohio.
Mazda Lamp Div., G. E. Co., Quality Engr.

Larson, Werner L. '28 M
General Electric Company, Schenectady, N. Y.

Laurence, Paul A. Sc. and Tech. '12
(See Paul A. Johnson)
Box 120, Fort William, Ont., Canada.

Laurence, Philip L. '15 C
(See Philip L. Johnson)
Hill Bldg., Lincoln Road and Pennsylvania Ave., Miami Beach, Fla. Contractor.

Lauritzen, Carl W. '24 E
507 E. Lincoln Way, Valparaiso, Ind.
Instr. E. E. Valparaiso University.

Lawrence, Scott '15 E, '16 EE
Montevideo, Minn.

Layden, Arthur L. '14 E

Lazarus, Morris W. '23 C
Melrose Park, Ill.
Miss. Valley Structural Steel Co.

Leach, Edward W. '10 C
Keewatin, Minn., c/o Bennett, Minn.
Gen. Supt., Western District, Pickands, Mather & Co.

Leach, Stowell D. '29 A
315 19th Ave. S. E., Minneapolis.

Lebeck, Carl E. '20 C
719 Security Bldg., Minneapolis.
Dist. Mgr., Genfire Steel Co.

Lebeck, Torarin E. '24 E
N. S. P. Co., Minneapolis, Minn.
Asst. Supt., Meter Dept.

LeBlond, Edmond J. '05 E
St. Paul, Minn.
N. S. P. Co., Elec. Supt.

Lee, Albert A. '26 E
Cutler-Hammer Mfg. Co., Cleveland, Ohio

Lee, Albert C. '27 E
Carington, N. Dak.

Lee, Alfred H. '28 E
General Electric Company, Schenectady, N. Y.

Lee, Engbret A. '97 C
704 Equitable Bldg., Denver, Colo.
Am. Smelting & Refining Co., Chief Engr.

Lee, Oscar C. '19 E
Elect. Mach. Mfg. Co., Minneapolis, Minn.

Lee, Paul R. '27 E
Mansfield, Ohio. Thermostat Engr. Dept., Westinghouse Elec. & Mfg. Co.

Lee, Walter J. '20 E
Youngstown Lamp Works, Hughes Street, Youngstown, Ohio.

Leegard, Clifford '29 M
2645 Hennepin Ave., Minneapolis, Minn.

Leider, A. E. '27 E
Incandescent Lamp Dept., General Elec. Co. Youngstown, Ohio.

Lende, Henry M. '20 G
Granite Falls, Minn.
Lende's Garage, Manager.

Lende, Willard H. '28 E
Westinghouse Elec. Elevator Co.,
Chicago, Ill.

Leonard, Aubrey C. '23 C
Olmsted Co. Highway Dept., Rochester, Minn.

*Leonard, Henry C. '75 BCE, '78 BS

Leonard, Thomas K. '15 C, '16 CE
5212 York Ave. S., Minneapolis, Minn.
Larson & McLauren.

LeTourneau, Edward H. '05 E
26 Broadway, New York City, N. Y.
Asst. Mgr., Standard Shipping Co.

Letson, Donald E. '26 M
Canton, Ohio.
Timken Roller Bearing Co.

Levens, Alexander S.
'22 C, '24 MS, (CE) '27 CE
University of Minnesota, Minneapolis, Minn.
Assistant Prof. of Drawing.

LeVesconte, L. B. '26 E
Prior Lake, Minn.

Levin, Jake M. '19 E
2303 Kennedy St. N. E., Minneapolis, Minn.
Westinghouse Elec. & Mfg. Co., Switchboard Designer.

LEVY, MAX L. '26 E
683 West Central Ave., St. Paul, Minn.

LEWIN, SHERMAN W. '26 C
3848 Blaisdell Ave. S., Minneapolis, Minn.

LEWIS, BERKELEY R., JR. '25 E
Montevideo, Minn.
Northern States Power Co., Division Eng.

LEWIS, CARROLL E. '19 G
412 Essex Bldg., Minneapolis, Minn.
Member, Lang, Raugland & Lewis.

LEWIS, EDWARD B. '05 M
2283 Commonwealth Ave., St. Paul, Minn.
Ellerbe & Co.

LEWIS, GEORGE R. '21 M
1286 Raymond Ave., St. Paul, Minn.
Rag Roofing Co., Salesman.

LEWIS, JOHN G. '24 E
West Barrington, R. I.
Minister, The Community Church.

LEWIS, LLOYD W. '27 E
531 Walnut St., Minneapolis, Minn.

LEXAU, OLE '28 C
1803 Ashland Ave., St. Paul, Minn.

LIBBY, CALVIN R. '28 M
3924 Harriet Ave., Minneapolis, Minn.

LIDDLE, RALPH W. '21 G
1829 Edison Bldg., Chicago, Ill.
Commonwealth Edison Co.
Editor, Edison Round Table.

LIEB, JANET '29 IA
Int. Dec. Shop, New York.

LIEBENBERG, JACOB J. '16 A
617 McKnight Bldg., Minneapolis, Minn.
Liebenberg and Kaplan.

LIEBERMAN, HENRY '23 E
1414 W. 78th St., Chicago, Ill.
Am. Tel. and Tel. Co.

LIESE, CARL R. '26 C
Cassilla 17, Tocopilla, Chile, S. A.
Anglo-Chilean Cons. Nitrate Corp.

LIESE, HERBERT W. '24 C
209 Gilfillan Block, St. Paul, Minn.
Foley Bros. Contracting Co.

LIGHTER, CLYDE W. '26 A
Thomas Ellerbe & Co., St. Paul, Minn.

LILLY, CLARENCE W. '17 E
1246 University Ave., St. Paul, Minn.
Minn. Highway Dept.

LILLY, EUGENE '19 G
223 Grotto Street, St. Paul, Minn.

LIN, SHU MING '20 A
Peking, China.

LINDELEF, CHARLES G. '09 E
Yellowstone Park, Wyo.
Chief Engineer, Yellowstone Park Hotel Co.

LINDELIEN, ENGEN '23 M
Grand Meadow, Minn.

LINDEN, HENNING '17 C
Fort Snelling, Minnesota. Capt. 3rd Inf.

LINDQUIST, OLIVER J. '26 E
3743 N. Kostner Ave., Chicago, Ill.

LINHOFF, CARL H. '22 E
230 S. Clark St., Chicago, Illinois.
Switchgear Specialist, Gen. Elec. Co.

LINSTEDT, PHILIP G. A. '26 C
3117 45th Ave. S., Minneapolis, Minn.

LIPCHICK, ALEX A. '26 C
4946 Kenmore Ave., Chicago, Ill.

LITTLE, ALICE V. '22 A
Greensboro, N. C.
N. C. College for Women, Art Instructor.

LITTLE, FRED W. '27 M
918 W. 18th St., Chicago, Ill.
National Lead Co.

LITTLE, LEROY C. '24 E
6132 Broadbranch Road, Chevy Chase, Md.
Patent Examiner, U. S. Patent Office.

LIU, MAOLING '29 E
U. of M., Physics Dept., Minneapolis, Minn.

LOBECK, TORARIN E. '24 E
Northern States Power Co., Minneapolis.
Asst. Supt. Meter Dept.

LOCKHART, HAROLD A. '29 E
2313 Priscilla St., St. Paul, Minn.

LOCKLIN, ROBERT B. '29 E
412 Rebecca, Wilkinsburg, Pa.
Westinghouse Elec. Co.

LOCKWOOD, RAYMOND A. '20 E
30 Pine St., N. Y. City.
Buying Dept., Goldman Sachs & Co.

LOE, ERIC H. '88 M

LOEFFLER, HENRY S. '14 E, '15 EE
G. N. Ry., St. Paul, Minn.
Bridge Engineer.

LOGUE, JOHN F. '24 M
885 Dayton Ave., St. Paul, Minn.

LOHN, ROBERT N. '29 C
210 N. Broadway, Joliet, Ill. (res.)
Draftsman, E. J. & E. Ry. Co.

LONDON, WILLIAM '29 E
420 Third Ave. S., Minneapolis, Minn.
American T. & T. Co.

LONG, FRED W. '96 C, '98 CE
1512 Barnett Bank Bldg., Jacksonville, Fla.
Contractor.

LONGFELLOW, DWIGHT W. '08 C
Elk River, Minn.
Elk River Concrete Products Co.
Secretary and Treasurer.

LONIE, JAMES H. '97 M
Western Electric Co., Chicago, Ill.

LOO, PANG CHIEH '28 AE
Tsing Hua University, Peking, China.

LOO, YUSON '27 M

LORENS, EDWARD R. '26 C
Patient at Glen Lake Sanatorium, Oak Terrace, Minn.

LOSTROM, HERBERT W. '26 E
517 23rd Ave. W., Duluth, Minn. (res.)
Asst. Dynamometer Eng.
820 N. P. Bldg., St. Paul, Minn.

LOUKS, ROGER '27 C
Psychology Bldg., U. of Minn.

LOVERING, HARRY D. '13 C, '14 CE
605 Builders Exchange Building, St. Paul, Minn.
Levering-Longbatham Co.

LOWTHER, WILFRED W. '27 M
Minneapolis, Minn.
2323 27th Ave. S., Minneapolis, Minn.

*LOY, GEORGE J. '84 C

LOYE, BENJAMIN W. '06 M
4647 Wesson Ave., Detroit, Mich.
Detroit Insulated Wire Co., Supt.

LOYE, DONALD P. '16 E, '17 EE
7046 Hollywood Blvd., Hollywood, Calif.
Elec. Research Prod., Inc.

LOYE, EDWIN M. '20 A
C31, Gramatan Court, Mt. Vernon, N. Y.

LOYE, PERCIVAL E. '21 E
602 Baker Bldg., Minneapolis, Minn.
Consulting Eng.

LUCE, ALEXANDER W. '21 M, '23 ME
Lehigh University, Bethlehem, Pa.
Instructor, Dept. of Mech. Engineering.

LUDLUM, ROBERT V. '25 E
5201 Santa Fe Ave., Los Angeles, Calif.
Illum. Engr., Edison Lamp Works of Gen. Elec. Co.

LUDVIGSEN, ELLIOT L. '25 M
430 Woodstock Pl., Milwaukee, Wis.
Fuller & Sons Mfg. Co.

LUEDEMAN, CLARENCE H. '23 AE
Pioneer Trust Bldg., Kansas City, Mo.
Comer Metal Lath Const. Co.

LUETHI, CARL F. '27 C
2600 Delaware St. N. E., Minneapolis, Minn.
Ground Flight Instr., Air Service, Inc.

LUMM, A. GORDON '25 A
1729 12th Ave., Seattle, Wash.
Contractor.

LUND, CLARENCE V. '26 C
1681 Smith St., Lincoln, Nebr.

LUND, EARL H. '22 C, '23 CE
730 Jefferson St. N. E., Minneapolis.

LUND, JEFFERY L. '25 E
1420 Ansel Road, Cleveland, Ohio.
General Electric Co., Salesman.

LUND, ROY V. '24 C
3956 S. 13th Ave., Mpls., Minn.
Engineer, Dept. of Building & Grounds, Univ. of Minnesota.

LUND, STANLEY D. '27 C
Sexton Building, Minneapolis, Minn.
Sales Engineer, Genfire Steel Co.

LUNDGREN, CARL W. '26 M
2810 Ulysses St. N. E., Minneapolis, Minn.

LUNDQUIST, C. D. VERNON '25 M
2515 Columbus Ave., Minneapolis, Minn.
Instructor M. E. Univ. of Minn.

LUNDQUIST, JOHN V. '23 E
North Hibbing, Minn.

LUNDQUIST, REUBEN A. '05 E
Plymouth Road and Grand River Ave., Detroit, Mich.
Export Manager, Kelvinator Corp.

LUNDQUIST, WILTON G. C. '28 M
2515 Columbus Ave., Minneapolis, Minn.

LUNDSTEN, FRANK R. '27 C
406 Federal Bldg., Milwaukee, Wis.
Jr. Eng., U. E. Eng. Dept.

LUPLOW, WALTER D. '17 C
Captain, Corps of Engrs.
Fort Humphreys, Va.

LUSHENE, JOSEPH P. '25 C
Box 2625, Ft. Myers, Florida.
U. S. Coast and Geodetic Survey.

LUTZ, RICHARD E. '15 E
1200 2nd Ave. S., Minneapolis, Minn.
R. D. Thomas, Civil Engineer.

LUX, ARTHUR E. '16 C
224 Aurora Avenue, St. Paul, Minn.

LUXFORD, RONALD F. '17 C
Madison, Wis.
U. S. Forest Products Co.

LYBERG, VERELE C. '26 E
Oakland, Calif.
Lab. Asst., Pacific Gas & Elec. Co.

LYFORD, DARTT H. '11 E
904 Hollingsworth Bldg., Los Angeles, Calif.
Sales Mgr. Newton Process Mfg. Co.

LYNSKEY, JOSEPH P. '26 E
72 W. Adams St., Chicago, Ill.
Commonwealth Edison Co.

LYON, GLENN H. '20 A
919 Mich. Trust Bldg., Grand Rapids, Mich.
Arch. Engr. with H. H. Turner and V. E. Thebaud.

MCAFEE, ALLAN L. '08 E
General Merchandise, Harrisburg, Ore.

MCANDREWS, HARRY N. '25 C
Cold Spring, Minn.
Cold Spring Granite Co.

MCCALL, HARRY J. '08 C
N. P. Ry., Pasco, Wash.

MCCANN, REALINO V. '27 A
O'Meara Hills, Architects, St. Louis, Mo.

MCCARTNEY, FLOYD A. '13 M
White Bear, Minnesota.
Equitable Life Insurance Co., St. Paul.

MCCAULEY, JOHN S. '29 C
825 Holly Ave., St. Paul.

MCCLELLAND, CLAUDE L. '02 C

MCCLUNG, KARL R. '25 E
N. S. P. Co., Minneapolis, Minn.
15 S. 5th St., Minneapolis.
Rate Dept.

MCCONNELL, EDMOND S. '24 E
111 W. Washington St., Chicago, Ill.
Anaconda Wire & Cable Co.

MCCOY, IRA C. '11 E
Joliet, Ill.
Inst., Joliet Township High School.

MCCRADY, ARCHIE R. '24 C
Chicago, Ill., Hawthorne Station.
Patent Attorney, Western Elec. Co.

MCCREA, JOHN A. '28 E
Westinghouse Elec. & Mfg. Co.
20 N. Wacker Drive, Chicago, Ill.

MCCREE, ANDREW A. '08 C
305 Hackney Bldg., St. Paul, Minn.
McCree and Company.

MCCUBREY, EVERETT J. '21 C
Asst. Eng., Minn. Highway Dept.,
St. Paul, Minn.

MCCULLOUGH, BRUCE M. '16 C
3700 Bryant Ave. N., Minneapolis, Minn.
Minister, Calvary Presbyterian Church.

MCCULLOUGH, ROBERT T. '23 E
Long Island Lighting Co., Bay Shore, N. Y.
Field Engineer.

MCCULLY, JAMES P. '25 E
Schenectady, N. Y.
Gen. Electric Co. Testman.

MCDANIELD, L. A. '28 C
Willow Springs, Mo., Missouri State Highway Dept.

MCDONALD, GEORGE A. '27 M

MCDONNELL, LAWRENCE P. '27 E
2725 17th Ave. S., Minneapolis, Minn.

McEachin, John L. '22 E
Minnesota Power & Light Co., Duluth, Minn.
Sales Manager.

McEwen, Alexander D. '25 E
East Pittsburgh, Pa.
Westinghouse Elec. and Mfg. Co.

McGinnaty, Wm. J. '28 AE
333 Michigan Ave. N.
Holibird & Root, Chicago, Ill.

McGladrey, Lyle '28 M
Insulite Lab., Columbia Hghts Sta.,
R. F. D. 9, Minneapolis, Minn.

McGregor, Frazer A. '24 E
Stanley, N. D.
Grain Buyer.

McIlvaine, Wm. D., Jr. '29 E
Teaching Fellow, Univ. of Minn.

*McIntire, Elmer E. '29 E

McKay, Earle D. '15 C, '16 CE
271 Madison Ave., N. Y. City.
Chas. E. Bedaux Co.

McKeehan, Louis W. '08 G, '09 MS, '11 Ph D
New Haven, Conn. Prof. of Phys. and Dir. of Sloane Phys. Lab., Yale University.

McKellip, Frank W. '98 E
525 Third St. S. W., Faribault, Minn.
General Engineering Practice.

McKenzie, Lauren F. '09 E
2901 1st Ave. South, Seattle, Wash.
Salesman, Linde Air Products Co.

McKenzie, Leonard F. '20 E
422 Corn Exchange Bld., Minneapolis, Minn.
Supt. of Construction, McKenzie-Hague Co.

McKesson, Lewis J. '27 E
Philippine Islands.
Radio Engr., Radio Corp. of Amer.

McKibben, Lloyd S. '21 E
Los Angeles, Calif.
Electrical Research Products, Inc.

*McKibben, Ray '17 E, '18 EE

McKittrick, James '01 C

McLean, Milton D. '21 G
Executive Secretary, Univ. of Chicago, Chicago, Ill.

McLeland, Lyle K. '24 E
Northern States Power Co., Mpls., Minn.

McMeekin, Glenn D. '21 G
718 South Water St., Waverly, Iowa.

McMillan, Franklin R. '05 C
33 W. Grand Ave., Chicago. Dir. of Research. Portland Cement.

McMillen, James S. '22 E
Eau Claire, Wis.
Sales Dept., N. S. P. Co.

McNally, Lee '28 C
1520 Soo Line Bldg., Minneapolis, Minn.
Draftsman, Bridge Dept., Soo Line.

McNeill, Lyle D. '27 M
Sioux City, Iowa.

McPherson, William B. '02 E
1000 Hamline Ave., St. Paul, Minn.
Minn. By-Product Coke Co.
Maintenance Engineer.

McQuillin, Raymond E. '11 E
Washington, D. C.
O. C. of Cavalry, Major, War Dept.

McVean, Norman S. '21 E
149 Shore Drive, Winthrop, Mass.

Mabbott, Leonard E. J. '24 E
Faribault, Minn.
Sales Mgr., Faribault Div., N. S. P. Co.

MacGowan, Irvin S. '25 C
1112 Builders Exchange Bldg.
Kalman Steel Co., Inc., St. Paul, Minn.

MacGregor, Helen J. '25 ID
2216 Humbolt Ave., Mpls. (res.)
William A. French Co.

Mackay, Donald H. '26 E
213 E. Hennepin Ave., Minneapolis, Minn.
McKay Equipment Co.

Mackintosh, William S. '21 C
920 Guardian Life Bldg., St. Paul, Minn.
Ramsey County Engr.

MacKusick, Elwood M. '99 E
Hotel Sequoia, Redwood City, Calif.

Madden, Francis '03 C
Dubuque, Iowa.

Madsen, Olav '20 G
Blue Bird Haven, Novelty, Ohio.

Magnusson, Carl E. '96 E, '97 MS, '05 EE
Univ. of Wash., Seattle, Wash.
Prof. Elec. Engineering, and Director, Engineering Experiment Station.

Magnuson, John E. '22 E
3519 Fairmont, Dallas, Texas.

Magoon, Herbert A. '24 A
2 W. 47th St., New York City.
Bertran-Goveruor-Goodhue Association.
Draftsman.

Mahachek, Ross F. '26 E
Austin, Minn.

Mahoney, William L. '13 E, '14 EE
Consumers Power Co., Grand Rapids, Mich.
General Superintendent.

Maine, Basil C. '21 E
Anglo-Chilean Consolidated Nitrate Corp.
Casilla 17, Tocopilla, Chile.

Maiser, Walter L. '23 C

Malloy, Charles J. '06 C
G. N. R. R., St. Paul, Minn.

Malmberg, Victor A. '20 C
St. Paul, Minn.

Malmgren, Richard V. '25 E
254 Maria Ave., St. Paul.

Malmstrom, Axel L. '17 E
2000 Second Ave., Detroit, Mich.
Detroit Edison Co.
Transmission Engr.

Manderfeld, Emanuel C. '21 E
463 West St., New York City.
Bell Telephone Laboratories.

Maney, George A. '11 C
N. W. University, Evanston, Ill.
Prof. of Structural Engineering.

Maney, James E. '26 M
Proctor, Minn.
Duluth, Missabe and Northern Ry.

Manger, Henry J. '23 C
3123 14th Ave. S., Minneapolis.
U. S. Engineers at Hastings, Minn.

Mangney, Elmer J. '21 E
15 S. 5th St., Mpls., Power Sales Dept., Mpls. Gen. Elec. Co.

Mangney, Hilding O. '24 E
1308 Powderhorn Terrace, Minneapolis (res.)
Northern States Power Co.

Mann, Alvin K. '26 E
Poughkeepsie, N. Y., Commercial Dept.
Central Hudson Gas & Elec. Co.

Mann, Fred M. '93 C, '98 CE
U. of M., Minneapolis, Minn.
Professor of Arch., Head of Department.

Manson, Philip W. '26 C
University Farm, St. Paul, Minn.
Tile Lab. Engineer, Ag. Eng. Div.

Marcroft, Harold C. '24 E
Test Engineer for Pennsylvania Water and Power Co.
Holtwood, Pa.

Marcroft, John C. '27 C
Asst. Hydraulic Eng., U. S. Eng. Office.
Sacramento, Calif.

Mark, Max B. '25 C
Room 225, I. C. Depot, Champaign, Ill.
Ill. Central R. R.

Mark, Reuben A. '11 C
A. M. Wold-Mark Construction Co., Brookings, S. D. Partner.

Mark, Walter J. '09 M
A. M. Wold-Mark Const. Co., Brookings, S. D.

Markhus, Olaf G. F. '97 E
411 Lloyd Bldg., Seattle, Wash.
Dist. Mgr. Wallace & Tiernan Co., Inc.

Markoe, James '12 M
2653 34th Ave. S., Minneapolis, Minn.
Mec. Engr., Stockland Rd. Mchy. Co.

Markson, Christian O. '22 C
1246 University Ave., St. Paul, Minn.
Resident Engr.

Markuson, Miner J. '23 A
Mass. Agr. College, Amherst, Mass.
Asst. Prof. Rural Engineering.

Markuson, Oscar S. '11 E
463 West St., New York City.
Bell Telephone Laboratories. Engineer.

Marshall, Chester R. '23 M
15 South Fifth St., Minneapolis, Minn.
N. S. P. Co.
Results Engr. Generation Dept.

Marshall, Donald E. '19 E
Staten Island, N. Y.
Procter & Gamble.

Marshman, Irving H. '24 E
General Electric Co, Schenectady, N. Y.
Asst. Attorney, Patent Dept.

Martin, Curtis R. '21 G
Supt. of Schools, Lake City, Minn.

Martin, Wallace H. '10 M
Corvallis, Ore.
Oregon Agricultural College.
Prof. of Heat Engr.

Martino, Anthony D. '25 M
5514 Raleigh St., Duluth, Minn.

*Mason, Arthur P. '16 M

Mathes, Richard E. '24 E
28 Geary St., San Francisco, Calif.
Radio Corp. of America.

Mathes, Robert C. '12 E, '13 EE
Radio Corporation of America, 66 Broad St., New York City.

*Matthews, Irving W. '84 C

*Matteson, Frank E. '06 M

Mattison, George C. '11 C
U. S. Coast and Geodetic, P. I.

Mattison, Oliver '05 C
701 Metro. Life Bldg., Minn. Bridge Co., Mpls.
President.

Mattson, Dewey F. '22 C
1246 University Ave., St. Paul, Minn.
Residence Engr., Minn. Highway Dept.

Maturi, Rudolph '28 C
Chisholm, Minn.

Matzke, Walter W. '29 M
Proctor, Minn.
Draftsman, Duluth, Missabe & Nor. Ry.

Mayer, Albert F. '20 E
2055 Lincoln Ave., St. Paul.
Mgr. J. E. Olen & Co.

Mayer, Francis L. '29 E
Westinghouse Elec. Co., Pittsburgh, Pa.

Mayer, Harris J. '14 M, '15 ME
900 Builders Exchange, Minneapolis, Minn.
F. W. Woolworth Co.

Mayer, Joseph S. '24 E
St. Paul Gas & Elec. Co., St. Paul, Minn.

Mayeron, Ben '28 C
5510 Harper Ave., Chicago.

Mayhugh, Ben F. '28 M
659 Manomin Ave., St. Paul, Minn.

Meader, Glenn S. '26 E
LaCrosse, Wis.

Meagher, Joseph E. '25 E
Curtiss Flying Service, Chicago, Ill.

Meany, James M. '07 M
306 Pine St., Portland, Ore.
Lidgerwood Pacific Co.
Branch Mgr.

Meeks, E. Donnel '29 E
Westinghouse Elec. Co.,
East Pittsburgh, Pa.

Mehandru, Behari L. '24 M
213 Monroe Bldg., Const. Engineer.
South Bend, Ind.

Meili, Rudolph E. '22 G
2215 Bryant Ave. S., Minneapolis.

Meixner, Bernard A. '10 M
St. Paul, Minn.
V. P., F. T. Hildred & Co.

Melander, Albin R. '21 A
No. 5 Sherwood Bldg., Duluth, Minn.
Starin & Melander, Architects.

*Melby, Einar C. '17 E

Melin, Kenneth R. '29 C
Atwater, Minn.

Melzian, Milton W. '29 A
Inst., Univ. of Idaho, Moscow, Idaho.

*Mentzer, Clarence A. '22 E

Merriell, Elmer W. '12 E, '13 EE
573 Caladonia Ave., Cleveland Heights, Ohio.
Mazda Lamp Div. of G. E. Co.

Merrill, Lewis E. '20 M, '21 ME
The Texas Co., Minneapolis, Minn.
Lubricating Engineer.

Merritt, Alva W. '22 E
531 Marble St., Joliet, Ill. (res.)
Public Service Co. of Northern Ill.

Mertz, Karl J. '14 E
St. Paul, Minn. N. S. P. Co.
Supt. Meter Dept.

Get every issue for 100% more Alumni News.

Meserve, Ralph H. '23 E

Meskal, George '23 C
1246 University Ave., St. Paul, Minn.
Minn. Highway Dept.
Resident Engineer.

Messer, Harold D. '23 M
22nd and Fisk St., Chicago, Ill.
Commonwealth Edison Co.

Methven, Clyde '11 C
1246 University, St. Paul, Minn.
Minn. State Highway Commission.
Division Engineer.

Meyer, Carl F. '10 C
103 Fifth Ave., Eau Claire, Wis.
City Engineer of Eau Claire.

Meyer, Herbert W. '14 E
15 S. Fifth St., Minneapolis, Minn.
N. S. P. Co. Statistical Engr.

Meyers, Clare '28 AE
LeRoy, Minn.

Meyerdick, Clarence C. E. '26 C
Villard, Minn.

Mikesh, Edward S. '22 M
Heating Engr., Crane Co., Fargo, N. Dak.

Mikesh, Martin A. '12 M, '13 ME
Foot Danforth Ave., Jersey City, N. J.
Devlp. Engr., M. W. Kellogg Co.

Miller, Andrew L. '21 E
Wyndmer, N. D., Minister, M. E. Church.

Miller, Archibald T. '24 E
Winona, Minn.
Union Fibre Co., Inc.
Purchasing Agent.

Miller, Ervin J. '11 C
1246 University Ave., St. Paul, Minn.
Highway Dept., Asst. Bridge Engineer.

Miller, George '20 E
417 Broadway, St. Paul, Minn.
Supervising Engr., Commonwealth Elec. Co.

Miller, Hollis D. '13 E
13th and Washington, Oakland, Calif.
Radio Dealer.

*Miller, Lucius W. '03 E

Miller, Marvel P. '28 M
309 Union St. S. E., Minneapolis, Minn.

Miller, William C. '16 M
260 W. Page St., St. Paul, Minn.

Miller, William J. '24 E
St. Paul, Minn.
N. S. P. Co.

Miller, William L. '97 E
Winona, Minn.
Union Fibre Co.
V. P. and Gen. Mgr.

Miller, William S. E. '27 E
4007 Zenith Ave. S., Minneapolis.

Mills, Hartzel '25 M
Wausau, Wis.
Wisconsin River Supply Co.

Millunchick, John W. '29 E
Westinghouse Electric, Pittsburgh, Pa.

Mindrum, Arthur I. '26 E
4338 5th Ave. S., Minneapolis.
N. W. Bell Tel. Co.
Equipment Engineer.

Mintz, Nathaniel '22 E
486 Marshall Ave., St. Paul, Minn.

Mitchell, Alexander C. '20 E
15 Dey St., New York, New York.
American Tel. & Tel. Co.

Mitchell, John B. '09 C
1233 G. N. Bldg., St. Paul, Minn.
G. N. Ry. Co., Asst. Engineer.

Mitchell, L. Morris '14 C, '15 CE
Whitney Bros., 620 Book Bldg.,
Detroit, Mich.

Mitchell, Lloyd S. '23 C
L. S. Mitchell Const. Co., Walterboro, S. C.

Mittag, Albert H. '11 E
Room 449, Bldg. No. 2, Schenectady, N. Y.
General Elec. Co., Research Dept.

Mixer, Walter R. '17 A
U. of M., Minneapolis, Minn.
Asst. Bldg. Supt.

Moffat, George N. '19 M, '20 ME
Ohio State University, Columbus, Ohio.
Mechanical Engineering Dept.
Instructor.

Moisesku, William '29 M
Swift & Co., St. Paul, Minn.

Molander, Edwin W. '25 A
Bugenhagen & Molander, Archs., Minot, N. D.

Molskness, Nels S. '20 E
400 Builders Exchange, Minneapolis, Minn.
Hartford Accident and Ind. Co.
Engineer.

Monsen, Manley B. '24 E
N. S. P. Co., Eau Claire, Wis.
Asst. Gen. Supt., Wisconsin Division.

Monseth, Ingwald T. '24 E
4535 Lindell Ave., St. Louis, Mo.

Montgomery, Albert '13 C
418 First National Bank Bldg., Oklahoma City, Okla. Portland Cement Association.

Montgomery, Ralph M. '24 M
2620 North Shore Ave., Chicago, Ill.
Engineer, George S. May.

Moody, Chester S. '16 M, '17 ME
2501 E. Slauson Ave., Los Angeles, Calif.

Moore, Clarence F. '20 G
300 Bldrs. Exchange, Minneapolis, Minn.
C. A. P. Turner & Co.

Moore, Gordon B. '27 E
408 Baker Bldg., Minneapolis, Minn.
Elec. Engr., G. M. Orr & Co.
Consulting Engrs.

Moore, John H. '24 M
N. S. P. Co., St. Paul, Minn.
High Bridge Steam Plant.

Moore, Norman R. '25 C
West End City Bldg., Springfield, Ohio.
Asst. Eng., Morgan Eng. Co.

Moorman, Albert J. '18 A
600 Chamber of Commerce Bldg., St. Paul, Minn. Moorman & Co., Architects.

Moorman, Frank S. '22 A
Moorman & Co., St. Paul, Minn.

Moosbrugger, Frank J. '27
Waukegan, Ill.
Chic. Central Sta. Inst., Public Service Co. of Illinois.

Moreno, Gerardo '23 E
4440 N. Lavergne, Apt. C., Chicago, Ill.

Mori, Nathaniel R. '15 E, '17 EE

Moris, Russel F. '25 C
Box 382, Norwich, N. Y.

Mork, George W. '26 M
118 27th Ave. W., Duluth, Minn.
Designer, Clyde Iron Works.

Morris, Frank A. '24 M, '25 ME
International Falls, Minn.
Research Eng., The Insulite Co.

Morris, George E., Jr. '27 C
U. S. Coast and Geodetic,
Manila, P. I.
Washington, D. C.

Morris, John E. '09 M
342 Madison Ave., New York City.
Decarie Incinerator Corp.

Morris, John O. '88 M, '03 ME
Monadnock Bldg., Chicago, Ill.
Consulting Engr.

Morris, Robert '05 E
Edmonton, Canada.
Alberta Dairy Supplies, Ltd., Manager.

Morris, Thomas C. '08 M
Syracuse, N. Y.
Atmospheric Nitrogen Corp.

Morrison, John E. '22 C
435 Sixth Avenue, Pittsburgh, Pa.
Byllesby Engineering and Mfg. Corp.
Gen. Foreman.

Morse, George '93 A
Harrisburg, Pa.

Morse, George A. '13 C, '14 CE
Lake Wales, Florida.
Owner, Morse's Photo Service.

Morse, George H. '93 E, '11 EE
Closter Bldg., Harrisburg, Pa.
Consulting Engineer, State of Pa.

Morton, Harold S. '12 M, '13 ME
420 Third Ave. S., Minneapolis, Minn.
Engr. N. W. Bell Tel. Co.

Morton, Harry G. '04 E
917 Hodgson Bldg., Minneapolis, Minn.
N. W. Bell Telephone Co.

Morton, Lyle W. '24 E
Portland, Oregon., Engr. Gen. Elec. Co.

Moses, Marlowe G. '27 E
Bismarck, N. Dak.
Asst. Gen. Supt., N. Dak. Power & Light Co.

Motl, Charles L. '10 C
1246 University Avenue, St. Paul, Minn.
Asst. Maintenance Engr.,
Minn. Dept. of Highways.

Mowery, Clarence W. '08 C
Curtis Hotel, Minneapolis, Minn.
Superintendent.

Mowry, Harry W. '06 F
149 Fulton St., New York City.
Western Electric Co.

Moyer, Amos F. '10 M
3042 Snelling Ave., Minneapolis, Minn.
Chief Engineer, Toro Mfg. Co.

Moyer, Malcolm B. '09 M
114 Academy Green, Syracuse, N. Y.
Sales Engineer.

*Mueller, Henry J. '05 C

Mueller, Robert '29 E
Bell Tel. Lab., New York.

Muessel, Robert W. '21 C
South Bend, Indiana.
South Bend Toy Mfg. Co.
Asst. Sales Mgr.

Muller, Carl C. '18 M
Robert St., St. Paul, Minn.
American Hoist and Derrick.

Munger, Maurice '27 M
Newark, Delaware.
Instructor, Univ. of Delaware.

Murdock, George B. '26 E
18 Union St., Schnectady, N. Y.

*Murphy, John '06 C

Murray, H. E. '27 C
Minneiska, Minn.

Murray, John H. '17 M
312 Genesee Bank Bldg., Flint, Mich.
Engineer for Mr. E. W. Atwood.

Murrish, Frederic E. '09 E
714 W. 10th St., Los Angeles, Calif.
Asst. Secy., Petroleum Securities Co.

Myers, Mortimer '97 E
41 So. 22nd St., Flushing, L. I., N. Y.
The Maintenance Co., 449-53 W. 42nd St., N. Y. City.

Nash, Russell O. '23 E
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.
Electric R. R. Dept.

Naslund, Gustave A. '26 A
508 Roosevelt Ave., Eveleth, Minn.

Nason, George L. '10 C
1200 2nd Ave. S., Minneapolis, Minn.
Nichols, Nason, and Cornell.
Landscape Architects.

Nasvik, Adolph C. '26 C
106 N. Hamline Ave., St. Paul (res.)
Contractor.

Nebel, Walter H. '11 E
70 Westland Ave., Boston, Mass.

Nee, Harold E. '24 E
Mason Fibre Co., Laurel, Miss.

Neill, Clarence L. '28 E
Marshall, Minn.

Nekola, John W. '07 M

Nelson, Arthur '28 M
3340 43rd Ave. S., Minneapolis, Minn. (res.)
G. E. X-Ray Corp.

Nelson, Carl C. '25 E
E. Pittsburgh, Pa., Westinghouse Elec. & Mfg. Co. Elec. Design Engr.

Nelson, Carl H. '10 E
1029 Drexel Bldg., Philadelphia, Penn.
Pacific Coast Lumber Co.

Nelson, Chester L. '29 M
Newark, N. J.
Carrier Engineering Corp.

Nelson, Clarence E. '27 E
Minneapolis, Minn.
N. S. P. Co. Generation Dept.

Nelson, Clarence H. '25 E
Main Engineering Bldg., U. of M.
Minnesota Tax Commission, Engineer.

Nelson, Clarence L. '20 E
15 S. 5th St., Minneapolis, Minn.
Minneapolis General Electric Co.

Nelson, Donald O. '20 C
463 Kerby Street, Portland, Oregon.
Truscon Steel Co., District Engineer.

Nelson, Edgar M. '24 E
Traffic Eng., Ohio Bell Tel. Co. Room 1407, 750 Huron Road, Cleveland, Ohio.

NELSON, EDWARD K. '24 M
2105 W. Superior St., Duluth, Minn.
Sales Mgr., Nelson Knitting Mills.

NELSON, EDWARD S. '09 C
715 Capitol Bank Bldg., St. Paul, Minn.
C. H. Johnston, Architectural Manager.

NELSON, EDWIN W. '25 C
Box 216, Grand Rapids, Mich.
U. S. Engineer's Office, Surveyor and Inspector.

NELSON, EINER '24 M
2225 W. Fourth St., Duluth, Minn.

NELSON, ELMER A. '23 C
210 Highland Ave., Detroit, Mich.

NELSON, ERLING W. '29 A
2853 44th Ave. S., Minneapolis, Minn.

*NELSON, GEORGE A. '12 E, '13 EE

NELSON, GEORGE A. '25 C
202 Burke Bldg., Seattle, Wash.
Junior Hydrographic & Geodetic Engineer,
U. S. Coast & Geodetic Survey.

NELSON, GLENN '23 C
4300 Colorado St., Long Beach, Calif.
Consulting Engineer.

NELSON, GUSTAF A. '19 E
28th Marshall St. N. E., Mpls.
Clerk, Northern States Power Co.

NELSON, LYLE C. '29 A
1220½ 1st St., Spokane, Wash.

NELSON, MARK L. '24 A
Rochester, Minn., Ellerbe & Co.

NELSON, MARTIN E. '24 C
Big Creek, Calif.
Camp 21, Concrete Inspector.

NELSON, NEAL N. '27 AE
2800 Dean Blvd., Minneapolis, Minn.

NELSON, NELS B. '04 C
Minneapolis, Minn.
Minneapolis Steel and Machinery Co., Manager,
Tractor and Thresher Sales.

NELSON, OSCAR B. '05 C
3229 30th Ave. S., Mpls.
Charles L. Pillsbury Co.

NELSON, OTIS S. '07 M
905 W. 60th St., Los Angeles, Calif.

NELSON, PAUL B. '26 E
180 North Mich. Blvd., Chicago, Ill.
Engr. College Magazines Assoc.

NELSON, RICHARD L. '21 E
3632 Park Ave., Mpls.
Division Transmission Eng. N. W. Bell Tel. Co.

NELSON, ROBERT B. D. '26 E
Trans. Eng., N. W. Bell Tel. Co., Minneapolis.

NELSON, THORWALD E. '90 M
720 Phoenix Bldg., Minneapolis, Minn.
International Falls Realty Co.

NEMEC, FRANK L. '09 M
R. No. 1, Hopkins, Minn.
Chief Engineer, Pegles Const. Co.
Minneapolis, Minn.

NERGAARD, LEON S. '27 E
Vacuum Tube Engineer,
G. E., Room 419, Bldg. 37, Schenectady, N. Y.

NEUBAUER, LOREN W. '26 C
U of M., Minneapolis, Minn.
Instructor in Ag. Eng. Univ. Farm.

NEVILLE, EARLE L. '20
209 Gilfillan Bldg., St. Paul, Minn.
Foley Bros., General Contractors.
Supt. of Construction.

NEWBERRY, LESTER W. '22 C
Dept. 7-G, 5842 Stony Island Ave., Chicago.
Universal Portland Cement Co.

NEWHALL, WILLIAM B. '00 M
3120 James Ave. S., Minneapolis.
Wendell Philips Junior H. S.—Manual Training Dept.

NEWHOUSE, JOHN C. '29 E
Commonwealth Edison, Chicago, Ill.

NEWMAN, JOHN M. '23 E
Milwaukee, Wis.
Cutler-Hammer Mfg. Co., Engineering Dept.

NICHOL, FRANK E. '25 C '26 MS (CE)
311 Seaboard Bldg., Seattle, Wash.
Engr., Truscon Steel Co.

NICHOLS, BROWNING '10 M
1546 Euclid Ave., Chicago Heights, Ill. (res.)
American Manganese Steel Co.

NICKERSON, EDWARD '25 E
221 Melbourne Ave. S. E., Minneapolis, Minn.

NICKERSON, NEAL C. '18 C
Carlton, Minn.
Carlton County Engineer.

NICKEY, WILLIAM E. '29 M
San Diego, Calif.
U. S. Naval Reserve.

NIELSON, ANDRES H. '27 E
22nd and Cicero Ave., Chicago, Ill.
Western Electric Co.

NIELSEN, EUNICE V. '23 A
412 Essex Bldg., Minneapolis, Minn.
Lang, Raugland & Lewis.

NIELSON, WALTER M. '22 E
Durham, N. C.
Duke University.
Instr. Physics.

NIERLING, GRANT C. '25 E
Sao Paulo, Brazil, S. A.
International General Electric Co.

