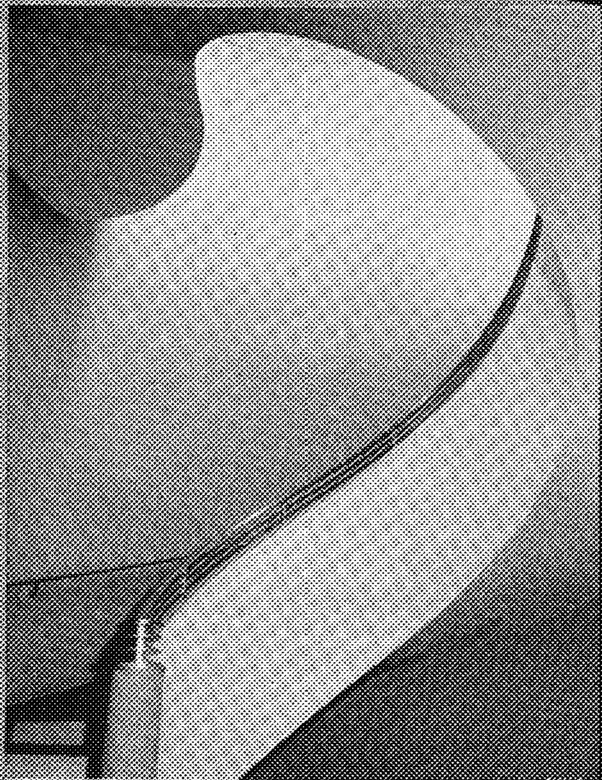
THE TECHNO-LOG



FEATURIN

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OCTOBER, 1940 VOL. XXI N

OF MINNESOTA

KNOW YOUR BEARINGS

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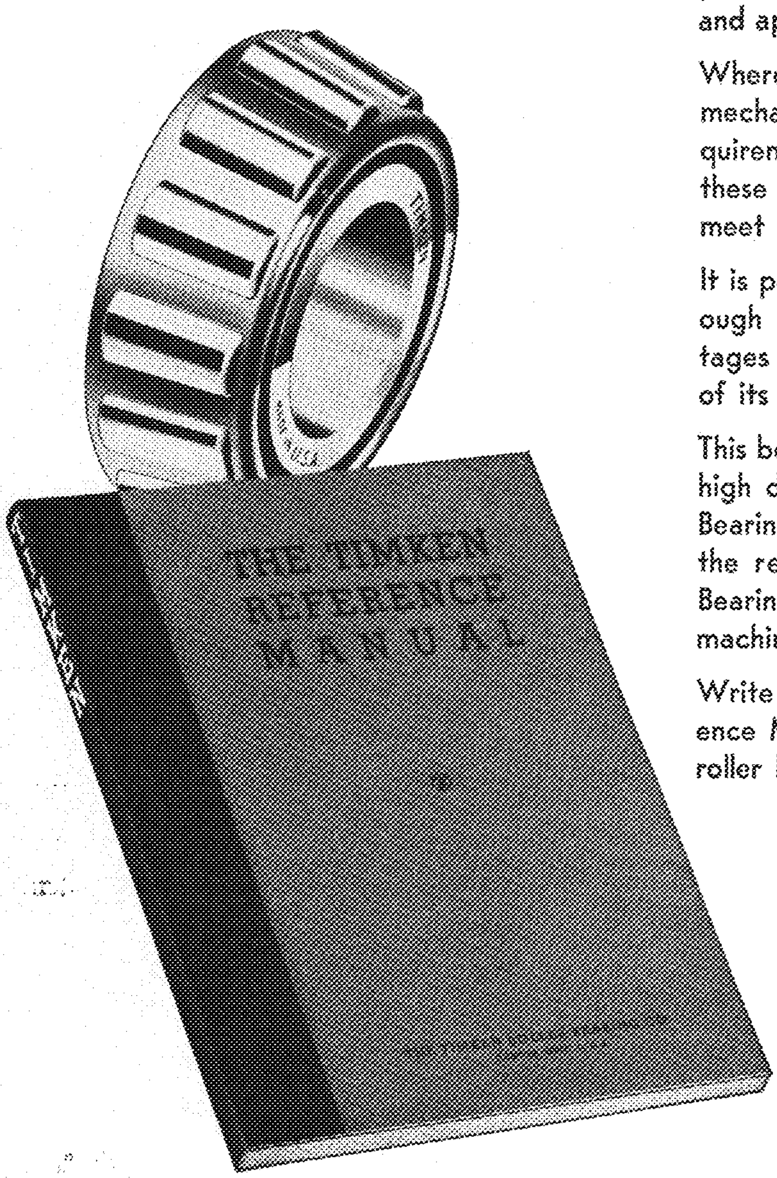

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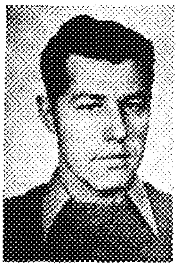
Authors . . . Staff . . . .

By Don McClure Ch. '42

Don Martin, C.E. '41 is the author of "The Grand Forties," an article which has all the inside dope about the 1941 civil engineers camp on Cass Lake. Don went to the camp and is well qualified to give the TECHNO-LOG readers the real "low-down" on the camp.



Don is a member of the A.S.C.E. After graduation, Don would like to go into exploration as a life work. However, in the event that there are no immediate openings for engineer-explorers, he would be very content with a job as engineer for a railroad.

Ronald Gourley's second article is again about a subject on which he is well qualified to write. His article on the new Union building will be interesting and instructive to architecture and engineering students alike. Professor Roy C. Jones, head of the school of Architecture, who acted as advisor to the architects for the Union, helped with the material for the article.

Ronald spent most of his time this summer over the drafting board of an engineering and architectural firm in St. Paul. He reports that he is also taking up golf, but so far is relatively unsuccessful. He still plans to work for a matser's degree and then go into the housing field, his main interest.

Short, stocky, athletic looking, sharp blue eyes behind thick-lensed glasses; this is **Al Wedge**, Mechanical Engineering Junior. Head of the Tech party; elected to the Union Board of Governors last spring: Al is an example of the engineering "drudge" who made good.

Want some promoting done? If it's constructive and for the good of the University just call on **Joe Atkins**, technology's number one busy man. Joe is a member of the all U Council and is always busy in some scheme to "better Tech." He is a junior in the five-year mechanical engineering business course and is a personification of what every freshman engineer hopes to be.

●

The Cover

The angles of the cover design are set off by the curves in the cover photo. The picture was taken by the University Photo Laboratory, and shows the circular staircase to the postoffice of the Union.

Editorial

●

Business

The editorial policy of the TECHNO-LOG is to present material for technology students which it is hoped will strike a happy medium between the superficial and the highly specialized.

The MINNESOTA TECHNO-LOG is published monthly, October through May, by the students in the Institute of Technology of the University of Minnesota.

The purpose of the TECHNO-LOG is two-fold: First, to put in the hands of TECHNO-LOG subscribers highly worth-while and interesting reading material; second, to offer technology students an invaluable opportunity to get writing, selling, and working-with-others experience.

THE MINNESOTA

Techno-Log

VOLUME XXI **OCTOBER** NUMBER 1

CONTENTS

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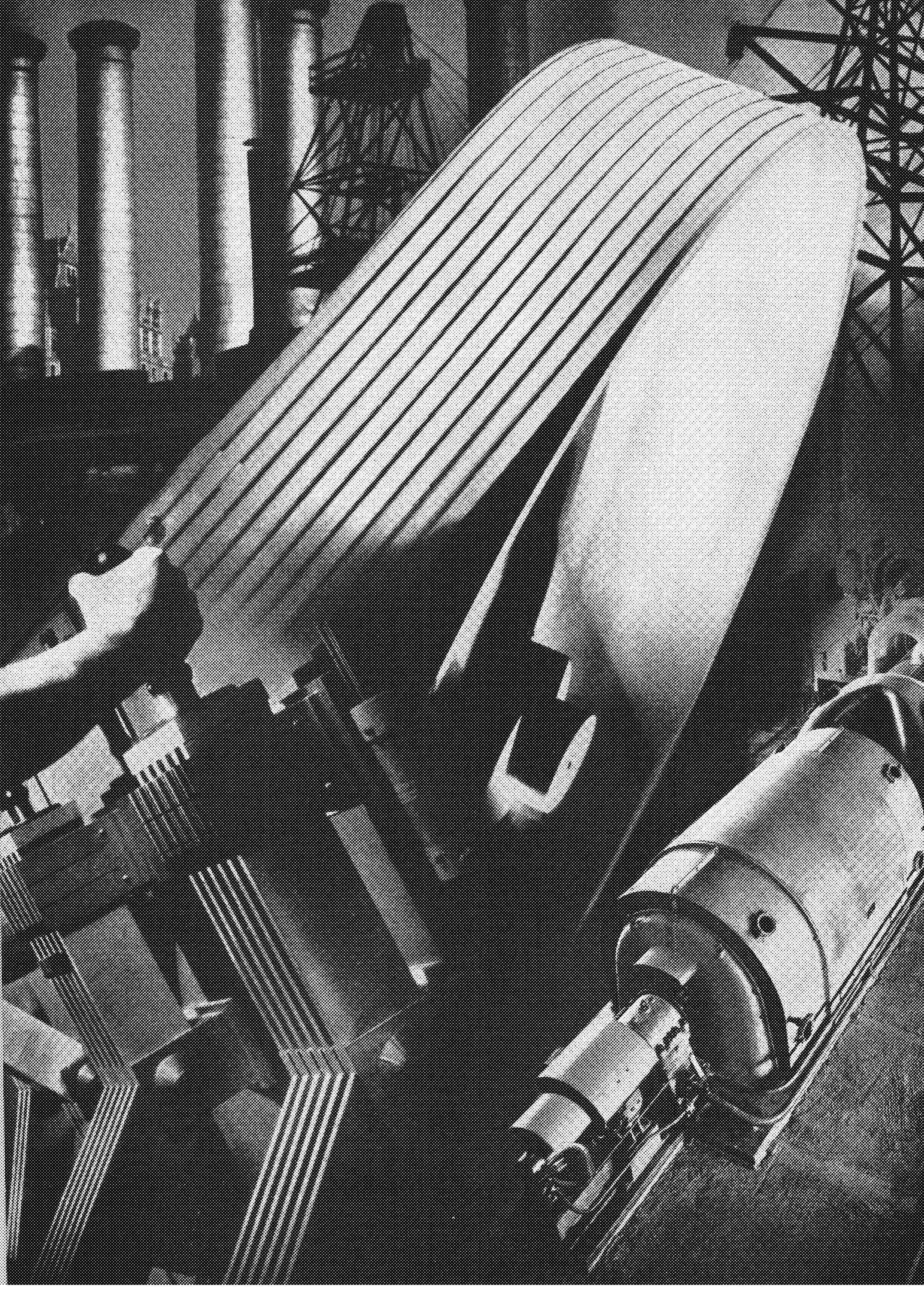


AN EDITORIAL

Don't Draft the Engineer

DON'T draft the young engineer! Local boards and national officials should hearken to that cry.

Today, many of our Institute of Technology men are registering for our nation's first peace time conscription to insure our land from invasion. Our students are deferred from being called to active service until July 1, 1941, but what will happen then? There is no mention in the Draft Law to further defer or exempt students and graduates of technical schools. After July 1, they will be drafted just as any other eligible registree, unless the nation or local boards wisely see fit to classify them as potentially vital to industry.

Our defense should not only be a temporary measure, but a long time program with its greatest strength in the future. Technical students, even recent graduates, are not immediately vital to industry, but these same men are the ones that compose the potential intelligent guiding power of our industrial system. Cut down their number by draft lottery and one of the most important defense pillars of our country will be chipped at the base. To say that an aeronautical engineer, or a chemical, or a civil, will be of more value to his country as a soldier of one year's training than as a specialized engineer with four years' tested technical schooling behind him is preposterous.

We believe that the administrators of our defense program are both intelligent and shrewd enough to realize that such a plan for ordinary conscription of engineers, though entirely within the rules, would be foolhardy.

Two alternatives are then open to the government. It can draft young technical graduates at a wage of $30 per month and place them in positions where their knowledge and experience will be of some use, or it may allow them to be assimilated normally into industry where by tried means they may gain the experience necessary to become vital to some industry, and, as a result, vital to our country.

To expect men, technically trained men, to do outstanding research and make exacting mental decisions for $30 a month is not reasonable. Furthermore, the urge to strive to the utmost for advancement will not be there as they look forward to their year's army job rather than to a lifetime in some industry. Many engineers would serve willingly out of pure patriotic enthusiasm, but even if they felt this urge within them, it is not human nature to do one's mental best under a yoke of arbitrary force.

Let these same men be absorbed into industry and gain the practical advice that association with older heads in their field will give them, and they will, in not too long a time, become valuable and, in a sense, even indispensible to their particular company and to our country as a whole.

The engineer wants to serve his country. The engineer is perhaps one of the best fitted to serve his country in this day of streamlined warfare. Put him where he may freely and most efficiently serve his country to the utmost of his ability.—W.K.B.

Our Meet

By Ronald Gourley

Courtesy University Photo Laboratory

Control of mass, rather than by elaborate detail, was used to get a main exterior effect in balance with the other buildings on the Mall. Particular attention is called to the striking light fixtures on the front of the building.

Below: The function of each room was considered in determining its scheme of decoration. Unusual colors, draperies, and lighting were designed to give the Union a luxurious club-like character not found in other Unions.

Courtesy University Photo Laboratory

MOST of our readers have marveled at the pomp of the New Union, but few realize how extensive were the plans and how meticulous the considerations which went into the final plans for that building. Technical men on their first visit to the Coffman Memorial Union have been immediately impressed by the fact that members of their own professions spent a tremendous amount of time and study in conceiving this building as it now appears. In view of this fact, this shall not be an attempt to publicize Union policies on activity programs, but shall be an attempt to provide, in a simple manner, an insight into the nature of the problem which confronted the architects and the procedure through which they went to plan and design the largest building on the campus.

Professional Service

A list of the professional men employed by the University to design the building completely reads:

C. H. Johnston; Architects

Pillsbury Engineering Company; Mechanical Engineers

Morell and Nichols; Landscape Architects

Johns Hopkins; Interior Designer

Roy Jones; Advisory Architect

The architects, the landscape designers, and the engineer, named above have designed most of the University's buildings and campus arrangements ever since the Cass Hilbert Plan was adopted in 1908. Johns Hopkins, a well known Chicago designer, has designed the interiors of many well known buildings, as well as the new Union Pacific Streamliners. Professor Roy Jones, head of the University's School of Architecture, acts as advisor to the University and the Board of Regents in their various building projects. He prepares programs of requirements for the architects, recommends sites, and in general contributes anything in the way of advice or suggestion necessary to help the University and its architects to get what the University needs.

In 1936 a new Union building was first proposed and a group of Minnesota faculty and students appointed by the late President Coffman investigated student Union buildings on several other Midwestern campuses. A detailed program of requirements was then drafted by Professor Jones. The part of the building to be used by the student body was to provide for:

1. Social facilities
2. Recreational activities (except athletics)
3. Cultural program
4. Dining center

It was thought that some functions could be taken care of interchangeably in the same space, as for instance, large dances, assemblies, and banquets in the ballroom. In addition to student requirements, complete facilities were to be provided for the Campus Club, a faculty organization.

Strategic Location

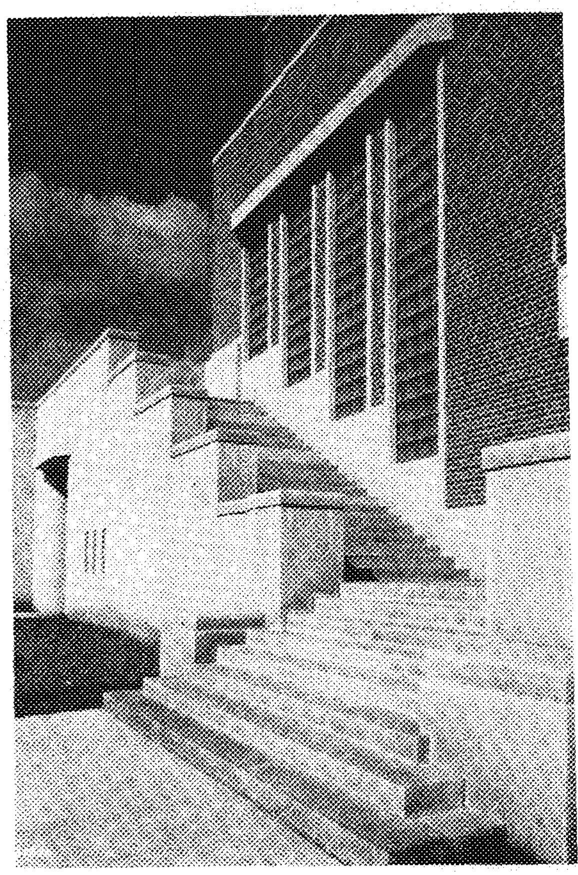
The primary step, as is the case in the planning of any new campus building, was the selection of a proper site. The objective was to place the building in the most convenient position for use by the student body as a whole. With this point in mind a thorough study of student population around the three possible sites was made by the advisory architect. From this it was determined that the idea of a site on the corner of Church Street and University Avenue, where the Natural History Museum now stands, should be abandoned. The second consideration, a site between the Armory and the Electrical Engineering Building, was discarded because the entire plan by which the campus has been devel-

Architects A Problem

Architecture '41

THE INCEPTION AND CONSTRUCTION OF THE COFFMAN MEMORIAL UNION

The bold square lines of this staircase are characteristic of the exterior architecture of the building.



Courtesy University Photo Laboratory

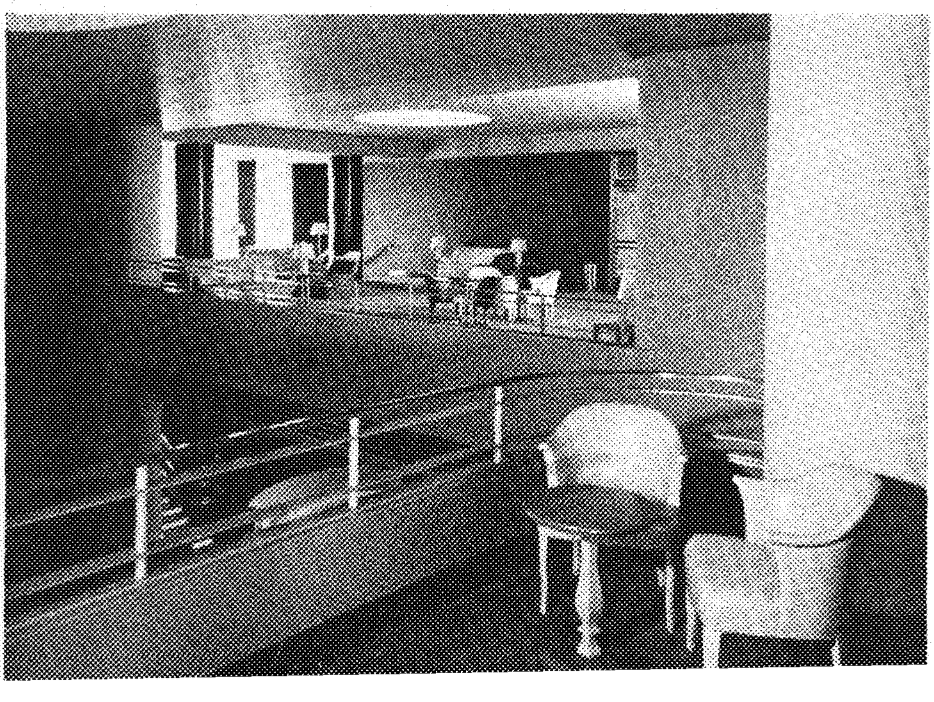
oped would be disrupted by placing the building there. The study that had been made of student population showed a steady progression of population to the south of the campus and forecast a continuance of that progression with the erection of new dormitories south of Washington Avenue. Therefore it seemed logical to erect the building in that vicinity. For the same reason the student P.O. boxes were to be placed there. In view of the unusual size of the building, the architects decided to place it so as to be a fitting architectural termination to the Mall in accordance with plans for the still growing University.

Symmetrical Plan

With the site definitely selected, the architects were at the crux of their problem—to conceive a scheme which would provide in adequate fashion for the complexity of facilities stated in the program of requirements. It is the general belief, but a gross misconception, that an architect is primarily concerned with drawing. The organization of a group of widely differing functions into an integral and unified whole, the conception of a plan, is the major work of an architect, and it is on this study of plan that he spends a major portion of his time. Drawing is naturally of importance to him, but it is only of secondary importance to form a pictorial record of his study. In the case of the Union, which was a very difficult planning problem because of its great size and unusual requirements, several schemes for plan were studied. The site obviously inferred a symmetrical solution. Because of the large and constant flow of traffic in, out, and through the building, it was deemed desirable to base the plan on a circulation pattern. The two types of circulation, student and service, had to be segregated so as to avoid confusion in the practicability of the plan. The pattern of circulation seemed to work best in a "U" shape with open end facing either North or South. The student facilities could be successfully accommodated in four floors, the Campus club in four floors above these. The architects finally decided that the scheme with the open end of the "U" facing the river, with service areas confined to the ground floor and inside corners, would best take advantage of the views afforded by the Mississippi River. For these reasons the present scheme was adopted and developed into the working plans.

Modern lines are somewhat modified in balcony overlooking the ballroom.

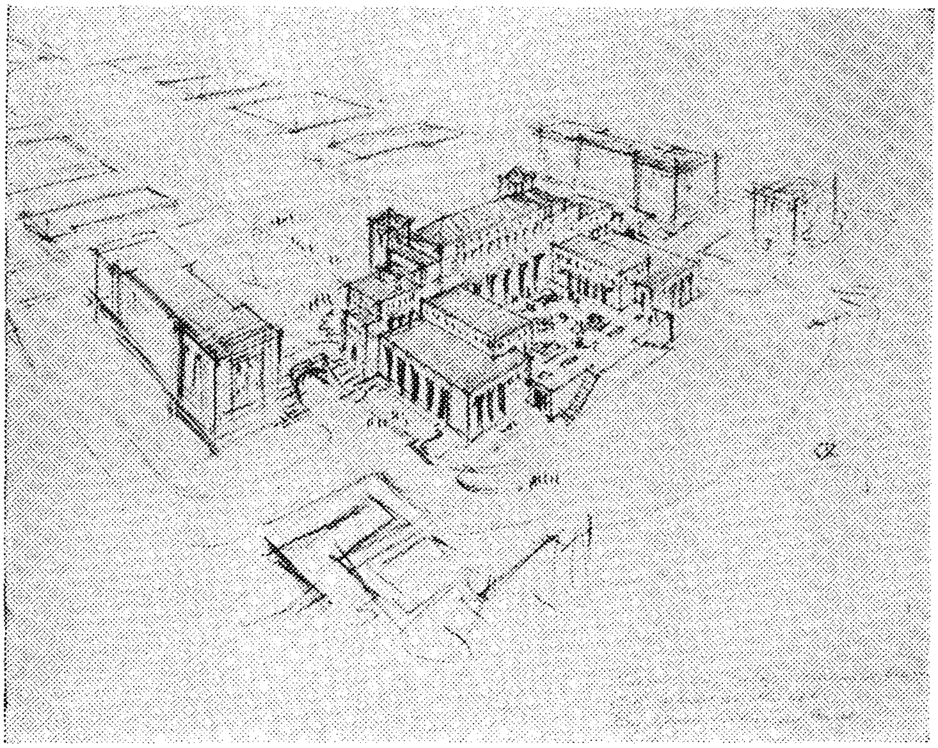
Courtesy University Photo Laboratory



Primary Construction

At this time, the immediate objective was to produce the working drawings as quickly as possible. The garage and foundation plans were prepared first so that fundamental construction work could be progressing while the remainder of the drawings were being made. During the process of making working drawings, the designs of the engineers—structural, mechanical, and electrical—were integrated and incorporated with the architects' design to make plans for a complete building. The technical character of the engineers' work, very important to any building, does not permit discussion here.

Through all the preliminaries the design of the exterior had undergone a constant



Architects' preliminary sketch showing the proposed plan of the Coffman Memorial Union. The design and arrangement of the building was made to conform with that of the other campus buildings which have been erected since the Cass Gilbert plan was adopted in 1908.

study. A desire had been expressed in the program of requirements for a building with light, air, color, and an atmosphere of generous welcome to convenient, pleasant quarters; therefore it would not be necessary to adhere rigidly to existing building types and thereby cramp the proper expression of the building's character. In their exterior design, the architects attempted to give the building the character of a club, which is the basic idea of a Union. The principle was to keep harmony with other buildings on the Mall through the use of the same exterior colors and materials, but to get the main exterior effects by control of the mass rather than through the use of elaborate detail. Symmetry was a prerequisite, but, judging from the final product, it seems plausible that more effective control of the mass might have been possible.

Interior Design

The design of the interiors was approached differently from those of any previous University of Minnesota building, because for the first time the services of an interior designer were acquired and to him was entrusted complete responsibility for the design of all interiors and furnishings. In his designs, Mr. Hopkins sought to express the same clublike character which the architects tried to express in the exterior design. The function of each room was considered the determining factor in its scheme of decoration. Through the use of unusual color schemes, lighting effects, draperies, varying wall and floor textures and materials, and specially designed furniture, the designer tried to give the interiors a luxurious quality, individual to this building and not found in other student Unions. At the same time he sought to make them bright and informal with at least a hint of modernity while not deviating too completely from the path of convention. In due respect, an unusual opportunity was offered Mr. Hopkins because of the fact that the Minnesota Union was conceived as a co-educational institution as is not the case on many campuses. In such instances as the latter, the decorator is usually confronted with the problem of furnishing the typical "Collegiate Architecture" type of building personified by dark rooms with leaded glass windows, heavily beamed ceilings, half timber, etc. The Coffman Union is an entirely different type of building than this and provided Mr. Hopkins a much more contemporary problem.

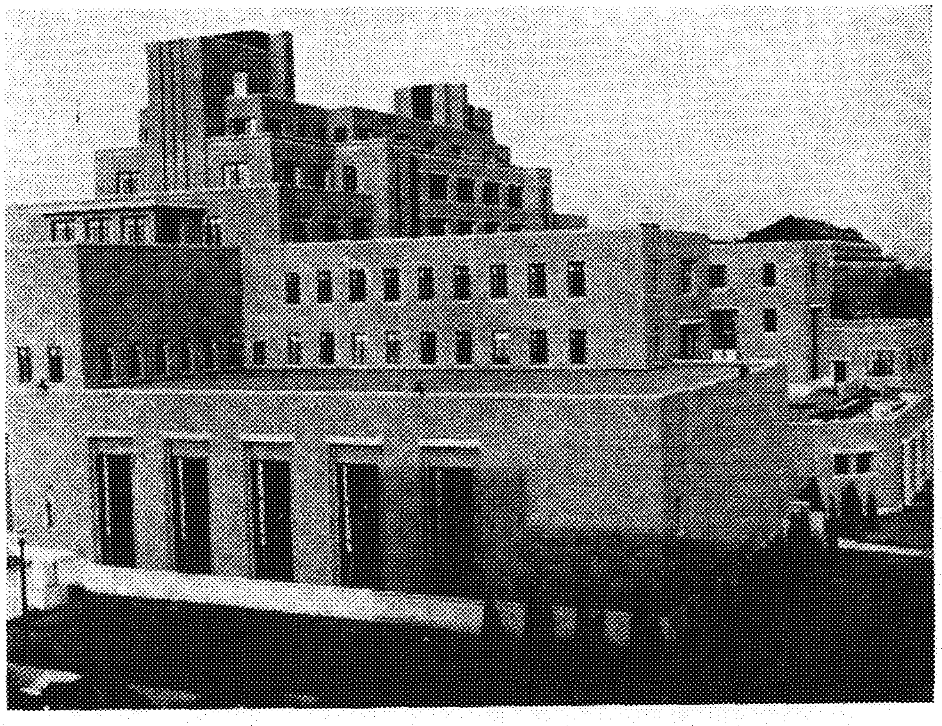
Final Step

The final step in the conception of the design of the Union was the landscaping, which was carried out in a manner in keeping with the existing campus landscaping so as not to disrupt the general scheme of things.

The building as constructed is of reinforced concrete frame, with brick walls and stone trim. The time required for building was less than two years, which is very unusual for a building of its size. The total cost, which includes all furnishings and all fees for professional services, was slightly under two million dollars. The architects were rather surprised to find that the cost, exclusive of furnishings, was under forty cents per cubic foot.

Such was the procedure in the design of the Coffman Memorial Union building which offered for the architects a most unique design problem. Whether or not they have successfully solved that problem remains to be determined.

Below: Photograph of the Coffman Memorial Union showing the comparison between the architects' preliminary sketch and the completed building.



College FOR *Knowledge?*

By R. W. Siler

Assistant Professor of Mathematics

THERE are fashions in education, as in everything else, a fact which students, who know only the style they are subjected to, seldom realize. I remember what a difference there was in the educational scene only a little more than ten years ago, when the present crop of college students was in kindergarten. For one thing, the average campus then looked like a menagerie because of the coonskin coats that were current. These coats were worn with the hair outside, and were not always coon; but coon or cat, they gave a glamor to college life which was typical of that era, the 'twenties, in education. Also at the time there were strange educational theories going the rounds, the central and pervading theme of which was that education was something to be absorbed like soup. For the college brand a man paid his tuition, bought himself a coonskin, and sat down to be fed pleasantly and painlessly at the trough of learning. Boiled down the new idea was just this: that higher education should be made easy, and a college career should be for four years the life of Riley.

Of course, there were a good many people who never quite accepted this theory. I do not believe that, taken as a whole, the technical schools of the country ever warmed up to the idea. No tech school, as far as I know, ever objected to having a coonskin around, but did shy at the thought of so thoroughly greasing the way for one that it could slide in, through, and out of a technical course without some mental effort.

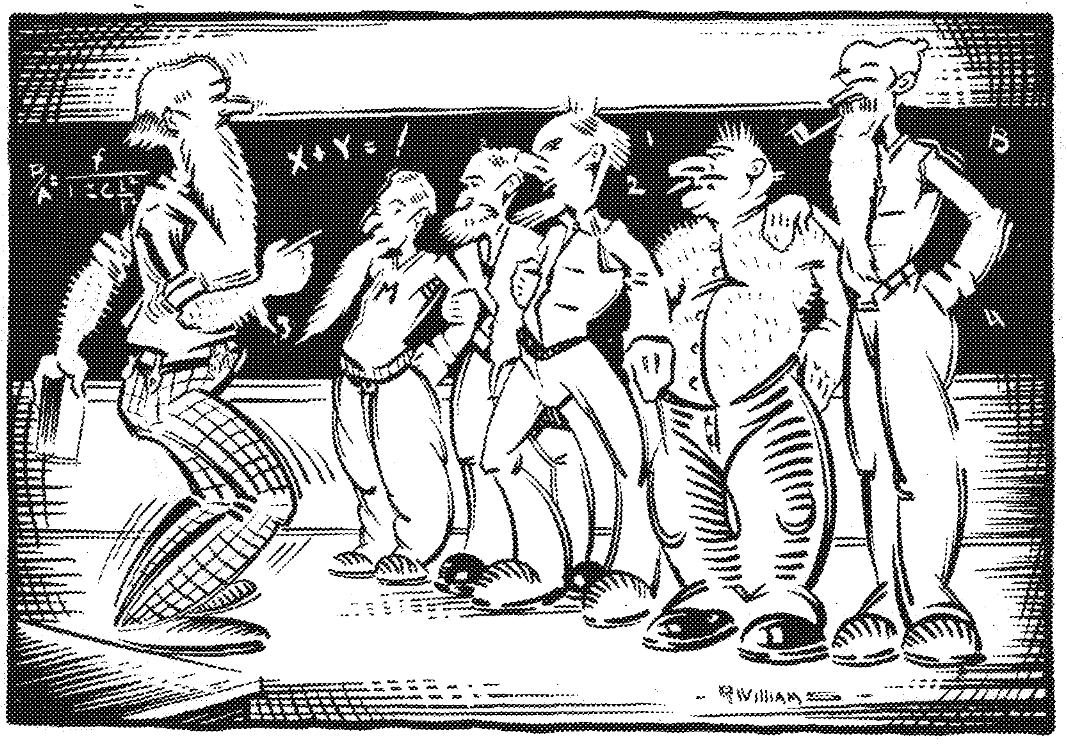
The great theory now shows signs of fizzling out. For life is harder going today, and education is being forced to keep pace with it. It is often said that life reflects education. But the reverse is just as true: that education reflects life. Social and individual necessity is what makes men think. Now we are once more realizing, what has really been known for a thousand years, that the fundamental fact of education is that it cannot be truly effective unless it qualifies as a mental discipline. In other words, education cannot be made easy and remain education.

What a student should realize is that there are two chief reasons for going to college. One is to gain information. The other is to do some thinking; to submit to a mental discipline. And of the two the second reason is the more important. As far as simply obtaining information is concerned there is no need to go to college. One can pick up a lot of information sitting around a radio; or, for that matter, sitting around a police station. There isn't a college in existence in the heads of whose faculty is one-tenth the information to be found in a good library. Stated in another way, faculties are hired not only to present information but to stimulate mental effort based upon the information.

This should explain to students the reason for the devices used to bring about the thinking, the mental exertion, which is the prime purpose of college education. Probably the most painful device is that known as "flunking." Flunking, like hanging, may be a pain in the neck to the person experiencing it, but we must accept the fact that in an imperfect world unless both effort and lack of it are properly rewarded there won't be much effort. And mental exertion is an effort, far more so than is physical exertion. It is, I think, for most of us unnatural, and hardly to be indulged in unless there are future rewards, one way or the other. Yet it is to this unnatural practice that schools are dedicated. This, and not the mere dishing out of information, is the chief reason for the existence of colleges and the way they earn their keep.

Thus a man who gets through college without much mental effort should never compliment himself on being unusually bright. In the first place, he has been cheated out of an education, and it is never bright to crow about being cheated. Secondly, he should know that natural mental ability, or even being unnaturally bright, is not the decisive factor in life. That which does the business is having the will to use the ability one has, the determination to think, and some previous practice in thinking. College is the place to do the practicing.

"Faculties are hired, not only to present information, but to stimulate mental effort . . ."



START INVESTING

ACTIVITIES PAY DIVIDENDS

IN THE FUTURE

By Al Wedge, M.E.B. '43, and Joe Atkins, M.E.B. '43

MANY students who come to the University are so wrapped up in their academic work that they are unable to see the opportunities which lie all around them. Studies must come first, but outside of this direct routine work there are other values lying in extra curricular activities. The University offers over 300 different activities. Among those listed are such activities as Freshman Week, Homecoming, Class Proms, etc. Within these activities falls a wide variety of work which requires all kinds of talent.

Of particular interest to engineering students are the activities within the Institute of Technology itself. These include work on the engineering publication, the TECHNO-LOG, committeework on Engineer's Day, and membership in the professional societies.

Pictured below are two of the more outstanding activities groups in the Institute. Upper: Last year's Techno-Log editors check final issue. Lower: The 1940 Engineers' Day Committee heads meet to plan the day's program.

Work on the TECHNO-LOG includes editorial or business work. Included in the editorial end are the writing of stories and columns, proofreading, make-up, and other duties necessary for the publication of a magazine. The business staff solicits and draws up ads for each edition. Anyone really interested in this type of work should contact either the editor-in-chief or the business manager of the TECHNO-LOG in their office in the basement of the Electrical Engineering building.

Engineers' Day

Engineer's Day, which is the official yearly recognition of the Institute of Technology on the campus, comes in the spring of the year. The executive board for Engineer's Day activities is composed of juniors and seniors, but there are many opportunities for underclass men to work on the various committees. This enables them to get the experience which prepares them to take over the more important positions. When Engineer's Day comes, everyone is given a chance to engage in whatever type of work he is interested.

The professional societies function in every branch of engineering and are junior societies of the national organizations. Membership may be continued after graduation, giving many values to the active engineer. These societies conduct membership drives during the year. Their activities consist of regular meetings with guest speakers and movies, tours of industrial organizations, and recreational get-togethers for all the fellows.

All-University Council

The all-University activities are headed by an All-University Council which acts as the voice of the student body in expressing the student sentiment to the administration and sponsoring all the activities for which the campus feels a need. This body consists of fifteen members, and its organization is such that several hundred different students are needed to execute any one of ten or twelve different programs which it sponsors during a year. In addition there are student problems which constantly come before the council, demanding immediate attention. Student committees are appointed to do this work. The council appoints chairmen of Freshman Week, Homecoming, and Minnesota Foundation by receiving the platforms submitted by the candidates and checking their qualifications. It also conducts all the major elections of the entire University.

The Minnesota Foundation was formed to instill a more personal feeling between the student and his University while he is in school, and which will stay with him after he has graduated. This mass loyalty created in the students would incite them as alumni to pass on to others the opportunities they themselves had. Through their contributions scholarships could be established and research carried on which would benefit society as a whole. This is a permanent organization performing campus services the year around. As a means of publicizing this organization, an all-university Foundation Ball is held every year. Both the permanent organization and the temporary committees of the dance afford opportunities for many active students.

Besides these continuously functioning activities there are numerous temporary activities, including Freshman Week, Homecoming, and Snow Week. These function periodically during the year, and calls for volunteer workers are issued well in advance of the scheduled time for the event. The chairmen are usually people who have worked as committee members in previous years. More students participate in these activities than any other ones on the campus.

Campus Politics

Political parties on the campus strive to place interested students in activities. This is accomplished by indorsing capable people for campus elective positions. If elected, these people recommend others for committee work from those who have shown their interest by volunteer campaign work involving sacrifice of time and energy.

A fine addition to the campus buildings this year is the Coffman Memorial Union. Besides its splendid physical layout the new Union has an expanded program of student activities. For the first time the University has a co-educational social center which in itself gives rise to new problems. These co-educational activities are under the direction of the Union Board of Governors composed of 15 students elected for two-year terms from the school at large; and five faculty members appointed by the University president. Under the new program each student board member serves as a sponsor for some committee. Students are appointed as chairmen of committees and also as members. This plan gives an opportunity for an unlimited number of students to work on the broad social and cultural program. Any student can find activity work by signing up in the board office on the second floor of the new building.

Although many positions on the campus are elective, a great many more are achieved through ability, interest, and active work. Editorships of all the publications are achieved by showing ability to head a staff which edits an acceptable product. Chairman of the large student programs such as Homecoming and Freshman Week receive their positions as a result of experience obtained on previous committee work. Other major positions are given out according to the merit for the particular job. The merit rating of the Union is used to choose the most capable candidates for future Union Boards. Under any merit system, the student must be willing to accept a minor position at first and by doing this job well he will then be ready to receive a more responsible position. Any student showing the ability and interest is usually rewarded with achievement.

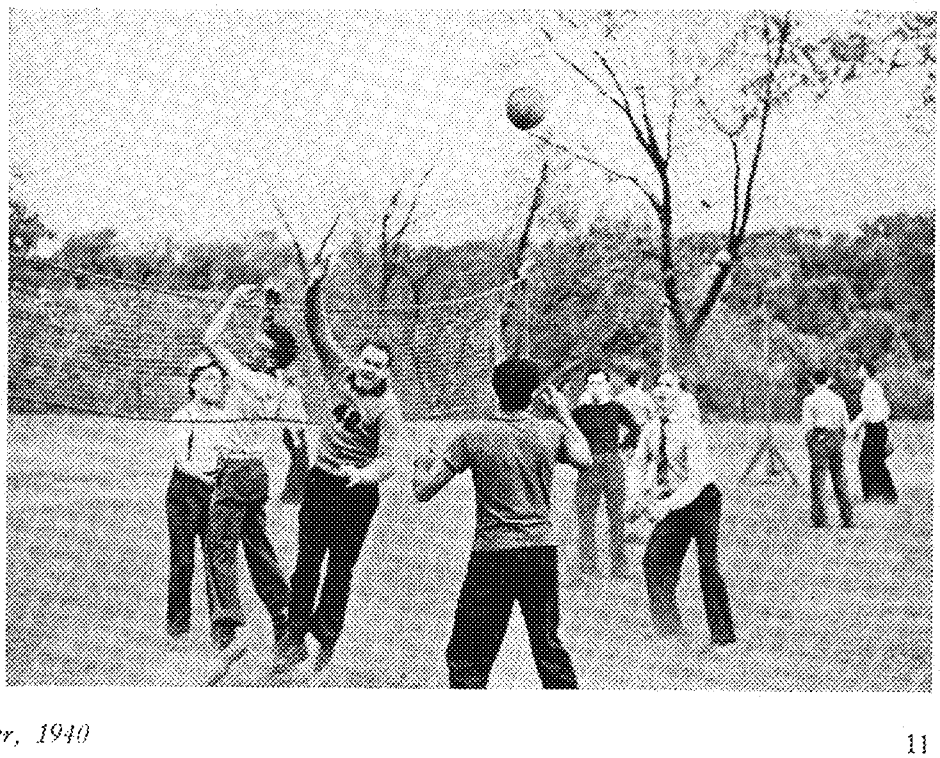
Many students say that they do not have the time to engage in activities. With some, this is true, but most students would make better use of their available time if they had something else to interest them besides studies. It is always possible to find time without neglecting school work if a person is really interested. No definite amount of time can be set for any activity; that is governed by the interest of the participant. In all cases the time spent is well worth the while.

Effect on Jobs

Every year personnel scouts from large engineering firms all over the country come to this university to hire men to carry on the work of their company. The men they hire must be capable of favorably representing the company. Therefore, the men who know their engineering and are able to creat a favorable impression are the ones who will secure the highest paid positions and climb to the top of their industrial field. In the past there have been men who have had very little better than a "C" average, and who, because of their extra qualifications developed through activities, have secured the best jobs offered any student in their field. Mr. A. S. Levens, director of the engineering placement service, stated last year that the combined percentages of participation in activities and of the benefits received from them in the way of personality development, range from twenty-five to over fifty per cent of the factors stressed in the selection of men for jobs.

A little less tangible but just as important are several personal benefits which one receives. Through active participation in campus affairs one is certain to meet many types of people and eventually he will be able to meet anyone in a free and easy manner. He will learn to work for others, to work with others, and to have others work for him willingly. Have you ever tried to accomplish the last of these? He will gain self confidence and will show other people that he can be depended upon. He will learn good habits of work which will follow him all through life. As a result of this he will probably get better grades because he will learn to budget his time and to study more efficiently. Above all he will begin to see a whole new world open up before him. He will have more interests and therefore be more interesting to other people. This point more than any other should be stressed because everyone likes to have mutual interests with others, and the more that a person knows that is of interest to the other fellow the better he will be able to converse with him. He will establish many friendships with older, more experienced men from whom he can seek advice. Some of the men whom he contacts in his work may even be able to employ him in their own company. Also he will recognize certain problems as they reoccur. In this way he will know his way around the problem on which he blindly used the "cut and try system" before. He will certainly learn to know what committee work is like and will be able to stand up before a group and express himself. A student may first go into activities to seek glory and success for himself, but he will soon come to realize that most of the work is enjoyable and that it is doing him a great deal of good.

Professional societies have the largest student participation of any Institute activity. Here is an inter-society volleyball contest as an example of the recreational part of their program.

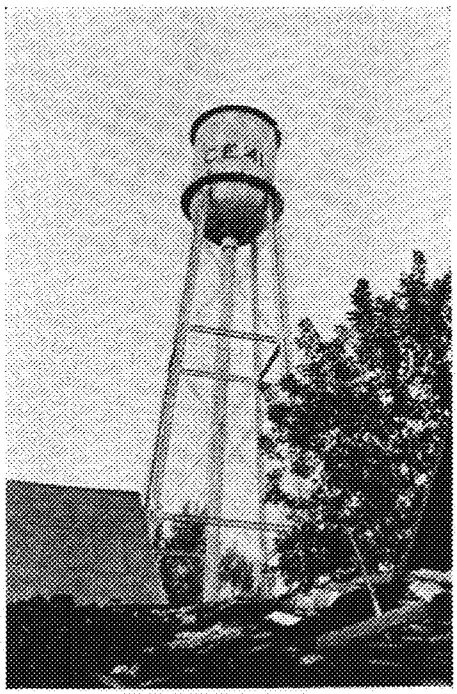


THE

GRAND FORTIES

By Don Martin, C.E. '41

48 MEN
43 DAYS
'41 CLASS



It took forty-one men.

For forty-three days and nights, forty-eight men commanded the CHIPPEWA NATIONAL FOREST and the towns of Cass Lake and Bemidji. Topography, leveling, railroad layouts and surveys, stream measurement, harbor soundings; all these and more constituted the late-summer program for 1940; to these may be added one day of "K.P." for each man. Two specific changes took place during the course of the camp. First, the number of fellows in swimming at 5:45 a.m. decidedly decreased as time progressed and as the Sun went farther south. Second, the hanging of a meat cleaver on a 30-inch circular buzz saw scared one into waking at first, but later it really became an efficient alarm clock. Baker's calling Schendel every morning acted as an alarm auxiliary.

Certain phases of the camp work appealed to certain fellows more than others, but being a civil engineer is no prerequisite to enjoying the work of railroad reconnaissance. Every real man would get a thrill when looking over a huge prairie of timber and underbrush, sighting and selecting possible preliminary lines for an embryo railroad right o'way; he would vision all along, the steel rails that would soon follow his path of camp fires. To be the first one, the trail-maker, to make way for the iron horse where nature beams in glory is a rare picture, framed by the open arms of Alaska or South America that every C.E. wants to bring to reality. And it is a direct challenge to culture students who claim engineer's minds to be crammed with steel and concrete and know nothing of trees and sky and waters.

He didn't even get his knees clean.

Triangulation surveys turned out to be rather precise affairs, even though a number of men were getting "logarithm sappy" from least squares, etc. Stream measurement was interesting as well as instructing and proved to be the cause of ha-ha bends for Mr. DeLapp, hydrographic assistant. It so happened that the author and Gordy Anderson were making a still-water rating for a current meter. These two mates were travelling back and forth in a boat along a 100 ft. taped guy line and were timing and recording the rpm's of the meter. However, the water was not still but mighty irregular in wave action, and as the last reading was about to be taken, the briny deep filled the scow to the gunnels and first-mate Andy bailed out (he used his head). But Commodore Martin was destined to get that last reading and had but one thought in mind: "Martin, you get that final reading if you have to shake hands with Davy Jones." The reading was gotten but as far as any medal of honor was concerned, Martin wasn't qualified. However, the water depth was only 18 inches and he didn't even get his knees clean.

Even though the day (and night) was not overloaded with leisure time, fun managed to creep in sometime at someplace. Who will forget the 36-man contingent that went into Cass Lake at 1:30 a.m. and in two hours painted "C.E. '41" and a huge "M" in four-foot black letters high atop the town's silvery water tower? Wouldn't an audience get a laugh from the facial expressions of Martinson's railroad location party when, just at the opportune time, Prof. Cutler came into the woods to find a beautiful red and white range pole, used as a javelin, stuck in a tree branch two feet from a stiffened porcupine? One can still hear faint echoes of that vocabulary produced by Brobaugh when, as a result of a magnificent water fight, his six-page Polaris Report became a mass of flowing ink. Funny too, the cause of it all. Gerber, while sitting in bed and smoking an enormous hunk of rope, suddenly became aware of an ignited ash in his chest "mattress." Immediately Ever-ready White presented him with a dipper of water across the smoking embers. Then that redhead, instead of giving thanks, rebelled and emptied the whole pail of aqua onto White. It started from there; tent No. 10 against brother White, then tent No. 2 to his frantic cries for aid, and in three and one-half minutes 13 tents of men were fast decreasing the water level of Cass Lake and giving each other many Saturday night jobs long overdue.

Beefing many times played the co-part with fun, such as in the touch-ball games that were played when Minneapolis and Duluth engineers took on the boys from St. Paul and the farms. Land slide scores were naturally in favor of the St. Paulites and shockers (guess where the author lives); ask Kogl about going out for a pass fifty-one straight times before someone finally threw him the ball. Further sport at the camp included a featured basketball game between the C.E.'s and Cass Lake; we lost 20 to 14. "Always a Ringer"-Dahlgren was crowned the horseshoe champ and "Walleye"-Dahl was the best fisherman.

Sunday mornings were spent by having chapel on the shore with a twenty or twenty-five man "choir," accompanied by Martin's accordion and led by congenial Prof. Zelner's mellow bass solos. It was an easy task for the mind to enjoy the more solemn part of the week buried in a setting of sunshine, tall pines, sand, and blue waters. As a matter of fact, "enjoyment" had become the camp synonym whether it was in the field or at play. With such able instructors as Messrs. Cutler, Zelner, Boon, and DeLapp, harmony within the camp was inevitable. And if it's any satisfaction, we are forced to admit the M.E.'s provided our camp with an able-bodied man in Ed Kirilnk to handle and maintain the outboard motors.

THE PROS AND CONS OF D. C. TRANSMISSION

PRESENT POWER TRENDS

By Paul Triplett, E.E. '40

THE development of large sources of by-product hydroelectric power from federal dams at Bonneville, Grand Coulee, and in the Tennessee Valley has forced the government to look for possible users of the power. Unfortunately, large load centers are hundreds of miles away from the generators; this situation forces the sponsors of the projects to consider how this abundant power which they have on hand may be economically delivered to large distribution systems.

An alternative would be to develop loads in the vicinity of the generators or to encourage industries to move from other regions to the area of low cost power. Colin G. Fink, professor of electrochemistry at Columbia University, in an address before the New York section of the American Institute of Electrical Engineers in 1939, expressed an opinion that the electrochemical industry will be able to absorb many kilowatt-hours of this vast amount of power. So far, however, expected markets have not appeared bringing to the fore the necessity of transmitting the available power to any ultimate consumers.

Sixteen government projects by the end of 1940 will have an installed capacity of 8,620,000 kilowatts, which will be 22 per cent of the total installed steam and hydro capacity in the whole country. It is thus evident that the government is very much in the power picture, and the disposal of large blocks of power from remote places like Grand Coulee in Washington is so far an unsolved problem.

Economic Restrictions

Since 1919 the overall thermal efficiency of steam plants has improved 234 per cent, so that now the cost of transmission of electricity for distances of 250 miles or over by present alternating-current 3-phase systems is greater than the cost of generation of the power at the load center. This condition has brought to the attention of electrical engineers the possibility of lower-cost direct-current transmission. The question arises, can d-c. transmission lines reduce costs enough to justify their erection?

All investigators are agreed that in theory at least the transmission of large blocks of power over great distances can be effected more cheaply with d-c. than with 3-phase a-c. All are also agreed that only at high tension voltages of 250,000 to 500,000 volts will d-c. transmission be economical. It is only within the last ten years in which large size mercury-arc rectifiers and inverters have been developed that transmission of large amounts of power by d-c. has become at all practicable. The accompanying diagram shows the most practical method of d-c. transmission known today. The electricity is developed by a-c. generators, raised to the required high voltage by step-up transformers, converted to d-c. by mercury-arc rectifiers, transmitted d-c., reconverted to a-c. by mercury-arc inverters, and distributed to the consumer through step-down transformers.

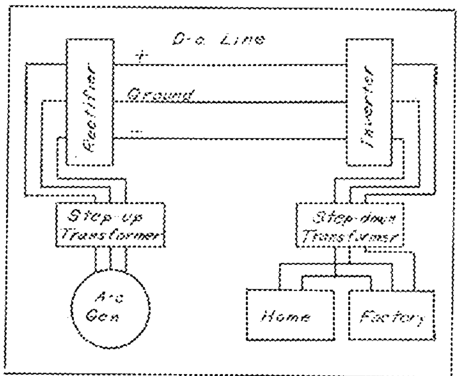
Direct-current transmission offers several distinct advantages over a-c. systems. Voltage regulation is much better, since there is no voltage drop due to inductance and capacitance such as occurs in a-c. systems; thus auxiliary equipment necessary on long a-c. lines to compensate for the reactive load of the line is eliminated. The absence of reactive effects in the line also suggests the possibility of using underground cables on long lines for certain situations such as river or ocean crossings or concealing the line in probable war areas.

Advantages

For the same insulation and factor of safety the d-c. voltage to ground can be 41 per cent higher than the effective value of the a-c. voltage to ground. This means that for any 3-phase line, considering voltage alone, the d-c. power that could be transmitted would be 9.4 per cent greater than the a-c. power. In addition the d-c. losses would be less because of practically no corona or skin effect losses. Corona loss is a function of the frequency, which is zero for d-c. current; consequently, it has been determined, d-c. voltages could easily be 72 per cent higher than corresponding a-c. voltages.

The stability of a d-c. transmission system would be much greater than an equally long a-c. system, because the stability would be influenced only by the ohmic resistance of the line. C. H. Willis, B. C. Bedford, and F. R. Elder, after extensive tests in 1934 in the General Electric plant at Schenectady, New York, emphasized the stability and reliability of the d-c. system. The constant-current line which they experimented on could be short circuited without damage to line or equipment. They also demonstrated the ease with which the line cleared itself of surge or lightning disturbances; it regained full load within 15 to 20 cycles. The General Electric company now has an experimental 27,000 volt d-c. line 17 miles long which has performed successfully ever since it was placed in operation in 1937. The full load rating of the line is 5,000 kva. at 90 per cent lagging power factor. The lagging reactive load is converted to a leading load by static condensers placed in a monocyclic network.

Schematic diagram of D.C. Circuit



Ease of Repair

From the standpoint of repairs, a d-c. line could be grounded on both sides of a fault and the repairs made without discontinuing service. This might eliminate the necessity of installing a double line to insure continuity of service.

These advantages of d-c. transmission are somewhat offset by the necessity for installing and maintaining high cost mercury-arc rectifiers and inverters. Sufficient static or rotary condensers would also have to be placed at the load end of the line to keep a unity or leading power factor, because mercury-arc inverters will not deliver lagging reactive power. Besides its initial cost, this equipment would also add for the most efficient conditions 2 or 3 per cent losses which would decrease the saving made on the line itself.

Many problems of a practical nature present themselves which as yet have not been solved. Means must be provided for suppressing any harmonic ripples in the line. Reliable d-c. indicating instruments and meters for the large amounts of power and high voltage must be developed. Adequate protection from lightning and other disturbances must be provided. Possible electrolytic effects in the ground and line must be considered. Power factor corrective devices at the load end of the line must be installed. As yet, because there has been no demand, mercury-arc rectifiers and inverters have not been built for the large sizes which would be necessary for economical d-c. transmission, but design engineers are confident that this and other technical difficulties can be overcome when and if d-c. transmission is attempted.

The whole question then resolves itself into an economic one. Electric power will be transmitted by direct current when it is more economical to get the required power by that means than by any other method. Direct-current transmission can be expected to be a gradual step-by-step development as new load and economic considerations demand.

Societies Hold First Meetings

A. I. Ch. E.

The first meeting of the A.I.Ch.E. was held in the game room of the new Union last Tuesday, Oct. 8. Mr. Grove of the department of chemical engineering talked on employment opportunities in chemical field. Dr. Mann, chief of the division of chemical engineering, is the organization's advisor for this year. Refreshments were served after the meeting.

I. Ae. S.

The I.Ae.S. gave a smoker on Wednesday, Oct. 9, in the new Union at which the members of the Aeronautics faculty gave short talks. The purpose of the meeting was to get acquainted with the Freshmen and to tell them something about the Institute.

A. S. M. E.

The A.S.M.E. held its first meeting of the year in the ballroom annex of the Union on Wednesday, October 10 at 7:00. It will continue work on the new mechanical engineering building campaign.

Architectural Society

Last June, the Architectural Society voted to disband and to form a new organization consisting of all the architectural students and a student council of seven members. The new body organized at a meeting in the Union, Oct. 1. John Holabird, famous architect from Chicago, spoke at the meeting. October 14 was set as the date for the election of the student council. The purpose of the new organization is to promote and to represent the interests of architectural students in University activities and in the School of Architecture.

Alumni Directory Completed

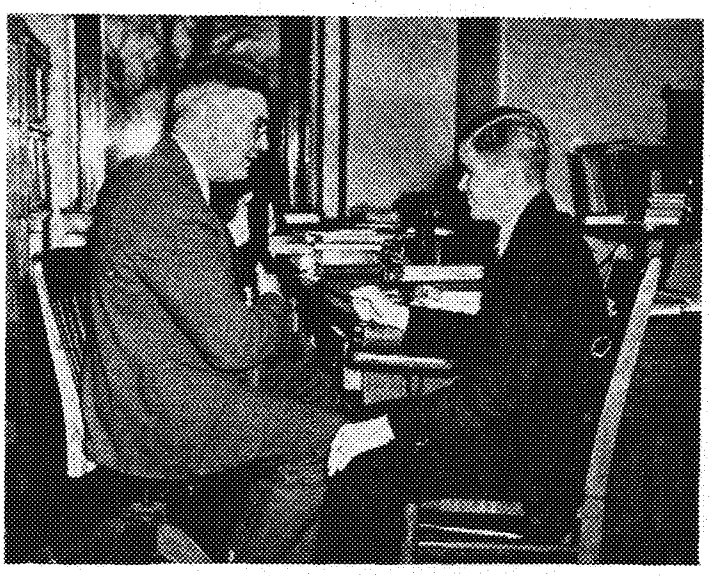
The Alumni Directory of the Institute of Technology has been completed by the staff of the Minnesota Alumni Weekly after a summer of work. This is the first directory of its kind in the Institute. It lists alphabetically, geographically, and by class all those who have received engineering degrees since the first one was granted in 1875. Copies of the new directory can be had for one dollar by applying at the alumni office in the new Union.

Recent Marriages

Cupid was surely busy this summer at least as far as our secretarial staff and graduate students were concerned. Among those stricken were Miss Willa Irwin, Ph.D. 1940, and Cyrus Guss also a Ph.D. 1940. They were married in Craig, Colo. on August 10 and will make their home in Midland, Mich.

Woolsey Motl, 1939 TECHNO-LOG editor and A.I.Ch.E. President, was married to Miss Louise Johnson, formerly on the secretarial staff of the division of chemical engineering, on August 17. They are living in Kansas City, Mo.

We Present . . .



Dr. M. C. Sneed

Head of the Department of Inorganic Chemistry

By DONALD McCLURE, CHEM. '42

PROFESSOR SNEED has just completed his twenty-second year at Minnesota. During most of this time he has been head of the department of inorganic chemistry and these two years have been full and interesting as any who knows him will testify. Dr. Sneed's main interest has always been teaching. His first teaching job was in Peabody College, Nashville, Tennessee, in 1911, where he took his A.B. degree. Teaching positions in a high school, a normal school, and in the University of Cincinnati followed, and in 1918, he came to Minnesota.

Teaching does not cover his activity at the University by any means, for he has conducted extensive research in qualitative analysis and has written several textbooks on chemistry. The qualitative scheme used by chemistry students has been under revision for the past twenty years. The changes have been coming so rapidly that Dr. Sneed's original text on qualitative analysis has had to be revised yearly. In hopes that the present system will be fairly permanent, Dr. Sneed is again writing a complete text on qualitative analysis. The new book will be one of the most complete in its field, for in addition to cation and anion analysis, it will present an adaptation of the ordinary analytical methods to semi-micro work, using Dr. Barber's newly developed micro-apparatus.

In addition to conducting work on the elementary qualitative scheme, Dr. Sneed has completed a method for the qualitative analysis of the platinum group. This work was published last year.

Dr. Sneed is also writing a new text on general chemistry. His other one, which was published in 1924, has been in use until quite recently. He completed the first four chapters of the text at his summer cabin on Wauman Lake this summer.

Wauman Lake is Dr. Sneed's usual summer hangout. With fishing, hunting (for crows in the summer) and working on something or other, he is busy all of the time. In the Fall he goes out after deer and waterfowl. He has a cabin near Ashby, Minnesota, for Fall hunting. He isn't quite the good shot he used to be—the bifocals interfere—but the fun never has worn off.

This year, Dr. Sneed has only 250 freshmen to lecture to. He is making up the "deficiency" by taking charge of the Freshman Work Committee which looks after the welfare of 700 freshmen. He is very much interested in this work.

The Sneed family—one son and three daughters—are educating or being educated at present. The oldest daughter is teaching, while the other two are taking courses at the University. His son, who has graduated from physical education, plans to do graduate work in biology.

When asked about retirement, Dr. Sneed said that it was a long way off for him, and that he never worried about it anyway. He went on to say that he would remain as busy as ever when the retirement rule relieved him of his teaching duties. A bit of practical philosophy concluded the interview; it was just that life is too important and too interesting to have time for worries or enemies; both are bothersome and hurt one's self more than others. It's one of those simple practical thoughts, which, if everyone followed would make this old planet a much better place on which to live.

? Humor ?
Leftovers

Englishman (eating corn on the cob for the first time): Boy, Boy.

Waiter: Sir?

Englishman: I say, old thing, fill it up again.

* * *

A group of tourists was on the brink of the crater of Mt. Vesuvius and staring fascinatedly down into the boiling depths below.

One of the two Americans in the group turned to the other one and remarked, "Beats hell, doesn't it?"

Two Englishmen overheard the Americans, and one Englishman turned to the other and exclaimed, "These bloody Americans have been everywhere."

* * *

Old Mother Hubbard went to the cupboard,
To get her poor daughter a dress.
But when she got there
The cupboard was bare,
And so was her daughter, I guess.

* * *

First Seagull: Who won the boat race down there, Yale or Cornell?

Second Seagull: Cornell just crossed the finish line first.

First Seagull: And to think that I put everything I had on Yale.

* * *

Pathetic Figure—The boy that lisps trying to tell a girl that he likes her size.

Humor Columnists • • •

Humor Columnists by the score signed up last spring, but when it came down to the cold, hard jokes, none turned up at the office this fall. We never want to run anything as pathetic as "Humor Leftovers" again. Why not get your best pal and take a crack at it. The deadline is October 21.

—And remember there are some clean jokes that are funny, *too.*

ALUM

'02

Harvey L. Burns, E.E., has retired after thirty-seven years with the Western Electric Company of New York. Mr. and Mrs. Burns live at 76 Oakland Road, Maplewood, New Jersey. They have two sons; one, a graduate of Massachusetts Institute of Technology, is employed by the Western Electric Company at its Kearny Plant; the other, a graduate of Yale, is teaching at Rollins College, Florida.

'19

Donald E. Marshall, is in charge of the manufacturing division of the Palmolive Colgate Company in Jersey City. He lives at 16 Greenbrier Road, Summit, New Jersey.

'20

Israel C. Mark, Mines, is a partner in the Mark Iron and Metal Company of Minneapolis. His new address is 1211 Vincent Avenue North.

Dr. E. J. Jones, Ch.E., is a physicist for the USDA Bureau of Plant Industry in Washington, D. C. His residence is at 5521 Colo Avenue N.W.

'22

Thorwald S. Paulsen, C.E., was made manager of the Boston office of the George A. Fuller Company on June 1.

'25

Charles J. Cosandy, E.E., '25 and M.S. '26, from Iowa State College, was fatally injured on June 26 at Blanchard's dam near Little Falls, Minnesota, while checking electric equipment for the Minnesota Power and Light Company. He passed away twelve hours later. His widow, Evelyn Graber Cosandy, and a daughter, Katherine Marie, survive.

Philip F. Hartman, C.E., is working as sales manager for the Goodyear Tire and Rubber Company, Ltd. At present he is down where the rubber comes from in Java, Netherland Indies.

'29

Frank S. Freeman, M.E., and wife proudly announce a feminine addition to the family. Frank is a salesman for the Ingersoll Rand Company. He lives at 377 10th Street N.E., Atlanta, Georgia.

'30

L. F. Kernkamp, A.E., is with the Douglas Aircraft Company, Inc. He resides at 321 North Elmwood, Burbank, California.

NOTES

'31

Russell M. Thayer, M.E., is an engineer for the Linde Air Products Company. His address is 70 Enola Avenue, Kenmore, New York.

'34

Sidney Karon, E.E., was married to Miss Sally Halpern on September 15. He is in Duluth at present.

Respectively President and Secretary of the Cleveland Alumni Club are **Gates C. Hunt,** E.E., '20, who is with the Cutler Hammer Company, and **Gladys Wallene,** '34, Bachelor of Mechanical Engineering, who is secretary of the American Steel and Wire Company.

'36

John L. Mills, Ch.E., 507 Fifth Avenue, Spokane, Washington, is a water inspector for the Northern Pacific Railway Company. He prefers his present territory, everything west of Missoula, to the bleak North Dakota country where he was formerly located.

'37

Thomas R. West, E.E., was married to Mary P. Putnam, a graduate of Arts in '38. Mr. West is a sales engineer with the Westinghouse Electric and Manufacturing Company. The couple will live at 11500 Florian, Cleveland, Ohio.

'38

Vernon Skogan, Ch.E., will be married to Miss Jeane Parker on October 19. He is a chemical engineer in the research laboratories of the Standard Oil Company in Whiting, Indiana.

'39

Charles Woolsey Motl, Ch.E., and Georgia Louise Johnson, were married August 17. Mr. Motl, the son of Charles L. Motl, '10 C.E., and Mrs. Motl (Lillian Loretta Woolsey, '11), is stationed in Kansas City.

Frank Larson, Ch.E., and Miss Helenore Crough of Port Arthur, Canada, were married at the Central Lutheran Church on August 30. Frank is junior assistant sanitary engineer of the Minneapolis Department of Health.

LAUGH, Damn You, LAUGH

BY WILLIAM CAMPBELL, E.E. '42

A Sultan at odds with his harem,
Thought of a way he could scarem.
He caught him a mouse,
Set it loose in the house,
Thus starting the first harem-scarem.

* * *

The beautiful young teacher asked Johnny to write on the blackboard.

He wrote: Johnny is a passionate devil.

Teacher at once reprimanded him and told him to stay after school for one hour that afternoon.

All of Johnny's classmates waited for him outside the schoolhouse door, waiting for him to put in an appearance. After the hour had passed Johnny strode jauntily out, to be immediately barraged by questions.

"I ain't saying nothin', said Johnny, "except that it pays to advertise."

* * *

"Is that your face?"
"Nobody's else's but."

* * *

Collegian: Jiggers, here comes a speed cop.
Second same: Quick, hang out the Notre Dame pennant.

* * *

Feudal Lord: I hear you misbehaved while I was away, son.
Knight: In what manor, sir?

* * *

Fan, looking into telescope: Gawd!
Friend: Gwan, it ain't that powerful.

* * *

He: Do you care for dancing?
She: No.
He: Why not?
She: It's merely hugging set to music.
He: Well, what is there about that you don't like?
She: The music.

* * *

J. P. Stodolka: I was out with a deer, last night.
Dick Lebens: Did you have any fawn?
Bill Carter: How much doe did you spend?
J. P.: A couple of bucks.

It seems that this summer, Joe Atkins, the 1st, was looking around for a position. One day he walked into a machine shop and asked the foreman for a job.

"What can you do?" asked the foreman.

"Anything," replied Joe.

"Can you file smoke?"

"I can if you'll clamp it in the vise for me."

* * *

"Who invented high heels?"

"A gal who was always being kissed on the forehead."

* * *

A tiny baby was needed for a scene in the picture, they called to the studio nurse: Please have a baby by eight o'clock tomorrow morning.

* * *

"What's the trouble, lady?"

Mrs. Newdriver: "They say I have a short circuit. Can you lengthen it while I wait, please?"

* * *

A fellow taking phrenology at evening school one time found that he had gotten a date on an evening that he had a class. He was in a quandry, whether to take his girl out or go to the class—he flipped a coin.

(All those needing an explanation see me and I'll draw a diagram.)

* * *

She: How do you like my new evening gown?

He: I can't tell until you get up from the table.

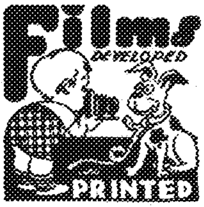
* * *

The sweet young thing has never before seen an elephant. Therefore, when she looked out in her garden one day and saw one there she became quite excited.

Hurriedly calling the police, she exclaimed, "Oh officer, hurry out here. There's a terrible looking monster out in my garden and he's pulling up all of my vegetables with his tail."

"And what's he doing with them, madam?" asked the officer.

"Oh! officer, you wouldn't believe me if I told you."



Faculty Leaves Institute for New Positions

Called to Washington, D. C. recently, to aid in the national defense program were L. H. Rumbaugh and Wilford W. Wetzel, both of the physics department.

Mr. Rumbaugh, Associate Professor of Physics, left the University on October 6 and will be gone for the duration of the quarter. Mr. Wetzel, Assistant Professor of Geophysics, left for Washington yesterday. He will assume a full time position in the naval ordnance department.

Mr. Gilbert Perlow will come from Chicago to take over some of the class work left by Messrs. Rumbaugh and Wetzel.

The latest addition to the chemistry staff is Bryce L. Crawford, Jr., Ph.D. 1937, Stanford University, who will act as Assistant Professor of Physical Chemistry. Dr. Crawford came to Minnesota from the staff of Yale University. He will fill the vacancy left in the teaching staff by Dr. Glockler, who is now head of the department of physical chemistry at Iowa State University.

Howard W. Barlow, Assistant Professor of Aeronautical Engineering, and last year acting head of the department, has resigned to become head of the aeronautics department at Texas A. and M. In his place is Albert Gail, new assistant professor of aeronautical engineering.

Dr. Marvin C. Rogers has resigned his assistant professorship in chemical engineering to accept a position with the R. R. Donnelly Printing Company of Chicago. He will investigate problems in drying, shrinkage, and inking.

Professor Richard T. Arnold has plenty to be proud of. He has been promoted from the rank of instructor to that of assistant professor. He was also promoted to the rank of father recently. The new arrival is a baby girl, Mary Lynn.

Food Technologists Meet

The first meeting of the newly formed Institute of Food Technology was held in Chicago this summer, from July 17 to 19. Doctors Sherwood, Ferrari, and Andrews of General Mills, Inc. were there as well as Dr. Firet of the University of Minnesota. The Institute was discussed in the April, 1940 issue of the Techno-Log in the article on food engineering.

Vacation

Professor J. A. Henry, of the department of Mathematics and Mechanics, toured the eastern half of the United States this summer. Starting from Minneapolis on August 15, he traveled to Florida, making frequent stops along the way to visit friends. He came back along the coast to New York and returned to Minneapolis on September 15. Professor Henry has added textbook writing to tutoring this year as extra-curricular activity.

TAMED *by Grinnell prefabricated piping!*

Recent specifications of a large steam power plant called for a complex piping system to carry pressure equivalent to a 5542-foot head of water . . . pressure 33 times that of Niagara Falls!

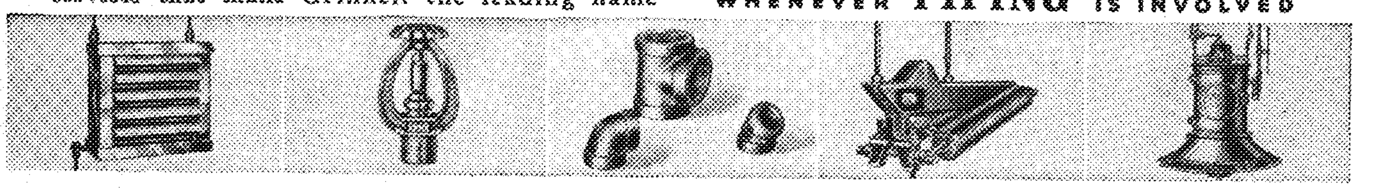
This super-pressure piping presented new problems in prefabrication. To insure interpretive engineering of these problems with expert laboratory collaboration, engineers "gave the plans to Grinnell." They chose the most efficient way to obtain "on time" deliveries of accurate, tested sub-assemblies requiring minimum field-fabrication.

Unusual prefabrication is but one of the many services that make Grinnell the leading name "whenever piping is involved." Others include: automatic sprinkler fire protection systems, Thermolier unit heaters, Amco industrial humidifiers, pipe fittings and pipe hangers. For detailed information on these services, write to Grinnell Co., Inc., Executive Offices, Providence, Rhode Island.