NILSON, WILHELM '02 E
R. F. D. No. 1, Box 77, Twin Valley, Minn.
Farmer.

NIMMER, WALTER B. '26 E
Wis. Power & Light Co., Sheboygan, Wis.

NISSENSON, PHINEAS P. '29 E
1223 Irving Ave. N., Minneapolis.

NOBLE, JOHN F. '21 G
Minneapolis, Minn.
Noble Realty Co.

NOEL, CLAY W. '20 E
St. Catharines, Ont., Canada.
Chief Engr. Canadien Croker Wheeler Co., Ltd.

NOGUEIRA, FREDERIC P. '28 E
Companhia Brazileira de Force Electrica
Caixa Postal 256, Rio de Janeiro,
Brazil.

NORBERG, HANS A. '27 E
General Elec. Co., Schenectady, N. Y.

NOLAN, GEORGE C. '27 E
402 Fulton St., St. Paul, Minn.

NORCROSS, ARTHUR F. '07 E
280 Madison Ave., New York City.
N. Y. Steam Co.

NORDENSON, ARNOLD '22 M
1728 N. 2nd St., Minneapolis.
Exp. Engr., Mahr Mfg. Co.

NORDENSON, WILLARD H. '26 M
Waterloo, Iowa.
John Deere Tractor Co.
Test Engr.

NORDLIEN, BERGER W. '22 E
1331 Tyler St. N. E., Minneapolis, Minn.
Electric Machinery and Mfg. Co.

NORDSTROM, CARL T. '14 C
410 Hamm Bldg., St. Paul, Minn.
Assoc. Highway Engr., U. S. Bureau of Public Roads.

NORDSTROM, ERNEST A. '22 M
2 Copeland Ave., La Crosse, Wis.
Standard Oil Co.
Construction Engineer.

NORDSTROM, MILTON E. '25 C
940 E. Hennepin Ave., Minneapolis, Minn.
Cowen & Co.
Estimator and Designer.

NORDVALL, GLENN W. '23 E
3328 26th Ave. S., Mpls.
Mpls. Gen. Elec.

NORELIUS, EMIL F. '08 M
Oroville, Wash.
Supt., West Okanogan Valley Irr. Dist.

NORELIUS, LEWIS M. '06 C
Oroville, Wash.
Tonasket Irrigation Dist.
Project Manager.

NORLEY, WILLIAM H. '29 M
Model Basin Navy Yard, Washington, D. C.

NORMAN, HENRY '27 C
U. S. Eng. Office,
406 Federal Bldg., Milwaukee, Wis.

NORMANN, ALAN K. '28 C
Highway Dept., Bureau of Public Roads,
Hopkins, Minn.

NORMANN, ROLF A. '24 C
Elk River, Minn.
Elk River Concrete Products Co.

NORRBOM, OSCAR '26 M
315 E. 41st St., Mpls.

NORTNER, SYLVESTER E. '16 C
State College, Pa.
Penn. State College, Capt. of Corps of Engrs., U. S. Army.

Get every issue for 100% more Alumni News.

NORTON, CLYDE W. '08 M, '09 ME
557 Grand Ave., St. Paul, Minn.
Bingham and Norton, Inc., Automobiles

*NOVIG, OLE STEFFENSON '03 C

NUTTING, HORACE W. '25 C
Box 424, Weslaco, Texas. Highway Dept.

NYQUIST, ROY A. '27 AE
A. Bentley & Sons Co., Toledo, Ohio
Struc. Eng.

NYSTROM, PAUL E. '24 A
Arch. Draftsman.
First Central Bldg., Madison, Wis.

NYVALL, CLIFTON S. '26 C
3411 Pillsbury Ave., Minneapolis, Minn.
Treas., P. H. Nyvall & Sons, Inc.
Mgr., Standard Sidewalk Co.

O'BRIEN, JOHN E. '97 M
2400 N. W. 16th St., Washington, D. C.

O'BRIEN, RAYMOND J. '11 E
30th and Walnut Sts., Phil., Pa.
Asst. to Sales Mgr. Westinghouse Elec. Co.

O'BRIEN, THOMAS E. '25 C
Room 1491, 212 W. Wash. St., Chicago, Ill.
Ill. Bell Tel. Co.,

ODEGAARD, HAROLD T. '20 M
908 S. Main St.
Aberdeen, S. Dak.

O'DONNELL, LAWRENCE '25 M
861 N. Lafayette Park Place, Los Angeles, Calif.

ODQUIST, CARL '23 C
LeSueur, Minn. State Highway Dept.

OFELT, GEORGE R. '27 E
547 E. Minnehaha St., St. Paul.

O'HANRAHAN, EDMOND '20 G
726 22nd St. N. W. (res).
Washington, D. C.
Patent Attorney.

OHMAN, GEORGE U. '26 C
406 Federal Bldg., Milwaukee, Wis.

OHMAN, LEO S. '28 E
Eveleth, Minn.

OKES, DAY I. '08 C
1501 Merchants Bank Bldg., St. Paul, Minn.
Partner Hanlon & Okes, Contractors.

OKES, SIDNEY R. '09 C
1501 Merchants Bank Bldg., St. Paul, Minn.
Partner Hanlon & Okes, Contractors.

OLAISON, CLIFFORD E. '15 E, '16 EE
720 S. Kenosha, Tulsa, Oklahoma.

*OLIEN, HAMLET C. '24 M

OLIN, HENRY A. '23 E
Minn. Power & Light Co., Duluth, Minn.

OLMSTEAD, CHARLES F. '22 M, '23 ME
4919 Russell Ave. S., Minneapolis, Minn.
(res.)
Asst. Sales Mgr. Mahr Mfg. Co.

OLSEN, A. G. '22 E
20 N. Wacker Drive, Chicago.
Pub. Serv. Co. of North. Ill.

OLSEN, ARTHUR O. '10 C
827 W. Forest Ave., Muskegon, Mich.
J. J. Olsen Co., Contractors.

OLSEN, MELVIN S. '08 C
2919 46th Ave. S., Minneapolis.
Prin. Boys Vocational School.

OLSON, ARNIM G. '22 E
Racine, Wis.
Gen. Mgr., Racine Iron & Wire Works.

OLSON, ARTHUR L. '24 M
1901 Peck St., Manitowoc, Wis.
Aluminum Goods Mfg. Co. Sales Research Engr.

OLSON, C. MILFORD '24 C
Evansville, Ind.
Arch. for Int'l. Steel & Iron Co.

OLSON, CLARENCE '28 C
1246 University Ave., St. Paul, Minn.

OLSON, CLARENCE E. '22 C
Asst. Bridge Engineer, Minn. Highway Dept.

OLSON, EDWIN E. '25 A
2405 29th Ave. S., Mpls.
Cordella & Olson, Architects.

OLSON, ELMER J. E. '23 C
Chisholm, Minn.
Oliver Iron Mining Co. Mining Engineer.

OLSON, KENNETH M. '25 C
Chicago, Ill.
Condron & Post, Designer and Detailer.

OLSON, RICHARD H. '19 E
53 Vanderbilt Ave., N. Y. City.
Electric Machinery Mfg. Co. District Sales Manager.

OLSON, ROY H. '23 E
Chicago, Ill.
Patent Attorney, 1133 Monadnock Bldg., 53 W. Jackson Blvd.
Cheever & Cox.

OLSON, VERNON H. '25 C
Special Agent, Hartford Acc. & Ind. Co., 1401 Arrot Bldg., Pittsburgh, Pa.

OLSTAD, OSCAR A. '11 M
New York City, N. Y.
Blaw Knox Construction Co.

OLTMAN, CHARLES A. '03 C
273 East Fourth St., St. Paul, Minn.
Asst. Engr., C. S. P. M. & O. Ry.

OMAN, LLOYD L. '29 E
3024 15th Ave. S., Minneapolis, Minn.

ORAM, ROBERT C. '11 M
719 Kearns Bldg., Salt Lake City, Utah.
Consulting Eng., Utah Copper Co.

ORBECK, MARTIN J. '11 C
106 E. Liberty St., Ann Arbor, Mich.
Holland, Ackerman and Holland, Prin. Asst. Engr.

ORNING, HAROLD '26 E
4428 Colfax Ave. S., Minneapolis, Minn.

ORR, GEORGE M. '15 M
2223 Emerson Ave. N., Minneapolis (res.)
408 Baker Bldg., G. M. Orr Co.

OSBURN, ROY W. '27
Minneapolis, Minn.
Eng., Elec. Mach. Mfg. Co.

OSCARSON, GERHARD L. '22 E
St. Louis, Mo.
Sales Engr., Elec. Machy. Mfg. Co., B 21 Ry. Exch. Bldg.

OSROWSKE, ARTHUR B. '28 M
401 98th Ave. W., Duluth, Minn.

OST, ROLAND E. '22 C
1525 5th St., Port Arthur, Texas.
Designing Engr., Gulf Refining Co.

OTT, LEONARD E. '14 C, '15 CE
1209 Bldrs. Exch. Supt., A. Guthrie & Co., Inc., St. Paul, Minn.

OTTO, FREDERICK A. '04 E
236 Broadway, New York, N. Y.
Dist. Mgr. Stewart R. Browne Mfg. Co., Inc.

OTTO, ROBERT W. '04 M
2801 4th St. S. E., Minneapolis.
Treas., Andrews Htg. Co.

OUSTAD, CARL B. '29 C
Box 1395, Van Nuys, Calif. (res.)
Junior C. E., Bureau of Eng., Los Angeles.

OUSTAD, OLAF L. '15 C
City Hall, Van Nuys, Calif.
City of Los Angeles Street Design Dept.

OVERHOLT, HARLEY G. '10 C
Asst. to Bridge Engr., Atlanta, Ga.
c-o Chief of Construction, City Hall.

OVESTRUD, MELVIN '13 M, '14 ME
1513 Central Ave., Minneapolis, Minn.
Superintendent, Pioneer Gravel Equip. Mfg. Co.

OWENS, LEO E. '11 M
St. Paul, Minn.
Publisher, St. Paul Dispatch Pioneer Press.

OWENS, R. R. '29 E
120 Broadway, N. Y. City.
Salesman, General Electric Co.

PAGE, MARK L. '03 E
Mare Island, Calif.
U. S. Navy, Radio Electrician.

PAGENHART, CLARENCE C. '12 C
711 7th Ave. S. E., Rochester, Minn.
General Contractor.

PALDA, CHARLES H. '22 C
1501 Merchants Bank Bldg., St. Paul, Minn.
Hanlon and Okes.

PALMER, HOWARD B. '22 C
Neenah, Wis.
Kimberly Clark Paper Co.

PALMER, ROY A. '21 E
817 Financial Center Bldg., Los Angeles, Cal.
National Lamp Works.

PAN, WEN PING '16 C
Hibbing, Minn.
Oliver Iron Mining Co. Mining Engr.

*PANCRATZ, ALEXANDER '05 M

PANCRATZ, FRANK J. '08 E
Perham, Minn.

PANGBURN, CARROLL G. '22 E
100 Central Ave., Kearney, N. J.
Equip. Engr. Western Elect. Co.

PAPENTHIEN, ROY O. '21 G
141 East Wisconsin Ave., Milwaukee, Wis.
Architect.

PARDEE, CHARLES A. '12 E, '13 EE
105 W. Monroe St., Chicago, Ill.
Pres., World Travel Service, Inc.

*PARDEE, WALTER S. '77 A

PARK, JAMES I. '27 AE
c-o K. S. Yum,
University of Chicago, Chicago, Ill.

PARKER, CLYDE '28 C
R. F. D. No. 1, Minneapolis, Minn.

PARKER, HELEN R. '25 ID
University of Minnesota, Minneapolis, Minn.
Artist, Dept. of Zoology.

PARKER, ROBERT M. '24 C
1500 LaSalle Ave., Mpls., Minn.

PARKHURST, HARLEIGH '00 E
Schofield Barracks, Honolulu.
Major, Field Artillery.

PARKIN, ORRIN G. '23 M
Los Angeles, Cal., Western Pipe & Steel Co.

PARRY, JOHN E. '26 E
429 19th Ave. S. E., Minneapolis, Minn.

PARSONS, SIDNEY A. '25 E
1403 Locust St., Philadelphia, Pa.
Engr., Ry. Equip. Engr. Dept., Gen. Elec. Co.

PARTEN, CARL D. '27 M
4916 11th Ave. S., Minneapolis (res.)
Parten-Blomstrom Machinery Co.

PAUL, FREDERICK T. '09 C
204 City Hall, Minneapolis, Minn.
Supt. of Cons. and Field Engr., Cedar Bridge.

PAULSEN, THORWALD S. '22 C
245 Longwood Ave., Boston, Mass.
Supt. on bldg. construction for Harvard University.

PAULSON, JOSEPH B.
Kalamath Falls, Ore., G. N. R. R.
Engineering Dept.

PAUSE, HAROLD A. '23 E
1967 Grand Ave., St. Paul, Minn. (res.)
Am. Tel. & Tel. Co., Minneapolis, Minn.

PAVEK, WILLIAM J. '19 M, '20 ME
1822 S. 50th Ave., Cicero, Ill.

PAYNE, HAROLD G. '06 E
31st & James Ave., Boston, Mass.
Jackson and Moreland. Engineer.

PEARCE, JOHN H. '07 E
2207 24th St. N., Seattle, Wash.

PEARSON, CHARLES W. '21 E
1321 Walnut St., Philadelphia, Pa.
Construction Dept., General Electric Co.

PEARSON, EINAR O. '27 C
702 N. Monroe St., Peoria, Ill.

PEARSON, GEORGE '28 AE
Sheridan, Wyoming.

PEARSON, HAROLD T. '27
Easton, Wash.

PEASE, MAYNARD W. '10 M

PEASE, RAYMOND A. '12 C, '13 CE

PECK, LLOYD '23 C
115 Van Buren St., Joliet, Ill.
Asst. Gen. Mgr., Laundry-owners, N. A. of U. S. and Canada.

PECKHAM, HAROLD E. '23 M
St. Paul, Minn.
N. S. P. Co. Gas Distribution Engineer.

PELLEY, LLOYD L. '24 E
97 Logan Ave. N., Minneapolis, Minn.

PENDERGAST, WEBSTER G. '25 M
74 Kail St., Buffalo, N. Y.
Curtiss Airplane & Motor Co.

PENGILLY, JOSEPH H. '11 E
1237 Huntington Drive, South Pasadena, Calif.

PEOPLES, JOHN S. '14 M
506 Washington Blvd., Maywood, Ill.
Branch Mgr., Winslow Boiler & Eng. Co.

PEROTTI, JOHN J. '29 E
Bessemer, Mich.

PERSON, OTTO C. '24 AE
374 Baker Arcade, St. Paul, Minn.
Schutt-Meier Co.

PESEK, CYRIL P. '25 AE
221 Fawkes Bldg., Hennepin and Harmon, Minneapolis. Architect & Engineer.

PETERS, CHAS. M. '27 E
15 S. Fifth St., Minneapolis, Minn.

PETERS, WALTER C. '22 M
St. Paul, Minn. N. S. P. Co.
Asst. Gas Distribution Engineer.

PETERS, WILLIAM G. '83 C
Tacoma, Wash.
Real Estate and Mortgage Broker.

PETERSON, ALBERT E. '19 E
72 W. Adams, Chicago, Ill.
Commonwealth Edison Company.

PETERSON, ALBERT L. '14 M, '15 ME
Fargo, N. D.
Pres., United Electric Service, Inc.

PETERSON, A. M. '14 E
400 E. Seventh St., St. Paul, Minn.

PETERSON, ARTHUR P. '19 E
515 Cathedral St., Baltimore, Md.
Assoc. of Electragists. Mgr. of Maryland Division.

PETERSON, ARTHUR S. '24 M

PETERSON, BARNEY J. '12 C, '13 CE
Dept. of Interior, Washington, D. C.
U. S. Geologic Survey.

PETERSON, CLARENCE A. '08 E
Washington, D. C.
Treasury Department.

PETERSON, CLARENCE R. '25 C
Room 202, Union Station, Chicago, Ill.
Draftsman, C. M. St. P. & P. Ry.

PETERSON, EVERETT L. '25 A
245 9th Ave. N., Minneapolis.
Board of Education, Architect.

PETERSON, GARVIN E. '25 C
125 North St., Tracy, Minn.

PETERSON, GEORGE T. '08 M
4516 Gladstone St., Duluth, Minn.

PETERSON, HAROLD C. E. '25 C
403 Selby Ave., St. Paul, Minn.
Mgr. Contracting and Bldg.

PETERSON, HAROLD L. '16 C, '17 CE
347 N. Broad St., Philadelphia, Pa.
Marmon Philadelphia Co.
General Manager.

PETERSON, HAROLD R. '18 G
Box 273, Orofino, Idaho.
Resident Engineer, N. P. R. R.

PETERSON, HAROLD W. '21 E
4435 41st Ave. S., Minneapolis, Minn.

PETERSON, LAURENCE L. '25 M
Milwaukee, Wis. Erecting Engr. Nordberg Mfg. Co.

PETERSON, LEWIS E. '25 E
800 W. 3rd St., Hastings, Minnesota (res.)
N. W. Bell Tel. Co., Minneapolis, Minn.

PETERSON, LLOYD L. H. '24 C
Dubuque, Iowa.
Asst. to Mgr., Northern Div., N. S. P. Co.

PETERSON, NEANDER E. '22 C
C. & I. M. R. R., Springfield, Ill.

PETERSON, PETER I. '20 E

PETERSON, RANDALL '28 E
Willmar, Minn.

PETERSON, RICHARD M. '20 E
State Bank of Cokato, Cokato, Minn.

PETERSON, ROY C. '29 M
Goodrich Rubber Co., Akron, Ohio.

PETERSON, VANCE C. '20 E
Kearney, N. J.
Western Elec. & Mfg. Co.

PETERSON, VOLGAR '28 E
Box 193, Pine River, Minn.

PETERSON, WILLIAM W. '16 C
Minot, N. D.
City Engineer, City Hall.

PETRICH, ALFRED C. '19 E
Mgr., Seattle Dist. Garland Affolter Engr. Corp., Seattle, Wash.

PETTERSEN, WILBER E. '28 M
Box 2039 Goodrich St. Station, Akron, Ohio.
Asst. Process Engineer, Processing Div., B. F. Goodrich Co.

PFEIFER, OTTO J. '29 M
100 Bldrs. Exchange, Minneapolis.
Insulite Co.

PHELPS, RAY R. '10 E
Kelso, Wash.
Owner, Central Garage.

PIERCE, WALTER H. '26 M
Box 202, LaSalle, Ill.
Director, Dept. of Engr. National Assn.

PIERSON, JOE W. '19 E
Crawford Ave. Station, Chicago.
Commonwealth Edison Co.

PIKE, JAY R. '26 M
Apt. 36, Stratford Arms, 6 Green St., Pontiac, Mich.

PILGER, CLARENCE L. '27 E
Northern States Power Co., Minneapolis, Minn.
PINSKA, LAWRENCE F. '22 C
St. Paul, Minn., 903 Globe Bldg.
L. P. Wolff, Consulting Engineer.
PLANK, HOWARD G. '22 E
Aluminum Goods Mfg. Co., Manitowoc, Wis.
PLATZER, GEORGE J. '27 C
Minneapolis, Minn.
Redman, C. M. St. P. & P. R. R.
PLESS, ARNOLD G. '20 C
Albert Lea, Minn.
County Highway Engineer.
PLOWMAN, GEORGE T. '92 A
9½ Madison St., Cambridge, Mass.
Artist.
PODOSIN, JOHN '21 E
POHL, LOREN F. '27
St. Paul, Minn.
Room 1234, Gr. Nor. Ry. Bldg.
POORE, ORSON B. '09 E
Federal Dam, Minn.
Proprietor, Summer Resort.
POSS, JOHN A. '29 AE
Eng. Insulite Co., N. Y. C.
POST, EDWARD '29 C
Jr. Eng., I. C. C., Washington, D. C.
POSTMA, JOHN '25 E
72 W. Adams St., Chicago, Ill.
POTTER, ROBERT P. '26 A
Milwaukee, Wis.
Milwaukee School Board, Arch. Dept.
POULSEN, GEORGE F. '17 A
Builders Exchange, St. Paul, Minn.
Asst. Mgr., Paul Steenberg Constr. Co.
POWELL, KNOX A. '20 M
903 Lafayette, Moore, Pa.
Cost Reduction Engineer.
Turb. Eng. Div. W. E. & M. Co., Lester, Pa.
POWELL, LOUIS H. '24 C
Broken Hill, Northern Rhodesia, Africa.
c-o Lonngna Concessions.
PRATT, ARTHUR C. '99 E
Butte, Mont.
The Montana Power Co.
PRATT, BENJAMIN A. '15 C
Minneapolis, Minn.
Teacher, South High School.
PREHN, VICTOR N. '27 E
21st St. and Clinton Ave., Irvington, N. J.
Lab. Asst. Pub. Service Elec. & Gas Co.
PRENDERGAST, ARTHUR A. '03 C
3050 Fourth Ave. So., Minneapolis, Minn.
Industrial Contracting Co. Vice-President.
*PRENDERGAST, PAUL S. '00 C
PRENTICE, ROBERT S. '08 E
740 E. North St., Indianapolis, Ind.
The Philip Carey Co. Branch Manager.
PREUS, CHRISTIAN K. '27 C
Experimental Engineer, U. of M., Minneapolis.
PRICE, CLARENCE R. '20 E
Room 947, Empire Bldg., Milwaukee, Wis.
Sales Engr., Milwaukee Office,
Century Elec. Co.
PRICE, JOHN R. '14 C
Slayton, Minn. Graveling Contractor.
PRICHARD, CHARLES E. '25 C
3140 Emerson Ave. S., Minneapolis (res.)
Barrett Co., 1 19th Ave. S.
PRIEDEMAN, GEORGE W. '08 M
143 27th Ave. S. E., Minneapolis.
Vice President and Secretary,
Mpls. Ornamental Iron Co.
PRIOR, CHARLES '28 C
U. S. Department of Interior, Geological Survey,
Post Office Bldg., Tuscaloosa, Alabama.
PRUDDEN, GEORGE H., JR. '17 A
Owner Pruden-San Diego Airplane Co.,
Foot of Juniper St., San Diego, Calif.
PULVER, RICHARD F. '23 E
Duluth, Minn.
Minn. Power and Light Co.
Power and Sales Engineer.
PURDY, IRVING B. '20 C
106 Bryant Bldg., Lakeland, Fla.
Purdy Const. Co.
*PURVES, LELAND E. '12 E
PUTNAM, GEORGE W. '18 G
1243 W. Washington Blvd., Chicago, Ill.
Research Eng., Creamery Package Mfg. Co.
PUTZ, JOHN H. '14 E, '15 EE
R. F. D., Spooner, Wis.

QUENSE, JOHN '01 C, '02 M
1322 East 63rd St., Seattle, Wash.
QUIGGLE, ARTHUR W. '13 C, '14 CE
428 First St. N., Minneapolis, Minn.
The Creamette Co. General Manager.
QUINE, WILLIAM M. '26 E
Stevenson, Minn.
QUINN, EDWARD I. '25 C
Mpls. Steel Mach. Co. Minneapolis, Minn.
QUINN, JOHN I. '08 C
212 Court House, Duluth, Minn.
QUINN, URSULA R. '25 C
Cold Spring, Minn.
(Mrs. H. N. McAndrews)
RADER, CLARENCE M. '17 C, '17 CE
1310 Realty B. & Bldg., Miami, Fla.
RALPHE, W. W. '30 C
Hastings, Minn.
RAMEY, JOHN M. '28 AE
319 19th Ave. S. E., Minneapolis, Minn.
RAMM, THEODORE D. '13 E
Youngstown, Ohio.
Penna-Ohio Power and Light Co.
Asst. Electrical Engineer.
RAMSTAD, EDWARD C. '03 M
1939 Euclid Ave., Berkeley, Calif.
RAND, LARS '12 M, '13 ME
4837 Wayburn, Detroit, Mich.
Delco Co.
RANEY, DONALD G. '29 E
Butterfield, Minn.
RANGER, DONALD R. '24 C
Byllesby Engr. Co., Pelican Rapids, Minn.
*RANK, SAMUEL A. '75 C
RANKIN, DEAN W. '25 AE
Chicago Board of Trade, Chicago.
RANKIN, RENVILLE S. '14 C
6 N. Michigan Ave., Chicago, Ill.
Pearse, Greeley and Hansen.
RANSOM, GLEN B. '22 E
750 Huron Road, Room 530, Cleveland, Ohio.
Div. Trans. Engr., Amer. Tel. & Tel. Co.
RANSOM, RALPH W. '23 M
Sioux Falls, S. D.
Care John Morrell & Co., Master Mech.
RASEY, RAYMOND R. '26 A E
RASK, LOUIS G. '03 E
Schenectady, N. Y.
Marine Engineering Dept., G. E. Co.
RATH, HARVEY C. '23 E
Erie, Pa.
General Electric Co., Erie Works.
RATHBURN, GEORGE A. '24 M
Oak Terrace, Minn.
Patient at Glen Lake Sanitarium.
RAUGLAND, ARNOLD I. '20 A
412 Essex Bldg., Minneapolis, Minn.
Lang, Raugland & Lewis, Archs. and Engrs.
RAUSCHER, PAUL F. '27 E
1211 Thomas St., St. Paul, Minn.
RAWSON, RALPH H. '07 M
1116 Yeon Bldg., Portland, Oregon.
Consulting Timber Engr.
READ, LELAND B. '29 M
Carter Carburetor Co., St. Louis, Mo.
REARDON, JOHN M. '22 C
St. Paul, Minn.
Dept. of Public Works. Asst. Civil Engr.
*REASONER, CARL M. '20 M, '21 ME
REDDING, JAMES '27 E
General Elec. Co., Schenectady, N. Y.
REDIN, R. K. '26 AE
1246 University Ave., St. Paul, Minn.
Draftsman, State Highway Dept.
REDMOND, FABIAN '29 A
Lanesboro, Minn.
REED, ALBERT I. '85 C
U. S. Engineer's Office, Milwaukee, Wis.
Associate Engineer.
REED, ARTHUR L. '06 C
Reed and Sherwood Mfg. Co. Anoka, Minn.
REED, GORDON '29 M
Chicago Central Stations Inst., Edison Bldg.,
Chicago.
REED, HENRY R. '25 E, '27 EE
Houghton, Mich.
Asst. Prof., Mich. College of Mining & Tech.
REEVE, CHARLES H. '19 E
Hibbing, Minn.
Hibbing High School and Junior College.
Instr., Electricity.

REEVE, HOWARD E. '23 E
420 Equitable Bldg., Des Moines, Ia.
Asst. Supt. Dist., Electric Light Co.
*REID, HARRY A. '10 E
REIDHEAD, FRANK E. '93 E, '98 EE
213 City Hall, Minneapolis, Minn.
Combustion Engineer.
REQUE, STYRK G. '01 E
901 Hamilton St., Allentown, Pa.
Penn. Power and Light Co.
Design Engineer.
REUTER, PETER T. '21 M
141 Milk St., Boston, Mass.
Mgr., Boston Office, Bailey Meter Co. of Cleveland.
REUTIMAN, F. R. '29 M
901 West Pine St., Stillwater, Minn.
REZAB, JOHN L. '07 E
72 W. Adams St., Chicago, Ill.
Public Service Co.
RHAME, PAUL W. '20 M, '21 ME
Flint, Michigan.
Chief Insp., A. C. Spark Plug Co.
RHOADES, HERBERT E. '26 E
Apt. 302, 1368 LaSalle Ave., Mpls.
RICHARDSON, PHILIP E. '25 E
Fort Wayne, Indiana.
Fractional HP Motor Sales, Gen. Elec. Co.
RICHARDSON, RALPH A. '27 M
General Motors Research Bldg., Detroit, Mich.
Research Eng., General Motors.
RICHARDSON, WILBUR P. '99 M
1202 Sauer Ave., Richmond, Va.
Valuation Dept., Chesapeake & Ohio R. R.
RIDDELL, JOHN DONALD '28 E
18 Union St., Schenectady, N. Y.
General Electric Co.
RIEDESEL, GEORGE M. '17 A
180 Michigan, Chicago, Ill.
Pond & Pond, Martin & Loyd, Archts.
RIEGEL, LOUIS F. '11 E
Electric Bldg., Richmond, Va.
Virginia Electric and Power Co.
General Sales Mgr.
RIEKMAN, HERMAN W. '17 C
Struct. Engr., Leonard Constr. Co., Chicago.
RIGG, ALWIN E. '25 A
686 St. Peter St., St. Paul.
RINELL, ERIC '28 C
RINGSRED, ARTHUR C. '06 M
4632 Grand Ave., Duluth, Minn.
Mech. Eng., Diamond Calk and Horseshoe Co.
RINGSTROM, GEORGE H. '27 E
Center City, Minn.
RINGSTROM, IVAN G. '12 E, '13 EE
Water Department. St. Paul, Minn.
RINGWOOD, JAMES '28 C
317 Union St., Joliet, Ill.
Elgin, Joliet & Eastern Ry. Co.
RITCHIE, JOHN R. '16 M, '17 ME
1611 Polk St. N. E., Minneapolis, Minn.
Mgr. Production & Engr. Rotary Snow Plow Co.
ROBBINS, ORISON B. '03 C
13th St. and Pennsylvania Ave.,
Washington, D. C.
Asst. Engr., Southern Ry.
ROBERTS, DIMON A. '27 M
Dayton, Ohio. Jr. Mech. Engr.
Material Div. U. S. Army Air Corps, Wright Field.
ROBERTS, EARL H. '15 M, '16 ME
105 Wells St., Milwaukee, Wis.
Secy., Seefeld Investment Company.
ROBERTS, HENRY M. '28 M
2015 Tribune Tower, Chicago, Ill.
Asst. Eng., V. B. Simons, Inc.
ROBERTS, NORMAN A. '26 M
1917 Brown, Milwaukee, Wis.
ROBERTSON, BURTON J. '14 E, '15 EE
Assoc. Prof. Gas Eng. and Automotives, U. of Minn.
ROBERTSON, CHARLES N. '08 C
New Ulm, Minn.
Highway Engineer, Brown County.
ROBERTSON, HANEY M. '28 M
Morgan-Gerrish Co., Minneapolis, Minn.
ROBERTSON, KENEFICK '25 EE
125 N. Prairie Ave., Sioux Falls, S. D.
N. S. P. Co.
ROBERTSON, PHILIP W. '01 M
2543 7th Ave., New York.

*ROBERTSON, SOREN M. '13 M
ROBISON, ARCHER R. '09 E
Findlay, Ohio.
Empire Pub. Service Corp of Philadelphia.
ROBINSON, LAWRENCE T. '26 EE
Schenectady, N. Y.
General Electric Co.
ROBINSON, PARKE D. '25 M
3225 Dupont Ave., Minneapolis, Minn.
Strong-Scott Manufacturing Co.
ROBINSON, RICHARD B. '27 E
ROCKWELL, HARVARD S. '14 C
418 Corn Exchange Bldg., Minneapolis.
Mfgrs. Agent, Steel Bldg. Products.
ROCKWOOD, FLETCHER '14 E, '15 M
1410 Yeon Bldg., Portland, Ore.
Attorney.
ROE, HARRY BURGESS '08 E
University of Minnesota, Minneapolis, Minn.
University Farm Campus, Asso. Prof. of Agric. Engr.
ROEPKE, OTTO B. '06 EE
Tokoma Park, Md.
Principal Examiner, U. S. Patent Office.
ROGERS, H. BARRETT '27 E
ROLFE, WEST A. '13 C
Butte, Montana.
Anaconda Copper Mining Co., Asst. Engineer.
ROLLIN, HAROLD E. '26 M
1515 Central Ave., Minneapolis, Minn.
Chief Draftsman, Pioneer Gravel Equip. Mfg. Co.
ROLLIN, VERNE G. '29 M
N. A. C. A., Langley Field, Va.
Junior Mech. Engineer.
ROME, ROBERT C. '22 E
Engineer, Traffic Dept.
N. W. Bell Tel. Co., Des Moines, Iowa.
ROMERO, CIRILO L. '17 E, '18 M
Havana, Cuba.
Eastern Cuba Cane Sugar Corp.
RONNING, NORMAN B. '27 E
530 Hanna Bldg., Cleveland, Ohio.
ROOD, ARNOLD E. '22 EE
928 Lake Ave., Racine, Wis.
The Milwaukee Elec. Ry. & Light Co.
*ROOD, OLAF T. '22 E, '23 M
ROOS, FRANK T. '24 C
640 Rand Tower, Minneapolis, Minn.
Sec., Paul Brown & Co., Inv. Trusts
ROOT, FRANK R. '24 AE
1117 Chaplin St., Wheeling, W. Va.
Supt. and Estimator for Engstrom & Wynn.
ROSE, NORMAN W. '06 M
Duluth, Minn.
Duluth and Iron Range R. R. Co.
Electrical Engineer.
ROSENBERG, RAHIL A. '24 A
542 S. Dearborn St., Chicago, Ill.
Braum Mfg. Co.
ROSENBLOOM, ABRAHAM '17 M
5466 Ingleside Ave., Chicago, Ill.
Tractor Designer, International Harvester Co.
ROSENDAHL, HAROLD R. '22 M
Asst. Supt., Waters Genter Co.
215 N. 2nd St., Minneapolis.
ROSENTHAL, OSCAR '19 C
210 Commonwealth Annex, Pittsburgh, Pa.
Sales Engineer, Lamson Co., Inc.
ROSENTHAL, PAUL '22 C
53 W. Jackson Blvd., Chicago, Ill.
H. R. Bradley and Company.
ROSING, DONALD C. '27 C
Highway Construction, Shell, Wyoming.
ROSOK, INGWALD A. '03 EE
P. O. Drawer J., Bisbee, Arizona.
Mgr. Arizona Edison Co.
*ROSOK, PETER A. '04 EE
ROSS, KENNETH R. '24 M
ROSS, RUSSELL H. '18 EE
32 West Superior St., Duluth, Minn.
Minn. Power and Light Co.
ROSTON, REES '28 AE
833 S. Fedora St., Los Angeles, Calif.
ROTH, LEWIS M. '11 C
1112 Builders Exchange, St. Paul, Minn.
Kalman Steel.
ROTHI, PAUL '04 C
U. S. Reclamation Service.
Imperial Irrigation District, Imperial, Cal.

ROUNDS, FRED M. '95 E
Dallas, Tex.
Supplies Supt., S. W. Bell Tel. Co.
ROUSSEAU, CLIFTON C. '24 M
Crosby, N. D.
ROWELL, LESTER J. '29 M
Central Station Ins., Chicago.
ROY, MILO C. '21 M
Duluth, Minn.
Fairbanks, Morse & Co.
RUEMMELE, A. E. '12 E, '13 M
7000 Stewart Ave., Chicago, Ill.
RUFSVOLD, OLAV M. '15 E, '16 C
1246 University Avenue, St. Paul, Minn.
Asst. Bridge Engineer, Minnesota Highway Commission.
RUSS, LLOYD A. '29 E
Sharon, Pa.
Westinghouse Elec. Co.
RUSSELL, CARL A. '16 E
RUSSELL, WINFRED W. '23 E
1842 W. 105th St., Chicago, Ill. (res.)
Ill. Bell Telephone Co., Transmission Dept.
RYAN, LOIEL S. '12 C, '13 CE
111 First St. N. E., Little Falls, Minn.
Wholesale and Retail Hardware Co.
RYAN, ROBERT M. '23 E
Minneapolis, Minn.
807 Lincoln Bank Bldg., Mpls.
Engr.-Dist. Dept., N. S. Power Co.
RYAN, WILLIAM T. '15 E
Univ. of Minn., Minneapolis, Minn.
Electrical Engineering Bldg.
RYDEEN, FRANCIS G. A. '05 M
Knob Lick, Mo.
General Store.
RYDEEN, JAMES '28 C
U. S. Geol. Survey, Corry, Pa.
RYKKEN, NORDAHL T. '29 C
Bureau of Public Roads, Washington, D. C.
SALISBURY, WILLIS R. '10 G
201 Main St. S. E., Minneapolis, Minn.
Salisbury and Satterlee Co. Secy.
SALSTROM, PAUL S. '26 E
925 Euclid Ave., Cleveland, Ohio.
General Electric Co.
SALTWICK, ANDREW '24 M
U. S. Engineers Office, Duluth.
SAMPSON, CLIFFORD L. '23 E, '25 EE
803 Telephone Bldg., Omaha, Nebr.
SANDBERG, CLIFFORD H. '26 C
Railroad Exchange Bldg., Chicago, Ill.
Santa Fe R. R.
SANDER, THEODORE, JR. '19 E
SANDERS, PAUL A. '29 M
B. F. Goodrich Rubber Co., Akron, Ohio.
SANDVIG, LAWRENCE A. '26 C
SANNICOLO, JOSEPH F. '22 E
Virginia, Minn.
Asst. to Civil Engineer.
SANTELMAN, RALPH '27 C
Minn. Highway Dept., St. Paul, Minn.
SANTO, LOUIS W. '29 A
Janesville, Minnesota.
SARTELL, PAGE M. '24 M
Navy Yards, Philadelphia, Pa.
Aero Eng. Lab., Naval Aircraft Factory.
SATORI, ROY H. '21 E
Construction Dept., Gen. Elec. Co.
Philadelphia, Pa.
SAUER, ARTHUR A. '23 C
Los Angeles Co. Architectural Dept.
1005 Hall of Records, Los Angeles, Calif.
SAUSEN, BERT R. '13 M
943 N. Harvey Ave., Oak Park, Ill.
President, Peerless Pneumatic Systems.
SAVAGE, EDWARD S. '97 M
215 Darthmouth St., Rochester, N. Y.
SAWYER, EMERSON D. '10 C
230 E. Huron St., Chicago, Ill.
SAXHAUG, ERLING B. '29 E
U. S. Patent Office, Washington, D. C.
SAXON, PAUL M. '29 E
72 W. Adams St., Chicago, Ill.
Commonwealth Edison Co.
SCHALLER, GEORGE C. '23 C
701 Bldrs. Exch., St. Paul.
SCHALLER, LOUIS M. '29 C
American Appraisal Co., Milwaukee, Wis.

SCHAVONE, ANTHONY P. '28 E
Electrical Engineering Dept.,
University of Minnesota,
Minneapolis, Minn.
SCHILDT, WILLIAM F. H. '08 E
SCHILKEN, DONALD R. '29 AE
Youngstown, Ohio, Truscon Steel Co.
SCHILLING, THEODORE F. '24 E
4529 2nd Ave. South, Mpls.
Mahr Mfg. Co.
SCHLATTMAN, EDWARD C. '08 C
Alberta, Minn. Farming.
SCHLENK, JOHN J. '23 C
1229 Plymouth Bldg., Mpls.
Gen. Insp. Bureau.
SCHLENK, HUGO, JR. '19 E
4307 S. Roman St., New Orleans, La.
Celotex Co., Marrero, La. Research Eng.
SCHLIEP, CARL J. '28 E
Ideal Elec. Mfg. Co., Mansfield, Ohio.
SCHMID, ROBERT J. '08 E
Union Bank & Trust Co.,
Los Angeles, Calif. Appraiser.
SCHMIDT, ROLAND L. '25 C
Decatur, Ill., Dept. of Highways of Ill.
SCHNECKLOTH, HARRY H. '25 E
Omaha, Neb.
N. W. Bell Telephone Co.
SCHNEIDER, FRANK M. '27 M
Excelsior, Minn.
SCHOEPF, ALFRED W. '08 E
Emprezos Electricas Brasileiras,
Sao Paulo, Brazil, S. A.
SCHOLZ, EDMUND H. '27 E
Illinois Bell Telephone Co., Chicago, Ill.
SCHOTTLER, GEORGE J. '23 E
Lincoln Bldg., 60 East 42nd St., N. Y.
Patent Attorney.
SCHOW, GARFIELD G. '24 E
3021 Holmes Ave. S., Mpls. Contractor.
*SCHOW, HARRY A. '06 E
SCHOW, WILLIAM P. '07 E
SCHROEDER, CARL W. '14 E, '15 EE
SCHROEDER, CLARENCE A. '26 E
72 W. Adams St., Chicago, Ill.
Commonwealth Edison Company.
SCHROEPFER, GEORGE '28 C
2694 University Ave., St. Paul, Minn.
Asst. Engineer, Met. Drainage Com.
SCHUCK, ROY D. '25 E
Excelsior, Minn.
SCHULTZ, ALBERT W. '27 E
603 Washington Ave. South, Mpls.
Sales Engr., Cash Co.
SCHULZ, ALEX A. '26 C
Nashville, Tennessee.
Tenn. Highway Department.
SCHULZ, ELTON A. '16 E
R. R. No. 2, Grand Forks, N. D.
Farming.
SCHULZE, LEROY E. '27 E
Electric Machinery Co., Milwaukee, Wis.
SCHUMACHER, JOHN H. '03 E
3730 Oxford St., Winnepeg, Canada.
President, Schumacher, Mackenzie, Ltd.
SCHWARTZ, JOHN S. '19 A
SCHWEISO, CLIFFORD C. '23 E
488 Sexton Bldg., Minneapolis, Minn.
SCHWEDES, WALTER F. '06 E
714 Wolvin Bldg., Duluth, Minn.
Oliver Iron Mining Co.
SCHWEPPE, WALTER A. '26 E
Eng. Dept. Interstate Power Co., Dubuque, Ia.
SCLAROW, ABRAHAM '23 C
41 Snelling Ave., Duluth, Minn.
Manhattan Woolen Mills.
SCOBIE, FRANCIS G. '08 E
Superior, Wis.
Philadelphia & Reading Coal Co.
Master Mech.
SCOTT, ELMER C. '15 C, '16 CE
SCOTT, FRANKLIN B. '26 E
SCOTT, HERBERT L. '23 E
1001 Hodgson Bldg., Minneapolis, Minn.
N. W. Bell Tel. Co.
SCOTT, WILLARD W. '17 E
1st Lieut., Coast Artillery Corp.,
Fort Shafter, Honolulu.