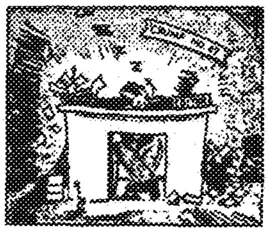
Grinnell Company, Inc. . . . Grinnell Company of the Pacific . . . Grinnell Company of Canada, Ltd. . . . General Fire Extinguisher Company . . . American Moistening Company . . . Columbia Malleable Castings Corporation . . . The Ontario Malleable Iron Company, Ltd.

GRINNELL

WHENEVER **PIPING** IS INVOLVED



Thermolier Unit Heaters — Automatic Sprinklers — Pipe Fittings — Pipe Hangers — Amco Industrial Humidifiers



Off the Editor's Desk

By Wallace K. Belin, Ch.E. '41

The Techno-Log for '40-'41 • • •

Modernism untainted by feminism was the watchword in laying out this year's magazine.

Note Walt Ziering's design of the cover with its bold lines and striking angles. Whether or not one likes it, he must admit that it gets away from the traditional stereotyped cover designs.

Our principle body type, called **Flash**, is a brush type with sturdy masculine strokes. The type's easy readability is further enhanced by using both upper and lower case.

Throughout the year we will run "picture articles," as we did on the Union this month if students react favorably to this sort of article.

Feature Articles • • •

Now is the time to get in articles you have been thinking about all summer. Turn them in to the "Log" office, room 39 in the basement of the electrical engineering building.

Staff Positions • • •

Any of you fellows that missed our cider luncheons for new staff men don't feel there isn't a place for you. One major and a few minor editorships together with several staff positions are still wide open. Drop in and see me, or contact one of the sub-editors.

Minnesota Industries • • •

A new series of articles playing up different Minnesota industries is planned for this year.

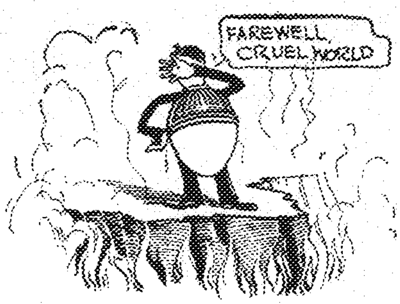
Iron mining, flour milling, etc., will be included, but we would also like to have something on our newer industries. If you have any ideas, send them in to the office.

On Our Editorial • • •

We hope we have not incurred the displeasure of any military man by our editorial, but we do feel that attention should be called to the danger eminent in drafting young engineers. We feel that the boards should be impressed with the importance of the technical student, lest in their enthusiasm to play fair they do our country a grave wrong.

Safe and sane judgment on the part of the boards is all that we ask.

G-E Campus News



SUICIDE LAMPS

DID you ever take up a newspaper and read that someone committed suicide by jumping off a bridge? That's what high-intensity street lamps have been doing, too—not jumping off bridges, but committing "suicide."

Certain smooth-surface street-light reflectors reflect heat back to the lamp filament, thus raising the filament temperature to the point of early "suicide" or burnout.

In an attempt to do something about this, G-E engineers developed the stepped reflector. The inner surface of the reflector is broken up into small steps in such a way that light and heat rays reflected back from the steps just miss the vital lamp stem. Tests showed that, with a 500-watt lamp, the temperature at the lamp stem was 275 F less with the new reflector than with the old one.

The engineers who developed the stepped reflector are graduates of the General Electric Test Course, open to selected graduates of recognized engineering schools.

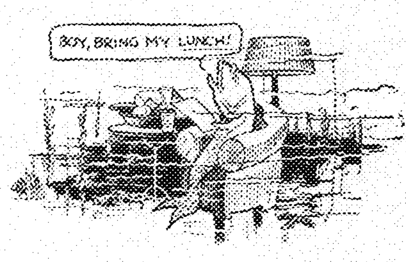
CHASING SHADOWS

HOW would you like to see carbon dioxide pour out of a beaker and snuff out the flame of a candle, or cold water from floating ice flow to the bottom of a glass? By accident two General Electric scientists recently discovered a comparatively simple way to force these and other ordinarily invisible things to show themselves.

It all began one day when a searchlight shining through the windows of the G-E Research Laboratory at Schenectady, N. Y., started the scientists on an investigation, resulting in equipment which gives the inside story of supposedly invisible happenings.

By holding transparent substances in a beam of light from a water-cooled mercury lamp, variations caused by changes in the index of refraction show up plainly on a screen. It's something like seeing heat waves rise from a hot pavement in the summer. Gases, liquids, or transparent solids cast strange shadows, revealing characteristics unseen to the naked eye. Although this has been done before with arc lights, the new method has many advantages.

The two G-E scientists identified with this accomplishment are Dr. R. P. Johnson, U. of Richmond, '29, and Dr. N. T. Gordon, Princeton, '13.



PISCATORIAL UTOPIA

INSECT laboratories have been air conditioned, rivets for dirigibles have been refrigerated so they can be driven better, and there is even a case where telephone books have been cooled mechanically to speed the hardening of the glue. But it was only recently that the first automatic heating installation designed specifically for the comfort and health of tropical fish was put into operation.

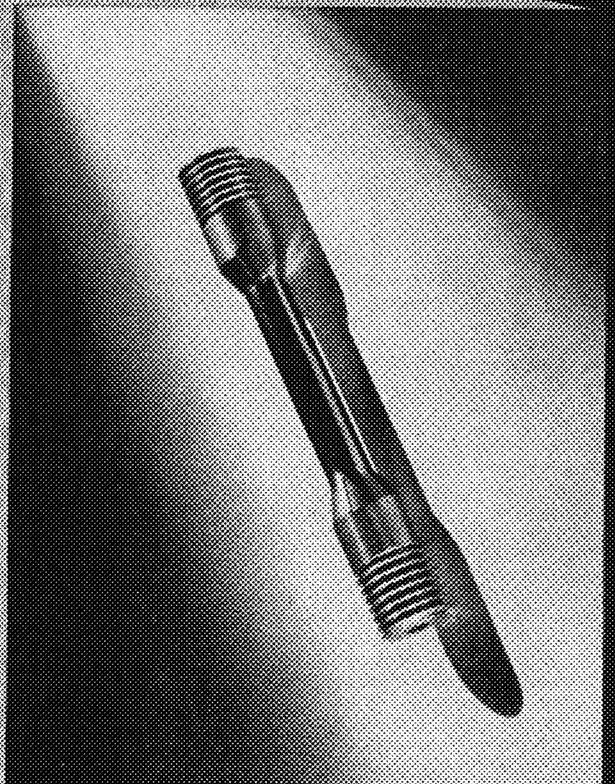
Devilfish, sharks, rays, the only porpoises in captivity, and thousands of other unusual specimens caper gaily around in their adopted home in the Marine Studios at Marineland, Fla. There, in huge tanks, the pampered fish live the "life of Reilly" (the porpoises are fed by hand) in water that is not only filtered and aerated but is also held at a temperature of 70 F.

Five General Electric oil furnaces do the heating job, holding the 500,000-gallon "oceanarium" at a temperature just like home for the transplanted tropical specimens.

At G.E.'s Bloomfield (N. J.) plant, where air conditioning equipment is manufactured, is a division of the General Electric Test Course. Here young student engineers gain practical experience in this branch of engineering.

GENERAL ELECTRIC

THE TECHNO-LOG OF MINNESOTA



FEATURI
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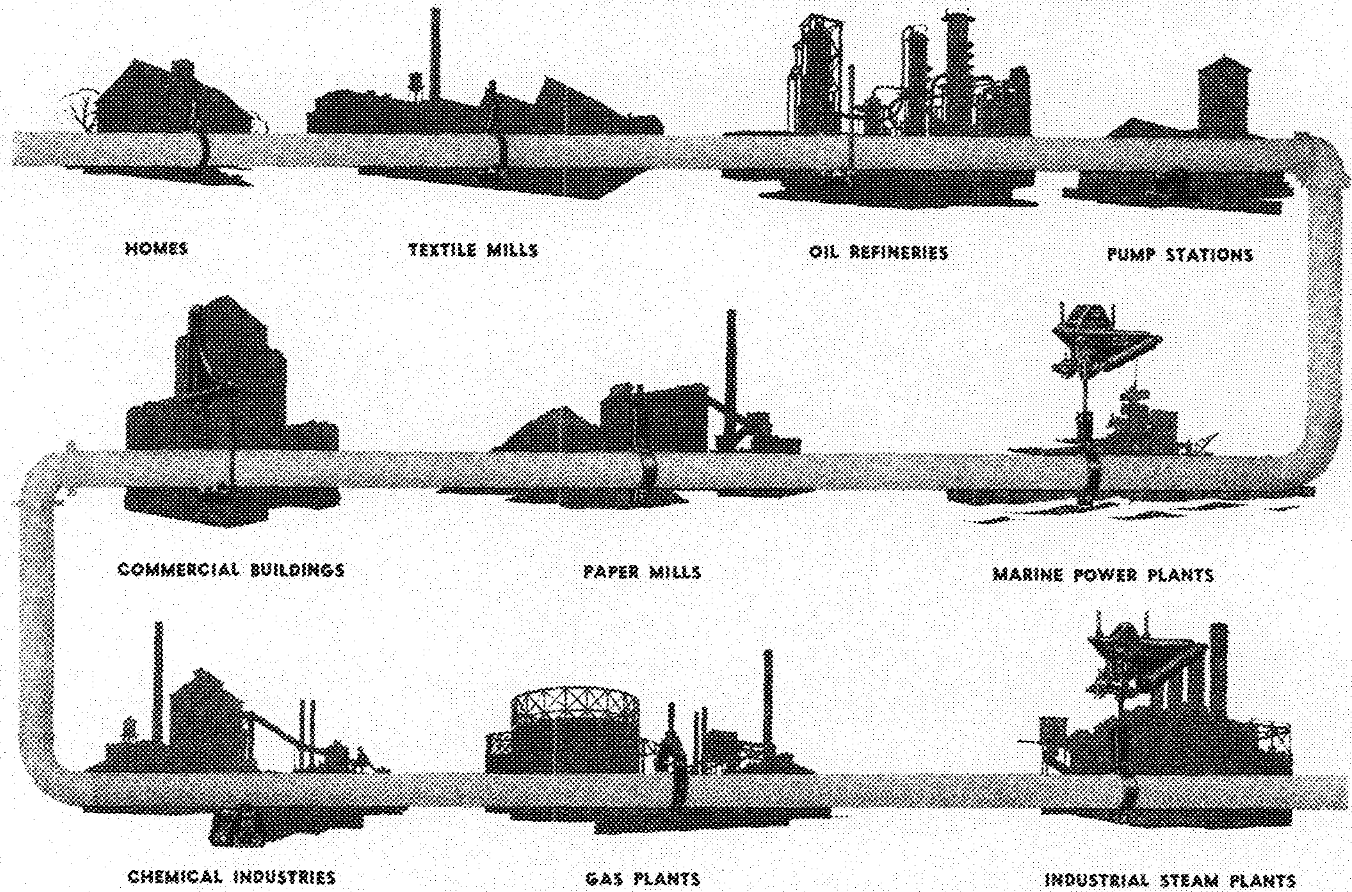
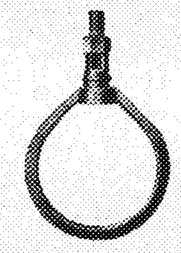
NOVEMBER, 1940 VOL. XXI N

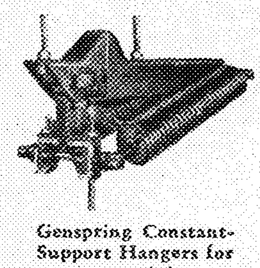
SCIENCE IN AN UNEXPECTED ROLE...



Pipe Hangers are now *Engineered* for each specific service



Adjustable Hangers for all low-pressure piping.



Genspring Constant-Support Hangers for power piping.

NO longer is pipe hanging a haphazard matter of fastening pipes "somewhere, out of the road." Every industry has individual requirements . . . every type of system its vagaries At one extreme is the domestic water system involving chiefly dead weight. At the other, pulsing steam power lines where thermal-movement and vibration demand scientific control.

Until Grinnell engineers attacked these problems, pipe hanging was given little attention. Today, Grinnell produces adjustable hangers in thousands of combinations to hang *any* piping *anywhere*.

This is merely one example of improved services developed by Grinnell. Others include prefabricated piping, automatic sprinkler fire protection, Thermolier unit heaters, Amco industrial humidifiers, extra-quality pipe fittings. Write for reference folder on Adjustable Hangers or other Grinnell products. Grinnell Co., Inc., Executive Offices, Providence, R. I. Branch offices in principal cities of U. S. and Canada.

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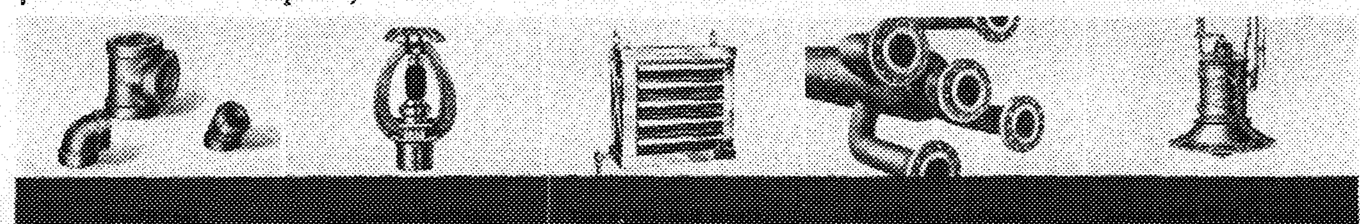
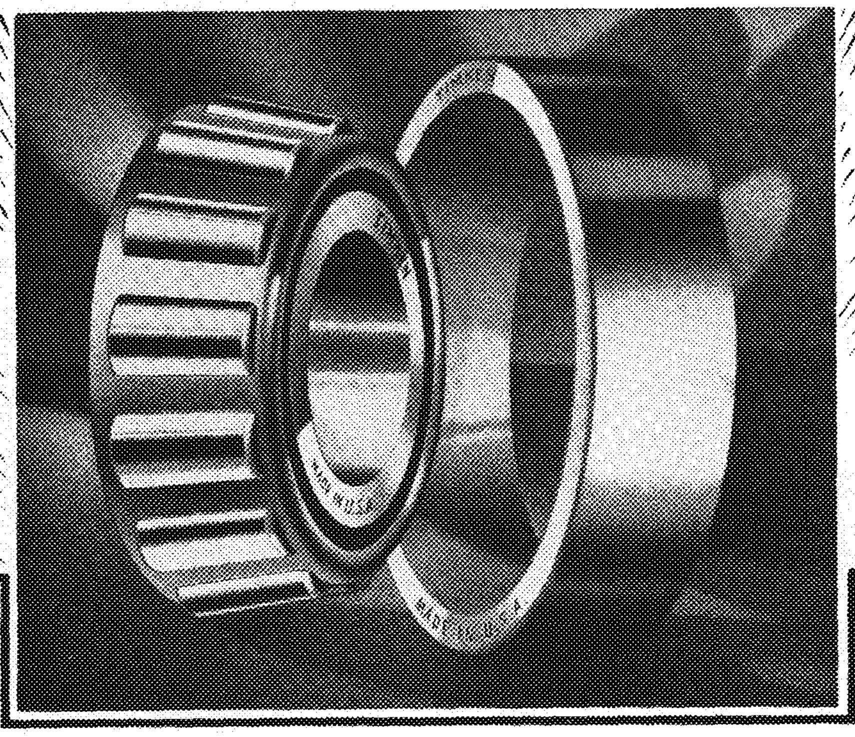
GRINNELL

WHENEVER **PIPING** IS INVOLVED





Authors . . . Staff . . . .

By Richard Opland, C.E. '43

Marvin Sandgren, M.E. senior, unpacks some of his accumulated knowledge in giving us an article on diamond turning. Marvin has also had some practical experience, having worked for Allis Chalmers of Milwaukee in the Engineering Sales Department. He is a member of Pi Tau Sigma and Tau Beta Pi, honorary engineering fraternities. If some of you frosh engineers are wondering how he does it, here's a tip: Marv whittles for relaxation. Upon graduating, he plans to go into design and development work.

The conversation never lags when **Don Drukey's** around, and he is just as proficient in turning out good technical articles. Many remember his explanation of the fluid drive in a spring issue. In this issue he gives you the lowdown on the university's lightning generator which is the largest owned by any college in the country. It may not be safe to visit him there, but, Don has a chemistry lab. in his basement which takes care of his spare time very nicely. A sophomore in Ch.E. and a member of the M.S.C.S., Don would like to go into research in the future.

Max Butterfield and **Bill Carter**, self-styled crystal-gazers, don't exactly agree on the weekly football roundup, but they have gotten together to offer TECHNO-LOG readers an interesting new feature, the photo section. The boys have chosen these pictures carefully and are enthusiastic over the result of their work.

A part-time job, together with a heavy M. E. business curriculum, keeps Max constantly busy. He is a former scoutmaster and would like to return to this activity.

Bill is a rugged-looking outdoor man who likes to hunt and fish, but don't ask him to play ping pong or checkers!

●

The Cover

The cover shows a section of steel shafting which has been superfinished in the center. The picture is used through the courtesy of the Chrysler Motor Company.

Wallace K. Belin

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The editorial policy of the TECHNO-LOG is to present material for technology students which it is hoped will strike a happy medium between the superficial and the highly specialized.

The MINNESOTA TECHNO-LOG is published monthly, October through May, by the students in the Institute of Technology of the University of Minnesota.

The purpose of the TECHNO-LOG is two-fold: First, to put in the hands of TECHNO-LOG subscribers highly worth-while and interesting reading material; second, to offer technology students an invaluable opportunity to get writing, selling, and working-with-others experience.

THE MINNESOTA

Techno-Log

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Courtesy of Chrysler Motors

The Hand Is Still There

Parking Is The Problem at Hand

Elimination of center aisle parking was a good step, but where are those cars being parked now?

INDIFFERENCE to the immediate and hopeful glorification of the future is characteristic of many an undergraduate engineer's attitude. The prevalent idea is, "Today I will not strain myself; but tomorrow, when something big comes up or when I get on that job, then I will really bear down."

As engineers we should have learned that success is attained by applying ourselves to the utmost to the problems at hand, whether they be great or small. The power of application and the confidence necessary for becoming competent come only with constant practice and not from supreme exertion.

Right now, on our campus, lack of parking space is one of the problems at hand. Will it be ignored, dodged—or solved? New buildings and landscaping have erased so many of the parking lots that unless you are an "early bird" it is well nigh impossible to find a parking place except in the center of a touchball field or on a street with a two-hour parking limit. We are faced with the problem of finding a place to park the cars of the many students who drive to school. To ignore the problem is despicable aloofness; to dodge the problem is unmanly—but to solve the problem is good engineering. An engineer must realize that the more difficult the problem the more glorious the solution.

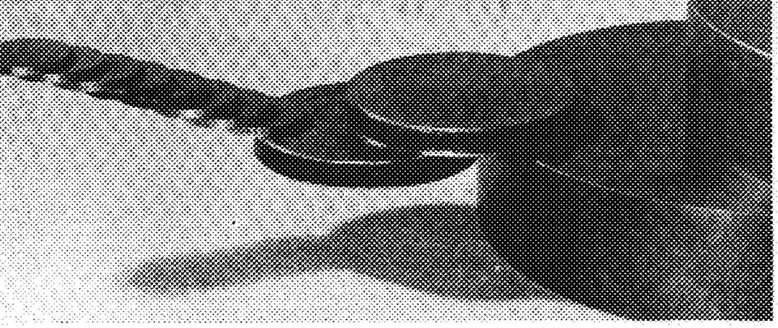
The results that the various investigations into the parking situation have brought about, have, in all instances which we can remember, accomplished nothing more than to discover that there isn't enough room for all of the cars to park, an amazing conclusion—one that all who have tried to park after 8:15 in the morning have reached.

The challenge is to the engineer who does not stop at observing, reporting, and despairing, but who ponders, calculates, and brings forth a solution to the problem. To him there is no use in decrying a situation unless he is willing and able to correct the evil himself or to see that someone else corrects it.

Surely, there is some engineer in the Institute who can give a sound, workable suggestion as to how to arrange parking space for our students. It may be a civil engineer specializing in city planning or it may be any other engineer who accepts the challenge to solve the problem at hand.

To date there has been too much voicing of discontent, and too little action. Now is the time for action. Engineers, step in!

WALLACE K. BELIN — EDITOR



When Superfinish principles are applied to flat work, a degree of optical flatness may be obtained regardless of the diameter of the work. This describes graphically the gage block accuracy and smoothness which Superfinish produces on flat work.

Diamond Turning

By Marvin A. Sandgren, M.E. '41

THERE are two terms pertaining to machining operations which today represent the acme in surface finishing. These terms are "diamond turning" and "superfinishing." Diamond turning is used for nonferrous materials, and superfinishing for ferrous metals.

Diamond turning was first used during the World War to machine bearings and alloy pistons for airplane engines. Since then, the diamond has been used extensively for accurate machining and finishing of nonferrous alloys, bearing metals, precious metals, and nonmetallic synthetic materials.

Diamond turning is a machining operation by which materials are turned in precision lathes using diamond-tipped cutting tools. The usual procedure is to rough turn the piece to the approximate size with an ordinary tool, and then finish-turn with the diamond tool. Very high speeds and fine feeds together with the burnishing action of the diamond produce a very accurate and highly polished surface. The burnishing action is a result of the lack of end clearance on the diamond tool.

Diamond turning is performed in precision lathes of the usual design. Because faster cutting speeds and finer feeds are used, the lathes must have special feed mechanisms, spindle drives, and tool holders. The depth of cut is controlled very accurately so that parts can be duplicated exactly.

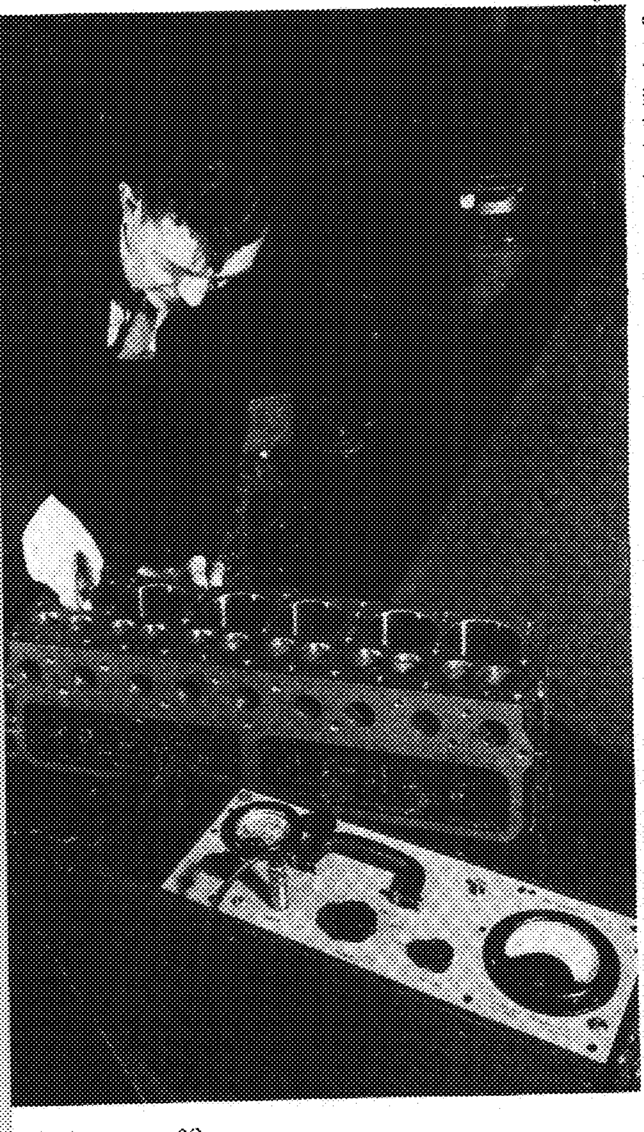
Diamond-tipped tools may be made by brazing or by cold-setting the diamond in a suitable holder. Rough diamonds are used for brazing. One end of the holder is recessed to receive the diamond, and a silver alloy brazing metal is introduced to hold the diamond in place. Brazing is not very satisfactory because the diamond may be damaged by the intense heat or by the exposure of the cutting edges to the flux.

Diamonds secured by cold-setting are held in a recess in the tool holder by a cover or clamp of some sort. Most diamonds set by this method are formed to fit the holder. The diamonds are usually ground flat on one surface and spherical on the opposite surface. The contour of the diamond may be formed to suit the need. Some of the forms are circular, square, triangular, and hexagonal. The diamond has no back rake and very little or no end clearance.

The average diamond tool costs about $50.00. The diamond itself weighs about one carat, and its structure is such that it is unsuited for use as a gem.

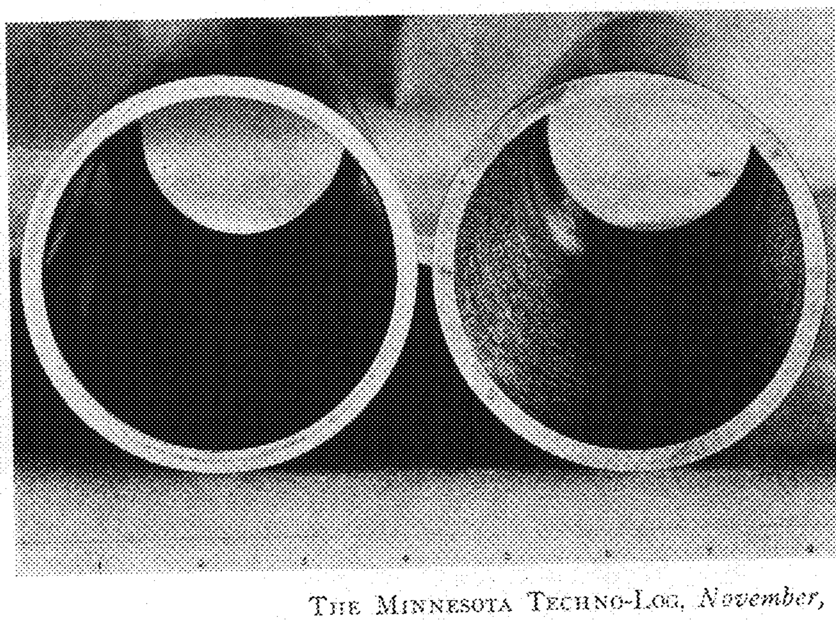
Superfinishing was recently developed by the Chrysler Corporation as a solution to problem presented in the finishing of bearings. The superfinish worked so

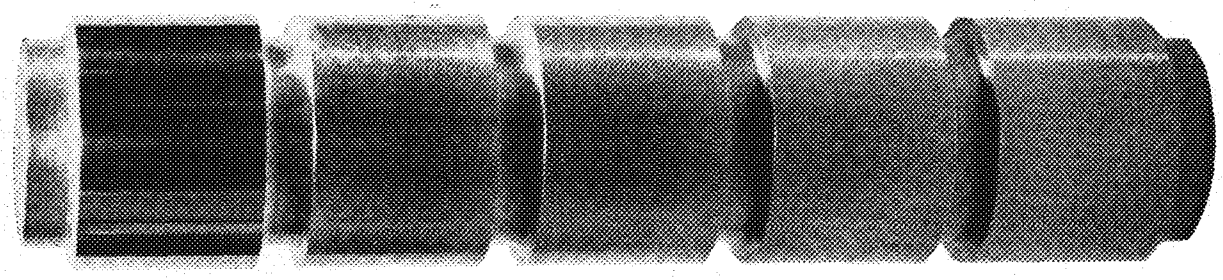
In times past the surface smoothness of cylinder bores had to be determined by the personal reactions and opinions of an inspector. The machine shown below, the profilometer, eliminates this personal element and gives an indication of surface smoothness.



Bore finishing is a metallurgical problem because fragmented material formed during the boring operation causes more of the same material to be formed. Superfinished bore on left.

All Illustrations Courtesy "Story of Superfinish"





Right to left: Ordinary grinding, Superfinished 5 sec., Superfinished 10 sec.. Superfinished 15 sec., completely Superfinished.

and Superfinishing

satisfactorily that its use was soon extended to the finishing of most engine parts and some chassis parts on Chrysler cars.

"Superfinish may be defined as an extremely fine crystalline surface produced upon flat, round, concave, convex, and other types of surfaces, either external or internal."* The secret to superfinishing lies in the removal of excess metal without generating sufficient heat to soften the amorphous metal cement which holds the crystalline grains together. This is accomplished by carefully controlling such factors as the motion, pressure, abrasive stone, and lubrication.

At least three different motions are absolutely necessary, and five or more are desirable for the production of a superfinish. The combination of many motions prevents the formation of a definite scratch pattern as is characteristic of all other finishes.

The cutting pressure varies from a few ounces to a few pounds per square inch of stone area. At the start of the operation the pressure is very light, but as the surface area in contact with the stone is increased the pressure is increased proportionately. At the end of the operation the pressure is such that the desired amount of superfinish is produced. Because of the nature of the operation, the finishing will not proceed any farther unless the final pressure is changed. This factor permits the production of controlled surfaces.

The stones used for superfinishing are made from ordinary synthetically produced abrasives. It is important that the stones have the proper grain and hardness, but a fine stone is not necessary unless a practically perfect finish is desired.

A viscous fluid is used during the process to carry away loose particles of abrasive and metal and to aid in stopping the cutting action of the stone after the proper finish has been produced.

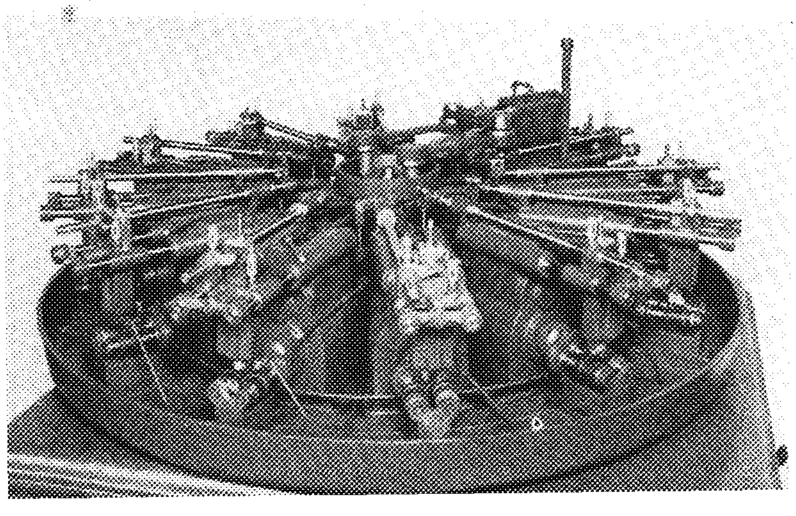
Superfinish is applied to parts which have been dimensionally finished by other machining operations. Superfinishing removes all surface defects left by the preceding operations and leaves a surface which has only a few scratches. These scratches are below the finished surface and serve as oil reservoirs. Only 20 seconds are required to superfinish a finish-turned part from a surface which is smooth to within 150 microinches to a surface which is smooth to within 20 microinches.

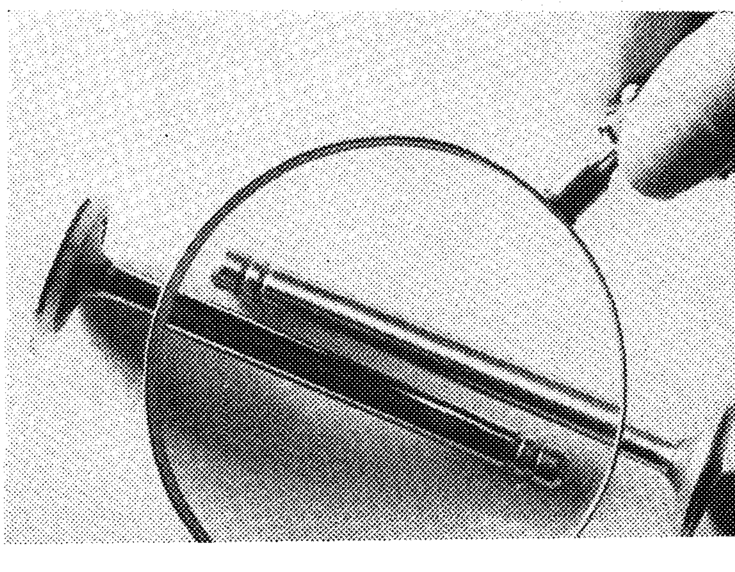
Properly lubricated superfinished surfaces are practically wear-proof. The oil film will not be ruptured no matter how thin it is unless the part is overloaded to the extent that the lubricant is forced out to permit metallic contact. Superfinished parts fit properly and maintain the proper fit because the parts do not have to "wear in." Superfinished brake drums permit the use of softer shoe linings and, as a result, smaller brake-pedal forces.

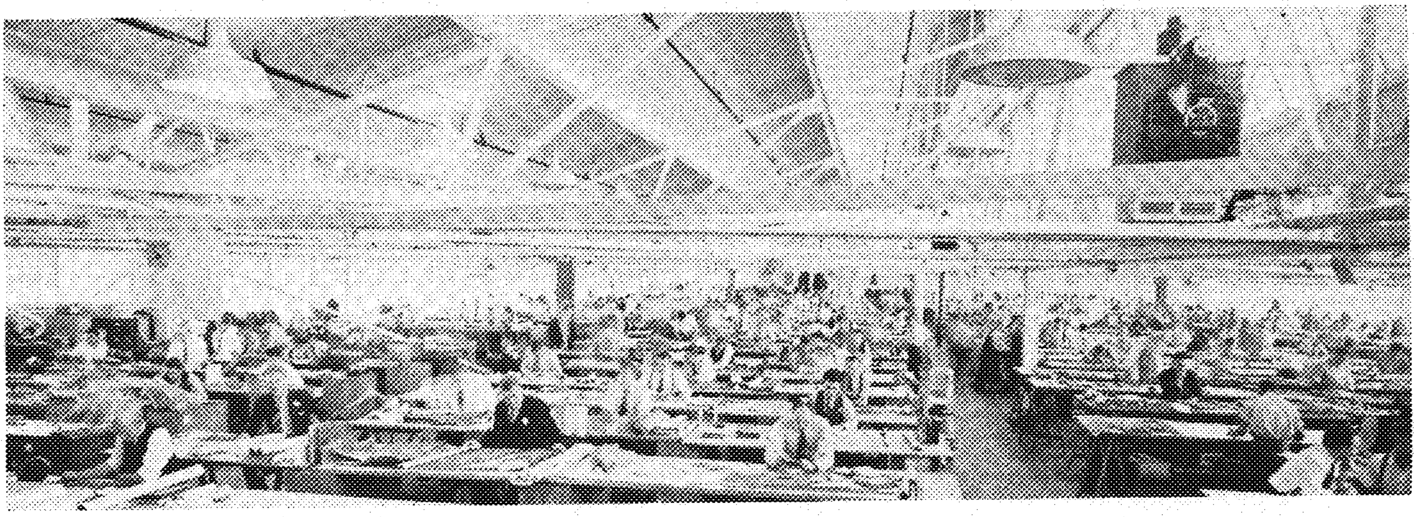
*From the "Story of Superfinish."

Valves used in internal combustion engines are exposed to high rubbing speeds, quick reversals in direction and tremendous heat. Therefore the rubbing surfaces of valve stems should have a maximum of surface smoothness. The dark Superfinished surface on the lower valve stem is definitely smoother.

This machine produces smooth bearing surfaces on precision tool production equipment.







Courtesy Douglas Aircraft

Design engineering provides employment for many young engineers. Drafting and engineering are indistinguishable terms in this type of work.

The Field of Aircraft Production

IT'S EXPANDING

IT'S FERTILE

IT'S COMPREHENSIVE

By C. T. Reid — **Director of Education, Douglas Aircraft Company, Inc.**

CONSIDERABLE popular interest is being directed toward opportunities in the aircraft industry now that it makes headlines for spectacular news stories and furnishes scarcely less spectacular anecdotes for the financial page.

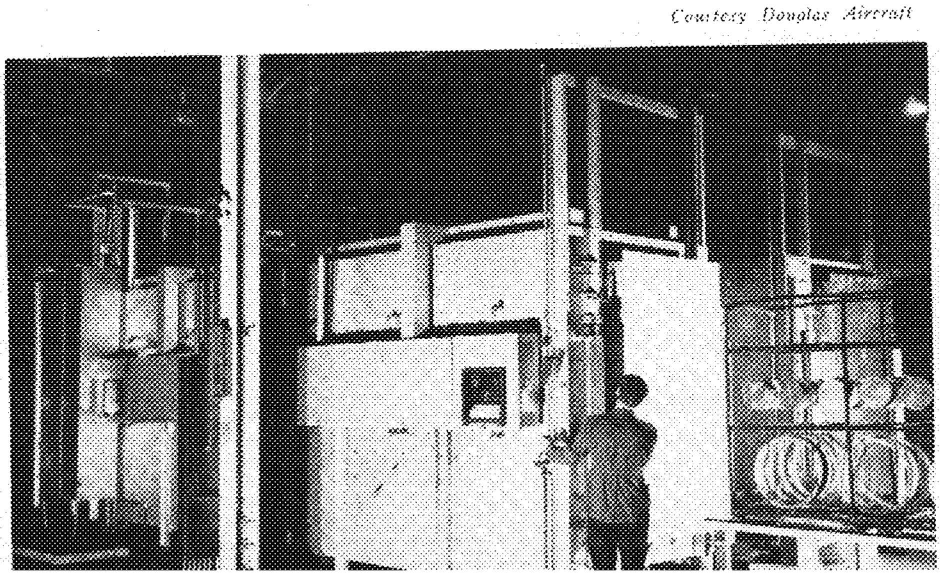
At this time, most of the interest is focused upon the manufacturing branch of the industry, for it is here that the great majority of employment opportunities occur. It will be the scope of this article to discuss the employment opportunities for new young technical graduates in a typical large airplane factory.

The aircraft manufacturing business depends upon an adequate supply of technically trained (as well as practically experienced) men because the entire routine is engineering by nature. The history of the building of a plane is told by a fascinating chain of events: research, development, sales, design, planning, tooling, and production. All these, not excepting sales, are (in this industry) phases of engineering. Other important engineering activities keep the plant, its equipment, and processes up to date and maintain them in efficient working order.

The requirement of highly specialized training shows its unwelcome head in some of the work but fortunately not in the kinds of activity that offer the numerous job opportunities. The principal demands upon the newcomer are a sound knowledge of the fundamentals of mechanical engineering, the correct idea of his own importance, and willingness to keep right on learning in spite of having graduated from a university.

This shows one step in the long process of building an airplane. Plates to be used for inspection of brace wires in the wings of the airplane are here receiving a final heat treatment.

Courtesy Douglas Aircraft



Job Varieties

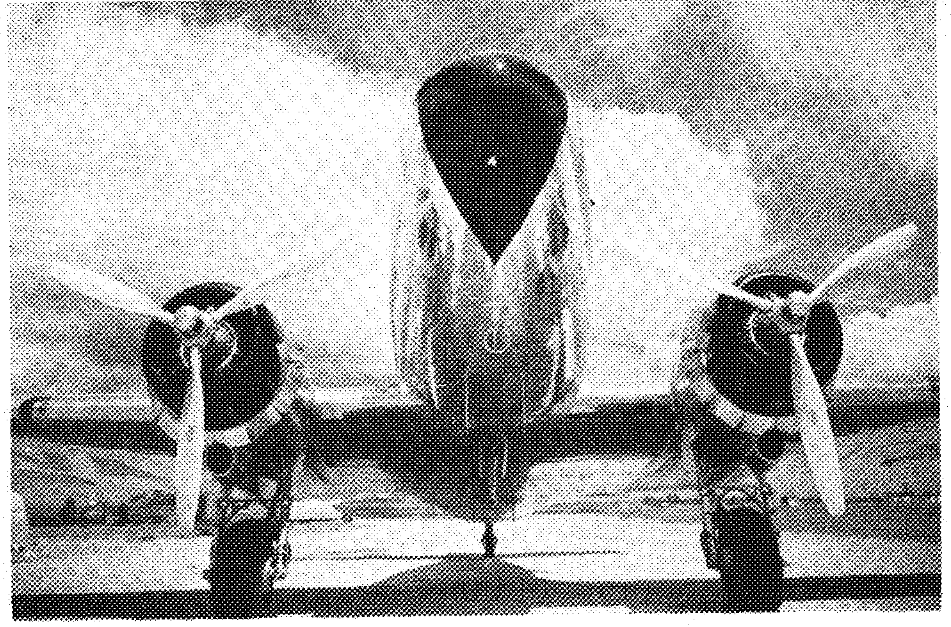
Treating the steps of work in chronological sequence as named earlier, let us consider the various types of employment and the prevalence of their opportunities. We confine our attention to the airplane proper, exclusive of engines, propellers, instruments, wheels and tires, because, in the United States, an airplane factory does not, as a rule, manufacture these units. Under research and development come the scientific studies and experiments to create improvements in the physical articles and their processes of manufacture. This work is mainly of two kinds; aerodynamical and structural. In the aerodynamical field a few young beginners enter each year, coming mostly from the postgraduate schools which teach full aeronautic specialization. On structural investigations, likewise, the demand is for highly specialized postgraduate education, but some who have made advanced studies of vibrational or elastic analysis methods or even pure mathematics, may, without aeronautical training, find occasional opportunities.

It may have been a surprise to see "sales" listed next in our chain of events and also to have it styled an engineering function. The two-fold explanation is briefly as follows: Airplanes are indeed sold from their early development sketches before even the details of design are worked out. Most of the work of an airplane factory's sales department consists of settling contract specification details affecting the fine points of design. Opportunities in sales engineering are open to a few young men with proper personal qualifications and technical training after they obtain a thorough grasp of the business, such as comes only through first-hand experience with all the main phases of factory work.

Designer's Delight

Design engineering is the mecca of the largest number of graduates. It provides room for a greater number than the previously discussed types of engineering combined. Most of these graduates are accommodated in drafting positions. Drafting and engineering are, in this industry, undistinguishable terms, the lower levels of engineering being almost pure drafting and the upper levels of drafting being assuredly engineering of a high order. Some of the newcomers in the design organization will, however, find duties at stress analysis and even aerodynamical work, but with the latter rarely offered to men with only four year training courses. The high ranking designer is often not an aerodynamicist at all, but is invariably a man whose many years of experience in actual employment have been divided between stress analysis and drafting, while constantly associated with manufacturing procedures as carried out in large shops. He may be a specialist on structures, hydraulic systems, power plant installations, armament, interior furnishings, electrical installations, etc. Group leaders, project engineers, draftsmen, chief engineers, etc., are chosen from these ranks.

The work done in an airplane factory's planning department is seldom referred to as engineering because the term "engineering" is, in the factories, nearly always used to mean creating new designs. Production planning is, however, a production engineering function vital in importance and able to give adequate expression to the talents of the technically educated production man. This is a large department which can assimilate a goodly number of newcomers.



University Photo Laboratory

In this sleek sky liner we see the concrete visualization of the designer's plans, the draftsman's blueprints, and the craftsman's handiwork.

Production Engineering

Tool design, dealing with creation of suitable jigs and fixtures, more than dies, offers a worthwhile share of opportunities. Like in the product design engineering department, the work is mostly drafting. The ideal employee here is a practical-minded mechanical engineer with a flair for invention.

In actual production the estimating, scheduling, and control functions offer opportunities closely akin to production planning. The same comments about styling these "engineering" apply here. There is room in this work for many new young production engineers.

We have enumerated the links in the chain that builds the airplane but must not overlook two very important small auxiliary departments for technical men, the closely allied "process engineering" and "plant engineering." The former operates physical and chemical laboratories and issues bulletins mandatory in the processes of fabrication and assembly of airplane parts. The latter installs and maintains (ofttimes even designs and builds) the necessary equipment to carry out these processes. A very few chemists, somewhat more electrical engineers, and still more mechanical engineers find employment in this work.

To re-emphasize a point made in the beginning, the foundation of training for practically all the work is mechanical engineering. From its fundamentals the various specialties branch off, most of them following some channel through the general field of metal product manufacture.

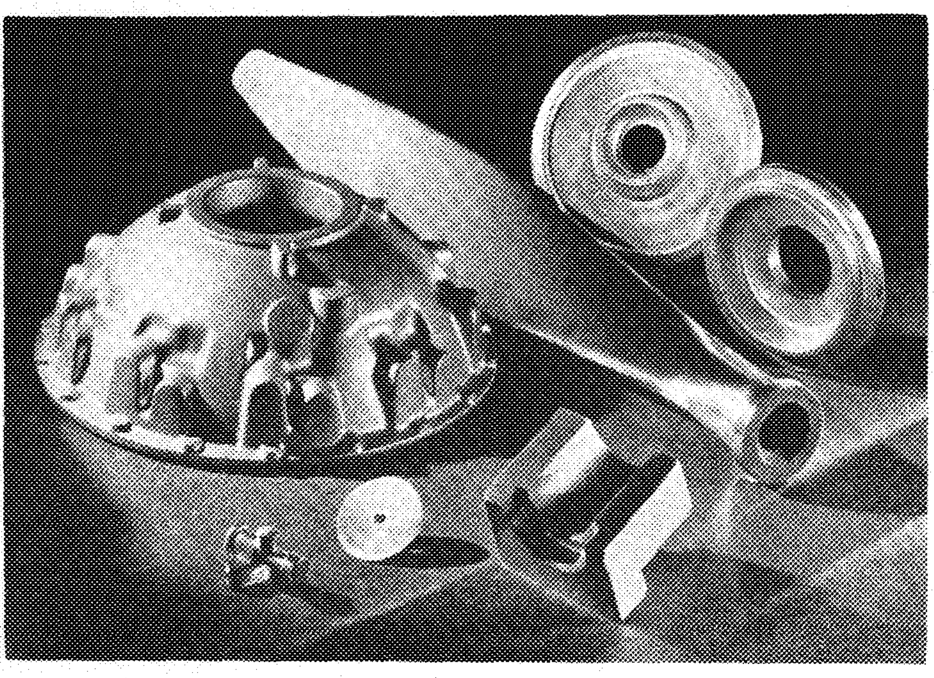
Because a combination of technical education with practical experience is valuable throughout all departments, some of the factories have perfected plans for shop training courses. Under these each year a few hand-picked graduates are put through a rotating schedule of employment in all departments of the plant to crowd into ten or twelve months an amount of experience not normally gained in less than half that number of years.

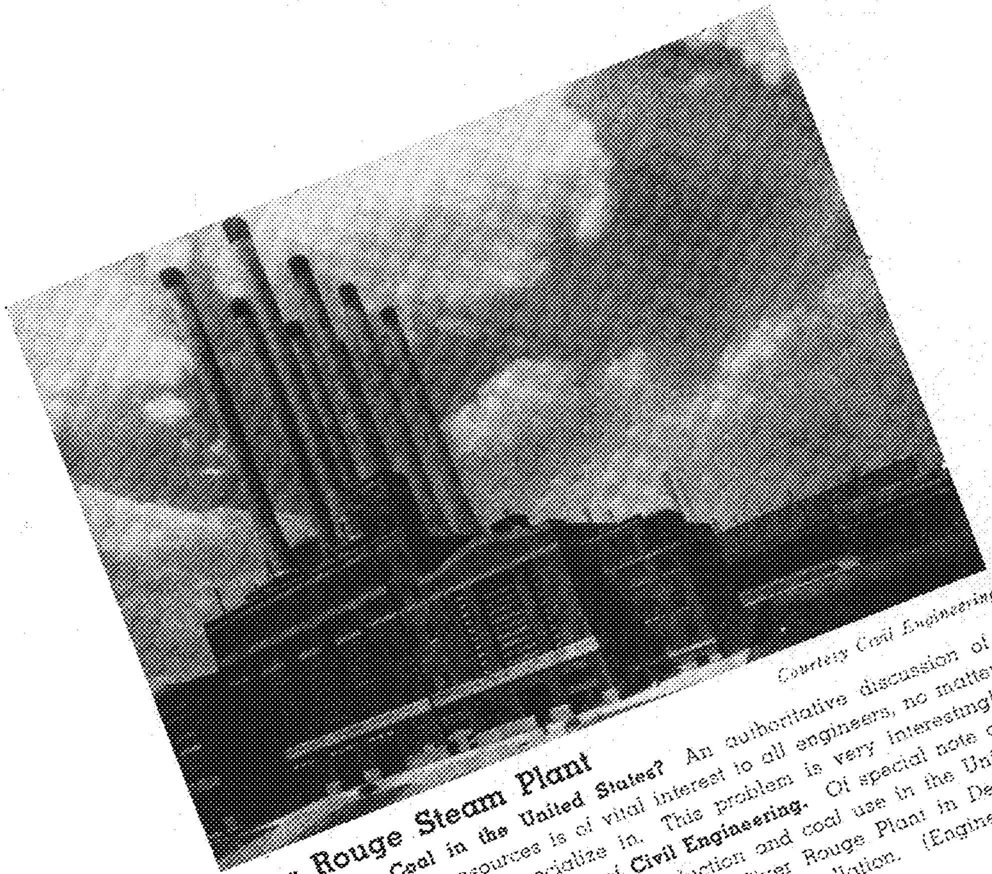
The comparative prevalence of opportunities in the various fields is about as follows:

Research and development engineering	4%
Sales engineering	3%
Design engineering	47%
Production (planning) engineering	10%
Production (tool) engineering	21%
Production (estimating, scheduling, and control) engineering	11%
Process engineering	2%
Plant engineering	2%
	100%

Modern airplanes feature extensive use of stronger and lighter structural materials. An example is this magnesium alloy propellor which makes possible a greater pay load for a lower power consumption.

Courtesy Douglas Aircraft





Courtesy Civil Engineering

River Rouge Steam Plant

How Much Coal in the United States? An authoritative discussion of our present coal resources is of vital interest to all engineers, no matter what field they may specialize in. This problem is very interestingly presented in the August issue of **Civil Engineering.** Of special note are recent statistics on steam power production and coal use in the United States. The photograph above is of the River Rouge Plant in Detroit, the world's largest industrial steam-power installation. (Engineering Library)

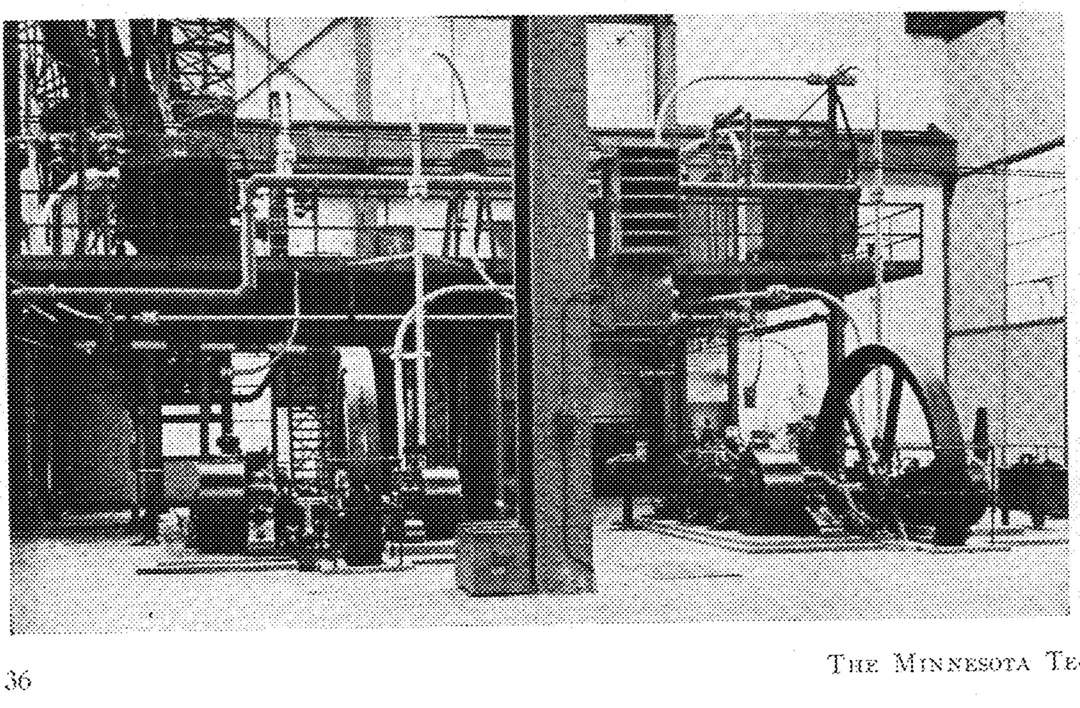
Small Oil Refiner

The World's Largest Oil
Of interest to engineers
and Gas Journal for Octo
lems of this giant of oil

Extraordinary Importance of Nitrogen to National Defense is stressed in an article in the June 25, 1940, issue of **News Edition**, published by The American Chemical Society. The author points out the inadequacy of our present facilities for nitrogen fixation and recommends the construction of a number of separate plants for the execution of the fixation process. (Chemistry Library)

Nitrogen-Hydrogen Gas Circulator

Courtesy News Edition



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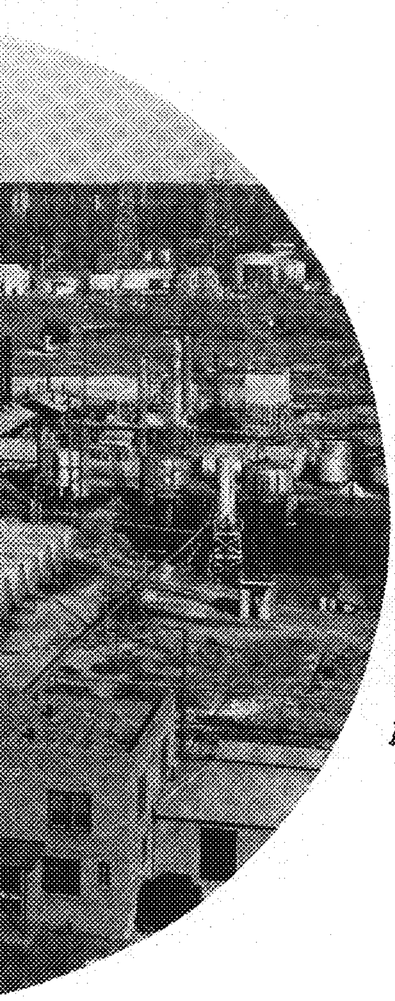
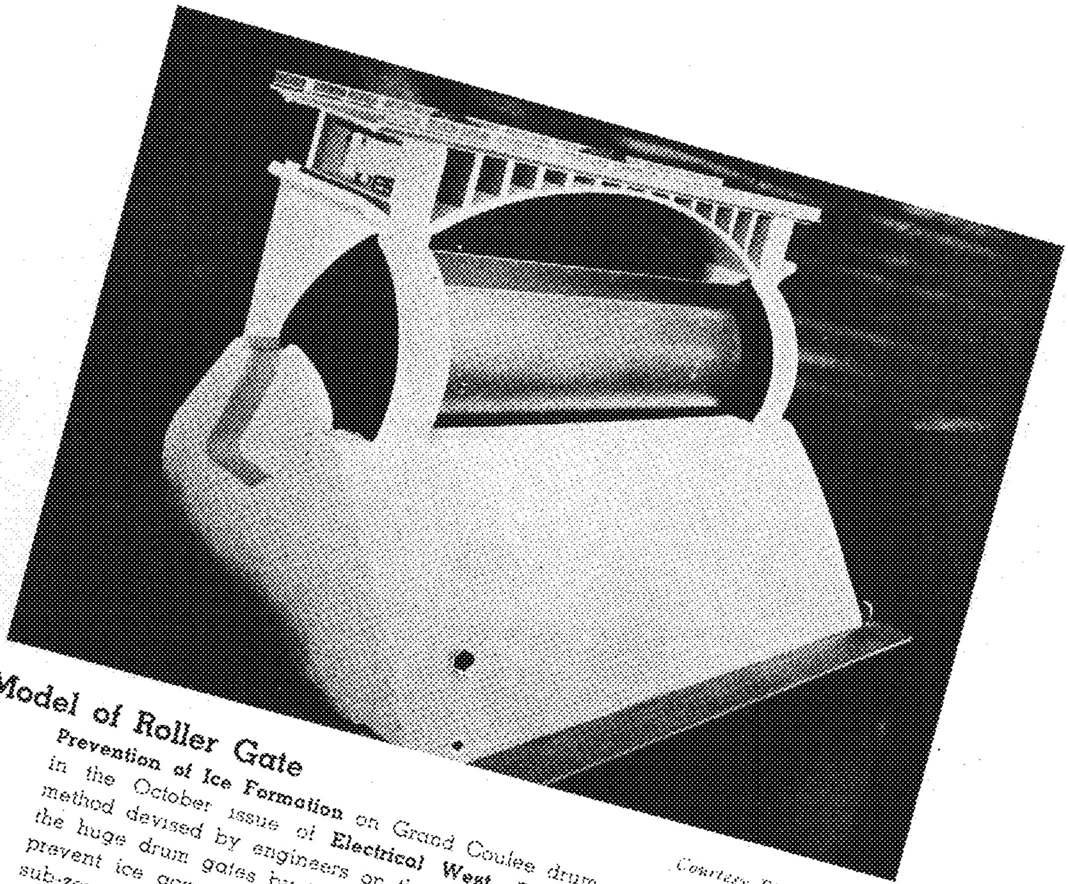


Courtesy Oil and Gas Journal

s its tenth birthday this year. … field is an article in **The Oil** … g the present and future prob- … (Mines Library)



Courtesy Electrical West

Model of Roller Gate

Prevention of Ice Formation on Grand Coulee drum gates is presented in the October issue of **Electrical West**. This article describes the method devised by engineers on the Grand Coulee Project for heating the huge drum gates by induced electrical currents. The system is to prevent ice accumulation and to permit the operation of the gates in sub-zero weather. (Engineering Library)

… in With … nology

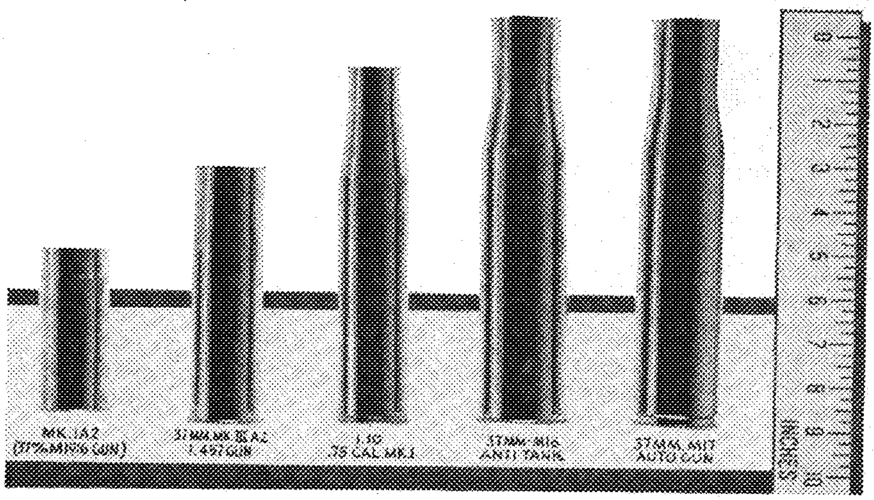
Bill Carter
E.E. '43

…ht that engineers who are abreast of the latest de… …tact with their technical and professional publica… …ntation to call the attention of technical students …rial which is presented in the various technical

This Problem of Munitions! The production of cartridge cases—machinery used, costs involved, production methods—is interestingly discussed by E. C. Bomar, Lieut. Col., Ordnance Department, U.S.A., stationed at Frankford Arsenal, Philadelphia, in the October 10 issue of **Iron Age**. The photograph below shows a group of representative cartridge cases produced at the Frankford Arsenal. (Engineering Library)

Cartridge Cases

Courtesy Iron Age



Tame Lightning

By Donald L. Drukey, Ch.E. '43

THERE is a good deal of research going on in the Institute of Technology but only a little of it reaches our attention. One of the more spectacular research projects is going on in the Electrical Engineering building. This is the work being done with a high power surge generator, which is the most powerful one of its kind owned by any school in the United States. The construction and work on the generator has been carried on by Mr. Newman and a few of his colleagues.

This generator was designed to produce artificial lightning effects in the laboratory for various experiments. These experiments include testing power lines under the actual effects of lightning surges to pave the way for better power service and to eliminate power failure due to breakdowns caused by lightning.

This instrument was made possible in a large part by donations of the Public Works Administration, the Josiyn Manufacture and Supply Company, the Northern States Power Company, the General Electric Company, and the North Central Electric Association. These organizations, as well as others, will benefit a great deal from the knowledge obtained through the research work.

Practical Applications

Much work has already been done with the surge generator through research on conditions of power lines when hit by lightning. This work is expected to lead to new developments in power line lightning arrestors and fuses. Lightning arrestors in use today do not by-pass lightning surges quickly enough, and fuses are often burned out during the momentary overloads. This causes annoying and expensive cessations of power, often at critical times. The work also includes research on the breakdown characteristics of gaps between various types of electrodes. Results have already been sent to some of the sponsoring organizations. These projects are of a great deal of importance to the power companies, although as yet very few laboratories are equipped to deal with the problems.

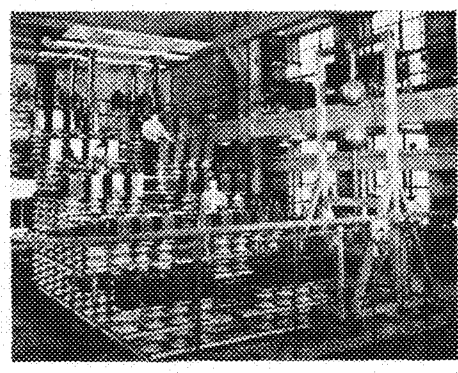
As has been previously stated this surge generator is the largest one of its type owned by any college in the United States. The generator is designed to produce potentials up to two and a half million volts and currents as high as one hundred and fifty thousand amperes. One hundred fifty thousand amperes is equal to the current passing through one hundred and eighty thousand, hundred watt, light bulbs! It must be understood that the current surge does not last very long, but neither does a bolt of lightning. In fact these surges are of such short duration that new instruments had to be devised to measure them satisfactorily.

Danger—High Voltage

The surge generator was designed so that it can be converted into a high voltage direct current power supply which would be the highest power supply available today. It would then be suitable for high voltage work with large x-ray tubes and similar equipment.

One can hardly say that the life of an experimental technician is boring or without danger. For an example we have an incident that happened a short time ago when the generator was being used for high amperage work. The condensers were almost fully charged when one of them developed a flaw. The result was that the other forty-seven condensers discharged through this faulty one. It is said that the resulting explosion hurled pieces of cardboard from the inside of the condenser through several inches of plaster on the ceiling. Luckily no one was hurt, but the electrical engineering department now has two nearly bombproof observation booths just in case.

This surge generator produces lightning of the same calibre as that of nature. It is employed in power transmission research.



Principles of Operation

It should be explained that the generator consists basically of a number of condensers, forty-eight to be exact. These are charged slowly in parallel, and then discharged nearly instantaneously either in series or in parallel depending on whether maximum voltage or amperage is desired. This process is not as simple as it sounds, but that is the general idea.

There are two working models at the electrical engineering building. The smaller model represents the surge generator reduced to one-fifth of its capacity, and the larger model represents the generator to the same scale with a proposed increase in size. The smaller unit was on display at the WPA exhibit in the Auditorium and also at the State Fair. Anyone who has seen the models in action can well imagine the terrific power of the full size instrument.

The electrical engineering department would like to have a generator of twice the capacity of the present generator as is proposed in the second working model. This is considered necessary if further difficulties like the one already mentioned are to be avoided. The designers propose to double the number of condensers, raising the number to ninety-six. This would double the ratings bringing the maximum to five million volts and three hundred thousand amperes. They also propose a separate high voltage building to house the new generator. Their aims are high, and we wish them luck.

These men would like a power line to experiment on, and it seems likely that they may get it, thanks again to the Northern States Power Company. They also want a portable high voltage laboratory for field tests on transmission lines. This will probably be provided for it is needed if the various backers are to get any immediate results.

BY C. I. HAGA

Engines of Democracy

IN *Engines of Democracy,* Roger Burlingame gives us a crowded book, reviewing the history of American invention and industry in the last eighty years. Among the dozens of books in its class, it is worth reading because it shifts the emphasis from the minor details of mechanical ingenuity to the more important and more significant cultural principles our recent amazing industrialization exemplifies. Organizing his exposition on rather loose lines, Burlingame divides his analysis of our progress into six sections: The Collective Impulse, Consolidation of Power, The Cultural Impulse, Speed, Economy, and the Social Lag—the first section surveying communication, and the others, in order, electrical technology, photography and printing, automobiles and highways, conservation and synthetic chemistry, and, finally, the varieties of inertia and friction that reduce the efficiency of our machines and institutions.

It is no mere catalogue of marvelous inventions or copybook anecdotes that *Engines of Democracy* furnishes. Minimizing the superficially spectacular quality all machines have when sprayed with World of Tomorrow glamour, the book focuses sharply on the men behind the machines and penetrates to the nature of the institutions moulding these men and to the effects of the machines on our ways of thinking and living. A good example of Burlingame's technique is his treatment of the Model T Ford. The kind of man Ford was is more important in Burlingame's eyes than the fact that millions of the Model T were turned out. And what the Model T did to America (and the reasons why it resulted in miracles of change) is more important than either Ford or all of River Rouge. The account of the Ford—the American system, in Burlingame's words—defies summary, for it includes LeBlanc's fumbling toward mass production a century and a half ago, whips on through the Declaration of Independence, the Constitution, Eli Whitney, the toolmakers of New England, the ore of the Mesabi, the cheap daily newspaper, the mass market—and a dozen more peculiarly American social and political phenomena. The Ford was therefore only the synthesis of innumerable inventions—mechanical, economic, social, political—and, in terms of human or cultural effects, it became something far greater than its spidery wheels and tinny body appeared to promise.

What Burlingame is trying to do is to show that the self-styled Machine Age is not astonishing merely because of its machines. All ages of man are but one age, the Human Age, and whatever gadgets man employs to do his day's work are worth examining only in terms of human history and their cultural effects. Consequently the parallel development of machines and human institutions is the only basis on which one may seriously concern himself with the history of mechanical invention.

This obvious principle of analysis was also used in an earlier book by Burlingame, *The March of the Iron Men.* There he read the history of mechanical invention in the United States up to the Civil War as a symbol of union. Given our continental area, our political institutions and social principles, our wealth in natural resources, and our cast of mind, only a united nation could exist or be desirable. Encouraged by this fundamental desire for unity and accelerated by the convulsive resistance to disunity in the Civil War, our increasing mechanization was a foregone conclusion. As Burlingame reads history, no other stimulus than the desire for unity could have evoked so powerfully the concentration on invention and industrialization, and no other means than general mechanization could establish the solidarity military and political effort had sought to maintain.

In this second book, the given data are the same, but to them have been added such other matters as our quadrupled population and the geographical fact that we must all live together with increasing neighborliness. In only one way can we make of this combination a going concern—democracy. In any nation postulating freedom and democracy as its social and political principles, the most necessary problem is the control and just distribution of power. Voting power, buying power, working power, playing power, thinking power—no figure of speech is needed to bridge the gap between the energy of a 10,000 kva. generator and that of a solemn citizen huddled in a voting booth and soberly X-ing for the American Way. Before we can set free all the power that lies untapped in the human spirit, we must free and control energy, whether in the muscles of a slave (as in Periclean Athens), or in the natural resources of the earth's surface. The more power we control, the more free we are. Yet this increased freedom lacks wholesomeness if control of this power is not diversified.

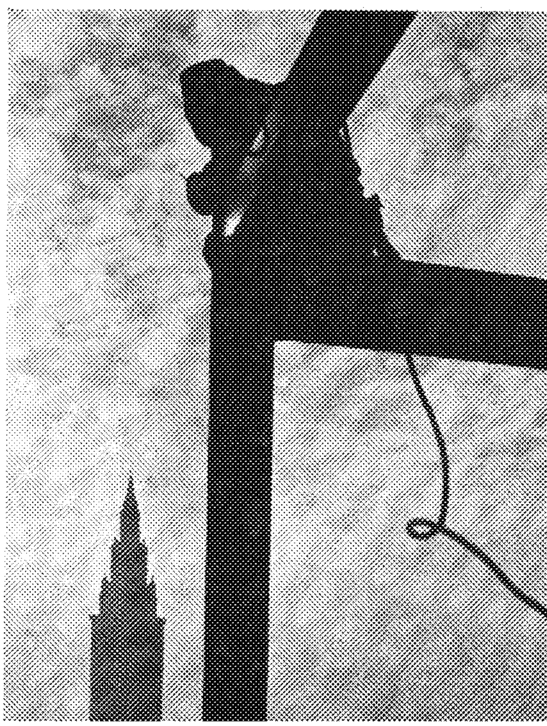
Just as the physicist has shown us that all electromagnetic phenomena have common qualities and can be measured in units based on a set of common concepts, *Engines of Democracy* claims that power is a unity. The democratization of the power embodied in machines and their products is as necessary to wholesome life as the democratization of the power incorporated in political institutions. The American workingman driving home in his '38 Chevrolet lights a cigarette with a paper match, and in those three devices he commands the resources of three corporations having a total in capital and assets of well over two billion dollars. Let him decide to walk and stop smoking, and these three corporations and dozens of others as well will have collapsed before he wears out one pair of shoes. Let him decide that Candidate X is better than Y or Z, and very little will happen as spectacular.

I urge you to read *Engines of Democracy* for the reason that William James urged the historical study of science when he said that to study the history of a subject is to make that subject cultural. Engineers often show a shocking self-criticism in confessing that their training seems of necessity to bar them from any but the most modest claim to culture. Since they all love machines and feel a happy, homelike intoxication in such company, how better can they purge their self-confessed uncouthness than by marching down the paths of history, hand-in-hand with a reassuringly familiar turret lathe or vacuum tube?

Burlingame's two books, *The March of the Iron Men* and *Engines of Democracy,* are not the first to relate mechanical invention to human culture. Few, however, so definitely portray mechanical progress as a symbol of social and political democracy. Other books of this kind you should be tempted to read are Lewis Mumford's *Technics and Civilization,* George Santayana's *Reason in Science,* Lancelot Hogben's *Science for the Citizen,* E. T. Bell's *Men of Mathematics,* and Abraham Wolf's *History of Science, Technology and Philosophy in the XVI-XVII Centuries.* With the exception of Santayana's *Reason in Science,* all are in the Engineering Library. Go to it.

The men are more important than the machines and the ideas more important than the men.

Courtesy Lincoln Ele



THAT FUTURE JOB—

It's Up To You

By A. S. Levens, Director of Placement Service

THE best employment record we have enjoyed since 1931 was made this year. One hundred three representatives from the various industries visited our institute to interview seniors and graduate students. Last year, 49 representatives visited; in 1938, 25; in 1937, 61; in 1936, 20. It is rather significant to note that several companies were here for the express purpose of employing juniors for summer work. We may look forward to an increase in summer employment.

As of November 1, two hundred ninety-eight or better than ninety-four per cent of the June class are employed. Last year at the same time 246 or 83 per cent were working. Salaries for the Bachelor's group this year range from $100 to $165 per month with an average of $127.50.

During the calendar year 1939, we received 175 calls for experienced alumni as compared with 92 during 1938. Recent months have been marked by a strong demand for experienced technical graduates. Much of this demand has been stimulated by the National Defense Program. There is little doubt that the crying need for well-qualified technical graduates will continue well into 1942.