SEAR, ARTHUR W. '23 E
3300 Federal St., Chicago, Ill.
Armour Institute of Technology.
Asst. Professor.

SEARS, DOW I. '14 C
Ironwood, Michigan.
Ironwood Water and Gas Dept.

SEBO, ARTHUR O. '24 M
Minneapolis, Minn.
Bailey Meter Co.
Service and Sales Engineer.

SEEGER, FRANKLIN H. '28 E
Annandale, Minn.

SEEMANN, ERNEST W. '20 C
642 Metropolitan Bank Bldg., Minneapolis.
Portland Cement Assoc.

SELANDER, KARL W. '22 E
Room 1404, 212 W. Wash. St., Chicago, Ill.
Ill. Bell Telephone Co.

SESSENG, GUNNAR '24 M

SHANNON, HAROLD R. '29 M
Refrigeration Engineering Dept.,
General Electric Co., Fort Wayne, Ind.

SHARPLESS, WM. M. '28 E
Radio Research, Bell Telephone Laboratories,
Red Bank, New Jersey.

SHAVOR, GEORGE J. '25 E
Sales Serv. Mgr., Elec. Mach. Co., Mpls.

SHEEKMAN, HARVEY Z. '24 E
488 Diversey Ave., Chicago, Ill.
Commonwealth Edison Co.

SHEFFIELD, FRED W. '09 C
No. 3, Magill Blk., Fargo, N. D.
Vice Pres., Fargo Bridge & Iron Co.

SHEIRE, JAMES R. '28 E
Montana Power Co., Great Falls, Mont.

SHELLENBARGER, L. R. '30 C
Route No. 2, Hopkins, Minn.

SHELLENBERGER, HIRAM R. '20 M
Bombay, India.
c/o Standard Oil Company.

SHENEHON, FRANCIS C. '95 C, '00 CE
2007 Foshay Tower, Minneapolis, Minn.
Consulting Engineer.

SHEPARD, DONALD D. '11 E
143 Lafayette Blvd., Detroit, Mich.

SHEPARD, GEORGE M. '09 C
312 Endicott Bldg., St. Paul, Minn.
Chief Engr., N. S. Contracting Co.

*SHEPHERD, BURCHARD P. '95 M

SHEPLEY, CHARLES R. '02 C
4537 Dupont Ave. S., Minneapolis, Minn.

SHERWOOD, EDWARD B. '20 C
Brownsville, Texas.

SHIFFLET, GLYNE W. '29 A
315 19th Ave. S. E., Minneapolis, Minn.

SHIPPAM, WILLIS '09 M
2769 So. Upton Ave., Mpls.
Major, C.A.C., Univ. of Minn. R.O.T.C.

SHOEMAKER, DOUGLAS H. '29 C
111 East 25th St., Minneapolis.

SHUCK, GORDON R. '06 E
Univ. of Wash., Seattle, Wash.
Assoc. Prof. in E. E.

SHUIRMAN, GARE '21 E
1826 Broadway, Flint, Mich.

*SHUMWAY, ERNEST J. '00 E

SICKEL, EDWIN C. '23 E
Northern States Power Co., St. Paul, Minn.

SIEGMANN, CHESTER W. '20 E
1916 14th Ave. S., Mpls. Standard Wood-Working Co.

SILLIMAN, HENRY D. '97 M
4219 Sunnyside Ave., Seattle, Wash.

SILLMAN, PAUL '28 C
Cleveland, Ohio.
Greyhound Management Co.

SILVERMAN, EMIL M. '22 C
Mpls. Steel & Mach. Co.

SILVERMAN, ISADORE W. '24 A
1342 Penn Ave. N., Mpls.

SIME, THEODORE L. '23 A
Greene and Chelton Ave.,
Germantown, Philadelphia, Pa.
H. A. Hamilton Co.

SIMMON, KARL A., JR. '05 E
San Francisco, Calif.
Pacific Coast Transp. Mgr.
Westinghouse Elec. & Mfg. Co.

SIMMONDS, RICHARD ROY '21 C
Jr. Engr. U. S. Engineer Office, Duluth, Minn.

SIMMS, CHARLES G. '24 M
A. C. Spark Plug Co., Flint, Mich.
Efficiency Dept.

SIMONS, WALTER W. '16 E
Installation Supervisor, Electrical Research Prod. Inc.
250 W. 57th St., New York, New York.

SINNOTT, I. G. '29 M
3203 Humboldt Ave. S., Minneapolis.

SIVERSON, SIGVEL J. '11 C
3108 43rd Ave. S., Minneapolis, Minn.
Contractor.

SIVERTS, SAMUEL A., JR. '09 C
454 Sexton Bldg., Minneapolis, Minn.
Consulting Municipal Engineer.

SJOBERG, ROY H. '26 E
1449 W. 10th St., Erie, Pa.
G. E. Co., Erie, Pa.

SKAGERBERG, RUTCHER '15 E, '16 EE
1497 Chelmsford St., St. Paul, Minn.
Consulting Eng.

SKANSE, C. THEODORE '29 M
Service Dept., Insulite Co., Minneapolis.

SKAROLID, CHARLES T. '24 E
1303 Tel. Bldg., Omaha, Neb.
N. W. Bell Tel. Co.

SKON, HERMAN W. '15 M, '16 ME
1339 Searle St., St. Paul, Minn.

SKRUKRUD, ODEAN M. '25 C
406 Federal Building, Milwaukee, Wis.
U. S. Army Engineer.

SKURDALSVOLD, PETER '15 C, '16 CE
2726 Dupont Ave. S., Minneapolis, Minn.

SKYTTE, ERNEST E. '10 E
622 Linwood Ave., Indianapolis, Ind.
Electrical Inst. Eng.,
Esterline & Angus, Speedway, Ind.

SLABY, LOUIS J. '26 M
St. James, Minn.

SLADE, LORING '22 C
Minn. State Highway Dept., St. Paul.
Sub. Resident Engineer.

SLAGGIE, EUCHARIUS L. '26 E
Dayton, Ohio.
Engr., Wright Field Airplane Branch.

SLOCUMB, MARY G. (MRS. L. A. TVEDT) '25 ID
1443 Tutwiler Ave., Memphis, Tenn.

SMART, GEORGE A. '16 M
West Allis, Wis.
John Obenberger Forge Co.

SMEBY, LYNNE C. '28 E
1564 W. Broadway, Minneapolis, Minn. (res.)
Chief Eng., KSTP, St. Paul, Minn.

SMILOW, LEO '29 M
U. S. Patent Office, Washington, D. C.

SMIT, CATHERINE '22 A
320 Embarcadero Rd.,
Palo Alto, Calif.

SMITH, BYRON E. '07 E
Valdez, Alaska.
Granite Gold Mining Co. Chief Engineer.

SMITH, CEDRIC B. '14 C, '18 CE
207 Laurel Ave., Belview, Penn.
Sales Mgr., Blaw-Knox Co.

*SMITH, CLINTON B. '05 E

SMITH, DONALD C. '18 E
A. T. & T. Co., 195 Broadway,
New York City, N. Y.

SMITH, DONALD T. '05 C
1003 T. & P. Ry. Bldg., Dallas, Texas.

SMITH, HAROLD D. '25 E
U. of M., Minneapolis, Minn.
Mgr., Engineers' Bookstore.

SMITH, HUGH A. '18 E
2902 Florida Ave., Longview, Wash.
Longview Public Service Co.

SMITH, JEROME C. '27 E
431 Liberty St., Schenectady, N. Y.
General Electric Co.

SMITH, LEIGHTON H. '03 C
543 N. Tower Ave., Centralia, Wash.
Proprietor of Auto Business.

*SMITH, LOUIS '83 C

SMITH, PAUL SHERBURNE '01 C, '03 CE
Porterville, Calif., R. 1, Box 712.
Rancher and County Hort. Insp.

SMITH, ROLF '29 M
Frigidaire Corp., Dayton, Ohio.
Product Engineering Div.

SMITH, SIDNEY H. '11 C
South Haven, Mich.
Supt., Board of Public Works.

SMITH, VERNA C. '25 ID

*SMITH, WILLIAM C. '09 C

SMITHSON, JOHN E. '07 E
Hood River, Ore.
President, Oregon-Washington Telephone Co.

SMOLENSKY, MARTINIAN G. '18 C

SNEVE, JACK S. '11 M
532 E. First St., Duluth, Minn.
J. S. Sneve and Co., Packard Motor Car Co.

SNOW, CLARENCE J. '14 M, '15 ME
417 Broadway, St. Paul, Minn.
Estimator, Commonwealth Electric Co.

SNYDER, DOROTHY E. '26 A
4126 E. 50th St., Minneapolis, Minn.

SODERHOLM, LAUREN V. '28 E
General Elec. Co., Fort Wayne, Ind.

SOLBERG, MIRL C. '29 C
Minn. State Highway Dept., Hastings, Minn.

SOLOMONSON, LAWRENCE D. '25 E
2nd Lt. Coast Artillery,
Ft. Kamhameha, Hawaii.

SOMERO, WAINO M. '24 C
Truscon Steel Co., Chicago, Ill.

SOMMERFELD, ADOLPH A. '10 C
Homewood, Ill.

SORENSEN, JOHN E. '22 E
Chicago, Ill.
Western Electric Company.

SORENSON, RUSSELL L. '27 AE
Albert Lea, Minn.
Sorenson Construction Co.

SOSHNIK, EDWARD J. '22 C
248 Foshay Tower, Minneapolis, Minn.
E. J. Soshnick & Co.

SOUBA, JOHN I. '25 M
7-219 General Motors Bldg., Detroit, Mich.

SOUBA, WILLIAM H. '09 M
707 Whalen Bldg., Port Arthur, Ont., Can.
C. D. Howe & Co., Consulting Engineers.

SOULEK, JOSEPH H. '11 E
Montgomery, Minn.
General Merchandise Business.

SOUTH, WILLARD A. '12 C, '13 CE
219 South 9th St., Mpls.
W. A. South Co., Gen'l Contractors.

SOUTHER, MORTON E. '12 C, '13 CE
1528 Branston St., St. Paul, Minn.
Contractor.

SPECHT, JAMES E. '29 E
Supply Engineering Dept.
Westinghouse Elec. Co., E. Pittsburgh, Pa.

SPEER, PAUL B. '27 M
Rice St. Station, N.S.P. Co.

SPEIER, PETER E. '27 M
1897 Marshall Ave., St. Paul, Minn.

SPENCE, WILLIAM J. '02 E
348 Hingston Ave., Montreal, Canada.
Northern Elec. Co., Ltd.

SPENCER, J. BOYD '27 M
Fullerton, Pa.
Fuller-Lehigh Co.

SPENCER, RAYMOND D. '23 C
1126 S. Lake St., Los Angeles, Calif.

SPERRY, LEONARD B. '05 M, '08 E
606 S. Michigan Ave., Chicago, Ill.
International Harvester Co.

SPOTTS, HERBERT J. '28 M
Draftsman, Superheater Co., East Chicago, Ind.

SPREHN, GEORGE H. '24 C
West Salem, Wisconsin.

SPRING, WILLIS W. '07 M
Duluth, Minn.
Northern Nat'l Bank, Asst. Vice-Pres.

SPRINGER, FRANKLIN W. '93 E, '98 EE
Univ. of Minn., Minneapolis, Minn.
Electrical Engineering Dept. Professor of E. E.

*STACY, ELMER N. '07 M

STAEHLE, GILBERT C. '20 C

STAEHLE, HASWELL E. '24 M
127 Campbell Avenue, Detroit, Mich.
Capital Testing Laboratory.
Designing Engr., U. S. Radiator Corp.

STAGEBERG, OSWALD C. R. '26 A
U. of Idaho, Moscow, Idaho.
Instructor of Architecture.

STANIUS, GODFREY '21 E
Town Mfg. Co., Cedar Rapids, Iowa.

STANTON, RAYMOND E. '04 M
2694 University Ave., St. Paul, Minn.
R. E. Stanton Co.

STARK, JOHN '29 E
Westinghouse Elec. Co., E. Pittsburgh, Pa.

STARRETT, HOWARD M. '09 M
Fairmont, Minn.
Factory Mgr., Fairmont Ry. Motors Inc.

STAUFFACHER, EDWARD L. '24 M
Bartlesville, Oklahoma.
Supt., Empire Oil & Refining Co.

STEFFENS, ROBERT A. '22 E
Western Elec. Co., Kearny, N. J.

STEINER, EDMUND F. '29 E
603 Broadway, Fergus Falls, Minn.

STEINERT, EMIL '25 E
Westinghouse Electric and Mfg. Co.,
Sharon Works, Sharon, Pa.
Transformer Eng. Dept.

STENGER, LAURENCE A. '06 E, '16 EE
Great Western Sugar Co., Denver, Colo.
Research Dept.

STEPHENS, CLIFFORD '23 C
3158 Snelling Ave., Mpls.
Sec. and Treas., Venice Art Marble Co.

STEPHENSON, OLIVER H. '07 M
3649 Aldrich Ave. S., Minneapolis, Minn.

STERNBERG, CARL '07 E
J. Bornstein & Sons, 562 1st St. South,
Seattle, Wash. City Sales.

STEVENS, BRUCE E. '28 E

STEVENS, DONALD T. '28 E
Airways Division, Department of Commerce,
Washington, D. C.

STEVENS, EVERETT B. '25 M
Lower Nicollet Island, Minneapolis, Minn.
Wm. Bros Boiler and Mfg. Co.

STEVENS, JESSIE '96 BS, '04 MS
See Jessie Hickok.

STEWART, CLARENCE H. '03 C
2151 Commonwealth Ave., St. Paul (res.)
Research Eng., N. S. P. Co., Minneapolis.

STEWART, GEORGE A. (GARNET) '22 A
613 N. 20th Ave., Seattle, Wash.

*STEWART, J. CLARK '75 C

STILLMAN, MARCUS H. '09 E
St. Johnsbury, Vermont.
c-o E. & T. Fairbanks & Co.

STIMART, ELWOOD L. '24 E

*STINSON, WILL V. '11 E

STODDART, HUGH A. '24 C
Box 3900, Portland, Oregon.
Bureau of Public Roads. Jr. Civil Engr.

STOLTE, SIDNEY L. '27 AE
2905 Columbus Ave., Minneapolis, Minn.

STONE, CHARLES W.
'16 M, '17 ME, '19 MS
101 W. Elmwood Place, Minneapolis, Minn.

STONE, HARRIS G. '06 E
5959 Yucca St., Los Angeles, Calif.
Electrical Contractor.

STONE, MELVIN O. '02 M

STONER, CLIFFORD M. '24 C
445 N. Sacramento Blvd., Chicago, Ill.
Griffin Wheel Co. and Griffin Eng. Co.

STOUTLAND, OLIVER A. '22 C
Fargo, N. D. Engr. Fargo Foundry Co.

STRAND, W. R. Ex. '31
c-o Alemite Stewart-Warner Co.,
Phoenix, Ariz.

STRATE, THOMAS H. '01 C
898 Chicago Union Station, Chicago, Ill.
C. M. and St. P. Ry.

STREGE, HENRY W. '24 E
Bellingham, Minn.

STREICH, HARRY C. '12 E
Sup. Dept. of Public Utilities, St. Paul, Minn.

STROM, ARTHUR '23 A
Rush City, Minn.

STROTHMAN, RUSSELL A. '20 E
195 Broadway, New York City, N. Y.
Am. Tel. and Tel. Co.

STUART, DONALD M. '28 E
Cloquet, Minn.

STURTEVANT, PERCY G. '08 E
934 W. 31st St., Erie, Pa.

STUSSY, WILLIAM '00 E
Butte, Montana. Montana Power Co.

*SUDHEIMER, EDWARD L. '02 M

SUHR, FRED W. '29 E
Lewiston, Minn.

SULLIVAN, FREDERIC V. '25 C
c-o Asst. Eng., Missouri Pacific R. R.,
Jefferson City, Mo.

SUNDBLAD, EVERTS W. '27 E
Alexandria, Minn.

SUSHAN, HARRY M. '19 C
367 Fulton St., Brooklyn, N. Y.

SUTHERLAND, SAMUEL J. '23 AE
130 Wisconsin Ave.
Herbst & Kuenzle, Archts.
Milwaukee, Wis.

SVENDSEN, GEORGE P. '08 E
16-18 E. Hennepin Ave., Minneapolis, Minn.
President, Boustead Elect. and Mfg. Co.

SVERDRUP, LEIF J. '21 C
Jefferson City, Mo.
Bridge Engr., Missouri Highway Commission.

SWANBERG, JOHN H. '25 C
Koppers Bldg., Pittsburgh, Pa.
Tech. Dept., American Tar Products Co.

SWANSON, CARL E. '27 E
1176 Lincoln Ave., St. Paul, Minn.
Electrical Engr., Univ. of Minn.

SWANSON, CARL E. '28 E
Minneapolis Elec. & Mfg. Co., Minneapolis.

SWANSON, CARL W. '29 M
Illinois Bell Tel., Chicago, Ill.

SWANSON, CLIFFORD L. '22 C
3405 Baltimore, Kansas City, Mo.

SWANSON, EDWIN W. '19 E
Minneapolis, Minn.
Electric Machinery and Manufacturing Co.
Control Engr.

SWANSON, PAUL H. '23 C
Builders Exchange Bldg., Minneapolis, Minn.
Concrete Engineering Company.

SWANSON, PHILIP G. '23 M
131 Pewabic St., Laurium, Mich.
Chicago Pneumatic Tool Co.

SWANSTROM, FRANK N. '08 E
14th and Tyler St. N. E., Minneapolis, Minn.
Chief, Elec. Design Electric Mach. Mfg. Co.

SWEDBERG, MARCUS R. '11 C
1415 Eighth St. S. E., Minneapolis, Minn.
W. D. Lovell, General Contractor.

SWEENEY, FRANK CHAS. '28 E
Owatonna, Minn.

SWEET, RAY R. '21 E
7046 Hollywood Blvd., Hollywood, Calif.
Elec. Research Products, Inc.

SWENINGSEN, OLIVER '08 E
1150 S. San Pedro St.,
Los Angeles, Calif.
Southern Calif. Telephone Co.

SWENSON, CHARLES A. '07 C, '10 LLB
County Attorney, Willmar, Minn.

SWENSON, CLARENCE Q. '17 M, '20 ME
U. S. Veterans Hospital, St. Cloud, Minn.

SWENSON, GEORGE W. '17 E, '21 EE
Head of Elec. Eng. Dept., Mich. College of
Mining and Technology, Houghton, Mich.

SWENSON, GUSTAV A. '20 G
3842 31st Ave. S., Minneapolis, Minn.

SWENSEN, KARL P. '06 G, '07 MS
100 W. 59th St., New York City, N. Y.

SWENSON, H. SEYMOUR '12 C, '13 CE
529 S. 7th St., Mpls.
Sales Engineer, The Hustad Co.

SWENSON, OSCAR E. '15 C, '16 CE
P. O. Box 951, Buffalo, N. Y.
Lackawanna Steel Const. Corp. Chief Engr.

SWENSON, THEODORE J. M. '12 E
St. Paul, Minn.
N. P. Ry., Statistician, Office of Pres.

SWIFT, DONALD C. '24 E
Asst. Results Engr.,
N. S. P. Co., St. Paul, Minn.

SWIFT, GEORGE E. '23 E
53 W. Jackson Blvd., Chicago, Ill.
Sales Engr., Electric Machinery Mfg. Co.

TALBOT, THOMAS F. '18 E
Birmingham Athletic Club, Birmingham, Ala.

TALLMADGE, EVERETT S. '14 E, '15 EE
2327 Wycliff St., St. Paul, Minn.
Produc. Engr., Sanitas Spring Mfg. Co.

TALLMADGE, HIRAM '16 E, '17 EE
Grand Rapids, Mich.
Mich. Construction and Highway Co.

TANNEHILL, LOUIS W. '16 A
912 Black Bldg., Los Angeles, Calif.
Holmes and Sanborn.
Mech. Engineer.

TANNER, ELO C. '29 M
Westinghouse Elec., Pittsburgh, Pa.

*TANNER, HARRY L. '95 E

TAPLIN, GEORGE C. '24 E
420 Third Ave. S., Minneapolis, Minn.
N. W. Bell Telephone Co.

TAPLIN, ROBERT B. '04 E

TARBELL, WILLIAM P. '22 C
Fargo, N. D. City Engineer.

TAUBER, JOS. '28 C
543 Michigan St., St. Paul, Minn.

TAYLOR, DUANE L. '17 M
U. S. S. Saratoga.
c-o Postmaster, San Pedro, Calif.
Lieut., U. S. Navy.

TAYLOR, EDWARD W. D. '98 C
Pomona College, Claremont, Calif.
Prof. of Eng. Mathematics.

TAYLOR, LYMAN D. '13 E, '16 EE
2700 E. 29th St., Cleveland, Ohio.
Eng. Electric Controller and Mfg. Co.

TAYLOR, RALPH G. '02 M
Supt. Plant No. 2, Standard Foundry Co.
Racine, Wisconsin.

TAYLOR, RICHARD G. '25 E
72 W. Adams St., Chicago, Ill., Room 614.
Line Extension Estimator, Commonwealth
Edison Co.

TEAL, CLARENCE W. '24 E
Omaha, Nebraska.
N. W. Bell Telephone Co.
Eng.-Asst. V. P. Dept.

TEBERG, ERNEST J. '16 E, '17 EE
61 Sumac Rd., Highland Park, Ill.
Vice-Pres., Metropolitan Dist. Realty Trust,
Chicago, Ill.

TEBERG, LAWRENCE E. '22 C
1707 Stanford Ave., St. Paul, Minn.

TEBO, FRANK '28 C
2621 18th Ave., Minneapolis, Minn.

TENBROOK, CHARLES '29 M
1009 West 4th St., Duluth, Minn.

TENNSTROM, CARL H. '23 C
1128 E. 3rd St., Duluth, Minn.

TESKE, FREDERICK C., JR. '27 C
165 Norton St., New Haven, Conn.

TEWS, ARTHUR W. '24 C
Minn. Highway Dept., St. Paul, Minn.

THALER, JAMES A. '00 E
Bozeman, Montana.
Prof. of Elect. Engr., Montana State College.

THAYER, CHARLES E. '76 C
447 Security Bldg., Minneapolis, Minn.
Electric Steel Elevator Co.
General Manager.

THAYER, PAUL W. '14 M, '15 ME
Newton, Iowa.
American Gas Construction Co.

THELIN, RUBEN E. '28 E
Ideal Electric Co., Mansfield, Ohio.

THOLSTRUP, HENRY L. '26 E
Radio Eng. Dept., Westinghouse Elec. Mfg. Co.,
Chicopee Falls, Mass.

THOMAS, RICHARD L. '25 E

THOMAS, WILLIAM A. '17 E
Builders Exchange Bldg., St. Paul, Minn.
Toltz, King & Day, Inc.

THOMAS, W. ALAN '24 M

THOMPSON, CLARENCE W. '25 C
Engineering Service Co.,
53 S. La Salle St., Aurora, Ill.

THOMPSON, CLAUDIUS A. '22 C
St. Paul, Minn.
Residence Engr., Dept. of Highways,
1246 University Ave.

THOMPSON, EVERETT '23 C
H. R. Bradley & Co.,
Monadnock Block, Chicago, Ill.

THOMPSON, HARRY T. '15 E, '16 EE
1631 Monadnock Block, Chicago, Ill.
Dist. Sales Mgr., Elect. Mach'y Mfg. Co.

THOMPSON, HERBERT L. '12 M
Rio De Janeiro, S. A.
International Steam Pump Co.

THOMPSON, JESSE L. '16 E, '17 EE
Auberry, Calif.
Kerckhoff Power House.

THOMPSON, NILES J. '27 E
North Bergen, N. J.
National Battery Co.
THOMPSON, ROY E. '00 E
861 Sixth St., San Diego, Calif.
Puchasing Agent, Gas and Electric Plant.
THOMPSON, THEODORE S. '24 C
Minnesota Highway Dept.,
St. Paul, Minnesota.
THOMSON, ANDREW '25 E
THORNE, DONALD E. '23 E
Cable Office, Western Union, New York.
*THORSHOV, OLAF '21 A
THORSHOV, ROY N. '28 A
39 Seymour Ave. S. E., Minneapolis, Minn.
THURAS, ALBERT L. '12 E, '13 EE
463 West St., New York City.
Western Electric Co.
THURSTON, HAROLD H. '13 C, '14 CE
Anoka, Minn.
Highway Contractor.
THWING, GEORGE '28 C
801 Globe Bldg., Minneapolis, Minn.
Winston Bros. Co.
THYBERG, CLARENCE W. '25 E
195 Broadway, N. Y. City.
Western Tel. Co.
TIERNEY, FESTUS P. '22 C
TIGHE, JAMES S. '26 E
1000 Hodgson Bldg., Minneapolis, Minn.
Transmission Engr., N. W. Bell Telephone Co.
*TILDERQUIST, WILLIAM M. '95 M
TILLER, LOUIN '29 M
TIMPERLEY, WILLIAM D. '10 C
Crown Iron Works Co., Minneapolis, Minn.
Sales Manager.
TODD, MILO E. '09 E
University of Minnesota, Minneapolis, Minn.
Asst. Prof. Electrical Engineering, College of Engineering and Architecture.
TOMLINSON, L. C. '04 E
454 Lincoln St., Franklin, Mass.
TONDELL, MANDELL '07 C
505 Manhattan Bldg., Duluth, Minn.
TORGERSON, I. E. '12 C, '13 CE
Southern Pacific Co., San Francisco, Calif.
Structural Engineer, Bridge Dept.
TORRANCE, ELI '09 C
4932 Fremont Ave. S., Minneapolis (res.)
Vice-Pres., Morris T. Baker Co.
TOWEY, JAMES M. '28 E
Macoun, Saskatchewan, Canada.
TOWLE, NEAL C. '12 E, '13 EE
Pittsburgh, Penn. Westinghouse Electric Co.
*TRACY, FRED C. '00 E
TRASK, ALFRED S. '23 E
15 S. 5th St., Mpls.
Sales Dept., Northern States Power Co.
TRASK, BIRNEY E. '90 C, '94 CE
325 2nd Ave. South, Mpls.
Mgr. Trask Constr. Co.
TRCKA, BENJAMIN C. '24 E
2 West Monroe St., Chicago, Ill.
Federal Public Service Corp.
TREXLER, RICHARD R. '27 M
U. S. Patent Office, Washington, D. C.
TRIEM, RALPH H. '20 E
N. S. P. Co., Ottumwa, Iowa.
Business Manager.
TRYON, PHILIP D. '17 C
Minneapolis, Minn.
Asst. Credit Mgr.
Washburn Crosby Co.
TUBBESING, NORMAN F. '27 M
With Mohawk Aircraft Co.
211 Earl St., St. Paul, Minn.
TUBBY, OLIVER G. '07 M
225 Bush St., San Francisco, Calif.
Standard Oil Co.
TUCK, GEORGE A. '05 M
537 4th St., San Francisco, Calif.
Atlas Heating & Vent. Co. President.
TUCKER, CARL W. '26 M
5241 27th Ave. S., Minneapolis, Minn. (res.)
Skelly Oil Co.
TULLAR, CHARLES E. '01 E
Mgr., Patent Dept., G. E. Co.,
Schenectady, N. Y.
TUNELL, CLEMENT R. '25 E
1 River Rd. Schenectady, N. Y.
General Electric Co.

TUNELL, ROBERT H. '24 E
Union Switch & Signal Co.,
Swissvale, Pa.
TUPPER, CHARLES E. '15 M
2111 4th Ave. S., Mpls.
Mgr. Manhattan Products Co.
TURNER, LESLIE E. '09 E
R115-205 W. Wacker Drive, Chicago, Ill.
Sales Eng.
TURNER, ROY H. '15 E, '16 EE
Engr. Dept.,
Minneapolis, Honeywell Reg. Co.
TURNQUIST, AXEL A. '16 E, '17 EE
Duluth, Minn.
Operating Engr.
Minnesota Power and Light Co.
TURRITTIN, HUGH L. '27 C
University of Wisconsin.
Instr. College of Engr., Madison, Wis.
TUTTLE, STANLEY B. '24 M
Beloit, Wis.
Asst. Chief Engineer,
Fairbanks Morse & Co.
TUVE, GEORGE L. '20 M, '21 ME
Texas Technological College, Lubbock, Tex.
Head of Dept. of Mechancial Eng.
TUVE, MERLE A. '22 E
1636 Kenyon St. N. W.,
Washington, D. C.
Assoc. Physicist, Carnegie Inst. of Wash.
TVEDT, LAWRENCE A. '25 AE
910 Fidelity Bank Bldg.,
Memphis, Tenn.
Estimator and Engineer,
Gauger Korsmo Const. Co.
TYVAND, JAMES A. '24 E
Public Service Bldg., 2nd and Mich. Sts.,
Milwaukee, Wis.
Milwaukee Elec. Ry. & Light Co.
UBELL, CARL D. '09 M
207 S. Broadway, Room 568,
Los Angeles, Calif.
Bureau of Power and Light.
UMBEHOCKER, FRANK '21 M
72 W. Adams St., Chicago, Ill.
Chief Operating Eng., State Line Generating Co.
UNDINE, EUGENE A. '29 IA
208 Oliver Ave. S., Minneapolis.
UNGERMAN, CARL M. '06 E
16-18 E. Hennepin Ave., Minneapolis, Minn.
Boustead Electric and Mfg. Co.
UNTINEN, AUGUST L. '25 E
N. W. Bell Tel. Co., Minneapolis, Minn.
UPTON, ALBERT P. '25 E
Minneapolis, Minn.
Inst., Dunwoody Institute.
UZZELL, GEORGE W. '07 E
Robinson, Ill.
Asst. Gen. Supt.
Lincoln Oil Refining Co.
VALLACHER, THEODORE L. '20 C
VAN CLEVE, HORATIO P. '07 C
Truscon Steel Co., Youngstown, Ohio.
VARTDAL, VICTOR K. '29 E
Kearny, N. J., Western Electric Co.
VAUDREUIL, LIONEL H. '25 A
303 S. Prairie St., Chippewa Falls, Wis.
VAULE, SVEN A. '21 M
VELZ, CLARENCE '24 C
650 Bergenline Ave., West New York, N. J.
Chief Engr., F. J. Oleri.
VIGNESS, C. IRWIN '29 E
East Pittsburgh, Pa.
Misc. Eng. Dept., Westinghouse Elec. Co.
VILLAUME, WALTER F. '23 C
110-130 West Fairfield Ave., St. Paul, Minn.
Minn. Macaroni Co.
VINCENT, JAY C. '03 E
303 City Hall, Minneapolis, Minn.
Elec. and Mech. Engr., City of Minneapolis.
VITA, THEODORE '09 E
Independence, California.
Elec. and Shop Foreman. Inyo Company.
VOLKENANT, GORDON W. '27 E
Jackson, Mich.
The Sparks-Withington Co.
VON ROHR, HERBERT H. '21 M
831 N. Broad St., Philadelphia, Pa.
Phila. Branch, Timken-Detroit Co.
VON SCHLEGELL, FREDERICK '95 E
William Garland Bldg., Los Angeles, Calif.
Gen. Mgr., California Standard Finance Corp.

VON SIEN, RUTH '28 ID
1105 Seventh St. S., Fargo, N. Dak.
VON STOCKER, SELMER '28 M
3535 Second St. N. E., Minneapolis, Minn.
VORISEK, JERRY '28 C
3041 Boston Blvd., Detroit, Mich.
U. S. Gypsum Co.
VYE, GEORGE P. '27 M
Equitable Trust, New York.
WABY, DELTON T. '23 M
72 W. Adams St., Chicago, Ill.
Public Service Co. of Northern Ill.
Elec. Heating Eng.
WAGNER, ADOLPH '98 E
575 Washington Blvd., Indianapolis, Ind.
Pres., H. T. Elec. Co., & Wagner Radio Co.
WAGNER, JOHN W. '24 M
Langley Field, Hampton, Va.
National Advisory Committee for Aeronautics.
Asst. Mech. Engr.
WAGNER, OTTO H. '07 M
Nelson Ave. and Rawson St.,
Long Island City, N. Y.
Engineer, Decarie Incinerator Corp.
WAHLQUIST, HUGO W. '21 M
420 Lexington Ave., New York City.
WAITS, JAMES GRANT '29 C
D. & I. R. R. R. Co., Duluth.
WALBY, ARTHUR C. '11 C
805 Plymouth Bldg., Minneapolis, Minn.
A. C. Walby, Archs. and Bldrs.
WALD, JOSEPH H. '27 E
Williamson Bldg., Cleveland, Ohio.
Sales Eng., Ingersoll-Rand Co.
WALDOR, N. THEODORE '25 C
Room 1204, R. R. Bldg., 5th and Jackson, St. Paul. Draftsman, N. P. Ry.
WALDRON, RALPH E. '20 E
328 North Lexington Ave., St. Paul, Minn.
WALIGOSKI, A. ARNOLD '24 E
Kearney, N. J.
Equip. Engr., Western Electric Co.
WALKER, FRANK B. '97 C
38 Chauncy St., Boston, Mass.
Chief Engr., Eastern Mass. St. Railway Co.
WALKER, GEORGE W. '08 C
747 Plymouth Bldg., Minneapolis, Minn.
WALKER, WILLIAM A. '11 E
WALLFRED, JOHN E. '20 M
Des Moines, Iowa.
Equipment Engr., N. W. Bell Telephone Co.
WALLIN, STANTON E. '29 C
Bucyrus-Erie Co., S. Milwaukee, Wis.
WALLING, BENJAMIN B. '09 E
1046 McKnight Bldg., Minneapolis, Minn.
Realtor.
WALQUIST, JOHN A. '23 A
WALSH, JAMES '08 M, '09 E
WALTERS, ROBERT P. '26 E
Skykomish, Wash. G. N. Ry.
WANGAARD, OSCAR H. '12 C, '13 CE
WANNAMAKER, HOMER F. '26 C
1011 Cotton States Bldg., Nashville, Tenn.
Tennessee Highways Dept.
WARD, ALVIN C. '23 E
3222 Holm Ave., Berwin, Ill.
Western Electric Co., Chicago.
WARD, JOHN, JR. '25 C
WARD, STANLEY '27 E
WARNEKE, ROMAN '29 E
Fort Wayne, Ind., Gen. Elec. Co.
WARREN, LAWRENCE C. '24 E
Schenectady, N. Y.
Apparatus Sales Dept., International General Electric Co.
WASHBURN, DELOS C. '93 AE
624 Maplewood Ave., Ambridge, Pa.
WATEROUS, FRED A. '20 M
80 E. Fillmore Ave., St. Paul, Minn.
Vice Pres. Waterous Co.
WATLAND, MAYNARD B. '29 M
Lake Park, Minn.
WATSON, FRED O. '16 C
618 National Bldg., Minneapolis, Minn.
Madsen Constr. Co.
WEATHERILL, CEDRIS S. '14 C, '15 CE
Marshalltown, Iowa.
M. and St. L. R. R.
WEAVER, ALBERT C. '95 M

WEBBER, CLYDE '27 E
Northern States Power Co., Stillwater, Minn.

WEBER, ERWIN L. '06 E, '08 M

WEBER, HAXARD P. '24 E
Chicago, Ill.
Hawthorne Works of the Western Electric Co.
Engr., Inspection Methods Dept.

WEBSTER, DONALD W. '13 C, '14 CE
1246 University Ave., St. Paul.
State Department of Highways.
Asst. Construction Engineer.

WEBSTER, HARRY M. '15 E
Boston, Mass.
Teacher, Mechanics Art High School.

WEEKS, LEONARD H. '27 E
1511 W. O. W. Bldg., Omaha, Nebr.
Western Union Tel. Co.

WEEKS, WILLIAM C. '94 C
333 North Michigan Ave., Chicago.
Lt. Col., Corps of Engrs., U. S. A.
District Engr., 1st Chicago District.

WEHLITZ, HUBERT F. '27
Chicago, Ill.
Transmission Tester, Suburban Div. Ill. Bell Tel. Co., Chicago.

WEIBLER, WILLIAM M. '08 E

WEIGEL, HOWARD N. '14 C, '15 CE
613 Bldrs. Exch., Mpls.
Contracting Engr., Mpls. Moline Power Implement Co.

WEINKE, ERNEST H. '16 C, '17 CE
St. Paul, Minn.
N. P. Ry.

WEIS, WALLACE D. '21 C
LeSueur, Minn.

WELIN, ARTHUR G. '12 C, '13 CE
St. Paul, Minn.
Dept. of Public Works.

WELLISCH, WALTON '23 E
887 Marshall Avenue, St. Paul, Minn.

WENNERLUND, ELIAS K. '99 M
Director, Prod. Engr. Dept.,
Gen. Motors Corp., Detroit, Mich.

WENRICH, JAMES R. '26 E
1421 Champa, Denver, Colo.
Charge of Carrier & Trans., A. T. & T. Co.

WENTZ, CLARENCE A. '27 C
Pitometer Co., 50 Church St., New York City.

WENTZ, EDWARD C. '26 E
Sharon, Pa.
Elec. Eng., W. E. & M. Co.

WENTZ, WALTER W. '14 E, '16 EE
Minneapolis, Minn.
Electrical Department, Dunwoody Inst.

WEOM, LAUREL A. '27 E
220 E. 5th St., St. Paul, Minn.
Fairbanks Morse & Co.

WERDENHOFF, JAMES H. '21 C
200 Groveland Ave., Mpls.

WESBROOK, DONALD M. '10 M
Pine St. and 5th Ave., Seattle, Wash.
Treas., Westberg & Childs, Inc.

WESSALE, GEORGE '21 E
Waconia, Minn. Sorghum Mills.

WEST, JANE '29 IA
405 5th St. S. E., Minneapolis, Minn.

WEST, JOHN C. '15 C
St. James, Minn.
Highway Contractor and Civil Engr.

WEST, ROBERT W. '12 C

WESTBERG, RUSSELL E. '20 E
Pine St. and Fifth Ave., Seattle, Wash.
Treasurer, Westberg & Childs, Inc.

WESTIGARD, GLENN A. '25 E
Minneapolis, Minn.
N. S. P. Co.

WESTON, WILLIAM S. '02 C
Landscape Gardener and Nurseryman.
Chatek, Wis.

WEYER, H. R. '29 E
Minneapolis, Minn., N. S. P. Co.

WHEELER, HERBERT H. '17 E
195 Broadway, New York City.
Engr. Dept., Western Union Telegraph Co.

*WHEELER, HERBERT M. '96 E

WHITE, ARDEN D. '22 C
Subway Terminal Bldg., Los Angeles, Calif.
Miller and White.

WHITE, CHARLES W. '13 E
Los Angeles, Calif.
Southern Calif. Edison Co.

WHITELEY, HOWARD O. '27 E

WHITMAN, EDWARD A. '00 C
1659 W. Minnehaha Ave., St. Paul, Minn.

WHITNEY, ALFRED C. '03 G
419 N. Fifth St., Minneapolis, Minn.
President, Schurmeier-Whitney Co.

WHITTEN, ROBERT C. '25 M
402 S. Fifth Ave. W., Virginia, Minn.

WICHMAN, MARTIN F. '22 E
St. Cloud, Minn., N. W. Tel. Co.
District Plant Supt.

WICKLUND, PAUL E. '25 AE
Asst. Archt. Supt., Graham, Anderson, Probst and White, Room 2648, 120 Bwdy, New York.

WICKS, JOHN '04 E
221 S. Kenilworth Ave., Oak Park, Ill.

WIDELL, GUSTAF F. '08 C
1109 N. Clark St., Chicago, Ill.
Lanquist and Illsley Co.

WIELAND, WILLARD W. '25 E
105 Heineman Blvd., Mansfield, Ohio.

WIELDE, JOHN A. '28 C
111 Norton St., Duluth, Minn.

WIESNER, FREDERICK E. '06 C
418 Howard St., Spokane, Wash.
Office Engr., G. N. Ry.

WIGGINS, GERALD G. '06 E
Transit Commission, 270 Madison Ave., New York City.

WIGGINS, JOHN B. '23 E
2105 Grove Ave., Byrwyn, Ill. (res.)
Western Elec. Co., Chicago, Ill.