Already we are conducting interviews of our graduating seniors and graduate students for employment next June. Several companies are sending representatives to select men from those who will graduate in December and from the recent alumni who feel that a change of position would improve their opportunities.

Employment Booklet

With regard to preparation for seeking employment, we urge all of you to read the excellent booklet, "Preparation for Seeking Employment," by H. L. Davis. Copies may be obtained in the Engineers' Bookstore. In addition, we have prepared a pamphlet, "Seniors—Be Prepared for that Job," which we believe will be quite helpful. Free copies are available in Room 133 Main Engineering. The juniors would do well to examine these pamphlets.

Once again we urge you to consider carefully the following suggestions:

(1) Get Acquainted with Your Instructors

Faculty members are frequently requested to express their opinions of you. The company representative knows that he cannot learn very much about you in a fifteen-minute interview. True, he can size you up to some extent. True, he can get some information concerning your personal appearance, approach, mannerisms, etc. However, in most cases, he depends largely upon available records, faculty ratings, and recommendations.

(2) Take Inventory of Yourself

(a) Try to determine your technical and personal qualifications. (b) Analyze your experience record. (c) What good has each job done for you? (d) What type of technical work do you really enjoy? (e) What subjects are least interesting? (f) Are you aggressive or retiring? (g) Do you like to work with a group, or do you prefer to work independently? (h) Do you plan your work or do you operate on a hit-or-miss scheme? (i) Do you give attention to your personal appearance, or are you indifferent? (j) Do you coöperate with others, or do you cause friction? (k) Are you lazy or industrious? (l) Are you satisfied to merely "get by"? (m) Do you always depend upon others? (n) Do you ever take the initiative? (o) Are you easily tempted? (p) Can you be trusted under the most trying circumstances? (q) In what type of work do you believe you would be successful?

Make Survey

(3) Make an Employment Survey

(a) Search for the names of companies engaged in the lines of work in which you are interested. For example, if you are interested in railroads, consult the *Railways Officials Guide;* if in public utilities, consult the McGraw-Hill *Central Station Directory;* if in manufacturing, the *Thomas Register.* In addition, you will find the following list quite useful:

Placement Service Mailing List—available in 133 Main Engineering Building

"Industrial Research Laboratories of the U. S.," Bulletin 102, published by National Research Council.

Mechanical Catalogue—published by the American Society of Mechanical Engineers. It contains a very good classified index to manufacturers.

Census of Manufacturers—Government Printing Office, Washington, D. C.

Department of Commerce Yearbook—Government Printing Office, Washington, D. C.

Chemical Guide—Chemistry Library

Catalogue Studies—One of the most complete sets of company catalogues.

Aero Digest—Directory in March issue.

Many more are listed in the above-mentioned pamphlet.

(b) If possible select 40 or 50 companies in the field in which you are most interested. Learn as much as you can about them. Many of the larger organizations have booklets which describe the work of their company. Why not consult the list which we have available in the Engineering Library?

The other day one of the December graduates visited the Placement Office to inquire about a certain company. This is what happened:

D. G.—"Mr. Levens, I would like to be interviewed by the representative of the ——— Company."

Mr. L.—"Why?"

D. G.—"Oh, I don't know. I thought it might be a good idea."

Mr. L.—"Would you like to work for that company?"

D. G.—"Oh, I don't know. By the way, what does the company do and where is it located? Do they use engineers?"

Mr. L.—"Have you ever taken the trouble to read the fine booklet which this company has published? In it you will find adequate descriptions of the type of work this company does and products it manufactures. You will also discover information concerning the policy of the organization, its training program, and other pertinent data. A copy of this booklet is available in the Engineering Library. Have you discussed the matter of employment with the local representative of this company? Have you at any time attempted to analyze your ability, training, and interests in light of the type of work performed by this organization?"

D. G.—"Gee Whiz! Am I supposed to do all that? Do you think I should read that booklet tonight?"

Mr. L.—"Goodbye. I'll see you again sometime soon."

Major Responsibility

Frankly, I wish our students would begin to realize that the major responsibility of getting a job is theirs. Of course, we are willing to help. Faculty members, alumni, and the Placement Service are continually making an effort to assist you. We are quite put out when many of our students make very little, if any, effort to use information which is available.

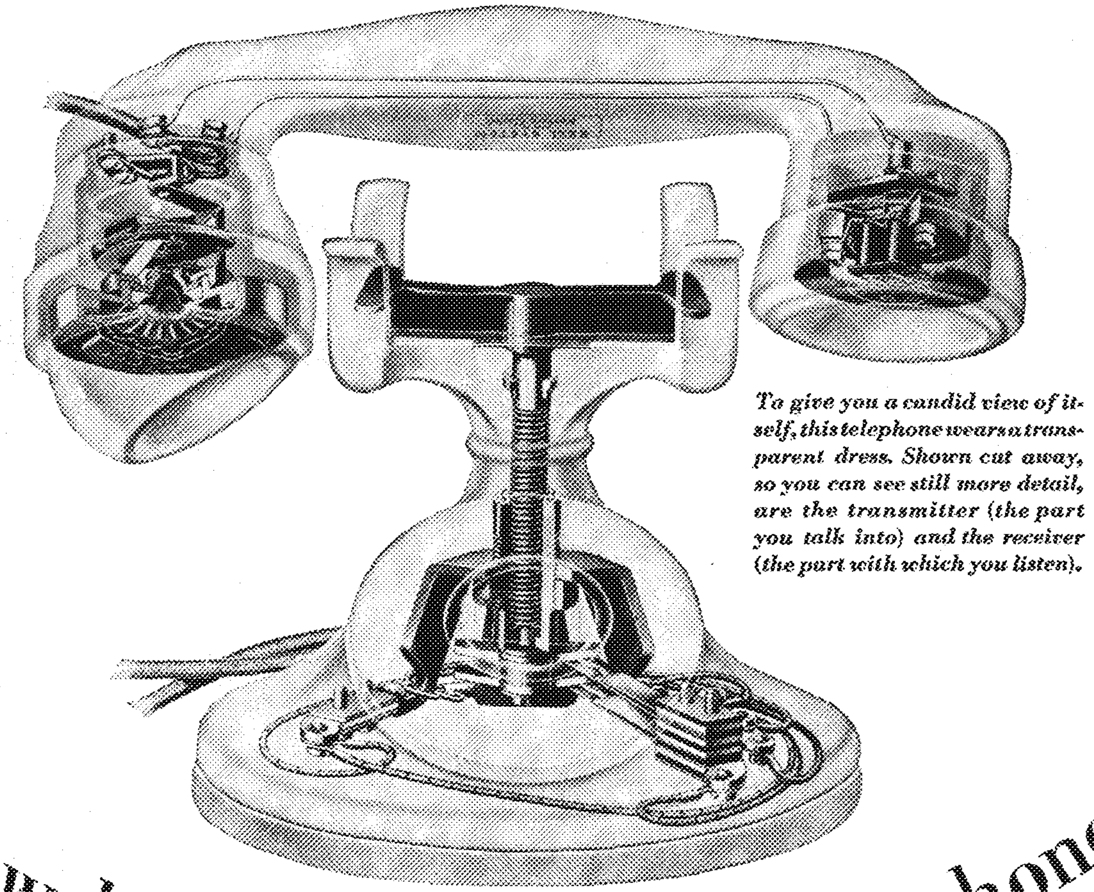
(4) Apply for a Position

(a) The most effective method is to apply in person.

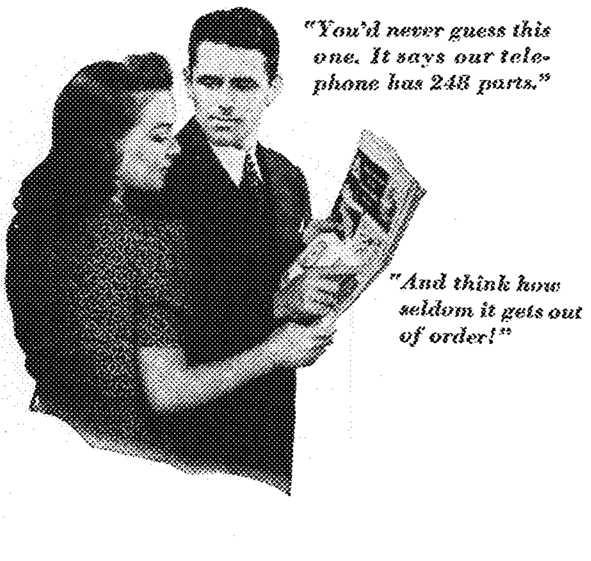
(b) Interview those who are responsible for employing college men. By all means make a definite appointment for the interview. Don't drop in any time and say, "You don't need an engineer, do you?" If you have made a careful analysis of the type of work the company does, you will be better prepared to answer the first question: "Well, son, what can I do for you?" and a subsequent question: "Just what would you like to do in our company?"

(c) Be prepared for the personal interview. Good taste in dress, poise, and personal appearance will be quite impor-

(Continued on Page 42)



Now look INSIDE your telephone



To Americans, telephoning is second nature. They do it 94,000,000 times a day. To them, who thus conquer space and time, telephones are a commonplace — these familiar instruments, gateways to 21,000,000 others in the homes and offices of this land.

Making Bell telephones so well that you take them for granted, is the achievement of Western Electric craftsmen. It's what they have learned in doing that job for 58 years. It's the way they make cable, switchboards, vacuum tubes, all the 43,000 designs of apparatus for the Bell System. The excellence of their workmanship thus plays a part in your daily life.

Western Electric *... is back of your Bell Telephone service*

(Continued from Page 40)

tant. Indeed, personal appearance is quite essential. Clean hands, clean fingernails, clean shirt, and looking your very best all help to make a good impression. Look as neat and bright as you would if you were calling on "the" lady friend. Remember, you have a selling job to do. It is not amiss to bring samples of some of your work, such as drawings, reports, or a paper you have written. BRING YOUR PERSONNEL SHEET ALONG. The data on these sheets will reveal much information to the prospective employer. Capitalize on any outstanding work that you have accomplished, especially if it has some bearing on the work of the company. Do not attempt to oversell. Every effort should be made to act naturally.

Qualifications set up by industry include scholarship, personality, extra-curricular activities, work experience, etc. Last fall we pointed out that in the selection of men for research, design, and development, scholarship was rated 57; personality, 21; extra-curricular activities, 6; work experience, 10; degree of self-support, 4; outside influence, 2, on a basis of 100. In general engineering the corresponding figures were 38, 31, 10, 13, 5, 3. In engineering sales 22, 49, 15, 7, 4, 3. One point that is always stressed is "the ability to get along with others." Almost invariably the failure to succeed is NOT due to lack of aptitude or training but rather to undesirable personality traits.

Membership in Tech Societies Increases

A. I. E. E.

With meetings, inspection trips, and dinners, the Student Branch of the American Institute of Electrical Engineers is off to a good start this year under the chairmanship of Bob Lyons. The first open meeting was held on October 11 at 7:30 in the Union. Professor Bryant discussed the advantages of entering the research prize paper contest which terminates every spring. Speaker of the evening was Dr. Hartig, who showed slides of the trip he took while on sabatical leave last year. Though he had been in all parts of the U.S., he spoke mainly on the South-West.

On October 21 at the joint dinner-meeting with the Minnesota Society of the A.I.E.E., the Engineers' Society of St. Paul, and the Minneapolis Engineers Club, Mr. C. M. Ripley of the General Electric Company spoke on "Electricity—the Master Tool of Management." The attendance was approximately 400.

On October 30 twenty members of the Student Branch inspected the Pillsbury Flour Mills.

Mr. Marshall Sigford of the Eastman Kodak Company was the guest of the Student Branch on November 14 at 7:30. He gave an illustrated lecture on "Color Photography," which, being a relatively new development, proved to be a very interesting talk.

A. S. M. E.

The second meeting of the A.S.M.E. was held during the seventh hour Monday, October 28, in Murphy Hall auditorium. Prof. Linn Helander, divisional manager of the organization and head of the mechanical engineering department at Kansas State College, was the speaker. He said that opportunities in all engineering fields have never been better and that the demand for men far exceeds the supply. "Our civilization is being built for the future and along with the National Defense Act the engineer has a great chance to be of service and to contribute something to society," Mr. Helander stated. The A.S.M.E. is now sixty years old and has about 14,200 members with a central building and library in New York. In order to get to the top, Mr. Helander said that membership in one's engineering society was of the greatest importance.

The meeting was well attended, especially by the senior class. In order to encourage membership in the A.S.M.E., Gordon Ersted, president, announced that a Membership Booth will be open every noon in the Mechanical Engineering Building.

The Minnesota section of the A.S.M.E. held a dinner meeting on Monday, October 28, at the Union. Prof. Linn Helander, district manager of the A.S.M.E. and head of the department of mechanical engineering at Kansas State College, spoke on the subject, "Factors in the Design and Operation of Steam Power Plants."

Mines Society

The School of Mines Society held its annual Freshman Reception in the School of Mines building on Thursday evening, October 17. Freshmen and transfer students were guests of the Society.

Heading the entertainment was Dean E. H. Comstock, who spoke on "Doodlebugs." Dean Comstock also introduced the faculty to the new students. Frank Beach, Bill Glenn, Reuben Olson, Burton Boyum, Rodney Dalton, and Bob Morken, told of summer field trip experiences. Comic movies and refreshments completed the program.

Roy Johnson was general chairman for the reception. He was assisted by Donald Holmquist, Garth Crosby, and Donald Hohenhaus.

M. S. C. S.

The M.S.C.S., Affiliate of the American Chemical Society, held a short meeting during Convocation hour in the Union on Nov. 7. Dean Lind gave a talk to the prospective members of the society explaining the function of the student group and its relation to the national society. The meeting gave considerable impetus to the growth of this organization.

A. I. Ch. E.

The second meeting of the A.I.Ch.E. will be held November 19. The meeting will feature two films which illustrate the methods of manufacturing plastics as well as their industrial applications. At the meeting new membership cards will be distributed and President, Wallace Belin, will welcome Freshmen and new members. Discussion will be held in regard to having a field trip in the near future.

It was announced that candidates for the chairmanships of the Annual Chemistry Banquet and of the Spring Dance should let the executive committee know before November 30. The December meeting of the A.I.Ch.E. will be held Tuesday, December 10.

A. S. C. E.

The next meeting of the A.S.C.E. was held Thursday in the Union Ballroom annex. The speaker was Professor Paul Anderson and Professor Wilcox acted as master of ceremonies. The meeting was the annual bean feed, and started at 6:15 P. M.

I. Ae. S.

The I.Ae.S. is conducting a drive for new members, encouraged by the large turnout of some 200 students at their first meeting of the year held at the Union on October 9. Officers and committeemen are planning the program for the coming year.

Prof. John Ackerman and Bob Sexton are assisting the mechanical engineers in their drive for a new mechanical engineering building.

Bowling Chemists

The new bowling alleys in the Coffman Memorial Union have produced an energetic reaction among the chemistry staff. An all-chemistry-league of six five-man teams started a schedule of matches on October 28. The team names are Bernoulli Boys, Independent Variables, Free Radicals, Auto-Catalysts, Vander Waals Force, and Isotopplers. With the interest at a white heat, the number and frequency of collisions should increase rapidly.

Institute Men On Foundation Committees

Headed by Jack Foeller as chairman the following Institute of Technology men have been appointed to the ticket sales and publicity committees for the Foundation Ball: Bill Van Braak, Joe Atkins, Hutch Thurston, Roy Nystrom, Wiley Souba and Gene Selmanoff.

This year's ball will feature the music of Ted Weems and his famous orchestra and will be held in the Minneapolis Municipal Auditorium on Wednesday, November 20.

The Foundation Ball yields the funds by which the work of the Minnesota Foundation is carried on. In addition to sponsoring the Thanksgiving Ball, the Foundation has an important rôle in granting scholarships, strengthening budgets of weak departments, maintaining the public relations council, and sponsoring the speakers bureau, the Cap and Gown day Cauldron Ceremony, Campus Tours, and the Spring Festival.

Dean Lind Makes Lecture Tour

Dean S. C. Lind, president of the American Chemical Society, left Minneapolis on October 12 for an extended tour of the Sections in the South. His itinerary included talks at Raleigh, N. C.; Columbia, S. C.; Gainesville, Fla.; Atlanta, Ga.; Oxford, Miss.; Birmingham, Ala.; and McMinnville, Chattanooga, Bristol, Knoxville, and Nashville, Tenn. Various topics in the field of radioactivity formed the subjects of the lectures. At the close of this tour, President Lind went directly to Boston, Mass., where he attended the Conference on Applied Nuclear Physics held at Massachusetts Institute of Technology, Cambridge, Mass., October 28 to November 2.

More New Faculty Members

Mr. Frederick P. Pike, M.S. in Chemical Engineering Practice, has joined the staff as instructor in chemical engineering. Mr. Pike had his training at the University of Virginia and the Massachusetts Institute of Technology, and comes to Minnesota from the Standard Oil Company of Indiana. During the summer of 1934 he was auditor of the Gold Division of the U. S. Treasury. He takes over the duties of Dr. Marvin C. Rogers, who recently resigned to go back into industrial work.

Mr. Firy is working with Prof. B. J. Robertson as an instructor in gas engines. Before the fall of the French government, Mr. Firy was in the United States as a French government representative. He inspected airplane engines purchased by that government in the United States.

Latest addition to the agricultural engineering department is Mr. Charles K. Otis, who comes here from Kansas State College. He is a graduate of the University of Wisconsin and has degrees in agricultural and mechanical engineering. Mr. Otis is teaching and doing research in farm structures, replacing Mr. W. L. Neubauer, who has accepted a position in the agricultural engineering department at the University of California.

Thomas R. Steadman, of Harvard University, is the new Hormel Foundation Fellow continuing research on fat under the direction of Professor Walter Lauer. Dr. Louis Keyser, first Fellow in this project, is now with the Rainier Pulp and Paper Company of Shelton, Washington.

A. R. Ford, professor of Internal Combustion Engines, has left the school on a one-year leave of absence to design engines for the United States Navy at the Philadelphia Navy Yards.

W. B. Renfrow, Jr., Ph.D., Duke University, and Leo Spillane, B.S., St. Thomas, are continuing the vitamin E researches in Professor Lee Smith's laboratory. They replace Dr. Wesley O. Fugate, who is now instructor in organic chemistry at Columbia University, and Dr. Joseph W. Opie, who has joined the staff of Merck and Company, Rahway, New Jersey.

Prof. R. C. Brinker, who is on a year's leave of absence from the University of Hawaii, is substituting for Prof. Joseph A. Wise in the civil engineering department. Professor Wise is now teaching at the Naval Academy in Annapolis. Professor Brinker taught at the University before going to Hawaii.

"Pick," the former lab mechanic of the experimental engineering station, is now a freshman in mechanical engineering. He is one of the very few freshmen who has a wife and children.

Rueben Olson has been appointed an instructor in the experimental engineering station. His time will be divided between teaching here and research at International Falls for the Minnesota and Ontario Paper Company project.

Women Convention Delegates Tour Institute

On Thursday, October 31, the women attending the Federated Women's Clubs of Minnesota convention in Minneapolis were entertained at a tea in the Coffman Memorial Union. Preceding the tea the ladies were taken on short tours through the Union and the aeronautical and mechanical engineering departments. Erick Schonstedt, Steitler Quist, and Bob Sexton had charge of the event with the engineering faculty and students on hand as hosts. During their convention, the organization passed a resolution asking the legislature to appropriate the funds for a new mechanical engineering building.

Professor Bryant Publishes Book on Utilities

John M. Bryant, professor of electrical engineering, has recently been brought to the foreground in the public utilities field by the publishing of his book *Elements of Utility Rate Determination.*

In this book Professor Bryant collaborated with Mr. R. R. Herrmann, of the Northern States Power Company of Minneapolis, to bring forth a comprehensive survey of the problems encountered in utility rate determination and a well organized and thorough formulary for their solution.

The book deals with the proven and practical problems in rate making. It maintains throughout an observant viewpoint of the courts and commissions which deal and have dealt with utility rate problems.

The book is timely, thorough and is a valuable aid to those concerned in utility rate determination. It serves to bring favorable notice to the University and national attention to Professor Bryant.

ALUM NOTES

By WARD HANSON, Ch. E. '42

'06

George M. Albrecht, E.E., is a member of the firm of Freeman, Sweet, and Albrecht, Patent Lawyers of Lakewood, Ohio.

'12

Guy N. Bjorge, Mines, is general manager of the Homestake Mining Company of Lead, South Dakota. With the same company are **Nelson E. Anderson,** E.E. '32, and **Clarence Kravig,** Mines '27, junior electrical engineer and assistant mine superintendent respectively.

'20

Frank C. Kracek, Ch. '20, Ph.D., is a physical chemist for the Carnegie Institution of Washington, D. C.

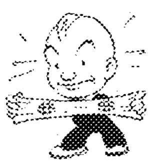
'28

Robert W. Ackerman, E.E., is district cable supervisor for the American Telephone Company at Lakewood, Ohio. Mrs. Ackerman is the former Anna Marie Langkammer, Nursing '28.

Theodore T. Budrow, Ch. '28, Ph.D., is patent manager for the R. and H. Chemicals department of the du Pont plant at Niagara Falls.

'33

Robert W. Helbig, Mines, is working for the Creamery Package Manufacturing Co. of Oak Park, Illinois, as a sales correspondent.



The stork visited Mr. and Mrs. William H. Ripkin on September 2, to the tune of a bouncing baby boy. **Mr. Ripkin,** M.E., is sales representative for the Fairmont Railway Motors, Incorporated, of Chicago, Illinois.

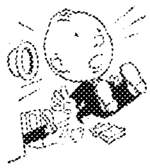
'37

Howard H. M. Baker, Aero., has a position as layout draftsman with the Vultee Aircraft Company at Downey, California.

Malvin N. Abramovich, E.E., is an electrical inspector with the Curtiss-Wright Corporation of Clifton, New Jersey.

'38

Henry W. Anderson, Ch., is continuing his studies in chemistry as a fellowship student at the University of California at Berkeley.



John T. Barber, C.E., is in South America as "party chief" for the Socony Vacuum Oil Company in Caracas, Venezuela.

Vernon G. Skogan, Ch.E., is a chemical engineer employed by the Standard Oil Company of Indiana.

Lee J. Thornson, Mines, has been transferred to Corpus Christi, Texas, by the Sun Oil Company. He was married April 12 to Golden Carter, a native Texan, whom he met while stationed in Kilgore, Texas.

'39

Homer S. Anderson, Mines, is mine shift boss for the New York and Honduras Rosario Mining Company at San Juancito, Honduras.

'40

Harry E. Hillstrom, Ch.E., is now assistant plant metallurgist for the Magnesium Corporation of Cleveland, Ohio.

W. Thomas Jackson is working as an engineer for the Parker Appliance Company, Cleveland Heights, Ohio.

H. N. Mahle, technical apprentice, is employed by the American Steel and Wire Company (Newburgh Wire Works) in Cleveland, Ohio.

Howard G. Nelson, production engineer, is now living in Cleveland, Ohio.

Robert E. Straub, of Dubuque, Iowa, is now employed in the Meteorology Department of the Pan-American Airways, Honolulu, Hawaii.

THE FIFTH COLUMN

By Bruce N. Torell, M.E. '42

ONLY IN THE CONFINES of a combination telephone booth and clothes closet such as is the unspacious TECHNO-LOG office could a tortured mind become so narrow as to attempt the writing of this column. Witness heretofore the only obvious remedy for this regrettable state is an appropriation for a new building such as houses the *Daily*, *Ski-U-Mah*, and other such minor publications, to be exclusively given to the use of the TECHNO-LOG. We would of course require sufficient lounges for the editorial staff, a rail for the business staff to lean upon, bowling alleys, a ginch wolfing gallery, billiard room and a reading room well stocked with Es......, ahem—Encyclopediæ, etc. And lest I forget, should there be a closet or a telephone booth to spare maybe we could make a TECHNO-LOG office out of it.

* * *

SUCH MORBID ACTIVITIES as pasteing pictures, tenderly removed from well-wolfed copies of a man's magazine (we columni must be so careful about commercials, and deans) on our pitifully few square feet of wall, need no longer be our sole sources of recreation. The time has come for a renaissance in the world of sport. But before going a foul vowel further I hasten to omit from the followers of both our old and new indoor sports, our hallowed editor and much-owed business manager. For C. V. Moe Olsen's time is too too absorbed by pondering over such things as who the H...... bought a chocolate bar with a negative nickel or why did I ever send Campbell over to collect my mail or more specifically, why did Ann have to mention insomnia in her note.

* * *

IN THE DREGS of sport history will go the name of John Schnappy-Time Kid Foeller. On the worst day of last week he brought forth as a combined fruit of his fertile brain and his laborious syllable by syllable reading of Joe Glug's Book of Parlor Games, a new game which will no doubt arouse the biliousness of the nation. The participant first obtains, 1. a pair of the largest scissors available; 2. a piece of paper the size of which varies inversely as his innocence; 3. a chair, with legs; 4. a table also with; 5. a wide open space; 6. a public indemnity policy; 7. documentary evidence from an approved psychiatrist vouching for his sanity.

The participant first grasps the scissors firmly in one hand and paper in the other. He then climbs on chair and from chair to table in two graceful steps. Throwing the paper into the air and simultaneously muttering a snappy Mohammedan war cry he, with much vigor and enthusiasm, attempts to sever the paper into as many pieces as possible before it, or they if one is fortunate, reach the floor. The score consists of the number of pieces on the floor after the participant has exhausted all possibilities. This number positively excludes any fingers, arms, ears, or miscellaneous tidbits of either participants or spectators which may have become involved in the cutting process.

* * *

LET IT NOW BE ANNOUNCED that the writer was one of the last to see our business manager when he staggered forth into the cruel wintery blasts on the afternoon of Tuesday, Nov. 12, appropriately whistling, "The Breeze and I," to begin a seven-mile trek to his little cabin in the Ozarks. Any one finding the body please return to me the beautiful scarf it is wearing after removing the thing it is tied around.

* * *

TEARS FALL from these well bagged eyes to hear of the sad plight of one William Campbell, the Cornville flash and ex-humor columnist of the TECHNO-LOG. It is whispered around that he lost his sense of humor at a revival meeting (or was it his sense of smell). Coincident with this sad bereavement comes the news of the ninth and final declaration of bankruptcy of the Stinko Joke Company.

* * *

All characters are strictly deficient and any reference to any person living, medium, or dead, is purely detrimental.

LAUGH!

It's Humor

By Ralph Hill, Ch.E. '41

Here's how it happened. We were doing sales work for the Black Sheep Woolen Mills. Always on the lookout for suckers or what have you, we stalked into the TECHNO-LOG office and confronted the editor.

"Would you be interested in some coarse yarns?" we asked, putting forth our best line.

"Sure, tell me some," said Hon. Ed. with a wild gleam in his eye. Well, worst led to worst, so here we are. Although "we" are only one person, "we" will be used, since we are leading a double life.

* * *

They say a hug is energy gone to waist.

* * *

Once upon a time, a long, long time ago, even before Roosevelt was president, the following incident occurred at a downtown speak-easy. It was late in the night, and two studes had proceeded to get plastered to the ears. Before long they were engaged in heated verbal combat at one end of the bar. The bartender, attempting to quiet the pair, sauntered over and asked what the trouble was.

"Well," said one of the drunks, "See that bug on the bar?" "He says that it's a cockroach and I say that it's a beetle, and we're both sure that we're right."

The bartender, tactfully took a long, close look at the insect and declared, "Boys, you're both wrong. That there's a Lady-bug."

Which brought forth the exclamation, "God, what eyesight!"

* * *

EPITAPH

Here lie the bones of Sally Brown.
For her death held no terrors.
Born a maid, a maid she died,
No hits, no runs, no errors.

* * *

This choice bit was overheard at the ballroom of the new union: Two fellows who had just been introduced, were talking.

First fellow: Who's that homely girl up there near the band-stand?

Second fellow: Oh, that's my sister.

First fellow: No, I don't mean that one. I mean the one with the plaid skirt, who looks like she was behind the door when looks were passed out.

Second fellow: That's my girl friend.

First fellow: Boy, she sure can dance!

* * *

Mother: Have a good time at the party and be a good girl.

Sweet Young Thing: Make up your mind mother.

* * *

We asked a certain sorority girl what made her so popular with the boys, and she said, "I give up."

Wit or WITOUT

Marvin Diers M.E.B. '42 Arthur Templin E.E. '41

* * *

Farmer: "And how's Lawyer Jones doing, doctor?"

Doctor: "Poor fellow, he's lying at death's door."

Farmer: "That's grit for ye; at death's door an' still lying."

* * *

"Well, my son, what did you learn in Sunday school today?"

"We learned all about a cross-eyed bear."

"About a what?"

"Yes, sir, named Gladly. We learned a song about him: all about 'Gladly, the cross I'd bear.'"

* * *

If the devil lost his tail where would he get a new one put on?

At any joint on seven corners, where the worst of spirits are retailed.

* * *

During a very wet day after a long spell of drought a farmer was heard to say to a friend, "An hour of this rain will do more good in five minutes than a month of it would do at any other time."

* * *

She isn't wild, anybody can pet her.

* * *

Why is a woman after a party like an arrow?

She can't go off without a beau, and she is all in a quiver till she gets one.

* * *

He: "If I should attempt to kiss you what would you do?"

She: "I never meet an emergency until it arises."

He: "But if it should arise?"

She: "I'd meet it face to face."

* * *

Customer: "Is it customary to tip the waiter in this restaurant?"

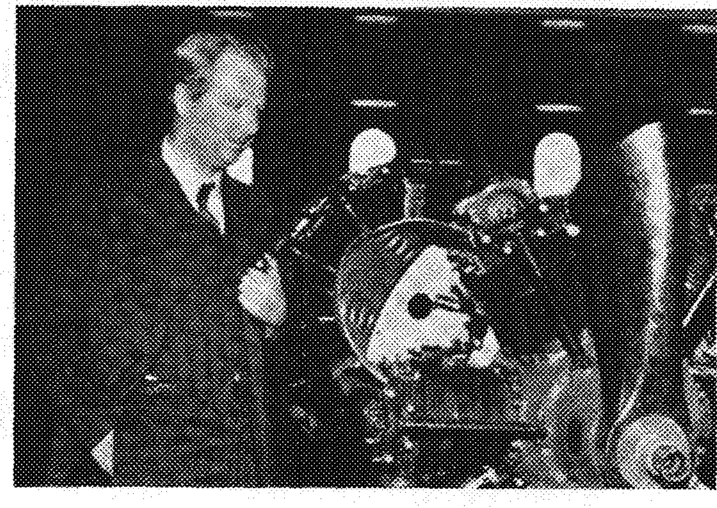
Waiter: "Why-ah-yes, sir."

Customer: "Then hand me a tip. I've waited three-quarters of an hour for that steak I ordered."

* * *

"Give me a sentence with the word 'Rotterdam' in it."

"My sister et my candy, an' I hope it'll rotter dam teeth out!"



ALBERT GAIL

Assistant Professor of Aeronautical Engineering

By WENDELL WILKENS, Aero. '42

A recent addition to the department of aeronautics is Professor Albert Gail who formerly was a research designer on the now famous Messerschmitt fighting plane.

Professor Gail who joined the faculty this fall was born and spent his childhood in a small village near Hanover, Germany. He attended the Institute of Technology at Munich, and in 1932 he was graduated with a "DIPLOM-INGENIEUR" which is the equivalent of our Master of Engineering degree. His first position was with the Bavarian Aircraft Company, at Augsburg, where he was a designer and research engineer under the famous Professor Messerschmitt who was chief engineer for that company. He collaborated in helping to build the Messerschmitt fighting plane which today is the backbone of the Nazi air force. Mr. Gail acted in this capacity with Professor Messerschmitt until late in 1936.

Dislike of Nazi rule and anticipation of the coming war caused Professor Gail and his family to leave Germany in 1937 and come to the United States. That summer he became a research engineer with the United Airlines. His work consisted of solving aerodynamic and vibration problems for the airline.

A year later he presented a paper before the annual pacific coast meeting of the Institute of Aeronautical Sciences on the "Influence of Ice Accretions on Airplane Performance." This paper also appeared in the *Journal of Aeronautical Sciences* in November 1939.

His various research activities led to his development of a method of dynamically balancing propellers. This is being used by United Airlines and the Northwest Airlines at the present time. In the summer of 1939 he presented a paper on this subject to the Engineering and Maintenance meeting of the "Air Transport Association of America" at Los Angeles.

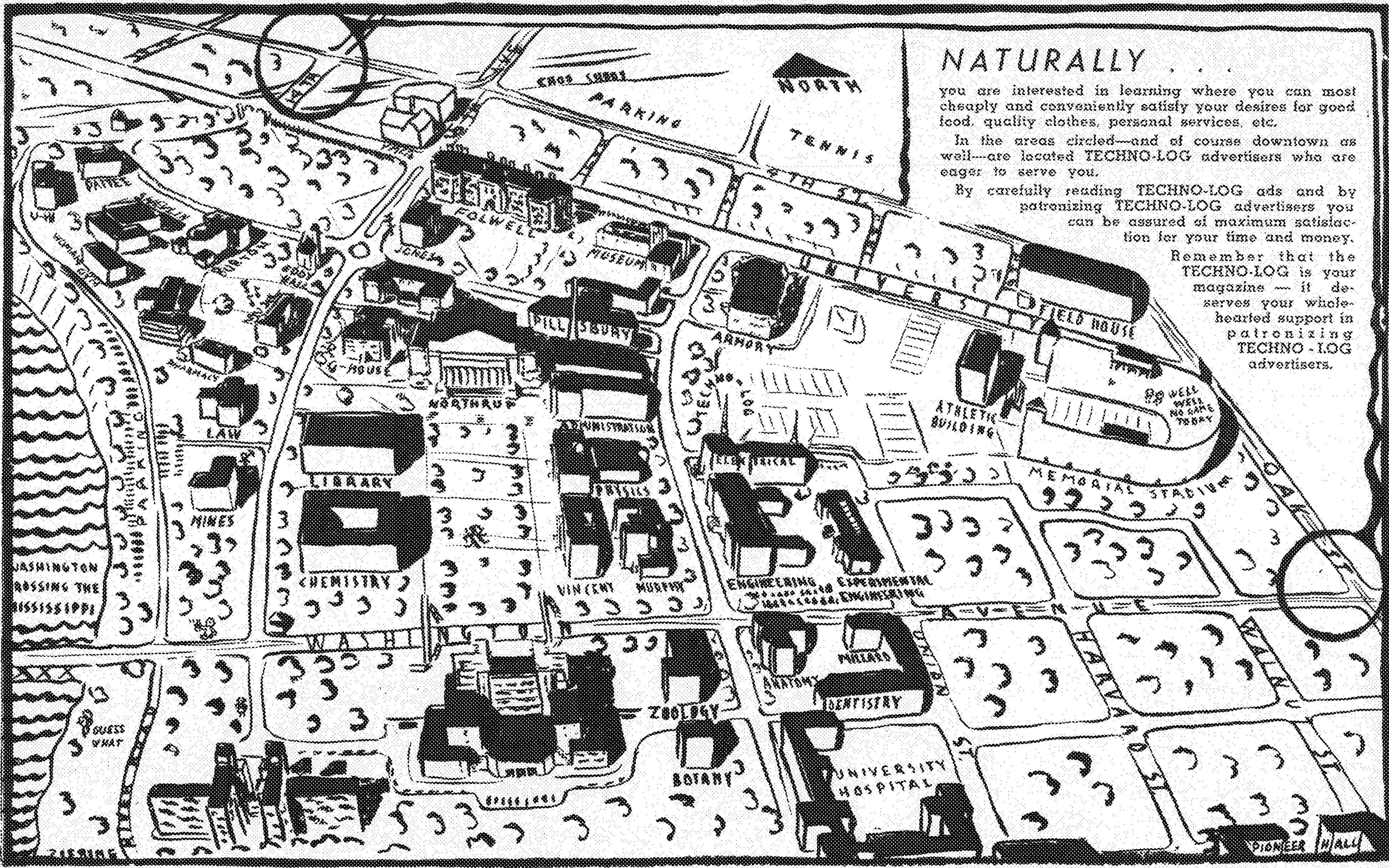
Mainly as a result of his extensive research work he was called to Georgia School of Technology at Atlanta, Georgia, to be the Assistant Professor of Aeronautics in charge of theoretical and applied aerodynamics.

With such a knowledge of aeronautics and research it is no wonder that he was asked to join the staff here at Minnesota. He is an instructor in Aerodynamics, Airplane Design and the study of vibration and its effects on the airplane. He is Assistant Professor of Aeronautical Engineering.

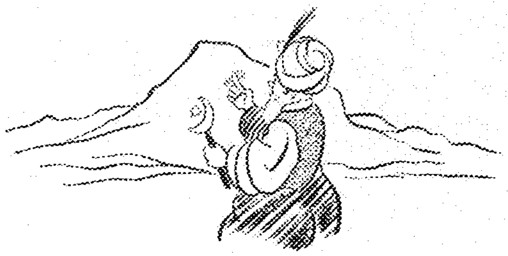
Mr. Gail has applied for his first naturalization papers, and he hopes to become a citizen in 1942. His children were both born in Germany and his daughter was only two months old when she came to the United States. His son is six years old. His hatred of the Nazi régime, which he endured for many years, has made him very thankful to be living where there is no suppression of personal liberties due to a totalitarian state.

Techno-Log Map

OF THE UNIVERSITY OF MINNESOTA CAMPUS



G-E Campus News

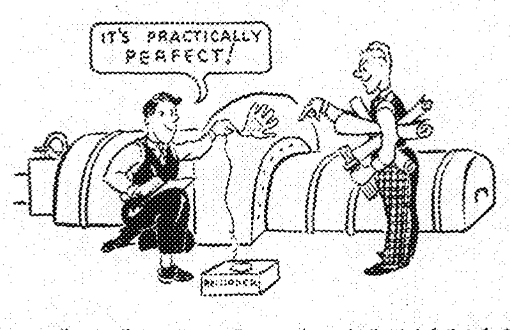


"HITHER, MOUNTAIN!"

IT'S been centuries since Mahomet resigned himself to go to the mountain because the mountain wouldn't come to him. If Mahomet were living today, he wouldn't have to go to the mountain, that is, if he were at Shasta Dam—the second largest concrete dam in the world—now under construction in California.

There the world's longest conveyor belt is moving mountains—5,700,000 cubic yards of concrete and 10,400,000 tons of sand and gravel—from the processing plant to storage piles near the dam site, a distance of 9.6 miles.

Driving the conveyor belt are General Electric motors and control, thoroughly checked and tested before going on the job by young student engineers taking the G-E Test Course. J. A. Jackson, Va. Poly. Inst., '00, and R. F. Emerson, Yale, '06, had charge of the engineering at Schenectady, and A. W. Moody, U. of Calif., '36, followed engineering on the job. All three are ex-Testmen.

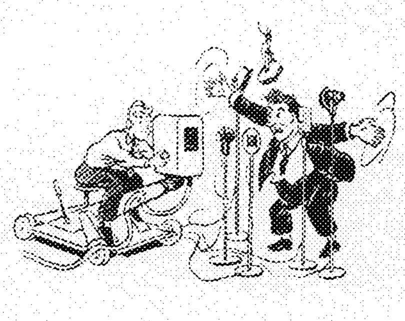


SUPER STREAMLINING

IN this modern age practically every means of transportation is streamlined—automobiles, airplanes, trains, and even baby carriages. The closest approach to perfect streamlining, however, is probably not found in any one of the foregoing but in a General Electric steam turbine, where nozzles must be designed to direct steam at the buckets at just the right angle.

G-E engineers have streamlined turbine nozzles to a point where they absorb less than two per cent of the velocity energy of steam traveling through turbines. Working with models, engineers about 20 years ago found they could feel low-pressure spots in an air stream blown through nozzle sections. Literally and figuratively they were "putting the finger" on streamlining deficiencies. Now, in a special laboratory, air is forced through model nozzles at a terrific speed (more than 700 miles an hour) while mechanical "fingers" feel for points of eddy or friction loss, and an automatic machine records the results.

These "streamline" tests, conducted by young student engineers "on Test" under the direction of experienced engineers, give records of inestimable value in the constant search for new ways to build more efficient turbines.



SIX VOICES

PEOPLE who have qualms about broadcasting probably would have passed right out if they had been in the shoes of George A. Mead, N. Y. State Commander of the American Legion, when he broadcasted recently from General Electric's television studios at Schenectady, N. Y.

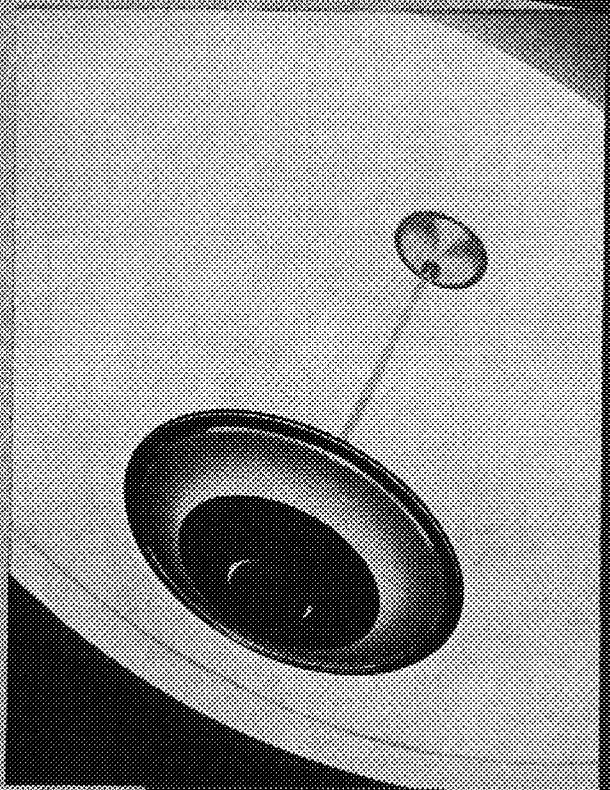
For the first time in history a voice was carried over every practical means of voice communication. Mead's talk, in addition to going out on the ultra-short-wave band accompanying the picture on television, was simultaneously carried by WGY on long-wave radio, WGEO on short-wave, W2XOY on frequency modulation, and by light beam and ordinary telephone. In all, six distinct frequency bands carried his words to the four corners of the earth.

Directors of this unusual broadcast were John Sheehan, Union, '25, manager of G-E short-wave broadcasting, and J. G. T. Gilmour, Union, '27, program manager of G.E.'s television station, W2XB.

GENERAL ELECTRIC

968-7

THE TECHNO-LOG OF MINNESOTA



FEATURING IN THIS ISSUE

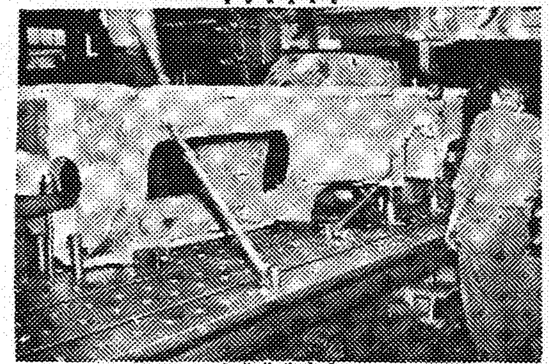
BEAUTY IN ILLUMINATION

SUPERCHARGING ENGINES

ISOLATION OF ISOTOPES

USING LOW GRADE ORES

DECEMBER, 1940 VOL. XXI NO. 3



A BUSINESS PAPER is a Manufactured Product

A business paper is a manufactured product just like an automobile, a suit of clothes or a piece of machinery. And its quality depends in like manner on the character of the materials that enter into it.

The editorial staff of a business paper sifts hundreds of feature and news articles every month. From the wealth of raw material they choose that which is best, the most suited for the purpose of informing and educating the readers.

The editorial staff must be aware of what is new and advanced in all branches of the field served.

They must not only know the character of the readers they serve but they must also understand their needs, the type of customers they have and the problems of business.

From all of this, they manufacture the finished product that is issued each month. Whether or not they have done well, depends on the interest displayed and the response to their effort.

Read all of your business paper carefully. Its news and feature content always contains much to help you keep abreast of the times.

Bruce Publishing Company, largest publishers of business and professional journals in the West, also publish the following:

- COMMERCIAL BULLETIN AND APPAREL MERCHANT
- FRATERNITY MONTH
- GROCERS COMMERCIAL BULLETIN AND MEAT DEALERS NEWS
- NATIONAL GRAIN JOURNAL
- HARDWARE TRADE
- THE LUMBER DEALER
- NORTHWEST ARCHITECT
- NORTHWEST INSURANCE
- NORTH WESTERN DRUGGIST
- NORTHERN AUTOMOTIVE JOURNAL
- PRISON WORLD

and

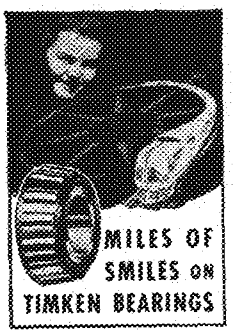
51 others for associations, companies, universities and fraternal groups.

BRUCE PUBLISHING COMPANY

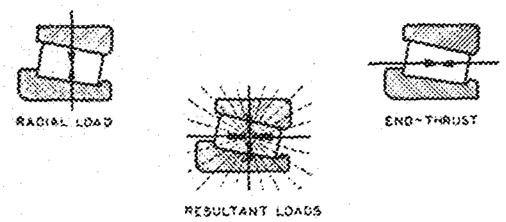
Minneapolis — Saint Paul

Minnesota

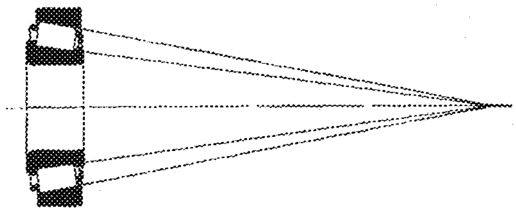
HERE'S WHY THE TIMKEN BEARING SUCCESSFULLY MEETS EVERY MODERN BEARING REQUIREMENT . . .



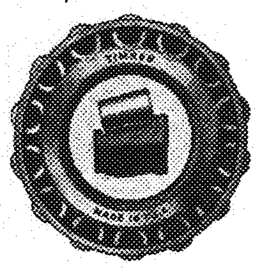
The fundamental characteristics of the TIMKEN Bearing, arising from inherent features of its design, make this bearing eminently suitable for every bearing application in every kind of mechanical equipment. In your future years as an engineer, bearing selection will be one of your many important responsibilities. The more you learn about bearings now, the easier your task will be.



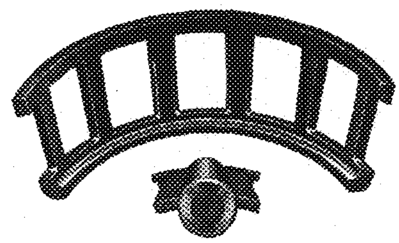
The most important feature of the TIMKEN Bearing is its basic tapered principle, introduced by Timken in 1898 and never superseded. This enables the bearing to carry all types of loads—radial, thrust or both together in any combination—without auxiliary supports of any kind, (such as thrust plates or thrust washers).



To assure true rolling motion and thus provide maximum anti-friction efficiency in operation, the bearing is so designed that lines projected along the tapered surfaces of the rolls and races meet at a common apex on the axis of the bearing.



Rolls are kept in exact alignment with respect to the races by two area contact of the large roll ends with the undercut rib of the cone (inner race).



A scientifically-designed and accurately-perforated cage keeps the rolls properly spaced around the cone so that each roll carries its proper proportion of the load.

For more than 41 years a constant process of engineering refinement has been going on, resulting in the perfected TIMKEN Bearing of today—a product of one of the world's largest and most famous engineering-manufacturing organizations.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

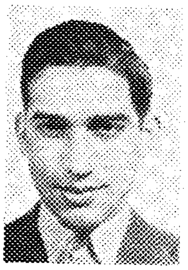
Manufacturers of TIMKEN Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; TIMKEN Alloy Steels and Carbon and Alloy Seamless Tubing; and TIMKEN Rock Bits.

TIMKEN
TAPERED ROLLER BEARINGS

Authors . . . Staff . . . .

By Richard Opland, C.E. '43

Sid Wolfenson is highly interested in fluorescent lighting, is enthusiastic over its future, and is well informed on the subject. This all adds to an A-1 article which no reader should pass over. Wolfenson is a graduate student and E.E. teaching assistant. He is working toward his Master's degree and plans to do research work in lightning in the future. Likeable Sid is well known to those who follow the Gopher gymnastic teams, having had three years of varsity competition. He likes to take pictures and is interested in high-speed photography. Wolfenson is a member of a number of organizations which include the M Club, the A.I.E.E., the Luminating Engineering Society, and Eta Kappa Nu, honorary E.E. fraternity.



A typical Irish-looking fellow, with his fiery top, is **John Lambert**, who'll tell you quickly enough that he isn't Irish at all but English. His interest in isotopes inspired his article in this issue on U-235 and Dr. Nier of the Department of Physics. John likes to write, but he also likes to sing, and he gives the Tech Glee Club the benefit of his vocal efforts. He is a member of the A.I.E.E., the I.R.E., and Eta Kappa Nu. Maybe it's the English in him, but John likes to build rowboats and enjoys boating. In 1938-39, he worked for the Minnesota Mining and Manufacturing Co. as a chemist's assistant in research. John would like to go into radio design or television for his life's work.

One of our more widely read authors is **Ralph Hill** who entertains you with his humor column each month. In this issue, however, Ralph becomes serious and gives us an interesting discussion of iron mining. A senior in Ch.E., he would like to acquire "a reasonably good job and settle down" after graduation. Besides belonging to the A.I.Ch.E., Ralph is a member of the Rangers, a group of fellows from the Iron Range who gather socially and also charter a bus on all their trips home. Spare time is a rarity to Ralph, but when the opportunity provides, he likes to listen to good music, both swing and classical, and also likes to dance. Ralph enjoys basketball, bowling, and swimming, and has worked as a lifeguard during two summer vacations.

●

The Cover

This month's cover picture, taken by Jack Rockwell, illustrates one of the striking effects that can be achieved by proper and scientifically engineered illumination.

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The editorial policy of the TECHNO-LOG is to present material for technology students which it is hoped will strike a happy medium between the superficial and the highly specialized.

The MINNESOTA TECHNO-LOG is published monthly, October through May, by the students in the Institute of Technology of the University of Minnesota.

The purpose of the TECHNO-LOG is two-fold: First, to put in the hands of TECHNO-LOG subscribers highly worth-while and interesting reading material; second, to offer technology students an invaluable opportunity to get writing, selling, and working-with-others experience.

THE MINNESOTA

Techno-Log

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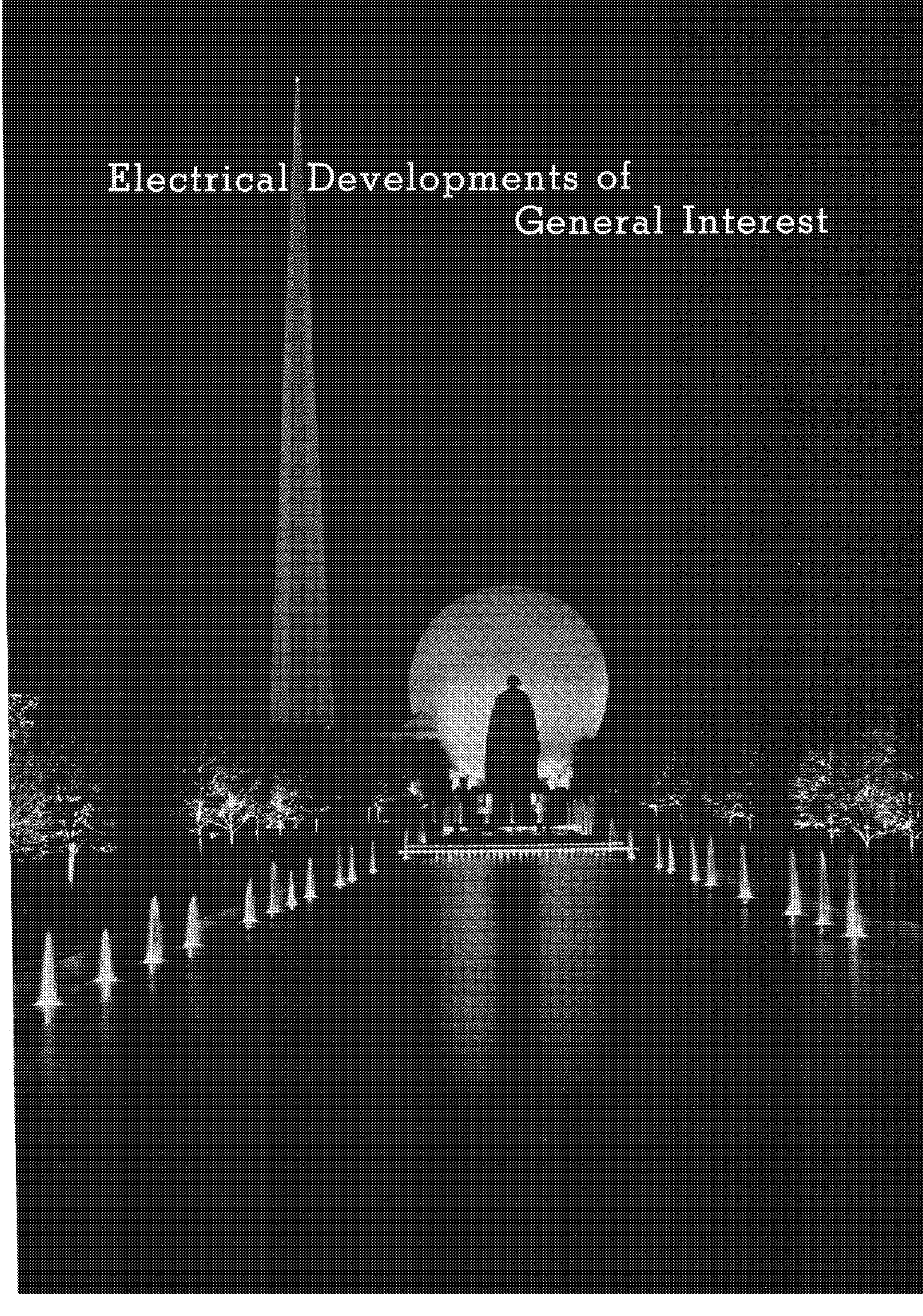
Electrical Developments of General Interest



AN EDITORIAL

Peace on Earth?

IN THIS DAY when war is raging everywhere and hate rather than goodwill is being imbued into men's souls, the words of that Christmas song, "Peace on the Earth, goodwill toward men," fall rather flat.

Even proposals of a Christmas truce have been bluntly refused. What sense is there in fraternizing with your so-called enemy one day and murdering him the next? What brought on all this hell? We don't know. We will even leave it to the political scientist to theorize and explain, but one thing that does irk us is the blame that is sometimes attributed to engineering and science.

Men have said that the brutality of the present conflict can be charged to the fact that technology has bounded forward unleashed and has outstripped the controlling power of man. All of which is true enough, but when they suggest impeding science to give the arts time to catch up we stamp our feet in disapproval.

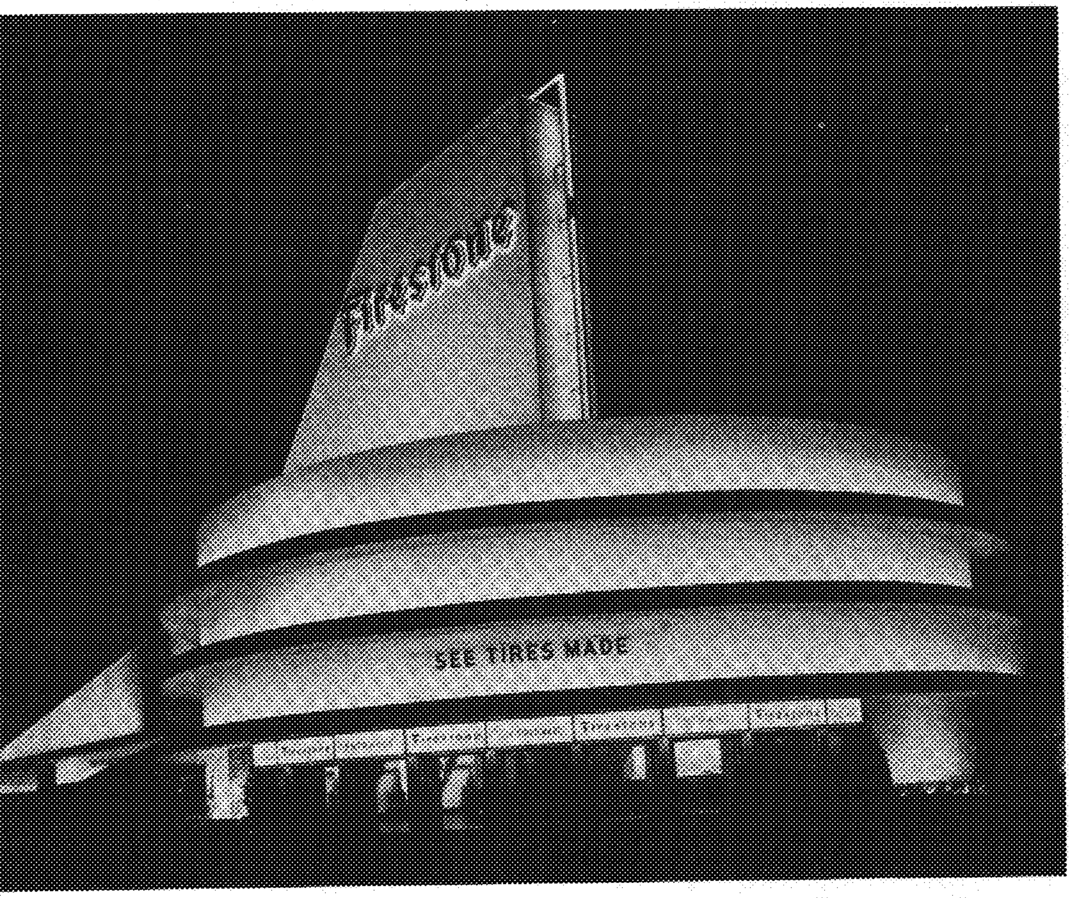
First of all, it is extremely doubtful if nature will allow man to be destroyed through his own ingenuity. The defense against dreaded weapons is never far behind the offense, and the rate of killing isn't being increased at an astonishing rate. Stopping engineering won't stop any wars; it will just make them proceed at a slower pace.

No matter how long the people of the world are given to study peace, we doubt if there ever will be any lasting peace. Furthermore, even if we subordinated science in this country we still would have a rather difficult time convincing certain foreign nations of our super development of the art of living in peace. Our best chance of maintaining our way of life under present conditions is to train more high quality engineers, to push scientific research, and to apply technical discoveries wherever needed.

Finally, to stifle the so-called inventions or discoveries of destruction would be to deprive us of much of the peace-time advantages these very discoveries offer. Cut out your explosives, motorized units, or aircraft, and where would our American way of life be? As one Doctor of Philosophy in political science recently said, "What we need is more engineers and fewer men that sit around and discuss theory."

BY WALLACE K BELIN, EDITOR

Fluorescent



By S. W. Wolfenson

All cuts courtesy.

FLUORESCENT lighting, the new, revolutionary illumination method, has gained rapid momentum in a relatively short time. The fluorescent lamp has risen from the ranks of mere discoveries and has proved to be an important factor in the lighting field.

Fluorescence may be defined as that property of a substance which enables it to absorb radiant energy at one wavelength and emit this energy at another wavelength. Although the phenomenon of fluorescence was discovered several centuries ago, it is just two years since its principle was first applied successfully in the form of a light source which could be utilized for commercial lighting.

The fluorescent lamp on the market today consists of a glass tube painted with a thin layer of a fluorescing chemical on the inner surface. Most fluorescent powders used are sensitive to invisible ultra-violet rays, particularly the 2537 A° line, and glow with visible brilliance when exposed to these rays. The ends of the tube contain sealed electrodes which are separated electrically from each other, and the conducting medium consists of low pressure mercury vapor and a trace of argon gas. Ultra-violet rays are produced when a proper voltage is applied across these electrodes, and a flow of electrons (electric discharge) takes place between the electrodes.

Unfortunately, electric discharges cannot take place at common commercial voltages without introducing auxiliary equipment. These auxiliaries consist of two separate parts: (1) a choke coil to limit the current to the designed value of the lamp; and (2) an automatic switch which, on starting, first closes the electrode circuit, and then suddenly breaks it in order to induce a high voltage across the electrodes for starting the arc discharge.

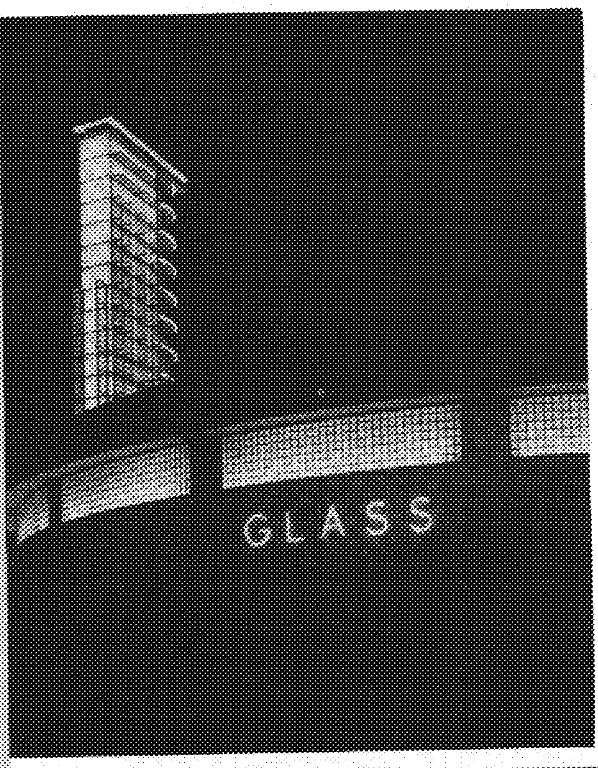
When standard household voltages are applied to a fluorescent lamp circuit, current will flow through the electrodes and auxiliaries. This current heats the electrodes to a dull red color, and electron emissions take place. If the starting switch is suddenly opened, a transient high voltage, due to the stored inductive energy, appears across the electrode terminals. This voltage breaks down the mercury vapor, and current flow takes place through the lamp.

Automatic Starter

The automatic operation of the starting switch takes place in the following manner. When the lamp is connected to an alternating current line, the voltage across the contact and bimetallic strip is sufficient to produce a glow discharge. The heat produced causes the bimetallic strip to expand and touch the contact which closes the circuit. When contact is made, the bimetallic strip cools and contracts due to the absence of the glow, and the circuit is opened momentarily. This sudden opening causes an inductive kick which starts the lamp. Once the lamp becomes started, the voltage across the starter is insufficient to cause a glow; thus no energy is consumed by the starter while the lamp is in operation.

It is due to this starting operation switch that the lamps do not light immediately after the line switch is closed, and usually a time lapse of approximately five seconds occurs.

The present rated life of the fluorescent



Fluorescent lighting on the Firestone and Pittsburgh Glass Exhibits at the World's Fair.

Lighting

E.E. Teaching Assistant

Claude Neon Lights Inc.

lamp is 2,500 hours. In general, the lamp does not burn out at this time, but tests show that it is not economical to burn the lamp after this period of time. Lamp life is materially affected by frequent starting, and if the lamp is started every minute, for example, the life will be greatly shortened; however, if lamps are burned continuously, the useful life will exceed 2,500 hours.

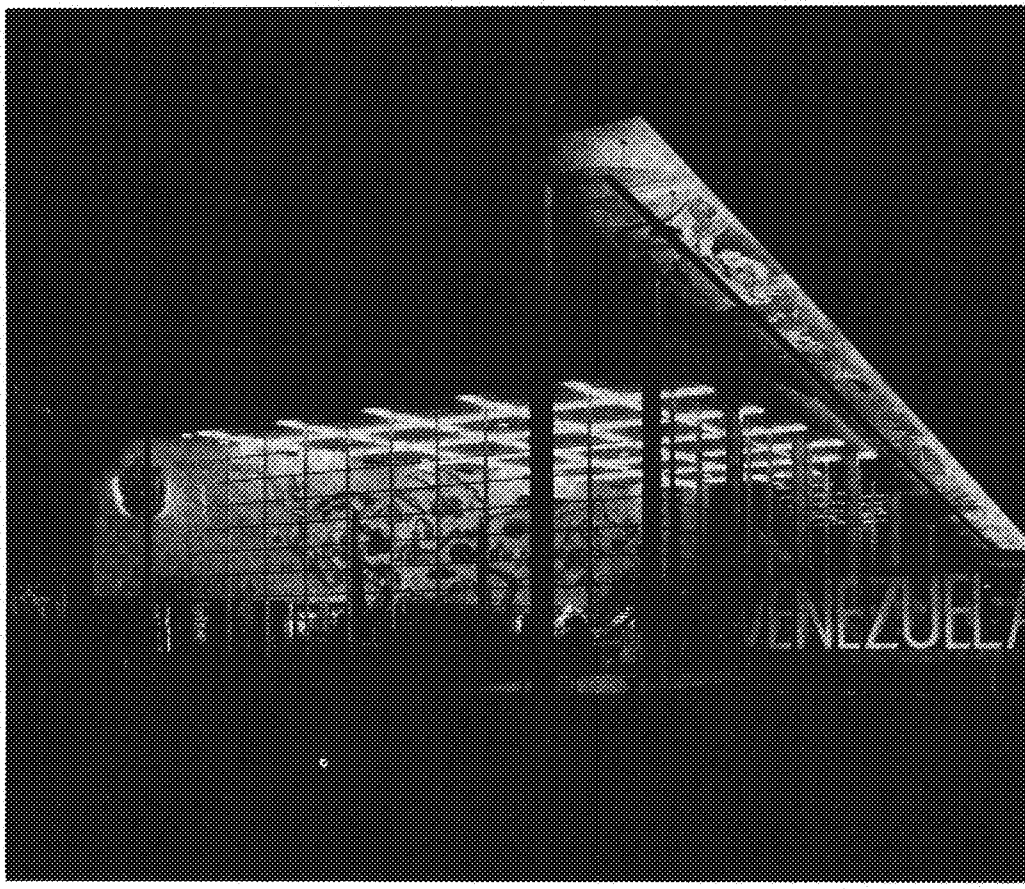
The fluorescent lamps on the market today have remarkably higher efficiencies than corresponding incandescent lamps of the same color. The daylight and white fluorescent lamps give approximately four times as much light output for every watt of input, while the colored lamps give from 10 to 150 times more light output than the same colored incandescent lamp. High efficiency light is produced by fluorescence because the process of obtaining color is done by re-radiation, while in the case of colored incandescent lamps, color is produced by light-absorbing filters. The fluorescent family contains seven different colored lamps. These colors are produced by precise blending of different fluorescent chemicals. In the case of the fluorescing of zinc silicate for example, the color produced is brilliant green while in the chemical zinc berryllium silicate the fluorescent color is yellow white.

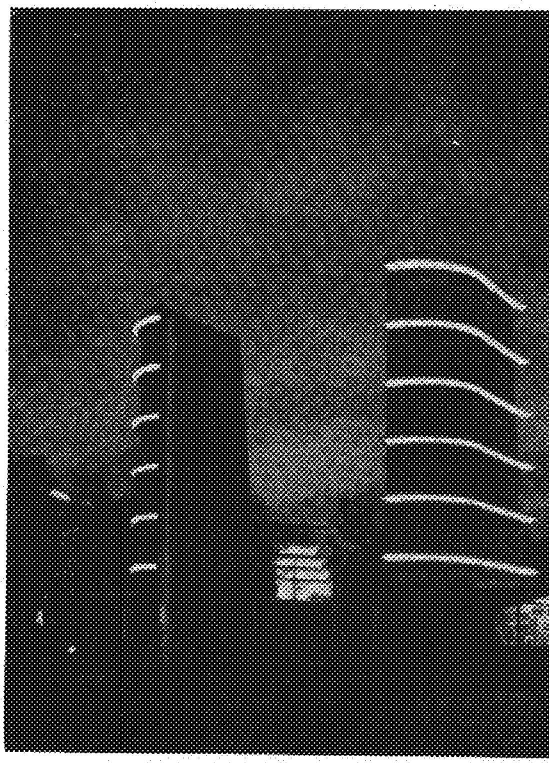
Artificial Daylight

It has always been the dream of lighting scientists to discover an efficient light source which would have the same spectral distribution as natural daylight. Now, this dream has been realized, because the daylight fluorescent lamp produces a color which is very similar to natural daylight. The bar graph, which shows a comparison of the spectral distribution of the daylight fluorescent lamp to the light of a clear day in June, will give an idea of the differences between natural light and fluorescent daylight. Now many artificial lighting installations which were inadequate with incandescent lamps can be successfully made with fluorescent lamps.

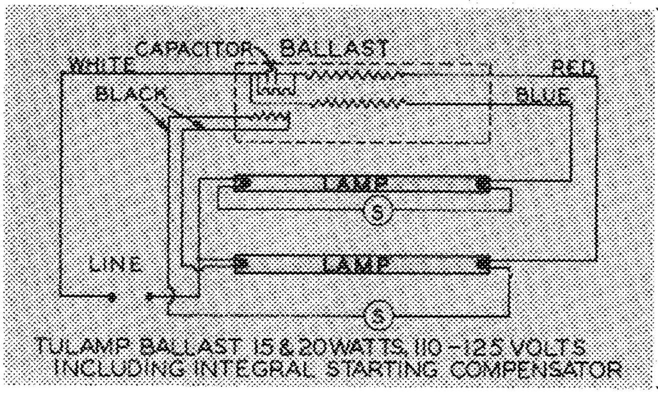
Fluorescent auxiliaries will have a characteristic transformer hum which originates from magnetic vibrations in the choke coil. Although the intensity of the hum will vary from time to time, it will be most noticeable when these vibrations resonate with supporting members in the frame or wiring channels. In most installations the noise due to hum will be insignificant, but in quiet environment such as libraries and private rooms, this hum may be disconcerting. However, mounting the auxiliary case in soft rubber or some similar non-rigid mountings will reduce noise due to hum to a minimum.

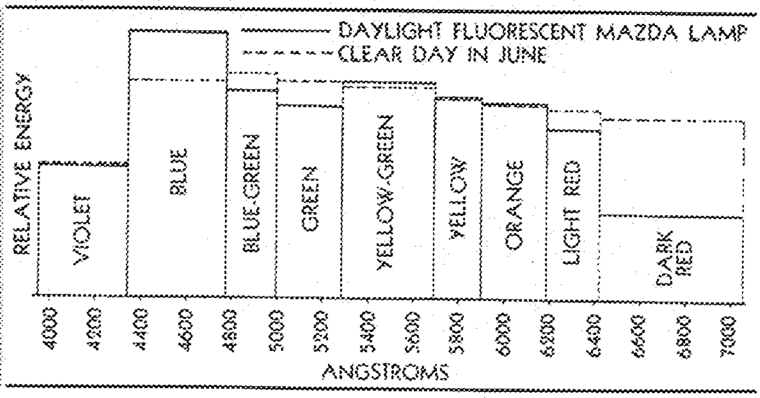
There is a slight tendency for fluorescent lamps to interfere with radio reception, especially if the receiving set is near the lamp. Three possible causes have been attributed to this interference and extensive experiments have already been performed to find ways of eliminating it. The three causes and corrections of radio interferences are: (1) radiation from the lamp which is eliminated by moving the receiving set at least four times the lamp length from the light source, or by shielding the antenna and grounding the set; (2) line feed back of radio frequency energy through the wiring circuit to the receiver which can be stopped by a regular type power filter; and (3) radiation from the wires carrying current to the lamp, which can be minimized by the use of triple fil-





Fluorescent lighting gives spectacular effects on these World's Fair exhibits.





ters installed at the lamps. Fortunately, little trouble due to radio interference has been experienced in practice.