WILCOX, HALSEY H. '15 E
309 Elec. Bldg., Omaha, Nebr.
Equip. Supervisor, Western Union Tel. Co.

WILCOX, HUGH B. '14 E, '16 EE
University of Minnesota, Minneapolis, Minn.
College of Engineering.

*WILCOX, LESLIE W. '13 E

WILD, CARL D. '15 C, '16 CE
Janesville, Iowa.
Cashier, Savings Bank of Janesville.

WILINSON, GLADNESS B. '27 I
89 S. 10th St., Minneapolis, Minn.
Webber-Werns Studios.

WILK, BENJAMIN '13 C, '14 CE
2977 Cortland Ave., Detroit, Mich.
Mgr., Standard Bldg. Prod. Co., Cleverdale Ave.

WILLARD, ARTHUR C. '22 E
435 6th Ave., Room 601, Pittsburgh, Pa.
Jr. Cost Engr.

WILLIAMS, ARTHUR H. '19 M
293 Northwood road, Riverside, Ill.
Chief Eng., Shaffer, Rolling Bearing Corp., Chicago.

WILLIAMS, CHARLES A. '16 C

WILLIAMS, EDWARD H. '03 M
800 Franklin St., Pottstown, Pa.
Consulting Engineer.

WILLIAMS, FRED M. '05 E, '09 EE
149 Fulton St., New York, N. Y.
Gen. Instal. Engr., Western Elect. Co.

WILLIAMS, FREDERICK J. '17 E
417 Broadway, St. Paul, Minn.
Commonwealth Electric Co.

WILLIAMS, MYRL J. '20 M
6126 S. LaSalle, Chicago, Ill.
Supt., Washburn Co.

WILLIAM, PERCIVAL H. '22 E
7506 N. Robey St., Chicago, Ill.

WILLIAMS, ROY N. '23 E
901 Fidelity Bldg., Duluth, Minn.
Salesman, General Elect. Co.

WILLIAMS, W. GLENN '29 E
Gen. Elec. Co., Schenectady, N. Y.

WILLIAMS, WILBUR S. '09 M
2901 Jennings Ave., Sioux City, Iowa.
Vice-Pres. and Treas., Williams-Minnick Motor Co.

WILLIAMS, WILLIAM R. '26 E
424 1st St. S. E., Minot, N. D.

WILLIS, BENJAMIN S. '17 E
Iowa State College, Ames, Iowa.
Instructor in Electrical Engineering.

WILLIS, ROY '08 C
St. Paul, Minn.
Asst. Engr., Dept. of Public Works.

WILLNER, WILLIAM E. '22 A
101 Park Ave., New York, N. Y.

WILLS, ARTHUR D. '21 A
Chicago, Ill.
Hawthorne Station, Western Elect. Co.

WILLS, DAVID C. '23 E
Chicago, Ill.
Western Electric Co., Hawthorne Station.

WILLSON, MANTON F. '98 M

WILLSON, STUART V. '24 M
La Crosse, Wisconsin.
N. S. P. Company.

WILSON, ABNER W. '22 E
Box 12, Wilkinsburg, Pa.

WILSON, CHARLES A. '22 C
500 Sexton Bldg., Minneapolis, Minn.
Hustad Co.

WILSON, ELIEL F. '01 M, '02 E
1108 Eighth St. S. E., Minneapolis, Minn.

WILSON, FRANK W. '23 E
2238 St. Clair St., St. Paul, Minn. (res.)
Sales Eng., N. S. P. Co., St. Paul.

WILSON, GLENN W. '11 E
Mountain View, Calif.
275 Castro So. Owner, Valley Elect. Co.

WILSON, PAUL R. '21 E
Room 1319 Telephone Bldg., Omaha, Nebr.
N. W. Bell Tel. Co.

WILSON, ROY A. '25 M
International Falls, Minn.

WILSON, WALTER E. '24 C
1001 E. 10th St., Duluth, Minn.
A. N. Nelson, Contractor.

WILTGEN, EDWARD '00 E
Schenectady, N. Y.
Commercial Engineer, General Electric Co.

WINKENWERDER, E. E. '25 E
Acme Wire Co., Chicago.

WINSLOW, HARRY J. '25 E
Instructor of Math.,
U. S. Naval Academy, Annapolis, Md.

WITHER, WARREN '15 C
37 Municipal Bldg., Chattanooga, Tenn.
U. S. Geological Survey.

WITT, EDWARD H. '28 E
New Ulm, Minn.

WITT, EDWARD J. '27 C
Concrete Steel Co., St. Paul, Minn.

WITTS, SETH N. '27 E

WOEHLER, WILLIAM L. '07 E
1308 Genoa St., Coral Gables, Fla.
Woehler Elect. Co., 320 W. Flagler St., Miami, Fla.

WOLF, MILTON C. '25 C
St. Paul, Minn.
N. P. Ry.

WOLFANGLE, RAYMOND J. '17 C
920 Guardian Life Bldg., St. Paul, Minn.
Ramsey County Engineers Office.
Principal Asst. Engineer.

WOLFE, GEORGE E. '24 E
Pampa, Texas.

WOLFF, HENRY E. '12 C, '13 CE

WOLFF, WILLIAM S. '15 M, '16 ME
811-13 East 7th St., St. Paul, Minn.
Wolff Motor Car Co.

WOLOSHIN, BORIS '27 E

WONG, JEE K. '16 M
Locomotive & Workshop Dept. Peking-Suiyuan Line, Chinese Gov't. R. R., China.

WOOD, JOHN W. '05 E

WOOD, LESLIE L. '28 M

WOOD, VICTOR R. '22 C
Barnum, Minn.

WOODMAN, HOWARD H. '97 C
1802 N. Locust St., Pittsburg, Kansas.
Coal Operator.

WOODMAN, JOSEPH C. '11 M
342 Madison Ave., New York City, N. Y.
Decarie Incinerator Corp.

*WOODMANSEE, CHARLES C. '86 AE

WOODRICH, OSCAR F. '08 C
308 Met. Life Bldg., Minneapolis, Minn.
Woodrich Construction Co.

WOODWARD, HERBERT M. '90 M
Dalton St., Cor. Belvidere, Boston, Mass.
Master in Mech. Arts Hi School.

WOOLMAN, HARRY D. '24 M
1572 Portland Ave., St. Paul.
Salesman, Modine Mfg. Co., 354 Baker Bldg.

WRIGHT, HARRIS H. '09 M
615 City Bank, Kansas City, Mo.
Proprietor, Mfgs. Agent, Heating Equipment.

WRIGHT, ROYDON V. '98 M
398 N. Walnut St., East Orange, N. J.

*WRIGHT, STEWART V. '19 A

*WUEST, KARL F. '14 E, '15 EE

WUNDERLICH, MILTON S. '19 M, '20 ME
Hampden and Wabash, St. Paul, Minn.
Flaxlinum Insulating Co.

WURZBACH, HENRY A. '25 E
1421 Champa St., Denver, Colo.
Training Supervision, Am. Tel. & Tel. Co.

WYLY, LAWRENCE T. '20 G
1447 E. 67th Place, Chicago, Ill.
Structural Designer, Strauss Eng. Corp.

YAGER, LOUIS '07 C
St. Paul, Minn. N. P. Ry. Co.
Assistant Chief Engineer. c-o Gen. Office.

YOUATT, GLENN B. '29 AE
Waupun, Wis.

YOUNG, CHARLES N. '12 E
5th and Walnut Sts., Philadelphia, Pa.
Mgr. Safety Engr. Dept., Const. Indemnity Co.

YOUNG, CLIFFORD L. '28 E
Algona, Iowa.

YOUNG, DONALD '29 M
1515 Central Ave. N. E., Minneapolis
Pioneer Gravel Equip. Mfg. Co.

YOUNG, EDWARD F. '26 C
836 Security Bldg., Minneapolis, Minn.
Universal Atlas Cement Co.

YOUNG, JOSEPH E. '21 G
Fergus Falls, Minn.
Supt. Water Dept.

YOUNG, TRUMAN P. '26 C
1020 Temple Bar Bldg., Cincinnati, Ohio.
Draftsman, Cinc. Union Terminal Co.

YOUNGQUIST, EDER B. '25 C
958 Berry Ave., St. Paul, Minn.
Concrete Steel Co.

YOUNGQUIST, C. VERNON '27 C
404 Engineering Exp. Sta.
Ohio State University, Columbus, Ohio.
Jr. Hydraulic Engr.

ZELENY, FRANK '98 M
Aurora, Ill. C. B. and I. R. R.

ZEUTHEN, VICTOR C. '29 C
611 13th Ave. S. E., Minneapolis, Minn.

ZIMMER, WILLIAM A. '06 E
Omaha, Nebr.
N. W. Bell Tel. Co.

ZIMMERMAN, ARTHUR C. '23 C
1345 20th St., Miami Beach, Fla.
Office Mgr. and Treas., G. O. Reed, Inc.

ZIMMERMAN, LOUIS P. '08 E
Waseca, Minn. Farmer.

ZIMMERSCHIED, CLARENCE '23 E
52 Vanderbilt Ave., New York.
Sales Engr., Elec. Mach. Mfg. Co.

ZUCKMAN, GEORGE J. '27 C
Ill. Hiway Dept., Springfield, Ill.

School of Chemistry

Alumni, help us keep these lists correct. In spite of our efforts we realize that there are errors and old and incorrect addresses. Those graduates whom we have not heard from have been listed with their addresses the same as last year. We would appreciate having corrections sent to the Dean's Office.

ANDERSON, ALVIN P. '25 B. S. (CH.)
236 8th St., Wood River, Ill.
Asst. Chief Chem., Shell Petroleum Corp.

ANDERSON, EDGAR G. '27 B. S. (CH.)
3436 5th Ave. S., Minneapolis, Minn.

ANDERSON, EDWARD X.
'08 B. S. (CH.), '09 M. S. (CH.)
417 N. 6th St., Grand Forks, N. Dak.
Associate Prof. Ch., Univ. of N. D.

ANDERSON, FREDOLF THEODE
'13 B. S. (CH. E.), '14 CH. E.

ANDERSON, M. M.
'20 B. S. (CH. E.), '21 CH. E.
1420 Hythe, St. Paul, Minn.
Mgr. Minnesota Union, Univ. of Minn.

ANDERSON, WINSLOW S.
'21 B. S. (BATES COL.), '23 M. S. (CH.)
Winter Park, Florida.
Dean of College, Rollins College, Winter Park, Florida.

ARNOLD, JEROME H. '27 B. S. (CH. E.)
Montevideo, Minn.
Mass. Institute of Technology, Cambridge, Mass.

ARONOVSKY, SAMUEL ISAAC
'21 B. S. (CH. E.), '22 CH. E.
131 E. Fairfield Ave., St. Paul, Minn.
Cloquet Wood Prod. Fellow, Ag. Biochemistry, U. Farm.

AYERS, ELLSWORTH B. '25 B. S. (CH.)
510 S. Atchison St., Eldorado, Kansas.
Skelley Oil Co.

BACON, CHARLES B. '09 B. S. (CH.)
301 Beechwood Ave., Bridgewood, Conn.
President, Write, Inc.

BACKE, EDMUND '24 B. S. (CH. E.)
642 Portland Ave., St. Paul.
Research Chem. Engr., Waldorf Paper Prod. Co.

BADGER, WALTER LUCIUS
'08 B. S. (CH.), '09 M. S. (CH.)
917 Church St., Ann Arbor, Michigan.
Prof. of Chem. Eng. Univ. of Michigan.

BAKER, RUSSEL E. '11 B. S. (CH. E.)
191 Macalester Ave., St. Paul.
Sec. C. H. Young Co.

BAKKE, OLIVER M. '03 B. S. (CH.)
Mt. Pleasant, Texas.
Chemist, St. Louis Southwestern R. R.

BAKKEN, ADOLPH C.
'19 B. A. (ST. OLAF) '23 M. S. (CH.)
Sales Department, Aluminum Co. of America, 1880 Elmwood Ave., Buffalo, New York.

BARBER, HERVEY H.
'18 B. A. CINCINNATI, '26 PHD (INORG. CH.)
400 Oak Street S. E., Minneapolis.
Asst. Prof. School of Ch., U. of M. and Supt. Supply and Equipment.

BARNABY, WILLIAM E.
'09 B. S. (CH. E.)
223 So. Kenmore, Los Angeles, Calif.

BARRETT, JOSEPH O.
'22 B. S. (CH. E.), '23 CH. E.
1494 Capitol Ave., St. Paul.
Chem. Dept. of Public Utilities.

BARROWS, VERA
'06 B. A., '17 M. S. (CHEM.)
Virginia, Minn.

BAUER, ESTHER E. (KOCH)
'21 B. A., '24 M. S. (CHEM.)
Hercules Powder Co., Wilmington, Delaware.

BEAL, JOHN L. '27 B. S. (CH. E.)
4624 Bryant Ave. S., Minneapolis, Minn.
Res. Fell. in Ex. Eng. Lab., U. of M.

BECK, MAUD G.
'05 B. A., '13 M. A. (CH.)
3042 Irving S., Minneapolis.
Science Teacher, West High School, Minneapolis.

BECKEL, ARTHUR C. '19 B. S. (CH.)
Dept. of Chemistry,
Long Island University, Brooklyn, New York.

BEKKEDAHL, NORMAN P.
'25 B. S. (CH. E.)
3945 Connecticut Ave., Washington, D. C.
Bureau of Standards, Washington, D. C.

BELL, GRACE M.
'09 B. A., '11 M. S. (CH.)
7613 Hampson St., New Orleans, La.

BELL, ALEXANDER DEWEY
'16 B. S. (CH. E.), '17 CH. E.
2287 Sergent Ave., St. Paul, Minn.
Vice-Pres. and Chem., Van Cleve Laboratories, Minneapolis.

BENNER, RAYMOND CALVIN
'02 B. S. (CH.)
305 Buffalo Ave., Niagara Falls, N. Y.
Carborundum Co.

BERCOVITZ, HENRY '27 B. S. (CH. E.)
231 Pa. Street N. E., Washington, D. C.
Dupont Rayon Co., Buffalo, New York.

BERNHAGEN, LEWIS OTTO '05 A. C.
Y. M. C. A., Beaumont, Texas.
Director of Sanitation, City of Beaumont.

BIERMAN, HARRY C.
'14 B. S. (CH. E.), '14 CH. E.
No. 1 Davis Ave., New Rochelle, N. Y.
Patent Attorney, 535 5th Ave., New York City.

BICKNELL, HENRY R. '10 B. S. (CH.)
1009 Virginia St., Vallejo, Calif.
Chem., Sperry Flour Co.

BLOSJO, HERBERT H. '28 B. S. (CH.)
3229 Park Ave., Minneapolis, Minn.
Mpls. Steel & Machinery Co.

*BOLTON, JOHN B. '11 B. S. (CH. E.)

BORROWMAN, GEO. L. '05 A. C.
2523 Park Street, Evanston, Ill.
Analytical and Consulting Chemist.

BOSTWICK, ROSS D. '23 B. S. (CH. E.)
E. 2428 Diamond Ave., Hyllyard Sta., Spokane, Wash. Graduate Student, University of Calif.

BOXELL, MORRIS L. '21 B. S. (CH. E.)
Foreman, Asphalt Stills, Union Oil Co., Oleum, Calif.

BRAY, MARK W.
'12 B. S. (LAWRENCE), '14 M. S. (CH.)
25 Lathrop Street, Madison, Wis.
Forest Products Lab., Madison, Wis.

BRICK, BAYARD '29 CH.
1013 Art Hill Place, St. Louis, Mo.
Inst., Math., Sch. of Eng.

BRINKER, HOWARD C. '25 B. S. (CH.)
7323 S. Marshfield, Chicago, Ill.

BRINTON, PAUL H. M-P.
'12 B. S. (CH.), '13 M. S. CH., '16 PHD
"Little Broom Gardens," Altadena, Pasadena, Calif. Private Research at Home

BROOKS, LESLIE C. '19 B. S. (CH.)
2528 N. E. Garfield Ave., Minneapolis, Minn
Natl. Pole & Treating Co., Bldrs. Exch. Bldg

BROWN, HAROLD H. '09 B. A.
'10 M. A. SYRACUSE, '14 PHD
Box 82, Norwood, Mass.
Chem., Holingsworth & Vose Co., East Walpole, Mass.

BRUCE, G. NORMAN '23 B. S. (CH. E.)
3206 Xerxes Ave. S., Minneapolis, Minn.
Chemist, Biscuit & Cracker Mfrs. Assn., Dunwoody Institute, Minneapolis.

BRUNKOW, HERBERT E. C. '12 CH. E
Delano, Minn. Mgr., Owner, Brunkow Electrical Shops.

BUNGER, HAROLD A. '26 B. S. (CH. E.
17 Seymour Ave. S. E., Minneapolis, Minn.
Shevlin Fellow in Chem., U. of M.

BURNINGHAM, F. A.
'17 B. S. (CH. E.), '18 CH. E.
29 Tenth Street, Berlin, New Hampshire.
Research Chem., Brown Co.

BUSCH, WILLIAM A. '22 B. S. (CH. E.)
R. R. 2, Robbinsdale, Minn.

BUSCH, JOHN S.
'20 B. S. (CH. E.), '20 CH. E.
3813 Bloomington Ave. S., Minneapolis, Minn.
Research and Experimental Chem., Insulite Co.

CADE, ARTHUR R. '15 B. S. WORCESTER POLYTECH. INST., '17 M. S. (CH.)
Chemist, Lavoris Chem. Co., 918 N. 3rd Street, Minneapolis, Minn.

CALLAWAY, R .S. '11 B. S. (CH. E.)
4037 Abbott Ave. S., Minneapolis.
Purchasing Agent, University of Minnesota.

CANTWELL, WILLIAM F., '11 B S. (CH.)
International Falls, Minn.
Physician and Surgeon.

CASSEL, NORMAN S.
'22 B. S. (CH. E.), '23 CH. E.
133 Chestnut St., Montclair, N. J.
United Piece Dying Co., Paterson, N. J.

CHADBOURNE, L. RODNEY
'22 B. S. (CH. E.), '23 CH. E.

CHANEY, ALBERT L.
B. A. WASH. MISSIONARY COLL. '20
'25 M. S. (CHEM.)
Assistant, School of Chemistry, U. of Minn.

*CHAPIN, LEWIS PAUL '97 CH. E.

CLARK, CARROLL A. '29 CH. E.
2510 2nd St., Duluth, Minn.
Grad. Student, U. of M.

COHEN, LILLIAN
'00 B. S., '01 M. S., '13 PHD.
2521 Humboldt Ave. S., Minneapolis.
Asst. Prof. of Inorganic Chem., U. of M.

CORL, CADY S. '21 B. S. (CH.)
5316 York Ave. S., Minneapolis.
Asst. Chemist, McLaughlin, Gormley, King & Co., Minneapolis, Minn.

CORNELL, L. WALLACE '27 B. S. (CH. E.)
630 S. E. 7th St., Minneapolis, Minn.
Asst. in Chem., U. of M.

CORNELL, REUBEN WILLETT
'21 B. S. (CH. E.), '22 CH. E.
Y. M. C. A., Red Wing, Minn.
Chem. Engr., Pittsburgh Plate Glass Co., Linseed Oil Division.

CORSON, BENJAMIN I. '17 B. S. (CH.)
2916 Constitution Rd., Camden, New Jersey.
Chemist, R. M. Hollingshead Co.

COULT, LYMAN H. '25 B. S. (CH. E.)
Asst. Mgr., Commercial Canning (Vegetables).
Fairmont Canning Co., Fairmont, Minn.

COVELL, PAUL L. '25 B. S. (CH. E.)
3129 Aldrich Ave. S., Minneapolis, Minn.
Gas Foreman, Minneapolis Gas Light Co. Works, 14th & River S.

*CRESSY, CHAS. R.
'08 B. S. (CH.), 13 M. S.

CRAWFORD, MARJORIE
'20 B. A. (MIAMI), '22 M. S. (IOWA), '27 PHD.
Inst. in Chem., Vassar College.
Poughkeepsie, N. Y.

CURTISS, FAITH (STERLING)
'09 B. S. (CH.)
408 College St., Portland, Ore.
Substitute teacher, Portland High Schools.

DAHLBERG, ARNOLD V. '05 A. C.
372 S. Ogden, Denver, Colo.
Agronomist, Anaconda Copper Mining Co.
Chicago and New York.

DAHLBERG, HENRY W. '10 B. S. (CH. E.)
1558 Monaco Parkway, Denver, Colo.
Mgr., Research Dept., Great Western Sugar Co.
The Great Western Sugar Co.,
Sugar Building, Denver, Colo.

DAHLEN, MILES
'24 B. S. (CH. E.), '28 PH.D.
2705 Jefferson St., Wilmington, Del.
Research Ch., E. I. duPont de Nemours,
Wilmington, Del.

DANIELS, ELMER ANSON '12 B. S. (CH.), '13 M. S. (CH.), '17 PHD.
268 North Garfield Ave., Hinsdale, Ill.
Development Engr., Western Elec. Co., Hawthorne Station, Chicago.

DANIELS, FARRINGTON
'10 B. S. (CH.), '11 M. S. (CH.)
Madison, Wis. Assoc. Prof. of Chem., Univ. of Wis.

DAVIES, EDWIN T. '07 B. S. (CH. E.)
5057 Upton Ave. S., Minneapolis.
Chem., City Engineer's Dept., 125 N. Bryant Ave.

DARLING, STEPHEN F.
'22 B. S. (CH.), '24 M. S. (CH.)
Crosby, Minnesota.
Lawrence College, Appleton, Wis.
Assoc. Prof. of Chem.

DEVANEY, GRACE M. '26 B. S. (CH.)
523 University Ave., Grand Forks, N. D.
Research Associate, Sch. of Mines, Univ. of N. D.

DEWITT, JOSEPH HENRI '10 B. S. (CH.)
966 Dayton Ave., St. Paul.
State Parole Agent for Minnesota State Prison and Reformatory. Office: State Capitol, St. Paul.

DIETRICHSON, GERHARD '10 B. S. (CH.)
Mass. Inst. of Tech., Boston, Mass.

DOBROVOLNY, FRANK J. '20 B. A. DAKOTA WESLEYAN, '24 M. S. (CH.)
Roessler & Hasslacher Chem. Co., Niagara Falls, New York.

DOMOVSKY, MAX '17 B. S. (CH. E.)

DONAUER, MAX
'18 B. S. (CH. E.), '25 CH. E.
1934 N. 14th St., Toledo, Ohio.

DORAN, JAMES M. '07 B. S. (CH.)
3051 N. St. N. W., Wash., D. C.
Commissioner of Prohibition, Washington, D. C.

DRESSER, EVA L. (ALVES)
'09 B. S. (CH.)
799 Faxom Ave., San Francisco, Calif.

DUMKE, WALTER H. '27 B. S. (CH. E.)

DUNNIGAN, MERTON A. '16 B. S. (CH.)
5045 Oliver Ave. S., Minneapolis.
W. H. Barber Co., Minneapolis, Minn.

DURHAM, SAMUEL W. '17 B. S. (CH.)
2001 E. Slauson Ave., Los Angeles, Calif.
Woodard-Durham Mfg. Co.

DYER, WALTER S. '24 B. S. ARKANSAS, '25 M. S. (CH.)
Prof. of Chem.,
Union College, Barbourville, Ky.

DYSTERHEFT, GEORGE A. '26 B. S. (CH.)
Asst. Ch. State Dairy and Food Lab.
St. Paul, Minn.

ECK, LESTER JOHN
'23 B. S. (CH. E.), '24 M. S. (CH. E.)
3240 Fremont Ave. S., Minneapolis, Minn.
Engineer of Tests, Minneapolis Gas Light Co.

*ECKMAN, LAWRENCE R. '17 B. S. (CH.)

EDGAR, DONALD E.
'23 B. S. (CH. E.), '27 PH.D.
60 Melbourne Ave. S., Minneapolis.
Res. Chemist, c-o E. I. Dupont de Nemours & Co., Parlin, N. J.

EDMUNDS, ALVIN M. '23 B. S. (CH. E.)
412 Ashman St., Midland, Mich.
The Dow Chemical Co., Midland, Mich.

EDWARDS, JUNIUS DAVID
'12 B. S. (CH. E.), '13 CH. E.
536 6th St., Oakmont, Pa.
Asst. Director of Research, Aluminum Co. of America, New Kensington, Pa.

*EGGE, WALTER '17 B. S. (CH.)

ELLESTAD, REUBEN B.
'22 B. S. (CH.), '24 M. S. (CH.)
'29 PH. D. (CH.)
721 15th Ave. S. E., Minneapolis, Minn.
Chemist, Rockefeller Rock Lab.

ELMQUIST, RUTH E.
'21 B. A., '24 M. S. (CHEM.)
Gov. Hotel, P. 2, Washington, D. C.
Department of Home Economics.

ELSTON, ARTHUR A. '27 B. S. (CH. E.)
Rich Valley, Minn.
Dow Chemical Co., Midland, Michigan.

ENGSTROM, LESLIE G. '19 B. S. (CH.)
Agent U. S. Internal Revenue
51 Melbourne Ave., Minneapolis, Minn.

ERNST, ROBERT C. '21 B. S., M. C. STATE COLL., '23 M. S. (CH. E.)
636 Huron St. S. E., Minneapolis.
Asst. Prof. Chem. & Eng., Univ. of Louisville, Louisville, Ky.

EPSTEIN, HYMEN '21 B. S. (CH.)
2816 Wells St., Milwaukee, Wis.
Production Mgr., Lavo Co. of America.

FAWCETT, ROBERT BEST
'28 B. S. (CH. E.)
Associated, Calif.

FEGAN, ELMER THOMAS
'15 B. S. (CH.), '16 M. S. (CH.)
900 30th Ave. S., Minneapolis.
Technical Supervisor.

FELION, ELMER T. '13 B. S. (CH.)
4628 33rd Ave. S., Minneapolis.
Asst. Chem., N. P. Ry. Como Shops, St. Paul.

FIEGER, ERNEST A.
'20 B. S. (CH. E.), '21 CH. E.
400 Corrine St., Baton Rouge, La.
Asst. Prof. in Chem., Louisiana State Univ., Baton Rouge, Louisiana.

FINKE, WILBUR W. M. '10 B. S. (CH.)
998 Ashland Ave., St. Paul, Minn.

FIRTH, CHARLES V. '23 B. S. (CH. E).
3244 38th Ave. S., Minneapolis, Minn.
Chem. Asst., Mines Expt. Sta., Univ. of Minn.

FISCHER, EARL B. '19 B. S. (CH. E.)
4921 Fremont Ave. S., Minneapolis, Minn.
Asst. Prof. of Pharmacognosy, U. of M.

FOKER, LESLIE W. '28 B. S. (CH. E.)
1134 6th St. N. E., Minneapolis, Minn.
Graduate Student, University of Minn.

FRARY, FRANCIS COWLES
'05 A. C., '06 M. S. (CH.), '12 PHD.
1318 Hulton Road, Oakmont, Pa.
Director of Research, Aluminum Co. of America, New Kensington, Pa.

FRECHE, HERTHA R.
'19 B. A., '25 M. S. (CH.)
4500 Wentworth Ave. S., Minneapolis.
Grad. Student, School of Chemistry.

FREDERICKSON, HUBERT M.
'23 B. S. (CH. E.)
527 5th Ave. S. E., Minneapolis, Minnesota.
Minn. Northern Power Co., Minneapolis, Minn.

FREDRICKSON, EDNA '24 B. S. (CH.)
Hackensack, Minnesota.
c-o Maiser Fox Farm.

FUHRMAN, ALVIN O. '24 B. S. (CH. E.)
565 Portland, St. Paul, Minn.
Chem. Eng. American Container Corp., 522 Front St., St. Paul.

FULMER, JERVIS M. '20 B. S. WASH. STATE COLL., '22 M. S. (CH.)
Head of Ch. Dept., Robert College.
Constantinople, Turkey.

FUSON, REYNOLD C. '20 B. A. MONT., '21 M. A. CALIF., '24 PHD
506 S. Gregory St., Urbana, Ill.
Asst. Prof. of Chemistry, U. of Ill.
Urbana, Ill.

GALVEZ, NICOLAS L. '25 B. S. (CH.)
Instructor in Chemistry, Agricultural College, Laguna, Philippine Islands.

GAUGER, A. W. '14 B. S. (CH.)
1122 Reeves Drive, Grand Forks, N. D.
Dir., Div. of Mines, U. of N. D.
Grand Forks, N. D.

GEHRENBECK, GILBERT B.
'28 B. S. (CH. E.)
White Bear Lake, Route 2, Minn.
Research Chem., Minn. Mining & Mfg. Co., St. Paul, Minn.

GERLICHER, HAROLD W.
'27 B. S. (CH. E.)
629 W. King St., Winona, Minn.

GERLICHER, ROBERT A. '28 B. S. (CH. E.)
56 Balch, Akron, Ohio.
Chem. Eng. B. F. Goodrich Rubber Co., Akron, Ohio.

GILLMAN, HYAM '25 B. S. (CH.)
2137 Canyon Drive, Los Angeles, Calif.
Calif.

Glaser, David W. '29 B. of Ch. E.
3111 Portland Ave., Minneapolis, Minn.
1901 E. Hennepin, Minneapolis, Chemist.

Glenn, Harry W. '24 B. S. (Ch. E.)
518 Carleton Ave., Cloquet, Minn.
Works Chem., Northwest Paper Co., Beater Engineer.

Goldberg, Will M. '28 B. S. (Ch. E.)
371 Irving Ave., Brooklyn, N. Y.
Chemist, U. S. Government.

Goldstein, Milton M.
'12 B. S. (Ch. E.), '13 Ch. E.
4600 1st Ave. S., Minneapolis.
Architect and Builder.
1406 West Lake St., Minneapolis, Minn.

Greenlaw, Charles E.
'19 B. S. (Ch. E.)

Grout, Frank Fitch
'04 B. S. (Ch.), '08 M. S. (Ch.)
911 Seventh St. S. E., Minneapolis.
Prof. of Geology, University of Minnesota.

Gutsche, Edward J. '04 B. S. (Ch.)
17 Fairwood Blvd., Pleasant Ridge, Detroit, Mich. Service Eng. on Sands and Bonding Materials, Great Lakes Foundry Sand Co., 2100 Penobscot Bldg., Detroit, Mich.

Gutsche, Frank Carl
'10 B. S. (Ch. E.)
611 N. Waiola Ave., La Grange, Ill.
Chem., Western Electric Co., Chicago, Ill.

Halvorson, Halvor Orin
'22 B. S. (Ch. E.), '23 Ch. E.
64 Melbourne Ave. S. E., Minneapolis.
Instr., Dept. of Bacteriology, U. of M.

Halverson, John Oliver '07 B. S. (Ch.)
110 Wakefield Ave., Raleigh, N. Ca.
Feed Inspection, Control and Investigations in Nutrition, Agricultural Experiment Station.

Halvorson, Henry A. '11 B. S. (Ch.)
1435 Grand Ave., St. Paul.
State Dairy and Food Dept., St. Paul.

Hamilton, Herbert Clifton '97 Ch. E.
160 Webb Ave., Detroit, Mich.
Pharmacologist and Research Biological Chemist, Med. Research Dept., Parke, Davis & Co.

Hamm, Homer A. '25 B. S.
119 Cockesill Ave., Takoma Pk., Md.
Junior Chem., Bureau of Stand., Wash., D. C.

Hammer, George F.
'20 B. S. (Ch. E.)
310 E. 31st St., Minneapolis.
International Milling Co., Bakery Service.

Hammond, Kathryn D. (Kelley)
'22 B. S. (Ch.)
Stevens Point, Wis.

Hansen, Theodore '28 B. S. (Chem.)
Sleepy Eye, Minn.

Hansen, Theodore B. '28 B. S. (Ch.)
Biscuit & Cracker Mfrs. Assn., Dunwoody Inst., Minneapolis.

Hargrove, Lorin D. '28 B. S. (Ch.)
Twin City Supply Co.,
177 East Third Street, St. Paul, Minn.

Harshaw, John Rippey
'12 B. S. (Ch. E.)
R. F. D. No. 1, Chenango Forks, New York.

Harris, Elwin E. '21 B. S. Hamline,
'22 M. S. (Ch.), '25 PhD.
Asst. Prof. of Chemistry, Univ. of North Dakota, Grand Forks, N. Dak.

Hartkemeier, Leonard '21 B. S.
Louisville, '24 M. S. (Ch. E.)
Asst. Prof. Chem., Colorado School of Mines, Golden, Colorado.

Hartnett, John G. '11 B. S. (Ch.)
Graceville, Minn. Assoc. Chem., Civil Service.

Hartshorn, Elden B.
'12 B. S. Dartmouth, '22 PhD.
11 Balch Street, Hanover, New Hampshire.
Asst. Prof. of Chemistry, Dartmouth College, Hanover, N. H.

Hatch, Lloyd '23 B. S. (Ch. E.)
1352 Raymond Ave., St. Paul.
Supt. of Abrasive Dept., Minneapolis Mining & Mfg. Co., St. Paul.

Hauge, Sigfred M.
'18 B. A. St. Olaf, '21 M. S. (Ch.)
253 Sheetz St., West Lafayette, Ind.
Research Chemical Lab., Purdue Univ., Agr. Exp. Station, LaFayette, Ind.

Haugsrud, Parmalee S.
'26 B. S. (Ch. E.)
Y.M.C.A. Hotel, 826 S. Wabash Ave., Chicago, Ill.; National Adhesive Corp., Chicago, Ill.

Hawkey, Harold K.
'19 B. S. (Ch. E.), '19 Ch. E.
2416 15th Ave. S., Minneapolis, Minn.

Heck, Frank J. '19 B. S. (Ch.)
Rochester Mayo Clinic, Rochester, Minn.

Heinemann, Gustave
1177 Hague Ave., St. Paul, Minnesota.
Pittsburgh Plate Glass Co., Barberton, Ohio. (July 1, '30).

Heisig, Lucille K.
'19 B. A., '22 M. S. (Ch.)
2400 35th Ave. S., Minneapolis.

Hella, Roy Paul '28 B. S. (Ch. E.)
The Northwest Paper Co., Cloquet, Minn.

Hennessy, Hugh J. '11 B. S. (Ch.)
1864 Marshall Ave., St. Paul.
Chief Inspector, Division of Feed Inspection, Minn. Dairy and Food Dept., 215 Old Capitol Building.

Hiegburg, Wm. '17 B. S. (Ch. E.)
4340 Winthrop Ave., Indianapolis, Ind.
Sales Mgr., Char. Products Division, Republic Creoseting Co., Indianapolis, Ind.

Hoff, John Edgar '20 B. S. (Ch.)
4102 Gilliat St., Duluth, Minn.
Auditor, Klearflax Linen Looms, Inc., Duluth, Minn.

Hoffman, Henry Joseph
'12 B. S. (Ch.), '14 M. S. (Ch.)
1085 Hawthorne Ave., St. Paul.
Chem., State Dairy and Food Dept., Old Capitol, St. Paul.

Hogness, Thorfin Rusten
'18 B. S. (Ch. E.), '19 Ch. E.
1405 Spring Way, Berkeley, Calif.
Asst. Prof. of Ch., Gilman Hall, U. of Calif., Berkeley, Calif.

Holst, James E. '27 B. S. (Ch. E.)
3118 Pierce St., Minneapolis.
Mayo Fellow, Rochester.

Hopkins, Joseph Irwin '04 B. S. (Ch.)
R. F. D. 1, Minneapolis.
Farming.

Hovland, Clifton R. '19 B. A. (St. Olaf), '21 M. S. (Ch.)
Asst. Chem. Eng., Chicago & Elto R. R. Co.
807 W. Washington St., Bloomington, Ill.

Humphrey, Gertrude J. '24 B. S. (Ch.)
641 Shepard, San Pedro, Calif.
Chief Chem., Philip R. Park, Inc., San Pedro, Calif.

Jackson, Myron Bangs '05 A. C.
Williston, N. Dak.
Treas.-Credit Mgr., Williston Grocery Co.

Jallings, Kenneth R.
'28 B. S. (Ch. E.)
Assistant Chemist, Maple Leaf Oil & Refining Co., Coutts, Alberta, Canada.

Jerabek, Henry S. '26 B. S. (Ch. E.)
1710 S. E. 5th, Minneapolis, Minn.
Inst. School of Mines, U. of M.

Jewett, Ernest E.
'25 B. S. (Ch. E.), '26 M. S. (Ch. E.)
4524 Mellwood Ave., Cincinnati, Ohio.
Chem., Laundry Research Dept., Proctor and Gamble, Ivorydale, Ohio.

Johnson, Donald Lee
'18 B. S. (Ch. E.), '19 Ch. E.
628 Tenth Ave. E., Duluth, Minnesota.
Technician, Water & Light Dept., Duluth, Minn.

Johnson, Einer
'11 B. S. (Ch.), '12 M. S. (Ch.)
901 Selby Ave., St. Paul.
Vice President and Chief Chemist, La Salle Products, Inc., 2220-22 Univ. Ave., St. Paul.

Johnson, Lester L.
'25 B. S. (Ch. E.), '27 M. S. (Ch. E.)
Chem. Eng., Roesseller-Hasslacher Chem. Co., Perth Amboy, N. J.

Johnson, Waldo C. '26 B. S. (Ch.)
3100 46th Ave. S., Minneapolis, Minn.
State Laboratories, Old Capitol Bldg., St. Paul.

Get every issue for 100% more Alumni News.

Johnston, Charles L.
'25 B. S. (Ch. E.)
Roessler-Hasslacher Chem. Co.
Perth Amboy, N. J.

Jones, Ernest Joseph
'20 B. S. (Ch. E.), '21 Ch. E.
4415 Fessenden St., N. W., Washington, D. C.
Fixed Nitrogen Bureau, Bureau of Standards, Washington, D. C.

Jordan, Wallace E. '26 B. S. (Ch. E.)
112 S. 59th Ave. W., Duluth, Minn.
Chemist, Western Paint & Varnish Co., Duluth, Minn.

Joselowitz, Goodwin, '18 B. S. (Ch.)
Glasgow, Montana.
State Grain Inspector, State of Montana Protein Lab., Glasgow, Montana.

Joyce, Floyd E.
'12 B. A., Iowa, '17 M. S. (Ch.)
378 Mt. Curve Boulevard, St. Paul.
Supt., Haskins Bros. & Co., St. Paul.

Juvrud, Ingvald Oliver '14 B. S. (Ch.)
2200 1st Ave., Great Falls, Mont.
Chief Chem., Royal Milling Co.
Great Falls, Mont.

Kameda, Tohru
'15 Tokio Tech. School, Japan, '26 M. S. (Ch.)
1321 6th St. S. E., Minneapolis.
Asst., School of Chem., U. of M.

Kampa, Edmund P. '23 B. S. (Ch.)
312 Seymour, Minneapolis, Minn.

Karatz, Lucian '12 B. S. (Ch.)
1122 Logan Ave. N., Minneapolis, Minn.
Chem., Intl. Sugar Feed Co.

Katz-Nelson, William
'13 B. S. (Ch. E.)
Consulting Chemist, Chicago.

Kennedy, William W. '07 B. S. (Ch.)
1831 Summit Ave., St. Paul, Minn.
W. W. Kennedy Co., 1398 Carroll Ave., St. Paul.

Kepner, Ben-Hur
'10 B. A., '11 M. S. (Ch.)
Maple Leaf Milling Co., Port Colburn, Ont., Canada.

Kern, Herbert A.
'13 B. S. (Ch. E.), '14 (Ch. E.)
Hinsdale, Illinois.
Pres., National Eliminate Corp.
6218 West 66th Place, Chicago.

Kessel, Herbert
'18 B. S. (Ch. E.), '19 (Ch. E.)
6637 Maryland Drive, Los Angeles.
Credit Mgr., B. H. Dyas Co., Los Angeles, Cal.

Kesselman, Leo '18 B. S. (Ch.)

Kester, Ernest B.
'22 B. A., '23 M. S. (Ch. E.)
1492 Marlboro, Wilkinsburgh, Pa.
U. S. Bureau of Mines, Exper. Sta., Pittsburgh, Pa.

*Keuffner, Otto Karl '09 B. S. (Ch.)

Kilburn, Elsie I. '24 B. A., '27 M. S.
1000 University Ave. S. E.
Instr. of Chem., Vassar College, Poughkeepsie, N. Y.

Knutson, Reuben W. '28 B. S. (Ch.)
Archer Daniels Midland Co., 29th Ave. S. E. and G. W. Tracks, Minneapolis, Minn.

Kobe, Kenneth A. '28 M. S. (Ch. E.)
711 Superior St. S. E., Minneapolis, Minn.
DuPont Fellow (Asst. in School of Chem. after June 15, 1930).

Koch, Arthur Louis
'19 B. S. Hamline, '21 M. S. (Ch.) '24 Ph. D.
Hercules Powder Co., Brunswick, Ga.

Kohlase, Arthur H.
'19 B. S. Hamline, '21 M. S. (Ch.) '24 Ph. D.
222 No. Lucerne Blvd., Los Angeles, Cal.

Kokatnur, Vaman R. '12 B. A. Bombay, '14 M. S. (Ch.), '16 PhD.
628 West 227th St., New York City.
Consult. Chem., 52 E. 41st St., New York City.

[K]page, Roy F. '20 B. S. (Ch.)
259 Park St., Fulton, N. Y.
Chief Chem., Peter Cailler Kohler Swiss Chocolate Co., Fulton, N. Y.

Kracek, Frank C.
'20 B. S. (Ch. E.), '24 Ph. D.
2951 Upton St., Washington, D. C.
Physical Chem. at the Geophysical Lab., Carnegie Institute, Washington, D. C.

Krantz, Rudolph W.
'24 B. S. (Ch. E.), '25 M. S.
2945 Dodier St., St. Louis, Mo.
Proctor & Gamble Co., St. Louis, Mo.

Kryger, Edward R. '21 B. S. (Ch.)
1748 St. Anthony Ave., St. Paul.
Chem., National Lead Battery Co.

Kuentzel, Ward Edward
'17 B. S. (Ch. E.)
6906 46th St., Chevy Chase, Md.
Bur. of Chem. & Soils, Dept. Agr.
Washington, D. C.

Kugler, Joseph H. '26 B. S. (Ch. E.)
1336 Van Buren St., St. Paul.
Minnesota Mining & Mfg. Co., Forest and Fauquire, St. Paul.

Kurtz, Kerwin K. '28 B. S. (Ch. E.)
Hercules Technical Club, Kenvil, N. J.

*Lando, Maximillian N.
'02 B. S. (Ch.)

Langseth, Axel O.
'22 B. S. (Ch. E.), '23 Ch. E.
298 W. 3rd St., Mansfield, Ohio.
Ohio Brass Co., Metallurgist, Mansfield, Ohio.

Lauer, Walter M. '13 B. A. Ursinus College, '24 Ph. D.
1907 Franklin Ave. S. E., Minneapolis, Minn.
Assistant Professor, School of Chem., U. of M., Minneapolis.

Languth, Karl H. '27 B. S. (Ch. E.)
Ohio Brass Co., Mansfield, Ohio.

Lavine, Irvin '24 B. S. (Ch. E.)
717 Chestnut St., Grand Forks, N. D.
Asst. Prof. of Chem. Eng., U. of N. D.

Leavenworth, Francis Maury
'11 B. S. (Ch.)
Box 274
McKean Co., Bradford, Pa.

Lee, Melville Richard
'21 B. S. (Ch. E.), '22 Ch. E.
4333 Armitage Ave., Chicago, Ill.
Consulting Engr., Gruen Mfg. Co., Chicago, Ill.

Leerskov, Gerhard Wilhelm
'21 B. S. (Ch. E.)
4404 Curve Ave., Minneapolis.

Levine, Arthur '16 B. A. Augustana College, '23 Ph. D.
603 Michigan Ave., Pullman, Wash.
Asst. Prof. of Chemistry, Washington State College, Pullman, Wash.

Lewenstein, Abraham
'26 B. S. (Ch. E.)
Y. M. C. A., Appleton, Wis.
Appleton Coated Paper Co.

Linton, James H. '97 Ch. E.
2422 5th Ave. W., Seattle, Wash.
Consulting and Analytical Chemist,
502 Lyon Bldg., Seattle, Wash.

Livermore, Harvey J. '22 B. S. (Ch. E.)
416 S. Warwick, St. Paul, Minn.

Longworth, Fred James '05 A. C.
c-o Tennessee Copper Co.
Copperhill, Tenn.

Lowe, John M. '08 B. S. (Ch.)
660 Drexel Bldg., Philadelphia, Pa.
Asst. Sec.-Treas., Bisbee Linseed Co.

Ludwig, Llewellyn G.
'24 B. S. (Ch.)
1801 Humboldt Ave. S., Minneapolis.
Gamble & Ludwig Paint Co., 901 Hennepin Ave., Minneapolis, Minn.

Luft, Hans Lawrence
'24 B. S. (Ch. E.), '24 M. S.
238 Belmont, St. Paul.

Luft, Oscar Wilhelm v. d.
'17 B. S. (Ch. E.)
18 Norwalk Ave., Buffalo, New York.
Technical Development Dept., Nat. Aniline and Chemical Company.

Luger, Karl E. '22 B. S. (Ch. E.)
4 30th St., Woodcliff-on-Hudson, N. J.
Salesman, Aluminum Company of America, 120 Broadway, New York City.

Lux, Albert R.
'26 B. S., '28 M. S. (Org. Ch.)
238 Midway Ave., St. Paul, Minn.
Asst. School of Chem., U. of M.

Lux, Lester L. '27 B. S. (Ch.)
283 Midway Ave., St. Paul, Acting chief chemist, Mines Exp. Station.

McBride, Russel S. '08 B. S. (Ch.)
Chevy Chase, Maryland.
Consulting Chem. Engineer, Colorado Bldg., Washington, D. C.

McConnell, John R.
'30 M. S. (Ch. E.)
77 Langford Pk. Pla., St. Paul, Minn.
DuPont Ammonia, Wilmington, Del. (July 1930.).

McKee, John B. '25 B. S. (Ch. E.)
Valentine Varnish Co.,
364 Manhattan Ave., Brooklyn, N. Y.

*McLeod, John Roderick
'12 B. S. (Ch.)

McMillen, Elliot L.
'23 B. S. (Ch. E.), '27 M. S. (Ch. E.)
756 Lafayette Ave., Palmerton, Pa.
Research Chem., New Jersey Zinc Co., Palmerton, Pa.

McMiller, Paul Raymond
'11 B. S. (Ch.)
715 7th St. S. E., Minneapolis.
Asst. Prof. of Soils, Agric. Exp. Station, University Farm, St. Paul.

Maehl, Kenneth A. '27 B. S. (Ch. E.)
139 Western Ave. S., St. Paul, Minn.
Tech. Asst., Mines Experiment Station, U. of M.

Manuel, Douglas R.
'22 B. S. (Ch. E.)
Spokane City Club, Spokane, Washington.
Chem., Curtin Howe Co., of New York, Spokane, Washington.

Manuel, Earle V. '07 B. S. (Ch.)
4259 Drexel Blvd., Chicago, Ill.

Markus, Benjamin '17 B. S. (Ch.)
426 Lincoln St., Hibbing, Minn.
Sec.-Treas., Purity Ice Co.

Marr, Horace Sinclair '17 B. S. (Ch.)
1639 Bunts Road, Lakewood, Cleveland, Ohio.
Research Lab., Nat. Carbon Co., 1259 West 73rd St., Cleveland, Ohio.

Marshall, Olive Wadleigh
'17 B. S. (Ch.)
4130 Nicollet Ave., Minneapolis.
Chem., Inyo Chem. Co., Cartago, Inyo Co., Calif.

Martin, Edmund W. H. '12 Ch. E.
7645 Sheridan Road, Chicago, Ill.
Mgr. Archer-Daniels-Midland Co.

Maslin, Marion Gordon
'13 B. S. (Ch.)
Canajoharie, New York.
Chief Chemist, Sierra Magnesite Co., Porterville, Calif.

Matthews, Glenn Earl
'20 B. S. (Ch.), '21 M. S. (Ch.)
31 Corona Road, Rochester, New York.
Photographic Research Chem., Eastman Kodak Co., and Technical Writer, Rochester, N. Y.

*May, Darwin R.
'14 B. S. (Ch. E.), '15 Ch. E.

Merrill, Grant S. '28 B. S. (Ch. E.)
1855 St. Clair St., St. Paul, Minn.
The Minn. Mining Co., St. Paul.

Merten, Howard Vincent
'14 B. S. (Ch.)
3816 Ivy St., Indiana Harbor, Ind.
Asst. Supt. of Blast Furnaces, Youngstown Sheet and Tube Company, Indiana Harbor, Ind.

Miller, Ralph Harrison
'13 B. S. (Ch.)
600 6th Ave. E., Mitchell, S. Dak.

Mitchell, Donald Francis
'20 B. S. (Ch. E.), '21 Ch. E.
Chemist, Mpls. General Electric Co..
2000 Grand Ave., Minneapolis, Minn.

Mitchell, Ralph Wallace
'12 B. S. (Ch.)
602 12th Ave., Menomonie, Wis.
Sec. & V. Pres., American Bakery Materials Co.
Menomonie, Wis.

Moe, Claude P. '20 B. S. (Ch.)
7411 4th Ave., Brooklyn, New York.
Cowles Detergent Co., New York City.

Moffat, Harold A. '27 B. S. (Ch. E.)
714 Marshall St., Milwaukee, Wis.
Chem. Engineer for Milwaukee Coke & Gas Co.

Morey, George W. '09 B. S. (Ch. E.)
425 Raymond Street, Chevy Chase, Md.
Phys. Chem., Geophysical Labs., Wash., D. C.

Morin, Wm. Truesdell
'22 B. S. (Ch. E.), '23 Ch. E.
1912 Vista Street, Hollywood, Calif.
Vice-Pres., Pacific Abrasive Supply Co., 1037 S. Los Angeles St., Los Angeles, Calif.

Morken, Carl H. '22 B. S. (Ch. E.)
348 W. 5th St., Mansfield, Ohio.
Metallurgist, The Ohio Brass Co., Mansfield, Ohio.

Morris, Vlon H. '22 B. S. (Ch. E.), Purdue, '24 M. S. Purdue, '26 PhD (Physical Ch.)
866 Hawkins Ave., Akron, Ohio.
Research Chem., Firestone Tire & Rubber Co., Akron, Ohio.

Morrow, Leon Walker '16 B. S. (Ch.)
7 Naples Rd., Salem, Mass.
Asst. Prod. Mgr., Nat'l Leather Co., Boston, Mass.

Morse, Guilford A.
'15 B. S. (Ch. E.), '15 Ch. E.
Empire Bldg., Boise, Idaho. Lumberman.

Morse, Minerva
'15 B. A., '20 M. S. (Ch.), '25 Ph. D.
3244 Clinton Ave., Minneapolis.
Asst. Prof. of Ch., Smith College, Northampton, Mass.

Murray, Robert '26 B. S. (Ch. E.)
811 No. Kenwood, Austin, Minn.
Chief Chemist, Hormel & Co., Austin, Minn

Neilson, Chris '18 B. S. (Ch. E.)
1029 S. Front St., Mankato, Minn.
Treas., Neil Neilson, Inc., Mankato, Minn.

Nelson, Ernest W.
'20 B. A., '24 M. S. (Ch. E.)
308 E. Broadway, Ponca City, Oklahoma.
Chem. Refinery Research., Continental Oil Co.
Ponca City, Oklahoma.

Nelson, Harry G. '18 B. S. (Ch.)
5428 Clinton Ave., Minneapolis.
Chemist, City Health Dept.

Nelson, William K. '13 B. S. (Ch. E.)
6906 Chappel Ave., Chicago, Ill.
Chief Chem. & Research Eng., Universal Gypsum & Lime Corp., 111 W. Washington, Chicago, Illinois.

Nesse, Charles O. '12 B. S. (Ch.)

Newman, Allen T. '12 B. S. Nebraska, '16 M. S. (Ch.)
958 Washington, Denver, Colo.
Dean of Col. of Dent., U. of Denver.
Denver, Colorado.

Nicholson, Harry G.
'21 B. S. (Ch. E.), '21 Ch. E.
1617 University Ave. S. E., Minneapolis.
Sales and Promotion, American Tar Prod. Co., Minneapolis, Minn.

Nietz, Adolph
'13 B. A., '15 M. S. (Ch.)
55 Harding Road. Research Chemist, Eastman Kodak Co., Rochester, New York.

Nye, Lillian L.
'09 B. A., '10 M. A. (Ch.)
1357 Como Ave. W., St. Paul.
Pediatrician, Lowry Bldg., St. Paul.

Nygard, Edwin Marcus
'21 B. S. (Ch.)
3037 Fifth Ave. S., Minneapolis, Minn.
Grad. Student in Chem., Harvard Univ.

O'Connell, Thomas Charles
'13 B. S. (Ch.)
615 Walnut Street, Donora, Pa.
Chem., American Steel & Wire Co.

Ohlweiler, Wm. '27 B. S. (Ch. E.)
Universal Oil Products Co.,
Riverside, Ill.

Olsen, Leslie Raymond
'15 B. S. (Ch.)
50 Luverne Ave., Minneapolis, Minn.
Director of Products Control,
International Milling Co., Flour Exch. Bldg.

OLSON, ARTHUR O. '11 B. S. (CH.)
3431 Tyler St. N. E., Minneapolis.
Analyst, State Dairy and Food Commission, St. Paul.

OTIS, LAWRENCE B.
113 E. Hines St., Midland, Mich.
Chem. Engr., Dow Chemical Co., Midland, Mich.

OTTERSTEIN, EARL FRANK '13 B. S. (CH.)
2110 West 49th Street, Minneapolis.
Mgr., Ohio Chemical & Mfg. Co.

OWENS, JAY CLYDE '17 B. S. (CH.)
1221 Howard Ave., Chicago.
Chief Chem., Sherwin-Williams Co.

PAGEL, H. ARMIN '22 B. A., '23 M. S. (CH.)
620 N. 14th St., Lincoln, Neb.
Inst. in Chem., U. of Nebr., Lincoln, Nebr.

PAGNUCCO, JOHN W. '23 B. A., '26 M. S. (CH. E.)

PAN, WEN PING '18 B. S. (CH.)
Hibbing, Minn.
Mining Engineer, Oliver Iron Mining Co.

PARKIN, GUY GEORGE '12 B. S. (CH.), '13 M. S. (CH.)
2162 Stratford Ave., St. Paul.
Sec. Mgr. Lincham Phonograph Co., Inc.

PARRETT, ARTHUR N. '20 B. S. (CH. E.), '21 CH. E.
Wilmington, Delaware.
Chemist, E. I. Dupont De Nemours Co., Wilmington, Delaware.

PAUL, KARL F. '24 B. S. (CH. E.)
Kenvil, New Jersey. Hercules Powder Co.

PAULSON, PAUL M. '23 B. S. (CH. E.), '24 M. S. (CH. E.)
27 Pierpont St., Rayway, N. J.
Roessler and Hasslacher Chemical Co., Patent Department, Perth Amboy, New Jersey.

PEARSON, ELMER A. '20 B. S. (CH. E.), '21 CH. E.
Graduate Student, School of Chem., U. of Minn.

PENNOCK, EDWARD MCMASTER '05 A. C.
2206 Doswell Ave., St. Paul
Vice-Pres., G. H. Tennant Co., Minneapolis.

*PETERSON, ANDREW PETER '10 B. S. (CH.), '11 M. S. (CH.)

PETERSON, CLIFFORD E. '23 B. S. (CH.)
Asheville, N. C.
Champion Fibre Co., Canton, N. C.

PETERSON, HENRY '13 B. S. (CH. E.), '14 CH. E.
3112 Hiawatha Ave., Minneapolis.

PETERSON, MARSHALL A. '21 B. S. (CH. E.), '22 CH. E.
554 Holly St., St. Paul, Minn.
Chief Chem., Minnesota Highway Department.

PETTIJOHN, EARL '11 B. S. (CH.), '12 M. S. (CH.), '19 PH. D.
Prof. Chem. & Physics, Missouri Valley College, Marshall, Mo.

PIPPEL, HERBERT AUGUST '20 B. S. (CH.)
1803 Ridge Ave., New Kensington, Pa.
Research Chem., Aluminum Co. of America, New Kensington, Pa.

PICHFORD, G. LEONARD '07 B. S. NEB., '10 M. S.

PLUMER, CLAYTON E. '14 B. C. E. MICH., '20 M. S. (CH.)
Union Carbide & Carbon Research Lab., Long Island Research Co., Long Island, N. Y.

POORE, CHARLES DELOS '05 A. C.
1342 Graynolds Ave., Glendale, Calif.
Teacher of Physics, Whittier Union H. S.

POPPE, FREDERICK W. '10 B. A. LAWRENCE, '11 M. S. (CH.)
Appleton, Wis.

PORTER, ALLEN HAROLD '08 B. S. (CH.)
1115 W. Church St., Champaign, Ill.
Porter Baking Co., 118 S. Neil St., Champaign, Ill.

PORTER, RALPH ELMER '13 B. S. (CH. E.), '14 CH. E.
234 Hampton St., Ashland, Ken.
Chemist, Ashland Leather Co., Ashland, Ky.

RADEMACHER, RICHARD L. '23 B. S. (CH. E.), '24 M. S. (CH. E.)
3844 22½ Ave. S., Minneapolis, Minn. (res.)
Republic Creosoting Co., St. Louis Park, Minn.

RAMSEY, SELMER '21 B. S. (CH. E.)
Sauk Rapids, Minn.
Rep. Diamond Motor Parts Co. of St. Cloud.

RAMSDEN, ALLYN M. '29 B. S. (CHEM.)
Homer, Minnesota.

RASK, OLAF S. '17 B. S. (CH.)
Associate in Bio. Chem. Johns Hopkins Univ., Baltimore, Md.

RATHMAN, FRANZ '24 B. A., '27 M. S. (CH.)
Asst. in Chem., U. of Ill.

RAUEN, THEODORE '26 B. S. (CH. E.)
2124 Como Ave., St. Paul.
Chem. Eng., Minnesota By-Products Coke Co., St. Paul, Minn.

RECK, ROBERT CARLYLE '21 B. S. (CH. E.), '21 CH. E.
711 8th Ave., La Grange, Ill.
Western Elec. Co., 48th and 22nd St., Chicago, Ill.

REHFELD, HAROLD
Rush City, Minnesota.
B. F. Goodrich Co., Akron, Ohio.

REITER, ALFRED A. '25 B. S. (CH. E.)
Inst. in Chem. Eng., U. of Wis., Madison.

REU, ALBRECHT H. '19 B. S. (CH. E.), '20 CH. E.
Brunswick, Georgia, Box 41.
Asst. Supt., Hercules Power Co.

RICE, EDGAR WHITMAN '02 B. S. (CH.)
117 Radford St., Yonkers, New York.
Chief Chemist, National Sugar Refining Co., Yonkers, New York.

RIDDINGTON, FREDERICK W. '21 B. S. (CH. E.), '22 CH. E.
1522 Highland Ave., Detroit, Mich.
Asst. Foreman in Plating Dept., Ainsworth Mfg. Co.

RILEY, PHILIP J. '21 B. S. (CH.)
613 Oak Street S. E., Minneapolis.
Curator, School of Chemistry, Univ. of Minn.

RINGSTROM, HUGO '15 B. S. (CH.), '17 M. S. (CH.)
517 Thompson Bldg., Seattle, Wash.

ROBERTS, WESLEY J. '21 B. S. (CH. E.), '22 CH. E.
5024 Walnut St., Philadelphia, Pa.

ROBINSON, H. MARJORIE '28 B. S. (CHEM.)
2635 Aldrich Ave. S., Minneapolis, Minn.
Analyst, Div. of Soils, College of Agri., U. of Minn.

ROBINSON, RHEA BENEDICT '12 B. S. (CH.)
4237 Washburn Ave. S., Minneapolis.

ROCKWOOD, RALPH H. '12 B. S. (CH.)
2129 Standford Ave., St. Paul.
Chief Chemist, City of St. Paul.

ROE, CHARLES P. '29 B. S. (CHEM.)
2219 Como Ave. W., St. Paul, Minn.
Assistant, School of Chem., U. of Minn.

ROEHRICH, VICTOR '09 B. S. (CH. E.), '10 M. S. (CH. E.)
327 S. Cleveland Ave., St. Paul.
Director of Bureau of Municipal Testing Lab.

ROGERS, MARVIN '26 B. S. (CH. E.) '27 M. S. (CH. E.)
1506 Packard St., Ann Arbor, Mich.
Ch. E., Whiting-Swenson Corp.
303 S. State St., Ann Arbor, Mich.

ROQUE, FELICIANO T. '24 B. S. (CH. E.)
224 W. 59th St., Chicago, Ill.
Chemist, Swift & Co.

ROSE, ANTON RICHARD '04 B. S. (CH.)
P. O. Box 376, Edgewater, N. J.
Chemist, Prudential Ins. Co., Newark, N. J.

RUCHHOLT, CLARENCE '21 B. S. (CH. E.)
6843 Dorchester Ave., Chicago, Ill.
Chem. Eng., Sanitary Dist. of Chicago.

SANDELL, ERNEST B. '28 B. S. (CH.)
2738 Johnson Street N. E., Minneapolis, Minn.
Assistant, School of Chem., U. of Minn.

SARVER, LANDON A. '15 B. A. (RANDOLPH MACON), '19 M. A. (LAFAYETTE), '24 PH. D.
119 Union St. S. E., Minneapolis.
Assistant Professor of Chem., U. of M.

SCANDLING, JOSEPH E. '25 B. S. (CH. E.)
2706 E. M'haha Pkwy., Minneapolis, Minn.
Northwestern Steel & Iron Co.

SCHERMER, OSCAR C. '21 B. S. (CH. ENG.), CH. E. '22
4209 10th Ave. S., Minneapolis.
Chief Chemist, Tri State Lab., 401 4th St. S.

SCHLAFGE, WILLIAM H. '26 B. S. (CH. E.), '27 M. S. (CH. E.)
2926 Tyler St. N. E., Minneapolis, Minn.
Research Chem., Insulite Lab.
1100 Builders' Exch., Minneapolis, Minn.

SCHMIDT, GEORGE HERMAN '12 B. S. (CH.)
Supt. of Mfg., City Baking Co.
Carey and Lawrence Sts., Baltimore, Md.

SCHULTZ, PETER D. '14 B. A. BETHEL COLL., '18 M. S. (CH.)
Professor.
Friends University, Wichita, Kansas.
Leave of absence 1930-1931.

SCHWARTZ, MARCEL '22 B. S. (CH. E.)
5901 Prairie Ave., Chicago, Ill.
Chem., Commercial Testing and Engr. Co.

SEESTROM, HJALMER ERNEST '28 CH. E.
4451 Mellwood Ave., Cincinnati, Ohio.
Proctor & Gamble, Ivorydale.

SELVIG, WALTER A. '09 B. S. (CH.)
814 Gearing Ave., Pittsburgh, Pa.
Dept. of Commerce, 4800 Forbes Street, Pittsburgh, Pa.

SEYFRIED, LILLIAN M. (MRS. W. H. HUNTER) '15 B. A., '17 M. S. (CH.)
100 Seymour Ave. S. E., Minneapolis, Minn.

SEYMOUR, MERRILL WILMER '21 B. S. (CH.)
24 Prince George St., Annapolis, Md.
Instructor, Chem., St. Johns College, Annapolis, Md.

SHABAKER, H. ARTHUR '29 B. OF CH. E.
Newport, Minn.
Du Pont Ammonia Corp., Wilmington, Del.

SHIELDS, CHARLES D. '29 B. OF CH.
465 S. Warwick St., St. Paul, Minn.
Fellow in Chem., Colo. Sch. of Mines, Golden, Colo.

SHIRK, LOREN H. '26 B. S. (CH. E.), '26 M. S. (CH. E.)
3344 Elland Ave., Cincinnati, Ohio.
Plant Chem. Eng., Proctor & Gamble, St. Bernard, Ohio.

SILVERMAN, REUBEN R. '28 B. S. (CH.)
Minneapolis Fish Co., 804-806 6th Ave. N., Minneapolis, Minn.

SKARTVEDT, PETER M. '06 B. A. ST. OLAF, '13 M. A. (CH.)
Prof. of Chem.
Gustavus Adolphus College, St. Peter, Minn.

SLY, CARYL '23 B. S., '24 M. S., '27 PHD.
Research Ch., E. I. duPont de Nemours, Wilmington, Del.

SMITH, ALLEN S. '26 B. S. (CH. E.)
109 N. 14th Ave., Hopewell, Va.
Supervisor of Test & Insp. Div.
Atmospheric Nitrogen Corp., Hopewell, Va.

*SMITH, CAROLYN HARRIET '10 B. S. (CH.)

SMITH, SHELDON HALLOWAY '10 B. S. (CH. E.)
1025 Linwood Place, St. Paul, Minn.
Adv. Mgr., Nicols, Dean & Gregg.
St. Paul, Minn.

SORENSON, BEN EDMUND '23 B. S. (CH. E.), '24 M. S. (CH. E.), '27 (PHD.)
E. I. duPont deNemours Co., Wilmington, Del.

SOUTHER, BENJAMIN L. '16 B. S. (CH.)
235 Darragh St., Pittsburgh, Pa.
Research Chemist, Mellon Institute of Industrial Research, Pittsburgh, Pa.

SPERRY, WILBUR A. '29 B. OF CH.
818 Washington St., Wilmington, Del.
Standardization Chem., Jackson Lab., E. I. Du Pont de Nemours & Co.
Carney's Pt., New Jersey.

*SPRIESTERSBACH, DAVID OSCAR '12 B. S. (CH.), '15 M. S. (CH.)

SPRUNG, MURRAY M. '25 B. S. (CH. E.), '28 PH. D.
91 Trowbridge St., Cambridge, Mass.
Nat. Research Fellow, Harvard Univ.

STENGER, LAWRENCE A. '06 E. E., '16 M. S. (CH.)
Great Sugar Co., 616 Sugar bldg., Denver, Colo. Statistical Dept.

STERNBERG, HEIME A. '20 B. S. (CH. ENG.), '21 CH. E.
Ill. Steel Co., So., Chicago, Ill.

STERNBERG, WOLDEMAR M. '08 B. S. (PETROGRAD, RUSSIA), '18 PH. D.
Utica, N. Y.

STIER, RUTH I. (MRS. CECIL MAYO) '25 B. S. (CH. E.)
San Diego, Cal.

STODOLA, FRANK HAROLD '28 B. S. (CH. E.)
9th Ave. N., Hopkins, Minn.
Asst. in Chem., U. of Minn.

*STONE, GEORGE H. '10 B. S. (CH.)

STONE, LESLIE F. '22 B. S. (CH. E.), '23 CH. E., '27 PH. D.
E. I. duPont de Nemours, Wilmington, Del.

STOPPEL, ARTHUR E. '20 B. S. (CH. E.)
129 Melbourne Ave. S. E., Minneapolis, Minn.
Asst. Prof. Chemistry, U. of M.

STOPPEL, ERNEST ALBERT '11 B. S. (CH.)
769 St. Marks Ave., Brooklyn, N. Y.
Tech. Dir., Valentine & Co., 364 Manhattan Ave.

STRONG, FRANK DUFRESNE '17 B. S. (CH. E.)
1935 Summit Ave., St. Paul.
Capt., U. S. Marines, Marine Barracks, Quantico, W. Va.

SULLIVAN, BETTY '22 B. S. (CH.)
43 Dell Place, Minneapolis.
Chem., Russel Miller Milling Co.

SUNDE, CONRAD J. '22 B. S. NORTH. NORMAL AND IND. SCHOOL, '26; M. S. (CH.)
Inst. Chem., N. D. Agri. College, Fargo, N. D.

SUTTER, HEDWIG MELANIE '13 B. S. (CH.) (MRS. ROGER WILSON)
144 Serrano Ave., Los Angeles, Cal.

SVERDRUP, EDWARD F. '26 B. S. (CH. E.) '27 M. S. (CH. E.)
208 Northland Ave., Buffalo, N. Y.
Ch. E., U. S. Rubber Reclaiming Co., Babcock, Hannah & William Sts., Buffalo, N. Y.

SWART, RICHARD HOUGHTON '21 B. S. (CH. E.)
1659 Webb, Detroit, Mich.
Eng., Kelvinator Div. of Electric Refrigeration Corp., Detroit, Mich.

SWEARINGEN, LLOYD E. '20 B. S. OKLAHOMA, '21 M. S. OKLAHOMA, '26 PH. D. (PHYSICAL CHEM.)
Faculty Exchange, U. of Okla., Norman, Okla.

SWENSON, GEORGE W. S. '28 B. S. (CH. ENG.)
937 Fremont St., St. Paul, Minn.
Minn. Mining & Manufacturing Co., St. Paul.

TAPPAN, RUTH W. (MRS. JOSEPH DOWLING) '22 B. S. (CH.)
102 Clarenden Ave., Providence, Rhode Island.

TAYLOR, CARL A. '10 B. S. (CH.)
238 Meyer Ave., New Castle, Pa.
Research Chem., Grasselli Powder Co., New Castle, Pa.

TAYLOR, CYRIL STEAD '13 B. S. (CH.)
Aluminum Club, New Kensington, Pa.
Physical Chemist, Research Bureau, Aluminum Co. of America.

TEMPLE, STERLING N. '05 PHB, '06 M. A. (HAMLINE), '15 PHD
129 Johnson Ave., Tottenville, S. I., New York.
Roessler Hasslacher Chemical Co., Perth Amboy, N. J., Head of Patent Department.

THOMPSON, WARREN L. '26 B. S. (CH.)
2630 E. 10th Street, Tulsa, Okla.
Mid-Continent Petroleum Corp., Tulsa, Okla.

THORDARSON, WILLIAM '23 B. S. (CH. E.), '24 M. S. (CH. E.)
3224 Grand Concourse, New York City, N. Y.
Western Union Telegraph Co., New York, N. Y.

THORSON, STUART JOHN '19 B. S. (CH.) '28 M. S. (CH. E.)
Glenwood, Minn.
Physician and Surgeon.

TIBBLING, ERNEST F. '14 B. S. (CH.)
3919 Sunrise Drive, Kansas City, Mo.
Chemist, Washburn Crosby Co., 3100 Guinotte Street, Kansas City, Mo.

TINDALL, JESSE E. '19 B. A. DENVER, '23 M. S. (CH. E.)
Minn. Linseed Oil Paint Co., 1101 S. 3rd St., Minneapolis.

TINKHAM, WILLIS M. '14 B. S. (CH. E.)
3641 Colfax Ave. S., Minneapolis.
Mill Chemist, Washburn Crosby Co.

TONCHEFF, STANIL T. '15 B. S. (CH.)
Hampton and Charles St., St. Paul.
Chem., N. W. Blau Gas Co., St. Paul.

TRONSON, CARL A. '10 B. S. (CH.)
Works Mgr., Anglo-Scottish Sugar Corp., Ltd. Felstead, Essex, England.

TRONSON, JOHN L. '26 B. S. (CH. E.)
453 Crestwood Ave., Akron, Ohio.
B. F. Goodrich Rubber Co., Akron, Ohio.

UNDERHILL, EDITHA '16 B. A. VASSAR, '23 M. S. (CH.)
417 11th Ave. S., Minneapolis, Minn.
Asst. in School of Chem., U. of Minn.

VAN DUZEE, EDWARD M. '28 B. S. (CH. E.)
1726 Grand Ave., St. Paul.
Assistant, School of Chem., U. of Minn.

VIEVERING, WM. A. '25 B. S. (CH.)
960 Bayless Ave., St. Paul.
Chemist, Minnesota Mining and Mfg. Co., St. Paul.

VON KUSTER, EDITH I. (MRS. W. JOHNSON KENYON) '07 B. S. (CH.)
44 Adelaide Ave., New Brunswick, N. J.

WALKER, GEORGE WARREN '09 B. S. (CH.)
9601 American Ave., Detroit, Mich.
Metallurgist, Chevrolet Motor Co.

WALLFRED, CARL LUTHER '20 B. S. (CH. E.), '21 CH. E.
4554 Wentworth Ave. S., Minneapolis.
Chem. Engr., Mines Exp. Sta., U. of M.

WANLESS, LYNN ALLISON '12 B. S. (CH.)
420 Walnut St., Minneapolis, Minn.

WASHBURN, FREDRICK M. '17 B. S. (CH. E.)
Chief Chem., Coke Plant, Wis. Steel Co., Chicago, Ill.

WEBBER, FREDRICK WALTER '97 CH. E.
3730 Dupont Ave. S., Minneapolis.
Deputy Collector, U. S. Customs, Minneapolis.

WEBER, LUDWIG J. '20 B. S. (CH. E.), '21 CH. E., '24 PH.D.
661 Ridge St., New Kensington, Pa.
Research Metallurgist, Aluminum Co. of America, New Kensington, Pa.

WEBSTER, CORA HELEN '23 B. S. (CH.)
Apt. C-3, 4417 Second Blvd., Detroit, Mich.
Chief Chem., Allied Prod. Co., Detroit, Mich.

WEITMAN, BRUCE '26 B. S. (CH.)
Texaco Co., Port Arthur, Texas.

WELLS, PERCY A. '28 B. S. (CHEM.)
Northport, Washington.
Research Chemist, U. S. Government, Northport.

WERNLUND, CHRIS B. A. (HAMLINE), M. S. (N. W.) '27 PHD.
Roessler and Hasslacher Chem. Co., Perth Amboy, N. J.

WESTERBERG, CARL GEORGE '21 B. S. (CH.)
3948 Ewing Ave. S., Minneapolis.
Mgr. LaVonne Prod. Co., 317 Plymouth Ave. N., Minneapolis.

WHEELER, ROGER B. '27 B. S. (CH. E.)
4414½ N. Keystone Ave., Chicago, Ill.
Asst. Varnish Supvr., E. I. Du Pont de Nemours & Co., 2100 Elston Ave., Chicago.

WHITE, ROBERT H. '23 B. S. (CH. E.), '24 M. S.
5116 Sheridan Ave. S., Minneapolis.
Sec. and Treas. of H. W. White Inv. Co., Minneapolis.

WHITED, ORIC OGILVIE '08 B. S. (CH.)
4432 Dupont Ave. S., Minneapolis.
Realtor, 728 Security Bldg., Minneapolis.

WHITNEY, R. B. '24 B. A., '27 PHD.
Inst. in Ch., Harvard Univ.

WIDELL, E. GIDEON '17 B. S. (CH. E.)
967 Burr St., St. Paul.
Research Chemist, Westinghouse Lamp Co., Bloomfield, N. J.

WILHOIT, ALBERT D. '05 B. A. MACALESTER, '06 M. A.
Wilhoit Chemical Lab., 619 Flour Exchange, Minneapolis.

WINSLOW, RAYMOND MARTIN '19 B. S. (CH. E.), '20 CH. E.
1545 Ashland Ave., St. Paul, Minn.
Vice Pres. and Gen. Mgr., A. M. Ramer Co., Grove and Olive Streets, St. Paul.

WOOLETT, GUY HAINES '10 B. S. (CH.), '16 M. S. (CH.), '18 PHD
University P. O., Mississippi.
Prof. of Chem., U. of Mississippi.

WYMAN, LEROY LINWOOD '22 B. S. (CH. E.), '23 CH. E.
271 Parker St., Newark, N. J.
Metallographist, Research Lab., G. E. Co.

YNGVE, VICTOR '13 B. S. (CH.), '14 M. S.
3061 Dorchester Rd., Niagara Falls, N. Y.
Read Process Eng., Lab., Natl. Carbon Co., Niagara Falls, N. Y.

ZEIDLIK, WM. J. '25 B. S. (CH. E.) '25 M. S. (CH. E.)
Jamestown, N. D., C/o Gladstone Hotel.
Service Engr., Western Elec. Sound System, Elec. Research Prod., Inc., 328 Plymouth Bldg., Mpls.

ZIEGLER, MILDRED R. '14 B. A., '15 M. S. (CH.)
610 13th Ave. S. E., Minneapolis, Minn.
Instr. of Pediatrics, U. of M.

ZIMA, ALBERT G. '24 B. S. (CH. E.)
2508 W. 21st St., Minneapolis, Minn.
Western Crucible Steel Casting Co., 2833 Grand Ave. S.