When any lamp is burned on alternating current, the light output is not uniform because of cyclic variations in the current. The hot tungsten in incandescent lamps stores energy so that the variation in light output cannot be detected except with sensitive instruments. In case of a discharge lamp, the light drops to zero every half cycle because there is no medium in which energy can be stored. Most fluorescent powders have a persistence of glow or phosphorescence which tends to reduce the flicker effect. The eye, however, cannot detect this flicker unless rapidly moving objects are placed in lighted areas. The use of two-lamp auxiliaries or multiple phase circuits reduces flicker to a negligible degree.

Since its commercial introduction, the fluorescent lamp has won favor from the ordinary man on the street, not only for its new colors and appearance, but due to the fact that it was the most efficient light source available and that it was the nearest approach to cold light. He saw in its high efficiency a possible means of reducing lighting costs and cold light offered him greater personal comfort.

It must be remembered, however, that the cost of energy alone is only one of several factors that must be considered when lighting costs are determined. Since the lamp itself is a low wattage source, it takes more lamps to provide the recommended high illumination levels necessary for eyesight conservation. Add to this the cost of lamp auxiliaries and the relatively high cost of the present luminaries and it is apparent that these costs may overbalance any savings in energy costs. Fluorescent lighting is not always low cost lighting!

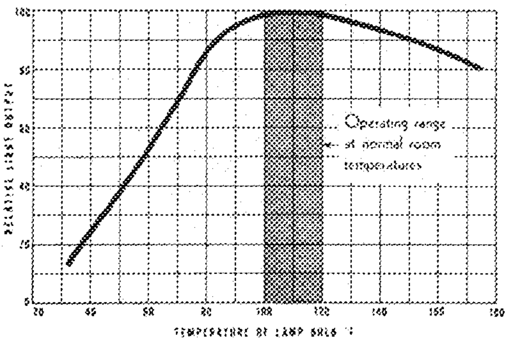
True economies in lighting can never be solved by cost alone since light quality and general satisfaction are also factors involved. The fluorescent lamp possesses advantages other than low cost energy consumption. For example, it offers many new colors at unheard-of efficiencies; it generates cool light with only about one-quarter the radiant energy of a similar amount of incandescent light; it provides a close approximation to daylight; and its shape is such that it can readily be concealed. These all are desirable characteristics, and they must be purchased at a premium especially if general illumination with fluorescent lamps is desired.

The general trend toward the applications of fluorescent lamps shows that the majority of over two million lamps already sold have been installed for the following lighting purposes: wall cases and showcases, show windows (small windows only), decorative merchandise displays, indoor directional signs, supplementary cove lighting, art museums (supplementary), industrial plants, night clubs, ball-rooms, theaters, bank cages and offices (supplementary), spotting and color discrimination (inspection).

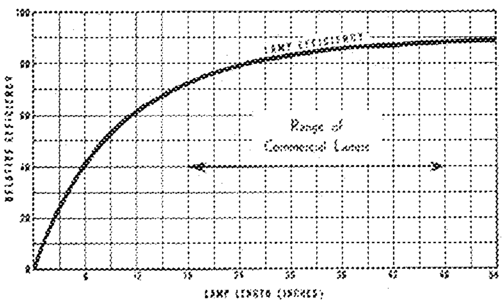
Upper left: Circuit diagram of two-lamp operation on a tulamp ballast.

Upper right: Spectral differences between natural daylight and fluorescent daylight.

Below: Effect of temperature on relative light output.

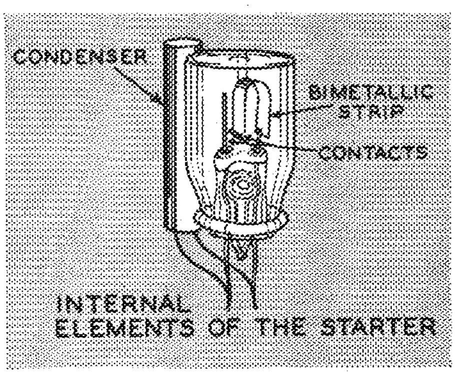


All diagrams courtesy General Electric



Above: Curve showing relationship between lamp length and efficiency.

Below: Internal elements of the starting switch.



Complete fluorescent installations are increasing at a rapid rate in offices, stores, and manufacturing plants. This increase is probably due to the fact that since the introduction of the fluorescent lamp, lamp and luminaire prices have been reduced approximately 50 per cent while lamp life has been increased 150 per cent and efficiencies have increased up to 51 per cent. The five-foot, 100-watt lamp, hardly on the market for more than a month should begin a trend toward totally indirect fluorescent lighting. Students, especially those in engineering, can use their ingenuity in devising fluorescent lamp fixtures for study purposes. Several electrical engineering students have been studying under fluorescent light for nearly a year with resulting improvements in light, sight and, consequently, grades.

The field of fluorescent lighting has grown with such rapidity that by 1943 the production is expected to be approximately ten million lamps per year. This figure is still only a few per cent of the 500,000,000 incandescent lamps sold annually, and it is logical to assume that the fluorescent lamp will supplement rather than replace the incandescent lamp.

Now that most major technical problems relative to the fluorescent lamp have been solved, more attention is being given to the problems which have resulted from two years of actually living with this new type of light. Through years of use, colors have been accepted as normal under incandescent light, but now the illuminating engineer must concern himself more with spectral study until time and use will automatically solve the color standard problem with fluorescent lamps.

With present-day research going at its usual rate the future of fluorescent type lamps looks very promising. Undoubtedly new colors, new sizes and shapes, and new efficiencies will follow, but in the meantime the public will have to become educated so that high illumination can be utilized in a practical, comfortable, and economical way. Lighting tables, designs, and fixtures will have to be approached differently—the important work is just beginning.

Supercharged Power

By Donald L. Drukey, Ch.E. '43

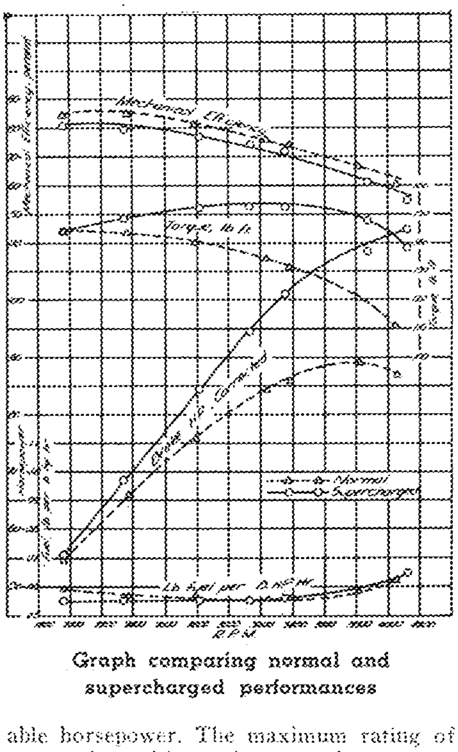
> In these articles, the Techno-Log's aim is to present to its readers complete coverage of research being carried on in the Institute.
>
> The Techno-Log welcomes your suggestions for this feature. If you know of any important or interesting research in your department, call our office, or drop in and see us.

DID you ever wonder what would happen if an ordinary gasoline engine were supercharged? If you did, one person who could relieve your mind is Professor B. J. Robertson. He and his associates borrowed an ordinary eighty-five horsepower Ford V-eight engine which had been adapted for marine use. They added a centrifugal supercharger and ran tests with and without the supercharger. The supercharger was a simple centrifugal blower hooked to the fan system with several V belts. With the aid of a Ford Motor Company expert, they adjusted the motor for peak performance. To determine such characteristics as developed horsepower, developed torque, engine speed, mechanical efficiency, and gasoline consumption, they ran a series of tests on the motor without supercharger. Then, the supercharger was put into operation, the engine readjusted, and the tests were repeated.

Stock Engines "Souped Up"

It must be remembered that the Ford engine is not designed for supercharging. It is a stock engine and cannot be expected to perform as well under the conditions of supercharging as would an engine which is especially designed for that purpose. No changes were made in the engine other than the addition of the supercharger and the substitution of "cold plugs" for the ordinary spark plugs. Theoretically, supercharging will increase the horsepower of any engine. The amount of increase, however, is dependent upon variables such as the efficiency of spark plugs, ignition coil, timing, cooling system, and the quality of fuel. In the experiments the variables were kept as constant as possible. It is logical to expect then, that even better results could have been expected with special apparatus.

The results of the experiments are shown in the accompanying graph. As was expected the supercharger increased the avail-



Graph comparing normal and supercharged performances

able horsepower. The maximum rating of the engine without the supercharger was 89 hp. which was developed at 3800 r.p.m. The supercharged engine, however, developed 106.5 hp. at the same speed and developed a greater horsepower at higher speeds. The highest speed at which the engine was tested was 4200 r.p.m. At this speed the engine developed 112.2 hp. with every indication that the number of horsepower developed would increase for at least slightly greater speeds. The Professor did not carry the tests beyond this point, however, for he feared that the engine and instruments might be damaged.

According to the present theory, the amount of fuel used per horsepower-hour would be expected to increase appreciably with supercharging. This was not the case in Professor Robertson's tests. He found that when the supercharged engine was running at slow speeds it actually used less fuel per horsepower-hour. It must be understood that this does not mean less fuel was used during any given time. This seeming contradiction is caused by the fact that the engine was developing more horsepower when supercharged. The low fuel consumption held until a speed of 3100 r.p.m. was reached. Above this point, the fuel consumption per horsepower-hour became slightly greater with the supercharged engine. Professor Robertson says that the lower fuel consumption is caused by the fact that the gas and air are better mixed, and more thoroughly vaporized in the supercharged engine.

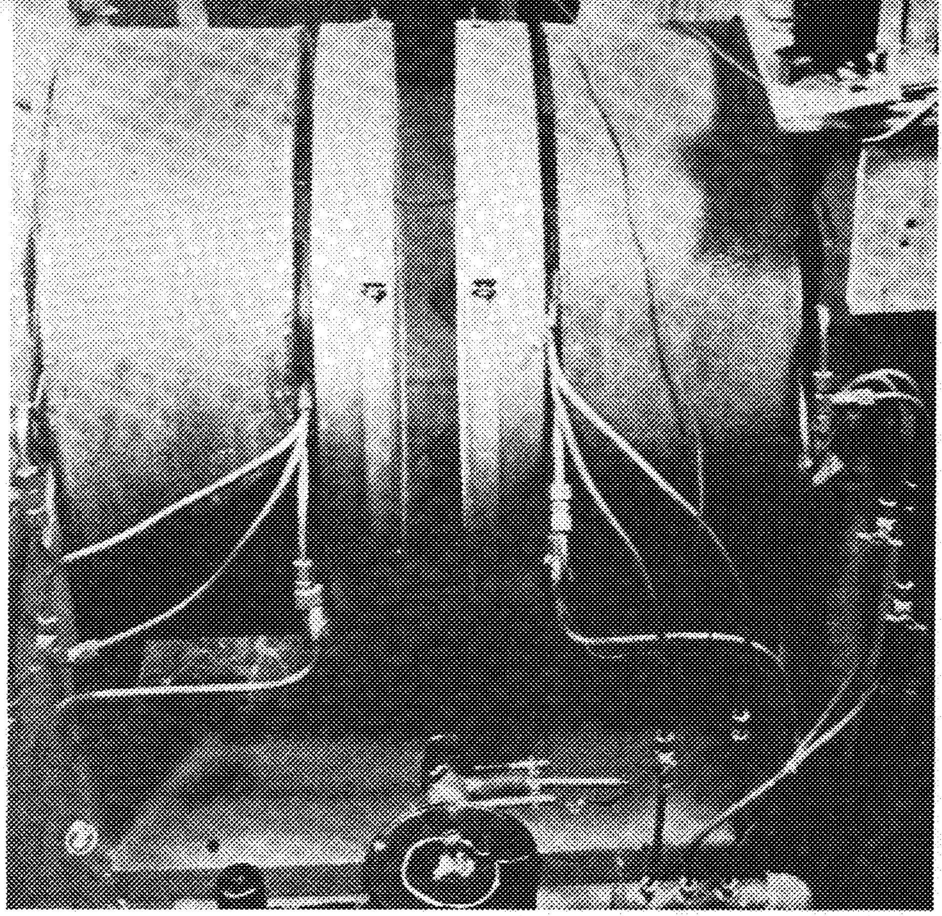
Efficiency Lowered

The other two observed characteristics, mechanical efficiency and developed torque, were not so spectacular in their variations. As was predicted, the mechanical efficiency was slightly lower when the engine was supercharged than when it was not. The difference was quite consistent and the two curves have nearly the same shape. The torque, a function of the horsepower, was naturally increased.

As has been previously stated, the experimenters found that ordinary spark plugs became too hot to perform well—in fact, the glaze on the porcelain was melted. To remedy this they installed standard ten millimeter "cold plugs" in special adapters.

A 67 octane fuel was burned in the supercharged engine for speeds up to 2400 r.p.m. A 78 octane fuel was found necessary at higher speeds.

Professor Robertson does not ordinarily advise the use of a supercharger on a stock engine not designed for the apparatus, on the grounds that it will probably shorten the life of the engine. However, special conditions might warrant its use. The engine on which the tests were run—now supercharged—has been put back into service as a marine power-plant, but no data is yet available as to its performance.



Looking between the pole faces of the two-ton electro magnet. When in use the spectrometer tube is suspended between the pole faces.

HE ISOLATES

Dr. Nie
Mass S

By John Lambert

EVERY month thousands of hours of significant research are conducted at the University of Minnesota, but only occasionally is a discovery made which has popular appeal. News of such discoveries is snapped up by newspapers and periodicals and flashed across the nation in a usually distorted and spectacular manner. Every good scientist is human and enjoys having his work popularized, but when the newspaper reporters make irrational predictions, the scientist as well as his entire profession is bound to suffer from it.

Such was the case last spring. Dr. Alfred O. Nier, working with the Messrs. Booth, Dunning, and Grosse of Columbia, made possible the confirmation of the Bohr theory prediction on Uranium isotope 235. The old "Uranium power" story was revived—speculations followed upon prophecies in a way reminiscent of H. G. Wells and Superman—and finally climaxed in a fantastic story in the *Post*.

It is interesting to study the apparatus which was guilty of starting this journalistic chain-reaction—the mass spectrometer in Dr. Nier's laboratory.

Operating Principle

Since the isotopic nature of elements was discovered by J. J. Thompson in 1912, physicists have worked constantly to improve the technique of determining masses and relative abundance of isotopes. In general, all of the atoms of a given element do not have the same mass. This is because their atomic nuclei contain different numbers of neutrons. For example, the nuclei of Neon atoms contain 10 protons and either 10, 11, or 12 neutrons, giving rise to the three isotopes of Neon: Ne^{20}, Ne^{21}, and Ne^{22}. Therefore, although primary positive ions formed from these different isotopes have the same charge (governed by the number of protons), they have different masses (governed by the number of protons and neutrons).

The operating principle of the mass spectrometer is based on the fact that these ions, because of their charge, follow curved paths when moving in a transverse magnetic field.

The radius of curvature of the path is given by the equation:

$$r^2 = 20750 \frac{mV}{eB^2} \text{ centimeters squared}$$

where m/e is atomic mass units per electronic charge, V is the energy of the ions in electron volts, and B is the strength of the magnetic field in gausses.

In this instrument, built with a constant r, B is kept constant; and V is adjusted to bring the isotopes with different m/e values into focus.

A ¾-in. copper tube, bent into a semicircle of radius r equal to 5 in., is used for the analyzer. This tube is enclosed in a 1½-inch sealed Pyrex glass tube containing the ion source at one end and the target at the other.

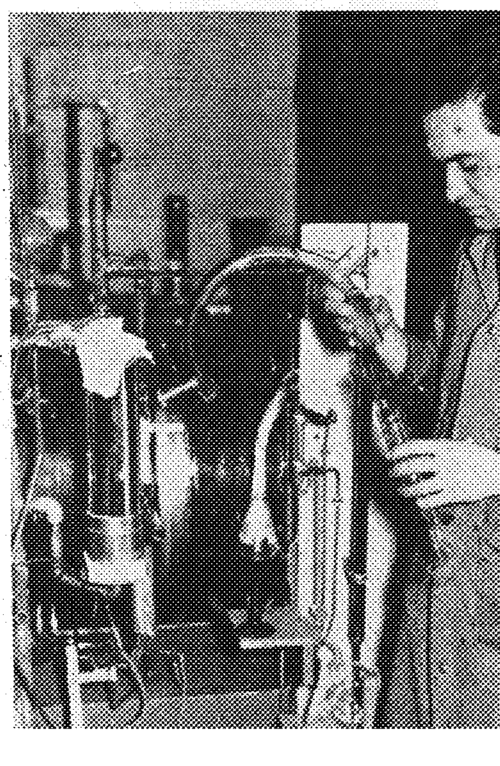
The ion source is a chamber into which the vapor of the material to be analyzed is fed through a capillary leak. Across this chamber passes a stream of electrons from a hot filament. When the electrons collide with molecules of the vapor, they dislodge electrons, leaving the molecules negatively deficient. These deficient molecules are the positive ions focused in the analyzer. The ions, given a controlled acceleration by a series of electrodes, pass through an 8x0.2 mm. slit into the curved copper analyzer tube. The pressure in the tube is maintained at about 10^{-6} mm. of mercury so that the ribbon of ions will not be diverted by collision with gas molecules. In the other end of the tube, 180° away from the first slit, the ions pass through another slit and strike a copper target. Here they retrieve electrons and thus cause an electric current to flow which is proportional to the number of ions.

Guiding the Ions

In order to make the ions follow this curved path, the tube is placed between the pole faces of a two-ton electromagnet. The pole faces are 18 inches in diameter, and a magnetic field of 5000 lines per square centimeter is produced across the two-inch air-gap between them.

Because of its intense magnetic field the resolving power of this spectrometer has been made extremely high without a

Dr. Nier holding the spectrometer tube.



ISOTOPES

...nd His ...trometer

Electrical Engineering '41

sacrifice of sensitivity. The ribbon of ions which passes around the tube is only 0.2 mm. thick, and the 0.3 mm. slit at the target end of the tube is ample for admitting all of the ions in the desired beam. The ions of other isotopes strike the walls and filter vanes of the copper tube and are grounded to prevent their interference with the measurement of the focused isotope.

Design Problems

It is interesting to note the ways that Dr. Nier dealt with some of the problems that faced him when he designed the spectrometer. The beam is very thin and the number of ions is extremely small, so the magnitude of the ion currents produced is on the order of 10^{-14} to 10^{-11} amperes. The accurate measurement of these currents is made possible by the use of a special electrometer vacuum tube developed in the General Electric and the Bell Telephone laboratories. This tube has an almost infinite inter-electrode resistance—which is accomplished by isolation of the grid cap, careful arrangement of the elements, and by use of a plate supply of only 4 volts—far below the ionization potential of any gas which might be present in the tube. From grid to cathode is connected a resistor of about 10^{10} ohms, and through this resistor flows the ion current from the spectrometer. It may be seen that a current of 10^{-11} amperes will cause an IR-drop of 0.1 volt across this resistor, providing the grid-cathode resistance of the tube is many times larger than 10^{10} ohms. The amplification factor of the tube is about 0.6 (compared to from 30 to 150 for ordinary radio tubes), and its plate current is either read on a galvanometer or balanced out in a bridge circuit. Since the plate current is a function of the grid voltage, the magnitude of the ion current can be determined from the plate current balance conditions.

Since accuracy is decreased by allowing more than one variable to change for the different e/m values of ions, it is important that the tolerances on all other apparatus conditions be close. Naturally, an apparatus of this kind contains a great many variables, and the necessity for holding these constant presented several engineering problems.

The electromagnet is energized by a 5-kilowatt direct-current generator. The generator output voltage appears across a balancing circuit and is held constant by a special vacuum tube compensator. A small off-balance voltage is amplified many hundreds of times and fed to the grid of the compensator tube, which tube tends to force the voltage back and beyond balance condition. In this way the output is held constant to within 0.01 per cent, giving a tolerance of *one-half line per square centimeter* in the 5000-gauss field.

We may see how important this is from the fact that the 0.2 mm. ribbon of ions is diverted through 180° in traveling 15.708 inches and must then pass through a 0.3 mm. slit. The ions are mutually repulsive and therefore the ribbon is slightly thicker than 0.2 mm. at the target-end of the tube. Thus it is seen that field variations cannot be allowed to cause a change in the course of the ions even by as much as 0.05 millimeters in 16 inches! With apparatus of this geometry and field strength, the ions require approximately 1200 volts of energy to be brought into focus. This voltage appears between the accelerating plates near the ion source so that when the ions pass through the slit into the analyzer tube they have all of the energy they will require. This voltage is supplied by a full-wave power supply and held constant at a given setting by means of an electronic stabilizer.

Apparatus Improvements

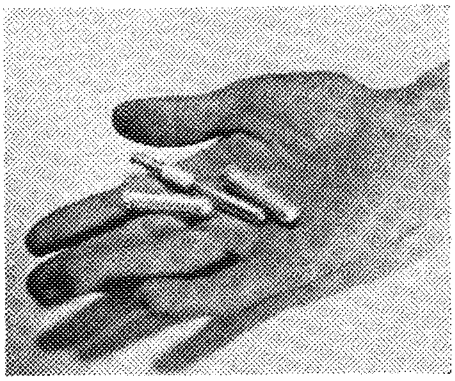
At present two battery eliminators are being built. These will replace the storage cells now used to supply the filament and to accelerate the ionizing electrons. Batteries are impractical, and Dr. Nier reports that the electronic stabilizers or "vacuum-tube filters" give an output which is practically ripple-free. These stabilizers are so efficient that even when they are used to smoothe out the output of a full-wave rectifier they require very little intervening capacity-inductance filter.

The curved analyzer tube of the spectrometer is enclosed by electric furnaces for outgassing and also for holding the temperature constant when certain vapors are analyzed. When lead iodide is analyzed, a particle of it is placed in the tube and vaporized by an electric furnace. The temperature of this furnace is critical and is held constant by means of a thyratron control circuit. It is seen that electron tubes form a major part of the spectrometer apparatus.

Spectrometers in general are of three types according to their method of indicating results. For measuring isotopic weights a photographic plate is used; for measuring relative abundance the electrometer tube circuit described above is used; for studying properties of the isotope itself a sample of it is removed from the target.

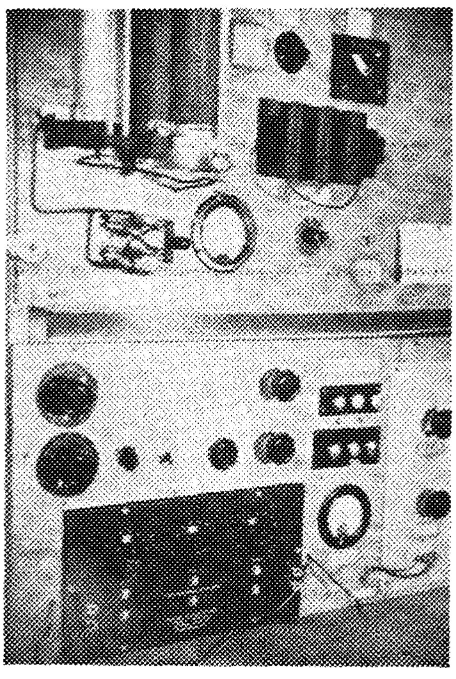
The most accurate method of determining the weights of isotopes is to measure their relative deflections in a magnetic field and refer them to a given index (O^{16}=16.00000 now generally used). This is accomplished in a photographic spectrometer or "spectrograph", in which a photographic plate is placed so that the isotopes which are present in the vapor will darken the plate at the positions where they strike it. The plate is developed, and the distances between these dark bands and the reference line are measured. From this the atomic weights of the isotopes can be determined to within 0.002 per cent. The relative darkness of the bands is a measure of the relative abundance of the isotopes. Measurement of the intensities of these dark spaces was formerly the method for determining isotopic abundances, but this method was tedious and involved many errors, so it has been abandoned in favor of the electrical measurement of ion currents.

Dr. Nier's current-measuring spectrometer is a very sensitive instrument. In fact, with regard to apparently "non-existant" isotopes such as those of arsenic,



Three lead samples as they are received by the Physicist for analysis. The tube on the right contains lead from a Uraninite sample over two billion years old!

Central control panel of the mass spectrometer in Dr. Nier's laboratory.



Dr. Nier will not be unscientific enough to say that they do not exist—he merely says that if As^{77} exists, it is less than 1 part in 100,000 of As^{75}, and that if As^{76} exists, it is less than 1 part in 50,000 of As^{75}—which gives a key to the accuracy of the instrument.

Ion Sharpshooting

The ions which strike the target retrieve electrons and become stable molecules, thus leaving a minute deposit of the material on the target. If a specimen of the isotope is wanted, the Pyrex tube can be broken open and the material removed from the target.

This arrangement was used by Dr. Nier in obtaining the specimen of U^{235} which made possible the confirmation of the Bohr theory prediction on this isotope. Dr. K. H. Kingdon and H. C. Pollock of the General Electric laboratories effected similar concentrations. This process is accurate but very slow, and it takes several days to collect a 10^{-8}-gram sample of a rare isotope like U^{235}.

In interpreting their results, the operators of the current-measuring spectrometer must really be on their toes. Many errors could creep in if they were not checked carefully. When carbon dioxide is analyzed, for instance, and V is adjusted to bring an atomic mass m of 45 into focus, there will be two different molecular ions measured: $(C^{12}O^{16}O^{17})+$ and $(C^{13}O^{16}O^{16})+$. In this case the fact that O^{17} occurs 1 part in 2500 of O^{16} is used to determine the quantity of each ion present.

In searching for the Beryllium isotope of mass 8, $BeCl_2$ vapor was used, and the 78 position $(Be^{8}Cl^{35}Cl^{35})+$ as well as the 43 position $(Be^{8}Cl^{35})+$ had to be investigated. This was because there was the possibility that either one of the above ions might be formed.

This spectrometer is superior to many others of its type in that it has no wax or grease seals, and can therefore be baked and thoroughly outgassed before use. This leaves a trace of water vapor, CO, and CO_2; but no other residual gases can be detected. Thus the danger of mistaking a residual gas for a rare isotope is almost absent. The possibility of forming hydrides is negligible because of the absence of grease vapor and the extremely low pressure of the water vapor present.

Sometimes a small amount of mercury vapor from the diffusion pumps was left in the tube. In measuring the lead isotopes then, the Pb^{204} current would be too great by an amount equal to the Hg^{204} current. This was dealt with by measuring the Hg^{202} current and figuring the Hg^{204} current from the known Hg^{202}/Hg^{204} abundance ratio.

Age Analysis

Dr. Nier is now investigating the age of minerals with the aid of the mass spectrometer. It has long been known that uranium disintegrates to form two stable lead isotopes, Pb^{206} and Pb^{207}; and that the natural disintegration of thorium results in the ultimate formation of Pb^{208}. If, then, the relative amounts of uranium, thorium, and lead in a given mineral are measured, along with the amount of common lead impurity, the age of the mineral can be determined from these data and the decay constants of uranium and thorium. These decay constants have been accurately determined and are measures of the amount of lead that will be formed when a radioactive element has been allowed to decay for a certain length of time.

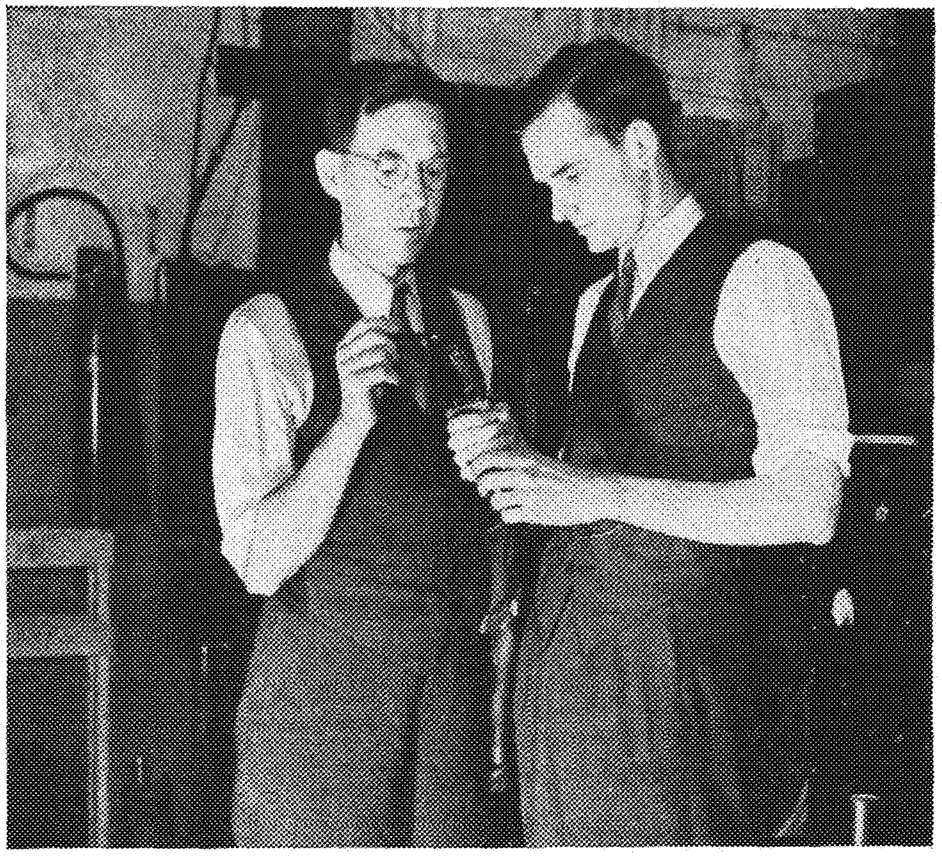
A crystal of the mineral to be analyzed is chosen and carefully examined by a mineralogist to determine whether it has been altered since it was first formed. If it is in good condition, the chemist runs a quantitative analysis on it to determine its relative content of thorium, uranium, and lead. The lead is then compounded with especially purified iodine to give lead iodide, which is vaporized and admitted to the spectrometer tube for analysis. The spectrometer determines the relative abundances of Pb^{204}, Pb^{206}, Pb^{207} and Pb^{208}. From the amount of Pb^{204} and the relative abundance of the Pb isotopes, the amount of common lead impurity in the decay products can be figured. This must be subtracted since it represents lead which was present when the crystal was formed. The net result is the amount of the lead isotopes which have been formed by normal radioactive disintegration of uranium and thorium.

Of course uranium and thorium are not always both present, but the age of the mineral can be determined from either of them. If they are both present in the mineral, they can be treated independently, giving results which can be checked against each other.

Unaltered Samples

Many difficulties have been met in these experiments, mainly with the failure to find specimens which have not been altered since their formation. Ordinarily when a mineral is altered it loses uranium. These things were carefully checked, and Dr. Nier indicates the limits of error in all of his results. A number of pitchblende samples from Africa have ages a little over 600,000,000 years; a sample of cleveite from Norway is a little more than a billion years old; while a sample of cleveite from Canada is about 900,000,000 years old. The real old timers come from northern Canada—a pitchblende sample from the Northwest Territory is about 1,400,000,000 years old, and a uraninite sample from Huron Claim in Manitoba is over two billion years old! This is interesting for the fact that it is older than the present assumed *age of the earth*. What is more disturbing to the men over in the Physics Department is the fact that any alteration which might have taken place would tend to make the uraninite appear *younger* than it actually is!

We will be hearing more from these experiments in the future.



Dr. K. H. Kingdon and H. C. Pollock of the General Electric laboratories whose work on U-235 paralleled that of Dr. Nier.

NEWS FROM THE TECH SOCIETIES

A. S. Ag. E.

The A.S.Ag.E. held an evening meeting at the Union on November 6. Mr. V. L. Fixen, instructor in contracts and specifications, spoke on various engineering problems.

Bill Johnson, president of the student branch, and John McEvoy, secretary-treasurer, reported on a few highlights of the national convention of the A.S.Ag.E., held at the State College of Pennsylvania from June 17-21, 1940. They hitch-hiked their way to the convention, leaving Minneapolis on June 15. Students from 21 states and Saskatchewan attended the meetings of the parent organization.

The annual faculty-student banquet of the A.S.Ag.E. was given by the agricultural engineering faculty on October 17 at the Union. Students were guests of the faculty. Mr. A. J. Schwantes, new head of the division, gave a short talk, and Mr. J. E. Shumway, instructor in gas engines, showed colored motion pictures of his last summer's trip through the Rockies. The group then adjourned to the bowling alleys, where the students trimmed the faculty.

I. Ae. S.

"Blind Flying", was the subject of the talk given by Harold Kittleson, pilot in charge of the Link trainer at Northwest Airlines, to members of the I.Ae.S. at their meeting on November 8. About 100 persons attended the meeting which was held in the chemistry auditorium.

A. I. E. E.

Approximately 35 members of the A.I.E.E. made an inspection trip of the Electrical Machinery Company of Minneapolis, on the afternoon of November 29. The trip was led by Mr. John H. Kuhlman, associate professor of electric power, and Mr. Robert Saunders.

Mines Society

Members of the School of Mines Society heard Mr. Donald M. Davidson relate his experiences as a geologist, in the copper country of Northern Rhodesia, at their meeting on November 28. At the end of his talk Mr. Davidson showed enlargements of photographs he has taken in Africa.

Dick Mollison, president of the Society, appointed Bob Larson as chairman of the committee in charge of the Miner's Shindig. He will be assisted by Ted Berquist, Roy Johnson and Bill McNally.

A. S. M. E.

Wednesday, November twenty-seventh, was the night of the annual bean feed held in the Minnesota Union. Nearly 100 loyal M.E.'s, representatives from every class, were in attendance. The highlight of the program was the awarding of a mechanical engineer's handbook to Lloyd Forrest, senior, for his work in the membership drive. As of November there were 93 active members. The remainder of the program consisted of colorful movies of Sun Valley, Idaho.

Committees appointed for the present year by the president, Gordon Ersted, include: Program Committee—Bob Peterson, Art Brickman, Jim Mitchell, Brad Hultgren, and John Moorehead; Inspection and Social—Jack Douglas and Bob Lindquist; Publicity—Warren Richard, Ray Anderson, Ed Bauser, and Lloyd Amacher. The next meeting will be held at the beginning of winter quarter.

A. I. M. E.

Dr. A. O. C. Nier spoke to members of the A.I.M.E. on "U-235" at a luncheon meeting held in the Union on November 28. Leo Brom and Reuben Olson were in charge of arrangements for the meeting.

M. S. C. S.

The Minnesota Student Chemical Society held it's last meeting of the quarter on Tuesday, November 26. Dr. Bryce Crawford, the newest addition to the physical chemistry staff, gave a very interesting talk on molecular structure. Plans for the future were discussed in a business meeting following the talk.

E. E. Elect Chairman

Senior electrical engineers elected Charles Scott as chairman of the biennial electrical engineering show. Scott defeated John F. Storm, after the two candidates had previously won a nominating election. Both candidates are members of Kappa Eta Kappa, electrical engineering fraternity. The electrical show will be held sometime during spring quarter.

Koepke Directs Training Program

At the request of the United States Office of Education the University of Minnesota will soon begin to teach courses designed to train men as quickly as possible for active participation in various defense industries. The courses will be open only to men who have already completed a stated minimum of basic training in engineering (in some cases as much as three years of college).

Prof. C. A. Koepke, administrative assistant in the Institute of Technology, will be the executive head of the training program, and administrator for the University. Professor Koepke stated that the training is intended only for persons who have dropped out of school after completing their basic work, or who are unable to finish their course because of financial difficulties.

The courses offered are of a highly technical nature. Courses in machine design, optical engineering, engineering drawing, metallurgy and metallography, and industrial engineering have already been prepared. All tuition and fees will be paid for by the federal government. The student must provide his own living expenses and books.

Courses will be offered in both day school and night school. Day school students will receive about 12 weeks of training, while the night school training will take about 24 weeks. The groups will probably be limited in number. The first course is expected to start sometime this week.

Jobs are not guaranteed, but the program is designed to comply with the requests of industry and the civil service. Professor Koepke said that the men enrolled in these courses will not be enlisted in the army, nor will they be paid for attending the courses. There is still some question as to whether credit will be given for the course, but it is definite that some type of certificate will be issued.

Dean Lind Travels

Dean S. C. Lind was the official delegate of the Institute of Technology at the meeting of the Land Grant Colleges Association. The meeting was held in Chicago, November 11 and 12. Dean Lind went to Cambridge, Mass., after this meeting, where he addressed the Northeastern section of the American Chemical Society on November 14.

Saving Our Resources

A NEW PROCESS OF ORE CONCENTRATION

By Ralph Hill, Ch.E. '41

All cuts courtesy Oliver Iron Mining Co.

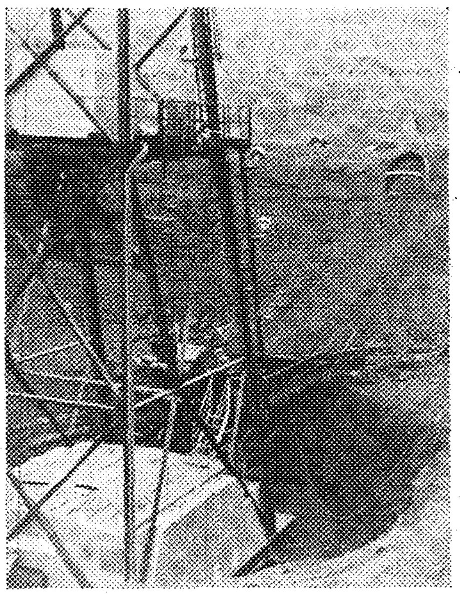
SINCE the inauguration of the new National Defense Program, much attention has been focused on the industries which produce ships, airplanes, and other war materials. The public has been prone to accept as a matter of fact the existence of the basic industries which supply raw materials for the building of a large war machine. Most important of the basic industries is the manufacture of iron and steel, for which iron ore is obviously the most important natural commodity. Most of the residents of Minnesota know very little about one of the major industries in our state, the mining of iron ore.

Nearly 90% of all American ore comes from the Mesaba, Vermilion and Cuyuna iron ranges of Minnesota. The Mesaba Range shall be considered here.

Mining in the Mesaba Range has grown rapidly since the discovery of the red Hematite ore by the Merrit brothers, about whom the book *Seven Iron Men* was written. Two general methods of mining prevail; open pit, and underground or shaft mining. The method of mining a known body of ore is determined largely by the ratio of the overburden to the size of the ore formation and quality of the ore. Where a relatively small amount of overburden covers a large ore body, the overburden is stripped off, and open pit operations are used. On the other hand, a large body of high grade ore at a considerable depth would be mined underground.

Location of ore bodies and the determination of their magnitude is accomplished by drill crews which drive diamond drills into the ground by means of a drill rig. These drills remove a core which may be analyzed to determine the composition of the ore in the body.

One of the tower excavators of the Spruce Mine, at Eveleth, Minnesota. The tower is erected over a vertical shaft connected to a conveying system which takes the ore out of the mine.

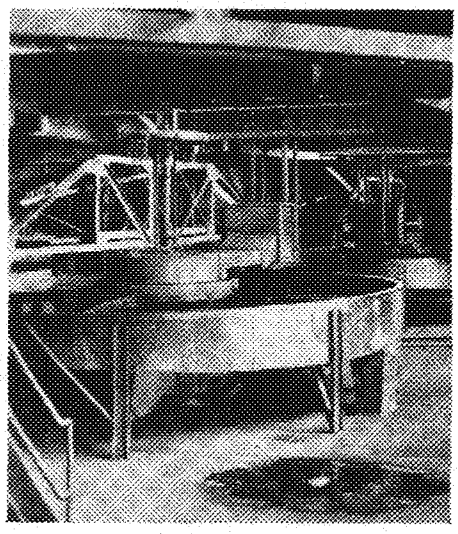


Open Pit Mining

The Mesaba Mountain Mine in Virginia, is a typical example of open pit mining operations. Operated by the U. S. Steel Corporation and leased from the State of Minnesota, this mine produced 6½ million tons of ore in 1929, a record for the largest tonnage ever taken from a single mine. Covering an area of 132 acres, the mine is about 300 feet deep. Trains, with strings of empty ore cars attached, descend into the pit on tracks which wind around the outer edge of the pit. The ore, loosened with dynamite and blasting powder, is loaded into cars with huge electric shovels which are mounted on rails. The ore cars used are constructed so that their 60-ton load may be dumped at either side. Six or seven of these cars constitute what is known as a "drag." When the cars are full, the "drag" is pulled to the surface and then to the nearby crushing plant, where the ore is reduced to a small size before it is shipped to the Lake Superior ore docks.

In the crusher, ore from one part of the pit is dumped into an assigned bin and kept separate from other ores. After passing through the crusher, the ore falls into waiting railroad cars of 75-ton capacity, which are made up in long strings of 100 or more cars, for shipment to the docks. Before the cars are moved the ore is sampled by sample boys, and the samples are sent to the company laboratory for analysis. The ore is analyzed for iron, silicon, sulfur, manganese and phosphorous. It is of great importance that the relative amount of sulfur and phosphorous in the ore are small, since these impurities give steel undesirable properties.

Before the ore train reaches the docks, the results of this analysis are forwarded to the crew at a switching point. Here the ore cars are switched to their respective docks, according to the analysis of the ore in them. The analysis also goes with the ore to the steel mills where it is used to determine the composition of the blast furnace charge.



One of the bowl classifiers at the Troutlake Washing Plant, Coleraine, Minnesota.

A good example of underground mining is the Spruce Mine in Eveleth. This mine consists of a large shaft which descends to the various levels at which the ore is mined. In the various tunnels, ore is loaded onto small rail cars which are brought to the shaft. Here they run onto an elevator which raises them to the surface. The cars are run out on a trestle and the ore is dumped into railroad cars below or in storage piles. Underground mining is carried on throughout the year whereas open pit mining is more or less seasonal. Special problems of ventilation and safety which are non-existent in open-pit mines are encountered in the shaft mines.

New Mining Methods

In the past few years, several novel methods of open-pit mining have made their appearance on the Mesaba Range. One mine in Eveleth uses a system of trucks and drag buckets to gather the ore. The cables of the buckets are operated from a central tower, and the ore is brought by truck and bucket to a hopper under this tower. From the hopper, the ore drops onto a belt conveyor, which is partly underground and partly on the surface. This conveyor brings the ore out of the mine. In some mines large 20-ton trucks have been used to carry the ore from the pit. The "Iron Horse," however, is still the "Big Push" in open-pit mining.

Of late, there has been much speculation as to the amount of high grade ore left in Minnesota, and the possible utilization of low grade ores for the production of iron and steel. At present there is still a large supply of high grade ore on the range, but there is also a great deal of non-marketable Hematite ore, according to the University Mines Experiment Station. This includes all Hematite ores from 24 to 50 per cent iron. The Mesaba Range produces practically all Hematite ore, much of it stored in large stock piles, which dot the landscape. Some of these piles contain low grade ore which has been mined in order to get at bodies of higher grade, marketable ore.

As a result of experiments carried out by the Mines Experiment Station, a new process for the concentration of low grade Hematite ore has recently been patented by E. W. Davis, Director of the Station, and patent rights assigned to the University of Minnesota. The process involves the reduction of non-marketable Hematite to Magnetite, which is then separated from gange material by means of magnetic concentrators. The experiments were carried out from 1930 to 1934, when a semi-commercial pilot plant was erected on the Mesaba Range at Coulee, about 15 miles west of Hibbing.

Ore Concentration

The first step of the process takes place in a vertical furnace, in which the ore is introduced at the top and gradually works down, but subjected to heat and a reducing atmosphere, which effect the conversion of the red Hematite to the black Magnetite. Hot gases from a combustion chamber are introduced near the top of the furnace and pass upward through the ore mass. These gases give up their heat, so that the ore is at a temperature around 750 degrees F. when it passes down from the heating zone. A reducer gas is introduced near the bottom of the furnace, and also passes up through the heated ore. The gas used contains about 48% hydrogen and 40% carbon monoxide, both of which are good reducing agents. This treatment takes out about one-ninth of the oxygen from the ore, and results in a magnetic product. The ore which passes out at the bottom of the furnace is then run through the concentrators, where it is separated from the gange material, by making use of its magnetic properties.

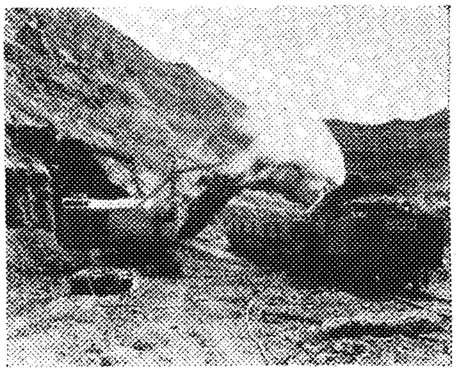
Two general types of concentrators are used to separate the Magnetite from the gange. For coarse materials, a drum type concentrator has proved to be very satisfactory. A horizontal steel drum, fixed so that it rotates on a central shaft, revolves slowly around a group of stationary electromagnets. These magnets are arranged close to the inside circumference of the drum in such a way that a magnetic field is produced a little more than half way around the drum. The magnetic field begins at a point at the top of the drum, where the feed is and extends around in the direction of rotation to a point a little past the bottom of the drum, where the concentrated Magnetite falls off, due to the termination of the magnetic field. The drum rotates half immersed in water, which serves as a wash. The reduced ore is fed onto the outside periphery of the drum at the top, and as the drum rotates, the gange material is washed off when it comes in contact with the water, while the Magnetite is held on the surface of the drum by the magnetic attraction of the electromagnets, until it reaches a point where the magnetic field ends and falls off. The gange material settles in one section of the wash trough, and the Magnetite in a different section. The concentrated Magnetite is now of a good commercial grade.

Another type of concentrator gives a greater capacity with finer materials. It consists essentially of a continuous belt moving horizontally between two stationary end pulleys. Between the top and bottom portions of the belt, are arranged a group of electromagnets, so as to create a magnetic field at the bottom portion of the belt. At the end where the belt passes from the top to the bottom of the pulley, the feed is introduced, so that the Magnetite is held on the underside of the belt which is moving away from the feed end. Since this portion of the belt is immersed in water, the non-magnetic material is washed off the belt and settles in a hopper near the feed end of the belt. The Magnetite is held on the undersurface of the belt by the magnetic field, and drops off at a point further on where the magnetic field ends.

The magnets are enclosed in a water-tight box. Feed is introduced in such a manner that the belt passes over it and picks up the magnetic portion of the material, brushing the gange into the first hopper.

Technically, and especially from a Metallurgical standpoint, the process, as developed, is sound. It would be commercially feasible on a large scale, providing that a cheap source of fuel were obtainable. On a commercial scale the number of units would be increased, rather than increasing the size of the separate units. The capacity of the present plant is about nine tons of Magnetic per hour. This Magnetite runs from about 61% to 65% iron. The possibility of constructing a pipe line to bring natural gas from the Oklahoma oil fields to the Iron Range has been considered, and steps have been taken in this direction in the past few years; if it does materialize, it would result in greater activity on the Mesaba Range. The natural gas would be used for heating the ore in the reducer, and some of it would be converted to carbon monoxide and hydrogen, to make up the reducer gas.

Credit for development of the process goes to John J. Craig, Charles V. Firth and Henry H. Wade, of the University Mines Experiment Station, who were engaged in the work.



Electric shovel used in open pit mining operations.

The Mesaba Mountain open pit mine at Virginia, Minnesota, which is 300 feet deep.

ALUMNI NOTES

Featuring In This Issue Institute Graduates

In Non-Technical University Positions

By Ward M. Hanson, Ch.E. '42

'30 Ray Higgins

High among Minnesota engineers who have made their mark in the world since leaving school, is personable Ray Higgins. *In* ten years Ray has acquired, largely by dint of his own efforts, (1) a job that he enjoys, (2) a $2,000,000 building to work in, and (3) a pretty secretary.

Back in 1930, while Ray was still a senior in chemical engineering, he accepted an offer to enter the training course given by the Goodrich Rubber Company. Fortunately for future Minnesotans (who at that time were lucky if they had donned their first pair of "longies") he applied for and obtained the job as manager of the old Minnesota Union. Today he manages the world's most beautiful, most luxurious, and most expensive college union.

Lest you think that his work is far removed from engineering, Ray will assure you that it is principally personnel work. And today, personnel work is considered by many to be a legitimate field of engineering. At any rate, Ray values his engineering training highly, and thinks that if he had to do it all over again he would probably take the combined engineering and business course.

Worthy of note are these timely Higgins' opinions: (1) Engineers should participate more in extra-curricular activities, and (2) Engineers are practical people, they have their feet on the ground!

'07 Roy S. Callaway

"Grew up in Minneapolis, went to school at the University of Minnesota, and after graduation returned to the University as purchasing agent"—that is the story of **Mr. Roy S. Callaway** who has become successful at home.

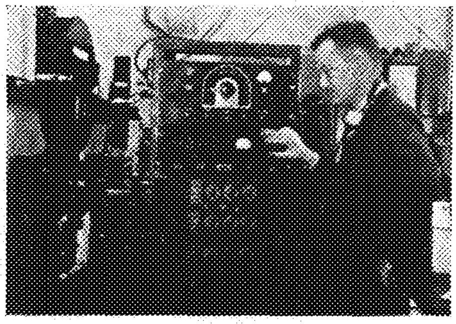
Mr. Roy S. Callaway has been intimately affiliated with the University since 1907 when he graduated from Minneapolis Central High School and enrolled in chemical engineering. Upon graduation in 1911 he went to Canada and was employed by the Canadian-Pacific Railway. Mr. Callaway then returned to Minnesota to work for the Carver County Sugar Co. of Chaska. In 1914 he moved over to the Lisbon Mill at La Crosse, Wisconsin and the following year (1915) returned to the University as storekeeper, a position which he held for two years.

The purchasing power of the University is centralized in Mr. Callaway's office and he has ample opportunity to make use of good judgment and common sense. The University facilities are made use of whenever it becomes economically feasible to test a proposed commercial article. Lack of University personnel is a handicap in this connection. Roy Callaway has watched the campus grow up, and with the campus his position has grown tremendously both in scope and flexibility.

'34 Everett Miller

Everett Miller, associate motion picture engineer for the Visual Education division of the University of Minnesota, first became interested in the motion picture industry as a junior in high school and has been making tremendous strides in his field ever since.

After attending college in Missouri a short while, Mr. Miller transferred to the University of Minnesota with advanced standing in 1929 in order to get training that he could not get in the Missouri schools.



Upon graduation in 1934 and during the next two years, Mr. Miller's work changed from that of operator to administrator. At the same time a centralization of university movie and public address equipment took place. The summer of 1937 saw him in Hollywood for four months where he studied methods of making motion pictures in anticipation of a Rockefeller grant to the university for research on the type of pictures suitable to certain college levels.

His first years at the university were not very prosperous for he had to earn his way by washing dishes, scrubbing floors, making beds, and doing almost every kind of odd job. However, better things were in store for him, and when the music auditorium was equipped with sound in 1932, he got a chance to work on the installation of the equipment. This lead to part-time work as a handy-man. By 1933 the job had developed into a full-time one.

His department purchased all the sound equipment for the Coffman Memorial Union Building within a period of two weeks. Even on such short notice, a marvelous job has been done and the new union building has the best system of its kind anywhere.

Mr. Miller believes there are distinct possibilities that motion pictures will be made exclusively in color, but this advancement is held back by excessive cost at the present. He feels however, that the recent development of three-dimensional films will become very popular.

'03

I. A. Rosok, E.E., and **Mrs. Rosok** vacationed in Cuba this summer. They drove to Key West, Florida from whence their car was transported to Havana, Cuba. There they attended the Rotary International Convention. They spent two more weeks leisurely driving around the island.

'40

C. Leland Batchelder is now with the Aluminum Company of America at Cleveland as a metallurgist.

Reuben Kravik, who lives at 3916 Benton street, Washington D. C., is now employed by the Rural Electrification Administration.

John A. Olsen has been employed by the American Steel Corporation of Cleveland, Ohio.

John W. Shannon, Ch.E., is employed by the Owens Glass Company of Streeter, Illinois.

Robert B. Hayden, Ch.E., is employed as a chemical engineer for the du Pont Company of Wilmington, Delaware.

(Continued on Page 68)

ALUMNI NOTES CONTINUED

'30

Bruce Strain, Ch.E., is on the staff of the Procter and Gamble Company of Cincinnati. His work is in the process development of soap. Mr. Strain is residing in the beautiful city of Wyoming, Ohio.

'34

Marian W. Sedin, Ch., '40 Ph.D., and **Albert H. Bushey** '32 (Wittenberg College), '40 Ph.D., were married last June. Mr. Bushey who held a chemistry assistantship, has been employed by the Aluminum Company of New Kensington, Pennsylvania.

Charles T. Healy, Mines, is employed as district manager for the Minneapolis Honeywell Regulator Company in New Orleans, Louisiana. Mr. Healy writes that the New Orleans climate is not bad at all after you get used to it although humidities of 85 and 90 per cent seem unbearable at first. He has found living conditions less expensive and business easier to transact than in the North.

Jennings F. Johnson, E.E., and Freda Millard of Minneapolis were married November 9, in Minneapolis. Mr. Johnson is a member of Kappa Eta Kappa fraternity and is employed by the Northern States Power Co. as a rate engineer.

Theodore B. Linstedt, Mines, who was formerly employed by John Deere Tractor Company of Waterloo, Iowa, is now employed by the International Harvester Truck Plant in Fort Wayne, Indiana. Mr. Linstedt reports he is not yet involved matrimonially.

'38

Wesley A. Coulter Jr., Aero, an aeronautical engineer at the Langley Memorial Aeronautical Laboratory, Langley Field, Virginia, died September 21, from injuries received in an accident at Hampton, Virginia.

An outstanding man on the University Rifle Team for three years, Wesley won many honors and represented the University at Camp Perry in 1938.

After receiving his degree as Aeronautical Engineer, he worked on a Master's degree under Prof. Akerman and Prof. Piccard. After leaving the University, Mr. Coulter became a junior engineer at Langley Field. He was mentioned along with his instructors in "Who's Who in Aviation."

Mr. Coulter is survived by his parents, Mr. and Mrs. W. A. Coulter, and a sister, Alberta, who reside in Minneapolis, Minnesota.

Harold William Cromer, Ch.E., was recently married to Helen Hanlin. They will be residing at 206 Main Street, Lawrenceberg, Indiana. Mrs. Cromer was formerly a student at Marylhurst College in Oswego, Oregon.

'40

Mr. Louis S. Parnteau and his wife are residing in Chicago where Mr. Parenteau is a chemist for Seagrams.

Mr. John Alfren Olsen has recently become engaged to Miss Mary Louise Wilson of Alpha Chi Omega sorority.

R. M. Nordby, E.E., is now living at 2116 West Venango, Philadelphia, Pennsylvania.

John M. Pit Blado is now engaged by the Carnegie Illinois Steel Corporation of Chicago. His address is 4935 South Dorchester.

We Present . . .

Professor Ralph L. Dowdell

Head of the Department of Metallography

By Donald S. McClure, Ch. '42

Among the best-liked men in the Institute of Technology is Professor Dowdell, head of the department of metallography in the School of Mines. He is the kind of professor who gets to know his boys and who takes a personal interest in them. He remembers his own student days well, and this may partially account for his keen interest in the students.

In 1914 Ralph Dowdell registered in the School of Mines at the University of Minnesota. Those were the days when the miners and the engineers were "deadly enemies," and the miners tried to carry off the Blarney Stone as often as they could. "Engineering" activities still interest Professor Dowdell, but he believes they are a little tame nowadays.

Even before he graduated, Professor Dowdell had a position as Assistant Metallurgical Engineer at the Lake Superior station of the U. S. Bureau of Mines, where the problem was the conservation of the nation's manganese resources. In December 1918, he came back to the University in the capacity of an instructor. By 1926 Mr. Dowdell had become Dr. Dowdell and had advanced from instructor to assistant professor. His research in steel treating and alloys, in conjunction with Dr. O. E. Harder, won him the medal of the American Society for Steel Treating two years later. Professor Dowdell left for about a year and a half, to become senior metallurgist on the staff of the U. S. Bureau of Standards. When he returned to the University in September 1930, he was made head of the department of metallography.

The research for which he is best known on the campus is the development of "Duckalloy." This alloy was developed in order to prevent the lead poisoning of wild ducks, which occurs when they eat lead shot along with grit in marsh regions which have been used as hunting grounds. The use of "Duckalloy" will eliminate the tremendous annual loss of ducks due to death by lead poisoning.

Professor Dowdell himself is a hunter and uses nothing but "Duckalloy" while gunning for the mallards. Besides ducks, he went out after deer just after the Armistice Day blizzard and brought one back with him. He admitted it took about a week to recover from wading through the snow, but the trip was worth it.

Professor Dowdell's thirty or forty technical papers on metallography and related fields attest to his interest and activity in the field. Last year he was chairman of the Handbook Committee for the American Society for Metals. As much as he is interested in metallography, he spends a good deal of time with his students and he likes to do "something different" just for relaxation.

LAUGH!

It's Humor

By Ralph Hill, Ch.E. '41

Well, time to masticate the muslin again. Joe Miller was a wonderful fella. Where would all these radio comedians be if it weren't for him—just where I am right now, behind the eight ball. . . . Rumor has it that Gordy Pascha's kid will be nicknamed "Weatherstripping," because he may keep his old man out of the draft. . . . With Christmas only a few days off, it's time to sit down and write my public some nasty letters. . . . When the Quints were born, they called Pappa Dionne stork mad. Wotta man. . . . Remember, if you want to be on the square, you can't be a rounder.

★ ★ ★

Then there's the Scotchman who quit smoking because, as he puts it, "When I smoked my own tobacco, I couldn't enjoy it because of the cost, and when I smoked O. P. (Other People's), my pipe was packed so tight, the damn thing wouldn't draw."

★ ★ ★

HUNTING STORY:

A pack of hounds in the chase had cornered two rabbits in the trunk of an old tree. As they sat inside the tree, the female rabbit said to the male, "What will we do? They outnumber us four to one."

To which the other rabbit replied, "I guess there's nothing we can do but stay here until we outnumber them."

★ ★ ★

Waiter, there's a fly in my soup.
That's all right, he won't eat much.
Yessir, Joe Miller was a swell feller.

★ ★ ★

A midwestern college of engineering once, in need of an English teacher, wrote a letter to Harvard, inquiring if they had a good man, who they would recommend. In a very few days they received a long letter from that erstwhile school, naming one Throckmorton Smythe, III, and stating his qualifications by tracing his ancestry back many generations, and listing among his forefathers several dukes, earls, counts, and other varieties of Blue Bloods.

The midwestern school impatiently sent another letter with the following message: "We don't want to breed the guy. Tell us if he can teach."

★ ★ ★

Two engineers (who else?) were sitting on a fence watching a shapely miss pass on the sidewalk. One, who knew the girl and her socially prominent family, said, "She's well reared."

"Yes," said the other observer. "She's not bad from the front either."

★ ★ ★

We'll leave you now in your misery with this warning. Draftees are warned not to eat Kellogs' All Bran Flakes, because they may end up by joining the "regulars."

Puns Aplenty

By Russell Anderson, Ch.E. '43

A: How many kinds of wood are used in making a match?
B: Two kinds. He would and she would.

● ● ●

A lunatic was trying to knock a nail into a wall. But he had the head of the nail against the wood and was hammering the point.

At length he threw down the nail in disgust and said, "Bah! Idiots! They gave me a nail with the head at the wrong end."

Another inmate of the asylum who had been watching began to laugh.

"It's you that's the idiot," he said, as he jerked his thumb toward the opposite wall. "Nail was made for the other side of the room."

● ● ●

1910: "Look! a car."
1930: "Look! a horse."
1960: "Look! a pedestrian."

● ● ●

Prospective Employer: "Everything in the establishment is run by electricity."

Applicant: "Yes, I quite believe you. The salary offered has already given me a shock."

● ● ●

Why is a good joke like a church bell? Because it's told often (tolled-for those who can't).

● ● ●

All through the game a Gopher enthusiast had loudly urged Minnesota to victory (first quarter—Wisconsin). But suddenly he became silent. Turning to his pal he whispered, "I've lost my voice."

"Don't worry," was the reply, "you'll find it in my ear."

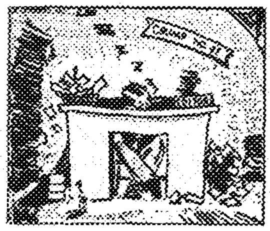
● ● ●

"I'm tired of this routine existence," explained the fraternity brother to his roommate.

"Let's do something extraordinary, startling, magnificent; something that will make our brains whirl, our pulses throb, and our hearts leap."

"O. K." replied the roommate.

And so they studied.



Off the Editor's Desk

By Wallace K. Belin, Ch.E. '41

Lest We Forget • • •

and be accused of being too modest as we were last month when a last minute rearrangement of the makeup cut out our little item on the Engineering College Magazines Associated Convention, let it be here mentioned that the TECHNO-LOG did win the distinction of being the best all-around magazine in the association along with four other departmental awards.

Our Alumni Section • • •

innovates a new policy of featuring specific groups of outstanding alumni in each issue. This month we are featuring men connected with the university but not in their respective fields of study. Next month we may feature graduates working in a particular part of the country or in some particular field of work. Of course, the shorter items about John's new baby boy or Fred's marriage to the girl back home will continue to be published.

Our Staff • • •

has grown considerably since our October issue, but don't let that discourage any of you who are interested in TECHNO-LOG work. The TECHNO-LOG always has a place for someone that really wants to come and work. Right now, each department could easily use one more good man.

All Writers, Attention • • •

Over the Christmas holiday is an excellent time to write that article that you have always dreamed about for the TECHNO-LOG. If you know a subject to write on, go ahead; if not, see Bill Campbell, the feature editor, for suggestions. He has a long list of possible articles.

A Griper's Column • • •

wherein engineers might get a chance to voice their dissatisfaction or approval of this, that, or the other thing is being considered for the TECHNO-LOG. If enough letters are sent in, we will publish such a column, but we will not write "gripes" ourselves just to keep it going, because on the whole we are a pretty happy lot. The only thing in the world we could wish for is a half-dozen beautiful girls to type our letters for us.

More Technical Than the Usual Article • • •

is John Lambert's description of Dr. Nier's mass spectrometer. It is a sane, sensible treatment of a subject that could have well developed into another sensational popping off on U-235. Congratulations to John!

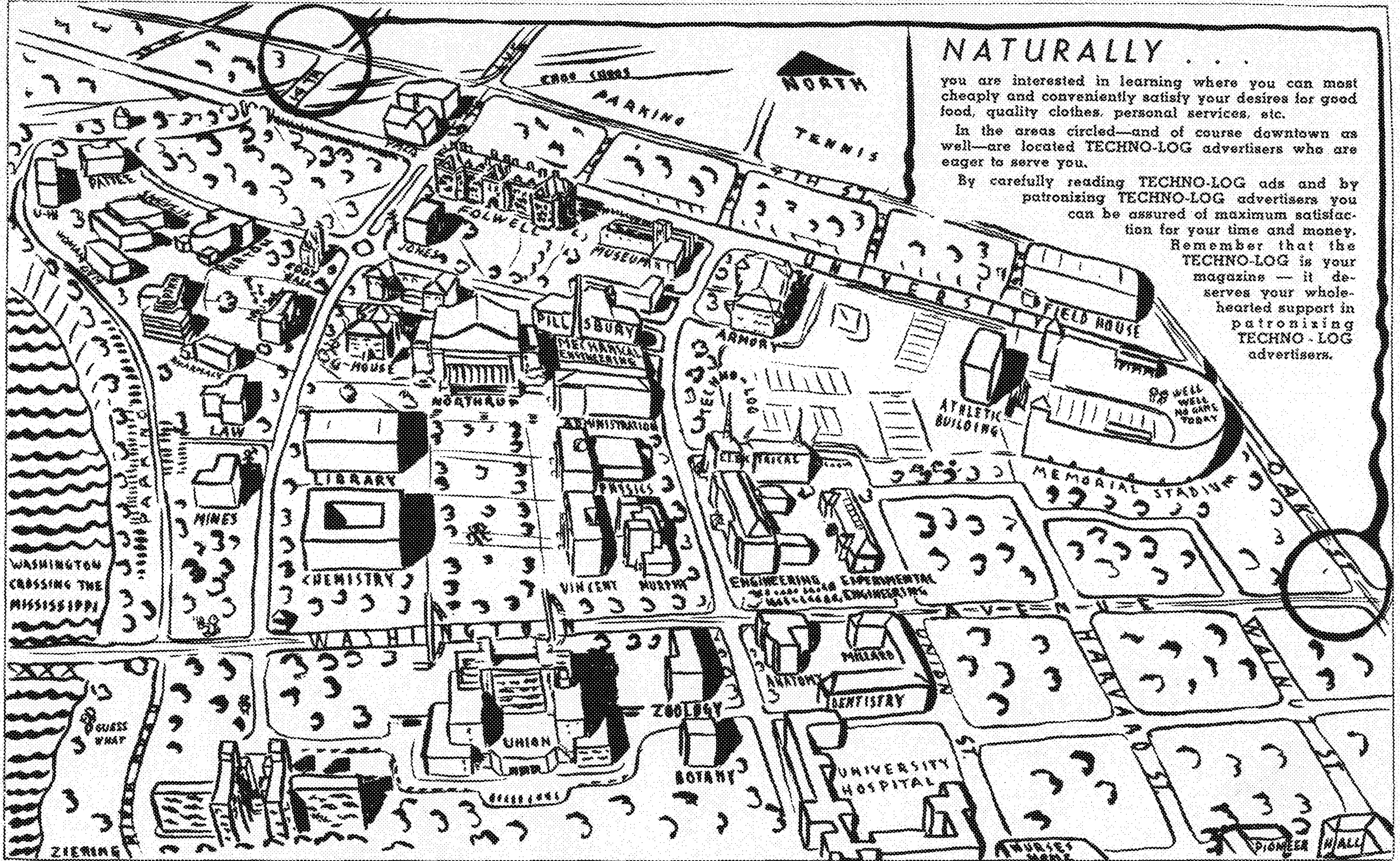
We would like to hear if some of those freshmen and upperclassmen as well who are not familiar with some of the terms used, thing that such articles should not be published in the TECHNO-LOG.

Looking Ahead • • •

to future issues we have several interesting articles in sight. An article on artificial rubber, is being written at the present time. We have a two-page story on rocketry, and Alvin Issacs has promised to write on the relationship between the military units and industry. Before we close with the promise that the humor columns won't be crowded out, let us mention Tom Mattson's article on gyropilots.

Techno-Log Map

OF THE UNIVERSITY OF MINNESOTA CAMPUS



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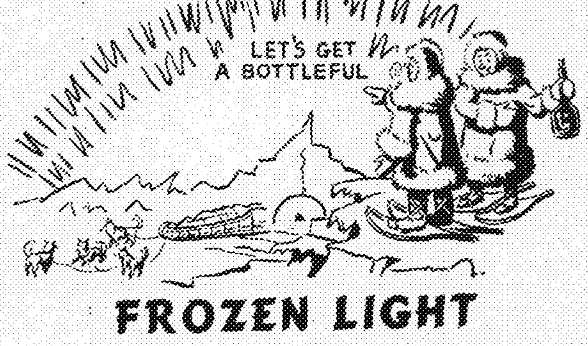
G-E Campus News

MICROANALYSIS

IN ordinary chemical analysis, where material is plentiful, the work is done on a scale most suitable for obtaining the results sought. Samples are relatively abundant; they may be used prodigally.

Not always, however, is the material for test so plentiful. The General Electric Research Laboratory at Schenectady, N. Y., handles the exceptions with its facilities for "microchemistry," in which the amount of test material available controls both the scale of operations and the strategy of attack. Micro-analyst Charles Van Brunt, Harvard, '92, of the laboratory staff is prepared to test material whose limit in smallness is set only by the refinements of manipulation attainable under the microscope with the aid of a "micromanipulator."

Seldom does Van Brunt attempt to identify or classify materials in solution volumes less than a cubic millimeter (about the size of a pinhead). But to analyze an ordinary drop, as delivered from a medicine dropper, is comparatively coarse work for him—near the upper limit of the true microchemical range.

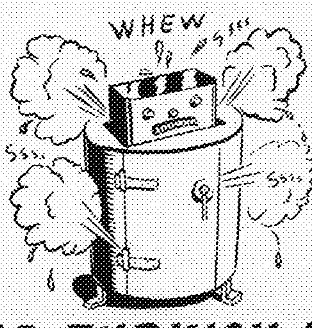


FROZEN LIGHT

THE "late" Baron Munchausen was accredited (by himself) with incredible feats among which was freezing the ring of a bell. Recently, however, General Electric Research Laboratory scientists at Schenectady, N. Y., outdid the Baron by freezing light.

In producing this frozen light, G-E scientists submerged fluorescent plates in a large thermos bottle of liquid air with a temperature of 320 degrees below zero. The bottle and the plates were then bombarded by x-rays, exciting the atoms of fluorescent material on the plates literally freezing them stiff. When the plates were removed and allowed to warm up, they glowed with all the colors of the rainbow.

A "bottle" of frozen light was sent to East Orange, N. J., where it was unveiled in connection with the ceremonies marking the premiere of the motion picture, "Edison, The Man."



RADIO TURKISH BATH

RATS and moisture seem to be the two chief enemies of radio sets in the tropics. A letter from the Belgian Congo testifies to the rats; the evidence for the humidity is already ample. Except for recommending traps, there is little the General Electric Company can do about the rats, but the study of humidity is right up its alley since G-E engineers at Bridgeport, Conn., have built a humidity chamber capable of reproducing the weather conditions of the tropics.

Lamps under water tanks provide humidity by vaporization, and generate enough heat to maintain a temperature of about 100 F. Humidity and temperature are controlled by time clocks outside the sealed chamber, while uniform weather conditions are maintained within the chamber by circulating fans.

Radio receivers placed in this room are continuously subjected to conditions far more severe than those of the tropics until failures occur in the sets. In this way, young engineering college graduates enrolled in the G-E Test Course gather data which contribute to the improvement of radio, not only in the tropics, but everywhere that radios are used.