GEOGRAPHICAL DIRECTORY

College of Engineering and Architecture and the School of Chemistry

ALABAMA

Anniston
Jesperson, Clarence M. '10 E

Birmingham
Grachau, Earl H. '21 C
Talbot, Thomas F. '18 E

Mobile
Batson, Charles D. '07 C

Tuscaloosa
Prior, Chas. '28 C

ARIZONA

Bisbee
Rosok, Ingwald '03 E

Globe
Kerns, Ralph W. '07 E

Hayden
Johnson, Nels '05 C

Jerome
Kruse, Helmer V. '13 C, '14 CE

Phoenix
Ekman, Harold '28 A
Strand, W. R. Ex '31

Tucson
Enke, Fred A. '21 C

ARKANSAS

Hazen
Anderson, Elwood C. '28 E

CALIFORNIA

Alhambra
Cram, Clyde M. '07 C

Associated
Fawcett, Robert '28 ChE

Auberry
Thompson, Jesse L. '16 E, '17 EE

Berkeley
Bostwick, Ross D. '23 Ch
Carlson, Anders J. '16 C, '17 CE
Ramstad, Edward C. '02 M

Big Creek
Barber, Harold A. '21 C

Cantago
Marshall, Olive W. '17 Ch

Claremont
Taylor, Edward W. '98 C

Compton
Carpenter, Hugh W. '21 C

Covina
Douglass, Fred L. '91 C, '99 CE

Fresno
Councilman, Halstad P. '08 M, '09 ME

Glendale
Everington, James W. '01 C
Poore, Chas. D. '05 AC

Hollywood
Howard, Monroe S. '93 E
Loye, Donald P. '16 E, 17EE

Imperial
Rothi, Paul '04 C

Independence
Vita, Theodore '09 E

Long Beach
Cameron, Harry D. '25 E
Gilbert, Roy '20 C
Nelson, Glenn '23 C

Los Angeles
Anderson, Milton L. '21 A
Bachrach, Alfred '08 E
Bean, William L. '02 M
Bushnell, Elbert E. '85 M
Cooper, Jack '28 E
Donnelly, William H. '25 M
Dorr, William R. '14 M
Dunn, Andrew P. '06 E
Durham, S. W. '17 Ch
Edwards, Richard G. '25 E
Felton, Ralph '02 M
Gibbs, Clayton T. '18 E
Gillman, Hyam '25 Ch
Hanauer, Monroe '06 C
Hansen, Edwin L. '21 C
Hartman, Walter K. '19 E
Hawley, Harry G. '07 C
Hendrickson, Arnold B. '22 E
Jevne, George W. '10 C
Johnson, Ellsworth '22 C
Kauffman, Roy '08 E
Kessel, Herbert '18 ChE
King, F. V. '12 C, '13 CE
Kreinkamp, Herbert A. '22 A
Kreinkamp, Linton H. '17 A
Kumm, Arthur W. '22 M
Larson, Glen M. '23 M
Ludlum, Robert '25 E
Lyford, Dartt H. '11 E
McKibben, Lloyd S. '21 E
Mathes, Richard E. '24 E
Moody, C. S. '16 M, '17 ME
Morin, Wm. T. '22 ChE
Murrish, Frederic E. '09 E
Nelson, Otis S. '17 M
O'Donnell, Lawrence '25 M
Palmer, Roy A. '21 E
Parkin, Orrin '23 M
Roston, Rees '28 AE
Sauer, Arthur A. '23 C
Schmid, Robert J. '08 C
Spencer, Raymond D. '23 C
Stone, Harris G. '06 E
Sweet, Ray R. '21 E
Sweningsen, Oliver '08 E
Tannehill, Louis W. '16 A
Udell, Carl D. '09 M
Von Schlegell, Frederick '95 E
White, Arden D. '22 C
White, Charles W. '13 E

More Island
Page, Mark L. '03 E

Mountain View
Wilson, Glenn W. '11 E

Oakland
Burrows, Robert P. '11 E
Duncan, George R. '19 EE
Elfstrum, Axel E. '11 C
Lyberg, Verly C. '26 E
Miller, Hollis D. '13 E

Oleum
Boxell, Morris L. '21 ChE

Palm Grove
Greenberg, Jack '22 C

Palo Alto
Rask, Olaf S. '17 Ch
Smit, Catherine '22 A

Porterville
Smith, Paul S. '01, '03 CE

Redlands
Dibble, Barry '03 E

Redwood City
MacKusick, Elwood M. '99 E

Sacramento
Marcroft, J. C. '27 C

San Bernardino
Barnes, Dean M. '21 E

San Diego
Blossom, Geo. F. '11 E
Clousing, Lawrence '28 E
Dann, Wilbur W. '90 C
Hoffman, Richard H. '22 M
Nickey, Wm. E. '29 M
Frodden, Geo. H. '17 A
Thompson, Roy E. '00 E

San Francisco
Anderson, Arthur R. '13 E
Becker, Ward E. '17 E
Benham, Claude F. '12 E, '13 EE
Bjonerud, Earl S. '22 E
Brown, William P. '12 M
Chowen, Walter A. '91 C
Dresser, Eva L. (Alves) '09 Ch
Gerry, Martin H. '90 M, '91 E
Godwin, Kenneth A. '21 CE
Green, Fred H. '07 C
Hoyt, Hiram P. '93 C
Jones, Raymond L. '05 E
Ringstrom, Hugo '15 Ch, '17 MS
Simmon, Karl A., Jr. '05 E
Torgerson, I. E. '12 C, '13 CE
Tubby, Oliver '07 M
Tuck, George A. '05 M

San Pedro
Taylor, Duane L. '17 M

South Gate
Brenchley, Walter C. '14 C, '15 CE

South Pasadena
Pengilly, Joseph H. '11 E

Vallejo
Bicknell, Henry R. '10 Ch

Van Nuys
Oustad, Carl B. '29 C
Oustad, Olaf L. '15 C

Visalia
Gadsby, Lester H. '09 E

Watsonville
Higgins, John T. '90 C, '94 MD

COLORADO

Boulder
Fulmer, Jervis M. '20 BS, '22 MS
Hartkemeier, Leonard '24 ChE
Rauk, Samuel A. '25 C

Denver
Anderson, Martin E. '01 E
Dahlberg, Arnold V. '05 AC
Dahlberg, Henry W. '10 ChE
Lee, Engbret A. '97 C
Newman, Allen T. '16 Ch
Stenger, Laurence A. '06 EE, '16 Ch
Wenrich, James R. '26 E
Wurzbach, Henry A. '25 E

Golden
Hartkemeier, L. W. '24 Ch E
Shields, C. D. '29 C

Fowler
Knowlton, Herbert H. '08 C

Pueblo
Dallimore, Arthur '98 C

CONNECTICUT

Bridgewood
Bacon, Charles B. '09 Ch

New Haven
Cornell, Geo. M. '25 C
King, Alfred B. '08 E
McKeehan, Louis W. '08 G, '09 MS, '11 PhD
Teske, Frederick C. '27C

DELAWARE

Newark
Munger, Maurice '27 M

Wilmington
Dahlen, Miles '24 ChE
Japs, Wilbur '28 M
Parrett, Arthur N. '20 ChE
Shabaker, H. A. '29 ChE
Sperry, Wilbur A. '29 Ch

DISTRICT OF COLUMBIA

Washington
Albrecht, Karl J. '25 EE
Anderson, Emil G. '24 E
Anway, Fred L. '29 AE
Bekkedahl, Norman P. '25 ChE
Berkner, Lloyd V. '27 E
Bolstad, Roswell C. '26 C
Chaney, Albert L. '25 Ch
Cohen, Nathan '06 E
Darmody, William J. '24 M
Doran, James M. '07 Ch
Earl, Donald E. '24 M
Engstrom, Leslie G. '19 Ch
Erickson, David W. '29 C
Eyberg, C. J. '29 C
Graf, Alois W. '26 E
Hafstad, Lawrence R. '26 E
Hamm, Homer A. '25 Ch
Hanrahan, Edmond C. '20 G
Ingberg, Simon '09 C
Jacobi, Alfred J. '25 M
Jones, Lewis A. '07 C
Jones, Ernest J. '20 ChE
Kracek, Frank C. '20 ChE
Kuentzel, Ward E. '17 ChE
Little, LeRoy C. '24 E
McBride, Russel S. '08 Ch
McQuillan, Raymond '11 E
Morey, Geo. W. '09 ChE
Morris, Geo. E., Jr. '27 C
O'Brien, John E. '97 M
O'Hanrahan, Edmond C. '20 G
Peterson, Barney J. '12 G, '13 CE
Peterson, Clarence A. '08 E
Post, Edward '29 C
Robbins, Orison '03 C
Rydeen, James '28 C
Rykken, Nordahl T. '29 C
Saxhaug, Ehrling B. '29 E
Smilow, Leo '29 M
Stevens, Don T. '28 E
Trexler, Richard '27 M
Tuve, Merle A. '22 E

FLORIDA

Fort Myers
Lushene, Joseph '25 C

Jacksonville
Long, Fred W. '96 C, '98 CE
Mattison, Geo. C. '11 C

Lakeland
Dindorf, Edward C. '23 C
Purdy, Irving '20 C

Lake Wales
Morse, George A. '13 C, '14 CE

Lakeworth
Hoag, William R. '84 C, '88 CE

Miami
Rader, Clarence M. '17 C, '17 CE
Woehler, William L. '07E

Miami Beach
Laurence, Philip J. '15 C
Zimmerman, Arthur C. '23 C

Pensacola
Heath, Delbert W. '29 C

St. Augustine
Coe, Clarence S. '89 C

Tampa
Graf, Donald T. '22 A
Hamilton, Jefferson M. '19 A
Larson, Edwin '21 A

Winter Haven
Larson, Peter L. '24 C

Winter Park
Anderson, Winslow S. '23 MS

GEORGIA

Atlanta
Chase, Arthur W. '93 E
Overholt, Harley G. '30 C

Brunswick
Ren, Albrecht H. '19 ChE

Columbus
Andrus, Harry J. '22 C

IDAHO

Arling
Alsop, Ernest B. '06 C

Avery
Janzen, William H. '20 E

Boise
Morse, Guilford A. '15 ChE

Lewiston
Kjosness, Ingraham G. '03 M

Moscow
Melzian, Milton '29A
Stageberg, Oswald '26 A

Orofino
Peterson, Harold R. '18 E

ILLINOIS

Alton
Cosh, Richard A. '19 M
Klammer, K. '28 I

Aurora
Brown, Homer L. '17 M
Thompson, Clarence W. '25 C
Zeleny, Frank '98 M

Berwyn
Anderson, Wesley J. '26 M
Bergman, Hilder '26 I
Eige, Elmer H. '23 M
Wiggins, John R. '23

CHAMPAIGN
Mark, Max '25 C
Porter, Allen H. '08 Ch
CHICAGO
Abrahamson, LeRoy M. '29 E
Ackerman, Robert '28 E
Appleman, Frank C. '24 E
Ashbaugh, Lewis E. '00 M, '07 CE
Aslakson, Baxter M. '91 M
Ayshford, Loren C. '26 E
Bayless, Harry C. '99 M
Beeman, Harry J. '21 G
Bergquist, Edwin T. '24 C
Bergquist, Philip L. '24 C
Bernt, Hans E. '20 C
Bezek, Albert J. '27 E
Bonsall, W. C. '24 A
Bouquet, Otto T. '23 E
Braden, Rene A. '23 E, '25 MS
Brinker, Howard C. '25 Ch
Brody, Mace J. '24 C
Cahn, Harold '29 E
Carlson, Richard E. '23 E
Carman, W. J. '26 E
Cassidy, Walter J. '24 E
Chernus, Maurice C. '22 C
Childs, Morris P. '25 E
Clark, Kenneth M. '27 C
Clark, Wm. G. '12 M, '13 ME
Colson, Lauren G. '21 E
Converse, Clovis M. '09 E
Cook, Lyle M. '27 M
Cook, Walter K. '22 C
Copeland, Floyd E. '23 M
Cornelius, Martin '06 E
Craig, Hamilton S. '25 C
Crosby, Milton E. '15 M, '16 ME
Curtis, Benjamin J. '13 C, '14 CE
Cutliffe, Wendell W. '29 E
Dahl, Merle G. '26 E
Dahlquist, Philip L. '10 C
Daniels, Elmer Anson '13 Ch
Danner, Jake '01 E
Dixon, Donald K. '27 M
Drills, Robert '26 C
Drost, Henry F. '22 E
DuBois, John H. '27 E
Dunlap, Lemuel J. '17 E
Eddy, Lynne W. '07 E
Edelman, Philip '16 E, '17 EE
Eilers, Baldwin C. '25 C
Elliott, Merle B. '28 M
Engler, Myer '27 C
Engquist, Emil '28 E
Fitts, Joel A. '09 E
Fogelholm, E. G. '28 E
Fornfeist, Elmer J. '21 M, '22 ME
Frank, Carl '28 C
Frankovich, John J. '28 E
Frear, J. B. '10 M
Froberg, Harold '28 E
Galanter, Samuel S. '25 C
Getchell, Earl '26 E
Gilchrist, Charles C. '98 E
Gillard, Herbert W. '24 C
Grant, Russell S. '26 M
Grossman, Frederic '28 A
Grow, Harry A. '03 C
Gutsche, Frank C. '10 ChE
Hagerman, O. S. '18 M
Hammett, Ralph W. '19 A
Hammond, Joseph A. '26 E
Hanke, Carl C. '20 C
Hart, Maurice W. '26 E
Hartman, Philip F. '25 C
Harwick, Henry C. '28 E
Hawkins, Edward W. '24 A
Hayes, Harold '22 G
Healy, Joe M. '29 E
Hodnett, Ralph M. '11 C
Hogness, T. R. '18 ChE
Holmsten, Victor '22 M
Holt, Leo '28 E
Hortberg, Reynold '27 E
Houston, Cecil C. '09 C
Howatt, John '04 E
Hubbell, Arthur C. '14 M, '15 ME
Hughes, Frank C. '03 M
Huseby, Gisle E. '24 E
Irons, Roy C. '27 M
Isaacson, Arthur M. '27 M
Johnson, Albert W. '23 C
Johnson, Raymond A. '26 C
Juell, A. Barton '26 C
Juran, Joseph M. '24 E
Kater, Jozef J. '24 E
Kern, Herbert A. '13 ChE
King, John E. '22 E
Kivley, Ray C. '18 M
Kleinfeld, Leonard S. '26 M
Klopsteg, Paul E. '11 G, '13 MA, '16 Ph.D.
Konstant, Nicholas '18 C
Krause, Fred E. '24 E
Kristy, George A. '09 E
Kroll, A. J. '25 C
Lagaard, Maurice B. '14 C, '15 CE
Lambie, Horace '23 E
Larson, Emil L. '25 AE
Lazarus, Morris W. '23 C
Lee, M. R. '21 Ch, '22 ChE
Lende, Willard '28 E
Liddle, Ralph W. '21 G
Lieberman, Henry '23E
Lindquist, O. J. '26 E
Linhoff, Carl H. '22 E
Lipchick, A. A. '26 C
Little, Fred W. '27 M
Lonie, James '97 M
Lynskey, Joseph P. '26 E
McConnell, Edmond S. '24 E
McCrady, Archie R. '24 C
McCrea, John A. '28 E
McGinnaty, Wm. J. '28 AE
McLean, Milton '21 G
McMillan, Franklin R. '05 C
Manuel, Earle V. '07 Ch
Martin, Edmund W. '12 Ch.E.
Mayeron, Ben '28 C
Meagher, Joseph '25 E
Messer, Harold D. '23 M
Montgomery, Ralph '24 M
Moreno, Gerardo '23 E
Morris, John O. '88 M, '03 ME
Nelson, Paul B. '26 E
Nelson, W. K. '13 Ch
Newbery, Lester W. '22 C
Nielson, Andres '27 E
O'Brien, Thomas E. '25 C
Olson, Kenneth M. '25 C
Olson, Roy H. '23 E
Owens, Jay C. '17 Ch
Pardee, C. A. '12 E, '13 EE
Park, James I. '27 AE
Peterson, Albert E. '19 E
Peterson, Clarence R. '25 C
Pierson, Joe W. '19 E
Postma, John '23 E
Putnam, George W. '18 G
Rankin, Dean W. '25 AE
Rankin, Kenville S. '14 C
Reck, Robert C. '21 ChE
Reed, Gordon '29 M
Rezab, John J. '07 E
Riedesel, Geo. Wm. '17 A
Riekmen, Herman W. '17 C
Roberts, Henry M. '28 M
Rolwes, E. A. '29 ChE
Rosenberg, Rahil A. '24 A
Rosenbloom, Abraham '17 M
Rosenthal, Paul '22 C
Rowell, Lester J. '29 M
Ruemmele, A. E. '12 M, '13 ME
Russell, Winfred W. '23 E
Sandberg, Clifford H. '26 C
Sawyer, Emerson D. '10 C
Saxon, Paul M. '29 E
Scholz, Edmond H. '27 E
Schroeder, Clarence A. '26 E
Schwartz, Marcel '22 ChE
Sear, Arthur W. '23 M
Selander, Karl W. '22E
Sheekman, Harvey Z. '24 E
Smith, Verna G. '25 ID
Somero, Waino M. '24 C
Sorenson, John E. '22 E
Sperry, Leonard B. '05 M, '08 EE
Staehle, Gilbert C. '20 C, '22 MS
Sternberg, W. M. '08 Ch
Stoner, Clifford M. '24 C
Strate, Thomas H. '01 C
Swanson, Carl W. '29 M
Swift, George E. '23 E
Taylor, Richard G. '25 E
Thompson, Everett '23 C
Thompson, Harry T. '15 E, '16 EE
Trcka, Benjamin C. '24 E
Turner, Leslie E. '09 E
Umbehocker, Frank '21 M
Waby, Delton '23 M
Ward, Alvin C. '23 E
Washburn, F. M. '17 ChE
Weber, Hanard P. '24 E
Weeks, Wm. C. '94 C
Wehlitz, Hubert F. '27 E
Wheeler, R. B. '27 ChE

- Williams, Myrl J. '20 M
- Williams, Percival H. '22 E
- Wills, Arthur D. '21 A
- Wills, David C. '23 E
- Winkenwerder, E. E. '25 E
- Wyly, Lawrence T. '20 G

CHICAGO HEIGHTS
- Anderson, Arthur P. '25 EE
- Nichols, Browning '10 M

CICERO
- Holmstine, Ralph D. '24 M
- Pavek, William J. '19 M, '20 ME

DECATUR
- Elwood, Daniel H. '23 E
- Schmidt, Rolland L. '25 C

ELGIN
- Johnson, Carl A. '11C
- Johnsen, Kenneth A. '27 C

EVANSTON
- Bailey, Geo. R. '22 C
- Borrowman, Geo. L. '05 AC
- Eckenbeck, Everett E. '17 E
- Jensen, Otto L. '26 E
- Maney, George A. '11 C

GENEVA
- Kapphahn, Ernest H. '19 G

HOMEWOOD
- Sommerfeld, Adolph A. '10 C
- Teberg, Ernest J. '16 E, '17 EE

JOLIET
- Daly, Frank A. '28 C
- Davis, Charles A. '05 E
- Lohn, Robert N. '29 C
- McCoy, Ira C. '11 E
- Peck, Lloyd '23 C
- Ringwood, James '28 C

LANARK
- Hoffman, John R. '26 C

LA SALLE
- Pierce, Walter H. '26 M

MAYWOOD
- Kruse, Orlin O. '20 E
- Peoples, John S. '14 M

OAK FOREST
- Gilman, Gaylord '23 EE

OAK PARK
- Cottingham, George, Jr. '15 C
- Forsmark, Ulrik E. '26 E
- Kelly, Raymond R. '26 C
- Sausen, Bert R. '13 M
- Wicks, John '04 E

PEORIA
- Kastner, Roy W. '27 C
- Pearson, Einar O. '27 C

RIVERSIDE
- Williams, Arthur H. '19 M

ROBINSON
- Uzzell, George W. '07 E

ROCKFORD
- Underhill, Edith '23 MS Ch

ROCK ISLAND
- Franks, Geo. E. '29 E

SPRINGFIELD
- Peterson, Neander E. '22 C
- Zuckman, Geo. J. '27 C

URBANA
- Bauer, Esther E. '24 MS
- Bergquist, John E. '13 C
- Dietrichson, Gerhard '10 Ch

WAUKEGAN
- Acomb, William E. '02 M
- Bergs, Charles J. '26 C
- Gill, Roscoe L. '29 E
- Mooshrugger, Frank '22 A

WOOD RIVER
- Anderson, Alvin P. '25 Ch

INDIANA

BOONEVILLE
- Johnson, Clarence C. '26 E

EAST CHICAGO
- Spotts, Herbert '28 M

EVANSVILLE
- Olson, C. Milford '24 C

FORT WAYNE
- Beveridge, Robert A. '26 E
- Ellis, Carl E. '25 E
- Fisher, Geo. '28 E
- Larson, Seymour R. '28 E
- Richardson, Philip E. '25 E
- Shannon, Harold R. '29 M
- Soderholm, Lauren V. '28 E
- Warneke, Roman '29 E

GARY
- Cotthingham, William P. '11 C
- Frederickson, Hubert M. '22 ChE
- Helseth, Paul A. '29 C

INDIANA HARBOR
- Merten, Howard V. '14 Ch

INDIANAPOLIS
- Higburg, Wm. '17 ChE
- Prentice, Robert S. '08 E
- Skytte, Ernest R. '10 E
- Wagner, Adolph '98 E

LAFAYETTE
- Hauge, Sigfred M. '21 Ch

SOUTH BEND
- Mehandru, Behari L. '24 M
- Muessel, Robert W. '21 C

VALPARAISO
- Lauritzen, Carl W. '24 E

IOWA

ALGONA
- Young, Clifford L. '28 E

AMES
- Willis, Benjamin S. '17 E

BOONE
- Lantz, Reuben '25 A

CEDAR RAPIDS
- Blomquist, Hjalmar '07 C
- Stanius, Godfrey '21 E

DAVENPORT
- Auxer, William L. '25 C
- Laupher, Murray N. '24 E

DAYTON
- Harris, Clayton '09 E

DES MOINES
- Ash, J. Wesley '08 C
- Kingsley, Norman W. '20 E
- Reeve, Howard E. '23 E
- Rome, Robert C. '22 E
- Wallfred, John E. '27 M

DUBUQUE
- Madden, Francis '03 C
- Peterson, Lloyd L. '24 C
- Schweppe, Walter A. '26 E

ELDORA
- Cribbs, Harry E. '23 C

HUMBOLT
- Christen, Ray L. '26 E

INDEPENDENCE
- Dunlap, Geo. M. '24 E

JANESVILLE
- Wild, Carl D. '15 C, '16 CE

MARION
- Christiansen, Hilmer B. '15 C

MARSHALLTOWN
- Weatherill, Cedric '14 C, '15 CE

MELVIN
- Deinema, George R. '26 E

NEWTON
- Thayer, Paul W. '14 M, '15 ME

SIOUX CITY
- Arzt, Emmanuel A. '97 E, '99 EE
- Donauer, Max '18 ChE
- McNeill, Lyle D. '27 M
- Williams, Wilbur S. '09 M

WATERLOO
- Nordenson, Willard '26 M

WAVERLY
- McMeekin, Glenn D. '21 G

KANSAS

ATCHISON
- Hastings, Clive '96 M

BAXTER SPRINGS
- Bisek, Peter P. '14 E

MANHATTAN
- Graham, Eugene C. '02 E

PITTSBERG
- Woodman, Howard H. '97 C

WICHITA
- Schultz, Peter D. '18 Ch

WINFIELD
- Beck, Vernon S. '10 E

KENTUCKY

ASHLAND
- Porter, Ralph E. '13 ChE

BARBOURVILLE
- Dyer, Walter S. '25 OCh

DUBLIN
- Donahue, Stephen '25 C

LOUISVILLE
- Ernst, Robert C. '23 ChE
- King, Harvey '18 A
- Smith, Allan S. '26 ChE

PADUCAH
- Knapp, Lester '12 E

LOUISIANA

Baton Rouge
Fieger, Ernest A. '20 ChE
Marreno
Fleming, Douglas B. '08 C
New Orleans
Hilgedick, W. C. '26 E
Schlenk, Hugo '18 E

MAINE

Portland
Ferguson, K. B. '26 E

MARYLAND

Annapolis
Winslow, Harry J. '25 E
Baltimore
Billau, Lewis S. '05 E
Grant, James A. '07 C
Koster, E. B. '23 MS Ch
Peterson, Arthur P. '19 E
Rask, Olaf S. '17 Ch
Takoma Park
Roepke, Otto B. '06 E

MASSACHUSETTS

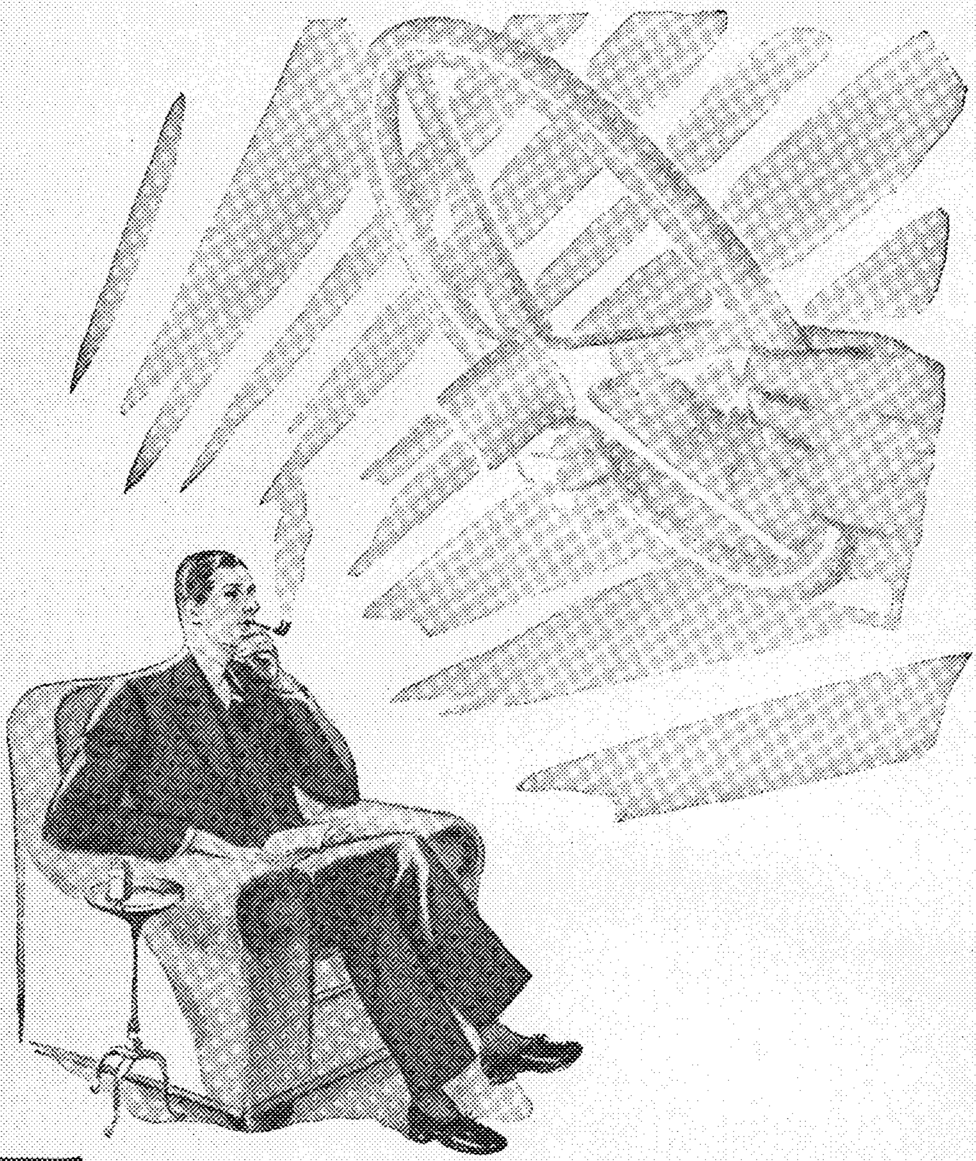
Amherst
Markusen, Miner J. '23 A
Boston
Beckjord, Walter C. '09 E
Damberg, Rheuben P. '21A
Emery, George C. '19 A
Grout, Benjamin '08 LLB, '11 LLM, '01G
Morrow, Leon W. '16 Ch
Nebel, Walter H. '11 E
Paulsen, Thorwald '22 C
Payne, Harold G. '06 E
Reuter, Peter T. '21 M
Walker, Frank B. '97 C
Webster, Harry M. '15 E
Woodward, Herbert M. '90 M
Cambridge
Arnold, Jerome H. '27 ChE
Darling, Stephen F. '22 Ch
Fuson, R. C. '24 PhD
Hochthausen, Walter '28 A
Ludwig, L. G. '24 Ch
Nygard, Edwin M. '21 Ch
Plowman, George T. '93 A
Sternberg, W. M. '18 PhD
Chicopee Falls
Barton, James P. '27 E
Forbes, Henry C. '22 E
Tholstrup, Henry L. '26 E, MS '28
Franklin
Tomlinson, L. C. '04 E
Northampton
Morse, Minerva '20 Ch
Norwood
Korslund, Harry J. '20 A
Pittsfield
Cederstrom, C. M. '29 M
Goodwin, Victor E. '04 E
Springfield
Cote, Rhoda '25 ID
(Mrs. J. P. Barton)
Jones, Ivor Vaughan '15 C
Walpole
Forssell, William O. '22 G
Winthrop
McVean, Norman S. '21 E

MICHIGAN

Ann Arbor
Badger, W. L. '08 Ch
Dow, William G. '16 E, '17 EE
Orbeck, Martin J. '11 C
Rogers, Marvin '26 ChE
Bessemer
Hoffman, Wallwin H. '29 M
Peretti, John J. '29 E
Dearborn
Hoppin, Glenn H. '08 E
Detroit
Ascher, Raymond C. '23 M
Babcock, Vernon M. '23 E
Bailey, Stuart L. '27 E, MS '28
Brewster, William E. '12 E, '13 EE
Brooke, Harold L. '18 E
Bull, Alvah Stanley '27 A
Dale, Dallas W. '24 M
Dodic, Richard J. '24 C
Grisson, Aubrey '25 AE
Gutsche, Edward J. '04 Ch
Halbrat, F. J. '26 C
Hamilton, Herbert C. '97 ChE
Huntoon, Milton B. '99 E
Kingston, Samuel P. '29 C
Koehler, Edwin F. '24 M
Loye, Benjamin W. '06 M
Lundquist, Reuben A. '05 E
Malmstrom, Axel L. '17 E
Mitchell, L. Morris '14 C, '15 CE
Nelson, Elmer A. '23 C
Rand, Lars '12 M, '13 ME
Richardson, Ralph A. '27 M
Riddington, Fred W. '22 ChE
Shepard, Donald D. '11 E
Souba, John I. '25 M
Staehle, Haswell E. '24 M
Swart, Richard H. '21 ChE
Voriack, Jerry '28 C
Walker, Geo. W. '09 Ch
Wennerlund, Elias K. '99 M
Wilk, Benjamin '13 C, '14 CE
Flint
Anderson, Joseph A. '24 M
Lamon, Harold J. '27 M
Murray, John H. '17 M
Rhame, Paul W. '20 M
Shuirman, Gabe '21 E
Simms, Charles G. '24 M
Grand Rapids
Benson, Mons '28 C
Lyon, Glenn H. '20 A
Mahoney, William L. '13 E, '14 EE
Nelson, Edwin W. '25 C
Tallmadge, Hiram '16 E, '17 EE
Houghton
Reed, Henry R. '25 E, '27 EE
Swenson, G. W. '17 E, '21 EE
Ironwood
Holmberg, Abner W. '15 M, 16'ME
Sears, Dow I. '14 C
Jackson
Briggs, William G. '21 E
Volkenant, Geo. W. '27 E
Kalamazoo
Blodgett, Chas. L. '24 M
Laurium
Swanson, Philip C. '23 M
Midland
Edmonds, Alvin M. '23 ChE
Otis, L. E. '29 ChE
Muskegon
Olsen, Arthur O. '10 C
Pontiac
Fike, Jay B. '26 M, ME '27
Sault St. Marie
South Haven
Smith, Sidney H. '11 C
Two Harbors
Holmstrom, George '29 E
Three Rivers
Chapin, S. Caryl '24 C

MINNESOTA

Alberta
Schlattman, Edward C. '08 C
Albert Lea
Carlson, Chauncy M. '17 E
Dock, Chester '22 G
Pless, Arnold '20 C
Sorenson, Russell L. '27 AE
Alexandria
Sunblad, Everts W. '27 E
Annandale
Seegar, Franklin H. '28 E
Anoka
Reed, Arthur L. '06 C
Thurston, Harold H. '13 C, '14 CE
Atwater
Molin, Kenneth '29 C
Austin
Augell, Glenn H. '28 M
Mahachek, Ross '26 E
Barnum
Wood, Victor R. '22 C
Bellingham
Strege, Henry '24 E
Belle Plaine
Groth, A. W. '28 E
Bemidji
Davison, Joseph H. '03 C
Bowlus
Johnson, James R. '26 C
Johnson, Ralph '28 C
Brainerd
Anders, Milton '27 E
Croswell, Leslie D. '26 C
Hallady, Leslie L. '21 C
Hendrickson, C. Edward '25 C
Jones, Harold W. '25 C
Breckenridge
Brataas, Mark '17 C
Holmgren, Charles E. '09 M
Buhl
Anderson, Ole A. '93 M, '08 ME
Butterfield
Roney, Donald '29 E
Campbell
Gran, Conrad L. '29 E
Carlton
Nickerson, Neal C. '18 C
Cass Lake
Hanson, James B. '29 C
Center City
Kingstrom, Geo. H. '27 E
Chaska
Johnson, Nels '23 C
Chisholm
Anderson, George T. '15 C
Arko, Frank W. '28 M
Elstad, Rudolph T. '19 C
Hammerstrom, Aleck A. '21 E
Maturi, Rudolph '28 C
Olson, Elmer J. '23 C
Cloquet
Aronovsky, S. I. '22 ChE
Backstrom, Russell E. '25 M
Glenn, Harry W. '24 ChE
Stuart, Don N. '28 E
Cokato
Peterson, Richard M. '20 E
Cold Springs
Quinn, Ursula R. '25 C
(Mrs. H. N. McAndrews)
Coleraine
Battles, Leon E. '18 C
Comfrey
Carlson, Elmer W. '27 C
Crosby
Darling, S. F. '22 Ch
Delano
Brunkow, Herbert E. '12 ChE
Duluth
Anderson, Milton J. '20 A
Bishop, Ira L. '11 M
Bradbury, Margaret E. '28 IA
Buck, Frederick W. '09 M
Burke, Roy L. '05 C
Butterworth, Allan C. '11 E
Clark, Carroll A. '29 ChE
Cassady, Chas. '25 E
Dinsmore, Arthur T. '12 M, '13 ME
Dorsey, John G. '15 C, '16 CE
Eaton, Paul F. '27 A
Eggen, Carl M. '29 C
Elleison, Selmer '16 E
Fee, E. Franklin '07 M
Fredrickson, F. C. '29 C
Gustafson, T. '28 E
Grubek, Rosabelle '29 IA
Hemenway, Ed. L. '28 M
Hibbard, Sheldon S. '23 M
Hoff, John E. '20 Ch
Holbeck, John I. '24 E
Holmes, Raymond H. '25 E
Hustad, Byron P. '10 E
Jaques, Robert '09 C
Johnson, Donald L. '18 Ch E
Jordon, W. E. '26 ChE
Kapphahn, R. J. '12 C, '13 CE
Kelly, Earl W. '07 C
Knutson, Harry '17 M
Kusmierek, Clenet J. '23 M
Larson, Victor F. '17 M
Lostrom, Herbert W. '26 E
Luft, H. L. '24 Ch MS
McEachin, John L. '22 E
Martino, Anthony '25 M
Matzke, W. W. '29 M
Melander, Albin R. '21 A
Mork, Geo. W. '26 M
Nelson, Edward K. '24 M
Nelson, Einer '24 M
Olin, Henry A. '23 E
Osrouske, Arthur B. '28 M
Peterson, George T. '08 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
Roy, Milo C. '21 M
Saltwick, Andrew '24 M
Schwedes, Walter F. '06 E
Solarow, Abraham '23 C
Simmonds, Richard R. '21 C
Sneve, Jack S. '11 M
Spring, Willis W. '07 M
TenBrook, Charles '29 M
Tennstrom, Carl H. '23 C
Toudell, Mandell '87 C
Turnquist, Axel A. '16 E, '17 EE
Waits, James G. '29 C
Wiede, John A. '28 C
Williams, Roy N. '23 E
Wilson, Walter E. '24 C
East Grand Forks
Dahlberg, A. V. '05 AC
Elk River
Balton, John M. '28 C
Longfellow, Dwight W. '08 C
Normann, Rolf A. '24 C
Ely
Boccowich, Paul '27 E
Kauppinen, Heino '25 E
Pearson, Elmer A. '20 ChE
Eveleth
Nastlund, Gustave A. '26 A
Ohman, Leo S. '28 E
Excelsior
Schneider, Frank M. '27 M
Schuck, Roy D. '25 E
Fairmont
Coult, Lyman H. '25 ChE
Curtis, Thomas H. '12 C
Eustis, Irving N. '17 M, '18 ME
Kasper, Walter '11 M
Kotz, W. E. '23 C
Krafft, Edwin A. '24 A
Starrett, Howard M. '09 M
Faribault
Crawford, Wallace '06 M
Klemer, Frank H. '01 C
Mabbott, L. E. J. '24 E
McKellip, Frank W. '98 E
Farmington
Brossard, Edward V. '23 M
Federal Dam
Poore, Orson B. '09 E
Fergus Falls
Christopherson, Arnold '28 E
Frankovitz, John J. '05 E
Gard, Donald '28 C
Hallan, Christian '02 C
Johnson, Carl J. '14 E, '15 EE
Steiner, Edmund F. '29 E
Young, Jos. E. '21 G
Ft. Snelling
Linden, Henning '17 E
Frazee
Chilton, Edward G. '13 C, '14 CE
Gaylord
Deterling, Edward W. '26 E
Hecht, Henry W. '24 E
Glencoe
Hankenson, John J. '92 C
Glenwood
Krieger, Keith M. '23 E
Graceville
Hartnett, John G. '11 Ch
Grand Meadow
Grimm, Raymond E. '28 E
Granite Falls
Lende, Henry M. '20 C
Halstad
Forseth, George O. '25 M
Hastings
Christenson, Elmer '27 C
Manger, Henry J. '23 C
Ralphe, W. W. '30 C
Solberg, Mirl C. '29 C
Hendriks
Larson, Maurice C. '29 E
Hibbing
Anderson, Alvin P. '25 Ch
Benesovitz, A. '28 E
Blomberg, Evar H. '16 E, '17 EE
Friedman, Edwin A. '23 E
Markus, Benjamin '17 Ch
Pan, Wen P. '16 C, '18 Ch
Reeve, Charles H. '19 E
Homer
Ramsden, A. M. '29 Ch
Hopkins
Anderson, Harvey B. '12 C, '13 CE
Norman, Allan K. '28 C
Shellenbarger, L. R. '30 C
Humbolt
Baer, Louis E. '07 E
Hutchinson
Higgins, Elvin L. '92 C
International Falls
Anderson, Ed. S. '21 E
Busch, John S. '20 ChE
Cantwell, Wm. F. '11 Ch
Morris, Frank H. 24 M, '25 ME
Wilson, Roy A. '25 M
Janesville
Santo, Lewis W. '29 A

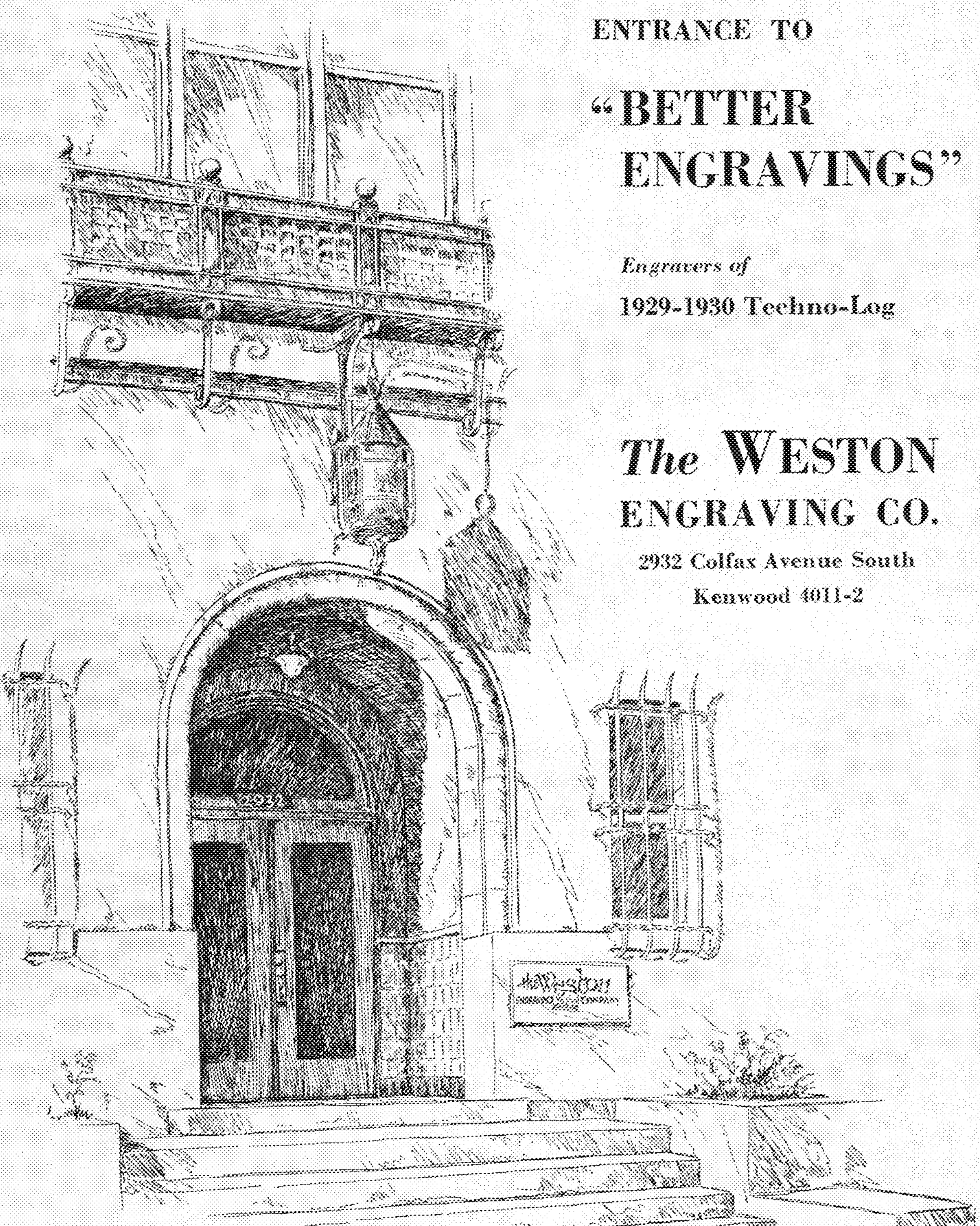


KEEWATIN
Bingen, William J. '12 C, '13 CE
Leach, Edward W. '10 C
LAKE CITY
Christilaw, George '21 C
Martin, Curtis R. '21 G
Tews, Arthur W. '24 C
LAKE PARK
Watland, Maynard B. '29 M
LANESBORO
Redmond, Fabian '29 A
Ellestad, R. B. '24 MS
LE ROY
Meyers, Clare '28 AE
LESUEUR
Crowell, Sidney '27 C
Odquist, Carl '23 C
Weis, Wallace D. '21 C
LEWISTON
Suhr, Fred W. '29 E
LITCHFIELD
Gehring, Lester G. '27 C
LITTLE FALLS
Donahoe, Robert E. '21 E, '22 EE
Grettum, Walter '24 E
Ryan, Loiel S. '12 C, '13 CE
LONG LAKE
Kelley, William '22 C
MADISON
Clausen, Elmer W. '23 E
Corliss, C. V. '28 E
MANKATO
Gerlach, W. D. '26 A
Kleinschmidt, Armin R. '22 M
Neilson, Chris '18 ChE
MANTORVILLE
Brossard, Henry F. '25 E
MAPLE PLAIN
Compton, Milton '28 E
MAPLETON
Borchert, Oscar H. '25 E
MARINE-ON-ST. CROIX
Gray, Wesley '29 E
MARSHALL
Neill, Clarence L. '28 E
MAYNARD
Johnson, Alexander B. '95 C
MINNEAPOLIS
Aasland, Christopher '13 C
Aasland, Arne '23 C
Abbott, Amos H. '16 E, '17 EE
Abramson, Harry W. '23 C
Adams, Edward H. '22 G
Adams, John W. '12 C
Affleck, Dean H. '28 AE
Akins, Clifford M. '27 M
Alexander, George D. '20 C
Algren, Axel B. '25 M
Alrick, Bannona G. '06 C
Amundsen, Leland R. '29 AE
Anderson, Clifford H. '26 C
Anderson, Emil '05 E
Anderson, Frank I. '16 E
Anderson, Hilder A. '18 M
Anderson, John G. '99 C
Anderson, Joseph W. '15 E
Anderson, Matthew '24 E
Anderson, M. M. '21 ChE
Anderson, Merle W. '29 E
Anderson, Nels S. '22 C
Andrus, Raymond J. '07 E
Arstad, Leonard O. '24 E
Asfalt, Filip J. '27 E
Aske, Irving E. '20 E
Asleson, Hans '10 C
Austin, Paul D. '21 E
Ayers, E. B. '25 Ch
Bachelder, William H. '24 C
Backstrom, Kenneth A. '27 A
Bailey, John T. '29 E
Baldock, Fred C. '29 M
Balkin, Samuel W. '26 C
Bancroft, Henry K. '26 M
Barber, Harvey H. '26 PhD
Barger, Harold L. '21 E
Barnes, James C. '28 E
Barnum, Marvin C. '11 M
Bayliss, W. C. '29 A
Beck, Maud G. '13 Ch
Beckel, A. C. '19 Ch
Beery, Charles B. '09 M
Bergford, Rolie
Bell, Axel D. '27 ChE
Bell, Maurice D. '07 M
Ben-Ora, Samuel '29 A
Benson, Ikel C. '25 E, EE '27
Berg, Swan F. '23 C
Bergford, Lester M. '23 C
Bergford, Rolf E. '23 C

Bergstrom, Marlow B. '22 E
Berman, Florence '28 ID
Bestor, George C. '24 C
Bevan, R. Louis '24 C
Bleecker, George W. '16 E
Bliven, Paul '27 M
Blosjo, Herbert '28 Ch
Blue, Clarence W. '25 C
Boehnlein, Charles '17 M, '19 ME
Boerner, Francis C. '11 C
Bordeau, Sanford P. '25 E
Boyce, H. J. '27 E
Boyce, John '28 M
Boyce, Norman '27 E
Boyum, Irvin '17 E
Braddock, Edward '24 C
Bradley, Byron H. '13 C, '14 CE
Brandt, Clifford A. '27 E
Brauns, Cyril M. '29 E
Breding, Lucene A. '29 IA
Brenchley, Harry E. '08 C
Brinton, F. H. '15 PhD
Brooks, Leslie C. '19 Ch
Bros, Bernard M. '23 M
Bros, Chester W. '22 M
Bros, Ernest T. '17 M
Bros, Kenneth D '27 M
Bros, Raymond J. '19 M, '20 ME
Brown, Floyd W. '17 A
Brownell, Otto E. '10 C
Bruce, G. Norman '23 Ch
Bruce, Hjalmar N. '16 C, '17 CE
Bullis, Everard J. '24 C
Bunger, Harold A. '26 ChE
Burch, Albert M. '96 C
Burch, Edward P. '92 E, '98 EE
Burlingame, Robert E. '25 E
Burnett, H. V. '14 C
Burt, Paul R. '26 M
Burtis, Wm. '92 E
Busch, J. S. '20 ChE
Cade, Arthur R. '17 Ch
Calloway, R. S. '11 ChE
Cameron, Lester W. '27 A
Capstick, Donald W. '22 G
Carlbom, Leonard H. '25 C
Carlson, Clifton C. '27 M
Carr, Harvey '03 C
Carter, Robert J. '08 E
Carter, Ruth '29 IA
Caswell, Thomas B. '25 M
Cayoia, Chester L. '28 A
Cerney, Glen C. '20 M
Chadbourne, L. R. '23 ChE
Chalmers, Charles H. '94 E, '03 EE
Childs, James A. '09 C
Christensen, Arthur L. '25 E
Clark, John S. D. '22 M
Close, Winston '27 A
Cohen, Lillian '00 Ch
Collins, Stewart G. '04 G
Colvin, James A. '14 M, '15 ME
Comb, Fred R. '10 M
Cooper, Leo H. '06 E
Cooper, R. Conrad '26 C
Corbett, Theodore R. '26 M
Cornell, L. Wallace '27 ChE
Corser, John '16 M
Covell, Paul L. '25 ChE
Cramsie, Kenneth J. '29 A
Critchett, Edward F. '13 M, '14 ME
Croft, Edna K. (Miss) '22 A
Croft, Ernest R. '11 C
Crounse, Avery F. '03 G
Cutler, Alvin S. '05 C
Dahlstrom, Raymond E. '18 E
Damberg, Paul S. '22 A
Davidson, Henry A. '27 AE
Davies, Edwin T. '07 ChE
Davies, Ralph M. '09 E
DeVaney, Grace M. '26 Ch
DeVay, Wm. T. '29 E
Deane, George B. '19 A
Del Plaine, Carlos W. '21 C, '22 CE
Denzen, Davis J. '19 A
Dewars, Allen G. '13 E, '14 EE
Diment, J. Morton '24 E
Doell, Charles E. '16 C, '17 CE
Doepke, Chris '29 M
Donaldson, Frank A. '12 M
Doolittle, William K. '14 C
Dorrance, Albert P. '12 E
Douglas, Addison H. '17 C, '20 CE
Dresser, Harry S. '16 M

Dreveskracht, Wallace '28 C
Drinkall, Leon R. '19 E
Dunnavan, Ralph B. '23 E
DuToit, George A. '10 M
Eck, Lester J. '23 Ch
Edgar, D. E. '23 Ch
Edlund, Ray C. '27 C
Eggers, Henry C. T. '15 E, '16 EE
Ehrenberg, Muriel L. (Miss) '26 ID
Ek, Gustaf A. '17 M
Ekberg, Carl E. '14 C, '15 CE
Ekman, Claes T. '10 C
Ellestad, R. B. '22 Ch
Elliott, A. Douglass '14 E, '15 EE
Ellsworth, Charles D. '20 E
Elmquist, R. E. '24 MS
Elsberg, Nels W. '09 C
Enger, Edward H. '11 C
Erikson, Henry A. '96 E, '08 PhD
Erickson, Lloyd '28 C
Erskine, Lawrence '25 M
Erskine, Robert K. '24 M
Estabrooks, Clyde F. '24 M
Everett, William R. '13 E, '15 EE
Fager, Simon R. '04 M
Farmer, John W. '21 M
Farnam, Julian P. '11 M
Fedders, Melvin P. '29 M
Fergestad, Marvin L. '29 AE
Firth, Charles V. '23 ChE
Fischer, Earl B. '19 ChE
Fischer, Harold W. '23 E
Fitzgerald, William J. '20 C
Flaaten, Percy H. '26 C
Flindt, Richard H. '23 C
Foker, Leslie W. '28 ChE
Ford, Robert E. '95 E, '03 EE
Forfar, Donald M. '09 M
Forsberg, Enock E. '18 A
Foss, Arbie '29 M
Fossen, George '17 C
Foster, Kenneth W. '26 C
Frantz, Willard F. '25 C
Freche, H. R. '25 MS
Fredrickson, Edwin '28 E
Frederickson, H. M. '23 ChE
Freeberg, George '25 A
Fruen, Arthur B. '08 G, '09 CE
Furber, J. Roscoe '24 E
Furber, Richard '23 E
Gammell, John H. '14 M, '15 ME
Garber, Gabriel E. '06 M
Garthus, Ira B. '24 E
Garzon, Julian R. '24 C
Gee, Harry J. '19 G
Gerrish, Harry E. '03 M
Gilfillan, Donald N. '27 AE
Gillete, George L. '05 C
Gilman, James B. '94 C
Glasser, David '29 ChE
Godward, Alfred C. '10 C
Goldberg, Hymen '28 C
Goldstein, Milton M. '12 ChE
Goetzenberger, Ralph L. '13 E, '14 EE
Gould, Edward S. '20 C
Grant, John W. '29 C
Gray, William I. '92 E, '98 EE
Green, Chauncy L. '24 E
Greiner, Harry S. '24 E
Grout, Frank F. '04 Ch
Guggisberg, Charles F. '17 M
Hagelin, Lawrence W. '22 E
Hall, John W. '27 M
Halvorson, Halvor O. '22 ChE
Hammer, George F. '20 ChE
Hammer, Harold E. '25 E
Hammond, K. D. '22 Ch
Hammond, Laurence D. '14 M, '15 ME, '19 MB, '20 MD
Hankins, Nathaniel R. '24 C
Harris, Nathan '20 G
Harris, Sigmund '05 M
Hartig, Henry E. '18 E
Hartkemeier, L. '23 MS
Hartzberg, Edward M. '19 M
Hawkins, Harvey C. '23 E
Hayden, John F. '90 C
Heath, Donald C. '16 A
Heath, Owen M. '29 M
Heidelberger, Otto F. '23 E, '24 MS
Heidelberger, Roy J. '22 E
Heisig, Lucille K. '22 MS
Helmick, Dan S. '15 C
Herberg, Sanford '24 C
Herrick, Carl A. '02 M

Herrmann, Raymond R. '12 E, '13 EE
Heyer, Robert H. '29 M
Hibbard, Truman '97 E
Hickok, Mrs. Harvey (Miss Jesse E. Stevens) '96 G, '04 MS
Hildebrandt, H. A. '99 E
Hill, Edward L. '25 E
Hirleman, Clark W. '12 M, '13 ME
Hobart, Walter B. '07 C
Holcomb, Harry S. '26 E
Holien, Gilman '28 A
Hoover, Lloyd '28 E
Hopkins, Joseph I. '04 Ch
Hopkins, Mark L. '09 E
Hotchkiss, Fred W. '18 E
Houlton, Amos D. '01 E
Houston, George S. '02 C
Huhn, George F. '91 E
Humphrey, G. J. '24 Ch
Hustad, Andrew P. '09 C
Hustad, John C. '14 C, '15 CE
Jackson, Otto E. '14 E, '15 EE
Jacobsen, Arthur C. '25 E
Jacobson, Carl A. '29 E
Jacobson, Frank H. '24 E
Jacobson, Howard C. '21 G
Jakkula, Arne A. '26 C
Jarchow, Theo. '28 E
Jensen, John A. '05 C
Jerabek, Henry S. '26 ChE
Johnson, Alphonse N. '21 C
Johnson, Clinton J. '29 M
Johnson, Edgar W. '14 C, '15 CE
Johnson, Elmer W. '14 E, '15 EE, '23 ME
Johnson, Enan C. '25 E
Johnson, Gustave F. '27 E
Johnson, Ira L. '16 M, '17 ME
Johnson, James P. '23 E
Johnson, L. '25 Ch
Johnson, Laurence E. '29 AE
Johnson, Paul (Laurence, Paul) S '12
Johnson, Robertson B. '25 E
Johnson, Theodore B. '29 C
Johnston, Charles K. '21 E
Jones, E. J. '21 ChE
Jones, George R. '14 E, '15 EE
Jones, I. V. '15 C
Judd, Maurice D. '23 C
Kameda, Tohru '26 ACh
Kaplan, Seeman '18 A
Kappel, Frederick R. '24 E
Karatz, Lucian '12 Ch
Katter, Calvin K. '22 M
Katter, Reuben L. '22 M
Kinsell, William L. '00 E
Klass, Fred '19 E
Kline, Frank W. '24 E
Kline, Marvin L. '29 AE
Knoll, Franklin O. '25 E
Knutson, Melvin I. '28 M
Kobe, Kenneth A. '26 ChE
Kopplin, C. Donald '28 C
KranzFelder, Robert H. '26 AE
Krefting, Arthur S. '26 C
Kritzer, Louis M. '28 E
Kronick, T. Gerald '26 A
Kuempel, Leo L. '29 M
Kvitrud, Ingwald '11 C
Lagaard, Alex S. '13 E, '14 EE
Lambert, Edwin M. '09 M
Lang, Charles A. '96 E
Langland, Harold S. '19 E
Larson, Amandus C. '20 C
Larson, Carl '16 C
Lauer, Walter M. '24 PhD
Lavine, Irwin '24 Ch
Leach, Stowel D. '29 A
Lebeck, Carl E. '20 C
Lebeck, Torarin E. '24 C
Lee, Melville R. '21 ChE
Lee, Oscar C. '19 E
Leegard, Clifford '29 M, '24 MS (CE) '27 CE
Lerrskov, Gerhard W. '21 ChE
Leonard, Thomas K. '15 C, '16 CE
Levens, Alexander S. '22 C, '24 MS (CE), '27 CE
Levin, Jake M. '18 E
Lewis, Sherman W. '26 C
Lewis, Lloyd W. '27 E
Liebenberg, J. J. '16 A
Lindstedt, Philip G. '26 C
Liu, Maolin '29 E
London, William '29 E
Looks, Roger '27 C



Minneapolis
Lowther, Wilfred W. '27 M
Loye, Percival E. '21 E
Luethi, Carl F. '27 C
Lund, Earl H. '22 C, '23 CE
Lund, Roy V. '24 C
Lund, Stanley D. '27 C
Lundgren, Carl W. '26 M
Lundquist, C. Vernon '23 M
Lundquist, Wilton '28 M
Lutz, Richard E. '15 E
Lux, Lester L. '27 Ch
McClung, Karl '25 E
McCullough, Bruce M. '16 C
McDonnell, L. P. '27 E
McGladrey, Lyle '28 M
McIlvaine, Wm. D., Jr. '29 E
McKee, John B. '25 Ch
McKenzie, Leonard F. '20 E
McLeland, Lyle K. '24 E
McMillen, E. L. '23 Ch
McNally, Lee '28 C
MacGregor, Helen '25 ID
Magney, Hilding O. '24 E
Mann, Fred M. '93 C, '98 CE
Manuel, Douglas R. '22 ChE
Markoe, James C. '12 M
Marshall, Chester R. '23 M
Mattison, Oliver '05 C
Mayer, Harris J. '14 M, '15 ME
Meili, Rudolph E. '22 G
Merrill, Lewis R. '20 M, '21 ME
Meyer, Herbert W. '14 E
Miller, Marvel P. '28 M
Miller, William S. E. '27 E
Mindrum, Arthur I. '26 E
Mitchell, Donald F. '20 ChE
Mixer, Walter R. '17 A
Molakness, Nels S. '20 E
Moore, Clarence '28 G
Moore, Gordon B. '27 E
Morton, Harold S. '12 M, '13 ME
Morton, Harry G. '04 E
Mowery, Clarence W. '08 C
Moyer, A. F. '10 M
Nason, George L. '10 C
Nelson, Arthur '28 M
Nelson, Clarence E. '27 E
Nelson, Clarence H. '25 E
Nelson, Clarence L. '20 E
Nelson, Erling '29 A
Nelson, Gustaf A. '19 E
Nelson, Harry G. '18 Ch
Nelson, Neal N. '27 AE
Nelson, Nels B. '04 C
Nelson, Oscar B. '05 C
Nelson, Richard L. '21 E
Nelson, Robert B. '26 E
Nelson, Thorwald E. '10 M
Nemec, Frank L. '09 M
Neubauer, Loren W. '26 C
Newhall, William R. '00 M
Nicholson, Edward '25 E
Nickerson, Edward '25 E
Nielson, Eunice V. '23 A
Nissenson, Phineas P. '29 E
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
Nygard, E. M. '21 Ch
Nyvall, Clifton S. '26 C
Olmstead, Charles '22 M, '23 ME
Olsen, Leslie R. '15 Ch
Olsen, Melvin S. '08 C
Olson, Edwin E. '25 A
Oman, Lloyd L. '29 E
Orning, Harold '26 E
Orr, George M. '15 M
Osburn, Roy W. '27 E
Otterstein, Earl F. '13 Ch
Otto, Robert W. '04 M
Ovestrud, Melvin '13 M, '14 ME
Pagel, H. A. '23 MS Ch
Parker, Helen R. '25 ID
Parker, Robert M. '24 C
Parry, John E. '26 E
Parten, Carl D. '27 M
Paul, Frederick T. '09 C
Pelley, Lloyd L. '24 E
Pesek, Cyril P. '25 AE
Peters, Chas. M. '27 E
Peterson, Everett L. '25 A
Peterson, Harold W. '21 E
Peterson, Henry '13 ChE
Peterson, Lewis E. '25 C
Pfeifer, Otto J. '29 M
Pilger, Clarence L. '27 E
Platzer, Geo. J. '27 C
Pratt, B. A. '15 C
Prendergast, Arthur '03 C
Prichard, Charles E. '25 C
Priedeman, George W. '08 M
Prues, Christian K. '27 C
Quiggle, Arthur W. '13 C, '14 CE
Quinn, Edward I. '25 C
Rademacher, Richard L. '23 ChE
Ramey, John M. '28 AE
Raugland, Arnold I. '20 A
Reidhead, Frank E. '93 E, '98 EE
Reiter, A. A. '25 Ch
Rhoades, Herbert E. '26 E
Riley, Philip J. '21 Ch
Ritchie, John R. '16 M, '17 ME
Robertson, E. J. '14 E, '15 EE
Robertson, Haney H. '28 M
Robinson, Parke D. '25 M
Robinson, Rhea B. '12 Ch
Rockwell, Harvard S. '14 C
Roe, Harry Burgess '08 E
Rollin, Harold '26 M
Roos, Frank T. '24 C
Rosendahl, Harold R. '22 M
Ryan, Robert M. '23 E
Ryan, W. T. '05 E
Salisbury, Willis R. '10 G
Sarver, Landon A.
'15 BA, '19 MA, '24 PhD
Scandling, Joseph E. '25 ChE
Schavone, Anthony P. '28 E
Schermer, Oscar C. '21 ChE
Schilling, Theodore '24 E
Schlafge, Wm. H. '26 ChE, '27 KE
Schlenk, John J. '23 C
Schow, Garfield G. '24 E
Schultz, Albert W. '27 E
Schweiso, Clifford C. '23 E
Scott, Herbert L. '23 E
Sebo, Arthur O. '24 M
Seeman, Ernest '20 C
Seyfried, Lillian M. '17 Ch
(Mrs. W. H. Hunter)
Shaver, George J. '25 E
Shenehon, Francis '95 C, '00 CE
Shepley, Charles R. '02 C
Shifflet, Glynne W. '29 A
Shippam, Willis '09 M
Shoemaker, Douglas H. '29 C
Siegmann, Chester W. '28 E
Silverman, Emil '22 C
Silverman, Isadore W. '24 A
Sinnott, I. G. '29 M
Siverson, Sigvel J. '11 C
Siverts, Samuel A. '09 C
Skanse, C. Theo. '29 M
Skurdalsvold, P. '15 C, '16 CE
Smeby, Lynne C. '28 E
Smith, Harold D. '25 E
Snyder, Dorothy E. '26 M
Sorenson, B. E '24 MS
Sosinik, Edward J. '22 C
Smith, W. A. '12 C, '13 CE
Springer, F. W. '93 E, '98 EE
Sprang, M. M. '25 Ch
Stephens, Clifford '23 C
Stephenson, Oliver H. '07 M
Sternberg, Heime A. '21 ChE
Stevens, Everett B. '25 M
Stier, Ruth I. '25 Ch
Stolte, Sidney L. '27 AE
Stone, Charles W.
'16 M, '17 ME, '19 MS
Stone, Leslie F. '23 ChE
Stoppel, Arthur E. '20 ChE
Sullivan, Betty '22 Ch
Sutter, H. M. '11 Ch
Swendsen, George P. '08 E
Swanson, Carl E. '27 E
Swanson, Carl E. '28 E
Swanson, Edwin W. '19 E
Swanson, Paul H. '23 C
Swanstrom, Frank N. '08 E
Swedberg, M. Roy '11 C
Swenson, Gustav A. '20 G
Swenson, H. Seymour '12 C, '13 CE
Taplin, George C. '24 E
Tebo, Frank '28 C
Thayer, Charles E. '76 C
Thorshov, Roy N. '28 A
Thorson, Stuart '19 Ch
Thwing, George '28 C
Tighe, James S. '26 E
Timperley, William D. '10 C
Tindall, Jesse E. '25 ChE
Tinkham, Willis M. '14 ChE
Todd, Milo E. '09 E
Torrance, Ell '09 C
Trask, Alfred S. '23 E
Trask, Birney E. '90 C, '94 CE
Trousou, John L. '26 ChE
Tryon, Philip D. '17 C
Tucker, Carl W. '26 M
Tupper, Charles E. '15 M
Turner, Roy H. '15 E, '16 EE
Undine, Eugene A. '29 IA
Ungerman, Carl M. '06 E
Untinen, August L. '25 E
Upton, Albert '25 E
Vincent, Jay C. '03 E
Von Stecker, Selmar '28 M
Walby, Arthur C. '11 C
Walker, George W. '08 C
Wallfred, Carl L. '20 ChE
Walling, Benjamin B. '09 E
Wanless, Lynn A. '12 Ch
Watson, Fred O. '16 C
Webber, Fredrick W. '97 ChE
Weber, Ludwig J. '24 Ph.D
Webster, Cora H. '23 Ch
Weigel, Howard N. '14 C, '15 CE
Wentz, Walter W. '14 E, '16 EE
Werdenhoff, James H. '21 C
West, Jane '29 IA
Westerberg, Carl George '21 Ch
Westigard, Glenn A. '25 E
Weyer, H. R. '29 E
White, Robert H. '23 ChE
Whited, Oric O. '98 Ch
Whitney, Alfred C. '03 G
Wilcox, Hugh B. '14 E, '16 MS
Wilhoit, Albert D. '06 Ch
Wilkinson, Gladness B. ID '27
Wilson, Charles A. '22 C
Wilson, Eliel '01 M, '02 E
Woodrich, Oscar '08 C
Young, Donald '29 M
Young, Edward F. '26 C
Zeidlik, William J. '25 Ch
Zeuthen, Victor C. '29 C
Ziegler, Mildred R. '15 Ch
Zima, Albert G. '24 ChE

Montevideo
Lewis, Berkeley R. '25 E
Scott, Lawrence '15 E, '16 EE

Montgomery
Soulek, Joseph H. '11 E

Moorhead
Hopeman, Albert M '05 C

Moose Lake
Handschu, C. E. '15 C

Mora
Hanna, Cyril C. '26 M

Newport
Knight, Ralph J. '15 C

New Ulm
Bockus, Gerald H. '22 E
Robertson, Charles N. '08 C
Witt, Edward H. '29 E

North Hibbing
Lundquist, John V. '23 E

Northfield
Barrows, Vera '17 MS
Cornell, Reuben W. '22 ChE

Oak Terrace
Greene, Alfred B. '24 E
Lorenz, Ed R. '26 C
Rathburn, George A. '24 M

Olivia
Kircher, Frank J. '09 M
Kircher, Geo. A. '09 M

Owatonna
Aultfather, David '22 E
Hosfield, Raleigh '12 C
Sweeney, Frank C. '28 E

Pelican Rapids
Ranger, Donald R. '24 C

Perham
Pancratz, Frank J. '08 E

Pine City
Peterson, Volgar '28 E

Plainview
Askew, Thomas A. '16 C

Prior Lake
LeVesconte, L. B. '26 E

Proctor
Bohannon, George W. '26 M
Maney, James E. '26 M
Matzke, Walter W. '29 M

Raymond
Haima, Mark '25 C

Red Wing
Cook, Harry C. '10 M
Gustafson, R. F. '27 A
Josephson, Eliot B. '10 E

Red Wood Falls
Burmeister, Charles '27 E
Clipiell, Carroll D. '05 M

Rochester
Aldrich, Louis W. '23 C
Boyce, Ellsworth R. '17 C
Bross, Peter P. '25 A
Buenger, Edgar '19 A
Heck, Frank J. '19 Ch, '24 MS
Leonard, Aubrey C. '23 C
Nelson, Mark L. '24 A
Pagenhart, Clarence C. '12 C

Rush City
Strom, Arthur '23 A

Rushford
Engh, Harris S. '24 M

Sauk Rapids
Gross, Leon A. '26 E

St. Cloud
Jurgens, C. R. D. '12 C, '13 CE
Swenson, Clarence Q.
'17 M, '20 ME
Wichman, Martin F. '22 E

St. James
Slaby, Louis J. '26 M
West, John C. '15 C

St. Paul
Abrahamson, Howard B. '17 M
Albrecht, Ernest G. '25 EE
Amidon, Roger '28 C
Anderson, H. M. '20 M
Anderson, M. M. '20 ChE
Anderson, Walter W. '29 C
Andrews, George L. '05 M
Arnesen, Herbert F. '11 C
Aune, Roy '22 M
Bachmann, Graydon A. '23 M
Backe, Edmund '24 ChE
Baker, Russel E. '11 ChE
Banovetz, John A. '25 C
Barlow, Harry E. '03 C
Barnaby, William E. '09 Ch
Barrett, Joseph O. '22 ChE
Barthelemy, Carl R. '28 M
Beaudon, Lawrence '28 C
Beck, Hiram D. '26 M
Beese, Harold U. '25 C
Bennett, John C. '26 M
Bennett, Walter J. '03 C
Bescler, Herman F. '28 M
Bingham, Stanley E. '08 M
Bird, Harold E. '25 C
Bisbee, Bertin A. '22 E
Biskup, Wm. F. '16 C
Blackshaw, Joe L. '28 M
Bohland, John A. '15 C
Borne, Floyd '27 C
Borst, Wellington L. '24 M
Boss, Ronald W. '28 M
Bowers, Raymond J. '28 M
Boyles, Ralph R. '15 M, '16 ME
Brockway, Royden R. '05 C
Brohaugh, Gustave C. '27 C
Bruess, Edward C. '29 M
Buenger, Albert '13 M, '14 ME
Bumgardner, Louis T. '23 E
Burch, Cecil J. '29 C
Carlson, Arvid P. '17 M
Carlson, Ernest '22 M
Carlton, Richard P. '21 G
Chapman, Leslie H. '95 C
Chapman, Wilbur J. '27 M
Christlieb, Frank B. '23 C
Collis, N. Stuart '24 M
Comfort, Clifford E. '26 M
Cooley, Gilbert '22 E
Corl, Cady S. '21 Ch
Crawford, Allen S. '12 M
Curry, Ezra Benham '20 M, '21 ME
Dahlen, Miles '24 ChE
Darrell, James E. P. '23 C
Daum, H. Arne '12 E
Davidson, John E. '28 AE
Davis, Gilbert M. '04 M
Dawson, John W. '22 A
Deegan, Raymond C. '26 C
Dehn, Eltur '21 C
Deschner, Richard E. '29 M
Deutsche, Richard E. '18 C
DeWitt, Joseph H. '10 Ch
Dills, Lyle A. '21 G
Dimond, Grover W. '12 C
Dimond, Harvey G. '14 C
Dougan, Henry K. '08 C
Dungay, Herbert F. '25 C
Dunnigan, M. H. '16 Ch
Dunning, Robt. M. '23 M
Duvall, Arndt J. '25 C
Edwards, W. H. '27 A

St. Paul

Eggleston, Smith '23 M
Ellison, Jay '09 C
Engquist, Victor E. '20 E
Erickson, Clarence P. '25 A
Erickson, Hugo '23 C
Felton, Elmer T. '13 Ch
Feyder, William H. '05 C
Finley, Joseph E. '05 C
Fiske, Frederick W. '09 C
Fleming, Frank R. '08 M, '09 EE
Flygare, August L. '12 C
Forsberg, Elmer J. '21 M, '22 ME
Francis, Paul E. '18 M
Fraser, Carlisle G. '22 C
Frenzel, Herman '26 A
Fuhrman, Alvin O. '24 ChE
Gage, Hugh N. '08 C
Garen, George M. '10 C
Gehrenbeck, G. R. '28 ChE
Gessert, George R. '07 M
Giertsen, Marcus O. '12 C, '13 CE
Gille, Willis H. '29 E
Gilstad, Arthur '23 M
Goebel, Rudolph C. '13 E, '14 EE
Goldberg, Maurice '23 E
Goldberg, W. M. '28 Ch
Goodkind, Leo '92 A
Greenberg, Morris '18 M
Grime, Edwin M. '00 C
Gurrin, George V. '24 C
Guesmer, George O. '24 C
Guesmer, Marie W. '26 ID
Gustafson, J. M. '28 C
Haberle, Edward '12 C, '13 CE
Haeberle, E. H. '06 E
Halvorsen, Henry A. '11 Ch
Hamilton, Sam '28 E
Hansen, Carlos C. '20 C
Hansen, Christian '10 E
Harris, Harold R. '14 E, '15 EE
Hartigan, James J. '29 C
Hatch, Lloyd '23 ChE
Havens, Paul M. '27 A
Hayden, C. E. '24 C
Heck, Frank J. '19 Ch
Hedenstrom, Ernest A. '12 E
Heinemann, G. '29 ChE
Hendricks, Clifford '25 C
Hendrickson, Norman '16 C
Hennessy, Hugh J. '11 Ch
Hewett, Maurice W. '13 C, '14 CE
Hill, Hilbert M. '23 C
Hiner, Walter G. '23 C
Hoff, Christopher '06 E
Hoffman, Henry J. '12 Ch
Hoffman, Michael J. '11 C
Hoisveen, Leonard '25 M
Holder, Laurence E. '24 C
Hosmer, Orville H. '23 C
Hovden, Conrad D. '12 E, '13 EE
Hovik, Lawrence E. '29 A
Hoving, John E. '27 C
How, Francis W. '27 C
Irons, George '26 E
Jacobson, Ruben A. '25 M
Johnson, Carl A. '21 M, '22 ME
Johnson, Elmer '11 Ch
Johnson, Laurence V. '27 C
Johnson, Nels '23 C
Jones, Edwin F. '17 M
Jones, Gordon '28 AE
Joyce, Floyd E. '17 Ch
Kampa, Edmund F. '23 Ch
Kastner, Arthur H. '27 A
Kearney, Adrian A. '23 E
Keeler, Jasper F. '22 C
Kennedy, Wm. W. '07 Ch
King, Lawrence W. '09 C
King, Wesley '05 C
Koch, Arthur Louis '19 ChE
Koch, Karl L. '23 E
Kochendorfer, Milton J. '05 E
Kopp, David '28 C
Kopper, Edward '14 M, '16 ME
Krauch, William '08 C
Kryger, Edward R. '21 Ch
Kugler, Joseph H. '26 ChE
LaBonte, Anton '23 C
Lambert, F. T. '02 C
Lang, Fred C. '08 C
Larson, Albin '14 C
Larson, Martin S. '11 M
LeBlond, Edmond J. '05 E
Levy, Max L. '26 E
Lexau, Ole '28 C
Lewis, Edward B. '05 M
Lewis, Geo. R. '21 M
Liese, Herbert W. '24 C
Lighter, Clyde W. '26 A
Lilly, Clarence W. '17 E
Lilly, Eugene '19 G
Livermore, Harry J. '23 ChE
Lockhart, H. A. '29 E
Loeffler, Henry S. '14 E, '15 EE
Logue, John F. '24 M
Lohmann, Ann N. '27 Ch
Lovering, Harry D. '13 C, '14 CE
Lux, Arthur E. '16 E
McCauley, John S. '29 C
McCartney, Floyd A. '13 M
McConnell, J. R. '29 ChE
McCree, Andrew A. '08 C
McCubrey, Everett J. '21 C
McMiller, Paul R. '11 Ch
McPherson, William B. '02 E
Macgowan, Irvin '25 C
Mackintosh, William S. '21 C
Malloy, Charles J. '06 C
Malmberg, Victor '20 C
Malmgren, Richard '25 E
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
Mayhugh, Ben F. '28 M
Meixner, Bernard A. '10 M
Mertz, Karl J. '14 E
Meskal, George '23 C
Methven, Clyde '11 C
Miller, Erwin J. '11 C
Miller, George W. '20 E
Miller, William C. '16 M
Miller, William J. '24 E
Mintz, Nathaniel '22 E
Mitchell, John B. '09 C
Moiseeko, Wm. '29 M
Moore, John H. '24 M
Moorman, Albert J. '18 A
Moorman, Frank S. '22 A
Motl, Charles L. '10 C
Muller, Carl C. '18 M
Nasvik, Adolph '26 C
Nelson, Edward S. '09 C
Neville, Earle L. '20 C
Nicholson, H. G. '22 ChE
Nolan, George C. '27 E
Nordstrom, Carl T. '14 C
Norton, Clyde W. '08 M, '09 ME
Nye, Lillian L. '10 Ch
Ofelt, George R. '27 E
Okes, Day I. '08 C
Okes, Sidney B. '09 C
Olson, Arthur O. '11 Ch
Olson, Clarence C. '28 C
Olson, Clarence E. '22 G
Oltman, Charles A. '03 C
Ott, Leonard E. '15 C
Owens, Leo E. '11 M
Palda, Charles H. '22 C
Parkin, Guy G. '12 Ch, '13 Ch
Pause, Harold A. '23 E
Peckham, Harold E. '23 M
Pennock, Ed M. '05 AE
Person, Otto '24 AE
Peters, Walter C. '22 M
Peterson, A. M. '14 E
Peterson, Harold C. E. '25 C
Peterson, Marshall A. '21 ChE
Pinska, Lawrence F. '22 C
Pohl, Loren F. '27 C
Poulsen, George F. '17 A
Rauen, Theodore '26 ChE
Rauscher, Paul F. '27 E
Reardon, John M. '22 C
Redin, R. K. '26 AE
Rigg, Alvin E. '25 A
Ringstrom, Ivan G. '12 BS, '13 EE
Rockwood, Ralph H. '12 Ch
Roe, Chas. P. '29 CH
Roehrich, Victor '09 ChE
Roth, Lewis M. '11 C
Rufsvold, Olav M. '15 C, '16 CE
Santelman, Ralph H. '27 C
Schaller, Geo. C. '23 C
Schroepfer, Geo. '28 C
Shepard, George M. '09 C
Sickel, Edwin C. '23 E
Skagerberg, Rutcher '15 E, '16 EE
Skon, Herman W. '15 M, '16 ME
Slade, Loring '22 C
Smith, Sheldon H. '10 ChE
Snow, Clarence J. '14 M, '16 ME
Souther, M. Edwin '12 C, '13 CE
Speer, Paul B. '27 E
Spehr, Peter E. '27 M
Stanton, Raymond E. '04 M

ST. PAUL
- Stewart, C. H. '03 C
- Streich, Harry C. '12 E
- Swenson, G. W. S. '28 Ch
- Swenson, Theodore J. M. '12 E
- Swift, Donald C. '24 E
- Tallmadge, Everett S. '14 E, '15 EF
- Tauber, Jos. '28 C
- Teberg, Lawrence E. '22 C
- Tews, Arthur W. '24 C
- Thomas, William A. '17 E
- Thompson, Claudius '22 C
- Thompson, Niles J. '27 E
- Thompson, Theodore S. '24 C
- Toncheff, Stanil T. '15 Ch
- Tuebesing, Norman F. '27 M
- Vievering, Wm. A. '25 Ch
- Villaume, Walter F. '23 C
- Walder, Ted N. '25 C
- Waldron, Ralph E. '20 E
- Waterons, 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
- Wesm, Laurel A. '27E
- Whitman, Edward A. '00 C
- Williams, Fred J. '17 E
- Willis, Roy '08 C
- Wilson, Frank W. '23 E
- Winslow, Raymond M. '19 ChE
- Wolf, Milton C. '25 C
- Wolfangle, Raymond J. '17 C
- Wolff, William S. '15 M, '16 ME
- Woolman, Harry D. '24 M
- Wunderlick, Milton S. '19 M, '20 ME
- Yager, Louis '07 C
- Youngquist, Eder B. '25 C

ST. PETER
- Skartvedt, Peter M. '06 Ch,'13 Ch

SLAYTON
- Price, John R. '14 C

STAPLES
- Ainslie, Arthur F. '11 C

STEVENSON
- Quine, William M. '26 E

STEWARTVILLE
- Beach, Geo. H. '27 E

STILLWATER
- Ageton, Edwin O. '26 E
- Englin, Charles F. '06 E
- Reutiman, F. R. '29 M
- Webber, Clyde '27 E

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, A. G. '05 M

TYLER
- Johnson, Anton A. '24 A

VILLARD
- Meyerdick, Clarence '26 C

VIRGINIA
- Sannicolo, Joseph F. '22 E
- Whitten, Robert C. '25 M

WABASHA
- Berry, George F. '24 M

WACONIA
- Wessale, George '21 E

WADENA
- Imsande, Fred '25 C

WASECA
- Johnson, Edgar F. '21 E
- Zimmerman, Louis P. '08 E

WHEATON
- Heggen, Reuben '24 E

WILLMAR
- Peterson, Randall '28 E
- Swenson, Charles A. '17 M, '20 MA

WINONA
- Boyum, Benjamin O. '10 C
- French, William O. '25 M
- Grettum, Leroy A. '23 E
- McAndrews, Harry '25 C
- Miller, Archibald T. '24 E

MISSISSIPPI

JACKSON
- Kroeze, Herbert A. '19 G

LAUREL
- Nee, Harold E. '24 E

UNIVERSITY P. O.
- Woolett, Guy H. '10 Ch

MISSOURI

GASCONADE
- Chapman, Burton L. '10 C

JEFFERSON BARRACKS
- Sullivan, Frederic V. '25 C

JEFFERSON CITY
- Espenett, Edward L. '22 C
- Sverdrup, Leif J. '21 C

KANSAS CITY
- Didriksen, Phillip '20 E
- Edey, Francis E. '29 E
- Glass, Clifton A. '98 C
- Halden, Herbert O. '23 M
- Hayward, L. W. '21 E
- Johnston, C. L. '25 Ch
- Kiesner, Frank C. '24 M
- Langman, H. R. '24 M
- Luedeman, Clarence H. '23 AE
- Swanson, Clifford L. '22 C
- Tibbling, Ernest F. '14 Ch
- Wright, Harris H. '09 M

KNOB LICK
- Rydeen, Francis G. '05 M

MARSHALL
- Pettijohn, Earl '11 Ch, '12 Ch, '19 PhD

MT. GROVE
- Hummell, Carl A. '26 E

NEW LONDON
- Glascock, Henry H. '06 E

ROLLA
- Eyberg '29 C

ST. JOSEPH
- Grant, Elberth R. '24 C

ST. LOUIS
- Brick, B. R. '29 Ch
- Haines, Allen K. '13 E
- Johnson, Noah '94 C
- Hawkey, H. K. '19 ChE
- Krantz, Rudolph W. '24 ChE, '25 MS
- McCann, Realino V. '27 A
- Oscarson, Gerhard L. '22 E
- Read, Leland B. '29 M

SPRINGFIELD
- Acker, Sol H.

TROY
- Ball, Hampton B. '20 M

WILLOW SPRINGS
- McDaniel, Loran '23 C

MONTANA

BILLINGS
- Berg, Karl A. E. '20 C
- Coleman, Frank D. '03 E

BOZEMAN
- Thaler, James A. '00 E

BRIDGER
- Coon, Lawrence C. '26 E

BUTTE
- Jordan, Frank W. '19 E
- Pratt, Arthur C. '99 E
- Rolfe, West A. '13 C
- Stussy, William '00 E

DEERLODGE
- Baker, Arthur W. '19 M

GLENDIVE
- Adams, Benjamin W. '10 C

GREAT FALLS
- Dow, James C. '00 E
- Fagan, E. T. '16 MS
- Hougan, Sander '21 E
- Sheire, James R. '28 E

HAVRE
- Haverson, Henry D. '07 C

HELENA
- Kivley, Warren O. '16 C

NEBRASKA

CRETE
- Hawlek, H. I. '19 C

LINCOLN
- Lund, Clarence V. '26 C

OMAHA
- Bunce, Paul F. '06 E
- Christensen, Edgar W. '19 E
- Eddy, Horace T. '95 E, '96 EE
- Johnson, Gustav A. '23 E
- Sampson, Cliff. L. '23 E, '25 EE
- Schneckloth, Harry H. '25 E
- Skareid, Charles T. '24 E
- Teal, Clarence W. '24 E
- Weeks, Leonard H. '27 E
- Wilcox, Halsey H. '15 E
- Zimmer, William A. '96 E

UNIVERSITY PLACE
- Japs, Barney G.