GENERAL ELECTRIC

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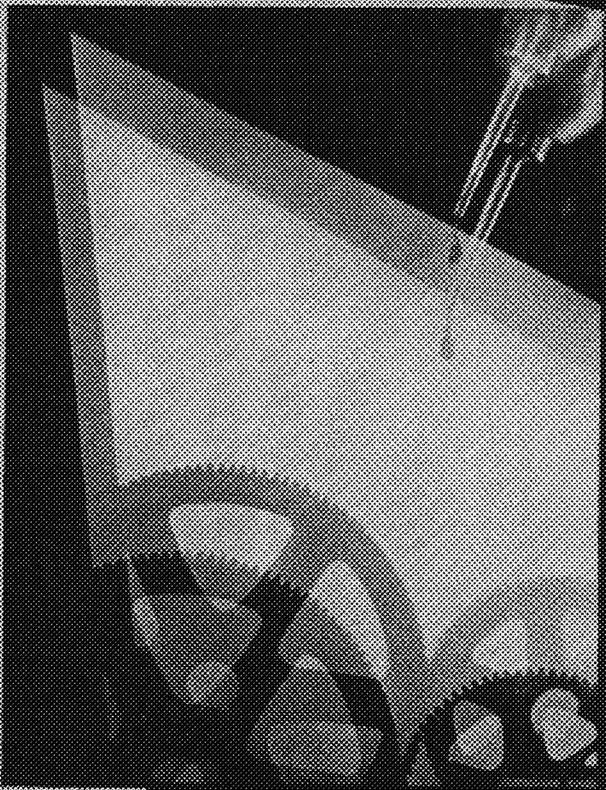
THE TECHNO-LOG OF MINNESOTA



FEATURIN

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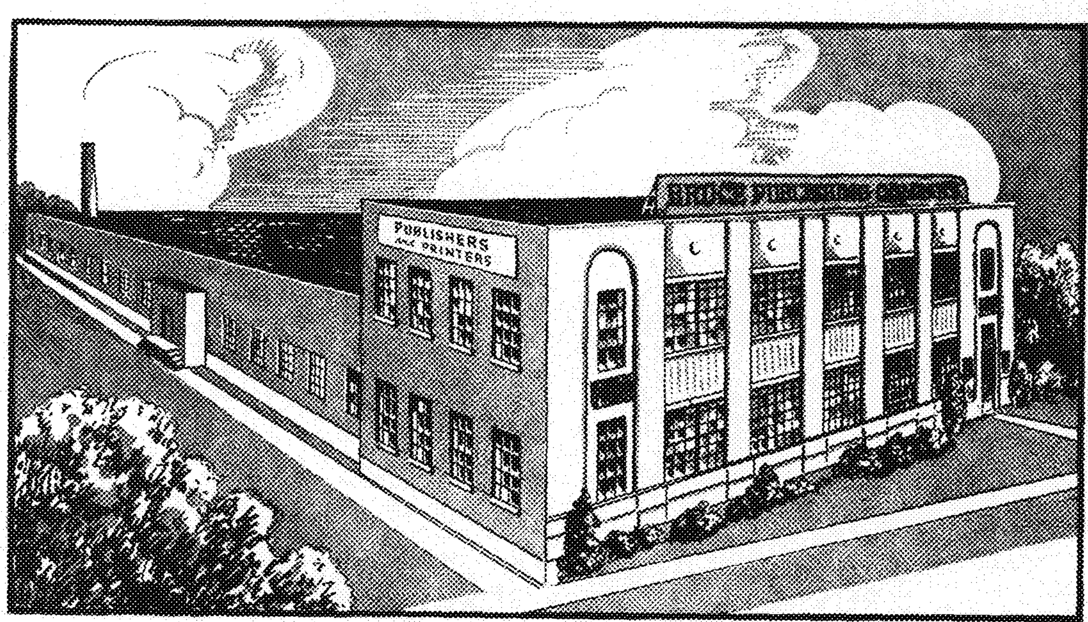
JANUARY, 1941 VOL. XXI NO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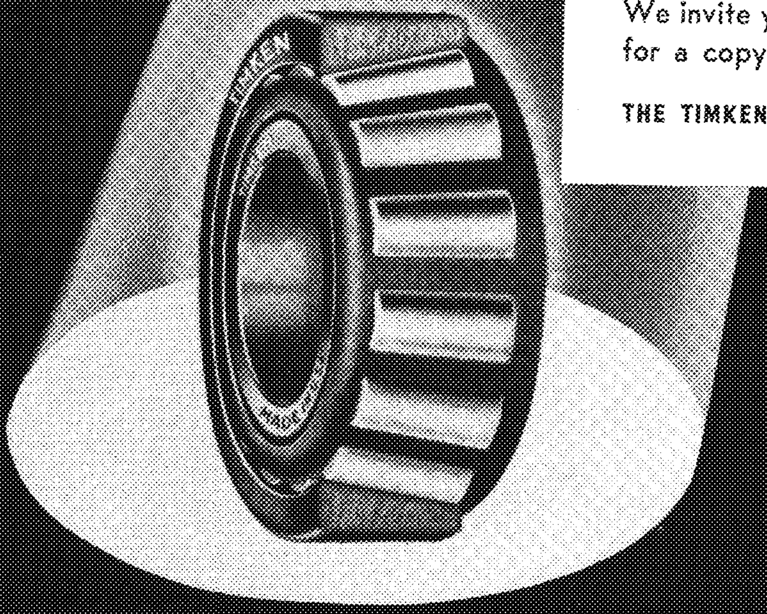

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By Richard Opland, C.E. '43

Washington D. Lacabanne, in his first contribution to the Techno-Log, writes on Deep Drilling. Mr. Lacabanne, an instructor of petroleum engineering in the School of Mines, is a graduate of the University of California and holds degrees as Doctor of Science and Master of Science. He is a member of Eta Kappa Nu, honorary electrical engineering fraternity, and also is a member of Sigma Xi, a national research society. Mr. Lacabanne has little time for the ordinary recreational pursuits but likes to relax with his cello, which he enjoys playing. Summer field trips are always looked forward to by the students, and Mr. Lacabanne enjoys them also as he accompanies parties to the iron range and to the petroleum fields.

Tom Matteson, author of "Gyro-pilots," is an intelligent-looking Aero junior whose ambition is to be employed in commercial airline equipment maintenance. Tom says he's a tympanist in the University Concert Band, but, to the rest of us, he just plain beats the kettle drums. Attention wise coeds: Tom likes to cook and has had plenty of experience on the Great Northern Empire Builder, last summer. For exercise, he likes swimming and bowling. Tom is a member of the I.Ae.S., and served as a sub-committee chairman for the last *Engineers'* Day. You guessed it; he builds model airplanes in his spare moments.

Bill Campbell ("Wild Bill," the future president of the Earth's Chapter of the Universal Interplanetary Rocket Corporation) has three articles to his credit. The latest is, of course, the one on rockets this month. In addition to the articles, Bill wrote one of the humor columns last year. This year, he will be one of the mainstays of the Techno-Log staff. Besides Techno-Log work and school, Bill is working as a bellhop in a downtown hotel.

Nobody, not even Bill, knows how he became interested in rocket ships, but he seems to be futurity minded about some other things, too, for he plans to go into television work when he graduates. If television isn't ready for him, Bill's next choice would be a job in technical writing.

•

The Cover

For the second consecutive month Jack Rockwell has submitted the best photograph for the cover. In keeping with the subject of the feature article his picture shows a drop of oil suspended in mid-air.

Wallace K. Belin

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The editorial policy of the TECHNO-LOG is to present material for technology students which it is hoped will strike a happy medium between the superficial and the highly specialized.

The MINNESOTA TECHNO-LOG is published monthly, October through May, by the students in the Institute of Technology of the University of Minnesota.

The purpose of the TECHNO-LOG is two-fold: First, to put in the hands of TECHNO-LOG subscribers highly worth-while and interesting reading material; second, to offer technology students an invaluable opportunity to get writing, selling, and working-with-others experience.

THE MINNESOTA

Techno-Log

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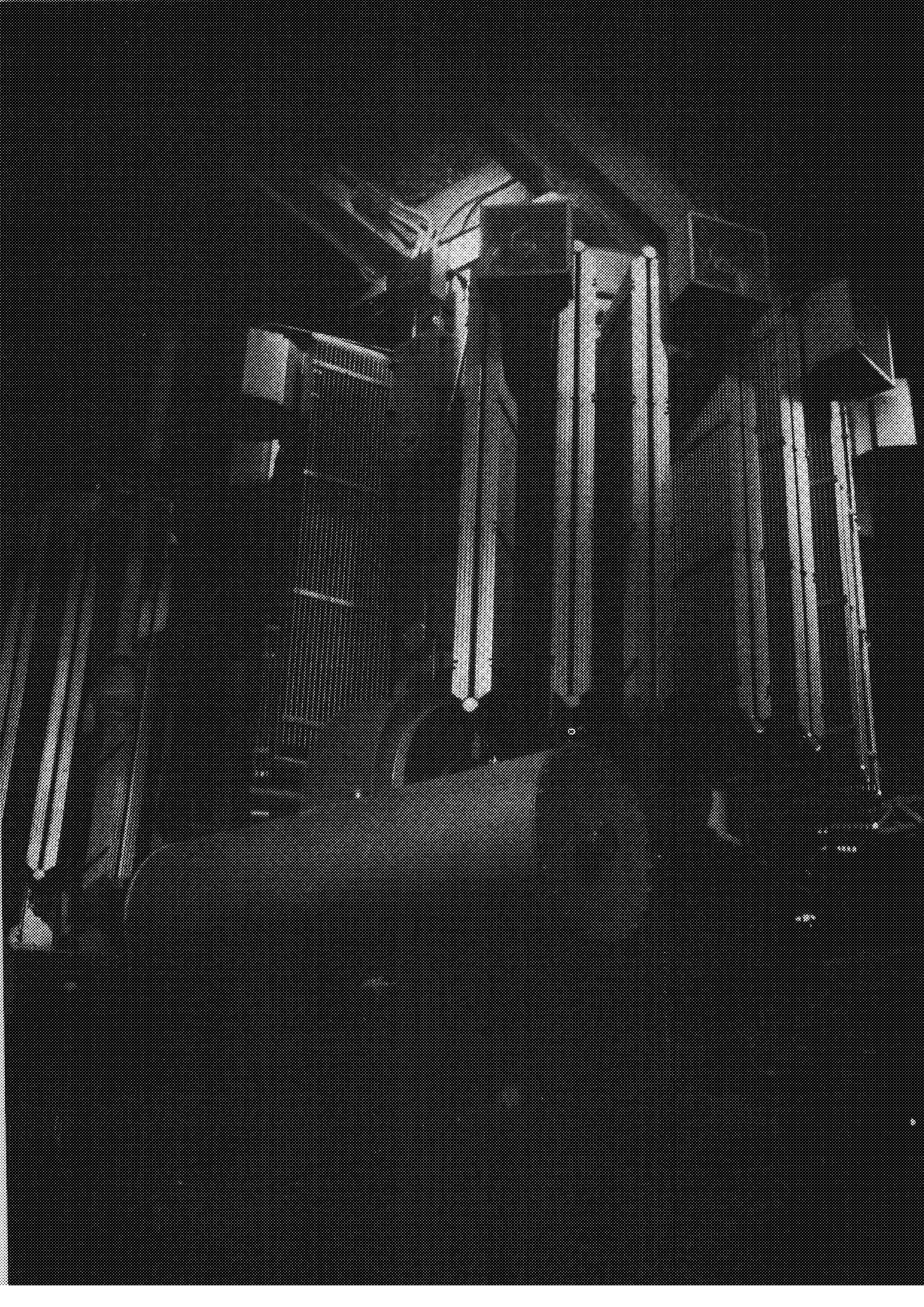
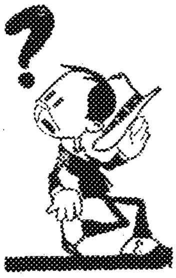
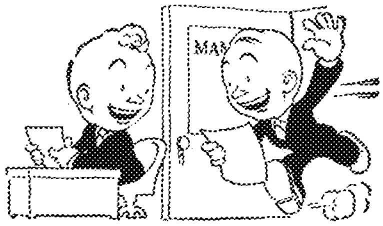


VITALITY





HUMAN VITALITY, that quality over which breakfast food advertisers make such a fuss on our signboards and in our daily newspapers, is certainly a queer characteristic of human beings. It seems to make little difference if one is blessed with much or little of this supposedly innate human quality, since any excess is generally dissipated, and any deficit is as a rule overcompensated for. In spite of these observations it is well that one be conscious of the part that vitality is playing in one's life.

Some people achieve success through their very lack of vitality. Conservation of their physical well-being and careful systematic planning of their work enables them to plod on to success through reliability and even through outstanding achievement. These individuals in stoic denial of themselves learn to do that which appears to be less interesting but more worthwhile. Patience and perseverence are the great and necessary attributes of those who attain success in the low vitality group.

On the other hand, many men in the high vitality group find it difficult to achieve success. In every department there is a fellow that everyone concedes is right up on top as far as brains are concerned, but who has so much vitality that he cannot confine himself to his studies but must dissipate excess energy in some other direction. In so doing he over-expends himself to such a degree that he has but little energy left for the main task before him which we shall call his studies.

Now this dissipation may be good or bad. It may be a Saturday night "binge" which takes him until the next one to fully recover. It may be activities or athletics. It may be his hobby, or even his girl friend. Whatever it is, good or bad, as long as it keeps him from being in best possible shape for his major purpose, it is dissipation.

In spite of this dissipation there are a few individuals who, because of their great ability, do make a success of their job, but most of the successful men in the high vitality group achieve their goal through self-control and moderation; through prudence and temperance. Theirs is indeed a fortunate lot.

Then, finally, there is the great majority of us who are neither living mummies nor human dynamos, but who get along from day to day without much fuss or bother. Ours is the privilege of conserving our vitality for an important event or period in our lives, and yet, being able to enjoy and broaden our lives by expending our energies in diverse directions without fear of disaster or utter failure.

BY WALLACE K. BELIN, EDITOR

ITS DEVELOPMENT

Black Gold -- The Life

By W. D. Lacabanne

OIL! The life-giving blood of modern industry—the Black Gold men have fought and died for. It turns the gigantic wheels of industry. It makes possible rapid transportation. Without it, our tempo of living would be slackened to a snail's pace. The demand for the precious fluid has become greater with each succeeding year. In 1939, 1,250,000,000 barrels of crude oil were produced. To the engineer, increased production embodies the application of newer and more efficient methods. It is of interest to study the processes which have made possible such tremendous production.

Oil is found beneath the surface of the earth, trapped in natural barriers called structures. These structures are located underground at various depths, often at random and sometimes in well-defined trends. The fact that oil is found in very few localities accounts for the difficulties encountered in discovering its structures. Of the million wells drilled since 1858, one-fifth of these have been dry.

Oil Sands

The average person has a vague idea of the underground occurrence of oil and thinks that it exists as lakes of oil, or perhaps as a river wending its mysterious subterranean way. A bucket filled with an oil-soaked and closely packed sand is analogous to an oil occurrence in underground oil sand. Some oil sands have the appearance of solid rock, but, being porous, contain much oil. A large body of such oil sand may contain, compared to its volume, as much as 20 per cent or more of oil.

The petroleum engineer is concerned with two problems. One is to discover the elusive oil field, for usually the surface gives little or no indication of its presence; and the other, once the field has been found, is to get down to the oil rock to extract the oil. The successful solution of these problems is attested to by the large number of new oil discoveries each year and the drilling of wells to a depth of 15,000 feet, or nearly three miles.

The search for oil pools today is no longer carried on by the old "hunch" methods. The newest advancements in geophysics and geology and ultra-sensitive instruments guide the engineer to oil structures. In 1939 about seventy-five per cent of the new oil fields were discovered through application of geophysics, which applies principles of siesmology and has drawn heavily on physics for electrical, magnetic and gravitational theory.

"Wildcat" Testing

Regardless of the methods used in locating an area which seems favorable for the presence of oil, the final answer to all speculations as to whether or not oil actually is present is to drill a well. Such a well testing for the presence of oil underground is known as a "wildcat." The mortality of wildcats is high—almost ninety per cent.

Sinking the oil shaft is a science which has been developed through many years of experience. The depths of modern drilling has been made possible only through the development of high grade steels and alloys and the perfection of engineering-design of tools and equipment.

Consider a machinist's drill equipped with a special cutting tip elongated until it is thousands of feet long, and hanging vertically in a well. This long, hollow steel thread, powered at the surface, rotates and transmits torque all along the shaft to the bit, which is forced to turn with the thread. To prevent the drill cuttings from clogging the hole, mud-fluid is pumped through the hollow drill stem and out through the bit. It picks up the cuttings, and returns to the surface through the annulus between the drill stem and the walls of the hole. At the surface the mud is cleaned and recirculated. Thus, the drill goes deeper and deeper, being returned to the surface occasionally for the replacement of worn bits.

When the drill has reached the proper depth, it is removed and the shaft is lined with a steel pipe called a casing. The casing prevents cave-ins and keeps water from seeping into the well.

To regulate the flow of oil, if the well is flowing naturally, an assemblage of valves and fittings called a Christmas Tree is fastened on at the top of the well and in some cases must have sufficient strength to withstand pressures as high as 6700 lbs. per square inch. If the well does not flow naturally, the oil must be lifted from the bottom of the well to the surface, and this requires the installation of some form of pump, of which there are many.

For maximum efficiency in oil well drilling, it is evident that the machinery and equipment used must be of the finest quality. The derrick is used as a support for the cable system which lifts and lowers the drilling tools into the well. The modern steel derrick embodies a high degree of engineering design, as it is subjected to heavy, vibrational, and suddenly varying loads.

Equipment Costly

The modern cutting bit is greatly responsible for the rapid rates of rock penetration in drilling. It usually consists of toothed rollers or cones mounted on roller bearings, and its drilling action is one of cutting, chipping and grinding. A 12¼ inch bit costs 155 dollars, and about forty-five are needed to drill an 8000-foot well. One Louisiana test well used over 900 various bits.

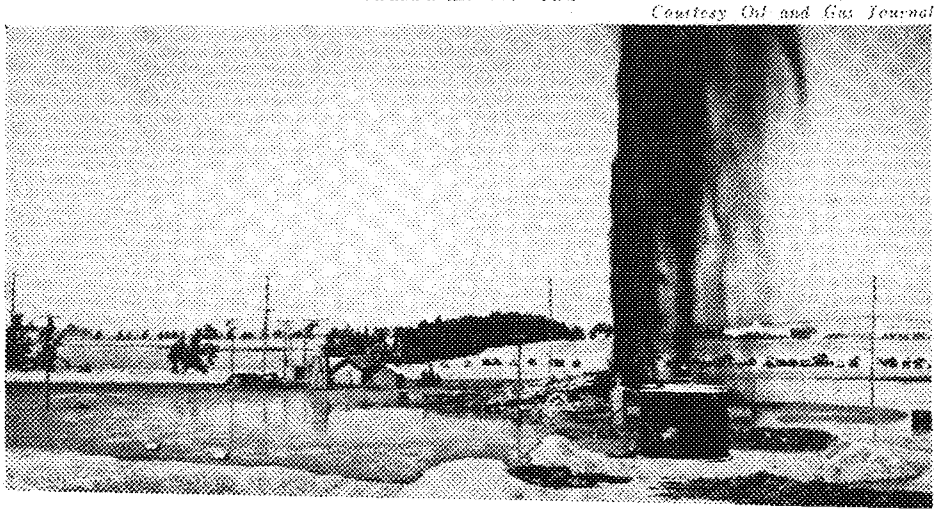
The circulating mud-fluid is another factor which must be carefully checked for efficient drilling. It functions to remove the drill cuttings, to clean and cool the bit, to strengthen the side walls of the shaft, to keep foreign matter out of the well, and to prevent the escape of gas and oil from the well during the drilling process.

The casing used to prevent caving-in of the well is one of the largest expenses met in drilling. The cost of the casing is usually about one-third of the entire expense of the well. The reason for this is that high grade steel must be used to withstand high tensile stresses near the top and high collapsing stresses at the bottom of the well.

The engineer is interested in knowing beforehand how much oil is underground and how difficult will be its recovery

A blowout at El Segundo Field, California. The well was drilled to 7,100 feet with only about 1,000 feet of casing in the hole, when gas sand at 1,100 feet caused the blowout.

Courtesy Oil and Gas Journal



ITS FUTURE

Blood of Industry

Instructor in Petroleum Engineering

Further, he is interested in accumulating geological knowledge and records which will also be of aid in discovering new oil fields. For this, special tools, methods, and laboratory techniques have been developed to a high degree.

To locate the oil-bearing strata, the engineer removes cores of earth and rock by means of special tools. In the laboratory the porosity of the cores is determined. The higher the porosity, the greater the possible content of oil. The permeability determines the number of interconnecting channels from pore to pore. The greater the permeability, the greater the ease of oil flow, and hence, the recovery. Finally, the oil and water content of the sand is determined with retorts and condensing equipment. Geological characteristics of sand grain size and range, certain mineral markers, micro-paleontological markers, specific gravities of sands, etc., are also measured.

This core knowledge, plus the physical dimensions of the oil sand, permits the calculation of the total amount of oil in place. Years ago the calculated amount of oil was always higher than the oil actually produced. It was assumed that the pore spaces in the oil sand were one hundred per cent oil-saturated, an assumption which is not always true. Recently, native or connate water was found to co-exist with the oil clinging in a thin film to the sand grains; and in many cases, the water amounted to fifty per cent of the fluids present. Now, calculated and production values are in better agreement.

Increasing Flow

Porous limestones contain oil, but often the permeability of limestone is not very high as the interconnecting channels between pores or fissures are missing or are poorly developed. Hydrochloric acid pumped down the well and forced out into the formation enlarges and opens the channels in the limestone by chemical action and permits facile fluid flow. In this way, oil well productions often are doubled and even trebled. Frequently wells are acidized as soon as completed to get the greatest possible flush oil yield. Five thousand gallons of acid at a time in a well is a common application and this may be repeated several times. To counteract and prevent acid action on the steel casing in the well and its eventual destruction and failure, the acid is "inhibited" with certain chemicals or "polarized" in the well by electrical means.

It is a problem for the engineer to determine whether or not he has drilled past the oil-bearing sands. The 1931, Anthony F. Lucas Gold Medal was awarded by the American Institute of Mining and Metallurgical Engineers to two French brothers, one posthumously, Conrad and Marcel Schlumberger, in recognition of "distinguished achievement in improving the technique and practice of finding and producing petroleum." Essentially, the Schlumberger Electrical logging method is to lower electrodes at the end of a special cable into a well and measure the electrical characteristics of the rocks penetrated. Oil sands have high and water sands have low resistance. Further, natural earth or spontaneous currents are measured for the permeability or porosity characteristics. These parameters are graphically recorded at the surface by special electrical equipment. Electrical logging is fast, almost always reliable, and provides a permanent graphical record, which now forms a part of almost all well records.

Radioactive well logging, just introduced, can be used in wells cased or uncased with steel pipe in contrast to electrical logging which is useful only in uncased holes. Geological strata give off gamma radiations, the strengths of which are characteristic for the rocks of a particular area and are independent of terrestrial temperatures and pressures. Shales are usually the most highly radioactive and quartz sands and limestones are the least. One end of the measuring device is lowered into the well at the end of a cable and the other end is connected to recording instruments at the surface. The instruments give a permanent graphical record.

Mud Analysis Logging

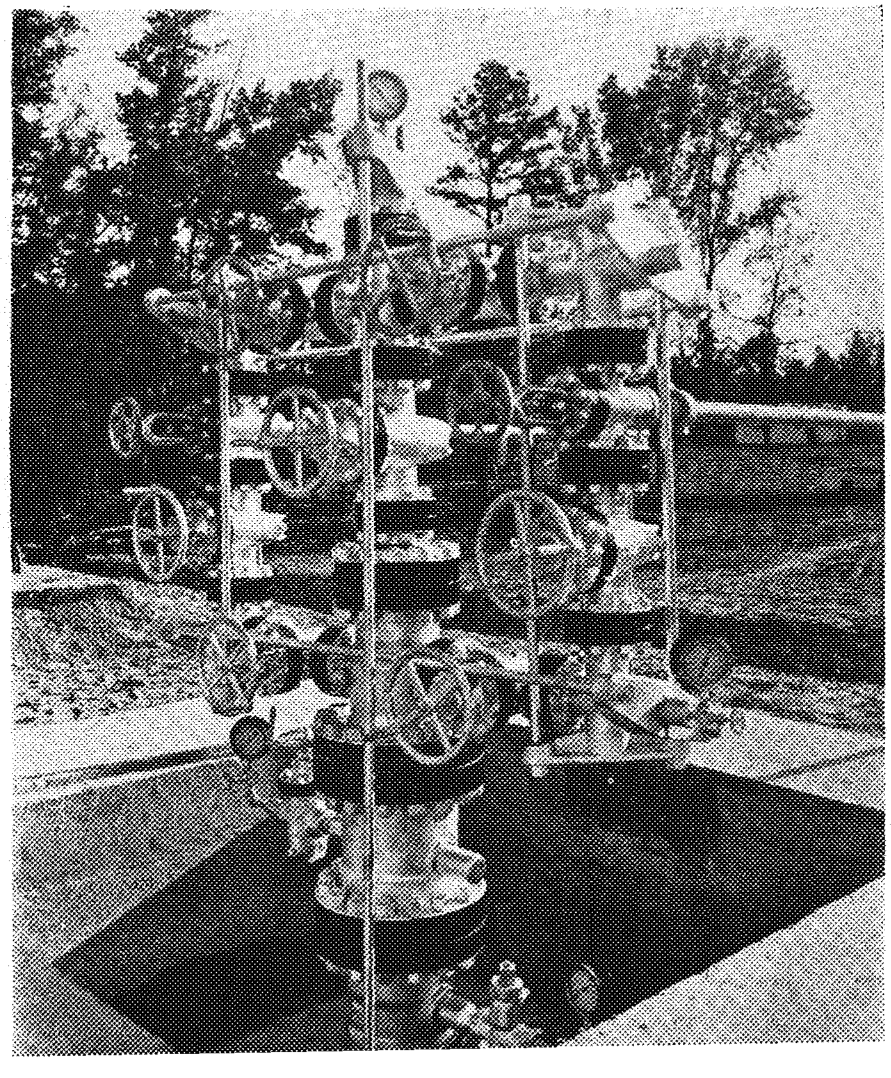
Mud analysis well logging, recently introduced, is used concurrently with drilling. The claim for this method is that the presence of oil or gas can be predicted fifteen to twenty feet ahead of the drilling bit. Of greatest interest to the engineer are the fluids, oil, gas, or water, present in the earth.

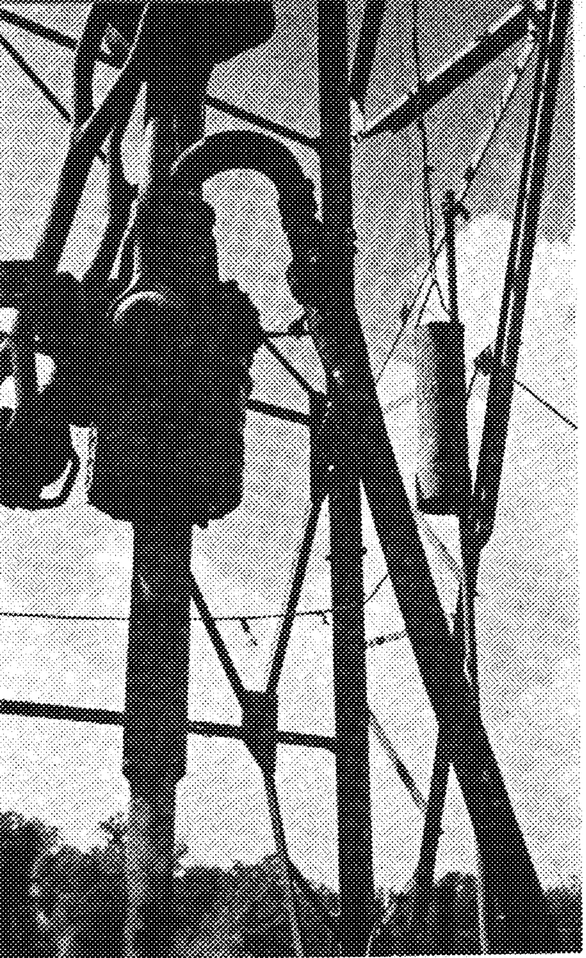
The circulating mud fluid is analyzed for gas, oil, and salt water and for the quantities of each present. One quarter of one per cent of gas in the mud can be detected easily by an electrical gas detector; minute quantities of oil in the mud show up under ultra-violet light radiations; contaminations of lubricating oil from the pumps or recirculated crude oil are easily distinguished from the new; and salt water is detected by the electrical conductivity of the mud.

Some oil fields, like the Dominquez Field of California, have as many as seven or

Christmas tree well assembly in Cotton Valley Field, Louisiana, operating at a pressure of 3100 pounds per square inch.

Courtesy Brewster Co.





Courtesy Oil and Gas Journal

The swivel hanging from the hook supports the rotating drill stem and permits mud fluid to pass through it into the drill pipe.

eight different oil sands one beneath the other. These are separated from each other by barren rock, each oil sand being a separate oil field in itself, and all stacked together like a Voltaic Pile under one surface area, or nearly so. All of the oil sands are not produced at the same time by a well but only one or a few at a time, beginning with the lowest sands. When the lowest sand is depleted and abandoned the next upper oil sand is tapped. However, the well is cased with steel pipe and to allow oil to enter the well the pipe must be perforated. The modern method is to gun-perforate by making use of a short barreled gun about three inches long over all, shooting a forty-five caliber, or smaller, solid steel bullet. The discharge is so powerful that three inch thick solid steel can be penetrated completely. Two or three strings of casing concentrically placed and separated by cement are easily pierced and the bullet goes on and penetrates into the sand a matter of feet. The bullets are discharged by means of an electrical circuit with the controls located in the surface equipment.

Directional Drilling

Straight, vertically drilled holes were always taken for granted in the past, but it has been found that the straight hole was the exception. A five thousand foot oil well is on record as having wandered horizontally 2,400 feet from its starting point, necessitating that some 800 feet of excess hole be drilled to reach the same vertical depth. The angular inclination in some wells has been as high as 60 to 70 degrees. Recently there have been developed clever well-surveying devices which measure inclination of the hole and the direction of the deviation. Either the well is surveyed periodically while drilling—and this is the usual case—or a single survey can be made after the hole is completed. Old holes which have no survey records use the latter method, and in some localities a hole survey is a requirement. The deepest oil well in the world, 15,004 feet (in California), has only a horizontal deviation of 21 feet at a depth of 11,700 feet and an angular deviation of but 2¼ degrees at 14,800 feet. Most oil states now require less than 3 degree angular deviation and most oil wells are kept within one degree.

Directional drilling is the intentional drilling of a crooked hole for special purposes. Oil fields have been discovered under shallow ocean waters just off the coast of California; in the Gulf; under lakes such as Lake Maracaibo, Venezuela; and under the swamps of Louisiana, where it is difficult, impossible, or too costly to build steel and concrete piers or islands from which to conduct drilling operations. Oil located under surface areas difficult of access or under graveyards which are inviolate can be tapped with less difficulty by the use of directional drilling.

In swamplands where roads must be built for long distances on piling, the drilling of many wells, each of which must have its own road, would be uneconomical. Instead, a single road and pier are constructed so that as many as nine wells can be drilled from one spot using the same derrick and equipment. These wells are drilled, radiating outward and downward, each being bottomed in a location which would be the same as if the well were drilled vertically from the surface at its properly spaced location. This makes the oil drainage areas of each well uniformly spaced.

The success of directionally drilled wells is due to two things. One is the effective use of well survey instruments which are required constantly to check the course of the hole and the other is the use of deflecting devices and drilling methods to "steer" the hole. These devices are whipstocks and knuckle-joints. The whipstock is a long wedge-like piece of steel with the tapered face hollow - ground, along which the drilling bit is guided in the new direction. It is run into the hole to the proper depth on a drill stem and oriented in the correct direction. Survey instruments similar to the surveyor's transit without the graduated circle are used to measure the twist of the drill stem as it is run into the hole, stand by stand, as its own weight straightens and untwists it. This is an "oriented survey" which measures the number of revolutions the pipe makes as it untwists. When the initial and final bearings are known the whipstock can be oriented to the desired direction.

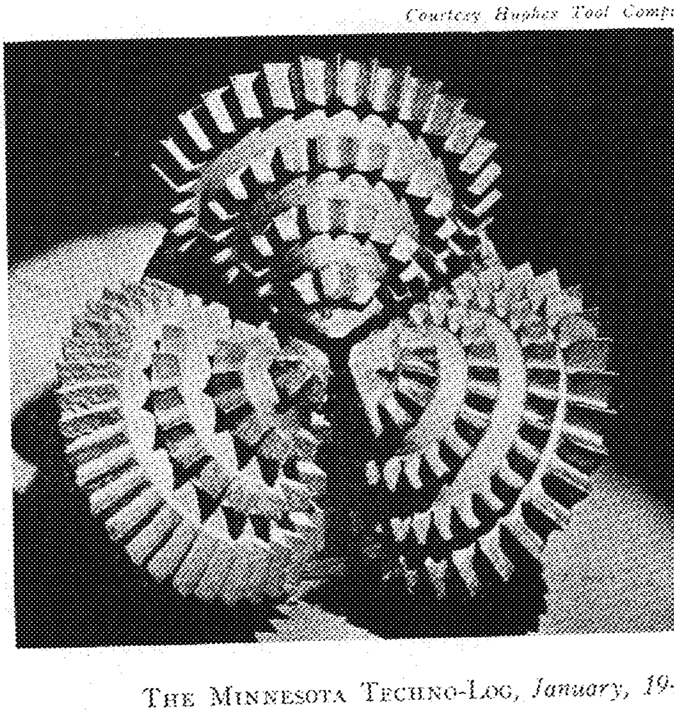
Fire Control

Perhaps the most spectacular use to which directional drilling has been put has been the extinguishing of disastrous oil well fires. When a high-pressure well blows out and catches fire the derrick and surface equipment is sometimes completely destroyed and a huge crater filled with mud, water and oil forms about the well. It is practically impossible to cap and bring under control this type of well. About eight years ago, to control a certain well fire, the then unknown inventor of the directional drilling device proposed to drill a second well a quarter mile distant from the burning one and so direct the course of the new hole as to come very close to the bottom of the first; then mud fluid would be pumped down to flood the oil sand, cut off the supply of oil and gas, and fill with mud the hole of the burning well. His success was sensational and later calculations showed that near the burning well the second well was bottomed within a ten-foot circle, at a depth which is believed to be around 7,000 feet.

In spite of the existence of a splendid body of scientific and technical petroleum knowledge, all oil fields are not exploited and all wells are not drilled according to the best oil-engineering principles. It is believed, however, that the scientific methods of well drilling will eventually replace the trial and error methods, and allow maximum efficiency in oil recovery.

A worm's eye view of a three cone rock drilling bit.

Courtesy Hughes Tool Company



High-Speed Pyrometry

By Donald L. Drukey, Ch.E. '43

IN SPITE of the poor facilities of the Mechanical Engineering building, the foundry department under Fulton Holtby is carrying on some of the most active research projects on the campus. One recent development is a fast acting thermocouple for measuring the temperature of molten metals. The new thermocouple has eliminated many of the difficulties in temperature measurement inherent in other instruments.

The optical pyrometer is one of these instruments. It measures the intensity of the radiation of some particular wave length emitted by a hot body. Evidently the intensity will be decreased by the presence of fumes in the surrounding atmosphere or by slag on the surface of the metal. Stray radiation reflected to the pyrometer will also cause false readings. Most of these objections have been overcome by the black body pyrometer. This is a graphite tube, closed at one end and attached to an optical pyrometer at the other end. The closed end of the tube is immersed in the metal and the pyrometer measures the amount of radiation from the carbon. Although the closed system eliminates errors due to slag, fumes and stray radiation, there is still some error caused by the fumes from the graphite. An accurate instrument is obtained when the graphite tubes are baked at high temperatures until this gaseous part is driven off. However, the graphite tubes do not last very long and the amount of carbon picked up by the metal is sometimes objectionable in research.

Overcoming Disadvantages

Another device for measuring temperature is a thermocouple made from platinum wire and a platinum 10 per cent rhodium alloy wire. The wires have to be protected against the action of carbon and for this reason are enclosed in a ceramic tube. In order to prevent fractures caused by sudden changes in temperature, the ceramic tube must be enclosed in a graphite tube. With an instrument of this kind, the temperature rises so slowly that the metal often cools before a reading can be taken, and it picks up an objectionable amount of carbon from the rod.

To overcome these disadvantages, Professor Holtby began to experiment with tungsten-graphite thermocouples. He chose these materials because of their high melting points and their high thermo-electric force. The first of these thermocouples consisted of a graphite tube closed at one end and a tungsten wire running through the tube making contact with it at the closed end. Porcelain insulators separated the tungsten wire from the graphite tube and a thin replaceable graphite protecting tube was used to keep metals from attacking the graphite element. The top temperature for this couple was 3300 degrees Fahrenheit. At this temperature, the insulators melted. The amount of carbon picked up by the metal from this instrument is considerably less than that from a platinum-platinum 10 per cent rhodium thermocouple, but it was found to be still too great for research practice. The quantity of carbon was reduced by coating the graphite tube with alundum cement. The resulting thermocouple has been found very satisfactory in many ways. It is quite rapid and it maintains its calibration very well. It has been used in industry for a short time, but Professor Holtby has developed a faster and more desirable one to supersede it.

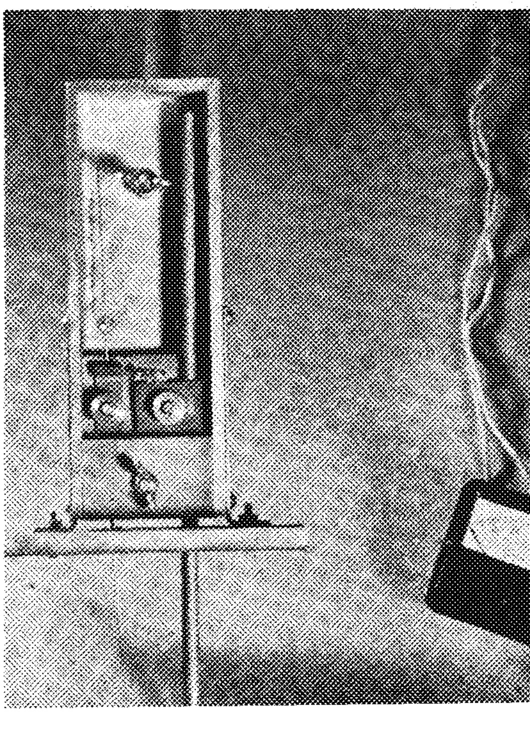
Latest Developments

The new thermocouple uses the metal to be tested as one of the thermocouple elements. Two rods, one of tungsten and one of graphite, dip into the molten metal. The e.m.f. from the tungsten-metal junction plus the e.m.f. from the metal-graphite junction add up to the e.m.f. of a tungsten-graphite couple regardless of the metal being tested. Copper wires are used as leads from the terminals of the thermocouple. If the copper lead wires were attached directly to the graphite and the tungsten, there would be an objectionable e.m.f. due to the fact that these junctions are not at room temperature (the temperature of the cold junction of the thermocouple). In order to compensate for this effect, a phosphor-bronze wire is attached to the graphite and is led to a point where the temperature is close to room temperature. Copper wire is then used out to the millivoltmeter. Copper is attached directly to the tungsten. With this arrangement, the e.m.f. from the copper-tungsten junction is equal and opposite to that from the phosphor-bronze-graphite junction, and thus the two cancel each other out.

The thermocouple rods reach temperature equilibrium with the molten metal very rapidly and readings can be taken in from four to five seconds as contrasted with the minute or two required for thermocouples of other design. Professor Holtby is designing a similar thermocouple using a thinner graphite rod and a thin tungsten wire as elements. Readings with this couple will take only about three seconds. It will be used to measure the temperature of the steel which goes into the making of watches.

About three years have been spent on the development of these tungsten-graphite thermocouples. Over eighty tests had to be made on the lead compensator before phosphor-bronze was found to be suitable. The results indicate that the work has been very fruitful. The new couples are accurate to within ten degrees F. at 3000 degrees. Their output of about 30 millivolts is within the most accurate part of the range of a standard low-priced millivoltmeter. The e.m.f. of a platinum couple is below this range and more sensitive higher-priced meters must be used. In addition to this cost factor, the platinum couples contain about seventy dollars' worth of platinum, while the tungsten-graphite couple contains only a few cents' worth of tungsten and graphite. The cold junction of all of these thermocouples is at the instrument. Variations in room temperature are not important since, especially with tungsten-graphite couples, the change in e.m.f. due to temperature changes in this range is completely negligible.

New tungsten-graphite thermocouple. Tungsten wire attached to copper compensator is at left. Graphite rod attached to phosphor bronze compensator at right.



Rocketry from Fable to Fact

A PREVIEW OF THE FUTURE

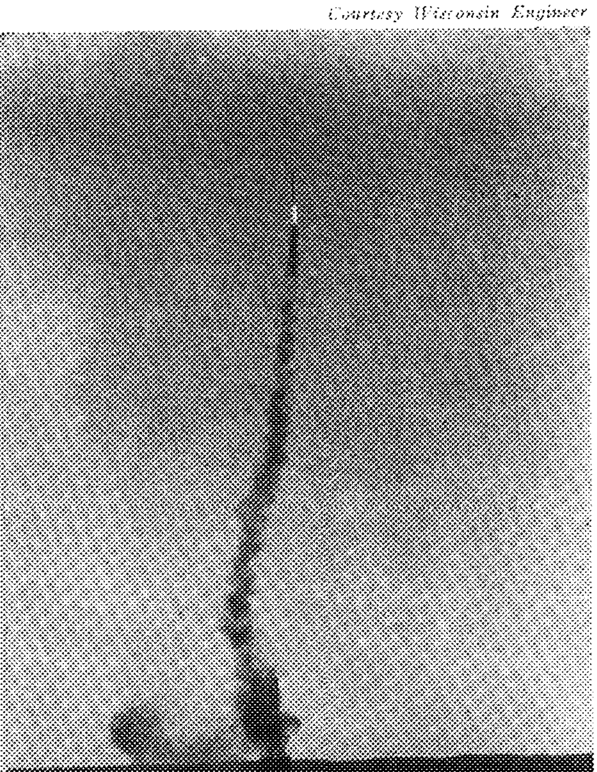
By William N. Campbell, E.E. '42

HOW to get to the moon and back may well be the problem of the first rocket travelers in the not-so-distant future. However, problems of a much more mundane nature still remain to be overcome before rocketry and rockets will have advanced sufficiently to permit relatively safe inter-planetary travel. To the average person the word rocketry implies some illusory branch of experimentation indulged in by men of even more fantastic tendencies. Alas, unbelieving, misinformed Mr. Average Person. What he needs is a good dose of the facts about rocketry, mixed with some prophecies, and a cure will be effected.

Mr. Average Person usually begins his dissertation on rocketry by stating that rockets won't work in the first place, basing his assumption on I. M. Looney's ninety-third law of physics; rockets can't work in space, 'cause there ain't no air to shove against. Well, what is the principle on which rocket propulsion is based? Just plain old Newton's Third Law of Motion; that for every action there is an opposite and equal reaction. A gun shot in space will recoil. Just so a rocket discharged in space will furnish a recoil and shove the rocket forward. The mass of the gas exploded and escaping through the nozzle or nozzles in back of the rocket reacts against the mass of the rocket and drives it forward. Now where does reactance against the atmosphere enter into that? In fact, a rocket will work better in space than in atmosphere in that there is no air resistance to impede the motion of the rocket.

Flight control of the rocket by means of a gyroscope.

Courtesy Wisconsin Engineer



Driving Power

The motivating force of a rocket is, of course, its motor. However, the term "motor" does not signify moving parts. A rocket motor is simply a combustion chamber and nozzle. The motor acts to receive and explode the fuel and pass it through the nozzle at as high a speed as possible. The fuel once was exclusively powder but this is no longer used. The fuels most widely used today are liquid alcohol and liquid gasoline. Using liquid oxygen as a combustion agent, either one of the fuels packs a terrific wallop. The fuel is piped from the fuel tanks, injected into the combustion chamber, and ignited by a spark. The hot gases expand very rapidly and escape through the nozzle at the rear of the combustion chamber. The reaction of the hot gases against the mass of the rocket furnish the propelling force.

Problems

This, essentially, is how a rocket works. However, there are many problems and difficulties presented which must be overcome. The paramount problem of all is money; money with which to buy the materials, and with which to pay for expensive experiments. Who, though, is going to put money into some scheme whereby he is not going to realize an immediate return, and especially if he cannot foresee any definite, tangible results from such an investment. However, the fact does remain that if enough money is expended, results will be forthcoming, and will be of much greater magnitude than ever before realized. This lack of funds is being overcome to some degree by formation of societies, where experimenters may pool their resources and ideas and thus build rockets which otherwise would remain only on paper. One of the finest societies in the world is our own American Rocket Society. The need for more members and more experimenters is expressed by this organization. People interested in rocketry are urged to write to the American Rocket Society, Room 382, 50 Church Street, New York, N. Y. for information about membership and branch societies.

Another difficulty is finding a metal that will stand up under the terrific temperatures of the hot gases in the combustion chamber and nozzle. The efficiency of the rocket is necessarily low because only a fraction of the potential power can be used with the metals now in use. These metals include molybdenum, steel, beryllium, and tungsten alloys. Metallurgists are now seeking a metal that is tougher, with a higher temperature coefficient, and with faster cooling properties, which may be used on a rocket with a high degree of efficiency. Such a metal has not yet been found, but there are indications that one may be found soon.

Fuel Injection

Another problem is that of fuel injection. On small rockets the pressure of the fuels in the tanks is used to feed the fuel into the combustion chamber. However, this is not feasible for larger rockets because the weight of the fuel tanks, built to withstand such a high pressure, would be excessive. The only alternative is to use a fuel pump. The fuel pump must be light, durable, simple, and with a large capacity. As yet the ideal pump has not been developed, but this knot is slowly being ironed out by experimenters.

The difficulty of controlling the rocket in flight was a ticklish proposition until Dr. Goddard, rocketry's No. 1 experimenter, solved it very neatly. He installed a gyroscopic control motivated by vanes revolved by gas pressure. It proved quite satisfactory.

Then there are such problems as overcoming the effect of air resistance; use of suitable metals for body and fuel tank construction; remote control; better fuels; et cetera.

All of these and more are being tackled by experimenters the world over, with indications of overcoming them in the near future.

The thought of interplanetary travel is a pleasant one on which to meditate. A flight to the moon could even now be made with the rocket and fuels we now have if the money were forthcoming to build such a moon rocket. It has been estimated that such a rocket would cost around two million dollars. The greatest difficulty of interplanetary flight is overcoming gravity. To escape the attraction of the earth the rocket must attain the speed of 66 miles per second. This velocity is called the "escape velocity" and does not have to be attained rapidly. This high velocity brings up the question of power. To attain such a velocity would require much fuel. Atomic power, if utilized would help greatly in furnishing the necessary power, but until this is developed the materials at hand must be used. The weight of the fuel necessary to furnish such power would be extremely high, so a method called the "step rocket" has been devised to make a rocket large enough yet with a high energy to mass ratio to carry a rocket to the moon and back. A step rocket is simply a series of detachable rockets. The first rocket, containing only fuel, would be shot until the fuel was used up, and then the second rocket would be shot until that too was used up. Each rocket when burned out would be detached from the rest of the rocket. The remaining rocket or rockets could be used for maneuvering in space. It has been calculated that three steps are enough to escape the earth. To go to the moon an additional step would be needed to bring the rocket back to earth. A rocket with a three to one ratio of fuel to non-full load would weigh 80 tons; a two-step, 640 tons; a three step, 5,120 tons; and a four step, 40,960 tons. It may be seen that the three step moon rocket would not be too heavy for space travel.

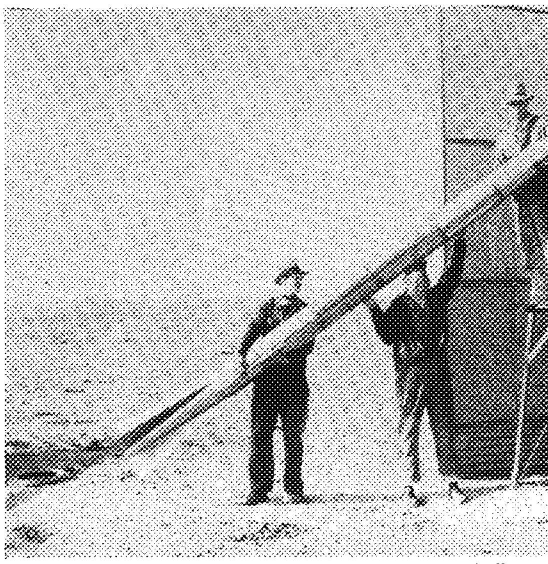
American Tests

Before the present war, experiments on rockets were conducted in most of the major countries. Now, however, American experimenters are conducting most of the tests. Experiments take two forms: ground tests with motor only; and actual test flights. Dr. Goddard, the ace of rocket experimenters, was the first to prove powder fuels unsatisfactory, and the superiority of liquid fuels. This started the serious scientific research in rocketry. In March, 1926, he made the first actual flight of a liquid fuel rocket. It flew 180 ft. at about 60 miles per hour. In 1929, he shot off a large rocket holding a barometer and camera. It made so much noise it brought people to investigate with the result it gave much unwanted publicity to Dr. Goddard. Many of the country's newspapers played it up as a moon rocket. Even though unwanted by Dr. Goddard the flurry created by the press took the attention of Charles Lindbergh who interested Daniel Guggenheim in rocket experimentation. As a result, the Guggenheim Foundation granted Dr. Goddard money to continue his experiments. In 1930, he shot his first New Mexico rocket. It reached 2,000 feet and went 500 miles per hour. None of these flights were for altitude but were solely to solve problems of fuel, materials, methods, and design. Later rockets have attained speeds as high as 700 miles per hour.

Atomic Power

Now that atomic energy is in sight, it brings up the interesting and speculative idea of applying it to rocketry. Since the atom of U-235 is broken up by slow neutrons, not fast ones, the energy of U-235 may be released by surrounding it by neutron-slowing water. When U-235 is put in water, all the water surrounding it bursts into super-heated steam. More water is fed in and the reaction continues until the water is removed, when the reaction stops. Very fine—all that is needed is to keep feeding water into the atomic power plant aboard the rocket ship and get all the power needed in the form of super-heated steam. But how is that power going to be transmitted to drive the rocket? If a higher jet-velocity is imparted to the atomic produced steam there would be greater power per pound of fuel than for the oxygen-liquid fuel reaction. But the higher velocity would mean higher temperature, and the oxy-gasoline or oxy-alcohol jet is already hotter than can be taken care of. So any gain made by super-heated steam would run up higher temperatures than any metal we have could stand. It is, in fact, rather ironical. Before, the desire was for more power. Now, when that power is available in quantities hitherto undreamed, it can't be used. However, there is only lacking a means of applying the fuel and can be worked out by the future atomic and rocket engineers.

For a little bit of prophecy, the rocket is nominally 90 per cent efficient. When all the difficulties are overcome and the practical efficiency approaches the theoretical, a grand and glorious future may be seen for the rocket. A new era in transportation may be opening up in which rockets may carry freight, mail, and passengers at speeds rivalling the telegraph. They are expected to usher in an era of swift communication, more revolutionary than that brought in by the telephone and airplane and "to alter once more the complexion of civilization as only basic inventions can alter it."

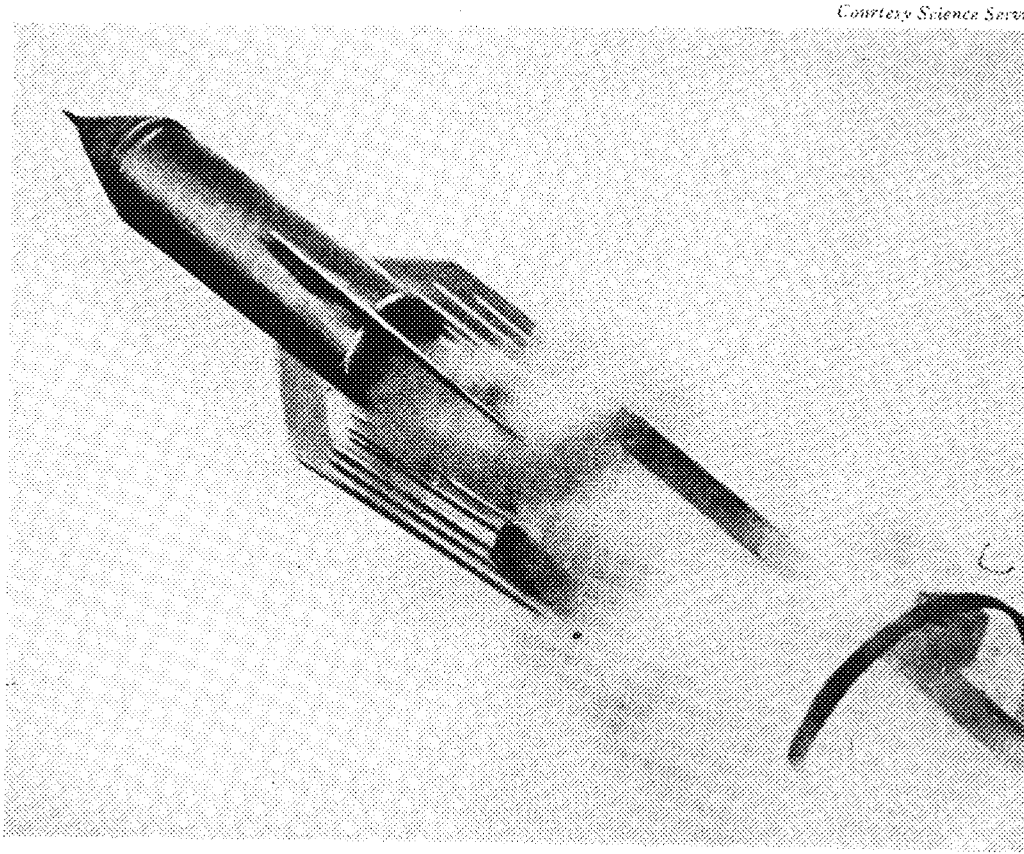


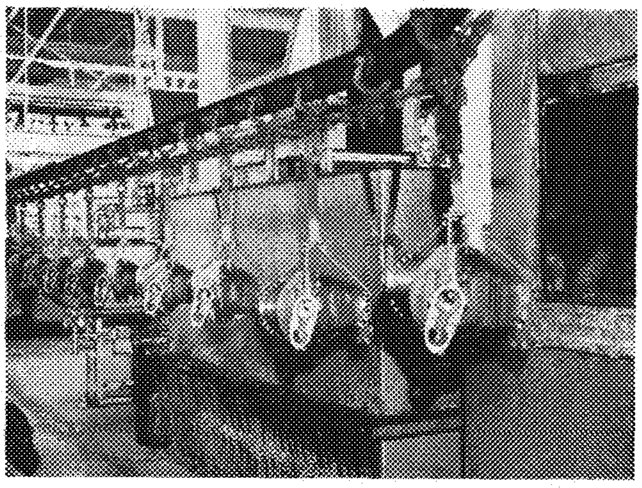
Courtesy Wisconsin Engine

Rocket being prepared for flight from flight tower.

This is a smaller sized German rocket invented by Gerhard Zucker, at the instant of take-off.

Courtesy Science Serv





Courtesy Aero Digest

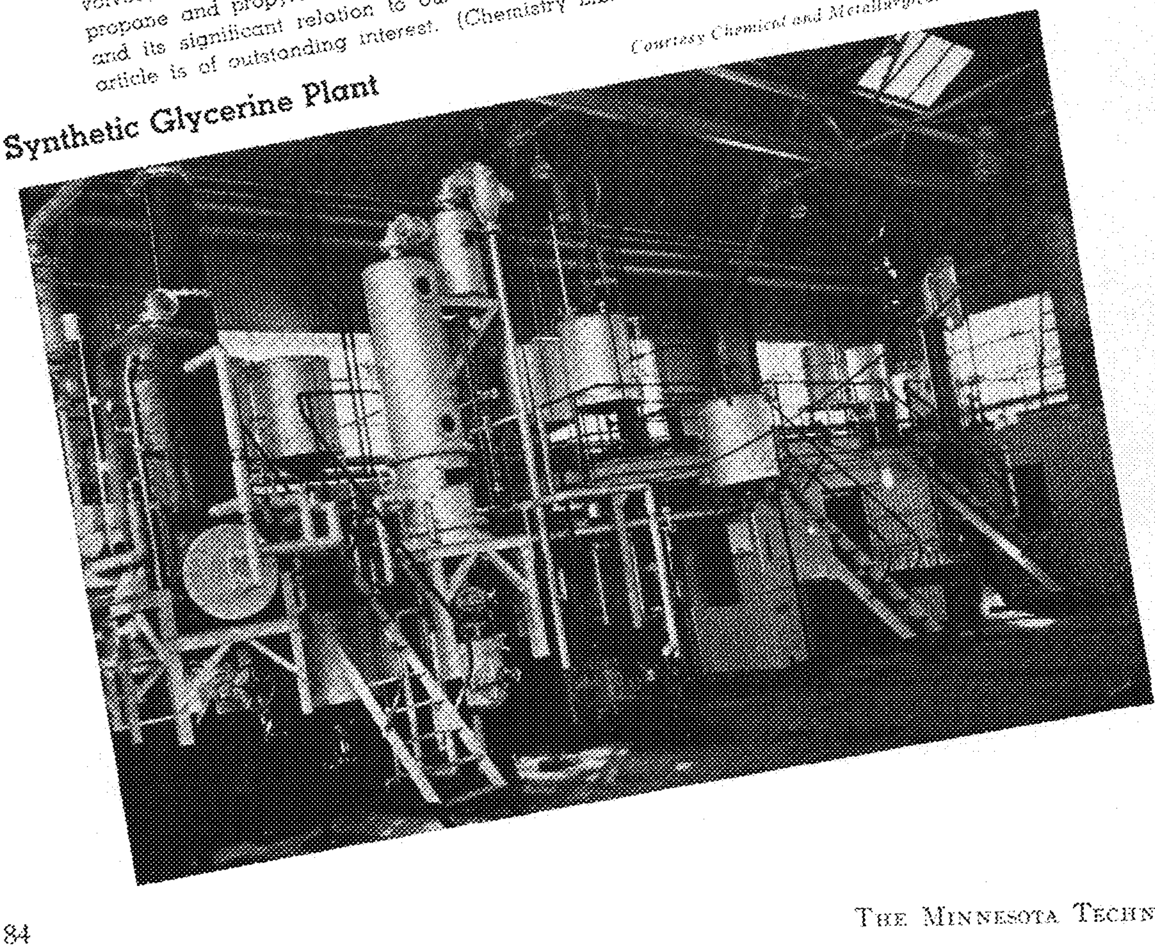
Engine Cylinders on Conveyor

Conveyor System Manufacture. In their new plant at Paterson, New Jersey, the Wright Aeronautical Corporation has installed a conveyor system in the paint shop to take advantage of cost reductions made by using line-production manufacturing methods. Production in the paint shop has increased 100% with a material cost reduction of 35% in addition to lessened worker fatigue. The photograph shows the conveyor system carrying engine cylinders into a vapor degreaser. This installation is described and illustrated in the **Aero Digest** for December, 1940. (Engineering Library)

Synthetic Glycerine. A new and remarkable discovery, the Shell synthetic glycerine process, is described in the December issue of **Chemical and Metallurgical Engineering.** This process is said to rank in importance with the Haber process for fixation of atmospheric nitrogen, developed during World War I. Although the article does not give a complete description of the process, an outline of the fundamental processes involved, and the problems encountered in synthesizing glycerine from propane and propylene is given. Because of its perfection at this time and its significant relation to our explosive raw material sources, this article is of outstanding interest. (Chemistry Library)

Courtesy Chemical and Metallurgical Engineering

Synthetic Glycerine Plant



Tunin
Tec

Max Butterfield
M.E.B. '42

Plastics From the Air.
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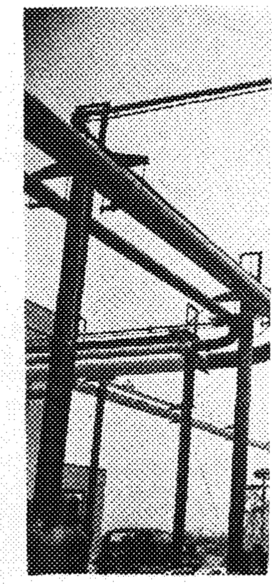
700-Foot Nickel P



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Bill Carter
E.E. '43

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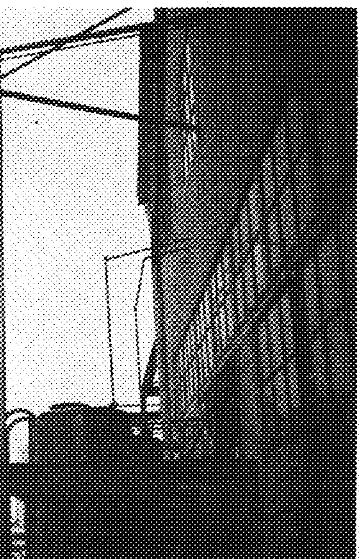

* * *

December issue of **Heating and**
pension-type service station and
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l room temperature, lack of heavy
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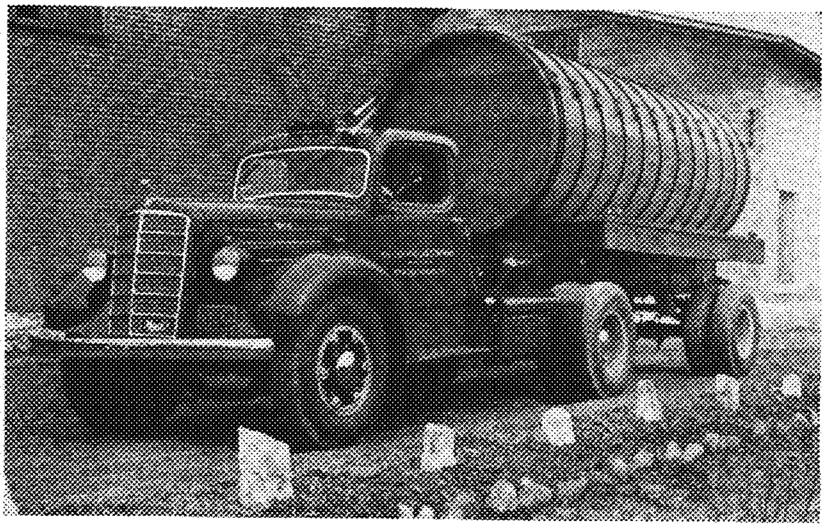
(Engineering Library)



Special Tractor-Trailer Unit

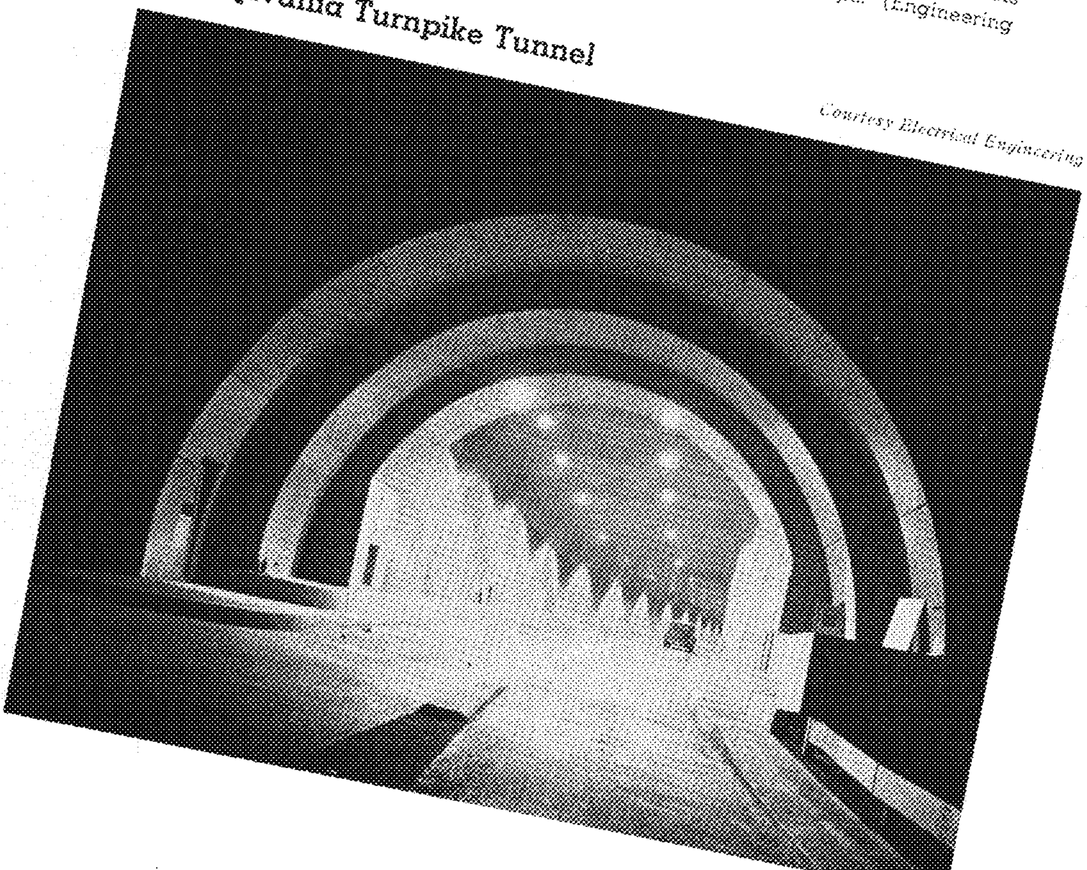
Courtesy Food Industries

Traveling Vinegar Barrel. Unusual applications of auto trucks in the food industries are shown and described in the December issue of **Food Industries.** The photograph shows a tractor-trailer unit mounting a 2,500-gallon, wood-stave vinegar tank for bulk transporation of vinegar to bottlers, pickle factories, and mustard mills. (Engineering Library)

Super Highways for America. The traffic safety lighting used for America's first important "super highway," the Pennsylvania Turnpike, is described in the December issue of **Electrical Engineering.** Four types of illuminants are used and their applications are described, as well as the provisions for emergency systems in the seven tunnels. These tunnels are the first tunnels ever lighted by mercury-vapor lamps. (Engineering Library)

Pennsylvania Turnpike Tunnel

Courtesy Electrical Engineering



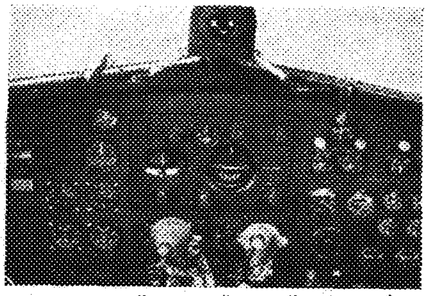
MODERN FLIGHT CONTROL BY GYROSCOPE

It's The Tops

By Tom Matteson **Aero. E. '42**

WITH the advent of larger commercial and military aircraft, the pilot's job has become a complicated routine including the reading of scores of gauges and meters which indicate power plant operation, condition of auxiliaries, and the speed, altitude and direction of the airplane; besides maintaining ground contact by radio, and controlling the plane in the air. In an effort to reduce the pilot's mental and physical strain, the Sperry Gyroscope Company introduced the first automatic gyropilot in 1932, the result of twenty-three years of experimentation with gyroscopes as a means of automatic control of aircraft.

So that the student engineer can best understand the operation of the gyropilot, a short discussion of physical properties of the gyroscope is advisable. The gyroscope, as a freely spinning body in space, exhibits two interesting properties: gyroscopic inertia, and precession. Gyroscopic inertia is the property by which the gyroscope remains in a set position regardless of the motion of its supports. This property is the basis of all gyroscopic control. This property is, however, only evident in gyroscopes having relatively small mass. Heavier gyroscopes have true north-seeking properties; that is, their axis tends to become parallel to that of the Earth. These larger gyroscopes are used in gyrocompass installations in ships. Precession is that property exhibited by a gyroscope when subjected to a force which tends to change its axis of rotation. If a gyroscope is subjected to an external force, instead of



Courtesy Sperry Gyroscope Co.

Gyropilot Panel

moving along the direction of this force, the axis of the gyroscope rotates in a plane at right angles to the applied force in the same direction as the initial spinning force. Precession presents a problem which must be overcome in order to obtain accurate gyroscopic control.

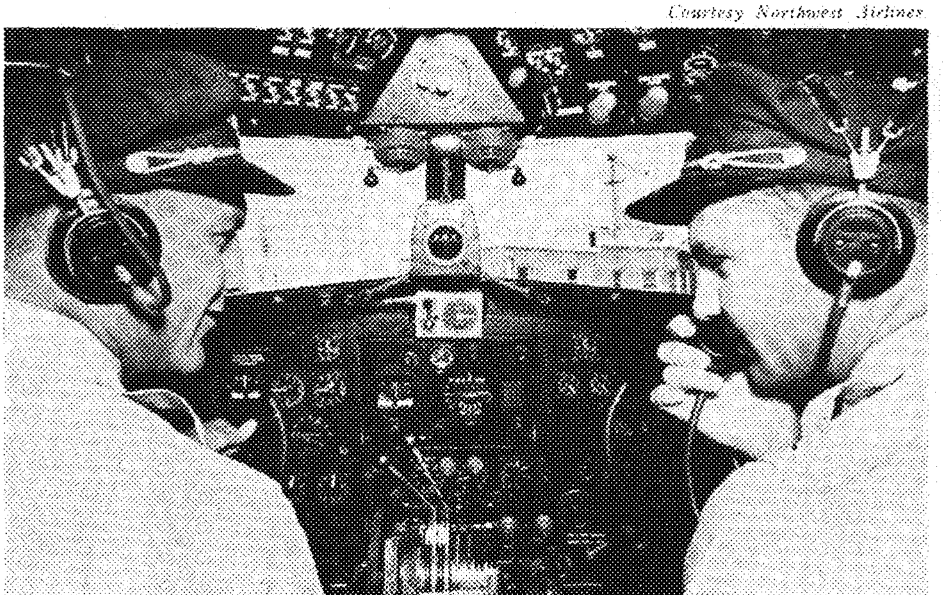
Early Experiments

The first successful gyropilot in a commercial airplane was installed in an Eastern Airlines Curtiss Condor in 1932. The essential elements of this equipment were two gyros—one horizontal, one vertical. Both were electrically driven. Displacement of the aircraft with reference to the gyros closed electrical contacts which energized solenoids, in turn, controlling a reversible bevel gear train fitted with a sawtooth type clutch for engaging and disengaging the mechanism. The horizontal or horizon gyro controlled the ailerons and elevator; the vertical or directional gyro controlled the rudder. These control units were mounted on a common power shaft rotated by a small wind-driven propeller mounted on the side of the fuselage. A hand clutch between the drive and the drum was introduced to enable the pilot to throw the automatic control on or off. To make the control surface movement proportional to deviation from the courses, a mechanical follow-up gear was applied to the contactors; this follow-up gear rotated the sliding switch contacts in the direction of the original displacement, causing the period of electrical contact to be proportional to the deviation.

The electro-mechanical type of control, although very practical, soon developed functional difficulties. The electrical contact system became unreliable, the gear train was cumbersome and expensive, the apparatus weighed 110 pounds, which was thought to be excessive, and horizontal and directional gyros were not fitted with the indicating dials which could be incorporated in the mechanism to aid the pilot in determining the position of the airplane relative to the ground. Because of these deficiencies, experiments began which resulted in the development of the Sperry gyro-hydraulic pilot.

Installation of the Sperry Gyropilot in a Northwest Airlines Douglas DC-3

Courtesy Northwest Airlines



The Modern Gyropilot

The gyro-hydraulic pilot mechanism consists of two separate units mounted side-by-side behind a single panel which contains the indicating and adjusting dials, the directional gyro mechanism, and the horizon gyro mechanism. The sensitive element of each mechanism is a high speed, freely suspended gyroscope. The rotor in the directional gyro is mounted so that its axis of rotation is horizontal, the axes of the two gimbal rings being at right angles to each other. This mounting arrangement allows the gyro to assume any possible position in space, the only resistance to its movement being friction in the gimbal ring bearings. In the course of time, friction and force due to acceleration tend to throw the directional gyro out of alignment approximately three degrees in a twenty minute period. A caging knob is used to reset the gyro by locking the gyro mounting and returning it, by means of pinion and ring gear, to the magnetic compass course. The caging knob is also used when a change in course is desired. A vacuum pump mounted on the airplane engine draws air through a filter to an air jet through which air flows striking serrations cut on the periphery of the rotor causing it to spin at 6000 to 7000 r.p.m. The air then is drawn past a rudder nozzle plate on top of the outer gimbal ring which regulates the flow of air into the air pick-offs. The air pick-offs are holes on opposite sides of the upper gimbal supports which lead to a balanced air valve. The upper gimbal support can be rotated to any magnetic heading by engaging and turning the rudder knob on the instrument panel. These headings are marked on the gyro follow-up card which is above the directional gyro card on the face of the instrument. When the follow-up card and gyro card readings are the same, the air pick-offs are in neutral, and the air flow into the pick-offs is equal, resulting in a balanced condition in the air valve. When the directional gyro is displaced to the left or right, the air flow to one side of the air valve is greater than to the other. This condition causes a displacement of an oil valve allowing oil at a maximum pressure of twenty five pounds per square inch to flow into one side of a double-acting hydraulic servo-motor directly connected to one rudder control cable. Oil pressure forces the piston to move in the cylinder producing a corresponding deflection of the rudder. An opposite displacement produces an opposite reaction in the system. A cable return again neutralizes the pressure in the air pick-offs as the plane returns to its position, so that the rudder is returned to neutral when the yaw has been corrected.

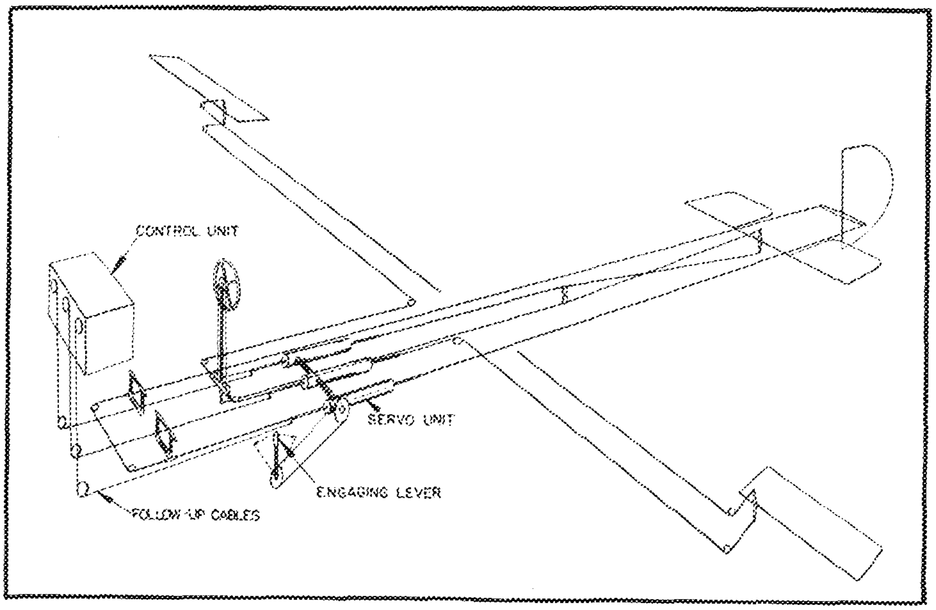
Turn Control

An automatic turn control, an accessory fitted on most hydraulic gyropilots, allows the pilot to turn the airplane to any heading by turning a switch on the instrument panel. The turn control operates an air valve which controls the flow of air to a small air turbine within the directional gyro control unit. This air turbine drives the rudder knob and follow-up card in the proper direction to produce the turn. To cease turning, the pilot moves the turn control to center position. While making the turn, he turns the aileron knob to produce the desired bank for the turn, returning it to its original position after the turn is completed.

The horizon gyro is mounted so that its axis is vertical, the axes of the gimbal rings being horizontal and at right angles to each other. Air drawn into the instrument case by the engine-operated vacuum pump flows through an air jet to the gyro rotor. Air leaving the rotor case flows through a ring-like hole around the lower rotor bearing, to a precession correction chamber. About the circumference of this lower part of the horizon rotor case are four rectangular holes at right angles to each other. Each hole is partially covered by a pendulous vane, pivoted about its upper end so that if the gyroscope case tilts, these vanes increase or decrease the amount of air passing through a given aperture. An uneven blast of air exerts a force at angles to the direction of tilt, and since, as previously stated, the gyroscope moves at right angles to an external force, the gyroscope rights itself. If there were no precession correction chamber, the gyroscope would lose all reference to the vertical axis about which it began to rotate, because of the external forces presented by acceleration and centrifugal force; and it would become useless as a controlling device.

Schematic Diagram Showing Relative Positions of Sperry Gyropilot Control Elements

Courtesy Sperry Gyroscope Co.



Air flows from the precession correction device past the aileron and elevator nozzle plates into the air pick-offs located on the rear and right of the gyro mounting. The banking pick-offs are connected to a follow-up pointer at the top of the indicating dial. The climbing-diving pick-offs are connected to a follow-up pointer at the right side of the indicating dial. As in the directional gyro mechanism, the elevator and aileron pick-offs are in neutral when they match those connected to the horizon gyro rotor. The climb and bank knobs on the instrument can be used to move the follow-up pointers into position prior to turning on the gyropilot, or they can be used to maneuver the plane while the gyropilot is in operation. An artificial horizon bar linked to the horizon gyro rotor is marked with the end view silhouette of an airplane and moves with relation to artificial horizon marks on the sides of the instrument face to indicate actual attitude of the plane.

If the airplane is banked beyond thirty degrees, the gyro rotor may invert and cease to be of any use until its movement is locked and rotated to its normal position by use of the horizon gyro caging knob. Two cable returns, which can be seen in the diagrammatic drawing, operate follow-up mechanisms which make correction proportional to the initial deflection. The hydraulic servo-motor systems are identical to that used in the directional gyro mechanism; one controlling the elevators, the other controlling the ailerons.

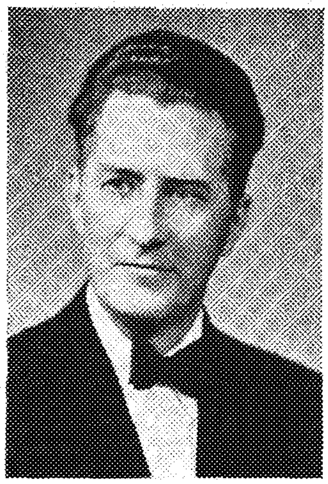
A level flight mechanism in the horizon control unit, which can be turned on or off by the level flight knob on the instrument panel, can be used to maintain the airplane at a constant pressure altitude during long flights. This device employs a balanced diaphragm which moves if the altitude of the airplane changes, actuating an air turbine. The air turbine drives the climb knob, returning the airplane to its original altitude. This device is especially useful in bumpy air where considerable loss of altitude may occur as a result of successive small losses in altitude.

Speed valves, controllable from the cockpit, regulate the reaction speed according to the airspeed of the airplane by reducing the oil pressure acting on the servo-motor cylinders. The servo-motor cylinders are usually located beneath the floor of the cabin in transport plane installations. Each cylinder has a by-pass valve through which the oil flows when the gyropilot is not in us. The air-operated oil valves, which control the direction of flow of oil to the servo-motor cylinders, are mounted behind the control unit on the instrument panel.

The hydraulic gyropilot has a direct reference means of setting it to any desired course. By pointing the airplane along the correct course and flight angle, then moving the directional and horizon gyro follow-up dials by means of the setting and caging knobs so that these dials coincide with the readings of the indicator dials, the gyropilot will hold the plane to the desired course. Turns, climbs, and dives can also be made while the gyropilot is in operation by turning the rudder, elevator, and aileron control knobs.

Wide Use

The Sperry gyropilot is a monument to American ingenuity. The entire device weighs less than 75 pounds, less than half the average pilot's weight; in spite of this it performs some tasks better than he can, allows the pilot to relax periodically on long, strenuous flights, and still enables him to take over should any emergency arise. The Sperry gyropilot is now being used in airplanes large and small by almost every major commercial airline and military power in the world. It is truly one of the greatest contributions to safety in commercial and military aviation.



ALUMNI NOTES

Featuring In This Issue Institute Graduates

In The Field of Mining and Metallurgy

By Ward M. Hanson, Ch.E. '42

'09 Samuel L. Hoyt

Dr. Samuel L. Hoyt, who is at present technical advisor for the Battelle Memorial Institute at Columbus, Ohio, is one of the mining graduates to whom the entire department of metallurgy points with pride. A native Minneapolitan, he graduated from the University of Minnesota in 1909, and has since been engaged in research work of various types.

Graduating from Minneapolis Central High School in 1905, Dr. Hoyt entered the University in the School of Mines in which he was an outstanding scholar. Upon graduation he studied from 1909-1911 at Columbia University working on a degree of Ph.D. The next two years he spent at the Royal School of Technology at Charlottenburg, Germany, where he completed the work on his thesis. The next year, 1913, he returned to the University of Minnesota as Assistant Professor of Metallography.

After some years Dr. Hoyt left the University to accept a position as metallurgist with the General Electric Co. at Nela Park, Cleveland, Ohio, where he specialized on tungsten lamp filaments. He was later transferred to the main division of the General Electric Co. in Schenectady, New York. In addition to his regular work, Dr. Hoyt at this time carried out some research on tungsten carbide which led to its being utilized as a cutting tool in the form of an alloy, carballoy.

Dr. Hoyt's next position was with the A. O. Smith Co. of Milwaukee, a firm which makes industrial equipment (cracking stills, etc.), where he was director of research. It was in 1939 that he went to the Battelle Institute as technical advisor, a position he has held up to the present.

A member of many technical societies and author of many technical papers, Dr. Samuel L. Hoyt is an inspiration to young engineers.

'10

Mr. C. E., and Mrs. H. J. Asleson of Minneapolis, Minnesota announce the engagement of their daughter, **Ruth Gertrude** '39, to **William E. Bronlow** '36 B. of Minneapolis. Mr. Bronlow is a graduate of Shattuck military school.

'12

Walter S. Olson, Mi., who has been located in Bakersfield, California, has been transferred to New York City in the employ of The Texas Company. He is handling the foreign geophysical and geological interests of the company. His mail should now be addressed to 135 East 42 St., New York City, c/o The Texas Co.

'17

Ellsworth R. Boyce employed by the Minnesota State Highway Department was recently promoted from the position of project engineer to district maintenance engineer. He has been stationed at Marshall, Minnesota.

'17 A. I. Levorsen

A. Irving Levorsen graduated from the School of Mines with the Degree of E.M. and through a combination of shrewd judgment, sound business ability, and a marvelous personality has advanced to a position where he is recognized as probably the best oil geologist in the world.

Upon graduation, Mr. Levorsen became geologist for the Greenwood Co. of Minneapolis. The same year, 1917, saw him ushered into the defense of Uncle Sam as a private in an engineering division. He emerged from the army as a Sergeant-Major in April, 1919, and returned to industry to work for the Greenwood Co. at Wichita, Kansas. From there Mr. Levorsen went to work for Johnston and Getzendaner at Okmulgee, Oklahoma, where he stayed through 1923. He then became geologist for the Gypsy Oil Co., the Philmack Oil Co., at Tulsa, and the Independent Oil and Gas Co., in succession. He is now Consulting Petroleum Geologist for the Tide Water Oil Co. of Tulsa.

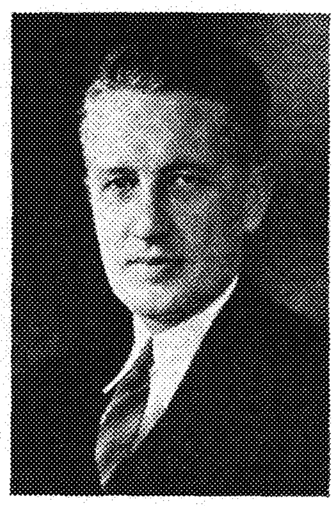


Photo by Bachrach

When the company for which he was chief geologist was merged with another in 1932, A. Irving Levorsen went out on his own. With seven partners he purchased some land in Oklahoma and proceeded to borrow money to sink the wells. They sank 120 oil wells which have produced 80 million barrels of high grade oil and are still producing.

Since he has become independent, Mr. Levorsen has devoted his time to furthering the interests of his profession. He has given a large number of lectures all over the country and is a member of the A.I.M.E., the A.A.P.G., and the G.S.A. He has a winter home in Tulsa and spends his summers with his family at his lodge near Erie. His son is coming to the University of Minnesota in 1941.

'19

Donald E. Marshall, E.E., is now in charge of the manufacturing division of the Palmolive Colgate Company in Jersey City. He is now residing in Summit, New Jersey.

'23

Lester J. Eck, Ch.E., is Superintendent and Chief Engineer for the Minneapolis Gas Light Company and resides at 3810 Ewing Avenue South, Minneapolis. Mr. and Mrs. Eck are well known in amateur photography circles and have had a number of their studies published.

(Continued on Page 94)

News From the Tech Societies

A.I.E.E. Is Active

Bill White, secretary-treasurer of the A.I.E.E., reports a very good membership this year. As the *Log* goes to press, the local membership just passes a hundred. Thirty-five have procured national memberships and are starting to receive their "*Electrical Engineering*" magazines.

Members of the A.I.E.E. will hear Mr. Willey of the Bell Telephone Company speak on the new coaxial cable between Minneapolis and Stevens Point, Wis., at their first meeting of the winter quarter.

All E.E.'s are warned to be on the watch for the campus appearance of Ralph Willey of the Northwestern Bell Telephone Company. He will give an illustrated evening lecture on the "Coaxial Cable," a product of engineering ingenuity which is coming to dominate the electrical communication field.

Charlie Scott, who was elected to the chairmanship of the Electrical Show, is anxious to hear from all E.E.'s who want to do committee work. Committee chairmen will be chosen very soon so that work on the show can get started. This show is a biennial gala event in the lives of all alert E.E.'s, and Charlie is confident that the spring of 1941 will see the best show yet.

Ags Present Award

At their last meeting, members of the A.S.Ag.E. voted to present an award to an outstanding member of their organization at the close of the school year. Leighton O'Hara was appointed chairman of the award committee.

A.S.C.E. to See Movies

Members of the A.S.C.E. will see at least two movies during the winter quarter. Scheduled for their first meetings are pictures of South America taken by an engineer who has only recently returned from there, and pictures of moving earthwork to be shown by Gordon Lundeen, C.E. '42.

The chapter is also planning to have a sleighride sometime in January or February.

I.Ae.S. to Drive for Building

At a meeting of all aeronautical engineering students sponsored by the I.Ae.S., plans were made to raise money for the publication of the pamphlet, "Aeronautical Engineering and Its Needs at the University of Minnesota" written by Prof. John Akerman. The meeting was held in the main engineering building on December 19. It was decided to ask for individual contributions from aeronautical engineers. The I.Ae.S. will make up any deficit in the contributions up to $50.

Published late last December, was a pamphlet written by Prof. John Akerman entitled, "Aeronautical Engineering and Its Needs at the University of Minnesota." The pamphlet stresses the need for a new aeronautical engineering building at the University. State legislators, and members of the State Federation of Women's Clubs will receive copies of the pamphlet.

A.S.M.E. Starts Drive

Bob Jacobson, chairman of the A.S.M.E. membership committee, will lead an intensive drive to increase the membership of the Minnesota chapter until it is one of the five largest student chapters in the country. The percentage of mechanical engineers who are members of the A.S.M.E. is far below that of last year, when the Minnesota chapter was in fifth place in the national rating. Gordon Ersted, president of the society, recently stated that, "Membership in his engineering society is the privilege and duty of every engineer."

Plans are being made to have a picture of the Minnesota chapter appear in an early issue of the *Mechanical Engineering* magazine.

Miner's Shindig Planned

Ted Berquist, chairman of the committee in charge of the Miner's Shindig, announced that the Shindig will be held at the Dyckman Hotel on Saturday, February 1. Larry Robert's orchestra will play.

A.I.M.E. Gives Luncheon

Student members of the A.I.M.E. were guests of the Minnesota section of the A.I.M.E. at a luncheon given in the Union on Tuesday, December 10. At the luncheon, each student was introduced to the members of the parent organization.

A.S.M. Hears Dr. Harder

Dr. Oscar E. Harder, national president of the American Society of Metals, spoke to members and junior members (students) of the Northwest Chapter of the ASM on the "Physical Metallurgy of Bearing Metals" at their meeting on January 6, in the Union. The talk followed a dinner meeting of the Society.

Dr. Harder was elected national president of the ASM at its convention in Cleveland, last October. He was professor of metallurgy at the University of Minnesota from 1919 to 1930, when he joined the staff of the Batelle Memorial Institute. At the present time Dr. Harder is the assistant director of the Institute. He is noted especially for his work in physical metallurgy. Dr. Harder holds membership in Phi Lambda Upsilon, Sigma Xi, Alpha Chi Sigma, and numerous technical societies.

Also on the program were Bill Eisenman, national secretary of the ASM, who spoke on Society activities, and Phil Brain's 1940 Minnesota football pictures.

Dr. Henry S. Jerabek, assistant professor of metallography, is chairman of the Northwest Chapter.

Draft Head Speaks to A.I.Ch.E.

The first A.I.Ch.E. meeting of the new year was held January 9 and featured as guest speaker, Col. Norman D. Dean, who spoke on the draft and the engineer. During the meeting plans for the Chemistry banquet were discussed, as well as field trips in the near future. A future meeting will feature the showing of a film on the reclaiming of rubber.

Dr. William Sohl To Speak At Chemistry Banquet

Dr. William Sohl, of Minnesota Mining and Manufacturing Company, has been selected as guest speaker and Dr. C. A. Mann, head of the Department of Chemical Engineering, as toastmaster for the Annual All-Chemistry Banquet to be held Tuesday, January 28, at 6:30 P. M. in the Junior Ballroom of the Coffman Memorial Union. Dr. Sohl will speak on the place of chemistry in industry as the need for increased production becomes imperative.

The program for this student-faculty banquet will also include playlets lampooning outstanding personalities on the School of Chemistry staff, community singing, and a surprise number in the form of a girl singer or dancer. Heads of chemistry departments will introduce the faculty members and graduate assistants on their respective staffs.

The speaker of the evening, Dr. Sohl, graduated from the Case School of Applied Science in 1928 with a degree of B.Sc. in Ch.E. After working for the Goodrich Rubber Company a year and a half, he left their employ to attend the University of Illinois, where he obtained his Ph.D. degree in 1933 and taught as a junior faculty member. He then accepted a position with Dupont to work in their experiment station at Wilmington, Delaware, but he was later transferred to the ammonia plant at Charleston, West Virginia. His work at Minnesota Mining and Manufacturing Company, where he has been employed since 1937, has been directed largely toward the study and preparation of adhesives.

Leroy V. Gullings is the general arrangements chairman for the banquet. He is being assisted by Kenneth Voge, program chairman; John Johnson, ticket chairman; and Robert Widing, publicity chairman. The banquet is sponsored by the student chapter of the American Institute of Chemical Engineers and is supported by the Minnesota Student Chemical Society.

Manganese Production Studied By Minnesota Professors

A federal grant of $25,000 has been allotted for a pilot plant study of the possible production of ferro-grade manganese from the South Dakota manganese deposits. Professor Lloyd H. Reyerson will be in direct charge of the tests, and will be assisted by Professor R. E. Montonna of the Department of Chemical Engineering and Carl Wallfred. The project is under the general supervision of the United States Bureau of Mines. First studies of these deposits were made by Dr. Reyerson and his associates under the Northwest Research Foundation.

Faculty Members Win Awards Speak at Conventions

One of the six $2,000 fellowships for research in organic chemistry recently given by the E. I. duPont deNemours Co. was awarded to R. T. Arnold, Assistant Professor of Organic Chemistry. This grant will provide Dr. Arnold with a Ph.D. research assistant for his researches now in progress. Minnesota also receives annually one of the $750 duPont postgraduate fellowships.

Dr. Edgar L. Piret, Instructor in Chemical Engineering, attended the annual meeting of the American Institute of Chemical Engineers at New Orleans, December 2-5. Dr. Piret and Mr. E. J. Kuth presented a paper on air flow measurements. At this meeting, Dr. F. C. Frary, Director of Research of the Aluminum Company of America, former student (Ph.D. 1912 Minnesota) of the School of Chemistry, was made president-elect.

The marriage of Dr. Bryce L. Crawford to Miss Ruth Raney took place in Chicago on December 21. Following the ceremony they left for a honeymoon in New York City where Dr. Crawford presented a paper at the "Symposium on Structure of Molecules and Aggregates of Molecules" entitled "Force Constants of Organic Molecules."

We Present . . .

John H. Kuhlmann

Associate Professor of Electrical Engineering

By John Lambert, E.E. '41

A MAN'S MAN—with a voice and bearing which is the envy of all men—is John H. Kuhlmann, Associate Professor of Electrical Engineering. He refuses to comment on the accusation that he was quite a lady's man, too, though his stories about people and situations have made him a much-sought toastmaster.

He received his B.A. from Wartburg College in 1913 and became head test-man for the Electric Machinery Company. In 1917, after attending classes and completing a thesis on design while working full time, he was awarded a B.E.E. at the University of Iowa. In the fall of 1920 he came to the University of Minnesota as an instructor, while continuing his work as a consulting specialist for the Electric Machinery Company. In 1921 he received his Professional Electrical Engineer degree from the University of Iowa. He spent the summer of 1926 in Schenectady designing industrial D.C. machinery for G. E.

Professor Kuhlmann is an active member of the A.I.E.E. and has attended several national conventions as official delegate from this district. In 1929 this took him to Toronto; in 1935 to Ithaca; in 1936 to Pasadena. On the latter trip he traveled 9,000 miles and saw every major engineering project, engineering school, and scenic spot in the West. This included the Grand Canyon, Boulder Dam, Dry Falls, Grand Coulee, Glacier and Yosemite Parks, the Tea Tongs, Boneville Dam, Crater Lake, Yellowstone, Palo Alto, Stanford, and U.C.L.A. At U.C.L.A. he dropped in for a chat with Spaulding, the former Minnesota coach. Another of his trips took him to Florida. He has seen nearly all of the major E.E. schools in the United States and thinks Minnesota rates tops.

He looks forward to spending a sabbatical leave in Europe when things quiet down over there. His wife has spent five summers there, but he was busy writing his book and unable to accompany her. Aside from his book, he has written articles for the *Electrical Review*—articles on vacuum-tube rectifiers and the calculation of characteristics for synchronous machines.

Mr. Kuhlmann likes to build things and likes to see the machinery itself at work—once during his first year at Iowa he was given permission to see the hydro plant. He stepped into the unlighted room and fell into the 8-foot waterhead just over the turbines. The water was boiling around him, and a lucky kick and grab left him dangling from the counterbalance of a water gate. He narrowly escaped becoming a shredded engineer and says he wouldn't want to try the same trick again.

He likes fishing, golf, and photography—owns an original glass-plate camera and hopes some day to go to Mexico where prices are down and buy an expensive modern movie camera. He is an all-around good fellow and a man much respected by every student in the E.E. department.

ALUMNI NOTES CONTINUED

'23

Charles V. Firth, Ch.E., is with the Mines Experimental Station at the University of Minnesota. The Firths who live at 2540 Seabury Ave., Minneapolis, are very proud of their new son who is scheduled for a fullback position of the Minnesota squad of 1959. Mr. Firth has been a guiding factor in the growth of the active chapter of Alpha Chi Sigma for the past ten years.

'24

Mr. L. A. Tvedt, C.E., and **Mrs. Tvedt** (Mary Slocumb, '25 E.) are living in Memphis, Tennessee where Mr. Tvedt is a partner of the E. O. Korsmo Construction Company.

C. Milford Olson, C. E., and **Carl H. Buetow** under the firm "Buetow and Olson" are doing architectural and engineering work. Their offices are in St. Paul, Minnesota.

'34

Gordon J. Bina, C.E., who is living at 404 Philippine St., Taft, California, is working in the Purchase and Stores Department of the Standard Oil Co. of California. He is in charge of inspecting of materials and shipping. There is also a Mrs. Bina. His hobby is photography.

Gordon P. Hollingsworth, Ch.E., research chemist for the Minnesota Mining and Manufacturing Company, has a new address in Detroit. It is 1155 West Six Mile Road, Detroit, Michigan.

Lt. L. F. Vobeyda, Mi., is stationed at Fort Winfield Scott at San Francisco, California.

Helmar E. Hanson, Mi., sales engineer for the Fairbanks-Morse Company of St. Paul, has just bought a house in the block where he has lived for the past few years. Mr. and Mrs. Hanson (Katherine Jones '35 Ex.) live at 732 East Arlington Ave., St. Paul.

'38

Lt. Robert R. Burns, Ae.E., traveling by car from Coronado, California, for the Michigan-Minnesota football game, was marooned with many other travelers by the blizzard. Lt. Burns will be able to judge for himself now which has the better climate, California or Florida, for he is being transferred to Pensacola, Florida, where he will instruct at the Naval Air Station.

Gordon W. Johnson, Ch.E., has recently been promoted in the employ of the American Hoist and Derrick Company in St. Paul. He is living at the chapter house of the chemical engineering fraternity, Alpha Chi Sigma.

Vernon Skogan, Ch.E., was married to Jeane Parker, October 19. He is working in the research laboratories of the Standard Oil Company of Whiting, Indiana.

'40

Mr. and Mrs. Nicholas Kenjoski, Jr.—she is the former Lorraine Belle Johnson, '40 H.E.—were recently married and are residing at 1430 Spruce Place, Minneapolis. Mrs. Kenjoski is a member of Phi Chi Delta sorority.

The wedding of Janet Bordewich, '42, to **William F. Johnson,** is announced by her parents, Mr. and Mrs. Harold Bordewich of Olivia. The wedding took place on December 22. Miss Bordewich is a member of Kappa Alpha Theta sorority. Mr. Johnson is a member of Beta Theta Pi and Tau Beta Pi fraternities. The Johnsons will live in Wilmington, Delaware.

Harry E. Hillstrom and **Leland Bachelder** have a new address, 5818 Lotusdale Drive, Parma Heights, Ohio.

Puns Aplenty

By Russell Anderson, Ch.E. '43

"Hello, is this the cooking school?" asked the bride, who had been married for only two weeks.

"Yes, it is," came the reply.

"Well, those biscuits you taught me how to make, I don't think they are very good."

"Why not?"

"My husband sat down at the table five days ago, and ate six of them. Then he just sat back and smiled."

"Smiled, eh?"

"Yes, and he's still sitting there—smiling."

• • •

A. "What caused the big collision today?"
B. "Two motorists after the same pedestrian."

• • •

George had taken his girl to lunch. As they sat down she spoke to a nice-looking man at the next table.

"Is that man a friend of yours?" asked George.

"Yes," she replied.

"Well, why don't we ask him to join us!"

"Oh, George, this is so sudden," cooed the girl.

• • •

At a busy corner downtown, the other day, two old maids and two sailors got on a bus. There being only two seats left, the old maids sat down. However, in a few minutes, one sailor leaned over and whispered to the other sailor.

One of the old maids overheard the talk and promptly warned her companion.

In a little while, the maids rose to leave, but very cautiously backed down the aisle—all the while facing the sailors.

Then, as they alighted, the second maid said to the first, "Why did you want to back down the aisle?"

"Well," replied the first, "I overhead that one sailor say to the other, 'Let's grab the old maids' seats as soon as they get up.'"

• • •

"Don't you ever get Jimmie and Jack confused?"

"Yes, Mother, I get Jimmie confused one night and Jack the next."

• • •

A gentleman in the optical business was instructing his son in the technique of edging a fair and honest price out of a customer.

He said, "Son, after you have fitted glasses to a customer and the customer asks, 'What's the charge?' you say: 'The charge is ten dollars.'

"Then you pause and watch for the flinch. If the customer doesn't flinch, you say: 'That's for the frames; the lenses will be another ten dollars.'"

"Then you pause again, but this time just slightly, and again and watch for the flinch."

"If the customer doesn't flinch, you say: 'Each.'"

• • •

Inquirer: "How in the world do you make a go of things at all?"

Storekeeper: "You see that fellow there? Well, he works for me and I can't pay him; so in two years he gets the store. Then I work for him till I get it back."

Wit or WITOUT

Marvin Diers M.E.B. '42 — Arthur Templin E.E. '41

A newly married couple, on a honeymoon put up at a skyscraper hotel. The bridegroom felt indisposed and the bride said she would slip out and do a little shopping. In due time she returned and tripped blithely up to her room a little awed by the number of doors that looked alike. But she was sure of her own and tapped gently on the panel.

"I'm back, honey! Let me in!" she whispered. No answer.

"Honey, honey! It's Mabel. Let me in!"

There was silence for several seconds. Then a man's voice, cold and full of dignity, came from the other side of the door.

"Madam, this is not a beehive, it's a bathroom."

* * *

"Mary, did I see you kissing that policeman in the kitchen? I'm amazed at you."

"Well, mum, it's against the law to resist an officer."

* * *

A woman was testifying in behalf of her son, and swore that he worked on a farm ever since he was born.

The lawyer said, "You assert that your son has worked on a farm ever since he was born?"

"I do."

"What did he do the first year?"

"He milked."

* * *

Said one glow-worm to the other, "When you gotta glow, you gotta glow."

* * *

The pompous judge glared sternly over his spectacles at the tattered prisoner who had been dragged before the bar of justice on a charge of vagrancy.

"Have you ever earned a dollar in your life?" he asked in fine scorn.

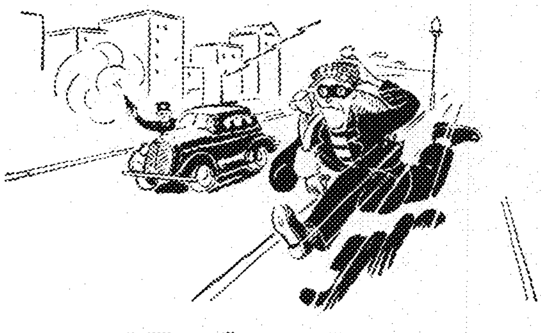
"Yes your honor," was the response, "I voted for you last election."

* * *

A Scotchman's wife was dying. Calling her husband to the bedside, she said, "John, I know you dinna like Aunt Janet but you'll let her ride with you in the carriage to the funeral?"

The husband, much moved, answered, "I'll do it for you, Maggie, but it'll spoil my day."

G-E Campus News



STOP THIEF!

BURGLARS and other criminals can no longer hope that bad radio weather will increase their chances of a getaway by gumming up police radio. Atmospheric disturbances, ignition noises, street car interference—in fact all the reception devils that plague the life of radio police practically disappear with the introduction of frequency modulation, the new method of broadcasting developed by Major E. H. Armstrong. Several two-way FM installations have already been made. One of the first was in Douglas County, Nebraska, which recently installed a number of G-E transmitters and receivers.

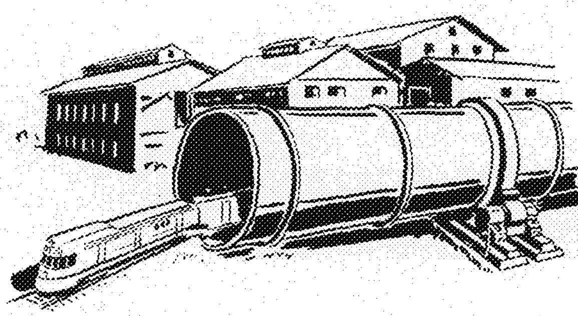
Among those responsible for many of the G-E developments which have made two-way FM possible are I. R. Weir (Rose Poly, '21) and H. P. Thomas (Harvard, '25)—transmitter engineers; and W. C. White (Columbia, '12) and K. C. DeWalt (Iowa, '27)—vacuum tube engineers.

GREASED LIGHTNING

THIRTY-ONE hundred revolutions a minute is lightning fast all right. But when a bearing revolving at that speed makes more noise than a boiler factory and coasts to a stop in 12 seconds, then it's time to look for a good lubricant. There's a catch though; the bearing is a part of an x-ray tube and operates in a high vacuum. The tendency of oil and grease to vaporize under these conditions makes it impossible to use ordinary lubricants.

So G. E. X-Ray Corporation engineers Atlee (Oregon State, '29), Filmer (Armour Tech, '31), and Wilson (College of Emporia, '31) set to work and developed a new lubricant—barium. When a thin film of this metal was applied to the bearing, its speed rose to over 3500 rpm, the noise of operation was materially reduced, and the coasting time was increased to eight minutes.

The benefit of these young men's research is not limited to the x-ray field alone, for their findings will apply equally well in all cases where rotating devices operate in a vacuum.



GARGANTUAN GARAGE

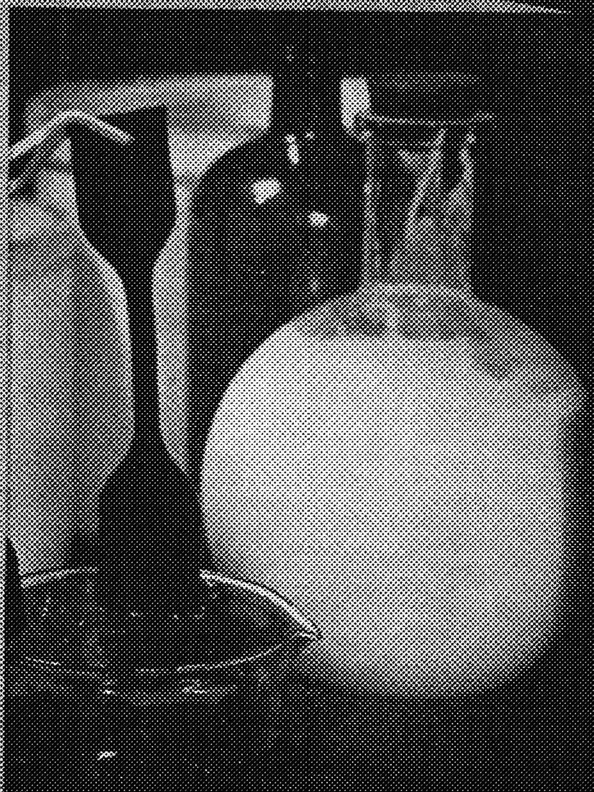
IF Burlington Railroad officials would give their permission, you could drive their Twin Zephyrs into the newest kiln of the Permanente cement mill in California and still have enough room left over for a large freight car.

This cement kiln, one of the largest pieces of rotating machinery in industry, measures 450 by 14 feet. It will be used in furnishing 6,000,000 barrels of cement for the construction of Shasta Dam.

The kiln will be driven by a 200-hp G-E motor—the largest ever built for this purpose and representing an innovation in design as well as size.

The big motor was tested by young engineering college graduates taking the General Electric Test Course at Schenectady.

THE TECHNO-LOG



FEATURI
RUBBER F
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ELECTRONIC M
NEW TYPE TEST
TESTING FOR PREC

FEBRUARY, 1941 VOL. XXI N

OF MINNESOTA

Authors . . . Staff . . . .

By Richard Opland, C.E. '43

The article on electron microscopes is written by **Otto H. Schmitt**, instructor in physics and zoology. Mr. Schmitt is an alumnus of Washington University, St. Louis, where he received his Ph.D. in 1936. He then journeyed to England where he engaged in research in bio-physics at the University College, London, under Professor A. V. Hill. Mr. Schmitt left England in the summer of 1939, with war being declared while he was crossing the Atlantic. He tells of the strict refusal of the ship's authorities to give out news concerning war developments. Determined to know what was going on, he connived to rig up his own wireless set and strung out of his cabin a wire which went unnoticed. The result was that he got all the news "hot off the wire."

Jack Rockwell and his pipe look like a tobacco advertisement when he's at work in the TECHNO-LOG office. In this issue, Jack gives us the lowdown on color photography, an innovation that is a great step toward improved pictures. With Jack, photography is a hobby, and he makes a valuable member of the illustrations staff. The December and January cover pictures are samples of his work. Incidentally, that double effect on the January picture was an accident, but it shows that, even when Jack makes a mistake, he does a good job. Scouting is another of his interests: he is an Eagle Scout and a Junior Assistant Scoutmaster. Jack calls sleeping America's greatest indoor sport and says his ambition is to harvest century plants. However, he'll probably make a good electrical engineer.

John McCool, who tells us about artificial rubber in this issue, is a graduate student in organic chemistry and is working for his Ph.D. under Dr. R. T. Arnold. Mr. McCool graduated from St. Thomas College in 1936 with a B.S. degree and then came to Minnesota to earn his M.S. degree. From 1936 to 1938, he served as a teaching assistant in chemistry at St. Thomas. Last year, he worked on a part-time basis with the Minnesota Mining Co. in the tape research laboratory. McCool is very much interested in rubber chemistry and has presented a paper on synthetic rubber to the Organic Chemistry Seminar. When he's not at work in the laboratory, McCool might be found at the bowling alleys, bowling being his favorite sport.

Professor Forrest E. Miller, Assistant Professor of Materials of Engineering, is the author of an informative article on the hydraulic press. Professor Miller graduated from Iowa State University in 1917 and faced a situation many draftees and army volunteers are facing today. He was sent to a Texas training camp and later saw service in France. On his return from abroad, he accepted a high school teaching position in his home town of Pulaski, Iowa. In 1923, Professor Miller acquired his Master's degree at Minnesota, and he later accepted a position at the School of Mines in Miami, Oklahoma. For sport and relaxation, Professor Miller likes fishing, and he also enjoys a good game of tennis.

Wallace K. Belin

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The editorial policy of the TECHNO-LOG is to present material for technology students which it is hoped will strike a happy medium between the superficial and the highly specialized.

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The purpose of the TECHNO-LOG is two-fold: First, to put in the hands of TECHNO-LOG subscribers highly worth-while and interesting reading material; second, to offer technology students an invaluable opportunity to get writing, selling, and working-with-others experience.

THE MINNESOTA

Techno-Log

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Frontispiece Courtesy of Westinghouse

THE COVER shows a synthetic rubber sample unaffected by deteriorating action of oil. Photo courtesy Firestone News Bureau.

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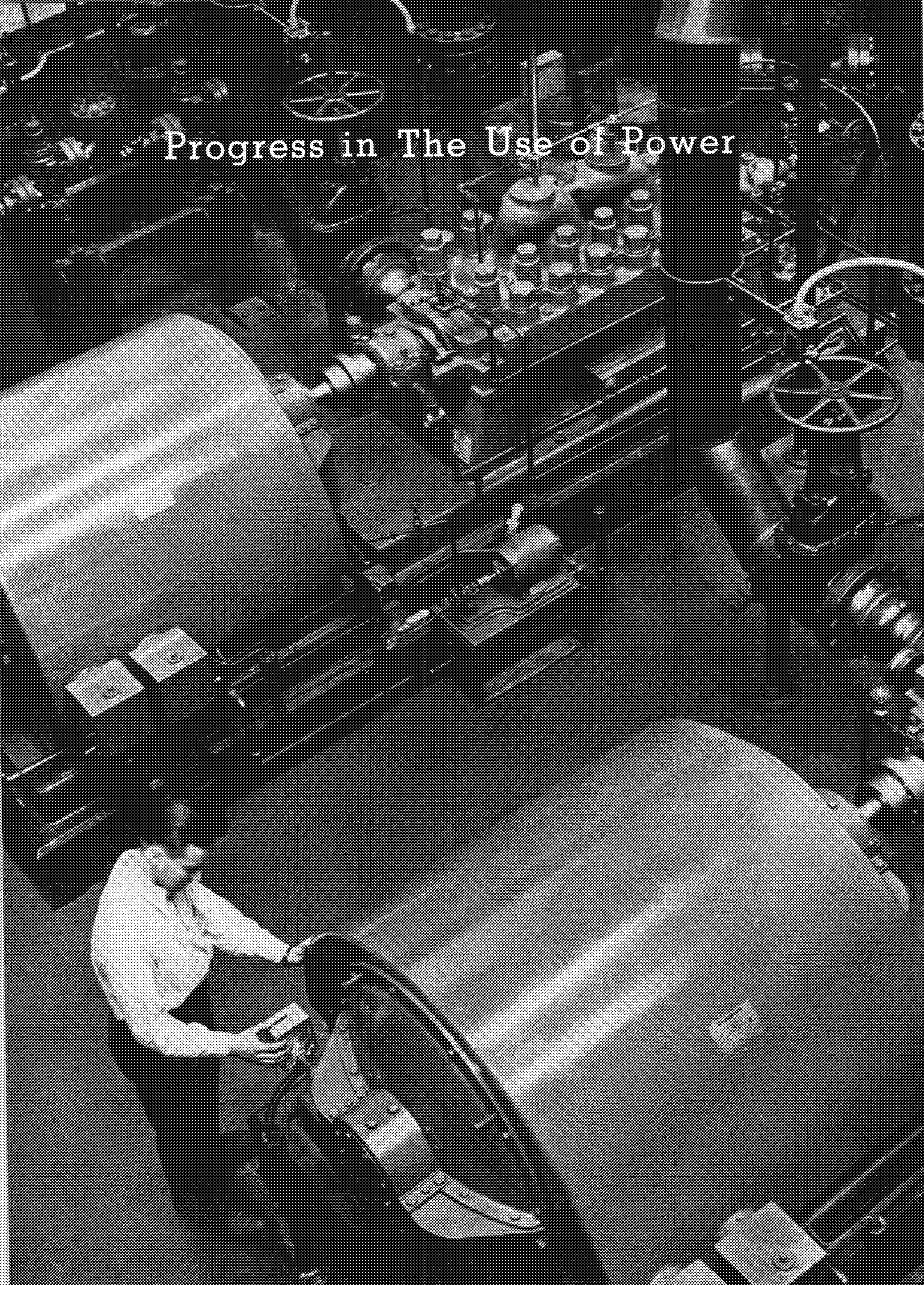
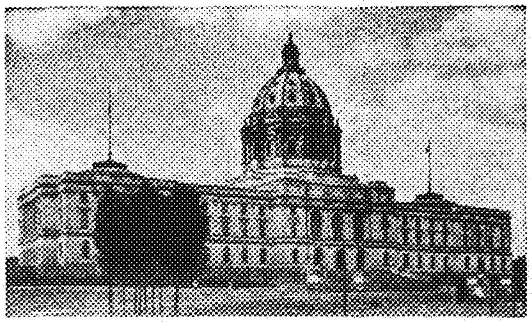
Progress in The Use of Power



AN EDITORIAL



Please Mr. Legislator

ON THE ALL-IMPORTANT LIST of appropriations which the governor approved, the absence of one item in particular struck a note of sorrow in more than one engineer's heart. That item represents the dream and vision and hope and ideal of two decades of M.E.'s—and more recently, the Aero E.'s—a new Mechanical and Aeronautical Engineering building.

To say that the present M.E. building is dangerous, inadequate, and antiquated would be merely boring repetition. Every student of the institute knows this as did every student ten years ago. The only change is that the degree of danger and inadequacy has increased alarmingly to a point where continued use could be compared to learning to skate with a bottle of nitroglycerine in one hip pocket; simply asking for trouble. This will not seem such a tremendous overstatement when one considers the comparative desirability of being blown to shreds or burned to death.

A ridiculous comparison?—normally yes, but not so ridiculous when one considers that the building is of such design and material that fire due to any one of a score of possible causes could spread so rapidly that students in the basement or locker-rooms would burn with less chance to escape than the rats. A trifle gruesome perhaps, but a truth which can be verified by the state Fire Marshal's report, or by actual inspection.

Let us suppose for illustrative purposes that the building were not the firetrap that it is. Then, our only complaint would be that increased enrollment and the recent inauguration of defense training courses have so severely taxed class room facilities that it may be necessary to restrict registration and remove vital courses from the curriculum. Neither of these drastic remedies could hardly be termed beneficial to the defense program in which we, as engineer's of the near future, should be vitally concerned.

We have no desire to question the governor's intention in omitting an appropriation for our long due building, for even our slight acquaintance with finance tells us that a state cannot be run on credit. We do believe, however, that if the governor and the legislators were fully aware of the situation facing the Mechanical and Aeronautical Engineering departments, they would not hesitate to insure the future safety of the students, as well as augment the future safety of America, by approving this appropriation.

We as students would be only too willing to stand on our heads and square six digit numbers on our slide rules with one hand if that would convince the legislators of the sincerity of our appeal. However, this would hardly be necessary if they could visit us and allow us to present the first hand evidence.

BRUCE N. TORELL — ASSISTANT EDITOR

A POTENTIAL RESERVE OF THE FUTURE

Test Tube Rubber

By John McCool

Graduate Student in Chemistry

RESEARCH in the twentieth century has brought forth many new developments in the field of naturally occurring products. One such development has been the study made on natural rubber as regards its structure and synthesis and the production of synthetic rubber. It should be noted at the outset that a synthetic rubber which agrees in composition, structure, and properties with natural rubber has never been produced, and, in the opinion of experts in this field, probably never will.

In 1860 an English chemist, Grenville Williams, isolated a low boiling oil by the destructive distillation of rubber. To this oil he gave the name "isoprene," and it was found to have the formula C_5H_8.

In 1875 Bouchardat proposed that rubber was built up of isoprene units, and in support of this idea, he pointed out that 1 part isoprene and 12-15 parts of fuming hydrochloric acid might be converted to a rubber-like material, which might be pyrolyzed to give back isoprene.

Early Experiments

In 1880 Tilden, in England, found a source of isoprene other than rubber, and this was from the thermal decomposition of turpentine. By using Bouchardat's synthesis, Tilden obtained "synthetic rubber," since he did not merely resynthesize rubber from isoprene, which in turn had been obtained from natural rubber. The product, while rubbery, was a far cry from the natural product; and, although Tilden worked along these lines for many years, he finally abandoned the idea of making rubber from isoprene in 1908. Tilden made one important contribution to the technology of this field when he found that isoprene spontaneously polymerizes to a rubber-like mass, and his discovery provided an impetus for later investigators.

Briefly, polymerization means the formation of higher molecular weight substances from smaller molecules. This process may be likened to the linking of a number of paper clips to form a long chain, which then acts as a unit. In the case of rubber, this linking effect arises from the chemical nature of the units, viz., isoprene, which may be considered the driving force in the spontaneous polymerization of isoprene.

Molecular Construction

Isoprene is chemically 2 methyl butadiene 1, 3,

$$CH_2 = \underset{\displaystyle CH_3}{\underset{|}{C}} - CH = CH_2$$

a member of unsaturated hydrocarbons known as the dienes. The dienes are chains of carbon atoms (with hydrogens attached) in which two pairs of carbon atoms are doubly linked. In the case of isoprene, we see that the number one carbon atom is doubly linked to the number two carbon atom, and the number three to the number four. It occurred to other investigators that it should be possible to use a different building block for synthesis of rubbery materials, i.e., other dienes.

In 1900 Kondakoff, in Germany, found that 2, 3 dimethyl butadiene, a close relative of isoprene, spontaneously polymerizes to a rubbery mass if left in a sealed tube for 1 year. This may be considered as the first synthetic rubber because the diene is fairly easy to obtain, compared with the Tilden method of obtaining isoprene from turpentine.

About 1910 the price of natural rubber began to rise due to the development of the automobile, resulting in a shortage of the natural product then obtained from wild rubber in South America. This instigated concentrated efforts in not only producing a suitable hydrocarbon for polymerizing, but also in finding a more rapid method of polymerizing the hydrocarbon since until this time, the polymerization was very slow.

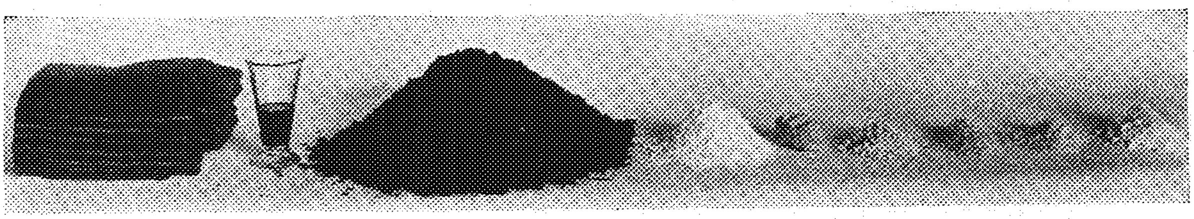
In 1910 Harries in Germany, and Matthews and Strange in England, almost simultaneously discovered that metallic sodium speeds up the polymerization, but the rubber so made was very disappointing, in view of the fact that it had a strong tendency to deteriorate. In order to prevent this, vulcanization (the process of heating with sulfur) was carried out, using organic bases such as piperidene. It is of interest to note that rubber accelerators, which are now so important in the industry, have their origin in connection with substitute rubbers.

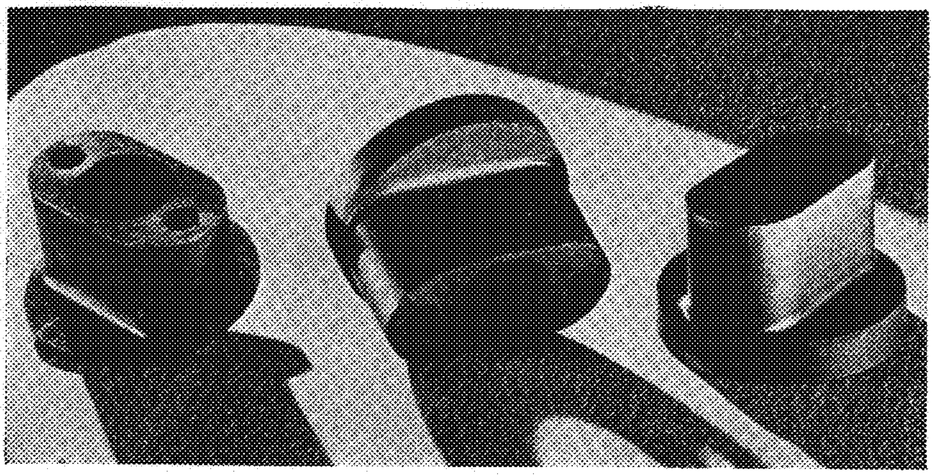
War Work

Due to the fact that plantation rubber from the East Indies began to appear around 1912-13, work along the lines of synthetic rubber was dropped until the World War. At this time, Germany found a need for a substitute for rubber because her imports were cut off. Under the direction of Fritz Hoffman, the German war rubber known as methyl rubber was developed. This was made in two ways from 2, 3, dimethyl butadiene; (1) by heating the diene at 70°; (2) by allowing the

Each ingredient in a "batch" has a definite effect on the properties of the finished product.

Courtesy duPont





Courtesy duPont

Resilient mountings for aircraft engines materially improve performance by damping out unwanted vibrations

diene to polymerize at room temperature. At the close of the war, the Bayer Co. had produced 2,350 tons of methyl rubbers W. and H. It was very expensive, and in 1918, the project was dropped because of the inferior quality of methyl rubbers and because of the big drop in the price of natural rubber which had become available.

Not until 1925, when the price of rubber rose to $1.25 per lb., was work resumed on the synthesis of a product that could compete successfully with the natural product. In 1927 the L. G. Farbenindustrie in Germany renewed work on the production of a rubber from butadiene, using sodium as a catalyst. The first patents came out in 1929 in this connection, and the products were called Buna rubbers. This name is derived from *Bu*tadiene and *Na*trium (Latin word for sodium).

America entered the field of synthetic rubber manufacture when the duPont company introduced a rubber made from chloroprene (2 chlor butadiene 1, 3), which was called Duprene and has been since changed to Neoprene.

It will be easier to understand the purposes of these synthetic rubber products if we know the important properties, good and bad, of natural rubber. Vulcanized rubber is elastic in varying degrees, is a good electrical insulator, and has good natural aging and fair weather-resistance properties. On the other hand, it has no resistence to ozone, oil, gasoline, or similar substances. It is combustible and its surface cracks when exposed to sunlight.

Several Methods

There are several methods for producing each of the dienes important in the manufacture of synthetic rubber. One of the most important of these is the process developed by the Universal Oil Co. for the manufacture of butadiene. The waste gases (low boiling paraffins) from petroleum refining are passed over the oxides of chromium, vanadium, etc., at 450 to 600 deg. to give the diene in 90 per cent yields.

The oldest methods for the polymerization of the dienes are spontaneous polymerization and heating. The first is too slow, and the second leads to various amounts of oily dimers depending on the temperature. Metallic sodium is used to polymerize the dienes in the manufacture of German Buna and several Russian synthetic rubbers. A very important method is that of emulsion polymerization. Its importance lies in the fact that a mixture of dienes can be emulsified and polymerized together. The resulting "copolymer" has the combined properties of the starting materials and some others as well. This results from the fact that the molecules of the two different hydrocarbons can join with similar molecules or with each other.

Buna Rubbers

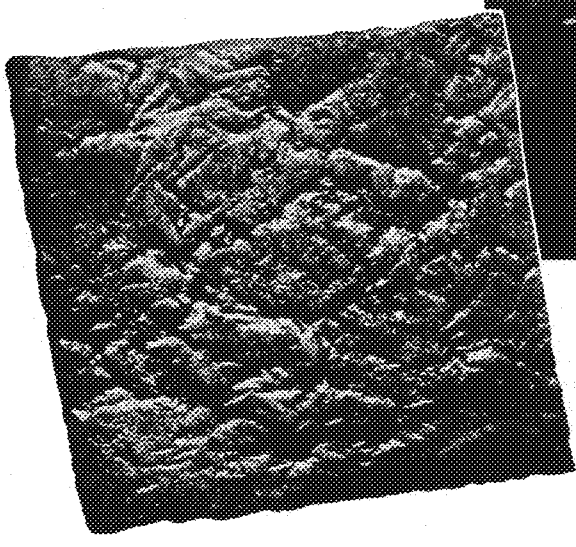
In 1927 the I. G. Farbenindustrie found that butadiene could be polymerized by sodium to the Buna rubbers. Three different Bunas have appeared—Buna 32, Buna 85, and Buna 115. The numbers refer to the approximate molecular weight in thousands. As the molecular weight increases, the rubber becomes harder and more difficult to compound. The products from Buna may be vulcanized in much the same manner as natural rubber, but they are lower in tensile strength.

Some years later, the development of emulsion polymers was successful, and two copolymer synthetic rubbers, Buna S and Buna N, now known as Perbunan, were produced. Buna S is a butadiene-stryene copolymer, while Perbunan is a butadiene-acrylo nitrile copolymer.

Perbunan and Buna

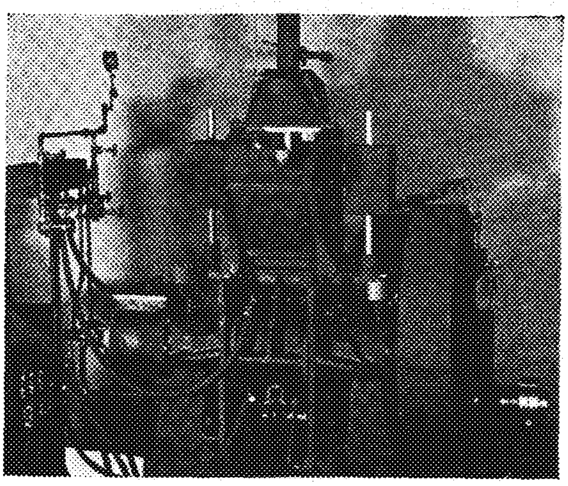
Perbunan and Buna S are much more oil resistant than the numbered Bunas and, therefore, much more resistant than natural rubber. It is believed that the numbered Bunas are being abandoned in favor of Buna S. Buna S is used with a great deal of success in tires, giving better mileage than tires made from natural rubber! It should be pointed out that Germany makes Buna S for exclusive domestic consumption, and that none is available for exportation. In America, the Standard Oil Co. has been licensed to produce Perbunan, and it is now being manufactured as a semi-works product.

The U. S. S. R. manufactures two types of rubber from butadiene—SKA and SKB. Both are made by the sodium method, the source of butadiene being the cracking of petroleum. SKB is made from butadiene obtained from alcohol via Lebedev's process. Very little is known about these products, but the consensus of opinion is that the products are inferior to the German numbered Bunas. The butadiene used is more impure than the German hydrocarbon,



Courtesy duPont

A step in the manufacture of chloroprene rubber is shown above. At the left is the crude material ready for use in the manufacture of resilient products.



Courtesy duPont

Internal mixers, known as Banburys, are available to mix batches of up to 1000 pounds.

and it is well known that the quality of rubber obtained is directly proportional to the purity of the hydrocarbon polymerized.

Russia also makes a synthetic rubber, Sovprene, by the method that the duPont Co. uses for Neoprene. It should be mentioned here that the Russian régime, of course, does not recognize anything as capitalistic as a patent. Although Russia has aims of becoming completely independent of foreign imports, and claims that her present program provides for this, it is definitely known that she has a long way to go before attaining her goal.

Source of Butadiene

The synthetic rubbers made in this country from butadiene are of the copolymer type. The petroleum industry has available over 500 billion cubic feet of waste gases which may be converted into butadiene with 90% yield, using the Universal Oil Products process; hence, a cheap source of butadiene of high purity is available. This places America in an excellent position as regards the starting material. The American Cyanamide Co. produces acrylo nitrile commercially, and consequently, all of the starting materials for a Perbunan-like material are available. So far, the butadiene rubbers are barely past the pilot plant stage —if that far. Several American companies are now experimenting with various types of synthetic rubbers.

Hycar (or Ameripol) is produced by the Hydrocarbon Chemical and Rubber Co., which is owned jointly by the Goodrich Co. and the Philips Petroleum Co. Hycar is probably a butadiene-acrylo nitrile polymer, although no technical information is yet available.

Chemigum is produced by the Goodyear Tire and Rubber Co. This polymer may be a butadiene-vinylidene chloride copolymer.

Butyl rubber is made by the Standard Oil Development Co. The product is closely related to Vistanex, a polymer made by polymerizing iso butylene, $(CH_3)_2 = CH_2$ by using boron fluoride at low temperatures. Vistanex is chemically saturated, that is, it cannot be vulcanized. The material is quite rubbery, but is not resistant to oils. By copolymerizing with a small amount of butadiene, butyl rubber is obtained which is then chemically unsaturated, and may be vulcanized to increase oil resistance. Vistanex was first manufactured in Germany by the I. G. Farbenindustrie, under the name Oppanol.

Neoprene is a polymer of chloroprene (2 chloro butadiene 1, 3). Chloroprene polymers arose as a result of the work of Father J. A. Nieuwland at Notre Dame, and the duPont Laboratory, working under the direction of Wallace H. Carothers. Chloroprene is a liquid with a boiling point of 57°, which spontaneously polymerizes to a soft rubbery material corresponding to vulcanized rubber. Whereas isoprene takes a long time to polymerize, chloroprene, because of its chemical nature, polymerizes much more rapidly. The polymer mentioned above is non-plastic and its properties cannot be modified. It is called poly chloroprene mu. If, however, polymerization is carried out under the correct conditions using strong illumination at 35° C., a different polymer arises, known as the alpha poly chloroprene. This polymer is plastic, and may be compounded like natural unvulcanized rubber. It may be converted to the mu polymer by heating to above 100° C. in the presence of certain oxides such as zinc oxide. This corresponds to natural rubber vulcanization, but differs in that no sulfur is required. In order to prevent the alpha polymer from spontaneously changing to the mu polymer, inhibitors, such as phenyl beta-naphthylamine are added; their inhibiting action disappears above 100° C. The alpha polymer may be made in a commercially feasible manner and is sold as such to be modified by the consumers.

Other polymers arise in the polymerization of chloroprene in addition to the alpha and the mu polymers. These are: beta polymer—a terpene-like oil, resulting from too high temperature during polymerization, w polymer—a granular mass, resulting from polymerization under conditions too slow for conversion of chloroprene to do the alpha or mu polymer.

Chloroprene may be polymerized in emulsion form, but great care must be exercised to prevent the reaction from becoming too violent. duPont is believed to be making emulsion copolymers from chloroprene and other substances such as 2 cyano butadiene, butadiene, and vinyl chloride.

Neoprene

The chemistry and development of Neoprene is very interesting and fascinating, and for further details the reader is referred to a paper presented by the author to the members of the Organic Chemistry Seminar on December 4, 1940, or to the original papers of Carothers and others for the period 1931-6 in the *Journal of the American Chemical Society.*

Thiokol is a rubbery material developed by J. C. Patrick, using alkaline polysulfides and ethylene dichloride or related dihalogen compounds. Like vulcanized Neoprene, Thiokol shows oil resistance, differing in its greater resistance to oil deterioration. In Germany, Thiokol is made under the name Perduren.

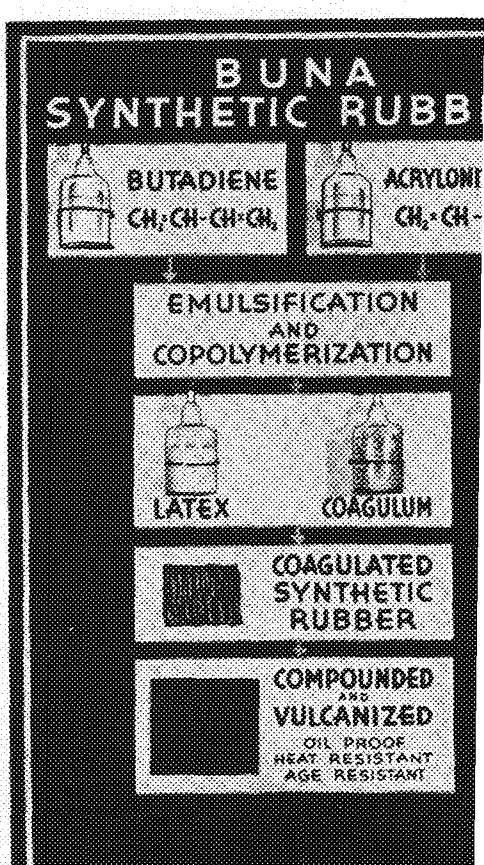
Two main tendencies regarding synthetic rubber are apparent. The totalitarian states are attempting to become completely self-sufficient in rubber, regardless of cost. In America, because of the higher cost of these materials, synthetic rubber finds its main uses where the cheaper natural rubber fails, such as aging, oil-resistance, etc. These synthetics vary in price from 50 cents to 90 cents per lb., while natural rubber is about 20 cents per lb.

Brilliant Future

Of course, we must not overlook the possibility that our natural supply may be cut off, as well as the fact that over $200,000,000 was spent last year in this country for rubber, of which 97% came from the East Indies. Contrary to the highly colored pictures painted for us by the press, most of the experts feel that synthetic rubber must go a long way before it can expect to supplant the natural product. On the other hand, the situation has excellent prospects—the present status being very comparable to that which prevailed in the dye industry at its conception. There is a brilliant future for American synthetic rubber, but first, the industry must obtain the experience, financial backing, and the method by which ample supplies will be available before it can hope to make us economically and geographically independent of the natural product.

Composition of Buna synthetic rubber.

Courtesy Industrial Engineering and



Centrifugal Furnace

By Donald L. Drukey, Ch.E. '43

ONE of the most interesting pieces of work in progress in the Minnesota School of Mines and Metallurgy is that being done by F. W. Scott and C. F. Quest under the direction of Professor T. L. Joseph. This research deals with the effect of slag composition on steel composition. Their method of attacking the problem is interesting and unique. For a proper understanding of the problem confronting them, an understanding of the basic principles of producing steel is necessary.

The production of steel from pig iron depends upon removing a part of the carbon, manganese, silicon, sulfur, and phosphorus from the metal. These are removed by chemical action between the slag and the molten metal. The slag floats on the top of the molten metal, and therefore, all refining reactions must take place at the surface of the metal. The reactions are essentially those between the ferrous oxide present in the slag and the various elements present in the molten metal. These elements are oxidized by the ferrous oxide and the resulting oxides then go into the slag. The ferrous oxide after giving up its oxygen leaves pure iron which goes into the molten metal.

Control of Ingredients

In laboratory studies, of course, quantities of slag and metal are small compared with the amounts handled in commercial practice. As the molten metal in an open hearth furnace may be three feet deep, it is easy to see that under these conditions, things may happen in practice that never happen in laboratory experiments, and conversely.

The greatest obstacle encountered in the reactions between the slag and the molten metal is the difficulty of maintaining purity of materials and controlling the effect of outside variations. Another disturbing factor in the research was the fact that on a laboratory scale, the slag and the refractory reacted to a greater degree, and consequently contaminated the metal more than in commercial furnaces. An ingenious method, developed by the U. S. Bureau of mines was adopted for overcoming this difficulty. Pure metal was placed in a furnace of special design, and the materials for slag formation were added later. After the metal had melted, the crucible was rotated at about four hundred revolutions a minute on a vertical axis. This caused the metal to rise along the walls of the crucible and left the surface of the metal slightly cupped. The materials for the slag were then added to the center of the cupped surface. Provision was made for adding the slag producing materials while the crucible was rotating. The atmosphere within the furnace was also controlled by enclosing the furnace in an air-tight jacket with connections for adding nitrogen to the furnace. Sufficient oxygen was added at the beginning of the test, and nitrogen, an inactive gas, was introduced to keep the pressure in the furnace slightly above atmospheric. The slightly higher pressure inside than that outside prevented air from seeping in and changing the composition of the atmosphere inside.

The furnace proper within which the crucible rotates is a high frequency, high voltage, induction furnace. Tests have been made at temperatures ranging from 2,850° to 3,080° F. At the end of a test, the slag is removed while the crucible is still rotating, and is analyzed to determine its final composition. The device for removing the molten slag consists of a small graphite cup which is connected to a vacuum line. As the cup is immersed in the slag, the slag is forced into the cup where it solidifies almost immediately. Because of the rapid cooling, the molten slag does not stay liquid long enough to change in composition. This arrangement makes it possible to determine the composition of the slag at the temperature of the test.

Purpose of Experiments

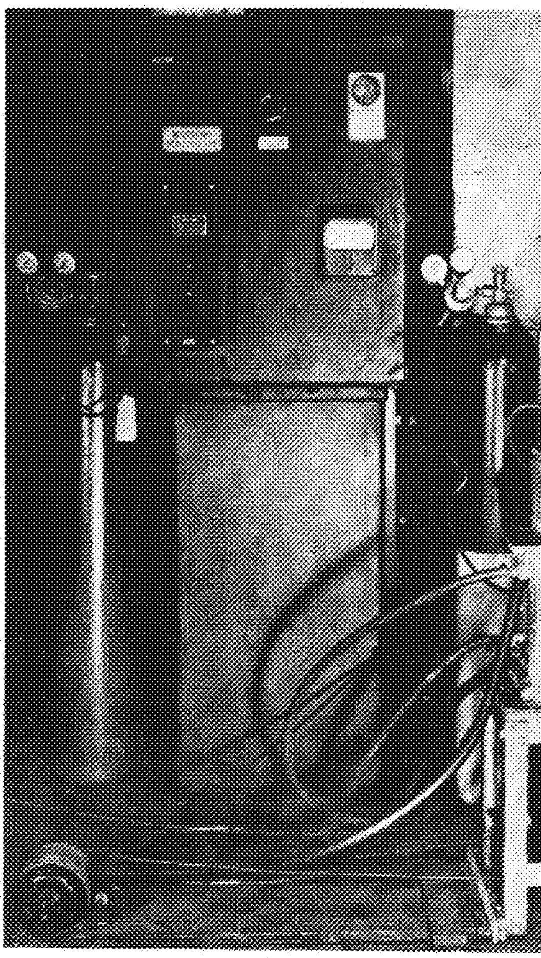
As has been stated, the production of steel is dependent on the chemical reactions between the metal and the slag. These reactions at high temperatures finally reach a state of equilibrium at which point no reactions take place provided that the temperature does not change, and that nothing is added or subtracted from the slag or the metal. It is these equilibria, and especially the effects of changes in temperature and concentrations of the various elements on these equilibria, that Mr. Scott and Mr. Quest are studying at present. This is of very great importance to science and industry inasmuch as it is these equilibria which determine the ultimate limits of the processes. For instance, if low carbon steels are desired, these experiments will show what conditions are most favorable for the production of steel of this kind from the available materials.

The experimenters have already done considerable work and they think that they still have several years' work to do. A great deal of time was spent in perfecting the centrifugal furnace.

After they have concluded their series of experiments on equilibrium points, the experimenters plan to conduct a series of experiments on the rates of various slag-metal reactions. These experiments will also be of tremendous value.

This is the first time that exact laboratory control of these variables has been available, and these men are leading the way to a long series of research works to improve the science of metallurgy.

The experimental centrifugal furnace and control board.



DULL GRAY BOWS OUT TO

Color Photography

By Jack H. Rockwell, E.E. '43

IN newspapers, magazines, and books—in fact almost anywhere one looks—he sees color photographs. The art of color photography has gone through rapid development in the last few years due to the tireless research of chemists, physicists, and other scientists.

At the present time there are two main processes of color photography. These are the so-called "one shot" process, and the "direct color" process.

The one shot process requires a special and very costly color camera, and for that reason is used chiefly by professional photographers. However, there are direct color films which can be used in any camera with a color corrected lens.

The two most widely used direct color films are Kodachrome and Dufaycolor. Kodachrome—a product of the Eastman Kodak Company—is exposed in much the same manner as ordinary black and white film. When it has been exposed, the film is sent to one of the manufacturer's laboratories where it is developed.

Dufaycolor is made by the Dufay Color Company, and is exposed in much the same way as Kodachrome. However, kits are now on the market which contain all of the chemicals necessary for the amateur to develop his own film.

Both the Kodachrome and Dufaycolor processes result in full color transparencies which can be viewed by transmitted light or may be projected on a screen.

The principle on which all color photography is based is merely that all colors can be reproduced through the combination of the three primary colors, red, yellow, and blue. In the one shot camera the colors coming through the lens are split up into these three components by means of filters in the camera, whereas in the direct color processes the light is divided by means of filters which are in the film.

One Shot Cameras

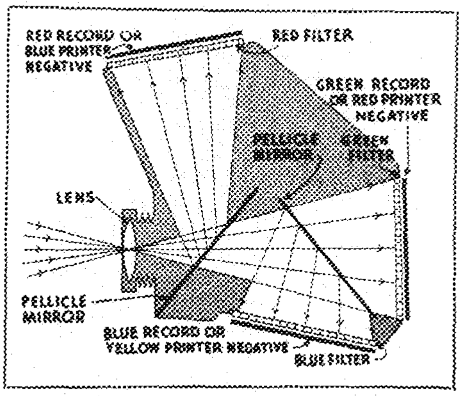
There are several different kinds of one shot color cameras, but in each, the basic principles are the same. The light entering the lens is split up, by means of filters, into the three primary colors. The image formed by each of these colors is then recorded on a separate film. The light which passes through the red filter is recorded on the film which will be used as the blue printer. The light coming through the blue-violet filter will be used as the yellow printer, and that through the green filter will be used as the red printer.

This process results in a series of three negatives which may be used in making the engraved plates for color printing. If a color print is desired, the negatives are printed on a special paper, and each print is toned or dyed its proper color. These three prints are then superimposed upon each other and mounted on a protective backing.

Direct Color Film

Two general methods are used in direct color photography. One method involves the use of microscopic dots of red, blue, and green over the entire picture area. The effect of these is added together by the eye without perception of the individual dots. This method of photography, which depends on the addition of red, green, and blue light, is termed the "additive method." Dufaycolor film operates on this principle.

The second or "subtractive" method involves taking away from each point in the image those parts of the three primary colors which are not wanted. Three superimposed color layers exert independent control of red, green, and blue light. Their purpose is to absorb at each point of the image those rays which the subject did not reflect. The color of each layer must therefore absorb the spectral rays transmitted by the corresponding taking filter.



Courtesy National Photocolor Co.

Diagrammatic sketch of a two mirror one shot camera.

Independent control of red, green, and blue light requires three layers on the film. Each layer must control only the one primary color and let the other two primary colors pass freely. This independent control is achieved by three superimposed images in this way: Red light is controlled by a blue green image which lets blue and green pass freely. Blue light is controlled by a yellow image which passes green and red freely. Green light is controlled by a magenta image which passes red and blue freely.