NEW HAMPSHIRE

BERLIN
Burningham, F. A. '17 ChE
HANOVER
Hartshorn, Elden B. '22 PhD

NEW JERSEY

BLOOMFIELD
Widell, E. Gideon '17 ChE
CAMDEN
Berglund, Erick '27 E
Burrill, Charles M. '23 E
Corson, Benjamin I. '17 Ch
Hargrave, W. A. '26 E
CARTERET
Kerns, Clinton B. '15 M
CLIFFWOOD
Sharpless, Wm. M. '28 E
EAST ORANGE
Chapman, A. G. '11 E
Wright, Roydon V. '98 M
HARRISON
Anderson, Oscar P. '10 E
Wyman, I. R. '22 Ch
IRVINGTON
Prehn, Victor N. '27 E
JERSEY CITY
Mikesh, Martin A. '12 M, '13 ME
KEARNEY
Dowd, Archie J. '19 M
Franzen, Roy O. '25 E
Pangburn, Carroll '22 E
Peterson, Vance C. '20 E
Steffens, Robt. A. '22 E
Vardahl, Victor E. '29 E
Waligoski, A. Arnold '24 E
KENVIL
Kurtz, Kerwin K. '28 ChE
MONMOUTH
Hoorn, Frederick W. '12 E, '14 EE
NEW BRUNSWICK
Moore, Norman '25 C
Von Kuster, Edith I. '07 Ch
(Mrs. W. Johnson Kenyon)
NEWARK
Burke, James '28 M
Cherne, Realto '29 M
Frederickson, Harry B. '11 E
Fritzberg, Hilding L. '28 M
Johnson, Welton V. '26 E
Nelson, Chester '19 M
Rose, Anton R. '04 Ch
PERTH AMBOY
Johnson, Lester L. '25 ChE
Kohlhase, Arthur H. '21 Ch
Paulson, Paul M. '23 ChE
Temple, Sterling N. '05 PhB
PHILLIPSBURG
Dey, Phillip S. '29 M
RAHWAY
Johnson, L. L. Ex '29
RED BANK
Sharpless, Wm. M. '28 E

NEW MEXICO

ALBUQUERQUE
Larson, Fred '25 C

NEW YORK

ALBANY
Bauer, Roscoe W. '24 C
ARLINGTON
Larson, Harold O. '29 E
ATTICA
Anderson, Ed I. '17 M, '19 ME
BAY SHORE
McCullough, Robert T. '23 E
BROOKLYN
Daly, Richard T. '21 C
Ely, Irving R. '05 E
Moe, Claude F. '20 Ch
Stoppel, Ernest A. '11 Ch
Sushan, Harry M. '19 C
BUFFALO
Bakken, Adolph C. '23 Ch
Crock, Jacob H. '20 M
Hammer, G. E. '20 Ch
Johnson, Carl S. '21 C
Jules, Harold A. '28 E
Kelsey, Howard C. '22 M
Luit, G. W. V. D. '17 Ch
Pendergast, Webster G. '25 M
Sverdrup, Edward F. '26 ChE
Swanson, Oscar E. '15 C, '16 CE
CANAJOHARIE
Mastin, M. F. '13 Ch
CHENANGO FORKS
Harshaw, John R. '12 Ch
FULTON
Korfhage, Roy F. '20 Ch
GARDEN CITY
Boyd, Paul M. '24 M
ITHACA
Barr, John H. '83 M, '88 MS
Fraser, George '19 A
LONG ISLAND CITY
Plumber, Clayton '20 Ch
Wagner, Otto H. '07 M
MASSENA
Heath, Arthur C. '25 M
MT. VERNON
Hiers, Charles R. '24 M
Loye, Edwin M. '20 A
NEW YORK CITY
Abbott, Arthur L. '97 E
Anderson, Fayette C. '24 E
Backstrom, Emil F. '24 A
Bauer, Ruben B. '20 E
Benner, R. C. '02 Ch
Berg, Samuel A. '21 BA, '21 E, '22 EE
Bierman, Harry C. '14 ChE
Bolme, Ole N. '10 C
Bonner, Arthur L. '27 E
Boman, Carl E. '05 E
Bosshardt, Willmert C. '22 E
Bouman, Bernard M. '04 E
Brattlof, Clifford '27 C
Brayden, Giles W. '27E
Buhl, John E. '09 M
Burns, Harvey L. '02 E
Cameron, Grace '27 I
Cannenberg, Walter E. '23 E
Case, Gerald F. '23 E
Cheney, Edward J. '04 E
Clark, Charles J. '29 E
Cousins, Van Meter '25 E
Covell, Russell O. '16 E
Crabbe, George N. '04 E
Craig, Robert '97 M
Dahl, Harold W. '24 E
Demarest, Charles S. '11 E
Eckberg, Curtis '24 E
Ellestad, Irwin M. '22 E
Elmer, Lloyd A. '21 M
Emerson, Lynn A. '11 E
Fox, Claire C. '29 E
Gannett, Danforth '16 E, '17 EE
Gerlach, Henry C. '22 A
Goodner, T. C. '29 E
Gregg, Tresham D. '05 G, '06 CE
Hakenjos, Fred M. '29 A
Heins, Harold '25 E
Hilferty, Charles D. '96 M
Hollen, Edward O. '23 A
Houts, Guy J. '01 E
Hubbard, Henry A. '09 C
Ireland, Ray R. '03 E
Johnson, Elving L. '23 A
Johnson, John E. '11 E
Juran, Nathan H. '29 A
Koepke, Walter E. '13 C, '14 CE
Koerner, W. M. '28 E
Kokatnur, Vaman R. '14 Ch
Kuhlman, Rudolph H. '23 M
Laird, Lee R. '03 E
Landeen, Arvid G. '10 E
LeTourneau, Edward H. '05 E
Lieb, Janet '29 IA
Lockwood, Raymond '20 E
Luger, Karl E. '22 ChE
McKay, Earle D. '15 C, '16 CE
Magnon, 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
Mueller, Robert '29 E
Myers, Mortimer '97 E
Nelson, Chester '29 M
Norcross, Arthur F. '07 E
Olson, Richard H. '19 E
Olstad, Oscar A. '11 M
Otto, Frederick A. '04 E
Owens, R. R. '29 E
Puss, John A. '29 AE
Robertson, Phillip W. '01 M
Rohrman, F. A. '27 ChE
Schottler, George J. '23 E
Simons, Walter W. '16 E
Smith, Donald C. '13 E
Strothman, Russell A. '20 E
Swenson, Karl P. '06 G, '07 MS
Thordarson, Wm. '23 ChE
Thorne, Donald '23 E
Thuros, Albert L. '12 E, '13 EE
Thyberg, Clarence W. '25 E
Vye, George F. '27 M
Wahlquist, Hugo W. '21 E
Wentz, Clarence A. '27 C
Wheeler, Herbert H. '17 E
Wiggins, Gerald G. '06 E
Williams, Fred M. '05 E, '09 EE
Willner, William E. '22 A
Woodman, J. C. '11 M
Zimmerschied, Clarence R. '23 E
NIAGARA FALLS
Dobrovolny, Frank J. '24 Ch
French, Edwin L. '02 E
Graling, Verney '99 E
Jackman, R. F. '29 Ch
Marr, Horace S. '19 Ch
Yngve, Victor '17 PhD
NORWICH
Moris, Russel F. '25 C
POUGHKEEPSIE
Kilbourn, E. I. '27 MS
Mann, Alvin K. '26 E
RIVERHEAD
Braaten, Arthur '28 E
ROCHESTER
Eaton, Wentworth Ch E
Matthews, Glenn E. '20 Ch
Nietz, Adolph '15 Ch
Savage, Edward S. '97 M
Seymour, M. W. '21 Ch
SCHENECTADY
Allee, David A. '02 C
Anderson, Lowell W. '26 E
Beardmore, Albert '21 E
Boe, Lester L. '25 E
Bottemiller, Edward L. '27 E
Downie, John M. '22 E
Dunham, Roy O. '14 E, '15 EE
Dybvig, Lloyd S. '29 AE
Edgar, Robert F. '27 E
Engstrom, Elmer W. '23 E
Fallon, Eugene L. '14 E, '15 EE
Fiene, Marcus '26 E, MS EE '28
Forsberg, Peter W. '11 E
Freeman, R. C. '29 E
Grobel, Lloyd P. '24 M
Haedecke, August D. '26 E
Harris, Gordon C. '29 E
Hartley, Lowell J. '26 E
Hathaway, Herbert F. '28 M
Heinemann, John R. '19 E
Larson, Werner L. '28 M
Lee, Alfred H. '28 E
McCully, James '25 E
Marshman, Irving H. '24 E
Mittag, Albert H. '11 E
Murdock, George B. '26 E
Norgaard, Leon S. '27 E
Norberg, Hans A. '27 E
Rask, Louis G. '03 E
Redding, James '27 E
Riddell, John D. '28 E
Robinson, Laurence T. '26 E
Smith, Jerome C. '27 E
Tunnell, Clement R. '25 E
Warren, Laurence C. '24 E
Williams, W. Glenn '29 E
Wiltgen, Edward '00 E
Wyman, LeRoy L. '23 ChE
STATEN ISLAND
Grimes, David '19 E
Marshall, Donald '19 E
Temple, Sterling '17 PhD
SYRACUSE
Jones, Robert A. '15 E, '16 EE
Morris, Thomas C. '08 M
Moyer, Malcolm R. '09 M
WEST NEW YORK
Velz, Clarence '24 C
WHITE PLAINS
Adams, George F. '95 E
YONKERS
Rice, Edgar W. '02 Ch

NORTH CAROLINA

DUKE UNIVERSITY
Haines, Howard N. '22 A
GREENSBORO
Little, Alice V. '22 A
RALEIGH
Anderson, W. S. '23 Ch
Halvorson, John Oliver '07 Ch

NORTH DAKOTA

BISMARCK
Moses, Marlowe '27 E
CARRINGTON
Lee, Albert C. '27 E
CROSBY
Rosseau, Clifton C. '24 M
ELKTON
Kelly, William J. '26 E
FARGO
Bertossi, Clarence F. '25 C
Grafsland, Geneva '27 I
Jones, Paul W. '28 A
Juvrud, Edwin C. '17 E
Mikesh, Edward S. '22 M
Peterson, Albert L. '14 BS, '15 M
Sheffield, Fred W. '09 C
Stoutland, Oliver A. '22 C
Sunde, Conrad J. '26 OCh
Tarbell, William P. '22 C
von Sien, Ruth '28 ID
GRAND FORKS
Anderson, Edward X. '08 Ch
Gauger, A. W. '14 Ch
Harris, Elwin E. '22 Ch
Kilpatrick, Porter W. '27 A
Schulz, Elton A. '16 E
HILLSBORO
Anderson, Fred S. '29 C
MINOT
Huston, David B. '07 C
Molander, Edwin '25 A
Peterson, William W. '16 C
Williams, William R. '26 E
STANLEY
McGregor, Frazer A. '24 E
VELVA
Gerow, Theron G. '20 M
WILLISTON
Jackson, Myron B. '05 A. C.
WYNDMERE
Miller, Andrew L. 21 E

OHIO

AKRON
Gustafson, Hugo F. '28 M
Morris, Vlen N. '26 PhD
Peterson, Roy C. '29 M
Pettersen, Wilbur E. '28 M
Sanders, Paul A. '29 M
Rehfeld, Harold '29 ChE
Tronson, John L. '26 ChE, '28 MS
CANTON
Edmunds, A. M. '25 Ch
Hektner, Joel '17 M
Lang, George M. '27 E
Letson, Donald E. '26 M
CINCINNATI
Harrington, Marcy V. '24 C
Holt, Gunnard T. '28 E
Seestrom, H. E. '28 ChE
Young, Truman P. '26 C
CLEVELAND
Arneson, Lloyd O. '21 M
Berzelius, Carl E. '29 AE
Bierman, George H. '18 M, '19 ME
Briggs, Hiram K. '19 G
Conley, Wilfred E. '10 E
Cowin, Clifford Cecil '21 G
Crane, Eugene C. '12 M, '13 ME
Dever, Francis A. '20 C
Drinkall, John F. '19 E
Estep, Harvey C. '08 M
Etem, Victor '26 E
Gilman, Howard B. '17 A
Hinman, Charles H. '24 A
Johnson, Leonard T. '10 E
Larson, Walter J. '20 E
Lee, Albert A. '26 E
Lund, Jeffery L. '25 E
Nelson, Edgar M. '24 E
Ransom, Glen B. '22 E
Ronning, Norman B. '27 E
Salstrom, Paul S. '25 E
Sillman, Paul W. '28 C
Taylor, Lyman D. '13 E, '16 EE
Wald, Joseph H. '27 E
CLEVELAND HEIGHTS
Merriell, Elmer W. '12 E, '13 EE
COLUMBUS
Curtis, Verne '22 M
Engstrom, LeRoy '28 C
Moffat, George N. '19 M, '20 ME
Youngquist, Eder B. '25 C
DAYTON
Coates, J. Edwin '27 M
Hanson, Manford P. '29 M
Roberts, Dimon A. '27 M

FINDLAY
Robison, Archer R. '09 E
IVORYDALE
Cassel, N. S. '23 ChE
Hamlin, Lehan H. '21 M
Jewett, Ernest E. '25 ChE
Krantz, R. W. '23 MS
Shirk, Loren H. '26 ChE
Slaggie, Eucharius L. '26 E
KENT
Pettijohn, Earl '19 PhD
LIMA
Cutter, Francis C. '05 M
MANSFIELD
Gaalaas, George L. '26 E
Ginnaty, J. Robert '29 E
Kutchevar, Jos. F. '28 E
Langseth, Axel O. '22 ChE
Lee, Paul R. '27 E
Schliep, Carl J. '28 E
Thelin, Ruben E. '28 E
Wieland, Willard '25 E
MARION
Barron, John H. '26 E
Brose, William C. '25 C
NOVELTY
Madsen, Olav '20 G
SPRINGFIELD
Keller, Raymond W. '25 E
Moore, Norman R. '25 C
TOLEDO
Buckhout, Donald H. '17 A
Feeney, Wayne '23 E
Nyquist, Roy A. '27 AE
YOUNGSTOWN
Birnberg, Zingel C. '09 M
Buhl, Paul S. '07 M
Elmburg, LeRoy '25 AE
Lee, Walter J. '20 E
Leider, A. E. '27 E
Ramm, Theodore D. '13 E
Schiiken, Donald R. '29 AE
Van Cleve, Horatio P. '07C

OKLAHOMA

BARTLESVILLE
Stauffacher, Edward L. '24 M
FAIRFAX
Burns, Dwight T. '25 C
Gobeli, Arthur W. '25 C
NORMAN
Swearingen, Lloyd E. '26 PhD
OKLAHOMA CITY
Montgomery, Albertus '19C
OKMULGEE
Paul, Karl F. '24 Ch
PONCA CITY
Nelson, Ernest W. '20BA, '24 ChE
TULSA
Olaison, Clifford '15 E, '16 EE
Thompson, Warren L. '26 Ch

OREGON

BURNS
Horstkotte, Arthur E. '22 C
CORVALLIS
Martin, W. H. '10 M
HARRISBURG
McAfee, Allan L. '08 E
HOOD RIVER
Smithson, John E. '07 E
KALAMATH FALLS
Paulson, Joseph B.
MAPLEWOOD
Sterling, Faith '09 Ch
MERRILL
Bogue, Nathan H. '04 C
MEDFORD
Brockway, Alvah E. '09 E
ONTARIO
Countryman, Peter F. '07 E
PORTLAND
Andersen, Christian '83 C
Anderson, Frank A. '05 E
Bjorge, Oscar B. '07 M
Cobban, Rollo J. '09 E
Cook, Robertson '02 M
Couper, George R. '93 M, '02 ME
Doeltz, William F., Jr. '08 C
Felthous, Donald G. '29 M
Hubbard, Fred A. '09 C
Johnson, Ivar W. '24 E
Juvrud, I. O. '14 Ch
Meany, James M. '07 M
Morton, Lyle W. '24 E
Nelson, Donald O. '20 C
Rawson, Ralph H. '07 M
Rockwood, Fletcher '14 E, '15 M
Stoddart, Hugh A. '24 C
VERONIA
Knauss, Archibald C. '16 C, '17 CE

PENNSYLVANIA

ALLENTOWN
Reque, Styrk G. '01 E
AMBRIDGE
Washburn, Delos C. '93 AE
BELVIEW
Smith, Cedric B. '14 BA, '18 C
BETHLEHEM
Jensen, Cyril D. '21 C
Luce, A. W. '21 M, '23ME
BRYN MAWR
Jones, Ivor V. '15 C
DARTMOUTH
Swanberg, John H. '25 C
DONORA
O'Connell, Thomas C. '13 Ch
EAST PITTSBURGH
Blackmore, Frank E. '28 M
Bohrer, Donald M. '29 EM
Borchardt, Lester F. '29 E
Burt, Fred R. '16 E
Briggs, Maynard R. '29 E
Brown, Louis M. '16 E
Farmer, Herbert F. '27 E
Finnell, Thomas C. '29 E
Fischer, A. M. '29 E
Gemmell, Robert W. '26 E
Gibson, Charles B. '05 E
Gibson, Robert '27 E
Goss, Harold R. '20 E
Hanft, Hugo '25 E
Heidmann, Karl R. '29 E
Hussey, Norman W. '25 E
Jones, Richard W. '26 E
Kaplan, Eugene V. '10 M
Koch, Winfield R. '25 E
Kueffer, E. L. '29 E
McEwen, Alexander '25 E
May, Darwin R. '14 ChE
Meeks, E. Donnel '29 E
Nelson, Carl C. '25 E
Russ, Lloyd A. '29 E
Schwenpe, Walter A. '26 E, '28 MS
Sioberg, Roy H. '26 E
Specht, James E. '29 E
Stark, John '29 E
Vieness, C. Irwin '29 E
EASTON
Anderson, Henry H. '27 E
ERIE
Bill, Earl M. '12 E
Brightfelt, John C. '29 E
Cass, Hoyt R. '24 E
Rath, Harvey C. '23 E
Sturtevant, Percy G. '08 E
FULLERTON
Spencer, J. Boyd '27 M
HARRISBURG
Morse, Geo. '93 A
Morse, George H. '93 E, '11 EE
HOLTWOOD
Mercroft, H. C. '24 E
LANDISBURG
Gerlach, Arthur C. '17 M
MOORES
Fisher, Addison '29 E
Powell, Knox H. '20 M
NEW KENSINGTON
Edwards, Junius D. '12 ChE
Frary, Francis C. '05AC
Pippel, Herbert A. '20 Ch
Taylor, Cyril S. '13 Ch
PALMERTON
McMillen, E. L. '23 ChE, '27 MS
PHILADELPHIA
Childs, John C. '86 C
Cross, Roland E. '23 M
Currie, Neill, Jr. '98 E
Dunnum, Orney E. '22 E
Fairchild, Albert R. '07 E
Freeman, Frank S. '29 M
Forber, Pierce P. '08 C
Hunt, Gates E. '20 E
Irwin, Vincent H. '13 E, '14 EE
Lowe, John M. '08 Ch
Nelson, Carl H. '10 E
O'Brien, Raymond J. '11 E
Parsons, Sydney A. '25 E
Pearson, Charles W. '21 E
Peterson, Harold L. '16 C, '17 CE
Sartell, Page M. '24 M
Satari, Roy H. '21 E
Sims, Theodore L. '23 A
Von Rohr, Herbert H. '21 M
Young, Charles N. '12 E
PITTSBURGH
Abrahamson, A. L. '29 E
Anderson, Arnold O. '29 E
Bleifuss, Donald '20 C
Burris, Arthur '28 E
Elmburg, John C. '28 E
Frazee, L. M. '24 E
Joesting, Frederick D. '26 E
Kester, E. B. 'Ch
Mayer, Francis L. '29 E
Milunchick, John W. '29 E
Morrison, John E. '22 C
Nash, Russell O. '23 E
Rosenthal, Oscar '19 C
Selvig, Walter A. '09 Ch
Southier, Benjamin L. '16 Ch
Swanberg, John '25 C
Tanner, Ela C. '29 M
Taylor, Carl A. '18 Ch
Towle, Neal C. '12 E, '13 EE
Willard, Arthur C. '22 E
PHOENIXVILLE
Feldman, Carl B. H. '26 E, '28 MS
POTTSTOWN
Williams, Edward H. '03 M
SCRANTON
Eberhardt, Otto I. '03 E
SHARON
Dahl, Paul '28 E
Granbois, Kenneth J. '29 E
Havey, Betram K. '27 E
Russ, Lloyd A. '29 E
Steinert, Emil '25 E
Wentz, Edward C. '26 E
STATE COLLEGE
Gjesdahl, Maurice S. '21 M
Nortner, Sylvester E. '16 C
SWISSVALE
Tunnell, Robert H. '24 E
WILKINSBURG
Bierwagen, Rudolph W. '29 E
Branch, Harold N. '29 E
Bullard, Henry M. '26 C
Dahl, Hjalmer A. '22 E
Johnson, Douglas O. '28 E
Johnson, Sheldon '28 E
Locklin, R. B. '29 E
Wilson, Abner W. '22 E
WILLIAMSPORT
Briggs, Luard E. '27 C
WILMERDING
Holmes, Roland W. '25 M

RHODE ISLAND

PROVIDENCE
Tappan, Ruth W. '22 Ch
(Mrs. Joseph Dowling)
Lewis, John G. '24 E
WEST BARRINGTON

SOUTH CAROLINA

CHARLESTON
James Grant '07 C

SOUTH DAKOTA

ABERDEEN
Odegaard, Harold T. '20 M
BROOKINGS
Mark, Reuben A. '11 C
Mark, Walter J. '09 M
HOT SPRINGS
Adler, Eugene H. '14 E, '15 EE
LIGHT CAP
Blake, Henry B. '01 E
MITCHELL
Miller, Ralph Harrison '13 Ch
RAPID CITY
Dimmick, Merton A. '26 C
SIOUX FALLS
Boyce, Leonard F. '12 M
Countryman, M. Alden '25 M
Holt, George A. '16 E
Ransom, Ralph W. '23 M
Robertson, Kenefick '25 E
WALTERBORO
Mitchell, Lloyd S. '23 C
WATERTOWN
Brown, Harry E. '22 G
Hawkins, G. C. '28 E

TENNESSEE

BRISTOL
Butterworth, Russell I.
'16 E, '17 EE
CHATTANOOGA
Knox, Chas. '28 C
Withee, Warren '15 C
GUILD
Irwin, Frank H. '16 E, '17 EE
MEMPHIS
Slocumb, Mary G. '25 ID
(Mrs. Lawrence Tvedt)
Tvedt, Lawrence A. '24 AE
NASHVILLE
Hansen, Arthur A. '25 C
Schultz, Alex A. '26 C
Wannamaker, Homer F. '26 C

TEXAS

AMARILLO
Bolmick, Harry W. '27 C
AUSTIN
Ferguson, Geo. '28 C
Helwig, Wm. F. '23 E
BEAUMONT
Berluhagen, Lewis O. '06 A. C.
BROWNSVILLE
Sherwood, Edward R. '20 C
DALLAS
Chestnut, Geo. L. '97 E
Dahl, George '21 B. S. (Arch)
Fernald, Frank O. '04 C
Magnuson, John E. '22 E
Rounds, Fred M. '93 E
Smith, Donald T. '05 C
FORT BROWN
Grow, Robert W. '16 C
HARLINGEN
Henry, Burt C. '21 C
HOUSTON
Downing, Frank E. '04 C
Crane, Fremont
'86 BS, '87 BCE, '93 CE
LUBBOCK
Kleinschmidt, Floren A. '20 A
Tuve, Geo. S. '20 M, '21 ME
ODESSA
Fortune, Harry G. '20 M
PAMPA
Wolfe, George E. '24 E
PORT ARTHUR
Ost, Roland E. '22 C
Weetman, Bruce '26 Ch
WESLACO
Nutting, Horace W. '25 C

UTAH

SALT LAKE CITY
Ashworth, Roy H. '11 E
Beyer, Theodore A. '03 C
Jones, Watkin W. '11 E
Oram, Robert C. '11 M

VERMONT

ST. JOHNSBURY
Stillman, Marcus H. '89 E

VIRGINIA

FORT HUMPHREY
Luplow, Walter D. '17 C
HAMPTON
Wagner, John W. '24 M
HAMPTON ROADS
Campbell, Douglas M. '27 C
Joachim, Wm. F. '20 M, '21 ME
HOPEWELL
Smith, Allen S. '26 ChE
LANGLEY FIELD
Rollin, Vern G. '28 M
NEWPORT
Holmstine, Arthur G. '17 M
RICHMOND
Richardson, Wilbur P. '99 M
Kiegel, Louis F. '11 E
ROANOKE
Fahland, Frank, Jr. '22 M
QUANTICO
Strong, Frank D. '17 Ch
UNIVERSITY
Anderson, Lawrence B. '27 A

WASHINGTON

CENTRALIA
Smith, Leighton '03 C
EASTON
Pearson, Harold T. '27 C
EVERETT
Beaulieu, Richard L. '02 C
KELSO
Phelps, Ray R. '10 E
LONGVIEW
Hetherton, Percival '08 M
Smith, Hugh A. '18 E

Napoleon
Longworth, Fred '05 AC
No. Yakima
Gilman, Nicholas A. '07 M
Oroville
Norelius, Emil F. '08 M
Norelius, Lewis M. '06 C
Pasco
McCall, Harry J. '08 C
Puget Sound
Benedict, Geo. F. '93 E
Pullman
Levine, Arthur '23 PhD
Seattle
Bowen, Fred P. '06 C
Bushnell, Chas. S. '78 M
Curtiss, Lindsley B. '09 G
Erickson, Carl G. '24 C
Grimshaw, William E. '02 M
Gustafson, Reuben W. '24 C
Guthrie, J. De Mott '93 E
Hayward, George I. '06 C
Hillman, Chas. K. '12 E
Hoffman, Ralph M. '11 Sc. & Tech.
James, Henry C. '11 E
Jenkins, Clifford H. '25 M
Linton, James H. '97 ChE
Lumm, Gordon '25 A
McKenzie, Lauren F. '09 E
Magnusson, Carl F. '96 E, '97 MS, '05 EE
Markhus, Olaf G. F. '97 E
Nelson, Geo. A. '25 C
Nichol, Frank E. '25 C, '26 MS (CE)
Pearce, John Henry '07 E
Petrick, Alfred C. '19 C
Quense, John '01 C, '02 ME
Shuck, Gordon R. '06 E
Silliman, Henry D. '97 M
Sternberg, Carl '07 E
Stewart, Geo. A. '22 A
Wesbrook, Donald McD. '10 M
Westberg, Russell E. '20 E
Skykomish
Walters, Walter P. '26 E
Spokane
Adams, Elmer E. '06 CE
Alton, Herbert D. '07 E
Manuel, Douglas R. '22 Ch
Nelson, Lyle C. '29 A
Wiesner, Frederick E. '06 C
Tacoma
Blake, Robert P. '97 M

WEST VIRGINIA

Charleston
Eck, Melvin C. '29 C
Giltinan, David M. '15 M, '16 ME
Hinton
Fenton, Paul C. '26 C
Morgantown
Amidon, Lee L. '23 M
Gill, James H. '92 M, '94 ME
Wheeling
Root, Frank R. '24 AE

WISCONSIN

Appleton
Erickson, Edwin C. O. '23 C
Lewenstein, Abraham '26 ChE
Poppe, Frederick W. '11 Ch
Beloit
Cole, Ernest C. '26 M
Tuttle, Stanley B. '24 M
Bruce
Brownell, Edward '26 C
Buhr, Leo '23 C
Chatek
Weston, Wm. S. '02 C
Chippewa Falls
Berdan, Hubert J. '22 C
Cray, Seymour R. '22 C, '23 CE
Vaudreuil, Lionel '25 AE
Eau Claire
Bergford, John '28 C
Cotton, Ernest H. '19 E
Dow, Clarence A. '13 E, '14 EE
Fairbanks, Geo. W. '23 E
Frahm, Alfred R. '08 E
Holm, Edwin R. '20 C
McMillan, James S. '22 E
Meyer, Carl F. '10 C
Monsen, Manley A. B. '24 E
Grantsburg
Nelson, Martin E. '24 C
Green Bay
Hartney, James L. '14 M, '15 ME
Kohler
Hvoslef, F. W. '17 M, '19 MS
La Crosse
Bergsland, Grant C. '23 M
Harrington, Russell '24 E
Meader, Glenn '26 E
Nordstrom, Ernest A. '22 M
Willson, Stuart V. '24 M
Madison
Bray, Mark W. '14 Ch
Church, Bruce R. '28 A
Daniels, Farrington '10 Ch
Hubbard, Robert T. '06 E
Knudsen, Esther M. '25 C
Kurtlaage, R. F. '20 Ch
Larson, Ludvig C. '21 E, '23 EE
Luxford, Ronald F. '17 C
Nystrom, Paul E. '24 A
Peterson, C. E. '23 Ch
Reiter, Alfred A. '25 ChE
Turrittin, Hugh L. '27 C
Manitowoc
Olson, Arthur L. '24 M
Plank, Howard G. '22 E
Marinette
Hornibrook, James W. '09 E
Menomonie
Mitchell, Ralph W. '12 Ch
Milwaukee
Albrecht, George M. '06 E
Bartholomew, Neal W. '25 C
Bjerre, Folmar I. '25 M
Borden, John C. '29 E
Borrowman, J. K. '27 C
Brimeyer, Ferdinand J. '25 AE
Brown, Glendon '28 E
Bunnell, Chas. W. '26 C
Chapin, Harold S. '12 M, '13 ME
Clark, Fred '27 E
Clarke, Charles P. '08 C, '09 CE
Cooke, J. M. '28 E
Flegal, A. I. '27 A
Hansen, Maurice J. '11 E
Hemsey, Clayton E. '22 M
Hutchinson, E. T. '27 M
Johnson, Herman R. '09 EE
Kendall, Walter '25 A
Larson, Louis J. '14 C, '15 CE
Ludrigsen, Elliot '25 M
Lundsten, Frank B. '27 C
Newman, John M. '23 E
Norman, Henry R. '27 C
Ohman, George U. '26 C
Papenthien, Roy O. '21 G
Peterson, Laurence L. '25 M
Potter, Robert P. '26 A
Price, Clarence R. '20 E
Reed, Albert I. '85 C
Robert, W. J. '22 ChE
Roberts, Earl H. '15 M, '16 ME
Roberts, Norman A. '28 M
Schaller, Louis M. '29 C
Schulze, LeRoy E. '27 E
Skrukrud, Odean M. '25 C
Sutherland, Samuel J. '23 AE
Tyvand, James A. '24 E
Wallin, Stanton E. '29 C
Neenah
Lande, Clarence C. '27 C
Palmer, Howard B. '22 C
Racine
Rood, Arnold E. '22 E
Taylor, Ralph C. '02 M
Sheboygan
Nimmer, W. E. '26 E
South Milwaukee
Johnson, Roy M. '29 M
Wallin, Stanton '29 C
Spooner
Putz, John H. '14 BS, '15 EE
Superior
Scobie, Francis G. '08 E
Waupun
Youatt, Glenn B. '29 AE
Wausau
Mills, Hartzell '25 M
Wauwatosa
Cross, Chas. H. '97 M
West Allis
Foltz, Russ Melton '19 M
Smart, George A. '16 M
West Salem
Sprehn, George H. '24 C

WYOMING

Shell
Rosing, Donald C. '27 C
Sheridan
Pearson, Geo. '28 AE
Yellowstone Park
Lindelef, Charles '09 E

AFRICA

Northern Rhodesia
Powell, Louis H.

ALASKA

Valdez
Smith, Byron E. '07 E

CANADA

Coutts, Alta.
Jallings, K. R. '28 ChE
Edmonton
Morris, Robert '05 E
Ft. Frances, Ont.
Hass, Paul O. '26 M
Fort William, Ont.
Laurence, Paul A. '12 G
Indian Head, Sask.
DuBois, N. Warren '26 M
Macoun, Sask.
Towey, James M. '28 E
Montreal
Adams, Wm. C. '05 C
Beyer, Randell '27 E
Spence, William J. '02 E
Port Arthur
Souba, William H. '09 M
Port Colburn
Kepner, Ben-Hur '11 Ch
St. Catharines
Noel, Clay W. '20 E
Tedford Mine, Quebec
Johnson, Ray V.
Toronto
Anderson, Oscar V. '10 E
Weyburn, Sask.
Casberg, James W. '08 E
Winnipeg
Borrowman, Leroy F. '08 C
Brown, Geo. J. '08 E
Joselowitz, G. '18 Ch
Schumacher, John H. '03 E

CHINA

Peking
Lin, Shu Ming '29 A
Lee, Pank Chuk '28 AE
Wong, Jee K. '16 M
Tientsin
Eliassen, Sigurd '18 C

CUBA

Havana
Romero, Cirilo L. '17 M, '18 ME

ENGLAND

Felstead, Essex
Trosson, Carl A. '10 Ch

GERMANY

Gottingen
Hogness, T. R. '18 ChE

HAWAII

Ft. Kamehameha
Solomonson, L. D. '25 E
Fort Shafter, Honolulu
Coe, Edward H. '19 C
Haakenson, N. T. '26 C
Scott, Willard W. '17 E

ICELAND

Reykjavik
Gunnarson, Jon '29 C

INDIA

Bengal
Dewaji, Gunaker '26 M
Bombay
Shellenberger, Hiram R. '20 M

MEXICO

Guadalajara
Burt, John L. '90 C

PHILIPPINE ISLANDS

Bay, Laguna
Galvez, Nicolas L. '25 Ch
Cavite
Cox, Richard F. '08 M
Malabon, Rizal
Roque, Feliciano T. '24 ChE
Manila
Aslakson, Carl I. '23 C
Morris, Geo. E. '27 C
San Juan
Mattison, Geo. C. '11 C
McKeson, L. J. '27 E

SOUTH AMERICA

Brazil

Rio de Janeiro
Nogueira, Frederic P. '28 E
Thompson, Herbert L. '12 M
Sao Paulo
Nierling, Grant C. '25 E
Schoepf, A. W. '08 E

Chile

Chuquicamata, Chile
Carlson, C. Philip '21 E
Knowles, Everett H. '20 E
Tocopilla
Carlson, Victor H. '20 E
Liese, Carl R. '26 C
Maine, Basil '21 E

Columbia

Barranquilla
Curry, Byron K. '23 C

Nicaragua

Managua
Johnson, Byron F. '20 C

Venezuela

Maracaibo
Gerdes, Carl H. '25 B. S. (C. E.)

TURKEY

Constantinople
Fulmer, Jervis M. '22 Ch

Remember the Alumni Service Fund

ENGINEERS IN GRAIN HANDLING

(*Continued from page 291*)

ease as a child would empty a box of salt. Although a very expensive machinery installation, the car dumpers effect a tremendous saving in labor and time. A single dumping machine will handle as many as eighty cars of wheat a day, or an average of one car every six minutes.

One of the characteristics of the old type of elevator was its dark, stuffy interior in which the air was saturated with fine grain dust making it a very unhealthful and uncomfortable place in which to work. Aside from the standpoint of health the presence of dust in the air was a great hazard due to the possibility of a dust explosion. In years past many lives have been lost and much property damage has resulted from dust explosions in elevators and mills. The right percentage of grain dust in the air forms a highly explosive mixture which ignites readily from such causes as cigarettes, defective wiring, etc.

Dust collecting systems have overcome this hazard and as a result the interior of the elevator workhouse has become as light and airy as a well-kept factory building. The dust collection is accomplished by means of a centrally located electrically driven exhaust fan from which air ducts extend to all points at which dust is liable to be stirred up. By catching the dust at these places before it has had a chance to mix with the air, the surrounding atmosphere is kept remarkably clear. The dust is carried through the ducts to large cone-shaped sheet metal expansion chambers or "Cyclone" collectors on the exterior of the building where, due to the decreased air velocity, the dust is dropped and the dust-free air escapes.

Because of the arrangement of the machinery the most convenient source of power in a grain handling plant is the electric motor. Due to the fact that any one or several units of conveying or conditioning machinery may be in use at one time while the remaining units lie idle, the sources of power cannot be centralized as in a mill. Usually each belt, elevator, or cleaning machine has its independent drive motor. In an average sized house several hundred horse power in motors may be divided among fifteen or twenty conveying units. This necessitates a very complicated and complete system of electrical interconnection and control between the units. This control system is often centralized in a control room where one man can supervise the operation of the whole house. In conjunction with the control equipment is an electrical signal system to permit communication between operators in different parts of the building. Automatic electric signals also warn the operators of clogging of a grain stream or the failure of any apparatus.

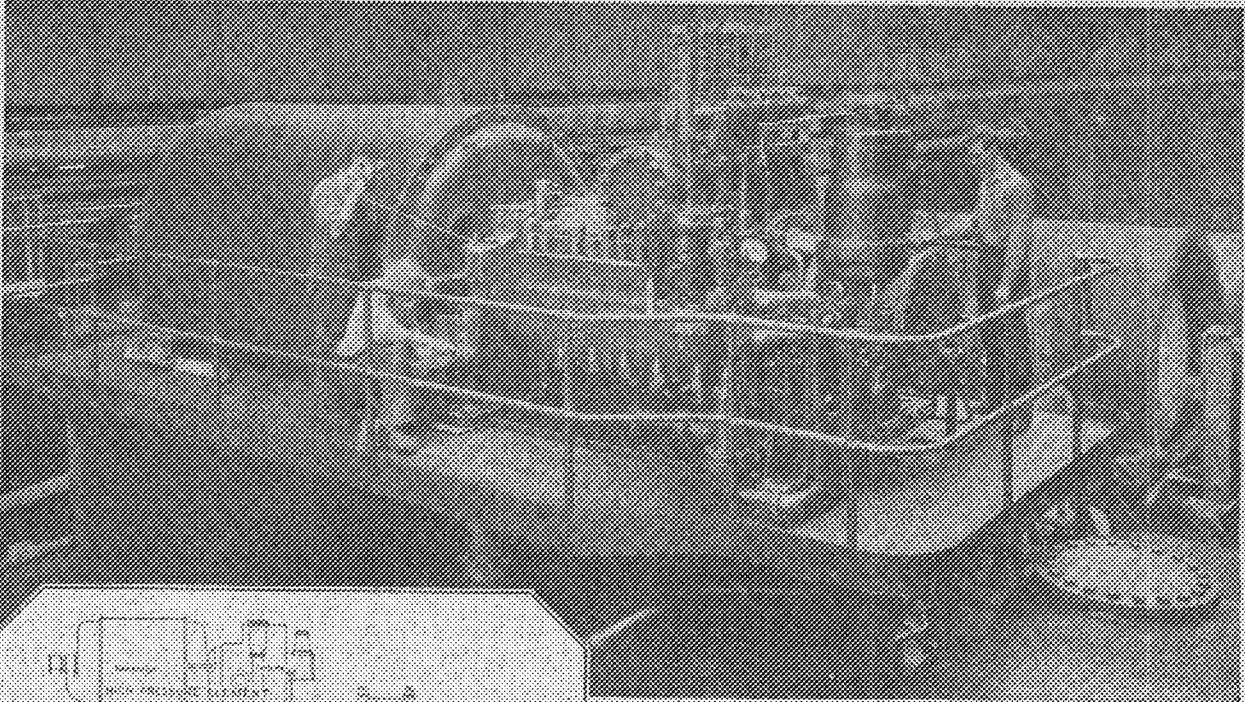
An important function of an elevator located on a harbor or waterway is the loading and unloading of grain into ships and barges. In the unloading of ships the factor of speed must be particularly emphasized to avoid unnecessary delay to the ship and her crew. In general, marine unloading is accomplished by two methods. The first and most common method used is the marine tower. This tower is actually a complete elevating unit in itself which is movable on railroad trucks along the waterfront side of the main elevator structure. The marine tower is entirely self-contained with complete mechanism for elevating the grain, manipulating the movable leg, and moving the tower itself. The tower is usually equivalent in height to a ten story building. A large port elevator has two or more of these towers by means of which as many hatches of a vessel can be unloaded at one time. An accompanying illustration shows a pair of marine towers in use at a waterfront elevator in Buffalo, N. Y., the leading grain port on the Great Lakes. It will be noticed that the towers extend well above the storage tanks which in this case are well over a hundred feet high.

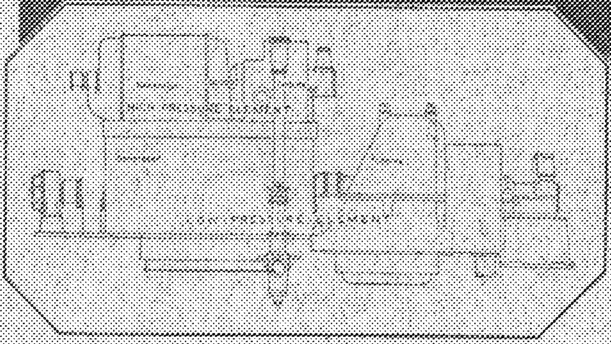
The grain is scooped from the hold of the ship by the marine leg which swings outward from the face of the tower and dips into the hatch of the vessel. The leg contains a bucket elevator which picks up the grain and carries it upward into the tower. At the upper extremity of the marine leg the grain is discharged into the bottom of a second elevator leg which carries it to the top of the tower from whence it is transported by gravity through a series of funnel-shaped collecting, or "V," spouts extending above the roof of the elevator gallery. When all grain has been removed from one hatch of the ship the marine leg is drawn in and the tower moves under its own motive power to the right or left until opposite the next hatch.

The second method of grain unloading from ships and barges is one which has been very little adopted in America until very recently. That is the pneumatic method, which has for a number of years been used quite commonly in European ports. Since the advent of recent improvements in this field American grain men are beginning to realize its convenience and efficiency and it is predicted that within a comparatively short time this system will become quite generally used in the United States.

In the pneumatic system the grain is sucked from the holds of a barge or ship through a flexible suction hose 4" to 6" in diameter. The vacuum is created by large rotary positive-suction air pumps which, in the high-vacuum systems produce a vacuum of 16" of mercury. In such a system the vacuum at the nozzle usually is about 8" which will produce an air speed of well over a hundred miles an hour within the tubes. The capacity of such a system is not as high as that of a marine leg but it is possible because of its compactness to use two or more suction units in a hold at one time. One man at a suction nozzle can clean up all wheat in the hold, thereby eliminating hand shovelling and sweeping.

Pneumatic systems are at present used in several eastern Atlantic ports and at New Orleans for the unloading of ocean-going vessels. A similar system with improvements is now under design for use at a Mississippi River terminal elevator at Davenport, Iowa, where it will be used for unloading wheat shipped by barge from Minneapolis and also from southern points. When this is installed it will be the only system of its type in America used for the unloading of river barges.





Elevation of the G-E vertical compound turbine-generator

Learning the Latest Word in Turbine Construction

An important departure in apparatus engineering is the General Electric vertical compound turbine-generator. In this machine, the high-pressure element, heretofore separate, is built on top of the low-pressure generator.

This compact construction does away with the necessity for building a separate foundation for the high-pressure unit, permits the use of one set of air coolers, requires less piping, and conserves floor space.

Test men—veterans, as well as more recent graduates of engineering colleges—take charge of the machine after assembly, test for oil leaks, bring it up to speed and check balance in the initial run, and set the emergency and operating governors. Electrical tests follow after the generators are coupled on. This work is part of the training program for general, industrial, sales, or advanced engineering work with the General Electric Company.

JOIN US IN THE GENERAL ELECTRIC HOUR, BROADCAST EVERY SATURDAY EVENING ON A NATION-WIDE N.B.C. NETWORK

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, NEW YORK