Subtractive Process

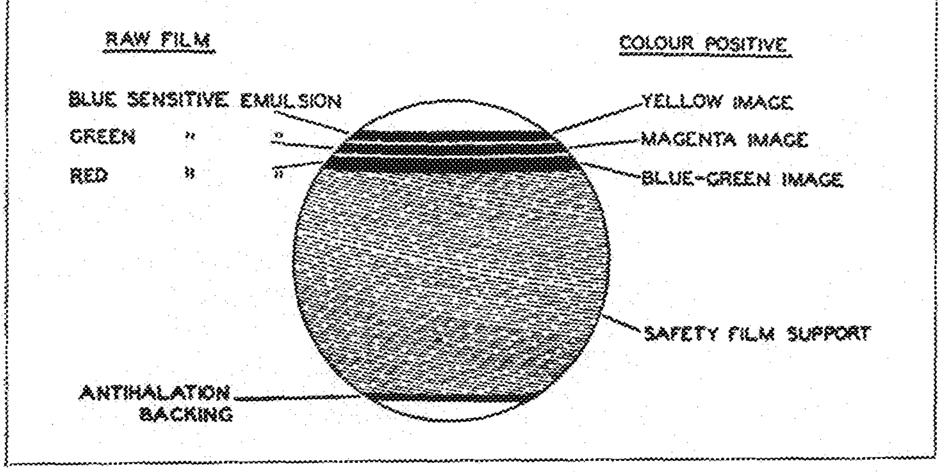
Subtractive color processes now in use differ principally in the manner in which the images of these three different colors are obtained and superimposed.

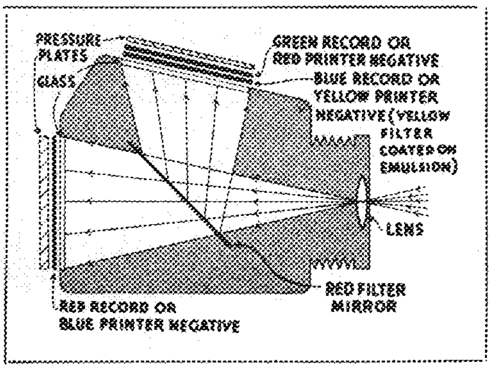
Although Kodachrome is by no means the only direct color film using the subtractive color process, it will be described here as being typical of the others.

Kodachrome film carries three emulsions on one face, separated by gelatin layers. The emulsion nearest the film base responds

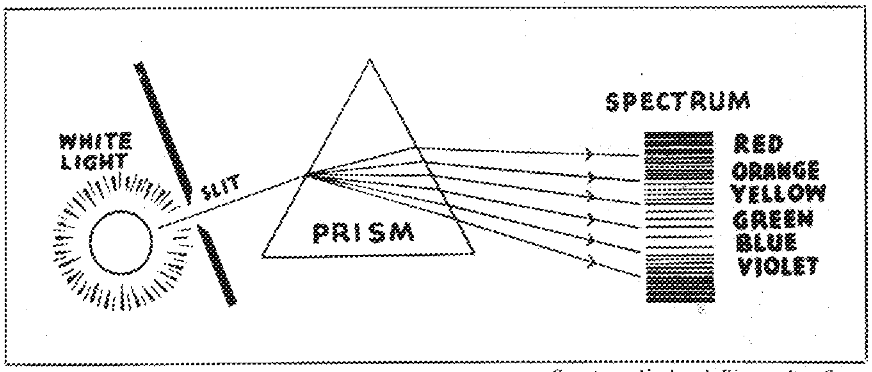
Cross section of Kodachrome film.

Courtesy Eastman Kodak Co.





Diagrammatic sketch of a one mirror one shot camera.



Courtesy National Photocolor Co.

This illustrates graphically how a prism may be used to break white light up into its component colors.

to red light, the middle emulsion to green, and that at the surface to blue. A yellow dye above the middle emulsion prevents blue light reaching the two lower emulsions, since these are also sensitive to blue, in addition to green and red, respectively.

The layers, so thin that their total thickness scarcely exceeds that of the emulsion layer of a black-and-white film, are coated on safety film base having an antihalation backing.

The picture on the top emulsion is taken by blue light, on the middle emulsion by green light, and on the bottom emulsion by red light. This is not accomplished by blue, green, and red filters, but in the following way: The top emulsion is sensitive to blue light only. The green and the red light pass through it without affecting it, so that the blue light alone makes the exposure. The yellow dye (mentioned above) prevents any blue light from reaching the two lower emulsions. The middle emulsion is sensitive to green but not to red. It is sensitive to blue as all emulsions are, but the blue light cannot reach it, and the red light passes through without affecting it. Therefore, the exposure is made by green light. The bottom emulsion is sensitive to red but not to green. It is also sensitive to blue, but the blue light cannot reach it, and the green light does not affect it. Hence, the picture is taken by red light alone.

After exposure all three emulsions are first developed to negatives. The metallic silver in the negatives is removed by a bleach which dissolves the silver, but the residual silver bromide which has not been developed because it was not exposed is left in the film. Then the film is re-exposed and developed in "coupler developers" so that in the final result the negative silver images are replaced by positive silver and dye images.

Coupler Developers

A coupler developer differs from ordinary developers in that it not only converts exposed silver bromide to metallic silver, but, at the same time, deposits a dye of predetermined color along with the silver.

The silver is then dissolved away, leaving only the dye images. The top layer is now an image in yellow dye, the middle a magenta image, and the bottom one a blue-green image. These colors it will be noticed are complementary to the colors to which the emulsion layers were originally sensitive. Where the emulsion was strongly exposed, there is practically no dye. Where the emulsion was not exposed, there is a full quantity of dye.[5]

When using color film, the photographer must take into consideration several important facts. One of these is that color film is balanced to a certain type of light, and it is important that the picture be taken with that type of light, otherwise the color values will not be true ones. At the present time Kodachrome is made in two types, one for sunlight and one for artificial light. In order to render true color values, it is also necessary that the exposure be correct. Color film does not have nearly the exposure latitude that black-and-white films do.

Uses

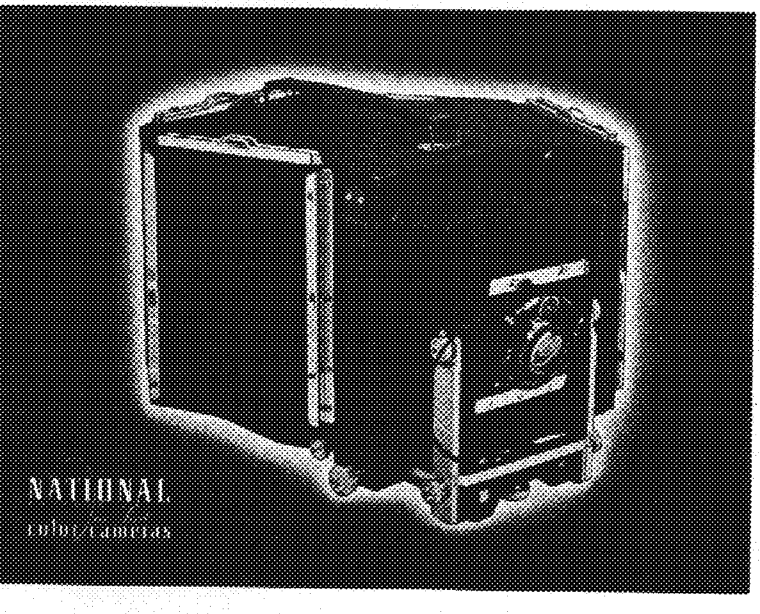
Color photography has long been used in the fields of advertising and illustration, but its uses are growing almost daily. It is being used to a large extent at the University of Minnesota to make record pictures of medical and dental cases. Color film has been made available to users of amateur movie cameras and is rapidly growing more and more popular.

The chief obstacle standing in the way of color photography at the present time is the difficulty and expense of making color prints. One eight by ten inch print made from a color transparency costs from five to ten dollars which, as the saying goes, ain't hay! It is for this reason that a large number of the color pictures which are taken are viewed by projection on a screen.

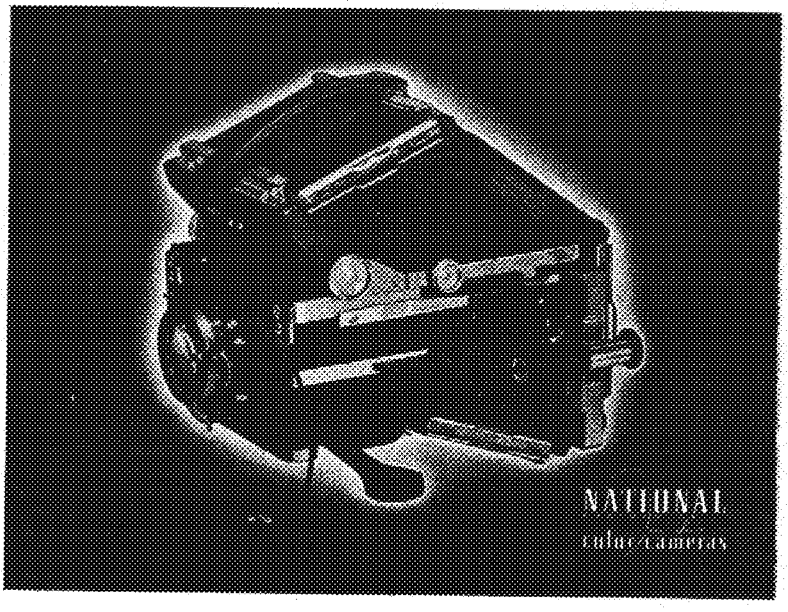
The high cost of color prints is just another problem for the scientist to solve, and he probably will.

[5]"Kodachrome," Eastman Kodak Company.

Photograph of a one mirror one shot color camera.



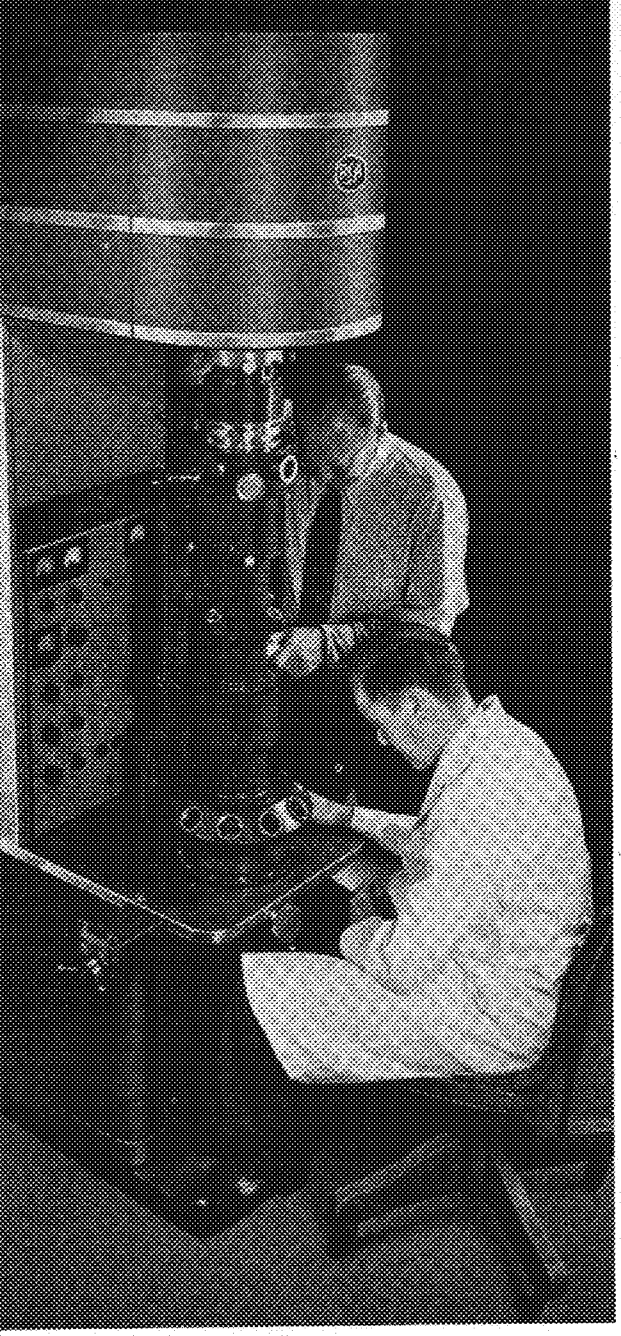
Photograph of a two mirror one shot color camera.



Science ... New

WITH THE EL

By Otto H. Schmitt



Courtesy RCA.

The electron microscope with its associated power supply and control panel.

ONLY a few years ago it was thought, even in well informed circles, that the fundamental natures of light and of electricity were thoroughly understood. Light had no material existence but was merely a vibration of an all-pervading ether. Electricity came in pellets of two different sizes; electrons like ping-pong balls, extremely light but reasonably large, and protons like lead shot, much smaller than the electrons but some eighteen hundred times heavier. When these particles cavorted planet fashion about each other in approximately equal numbers they constituted the atoms of which all matter was built. When they streamed, Indian-file, down a conductor they constituted electrical currents.

This convenient picture of the nature of things has gradually and reluctantly been relinquished under the continued bombardment of new experimental facts from the realm of what is now called "modern physics." But as each new finding chipped out a bit of classical theory, room was made for some new development which, after being perfected in research laboratories for a few years, emerged in the form of some technologically useful idea.

In the case of light it was found some 35 years ago that in addition to the familiar wave nature there was a distinctly particulate aspect which kept recurring with an awkward persistence. Light traveled through space and interacted with the media through which it passed as a well-behaved wave motion should, but at the points where it originated and became absorbed it suddenly took on the character of particles or quanta. This discovery, already over a quarter of a century old, is only now being accepted technologically in the light of new evidence compiled by use of innumerable photoelectric, photographic, and fluorescence devices based on the quantum principles.

The electronic counterpart of this quantum theory—the idea that the elementary particles of matter might behave as waves—did not gain credence until about 1925 when Bell telephone physicists proved conclusively that electrons could be diffracted by metal crystals much as light is diffracted by a diffraction grating. Strangely enough, the wave length of an electron was found to depend upon the speed with which it moved and consequently upon the voltage used to accelerate it. The actual wavelength in Ångstrom units (an Ångstrom unit is about 4 billionths of an inch) can be computed by dividing 12.2 by the square root of the voltage used; thus, with 1 volt the wave length would be 12.2 Å for 100 volts 1.22 Å, and for 10,000 volts 0.122 Å, etc. It is this extremely short wave length which makes possible the electron microscope.

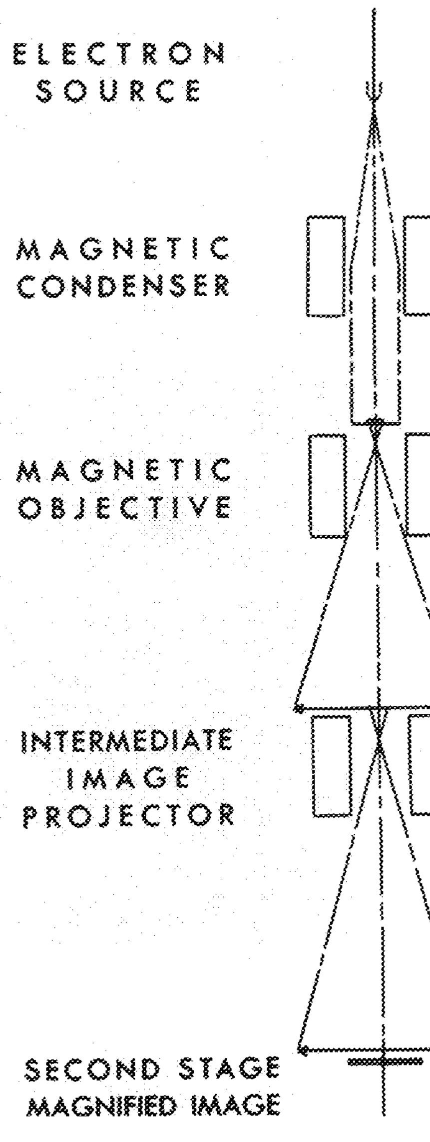
A fundamental theorem of optics is that no object can be seen clearly or "resolved" by any wave motion of wave length more than twice as long as the object. This means that if a light with a wave length over twice the length of an object were directed on the object, the object could not be seen. For ordinary visible light of wave length 5000 Å, the shortest object that can be seen, is about 2500 Å or about 10 millionths of an inch in length. Even with the ultra-violet light this limit is moved only to about 1500 Å. The use of x-rays has frequently been suggested as these rays are easily produced in the range 0.1-5Å, but since no practical method of refracting x-rays has been discovered, their use is impossible. However, when electrons were made easily available in the range 0.1-10Å, it remained only to find a suitable electron "lens" to make the electron microscope a reality. Two such lenses have since been devised; the electrostatic and the electromagnetic lenses.

Construction of Lenses

The 'static lens consists of a pair of circular, open-ended, metallic cylinders between which a potential difference is applied, and along the common axis of which the electron beam passes. The curvature of the electrostatic field between the cylinder brings a large portion of electrons originating at any one point on the axis to a common focus at a point determined by the voltage applied between the cylinders. In this respect, the electron lens behaves as does an ordinary lens except that the focal length of the electron lens can be changed at will. For this reason the lenses in the electron microscope need never be moved to focus but, instead, are changed in focal length by means of a rheostat.

The magnetic electron lens consists of a magnet coil arranged so that the electrons pass along the axis of symmetry of the

The electron microscope is similar in principle to the light microscope.



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N MICROSCOPE

Instructor in Physics

field. It has the same variable focal length properties of the electrostatic lens, but in addition, it rotates the whole image without distorting it. The fact that magnetic lenses can be made powerful more easily than electrostatic lenses accounts for their use wherever great magnification is desired. Electrostatic lenses, however, are used for moderate refraction because of their simplicity and because they do not twist the image.

Given the electron lenses, one can draw upon optical experience and build an electron microscope based upon the principles of any ordinary microscope. The essentials are: some method for illuminating the object, an enlarging system, and a viewing screen as electrons cannot be seen directly.

The simplest type of microscope, analogous to the pinhole camera, consists of a hollow glass sphere, evacuated, and coated inside with a thin, transparent coat of gold for conductivity and with fluorescent powder to render electron bombardment visible. The specimen is supported at the center of the sphere by a slender rod and electrons are drawn out of the specimen and across the evacuated space by a strong magnetic field applied between the specimen and the sphere. As this type of microscope depends upon low temperature emission from the specimen, its use is limited. However, the microscope has been used very advantageously in England for settling questions regarding the points on a crystal from which electron emission occurs.

Refined Microscope

A somewhat more refined microscope consists of the electron source to be examined, a single electron lens, and a fluorescent screen enclosed in a vacuum. This microscope is not useful for great magnification since it corresponds directly to the common reading glass but it has proved to be of great value in determining the properties of materials used for vacuum tube cathodes and filaments, and in determining how various contaminations in these materials poison emission. Magnifications obtained with this instrument compare favorably with a good, ordinary microscope. A microscope of this type can easily be improvised from an ordinary cathode ray tube by readjusting the potentials applied to the focusing grid and anodes. A clear image of the cathode surface is obtained and various areas of the cathode can be explored by judicious application of a small bar magnet near the base of the tube. The application of the magnet deflects electrons and brings new areas of cathode refraction into view.

Passing now to the high magnification, electron microscopes being developed for commercial use by the large electrical firms of RCA in this country, Metropolitan Vickers in England and Siemens-Halske in Germany, we have the strict equivalent of the standard research optical microscope as illustrated in the comparison diagram. A beam of illuminating electrons is generated at a hot filament. This beam is condensed by a fairly large electron lens corresponding to the microscope substage condenser.

The material to be viewed is placed on a thin sheet of "electron transparent" material, usually a film of collodion or of cellophane which corresponds to the ordinary glass slide and the "slide" is mounted on a movable plate corresponding to the usual mechanical stage. Because great magnifications are used, this stage must be very steady and accurately manipulable since a movement of only 1/10,000 inch of the stage would cause the image to move as much as three inches on the viewing screen.

Instrument Focus

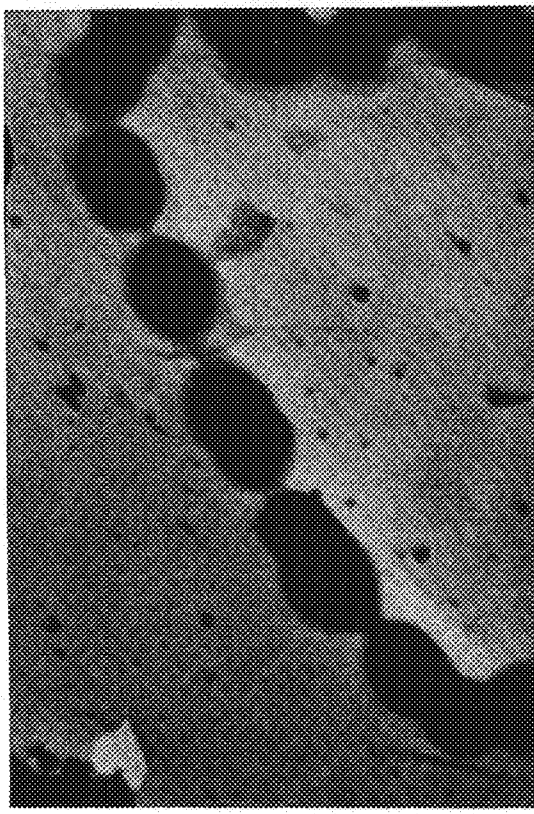
Above the stage is a small, very powerful "objective" lens which forms a magnified image of the specimen either on a viewing screen or in the object plane of the "ocular" lens. Since this image is at a magnification of only 200 to 500 diameters, it is used to locate the general region to be further magnified. Once the correct region is located the viewing screen is swung out of the way and the first image further magnified by an electron lens. This lens is usually less powerful, 50 to 200 diameters but of larger aperture than the objective so that it can form large, clear images either on the second viewing screen (for visual observation and adjustment) or directly upon a photographic film since electrons do activate photographic emulsion directly.

Certain difficulties are inherent in the use of electron microscopes; they must always work in a vacuum and so cannot be used with wet specimens, they require carefully regulated lens currents if focus is to be held, and they are necessarily much more complicated and costly than their optical counterparts. Still, the new instrument has great possibilities in medicine, in chemistry, and in physics, as well as in industry.

The ultimate usable limit of the electron microscope has been set at about 10 A which means that it will, in course of time, be able to investigate the structure of large organic molecules and of the smallest discrete particles.

Already it has shown considerable detail in the diphtheria, the whooping cough, the hemolytic streptococcus, and other micro-organisms previously unresolvable. There seems no reason to doubt that suitable specifically absorbable electron "stains" can be devised to do for electron microscopy what has already been done for the optical case.

Analysis of a sort has already been undertaken with the new instrument. Because the crystal units of various substances and of the same substance differently processed are very characteristic, they can easily be identified. Consequently slight contaminations can often be traced and processing differences controlled. This applies especially to powdered or powder-



Photograph of Streptococcus haemolyticus magnified 20,000 diameters.

able materials and to surface treatments. For observing surfaces of solids, the electron beam is usually reflected from the surface instead of being transmitted through the specimen.

The electron microscope cannot "see" actual atomic positions in molecules but it is possible and even probable that it will be of great help in identifying and working out the structure of polymers and "macromolecules" familiar to plastics and protein chemists.

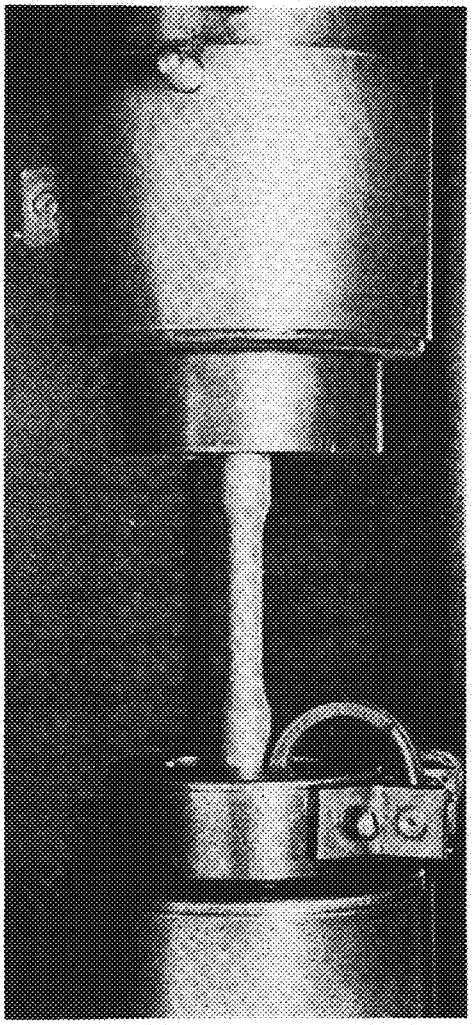
With the application of the new electron-multiplier principle to intensification of the images it is probable in the near future that the beam of electrons bombarding the test object can be considerably decreased thus extending the range of the instrument to many more delicate substances now destroyed almost instantly by the powerful electron beams used.

FOR PRECISION

Testin

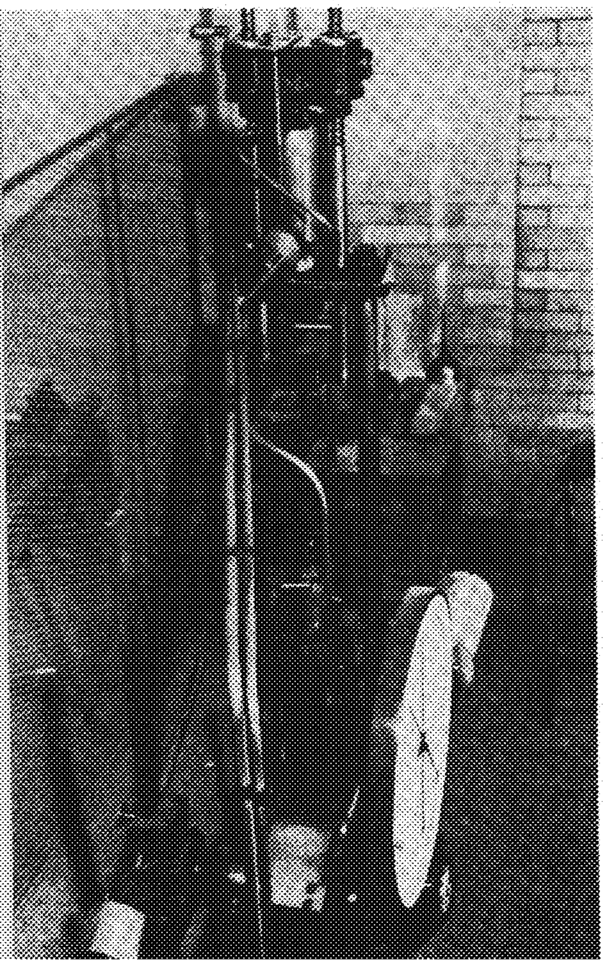
WILL PROV

By Forrest E. Miller, Asst.



Standard 0.505 inch diameter test specimen under tension.

Below: 30,000 pound Amsler hydraulic testing machine.



TODAY, more than ever before, industry demands precision products: products that are accurately constructed, that have endurability, and that will sustain sudden stresses and strains. Supplying this demand requires that manufactured goods be subjected to severe tests before they are put into service. To this end, there has been developed a material testing science to test any materials being considered for use, and to assure the engineer beforehand that the article will not fail under working conditions. Accurate machines have been constructed that will subject these materials to any stress or strain that will be encountered in service, and that will provide statistical data of the characteristics of the material.

Although most machines of this age are designed to do work of a constructive nature, or to perform useful tasks, the testing machines are designed to perform operations which, if carried to completion, are, in most cases, destructive.

While testing machines may be able to deform specially prepared specimens, or even structural members of reasonable size to destruction, they are designed to do this for the purpose of obtaining data which, when properly interpreted, will furnish valuable information concerning the mechanical and elastic properties of engineering materials. Ordinarily, the data of greatest concern are the magnitudes of certain loads and deformations.

Typical Tests

Tests most frequently made upon engineering materials are those of simple tension and compression. Other tests of equal importance in their place are shearing, either by simple shearing forces, or by twisting moments, transverse bending, hardness, impact, repeated loading, and bending.

In order to carry out these tests properly, testing machines must have a frame or base upon which are mounted suitable supports for holding the specimen, a means of applying the load at a reasonable rate of speed, and an independent mechanism for accurately measuring the load applied. An exception to the third requirement may be noted in the case of the machine for cold bending a rod or bar of ductile or malleable metal about a pin of given diameter as in wrapping one wire about another. Such a test, however, is carried out to determine the toughness of the material as indicated by the angle through which the specimen can be bent without developing cracks, consequently the force is without significance. Impact and hardness testing machines also do not have the customary load measuring devices. The former deliver to the specimen a certain amount of energy determined by the weight of a hammer or pendulum falling from a given height above the specimen. The latter, with one or two exceptions, apply relatively small loads of standard size by means of fixed weights.

The first testing machine of record built in this country was that developed at the Franklin Institute in 1832. Though still in serviceable condition, it is unsuited for present-day needs and, consequently, is now kept in the museum of the Institute for its historical value.

Although testing machines are many and varied, the one machine which is most adaptable and widely used is the universal testing machine. The universal testing machine is designed primarily for carrying out tension and compression tests. With suitable accessories it may also be used for making many other kinds of tests. Typical of these, but not all-inclusive, are the following: transverse bending, direct or torsional shear, determination of Brinell hardness, and the bending about a pin.

Essentially the machine consists of at least two parallel crossheads, one fixed or stationary, the other capable of being moved so that the distance between them may be varied as desired. The stationary head supports the specimen and is connected to the load-weighing mechanism while the movable head, usually power-driven, applies the load.

Most present-day universal testing machines have two more or less widely separated stationary crossheads forming one continuous framework with the movable head set between them. This arrangement permits the application of tensile, as well as compressive, forces to a specimen, since the movable head must always transmit its force to the fixed head to which the weighing mechanism is connected.

Two Types

Universal testing machines are of the screw-gear or hydraulic type, depending upon the method employed in driving the moving head. In the former, the movable head is fixed to heavy-threaded shafts or screws which, in turn, are connected to a motor through a train of gears, thus securing any desired speed. The usual screw-gear machine transmits the load, many times reduced, from the stationary head to the scale beam by means of a series of levers supported on hardened steel knife-edge bearings. The moving head of the hydraulic machine is operated on the principle of the hydraulic ram or press. The load is determined from the pressure of the fluid, usually a light oil, and the area of the ram.

Either type of machine may be vertical or horizontal design. That is, the movable head may be designed to operate vertically in one case or horizontally in the

PRODUCTS

Machines

ROVED MATERIALS

Professor of Mathematics and Mechanics

other. The horizontal design permits greater access to machine and specimen particularly when they are long. On the other hand, the vertical design does not allow the specimen to bend of its own weight as is the case in the horizontal.

No discussion of universal testing machines would be complete without mentioning the Emery testing machine which is world-famous for its sensitiveness and accuracy combined with ruggedness. The first machine was built in 1879 by A. H. Emery at the Watertown Arsenal, Watertown, Mass.

The essential features of this machine are a hydraulic ram at one end for producing the load and a hydraulic capsule through which the load must pass at the other. In principle the capsule consists of a heavy, shallow cylinder filled with oil and covered with a metal diaphragm against which the load acts. From the capsule the load is transmitted by the fluid pressure to a smaller auxiliary hydraulic cylinder also covered with a diaphragm. From the hydraulic cylinder the load is transmitted through an ingenious weighing mechanism in which all levers have plates or diaphragms as fulcrums. Thus, the force applied to the specimen is transmitted without friction at any point to the scale beam where it is accurately measured.

The Emery Machine

The capacity of the United States testing machine, as the Emery machine at the Watertown Arsenal is called, is 1,000,000 pounds in compression and 800,000 pounds in tension.

As an indication of the extreme care with which this machine was made, the poise weights are gold-plated to prevent corrosion. To eliminate the possibility of injury, the scale beam, levers and poise weights are all inclosed in a glass case with provision made for manipulating the weights from the outside.

When first tested, the machine registered a maximum load of 722,800 pounds in breaking a steel bar 5 inches in diameter. Following this a single horse hair was broken at an indicated load of 16 ounces, a value as accurate as that given by a small spring scale used as a check.

Obviously the first Emery hydraulic scale was too expensive for the average testing laboratory, consequently its field of application was quite limited. It has since been redesigned to meet the more practical needs of materials testing and many of these machines are now in use.

As to the materials testing machines at the University of Minnesota, a large majority of these are located in the Experimental Engineering Building. The remainder are found in the laboratories of Agricultural Engineering, on the Farm Campus, the School of Mines, Mechanical Engineering, and in the Oak Street Laboratory.

Altogether, the University owns about eleven universal testing machines ranging in capacity from 300 kgs. to 400,000 pounds. Most of them, however, have capacities of 50,000 to 100,000 pounds. All are of vertical design. Of the total number only three are of the hydraulic type. One of these uses the Emery principle and is designed particularly for testing 6-inch by 12-inch concrete cylinders in compression. Its capacity is 75,000 pounds.

The maximum length of specimen which the above machines can test depends, of course, upon the maximum distance obtainable between the heads and upon the kind of test to be made. For the smaller machines the maximum distance permitted between the heads is roughly about 2 to 2½ feet, while for the larger machines it is about 8 to 10 feet.

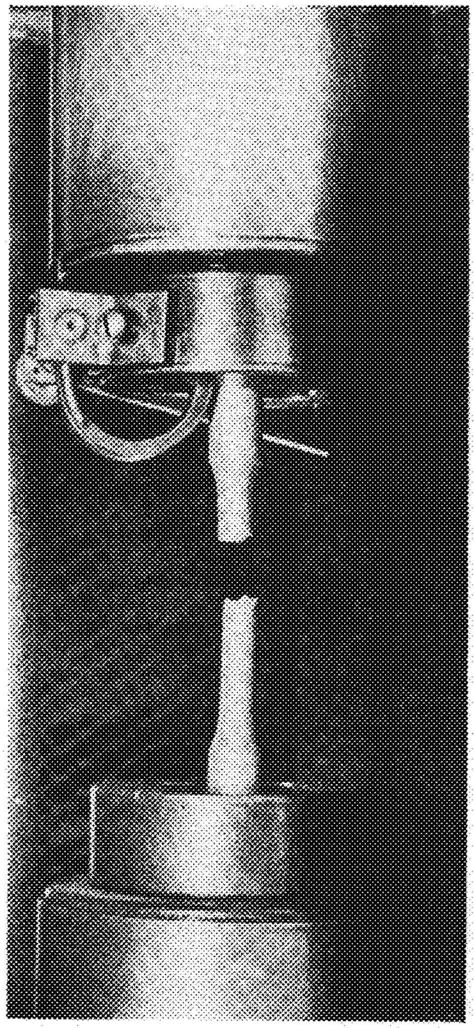
Machine Capacities

The largest universal testing machine in the country or in the world so far as the writer is aware is the 10,000,000-pound machine at the U. S. Bureau of Standards at Washington, D. C. This is a four-screw vertical type machine for testing slabs and long columns. Columns up to a maximum of 6 feet square and 65 feet long can be tested in this machine.

The most powerful machine in the country when speed is considered is the Templin precision machine in the laboratory of the Aluminum Co. of America. This machine is used largely as a forging or forming press and can exert a force of 3,000,000 pounds in compression and 1,000,000 pounds in tension. The unusual feature of this machine is that it can exert its full load at a maximum speed of 36 inches per minute as compared to a speed of 0.05 inch per minute required in many tests.

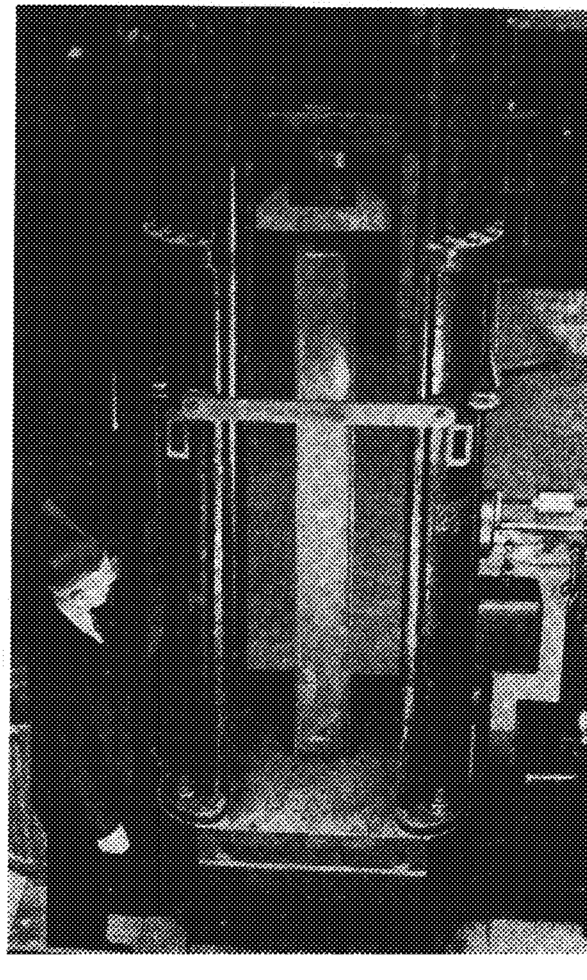
Materials testing machines are of no value as such until they have been accurately calibrated. At times this has been a very difficult job, and in some cases almost as difficult as making the machine itself. Proving rings, calibration boxes and the like are now available to assist in the process and also to enable the accuracy of the machines to be checked from time to time.

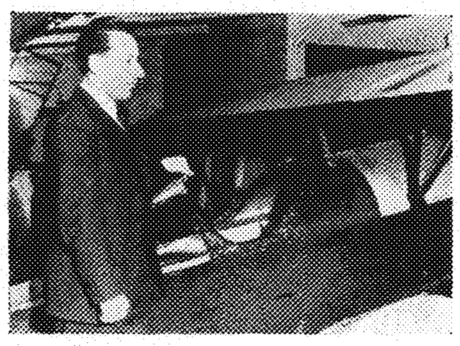
In conclusion, it may be said that the possibilities or advantages of materials testing machines are not utilized to the fullest extent unless precision instruments for measuring the deformations of the specimens are used in conjunction with them. The latter instruments have a variety of forms and degrees of precision.



Standard 0.505 inch diameter test specimen after fracture.

Test of "I" column in 400,000 pound screw-gear universal testing machine.





ALUMNI NOTES

Featuring In This Issue Institute Graduates

In Aeronautical Engineering

By Ward M. Hanson, Ch.E. '42

'36 Garvin Von Eschen

Like many who have adopted aeronautics as a profession, Mr. **Garvin L. Von Eschen** first became interested in flying while building model airplanes in high school. He entered the University of Minnesota in 1931 and during the summers between his freshman, sophomore and junior years worked in the tool room of a canning factory in Faribault, Minnesota.

Mr. Von Eschen graduated from aeronautical engineering in 1936 and the next fall began instructing in aeronautical engineering and engineering drawing at Duluth Junior College. Later that fall he returned to the University as an instructor in drawing and descriptive geometry, a position which he held until the spring of 1940.

During the summers of 1937 and 1938 Garvin Von Eschen was assistant instructor at the senior civil engineering camp at Cass Lake. The next two summers he went to the Lockheed Aircraft Company as an engineer. The first year he worked in the controls group, while the next year he worked in the wing and center section division, after which he was in charge of a group working on the design and installation of electric equipment. In working towards his master's degree, which he received in 1939, Mr. Von Eschen made a study of the effect of fuselage location on the span-wise air-load distribution of an airplane wing. He is now very interested in the development of rotating-wing aircraft, more specifically the helicopter type.

Although his main interest after completion of work on his doctor's degree is teaching, Mr. Von Eschen is looking forward to frequent trips into industry during his spare time in order to keep in touch with new developments. Mr. Von Eschen has already made his solo flight and is now flying toward a private pilot's license as well as teaching ground school for the C.A.A. and instructing in aeronautical engineering at the University of Minnesota.

'36

E. N. Van Duzee, Mi., who is now manager of Shell Oil Company's Louisiana Division, was transferred from their Tulsa Division and may be addressed at Shell Oil Co., Inc., Lake Charles, Louisiana.

Robert R. Mumm, Ch.E., is now residing at 239 East Mauch Chunk Street, Tamaque, Pennsylvania. During March and April of 1940 he was at the Chemical Warfare School at the Egewood Arsenal in Maryland.

William A. Brastad, E.E., and his wife **(Jean Downey,** '40 H.E.) live at 1435 Grand Avenue, St. Paul. Mr. Brastad is employed in the mineral laboratories of the Minnesota Mining and Manufacturing Company of St. Paul. The Brastads were married June 29, 1940.

'37

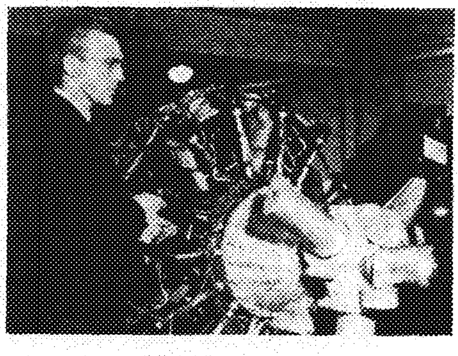
Robert N. Brownlee, Ch.E., is a member of the development department staff of the Wood Conversion Company of Cloquet. His address is 214 Avenue D, Cloquet, Minnesota.

Richard S. Olsen, Ch.E., formerly with the Newark office of du Pont Co., was transferred to Philadelphia as head of group engineers. His residence is in Drexel Hills, Pennsylvania.

'39 Henry Stillwell

Not many engineering students are privileged to have a young instructor lecturing in the class room and helping them in the laboratory who has had much industrial experience. Students of aeronautical engineering are indeed fortunate in this respect for they have as a member of the staff a man who has been working in the aeronautical industry for the past five summers, Mr. **Henry Sheldon Stillwell.**

Mr. Stillwell entered the University of Minnesota in 1935 and after completing his first year's work in aeronautical engineering was employed by Transcontinental and Western Airways in the maintenance department and also by Tipton Aircraft as a draftsman during the summer. The next two summers saw him with the Porterfield Aircraft Corporation at Kansas City. With Porterfield he was engaged in engineering work, specializing in the design of small airplanes with 40-90 horsepower. After graduation in 1939 Henry Stillwell became an employee of Consolidated Aircraft in California where he worked on the design of the Model 31 trans-Atlantic flying boat of 4,000 horsepower which was then in construction, as well as 4-engine flying boats for the navy which were classified as patrol bombers.



In the fall of 1939, Mr. Stillwell returned to the university in the capacity of a research assistant while working towards a higher degree at the same time. His research was concerned with the structural testing of stainless steel for aircraft and resulted in the presentation of a paper, "Strength Investigation of Thin Stainless Steel Sections," and the publishing of a paper on "The 'Plug' Method for Obtaining the Compressive Elastic Properties of Thin-Walled Sections," of which he is co-author.

After receiving his degree of M.S. in June, 1940, Mr. Stillwell worked on the structural design of observation aircraft and torpedo bombers for the Vought-Sikorsky Aircraft Company at Stratford, Connecticut. He returned to the University last fall and is teaching while working on his degree of Ph.D. As to the future Henry Stillwell looks forward to a teaching career which will enable him to return to industry during some summers so that he will be able to keep up with industrial advancement. Mr. Stillwell believes this plan is essential for an instructor to be truly a success.

'39

Frederick W. Meile, Ch.E., employed by the Minneapolis Gas Light Company, recently built a new home at 1900 East River Terrace in Minneapolis. He says he is looking for a wife to help him enjoy his new home.

Lloyd P. Tyler, Ch., was married recently and lives at 512 Delaware S. E., Minneapolis. Mr. Tyler works for the Minnesota Highway Department and was transferred last summer to Waterloo, Arkansas, for ten weeks. His wife is now working on an advanced degree.


Little things help
to keep telephone
rates low...

News from the

Foundry Students Organize

In spite of the lack of facilities in the mechanical engineering building, interested foundry students have been teeming with action. Under the direction of Herbert F. Scobie, foundry instructor, they have organized the first student chapter of the American Foundrymen's Association ever formed in the United States. The motto of the A.F.A., "Coming together is a beginning—keeping together is progress—WORKING together is SUCCESS," will be the inspiration of the organization.

The new group will have several objectives. Foremost among them will be to give interested students a chance to get better acquainted with the foundry field and with each other and also to promote interest in foundry education and an understanding of the foundry industry. The group will try to stimulate student foundrymen to direct their attention toward design, inspection, control, research, and production of castings.

Charter members are James H. Anderson, Leo J. T. Brom, Jarl A. Havnen, LeRoy Kelman, Donald A. Johnson, and Rudolph Schummer. Students are encouraged to see Mr. Scobie if they are interested in joining this group.

Jobs for Seniors

Engineering seniors interested in securing jobs after graduation, may attend three informative meetings designed to help them to that end. Clifford I. Haga, professor of English, will speak on "Writing a Letter of Application" on Thursday, February 13.

On Thursday, February 20, Mr. Diamond of the Pratt and Whitney Company will speak on "What Does Industry Look for in the Selection of Technical Graduates?"

The last meeting will be held on Wednesday, February 26, when Paul Boynton will give the highlights of his newly published book, "Six Ways to Get a Job." All meetings will be held in the physics auditorium, starting at 7:30.

Sleighride Held for A.S.C.E.

Features of the A.S.C.E. meeting, Friday, January 24, were motion pictures on earthwork shown by Gordon Lundeen, and a scandal sheet read by Don Blaisdell. Plans were discussed about the adoption of class keys for the civil engineers. Also considered were plans for the Society's annual sleighride at Eaton's Ranch some time in February. A representative of the State Board of Health has been secured to speak on sanitation at some future meeting. Members of the A.S.C.E. are conducting a membership drive at the present time.

A.I.E.E. Plan Electrical Show

Mr. Willey, special designer for the Northwestern Bell Telephone Company, told 40 E.E.'s about the Minneapolis-Stephens Point coaxial cable at their meeting on January 16. He showed slides as well as some actual samples of the cable, amplifiers, and other equipment.

Charles Scott, chairman of the Electrical Show, recently an-

Tech Societies

nounced his appointments of committee heads. The committees and their chairmen are: vice chairman, Walter Fish; freshman representative, Kim Cummings; apparatus, Robert Lyons; A.I.E.E. representative, Eugene Ecklund; dance, Art Smythe; finance, Paul Chalmers; M.F.G. exhibits, K. Carlson, J. Storm, and W. Weden; program, Eldridge Mandeen; student exhibits, Howard Schoonover; tickets, Edwin Brandt; publicity, John Lambert. Several committee chairmanships are still open.

Sophomores are urged to sign up for work on the show so that they will be eligible for executive positions at the next Electrical Show. Any other electrical engineers who want to help can sign up in the electrical engineering office or in the basement lunch room.

I.Ae.S. Eats Beans

Members of the I.Ae.S. had a joint bean feed and meeting in the ballroom annex of the Union on January 21. Feature of the meeting was a talk by Lt. Lindner, of the Naval Air Base at Wold Chamberlain field, on "Aircraft Maintenance."

Rodger Ringham and Dale Drinkwater were appointed co-chairmen of the Aero Ball, to be held at the Nicollet Hotel on Saturday, February 21. Freddy Rick's orchestra will play at the Ball. Co-chairman Ringham has announced that the aero's will once again blitzkrieg the campus with free tickets to the Ball.

A.S.Ag.E. Helps

The A.S.Ag.E. met January 16 to discuss plans for Farm and Home Week, which was held from January 20 to 25. Members of the Society operated an information booth and check room for Farm and Home Week visitors. The booth was under the direction of William Johnson, George Gardner, Clifford Merrill, and Phillip Manson, instructor in land reclamation. The agricultural engineering department had several exhibits dealing with farm mechanics, structures, machinery, tractors, rural electric power, and land reclamation.

A.S.M.E. Hears Rowley

With a variety of humor, business, entertainment, and refreshments the A.S.M.E. held its first meeting of the quarter on January 23. Skeptical engineers were convinced that music and science mix when Professor Fulton Holtby entertained the audience with a reënactment of his recent training—20 easy lessons in playing the piano by mathematics.

Professor Frank Rowley, new head of the mechanical engineering department, presented a sketch of the work which has been done by the Board of Regents, the mechanical engineering faculty, and the A.S.M.E. on behalf of a mechanical-aeronautical engineering building. Professor Rowley believes that the chances of getting state appropriations are still fairly good. He feels convinced that the money would be appropriated if the legislature could see the actual conditions which exist.

Plans were made for future meetings, and the idea of publishing a mimeographed, departmental news-sheet was discussed. The meeting was concluded with a sound movie and coffee and doughnuts.

Professional Fraternity News

KAPPA ETA KAPPA—Electrical

One of the largest and most active chapters of Kappa Eta Kappa, Professional Electrical Engineering fraternity, is to be found here, on the University of Minnesota campus.

The fraternity was founded February 10, 1923, at the University of Iowa, Iowa City. Beta chapter at Minnesota was established that same year on May 26, with 18 students and 2 faculty members being initiated as Charter members. One of the faculty members who is still very active in the affairs of the fraternity and at whom the boys at K.H.K. point with just pride as a past National President, is Professor John H. Kuhlmann, genius of "electrical design" in the electrical engineering department.

The active membership at the close of the Fall quarter was 25, with 15 of these being members of the K.H.K. Radio Club. The Radio Club members have built and operate a phone and CW transmitter in the "Ham" shack located in the basement of the chapter house. The transmitter is now operating on 75 meter phone, and the call is W9QND for the benefit of you "Hams" interested in making new contacts. The club maintains a schedule with other chapters of K.H.K.

This year's President of K.H.K. is John Dahlberg, who doubles in brass with his own (Larry Roberts') dance orchestra at many of the important University functions. Vice president is Ernest Pappenfus; secretary, Robert Albee; and treasurer, Paul H. Chalmers.

ALPHA RHO CHI—Architecture

Alpha Rho Chi's great basketball teams of the past few years need have no fear that the tradition which they have built up will be shattered this year, since the "Architects" predict they'll have another real contender for University honors again this year. (Alpha Rho Chi won the 1940 All-University Championship in basketball.)

Also worthy of mention is the "Architects'" record of first prize in the Professional Fraternity Homecoming exhibit contest for three straight years, from 1937 through 1939, and second place in 1940.

TRIANGLE—Engineering

The engineers at Triangle fraternity entertained the national convention for the 16 chapters of the fraternity, and 'tis said the local boys fixed the visitors up with some fairly representative campus "Queens" for the evening sessions. After the business of the convention was taken care of, the guests were treated to tours of Minneapolis, a boat ride on Lake Minnetonka, and various dinners and dances.

Recently, the fraternity has had as dinner guests, Professors Dowdell, Shoop, Ackerman, and Levins, and are looking forward to the visit by Carol Geddes of the student affairs office.

ALPHA CHI SIGMA—Chemistry

Beta of Alpha Chi Sigma again is active in the intramural sports program. After winning the professional crown and going to the All-University finals in the fall quarter, the bowling team is again headed toward the top position. The hockey team repeated last year's performance by winning the professional fraternity championship.

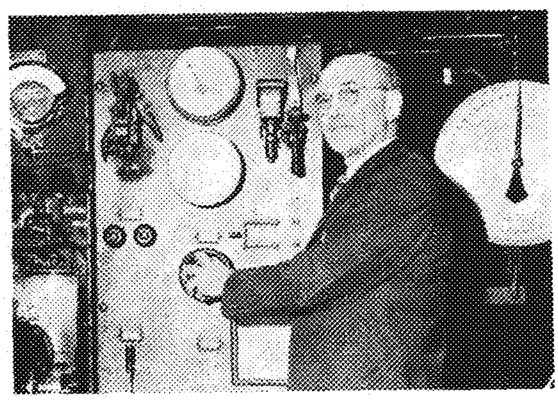
Social events for the fall quarter included a homecoming dance at the Greenhaven Country Club and a Hard-time party in the Maroon and Gold Room of the chapter house. Dr. C. A. Mann, head of the Department of Chemical Engineering, was present at the freshman smoker.

THETA TAU—Engineering

Alpha chapter of Theta Tau has spent a successful fall quarter under the leadership of regent Burton "Bud" Royum. The chapter held two regular monthly professional meetings during Fall quarter. Speakers at these meetings were E. J. Longyear, president of the E. J. Longyear Company, and Mr. Walter H. Wheeler, consulting engineer. Mr. Wheeler is an alumnus of Alpha Chapter.

Editor's note: Professional fraternity notes will be a monthly feature of the Techno-Log. In each issue news from each fraternity will be published together with a history of one of them.

We Present . . .



Professor B. J. Robertson

Associate Professor of Internal Combustion Engines

By Wendell L. Wilkins, Aero, E. '43

A friendly laugh and a distinguished smile show Burton J. Robertson to be an amiable man who understands the secret of making friends with all types of people. His words carry the wisdom of a person who knows that making friends and influencing people is the largest step toward success.

He was graduated from the Austin, Minnesota, high school in 1901. The next eight years of his life were spent in various activities including building and operating a telephone exchange at Lyle, Minnesota, acting as Postmaster in the same city, and later organizing the Thompson Auto Company for the sale and repair of automobiles.

His further education was begun at the University of Minnesota in 1910 in the College of Engineering. He received the degree of B.S. in engineering in 1914 and the degree of E.E. in 1915. Although receiving this degree in E.E. he soon found work more to his liking in Mechanical Engineering and was appointed an Instructor in Mechanical Engineering and Assistant Director of the Experimental Engineering Laboratories in 1919. His work since 1937 has been centered in the Internal Combustion Engines division of the Mechanical Engineering Department where he is in charge as well as being an instructor and carrying on extensive research and experimental work in the Oak Street Laboratories.

Professor Robertson is a member of Tau Beta Pi, Sigma Xi, and Pi Tau Sigma honorary societies. He has served in various offices of the Minneapolis Section of the A.S.M.E., including Secretary, Chairman and the Minneapolis delegate to the annual meeting of the society. He is a member of the Minneapolis Engineers Club, Campus Club, and is registered as a professional electrical and mechanical engineer by the Minnesota State Board of Registration.

His main interest is in engines and research, with a recent trend toward aviation engines. He spent last summer at East Hartford, Connecticut, doing research on superchargers for the Pratt and Whitney Corporation. He has investigated winter motor oils and piston rings very extensively. Many of his publications can be found in *Diesel Power*, Engineering Experiment Station Bulletins, and various journals.

Mr. Robertson's pet hobby is lake fishing, and he is very proud of the collection of tackle and flies owned by his friend, Professor Doeringsfeld. While living at Lyle, Minnesota, he was a very active musician and still has a deep appreciation for good music.

LAUGH!

It's Humor

By Ralph Hill, Ch.E. '41

Our hats off to the street cleaner. He's one guy who knows enough not to put the cart before the horse.

They called him "Stuka," because every time he went into a dive, he came out shot.

Gently, he pushed her quivering shoulders back against the cushioned chair. She raised beseeching eyes in which faint hopes and fear were struggling. From her parted lips, the breath came in short, exciting gasps. BZZZZ, went the dentist's drill.

They say kissin' is only face lifting.

If a girl expects to win a husband, she ought to exhibit a generous nature—or how generous nature has been to her.

Our nomination for the most popular Saturday evening sport is, "Ring around the bathtub."

Down Alabama way, there was once an old gentleman who experienced some difficulty with his Negro servant, Mose. It seems that Mose was sent down to the river to get some water, and just as he dipped the pail into the water, a large alligator snapped at it, and caused the colored stooge to drop the pail into the river. Upon telling his boss, Mose was sent back to get the pail and return with the water, alligator or no alligator. Mose fished the pail out of the river, but again the alligator snapped at it. When he reported again to his boss, said boss said, "Why Mose, that 'gator is probably just as scared as you are."

Whereupon Mose replied, "Boss, if that there alligator is as scared as I am, that water ain't fit to drink."

"Some day you're going to look up to me."
"When's the hanging?"

They tell of the sorority girl who went around to the fraternity houses selling the *Saturday Evening Post.* Her sales were greater than anticipated, and when she ran out of Posts, they took Liberties.

Sign in a grocery store: "The world is coming to an end. Pay your bills now so we won't have to look all over Hell for you."

A true lover of music is the man who, upon hearing a soprano voice in the bathroom, puts his *ear* to the keyhole.

Heard on the Snow Train:
"Are you drunk?"
"Boy, them Four Roses ain't pinned on me."

ENGINEERING ENIGMAS

Dave Christianson, E.E. '41

and Howie Bushnell, E.E. '41

Coulomb-us took a chance, why shouldn't we?

We're just a couple of armatures at column writing, but we want to find your resistance to our type of punishment. Our gauss is that we won't be the current success of the field, but if we could induce you to volt for us, who knows watt-hour column may turn into? We probably won't dare show our phases after this electrifying display of the more series-turn of our mind. In fact, we'll probably stay ohm, we're sol-enoid with the reaction to our impedance.

* * *

Commutator: A man who talks over the radio about war news.

Field: What a man does around when he looks for his overshoes in a dark closet.

Armature: A fellow that won't accept cash prizes when he wins sporting events.

Armature Conductor: A new streetcar employe.

Bus Bar: The latest development in public conveyances.

Capacitance: A base for measuring relative "he-man" qualities of two engineers.

* * *

When we took our girl home, we tried to oscillate, and she almost had hysteresis, but we couldn't transformer. As we were walking up the sidewalk, a de-generate girl with brown coils threw ergs at us, so we called a copper to arrester. She said she had been dyne to do it ever since we rotor that letter. We didn't know it would a-vector that way.

* * *

Suspender buttons weak
Elevators fluctuating wildly up and down
Many runs on the silk stocking market
Dresses sold short, skirts higher
Red flannels off
Autos sold on curb
Airplanes constantly coming down, a crash is feared
Mountain railroads on upgrade
Scotch strong
Grand pianos heavy

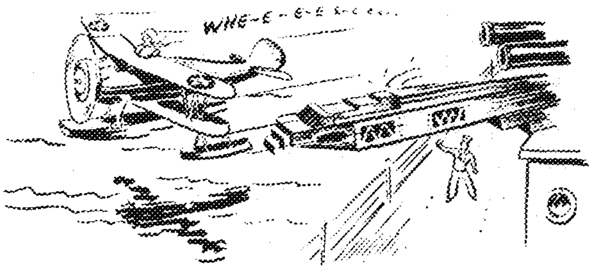
* * *

Tonight we're going to have a big time at the A.I.E.E. dance. There's a swell orchestra, and their theme song is "Ohm man mhos is dead." Henry, Gilbert, and Max-well be there. Last time, on the way home, the conductor asked, "Wire you getting insulate?" We told him with e.m.f.asis that he shunt torque so much. We had to go down to Jake Joule's first to get a new suit. He told us that the more he saw of us the battery liked us.

* * *

We wish that we were in our bed
With nothing to be but dumb—
With all the things we have to cram,
Crum.

G-E Campus News



SPEED INDICATOR

WHEN an airplane catapult hurls a plane into the air too fast, the pilot may be injured and unnecessary strain put on the plane. If the plane takes off too slowly, it will drop into the water. In the past, barrels have been substituted for planes for testing purposes.

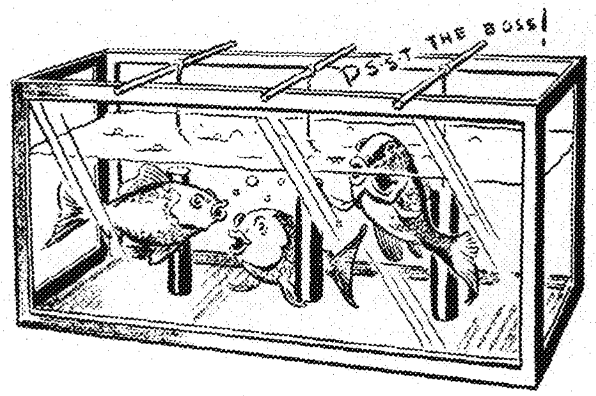
A new speed indicator, designed by the General Electric Company, checks the adjustment of the catapult without risking pilot or plane. The skid is shot down the track empty; if it registers the proper speed, the plane can then be placed on it and launched into the air at the correct speed. With some changes the equipment may be used to time other moving objects.

EYES FOR DEFENSE

PEOPLE in and around Schenectady, N. Y. are looking up these nights, watching the beams from giant searchlights being tested at the General Electric plant. In other parts of the world whole cities huddle underground, while sirens wail and bombs crash—but these Americans watch without fear. The sharp fingers of light sweeping silently across the sky are reassurance, symbols of security. Industry is on the job, providing the eyes of defense.

Searchlights are not the only defense items being built in Schenectady and in the other plants of General Electric. Great steam turbines are under construction, totalling millions of horsepower, to drive the ships of America's expanding navy; intricate controls will direct the operation of warships, tanks, planes, and guns; radio equipment will facilitate communication on land and sea and in the air.

And playing a vital part in these defense preparations are Testmen, young student engineers just off the campus, whose responsibility it is to test these machines.



INDUSTRIOUS FISH

SAMUEL JOHNSON, a chemist in the General Electric plastics research laboratory at Pittsfield, Mass., has three fish as helpers.

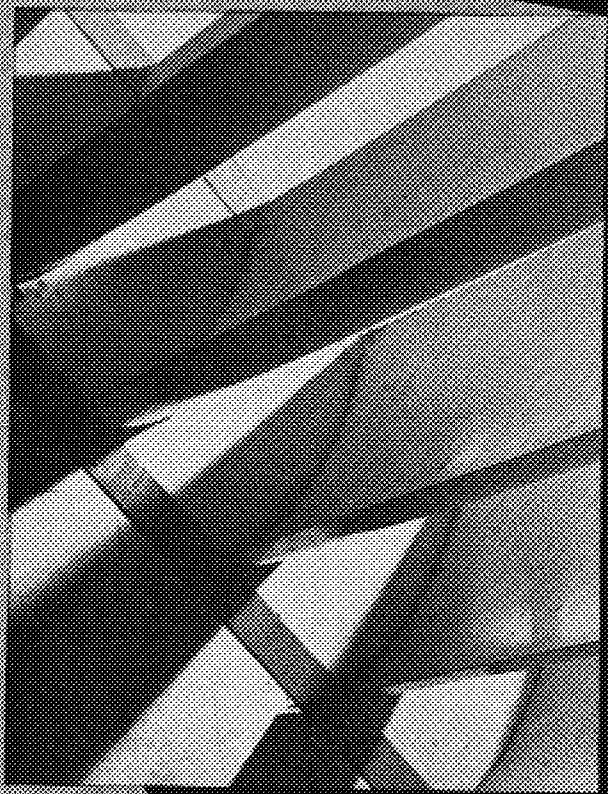
A large glass jar, used in the laboratory to keep a constant temperature bath for measuring the viscosity of plastic materials, collected scum inside, making the glass opaque. Since it was necessary to look through the glass, the jar had to be emptied and scoured once or twice a week. This was a tedious job, because the scum stuck. Acids didn't work. Snails were even put in the jar as scavengers, but high temperatures killed them. Then, just by chance, Johnson tried three goldfish from the "five and ten."

The fish took to the scum like a kitten takes to milk; within two or three days the jar was as clean as a whistle. It has remained so ever since.

GENERAL ELECTRIC

958-18

THE TECHNO-LOG OF MINNESOTA



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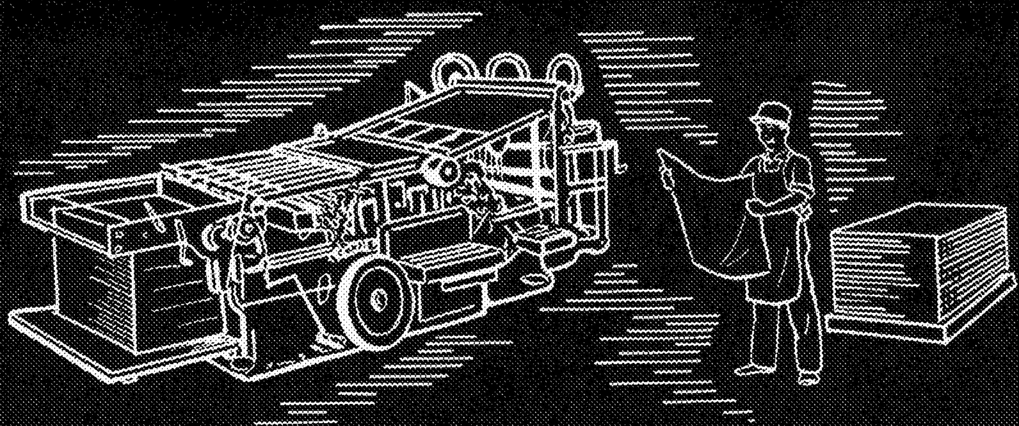


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PRECISION

AT THE

BEGINNING

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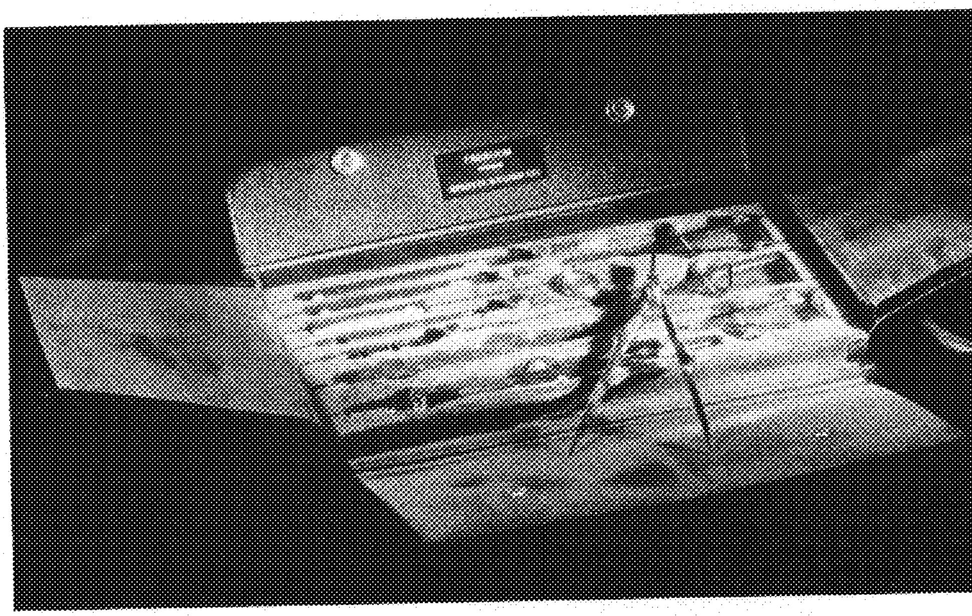
It is here at the beginning that K & E drawing instruments have since the beginning of the engineering profession helped to make drawings of the highest standards.

There is a K & E drawing set for every type of work, student and professional, and all are built to the fine precision that has always made K & E drawing instruments the selection of "Critical Engineers."



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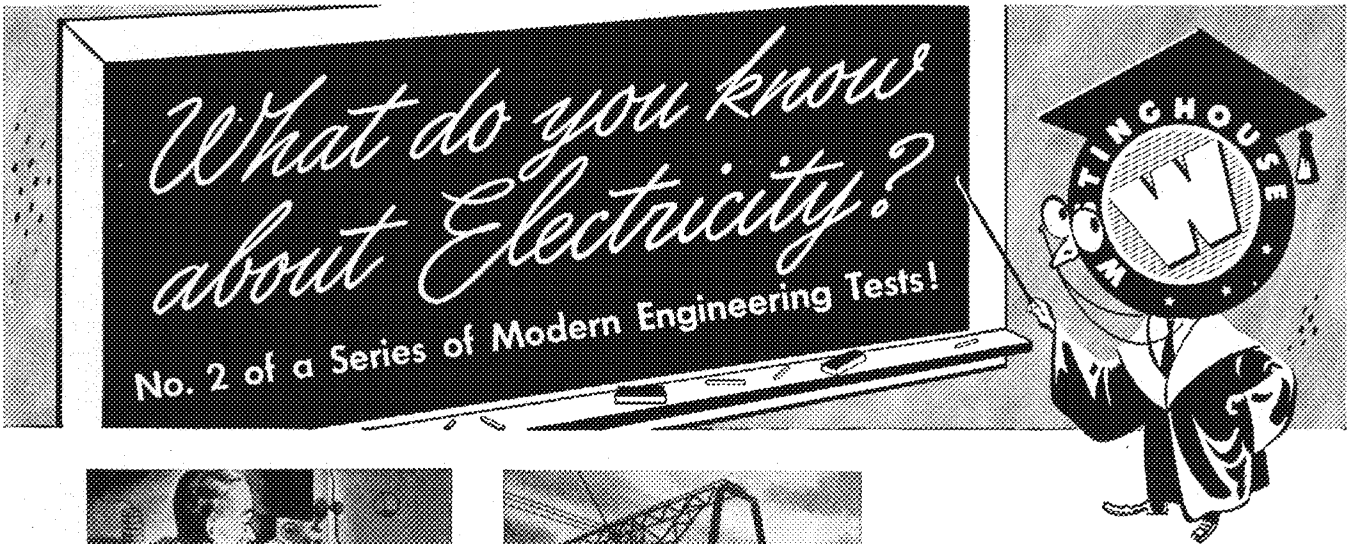
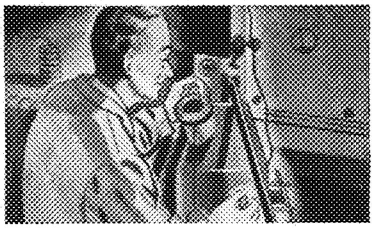
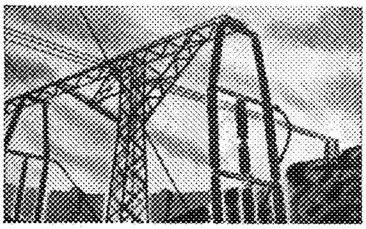




THE OSCILLOGRAPH

The Westinghouse cathode-ray oscillograph makes written records of electrical events occurring in as short a time as:

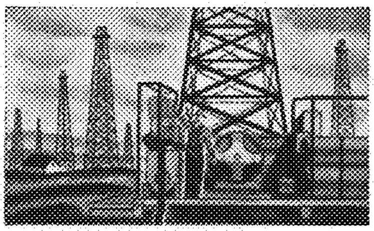
1. One second
2. One cycle of a 60 cycle per second wave
3. One-thousandth of a second
4. One-millionth of a second.



LIGHTNING ARRESTERS

Lightning is a constant threat to transmission lines. Westinghouse has constructed lightning arresters that protect the highest voltage carried, which is:

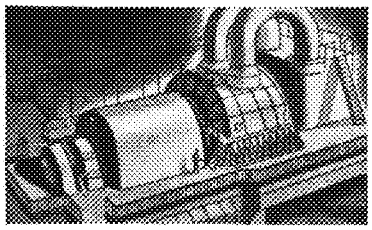
1. 33,000 volts
2. 66,000 volts
3. 220,000 volts
4. 287,000 volts



DEEP OIL WELL DRILLING

Great depth is being attained with electric rigs using Westinghouse equipment. To date, holes have been drilled as deep as:

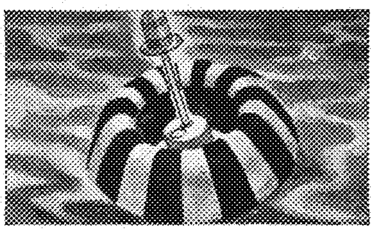
1. 1200 feet
2. 4800 feet
3. Two and one-half miles
4. Six and one-third miles.



STEAM-TURBINE GENERATOR

Installed in Philadelphia is the largest single-shaft steam-turbine generator ever constructed. It was built by Westinghouse and can develop:

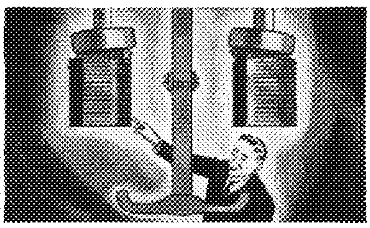
1. 17,500 kw
2. 72,500 kw
3. 165,000 kw
4. 850,000 kw



SEADROME CONTACT LIGHT

The Seadrome Contact Light, developed by Westinghouse to facilitate night landing of seaplanes, is turned on and off by:

1. A man in a launch
2. An electric eye
3. Radio signals from shore
4. A submerged cable.



DE-ION PRINCIPLE

As pioneered in 1928 by Dr. Joseph Slepian, Westinghouse Research Engineer, the De-ion principle is concerned with:

1. Faster, more efficient extinction of electric arcs
2. A new method of charging for electric power
3. The theory of magnetism
4. Harnessing the power of the atom.

Let's Try It Again!

Regardless of how you came out on the last series of questions, here's another chance for you to see how familiar you are with important developments in the field of electrical engineering.

Optional answers are provided for each of the six questions listed at the left. Your task is to check the correct answer in each instance. To eliminate any peeking, the answers are printed below, upside down.

If you get four out of six correct you'll be doing all right. Five out of six passes you with honors. If you should know all the answers you can give yourself a good pat on the back.

★ ANSWERS ★

The Oscillograph .... Ans. 4.
Lightning Arresters .... Ans. 4.
Deep Oil Well Drilling .... Ans. 3.
Steam-Turbine Generator .... Ans. 3.
Seadrome Contact Light .... Ans. 3.
De-ion Principle .... Ans. 1.

Westinghouse *"The name that means everything in electricity"*

Authors . . . Staff . . . .

By Richard Opland, C.E. '43

A better understanding of frozen foods should result from reading the article by **James D. Winter**, Instructor of Horticulture on the University farm campus. Mr. Winter is at present devoting considerable time to research in frozen foods and is well qualified to write on the subject. He is an alumnus of Minnesota and obtained his master's degree in 1929. From 1922 to 1933, he was employed by the Minnesota State Department of Agriculture as Assistant State Entomologist in charge of Nursery Inspection. Mr. Winter is the editor of the *Minnesota Fruit Grower*, a publication giving advice and information to farmers, and he also edits the "Farm and Orchard" column in *The Farmer*, the fruit growers' page in the *Minnesota Horticulturist*, and "Minnesota News" in the *American Fruit Grower*. For recreation, golf and fishing rate at the top of Mr. Winter's list. He is a member of Alpha Zeta, Gamma Sigma Delta, and Sigma Xi.

The article on the wind tunnel is written by **Garvin Von Eschen**, Instructor in Aeronautical Engineering. Mr. Von Eschen graduated from the University of Minnesota in 1936 and acquired his master's degree here in 1939. He taught aeronautical engineering and engineering drawing at Duluth Junior College in the fall of 1936, but later that same fall returned to Minnesota as an instructor in drawing and descriptive geometry, a position which he held until the spring of 1940. During the summers of 1937 and 1938 Mr. Von Eschen served as assistant instructor at the civil engineering camp at Cass Lake, and the next two summers he was employed by the Lockheed Aircraft Co. Building model airplanes was the spark that kindled his interest in aviation and started him on his career. Mr. Von Eschen intends to acquire a private pilot's license and is well on his way, having made his solo flight.

Herbert F. Scobie, instructor in foundry practice, writes on foundry sand for TECHNO-LOG readers. This is not Mr. Scobie's first dissertation on the subject, as he has written a paper with Professor Holtby on synthetic molding sand. Mr. Scobie graduated from Minnesota in 1935 as Bachelor of Chemistry and was employed by the Strutwear Knitting Co. He later moved to the American Hoist and Derrick Co. as chief chemist before returning to Minnesota as an instructor. Mr. Scobie is the Alumni President of Triangle and is a member of the American Society for Metals, the American Foundryman's Association, the American Chemical Society, and the Minnesota Industrial Chemists' Forum. During the summer, he serves as camp director for Minneapolis area Boy Scouts at Ness Lake and at Lake Sylvia. When time provides, Mr. Scobie enjoys figure skating, hockey, and swimming.

The Cover

This month's cover—an interesting study of the end-vanes in the new wind tunnel—is by Jack Rockwell. Incidentally, this is his third cover picture this year.

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The editorial policy of the TECHNO-LOG is to present material for technology students which it is hoped will strike a happy medium between the superficial and the highly specialized.

The MINNESOTA TECHNO-LOG is published monthly, October through May, by the students in the Institute of Technology of the University of Minnesota.

The purpose of the TECHNO-LOG is two-fold: First, to put in the hands of TECHNO-LOG subscribers highly worth-while and interesting reading material; second, to offer technology students an invaluable opportunity to get writing, selling, and working-with-others experience.

THE MINNESOTA

Techno-Log

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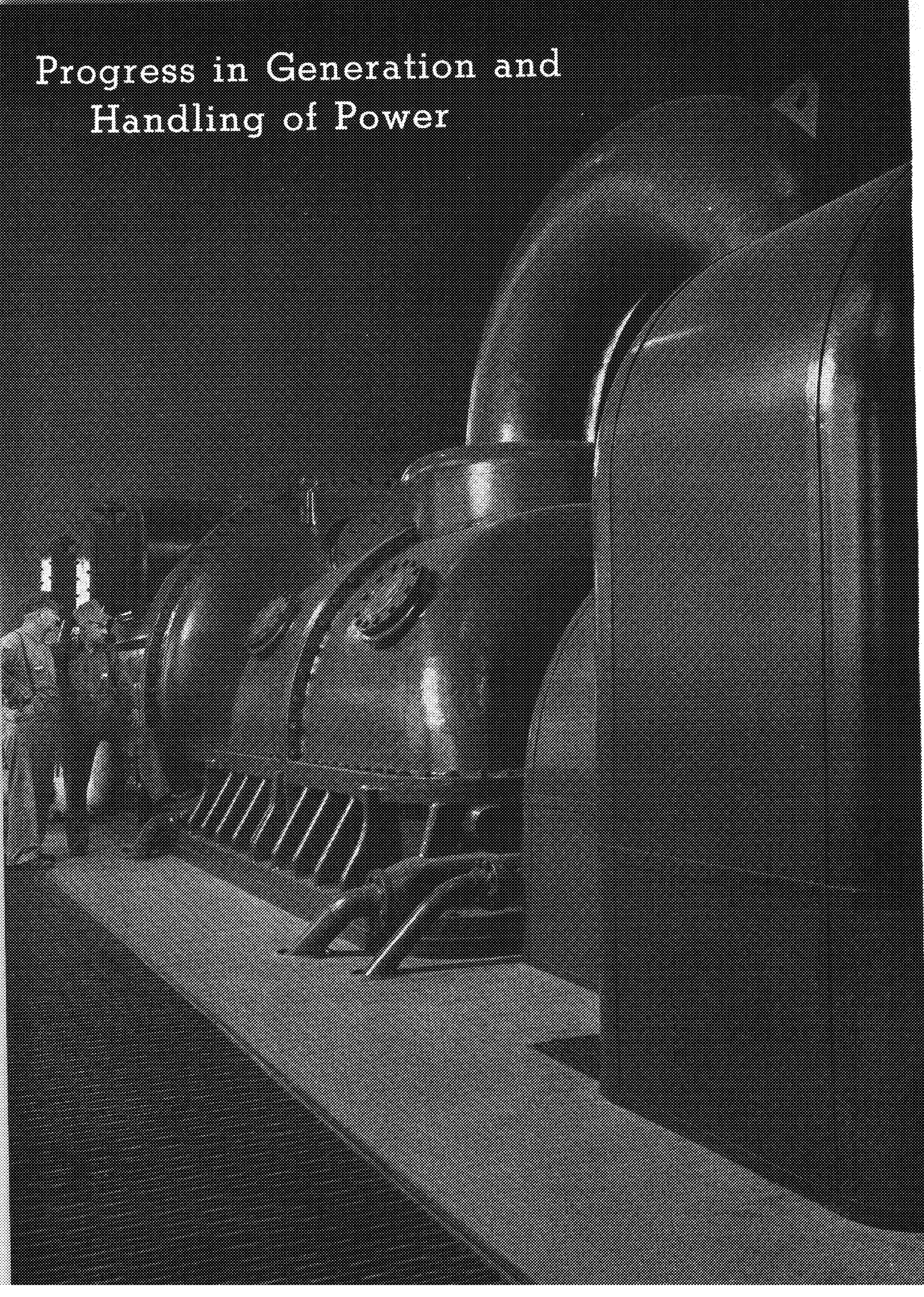
Progress in Generation and Handling of Power



AN EDITORIAL

Too Many Dabblers

DABBLING is one of the vices that the engineering course of study promotes. The cause probably can be attributed to the intensity and the rush of study, but the result as evidenced in the individual is probably even worse than it would have been had he stayed out of activities altogether.

Engineers do have the training and the practice in straightforward thinking necessary in organizing and carrying out extra-curricular projects. Many of them, in fact, hold outstanding offices and do outstanding pieces of work outside of their actual classroom work, but the number of these could be greater if more engineers would come out of their shells and if more of those that do come out would not be dabblers.

The grind or the bookworm has been run to the ground from time immemorial, but the dabbler apparently gets credit for trying and escapes unscathed. To blazes with the credit for trying! Most of them have the ability or they wouldn't have stayed with their engineering course for two or three years. They have some interest, they have the ability, but they just won't get out and fight for their extra-curricular activity.

These dabblers are the product of the "no activities for me" attitude that lasts for maybe a year or two. After that time, they begin to realize that maybe they have missed out on something after all. They try one activity, then another, and maybe even a third; but they cannot seem to make a go of any of them. Somewhat crestfallen, they crawl back into their shells and decide that they are not cut out for activities.

What they forget is that it takes work to make a success of an activity just as much as it takes work to make a success of a course of study. Both studies and activities are important, and by good hard work one can make a success of both.

Let's have fewer dabblers and more workers to make institute activities really hum.

BY WALLACE K. BELIN, EDITOR

ENGINEERING INGENUITY MAKES

Frozen Foods

A PROMISING INDUSTRY

By James D. Winter

Instructor in Horticulture

Modern commercial freezing plants are the result of new technical engineering practices developed to provide a rapid rate of heat transfer in freezing, reduction of moisture-vapor losses by means of controlled humidities and proper packaging, rapid handling of large quantities of foods, and accurate control of other factors that go into the production of high quality "quick-frozen" products.

WE learn from the diaries of the early New Englanders that the freezing of foods in the United States dates back to the days of the Pilgrim Fathers. Under the guidance of friendly Indians, food such as corn, beans, and chopped squirrel meat or other wild game was stirred together and set outside to freeze. This mixture remained palatable as long as the weather remained cold.

Modern quick freezing technique has two important advantages over the old slow-freeze method. First, the reduction in temperature of the warmest portion of the food is rapid enough to prevent spoilage or loss of quality due to microbial action. Second, the rate of freezing is fast enough to assure the production of ice crystals of small size, which are well distributed throughout the tissues. Ice crystals originate both intercellularly and intracellularly, and the size of these crystals may be increased as much as 500 times by slowing down the rate of freezing. The presence of large ice crystals results in crushing, rupturing, and distortion of the cell structure. This makes the frozen product incapable of reabsorbing, on thawing, a satisfactory amount of the water which has separated out as ice in freezing. The new quick freezing methods, on the other hand, cause tiny needle-fine crystals of ice to form. However, merely obtaining small ice crystals is not sufficient to guarantee satisfactory reabsorption on thawing, as the dehydration on freezing may become irreversible at very low freezing temperatures.

Economy

In the frozen food industry, as in any other industry, considerable importance is placed on cost reduction and production efficiency. This necessitates careful consideration of the heat transfer characteristics of the cooling media, container and packaging materials, and products being treated, as well as humidity control, preparation, handling and other factors.

Methods for freezing foods vary from one product to another. While it is true, however, that different products must be handled in different ways, they will all fall into three main classes: (1) Barrel frozen foods; (2) Package frozen foods; (3) Loose pack frozen foods.

The barrel freezing system is one of the first and oldest freezing methods and is used for berries and for sour cherries. The fruit is packed into large barrels, either with or without sugar according to the kind of fruit and the use for which it is intended, and the product is frozen and stored at temperatures of —5 to —10 degrees F. When packed in sugar, the containers must be agitated and turned during the packing and freezing process to insure even distribution of the sugar.

Package freezing consists of freezing the product after it is packed into one of the many types of frozen food containers now on the market.

The term "loose pack" refers to products frozen before being packed into containers, and, in some instances, frozen vegetables are retailed in loose frozen form in any desired quantity.

There are many ways of producing the cooling effect which freezes these new food products. Many plants use air as the cooling medium. The general method in an air-cooling system is to run the food through a freezing tunnel in which cold air is force circulated by fans. The cooling tunnel consists of a well-insulated space with ammonia cooling coils mounted near the ceiling. The food, either packaged or loose pack (in trays), runs through the tunnel on conveyor belts or trucks.

Typical Installation

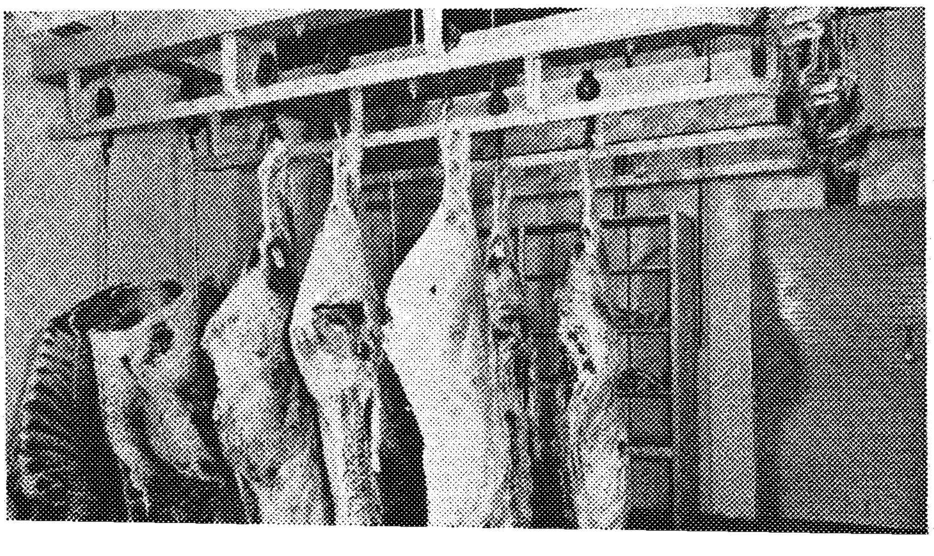
A typical installation would consist of a 90-foot tunnel equipped with a variable-speed, wire mesh belt capable of freezing about 1½ tons of food per hour, and with a fan capacity of about 30,000 cu. ft. of air per minute. Although temperatures as low as —80 deg. can be attained, air temperatures of —10 deg. to —30 deg. F. are commonly used.

More recently a multi-stage tubular freezer has come into use, designed to avoid subjecting the food to a large differential in vapor pressure during the freezing process. The food is first precooled to about 32 deg., followed by an initial freezing at 18 to 24 deg. Thereafter the food temperature is lowered in seven or eight progressive steps to a temperature of about —5 deg. The freezing process requires about 25 minutes. This system efficiently reduces dessication or dehydration.

Loose-pack frozen foods can either

Quick chilling with controlled temperatures is essential for best results with meat.

Courtesy U. of M. Extension Service.



Courtesy U. of M. Extension Service.

Modern cold storage rental lockers.

be frozen in trays or on conveyor belts. To freeze by tray, the food is placed on trays mounted on trucks which roll into the cooling room. This system is compact and flexible and is well adapted to the smaller plant. An innovation in tray type freezers is the multi-stage freezer. In this freezer, three different temperatures can be maintained and a first section of trucks can be precooled, the next frozen and the last tempered. Packaged foods can also be efficiently frozen in tray-type freezers. Tray cooling, however, has its disadvantages. The greatest one is the labor involved in filling, cooling, unloading, and emptying the trays. Also, particles of food tend to stick together.

Because of these disadvantages, the conveyor freezing system is now widely used, especially in larger plants. The conveyor system consists of one or more long conveyor belts running through a freezing tunnel. The produce enters in the natural state at one end and emerges frozen at the other. These systems are generally cooled by the air blast method. Here again, package frozen foods are easily adapted to a loose-pack system.

Two-Stage Freezer

An inherent disadvantage of the conveyor system is the tendency for foods to stick to the cold parts of the freezer because of the large temperature differences. To eliminate this difficulty, a two-stage freezer has been adopted. In this freezer the first stage is cooled by a brine spray unit. Here, the temperature is maintained at about 20 deg. This temperature chills the food and tends to freeze the film of water on the outside surfaces of the food, thus preventing sticking both to the machine and to other food particles. The second stage completes the freezing process. Package frozen foods are also adaptable to this loose-freeze system.

Storage is the final step in the preparation of frozen foods. After the produce is frozen, it must be stored until it is ready for consumption. This is done in constant temperature rooms held at —0 to —10 deg.

Liquids can be effectively used as the cooling medium for freezing, and with this refrigerant, the process is called freezing by immersion. In the immersion cooling system, the food is lowered into a circulating cooling liquid which is maintained at temperatures around zero deg. The first requirement of a medium for immersion freezing is that it remain unfrozen at zero deg. and slightly below. Meeting this requirement are a large number of solutions of sugars, salts, alcohols, hydrocarbons, and others. Sugars, glycerol, and sodium chloride are, so far, the most satisfactory. The second requirement is that the medium must be edible, since the product absorbs two to seven per cent of the medium during the freezing process.

Contact Cooling

Another popular freezing method is that of placing the packaged food under pressure between refrigerated plates of stainless steel, which are cooled by liquid media.

Brine spray is also effectively used as a coolant, and the other types of cooling media already mentioned are frequently combined in various ways.

One of the most important steps in the freezing process is the actual preparation of the food. An important step in this preparation is called blanching. Blanching is the process which stops the action of plant enzymes which would cause poor flavor or odor in the foods, and consists merely of a bath in boiling water or live steam. As an example of the steps in preparation, let us trace a quantity of peas as they are prepared for freezing.

The first step after harvesting the peas is the removal of the pods. Next, they are washed and graded for size. They are then blanched with steam for about two minutes, run through a cooling trough, and then through a liquid grader. This grader contains a definitely controlled density of salt brine. Over-ripe peas sink to the bottom, and good peas float off at the surface. The peas are again washed, checked by workers, and are then ready for the freezer.

Freezing Controlled

It can readily be seen that, for quality production, all of the freezing conditions, such as temperatures and time rates, must be accurately controlled. As an aid to this accurate control, much research has been directed toward increased knowledge of micro-physical changes occurring in fruits and vegetables during freezing for preservation. Among the work done upon this subject has been: (1) measuring the size, shape, and location of ice crystals and their relation to plant cells, and to eating qualities; (2) measuring the firmness of fruit and vegetable tissue before and after freezing to determine specifically the changes in structure due to freezing and thawing; (3) measuring the rate of hardening of berries and other fruits during freezing as an indication of the rate of freezing; (4) studying color changes during and after freezing.

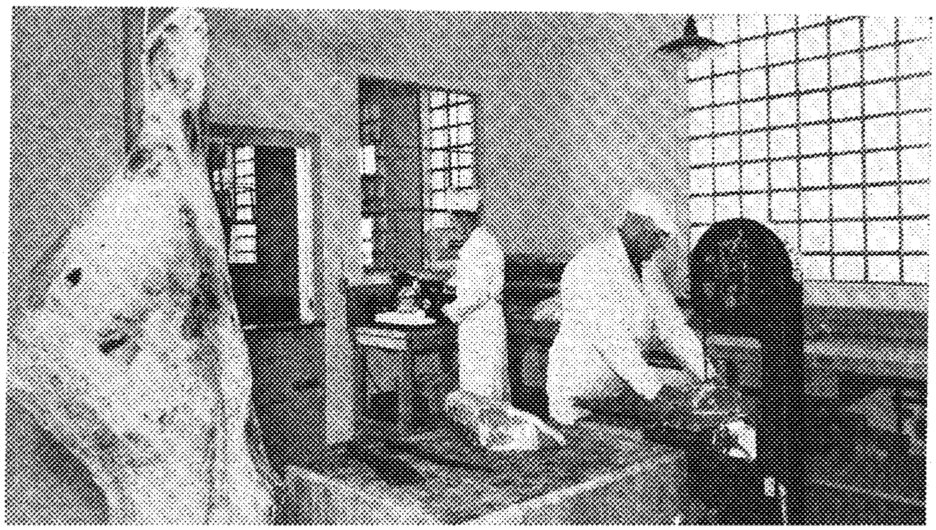
A new phase in the remarkable development of this food-preserving industry is the refrigerated locker system. These lockers are maintained at proper freezing temperatures and may be rented by individuals for 10 to 20 dollars per year. Small quick-freezing facilities are usually available with the lockers. So far, the primary use of these lockers has been the preservation of meat, and it is readily apparent that these lockers are a boon to farmers and small town dwellers who can, in this way, preserve meat from their own livestock.

Among the services offered to patrons of the food lockers are: cleansing and sterilizing services, regular inspection of meat products, and supervision of wrapping, freezing, food quality and personal cleanliness. The popularity of the food locker plan is evinced by the fact that approximately one million Americans are using frozen food lockers today.

Here then, we have the frozen food industry. It is a new industry and one involving many new ideas, but it has already shown great possibilities and can be considered just one more field of operation for the engineer.

The power saw speeds up preparation before freezing.

Courtesy U. of M. Extension Service.



RESEARCH IN

Minnesota's Wind Tunnel

FOR FASTER AND SAFER AIRCRAFT

By G. L. Von Eschen **Instructor in Aeronautical Engineering**

MODERN SCIENCE has made such tremendous progress in recent years as has the science of aeronautics. Within the space of ten years, air speeds have been doubled, and the efficiency of air travel has been greatly increased. One of the greatest factors in the aerodynamic research that made possible the designing of safer and faster aircraft has been the wind tunnel. Many recent advancements are entirely due to research made possible by this apparatus. During the last few years, it has become increasingly evident that a large wind tunnel has been needed at the University of Minnesota.

Test Models

Wind tunnels provide a means of getting relative motion between the air and the model being tested and still permit all measuring and mounting devices to be held stationary for simplicity, accuracy, and economy. Essentially a wind tunnel is a duct system through which air is forced at high speed by a fan or propeller. Somewhere in this duct system is included a test section through which the air is made to flow fairly uniformly and steadily by means of vanes or a honeycomb which tend to straighten the airflow upstream from the test section. The model to be tested is held in place in this test section by wires or streamline struts which are connected to scales for the determination of the air forces and moments acting on the model.

The University of Minnesota has two small wind tunnels in operation suitable only for demonstration and classroom work and a third, larger tunnel suitable for research nearing completion at the Oak Street Experimental Laboratories.

Wind tunnel results are not directly applicable to full-scale, free air flight prediction. The Reynold's Number of the Model, turbulence, and wind tunnel wall interference, are three major factors associated with wind tunnel design and performance which must be considered. Without going too deeply into consideration of these factors, it is evident that a high Reynold's Number for the Model—one approaching that of a full scale aircraft in flight—is desirable, necessitating a large, high speed tunnel. Reynold's Number may be expressed as,

$$R.N. = \frac{VL}{\nu} = \frac{\rho VL}{\mu}$$

where V=vel. of the air in ft./sec.

L=Dimension of model parallel the air stream.

ν=kinematic viscosity=ft. ^{2}/sec.

$$\nu = \frac{\mu}{\rho}$$

μ= coef. of viscosity = slugs/ft. sec.

ρ=density of air in slugs /ft.^{3}

Examination discloses that for a given state or condition of the air as would be encountered in the operation of an atmospheric tunnel (open to the atmosphere at the test section) the velocity (V) and the length (L) are the two independent, controllable variables. Increasing V or L or both V and L will increase the Reynold's Number. A variable density tunnel (a sealed tunnel in which the air pressure and density may be varied at will) would also involve the kinematic viscosity as an independent variable. Increasing the density would result in raising the Reynold's Number. Not many variable density tunnels have been built because of the added expense and other difficulties.

The original idea of building a new wind tunnel crystallized at the time the W.P.A. program was inaugurated. Plans and specifications were submitted to the W.P.A. in June, 1936, for a wind tunnel with a 7x10 ft. test section through which a fan or propeller driven by a 600 hp. electric motor was to force air at about 153 mph. (see Fig. 1). This corresponded to the date at which the University decided to outfit the Oak Street Experimental Laboratories.

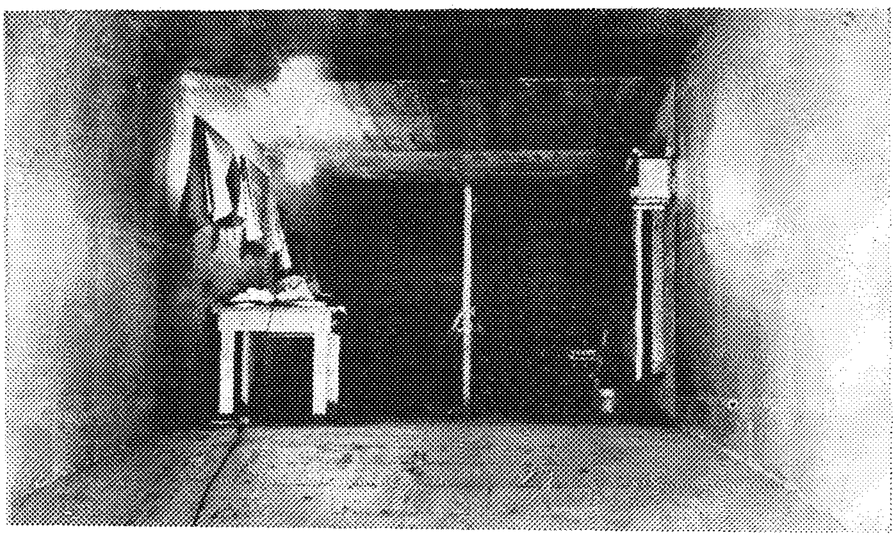
Construction of the wind tunnel was started in the spring of 1937. Work was partially completed by the time the first W.P.A. program expired in November, 1938. Progress, however, was relatively slow because of the experimental nature of the project. Lack of precedent in the work necessitated slow and difficult hand fabrication in the laboratories. Another major problem was the task of actually hoisting the sixty vanes, which weighed 440 pounds each, into place.

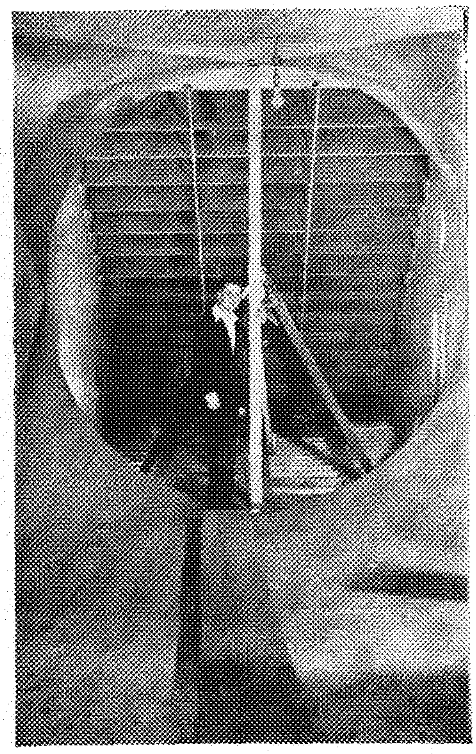
Installation of Vanes

At present, the vanes have now been installed, the plumbing for the cooling system to the vanes has been completed, the power plant has been moved into place, and the propeller shaft and propeller are in process of installation. Actual operation of the tunnel will begin in the near future. Of course, much testing, adjusting, and calibrating will have to be done before special problems of research can be attacked.

The new University of Minnesota tunnel is of the closed-circuit, closed-throat, Prandtl or Göttingen type. The air follows the path indicated by the arrows in Fig. 1 being circulated constantly through the closed-circuit by the propeller. The tunnel rises to a height of about 33 feet, is nearly 80 feet long, and is about 21 feet wide at the widest section. The venturi section with its greatest stricture at the test section causes the high velocity in the test section. Application of Bernoulli's theorem

The new tunnel looking from air intake end toward the test section.





Looking south from the test section.

readily indicates the conversion of a part of the static pressure in the large duct section to dynamic pressure in the small test section, increasing the dynamic pressure, and therefore, the velocity.

Accurately designed corner vanes are necessary to maintain a uniform dynamic pressure across the test section. The inertia of the moving air causes the air to be thrown toward the outside of the turns with a consequent non-uniform dynamic pressure distribution. The 60 corner vanes in this tunnel perform the function of practically breaking the tunnel passageway into a large number of small circuits or tunnels in each of which inertia causes high dynamic pressures at the outside of its turns. This results in alternate layers of high dynamic and low dynamic pressure for short distances behind the vanes. These layers mix and merge to give a relatively uniform flow some distance from the vanes. These vanes also furnish cooling area for the dissipation of the heat generated during the tunnel operation. Cold water is circulated through the hollow vanes as an absorbing medium. The amount of heat that must be absorbed to keep the temperatures in the tunnel down in a workable range is enormous. At the tunnel design power of 600 hp., the heat developed would be equivalent to that put out by a 430 hp. boiler. This same heat could maintain proper room temperatures in twenty-five well-insulated eight-room houses if the outside temperature were —20 degrees F.

Variable Pitch Propeller

The power plant will drive a 3-blade Hamilton Standard Hydromatic variable pitch propeller which was formerly used on a Douglass DC-2 transport. The propeller has a diameter of 10 ft. 10 in. with a pitch range of from 10 to 30 degrees. The propeller weighs 450 lbs. A 4 in. diameter propeller shaft 20 ft. long transmits torque from the power plant, which is located outside the tunnel, to the propeller within.

The balance system for the measurement of the aerodynamic forces and moments acting on the model being tested is to be located in the balance room below the test section. (See Fig. 1.) In designing the balance system the builders are confronted by a difficult problem. When testing a model with a span approaching 9 feet, the lift forces may reach 3,000 lbs., while the drag force approaches 1000 lbs. Measurements accurate to 0.01 lbs. are desirable. The problem then is to build a balance system capable of weighing 3000 lbs. to an accuracy of 0.01 lb.

A six-component balance has been designed that is capable of measuring six quantities: lift, drag, side force, pitching moment, yawing moment, and rolling moment of the model. Three streamline struts or spindles transmit the loads to the balance and hold the model in position in the test section. The angle of attack of the model is changed by an electric motor which drives a worm gear quadrant to which is attached a lever arm. This arm forms one side of a parallelogram and the axis of the test model forms the opposite side. Measurement of the angle of attack of the lever arm in the balance room indicates exactly the attitude of the model in the test section above. The angle of attack can be read on a counter dial accurately to 0.01 of a degree. A turn table on the top platform of the balance system permits swinging the model about a vertical axis to simulate a yawing flight condition.

Balance Beams

Small electric motors on each of six individual balance beams will automatically rotate threaded shafts with which rider weights are engaged, until a balanced condition is obtained in each. Because of the heavy loads involved, flexible steel tension bands are being used on the balance beams to replace knife edges as fulcrums. A total of four bands for each balance beam, with two on each side for stability, are arranged to lie in two intersecting planes which make equal angles with the longitudinal axis of the beam. A broadside elevation view of the balance beam, assuming the axis of rotation of the beam is a horizontal line, would show the planes of the bands projected on edge as a cross with the intersection appearing as a point on the horizontal center-line of the beam. The upper base of the cross is anchored to a rigid support and the lower base is attached to the balance beam as far below the centerline of the beam as the upper support is above. Effectively, then the line of intersection of the planes of the bands becomes the axis of rotation or the fulcrum support for the beam. Both vertical and horizontal loads perpendicular to the axis of rotation can be taken by the bands. For a small rotation of the beam the center of the cross will be capable of resisting only negligible moments providing the thickness of the bands is kept low and the flexibility high. A close approximation to a frictionless fulcrum is thus obtained.

Model Inverted

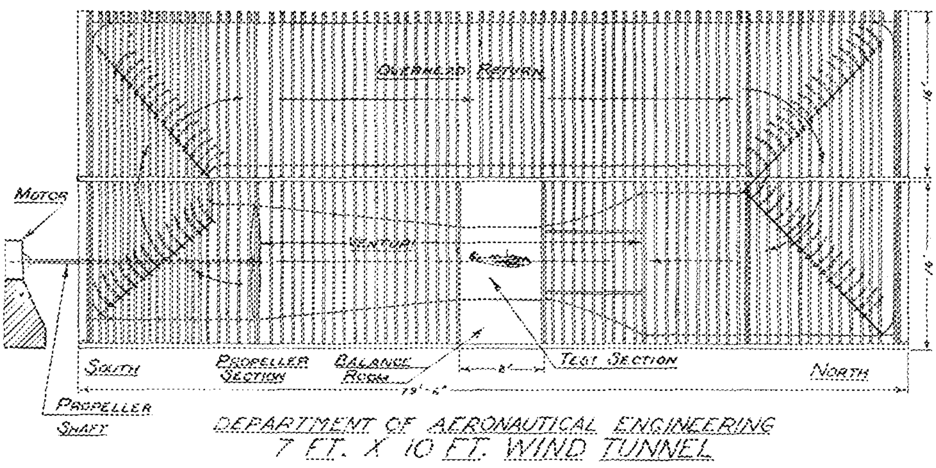
The mass of the balance has been made great enough so that the model may be mounted either right side up or in an inverted position. Normally, tests will be run with the model inverted so that lift forces will be directed downward in the direction of gravity.

The layout and assembly of the balance has been completed and the details are being completed rapidly. Construction of the balance itself is about to begin.

The controls for power plant operation and wind tunnel calibration instruments are to be located in the balance room. The central location of instruments and controls will permit operation of the wind tunnel by as few as two men.

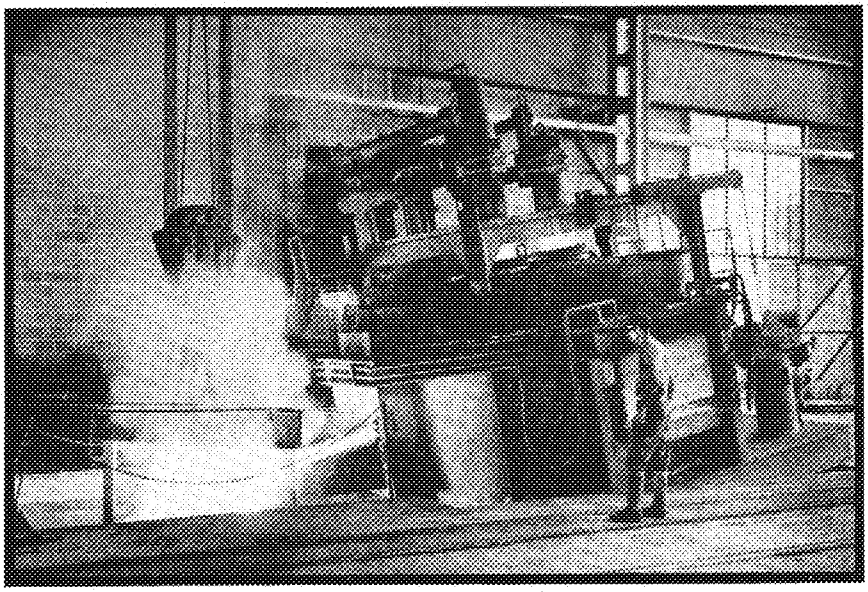
Members of the staff and students of the aeronautical engineering department are looking forward to completion of the tunnel. The new tunnel will permit research impossible in the smaller tunnels. Testing projects will probably be obtained from NACA and commercial companies. If this occurs, the University of Minnesota department will derive prestige and actual income for operation. Since wind tunnel testing is such a fundamental part of airplane design, the new tunnel should help the university to maintain its place in the aeronautical world.

Elevation of new wind tunnel.



Tuning ... Tec

Max Butterfield
M.E.B. '42

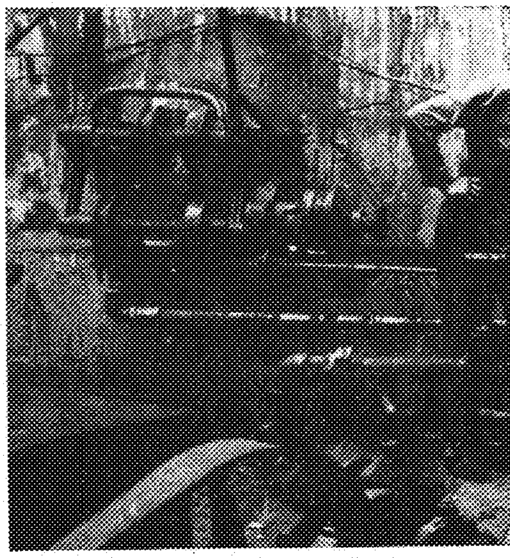


Courtesy Iron & Steel Engineer

Electric Arc Furnace

Developments in the steel industry during 1940 are reviewed in the January issue of **Iron and Steel Engineer.** The electric furnace has been brought into much greater use due to the demand for increased tonnage of high grade carbon steels. A new steel making process, an improved type of normalizing furnace, and the numerous applications of welding in construction work are among the topics discussed in the article.
(Engineering Library)

An article in the January 20 issue of **The Oil Weekly** tells of progress that has been made in this comparatively new method of well drilling. A vertical shaft is first sunk and holes are drilled horizontally through the shaft wall. Drilling time is reduced by 75% to 90% due to the fact that the wells are drilled in opposite directions and while one is being cut, the core is removed from the other in one operation. A second great advantage of the method is that as many as 800 acres of ground can be worked from a single vertical shaft.
(Mines Library)

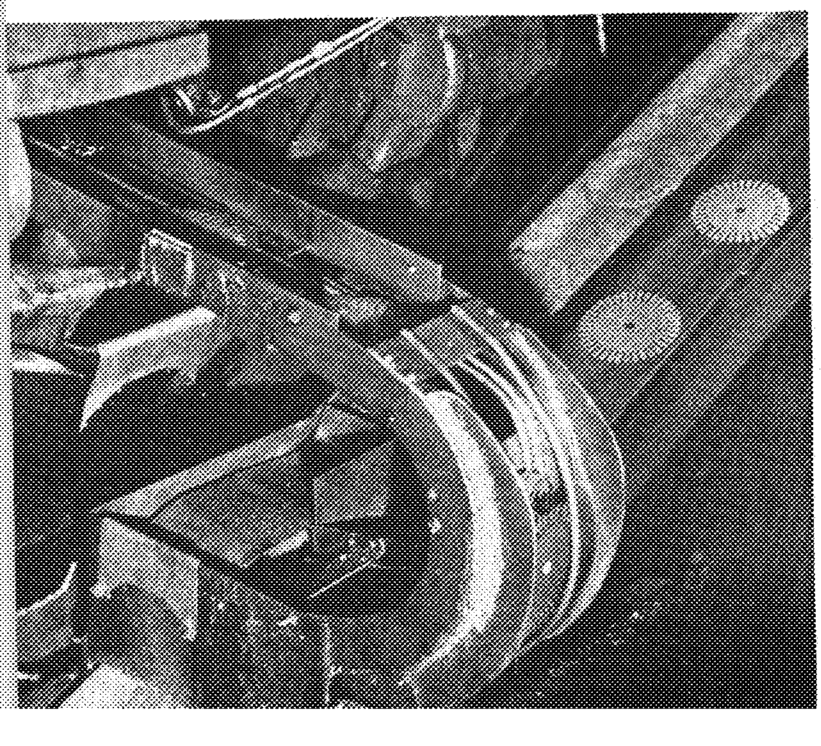


Horizontal Well-Drilling

The Sunlight Electrical Division of General Motors Corporation has reached an operating efficiency that makes possible the manufacture of 4,000 fractional-horsepower electrical household motors daily in a plant employing only 780 workers. An article in the February 5 issue of **American Machinist** describes production processes and the special machines used in effecting this mass production.
(Engineering Library)

Conveyor Manufacture

Courtesy American Machinist



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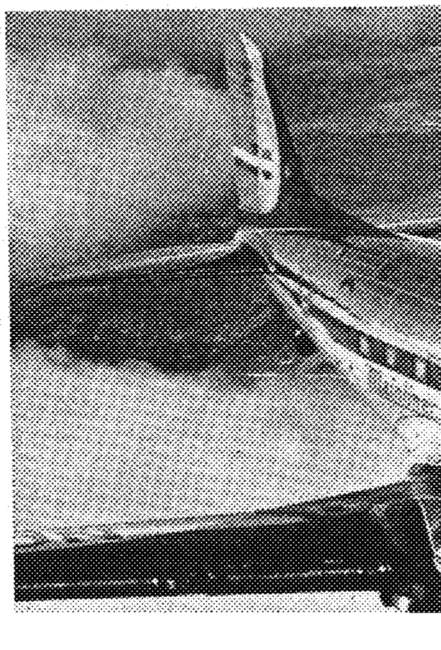

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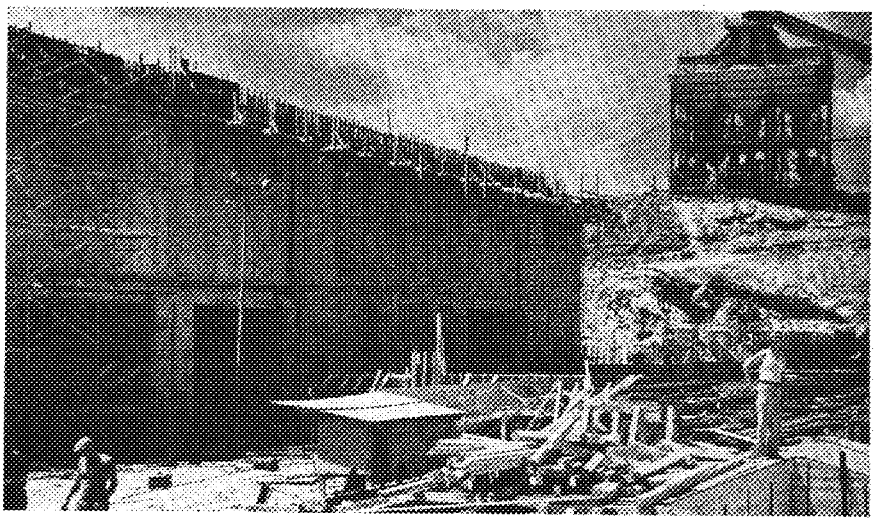
Bill Carter
E.E. '43

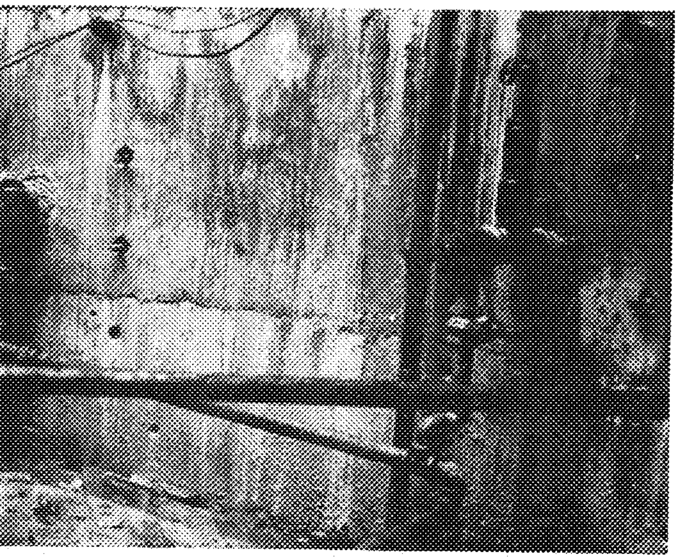


Courtesy Sheet Metal Worker

World's Largest Filtration Plant

The installation of 150,000 pounds of sheet copper in the world's largest filtration plant is described in the February issue of **Sheet Metal Worker.** The new plant, serving the Chicago area, will have a capacity of 320 million gallons per day and will represent an investment of $21,000,000. The copper is called into use in a system of expansion joints between sections of concrete, and thus serves much the same purpose as does pitch in filling crevices in highway paving.

(Engineering Library)



Courtesy The Oil Weekly

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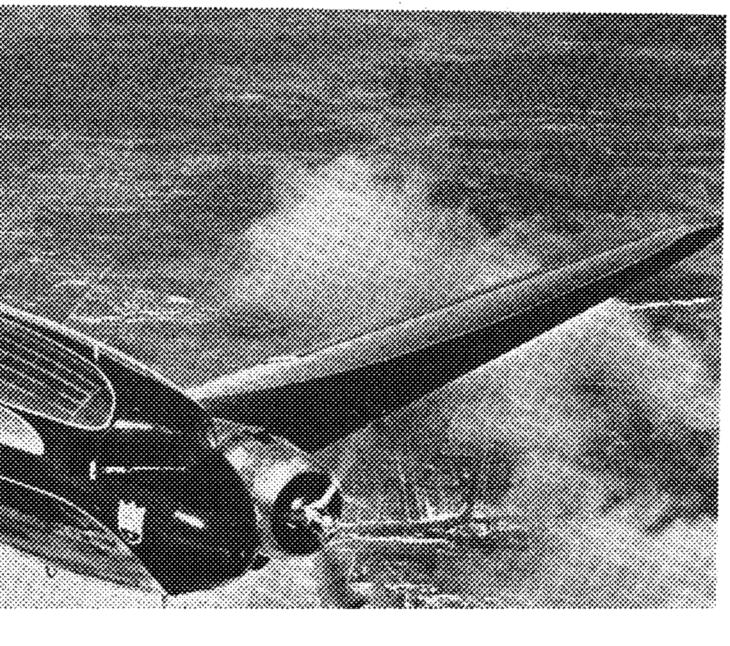
...**Heating, Piping, and Air Conditioning** presents some ...must consider in the construction of heating and ...mmercial airplanes. The author gives an explana- ...individually controlled ventilators, and a recently ...egulation of temperature.

(Engineering Library)

Courtesy Heating, Piping, and Air Conditioning

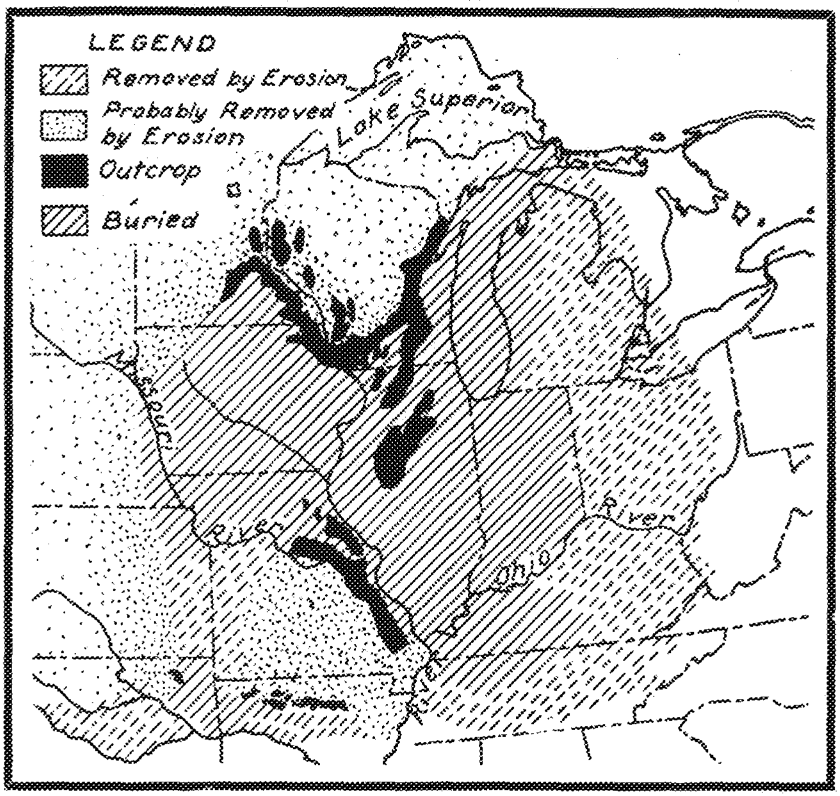


Shaping of 50,000,000 tons of steel ingots into final form is the job performed each year in the railroad forge shops of America. An account of the forging operations conducted in the shops of the Missouri Pacific Railroad is presented in the December issue of **Heat Treating and Forging.** Procedures in the manufacture and repair of locomotive and coach springs, radius rods, and driving box saddles are given in detail.

(Engineering Library)

Forging Locomotive Main Rod

Courtesy Heat Treating & Forging



Courtesy American Foundrymen's Association

Map showing the location of the St. Peter sand formation.

Sand

WHEN sand and defense are mentioned together, most people think of sand-bagged entrances to air-raid shelters, or British Colonials charging across the Libyan Desert. The foundryman, however, continues to think of sand as he always has—in terms of more and better castings.

Ever since the first American casting—a cooking pot produced in 1642 by the Saugus, Massachusetts Iron Works—the use of castings in all types of machinery, equipment, fixtures, and hardware has increased steadily. Increased production rates, lower cost, and higher quality castings—all have been the result of the expansion of the foundry industry. At present, there are over 5,000 foundries of all types in the United States.

Castings are used extensively wherever metal is needed. Over 75 per cent of the material used in a steam shovel is produced in a foundry. For a tractor, the figure is approximately 50 per cent. An overhead crane is about 25 per cent castings by weight. Airplanes contain many light-metal alloy castings. Trucks, tanks, and gun carriages require castings. Ships and submarines can be made more rapidly and at a lower cost through their use.

The countless castings needed for national defense must meet rigid specifications. Every detail of production must be watched carefully. Control of operations and materials is essential, and not the least of these is sand control.

Unless they are engaged in permanent mold-casting, die-casting, or other special phases of the industry, foundrymen make their living by producing and selling metal fabrics cast in sand. Most of the sand in a foundry is used to make molds by packing it around patterns of the shape and general dimensions of the desired casting. The pattern is withdrawn and the cavity is filled with molten metal. The metal solidifies and a casting is produced. Although sand is usually used in the green (or wet) condition, the molds may be dried or baked.

Core Sands

Internal casting surfaces, reëntrant angles, and intricate shapes are produced in castings by means of cores which are inserted in the mold during or after its preparation. Cores are rigid shapes which withstand storage and handling because the sand from which they are made is bonded with one or more materials such as a drying oil, a polymerizing oil, gelatinized starch, or certain waste products of the sulfite paper pulp process. Cores must be baked at 375 degrees F. to 425 degrees F. to develop the desired combination of properties.

Minor uses of sand in the foundry include bottom sand for melting furnaces such as the cupola and air furnace, and blasting sand for sand-blasting castings during cleaning preparations.

Great tonnages of sand are required by the foundries for molding purposes. In the larger foundries it is not uncommon to condition and use 100 tons of sand daily, although small foundries may require as little as ten tons of molding sand. Fortunately, most of the sand is suitable for repeated use; however, it is necessary to replace 40 to 80 pounds of sand per ton of iron cast, and 250 to 400 pounds per ton of steel cast.

Castings which are not salable because of defects are scrapped for remelting. Since 50 to 90 per cent of scrap castings may be attributed to faulty preparation or misuse of molding sand, foundrymen concern themselves with careful selection and conditioning of the sand. They are critical of the size of the silica grains that make up the bulk of the sand, because on this depends mold permeability. This ability of a mold to permit large volumes of steam and other gases to pass through it increases with average particle size and lack of disparity in particle sizes. On the other hand, casting surfaces are smoother if grain size is smaller.

Unless finely sorted by natural agents such as wind and water, sands are made up of grains of many sizes formed by the weathering of the igneous lithosphere of the earth. Part of this stony outer shell is quartz which supplies the silica grains. Other materials decompose to form clay which, when mixed with the silica grains and the proper amount of moisture, lends plasticity and strength to the sand. The sand must assume and retain the shape imparted to it during molding, pouring, and until the metal solidifies. Standard testing methods evaluate green strength, dry strength, and hot strength to tell the foundryman how his sand can be expected to behave. Insufficient clay results in low strength; excessive clay decreases permeability and fusing temperature. The type of clay is related to the durability of the sand.

If sand and clay are found together, the combination is made suitable for molding by merely adding water and mixing thoroughly. This is a natural sand. Some sands are found quite free of clay, because they have been transported to other places by wind or water or both. Such sands are suitable for cores or for the preparation of synthetic sands. The latter continually increase in importance because of the depletion of natural molding sands and the desirability of maintaining uniform sand conditions in production foundries. Synthetic sands are prepared by mixing clean (clay-free) sand with predetermined amounts of various binders such as one of the bentonites, a fire clay, or other clay-like material. Pitch, gelatinized starch, and other organic binders sometimes are added to develop special mold properties.

The foundries of Minnesota do not use synthetic sands to a great extent, nor do many of them exercise careful sand control. The non-ferrous foundries use natural sands, iron foundries use both synthetic and natural bonded sands, while steel foundries use synthetic sands almost exclusively. Because the use of synthetic sands entails continuous vigilance, they will not be used by foundries until their superi-

and National Defense

By Herbert F. Scobie **Instructor in Mechanical Engineering**

ority for many types of work is clearly recognized, or until useable natural sands are no longer available. However, as the cost of equipment for testing and conditioning sand decreases, more foundrymen will make the investment enabling them to exercise better sand control.

Minnesota Sands

Previous to World War I the foundries of Minnesota (numbering over 50 at that time) required more than 100,000 tons of sand annually. Much of the sand was obtained at a great price from other localities which, erroneously, had developed a reputation among foundrymen as having the only sand suitable for certain types of work. Thus, foundrymen procured sand from New York, Illinois, Kentucky, Missouri, Wisconsin, and even France, at exorbitant prices ranging from $15 a ton to $16 a barrel for the French sand. Sands which were equal, and in some respects superior, to the imported sands could and can be obtained from Minnesota sources for a few dollars per ton delivered.

During the war, the federal government found it necessary to use the railroads for hauling materials deemed more important than sands for Minnesota foundrymen. The work of locating and evaluating foundry sands of Minnesota was detailed to G. N. Knapp of the University of Minnesota Department of Geology in June, 1918.

Minnesota has molding sands suitable for some types of foundry work, but lacks a highly refractory clay. While—to paraphrase an old expression—a few Minnesota foundrymen still think distant pits look sandier, most of them use Minnesota sands. The Minnesota foundry industry is thereby saved thousands of dollars annually, and the money that is spent for sand goes to help support another Minnesota industry, the mining, washing, grading, and selling of sand.

Only a few of the 26 formations of Minnesota's geologic column are suitable for foundry use. The Glacial formation, up to 300 feet in thickness, supplies loams for loan molding. Benton shales, as high as 550 feet in thickness, provide clays suitable for foundry use. Quartz sands, especially suitable for cores and steel foundry service, are found in the St. Peter, Jordan, Red Clastic, and Pokegama formations. The Jordan sand is recognized by geologists as the most valuable quartz sand in the state. It is used by at least one of Minnesota's electric steel foundries. It is interesting that the coarser grains of the Jordan formation cannot be distinguished from the same sized grains of Ottowa (Illinois) sand, long used as a standard sand

The most readily available foundry sand of Minnesota is that of the St. Peter formation. It is the white sand dug from the tunnels of the Twin Cities sewers. Over 400,000 cubic yards of this material have been excavated in the construction of sewer tunnels and much more is available, for the thickness of the formation in Minnesota averages 100 feet. A sand mine far below the St. Paul plant of the Ford Motor Company supplies St. Peter sandstone for the manufacture of glass.

This same sand underlies a large area of Minnesota, Wisconsin, Iowa, Illinois, Missouri, Indiana, Michigan's lower peninsula, and parts of Arkansas, Ohio, and Kentucky. Readily available outcroppings of the St. Peter sandstone are found in southeastern Minnesota, north central Illinois, southern and eastern Wisconsin, and eastern Missouri.

St. Peter Sands

St. Peter sand, or sewer sand, as it is frequently called, is used by some Minnesota foundries for cores for non-ferrous, iron, and steel castings. Because sewer sand contains a negligible amount of clay and consists of fairly well-sorted silica grains of rounded shape, it is particularly adapted to this purpose. For the same reason, it is suitable for synthetic sands.

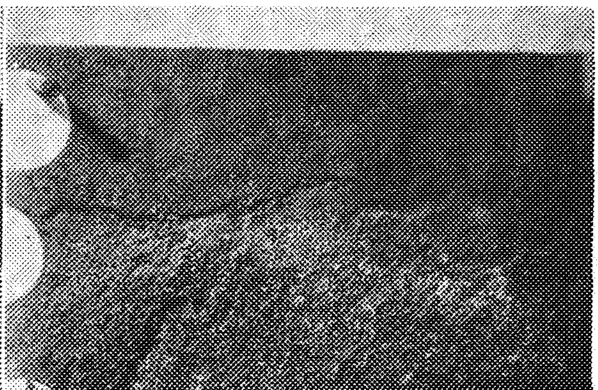
Work done in the Foundry Laboratory at the University of Minnesota shows that suitable synthetic sands having a wide range of desirable properties can be prepared from sewer sand, bentonite, gelatinized starch, and water. Such sands have been used for several years for research purposes by the Foundry Department because of the uniformity of mold properties. This is somewhat contrary to the information published by a local, uninformed newspaper which mentioned that the sewer sand was being used in the forges of the University foundry to make boilers. Similar mixtures will be used by more Minnesota foundries when production schedules, casting appearance, and specifications demand a highly controlled sand which gives uniform dependable mold properties.

A good molding sand for use in iron foundries may be found in the waste "fines" from steel foundries. Because of the high permeability requirements of steel foundry sands it is desirable to remove the finer grains which result from mechanical and thermal shock to the sand. In the process of separating fines some of the bond goes with them. Thus, the waste sand, undesirable in the steel foundry, becomes a valuable material to the iron foundry. Waste fines from a Minneapolis steel foundry have been tested and used successfully by the Foundry Department. The steel fines may be blended with other sands, rebonded if necessary with various clays, to produce iron molding sands of good strength and high permeability.

Minnesota foundrymen need not fear that suitable sands will be denied them. For those who still import sands, the local supply will be available if the railroads are needed for hauling other freight. When synthetic sands are desired good silica sand is available for their preparation.

The defects in this casting are due to low permeability of the molding sand.

Casting wash defect caused by low, dry and hot sand strength.
Courtesy Harry W. Dietert Co.



Better Galvanizing

By Donald L. Drukey, Ch.E. '43

MUCH of the advancement in present-day industry depends upon discoveries made in research departments of technical schools on improved manufactured products, increased production efficiency, and lower operating costs.

At the University of Minnesota, the Department of Metallography in the School of Mines has been constantly engaged in research projects from which Industry has derived many benefits. Of particular concern to the sheet metal and wire industries has been a project undertaken by a graduate student of the department, Robert W. Sandelin, to determine which iron alloys react best to galvanizing, and to determine the effect that impurities in the alloys have on the deposited zinc. Mr. Sandelin is the first person to use scientific, controlled methods in obtaining facts and conclusions, and he did discover the effect that the elements carbon, silicon, phosphorus, copper, manganese, titanium and aluminum have when they are introduced into the iron from which the sheet metal to be galvanized is manufactured.

Problems

After reading the small amount of literature that had been written on the subject, Mr. Sandelin found that little was actually known and that most of the information was conjecture. He concluded, then, that he had three problems to investigate. These were as follows:

1. What are the most desirable characteristics of the galvanized coating, and how can they be measured?
2. What effect on the adherence properties of the zinc do the previously mentioned elements in the galvanized sheet material have?
3. What are the physical appearances obtained by galvanizing that have the greatest "eye-appeal" to the consumers, and which elements introduced into the sheet material to be dipped produce the best surface?

Mr. Sandelin decided that the thickness of the zinc coating obtained through galvanizing is one of the most important physical characteristics of galvanized products. The zinc, since it is not easily oxidized by the air, acts as a protective cover over the more active metal to which it adheres. The thicker the layer of zinc, the greater is the resistance of the galvanized product to corrosion, providing the zinc itself does not introduce impurities that stimulate corrosion. To determine the thickness of the zinc coating on a specimen, he decided that the best method was to weigh the specimen, remove the zinc by the use of chemical etching, reweigh the specimen, and express the difference in weight as the number of pounds of zinc per unit area of surface

Grading

Appearance determinations he made by simply grading the samples by sight. The most desirable surface is smooth, shiny, and spangled.

The third problem Mr. Sandelin investigated was the most difficult. To determine adherence of zinc to various alloys required exacting, precision testing. With specially prepared samples he was, however, able to discover which elements present in the sheet material affected the adherence of the zinc when the sheet iron alloy was subjected to bending.

To begin his experimentation, Mr. Sandelin prepared four uniform specimens for each of seventy-two iron alloys containing the afore-mentioned elements. To insure uniformity, he prepared the four samples of each alloy from one batch of melted alloy to which had been added the element whose effect on the galvanizing process was to be noted. From the center of rolled alloy ingots he removed specimens 6 inches long and ¼ inch square. The surface of each specimen he had precision ground, so that any inaccuracies in results due to surface differences would be reduced to a minimum.

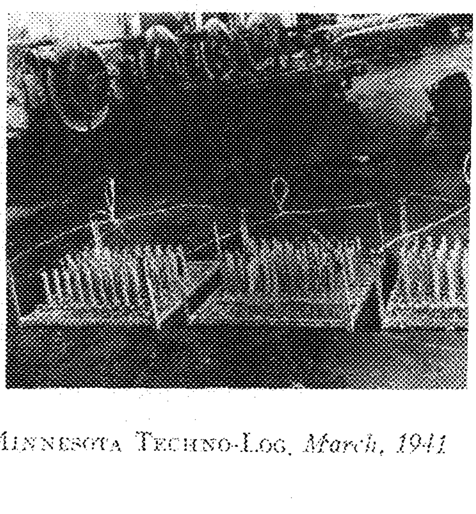
He then arranged one each of the seventy-two alloys in four racks so that all the samples in one rack could be dipped simultaneously for the same length of time. Each of the racks he immersed in melted zinc for various time durations, for in this way he could tell which of the elements in the alloys stimulated the formation of thick zinc coatings. When the zinc had hardened on the samples, Mr. Sandelin noted the appearance of each, and then, to determine adherence, subjected them to bending and stretching tests.

The results of the experiment were extremely satisfactory. It was found that copper, carbon, aluminum, and titanium have a negligible effect on any of the factors considered. Phosphorus and silicon, however, decidedly affect galvanizing action. These elements stimulate the formation of thick zinc coatings, but the coatings are dull, rough, and generally unattractive. When subjected to bending, the coats easily chipped and crumbled on the outside of the bend. The inside of the bend, however, proved to be very durable.

Manganese, according to the results obtained, is highly beneficial in promoting formation of firmly adhering zinc coats of superior appearance.

For his achievements, Mr. Sandelin has been awarded a plaque by the Wire Association of the United States. Through his efforts, industry is now able to prepare a superior galvanized product by limiting in sheet metals the elements responsible for poor quality.

Three racks of samples ready for dipping.



Courtesy of Electrochemical Society, Inc.

Dr. Frary is shown receiving the Edward Goodrich Acheson award.

ALUMNI NOTES

Featuring In This Issue Institute Graduates

In The Field of Chemical Engineering

By Ward M. Hanson, Ch.E. '42 and Allen Polson, Ch.E. '42

'05 Francis C. Frary

Equipped with a keen analytical mind, and a definite curiosity with regard to the unknown, Dr. Francis C. Frary has been responsible directly and indirectly for many of the discoveries and advancements set forth by the Aluminum Co. of America's Research Laboratories.

Graduating from the University of Minnesota in 1905, Dr. Frary, a native Minneapolitan, carried out his first formal research work under Dr. Frankforter, then Dean of the School of Chemistry, for which he received his degree of Master of Science. After a year of study in Germany, he returned to the University in a teaching capacity.

During the next nine years, besides obtaining his doctor's degree and teaching fifteen different courses at the same time, he carried on many research projects which led to the publication of several papers.

As the result of some very fine work on match-head compositions—particularly on the material phosphorus sesquisulfide—Dr. Frary obtained his first patent and then sold it to Mr. F. Austin Lidbury of the Oldbury Electro-Chemical Company of Niagara Falls, who then insisted on Dr. Frary's coming to the Falls to work. It was here that Frary became an expert on the handling of phosgene—a talent which he made use of during World War I when selected with Prof. D. J. Demorest to design and operate a phosgene plant at Edgewood Arsenal. Leaving the Army as Major in the Chemical Warfare Service in 1918, Dr. Frary began his career in aluminum as director of research in the new laboratories of the Aluminum Company of America.

The accomplishments of Dr. Frary and his staff are so many and varied that they cannot be enumerated here. Probably one of the most outstanding would be the production of aluminum of 99.99 per cent purity—aluminum which enabled physical chemists to study the true physical properties of the substance, and consequently led to the development of new alloys.

In 1938, Dr. Frary was the recipient of the Edward Goodrich Acheson Medal and Prize of one thousand dollars, the highest honor that the Electrochemical Society can bestow on one of its members. He donated his prize to a fund which would enable employees of the Aluminum Company to go to night school if they so desired. The company also donated to this fund to the extent of two thousand dollars. This gesture was typical of Dr. Frary who has maintained the high ideals of his youth. Dr. Frary is truly a credit to his profession and is one who is greatly admired and respected by his friends and acquaintances, as well as those who knew him when.

'90

Services for **John Foot Hayden,** Ch., 1920 Irving Avenue South, Minneapolis, were held at his home on December 26. Mr. Hayden died Christmas day at the age of 74. He was born in St. Peter, Minnesota, and had been a resident of Minneapolis for fifty years. He was also a member of the University's first football team.

'06 Walter L. Badger

In 1906 a very good friend of Dr. Frary graduated from the University of Minnesota who was to become just as successful in his field as Dr. Frary was in his. This man is Walter L. Badger. Mr. Badger and Dr. Frary were the best of friends as students on this campus; their favorite recreation at that time was long hikes on their free Saturday afternoons.

Mr. Badger is a vigorous, pace-setting individual and is not afraid to express his views. As a professor of chemical engineering at the University of Michigan and as an instructor at the University of Minnesota, Mr. Badger required his students to pay strict attention to detail.

Since he graduated from the University of Minnesota Mr. Badger has held several positions; namely, industrial chemist, professor of chemical engineering, director of research, and consulting engineer. At the present time, Mr. Badger is the consulting engineer for the Dow Chemical Company of Ann Arbor, Michigan. Previously he worked for the Whiting Corporation, the United States Bureau of Standards, and the Great West Sugar Company. For several years he was active as a professor of chemical engineering at the University of Michigan.

Equipment design, especially with regard to heat transfer equipment, has always been Mr. Badger's favorite work. While he was working as the director of research of the Whiting Corporation he designed the now well-known Swenson Evaporator. Mr. Badger's most recent work has been experimentation with diphenyl in order to determine its properties as a heat transfer medium.

On this campus, Mr. Badger is probably best known as the co-author of the fundamental text used in chemical engineering, namely, "Elements of Chemical Engineering."

'36

Michael P. Tierney, Met.E., mining engineer for the Chile Exploration Company of Chuquicamata, Chile, South America, has been there since last March. Being new in the South, he finds it difficult to contact Minnesota men in the vicinity and would like to know some names and addresses of men working thereabouts. He was formerly with the Montana Light and Power Company, as well as the Anaconda Copper Company.

'40

Herbert Gaustad, C.E.B., is with the Kimberly-Clark Corporation at Neenah, Wisconsin. He has found the paper industry very fascinating and is residing at 142 Third Street.

Edward F. LaClare, Aero. E., has had a varied program since graduation. After a month at the Vega Aircraft Company, he enlisted in the Army Air Corps. He spent five weeks as a flying cadet at Oxford, California, and then five more weeks at Glendale. Since then, he has been at Randolph Field. He hopes to get his commission by the middle of March. His address is Company B, Flying Cadet Attachment, Randolph Field, Texas.

News from the Tech Societies

A.I.Ch.E. Presents Award

Mr. L. F. Warrick, Wisconsin State Sanitary Engineer, stressed the growing need for chemical engineers as well as civil engineers in the sanitation field in his talk entitled, "Industrial Waste and Sewerage Disposal" given at the A.I.Ch.E. meeting on Tuesday, March 4. The civil engineers were invited as guests to this meeting of the A.I.Ch.E.

Ward Hanson received the A.I.Ch.E. award from the national senior organization for having the highest grades of any student in the junior class during his first two years in chemical engineering.

Plans for the spring dance and the annual picnic are being made by the executive committee.

A.I.E.E. Sees Mining Movies

Junior members planned the meeting of the A.I.E.E. held in the Union on March 5. Miag Ching Swen, electrical engineering student, spoke on his life in China, and moving pictures of copper mining and processing were shown. Refreshments were served at the end of the meeting. Eugene Ecklund was in charge of arrangements.

Twenty-five electrical engineering students attended the A.I.E.E. field trip through the studios and control room of WCCO, on February 13. The tour was conducted by Mr. Peck, WCCO operator, who showed the students the master control room. John Storm made the arrangements for the trip.

Aero's Investigate Fog

Members of the I.Ae.S. heard S. M. Serebreny, instructor in meteorology, speak on "Recent Fog Investigations" at their meeting in the chemistry auditorium on February 26.

The Society has received numerous contributions from alumni all over the country to help pay for the publication of Prof. John Ackerman's pamphlet, "Aeronautical Engineering and Its Needs at the University of Minnesota." Unusual contribution was that made by Don Frankel, Aero '40 (and former TECHNO-LOG humor columnist), who is working in England at the present time. Frankel instructed the Society to take his contribution out of his salary, which is deposited in this country.

A.F.A. Elects Officers

The newly formed student chapter of the A.F.A. elected temporary officers and drew up a constitution at its first meeting on February 21. The officers are: Chairman, LeRoy Kelman, and Secretary-Treasurer, Jim Anderson. A membership drive is the chief item on the agenda at the present time.

A.I.E.E. Prize Paper Contest

April 1 has been set as the deadline for papers submitted in the Minnesota Section of the A.I.E.E. "Prize Paper Contest." The contest is open to all student members of the A.I.E.E.. The papers may be either technical or non-technical in subject matter.

Papers submitted in the local contest will be read by a prize paper committee, which will choose the best four papers. The four authors will present abstracts of their papers at the Section meeting on April 14 or 15. The papers will then be rated by members of the A.I.E.E. present at the meeting and by the prize paper committee. The following prizes will be awarded: $15 for first place, $10 for second place, and $5 for third and fourth places.

Papers may also be entered in the fifth district contest to be held at the district convention in Ft. Wayne, Indiana, the latter part of April. First prize at this contest will be $25.

In addition, all papers are eligible for the national "Prize Paper Contest," in which a first prize of $100 will be awarded. Further information may be secured from Prof. John Kuhlman or Robert Lyons.

A.I.M.E. Visit Pig's Eye

Members of the A.I.M.E. visited the sewage disposal plant at Pig's Eye Island, on Saturday afternoon, February 15. The plant is the most modern one of its kind in the United States. Mr. C. R. Raiter, graduate of the School of Mines in 1920, led the tour of the plant and gave an up-to-the-minute discussion on the application of ore dressing equipment to sewage disposal. A bull session was held at the end of the trip during which Mr. Raiter compared the School of Mines of yesteryear with the School of Mines of today. Reuben L. Olson, who was in charge of arrangements, promises similar educational trips in the near future.

Miners Hear Calhoun

Mr. A. B. Calhoun, former manager of the Burma Mines, largest lead, zinc, and silver mine in the world, addressed the School of Mines Society on Thursday, February 27. Mr. Calhoun graduated from the School of Mines in 1905, and is now residing in Minneapolis.

Dr. C. A. Mann, head of the chemical engineering department, spoke to the Society at their meeting on February 6. He discussed "Citizenship."

A.S.Ag.E. Plans Award

The A.S.Ag.E. held a short business meeting at the Union on February 20. A tentative set of rules for the proposed student award was submitted by Gordon Nelson, chairman of the award committee. The award will be based on scholarship, activities in the Society, and other engineer's activities. Plans for the annual faculty-student party, to be given during the first part of next quarter, were discussed.

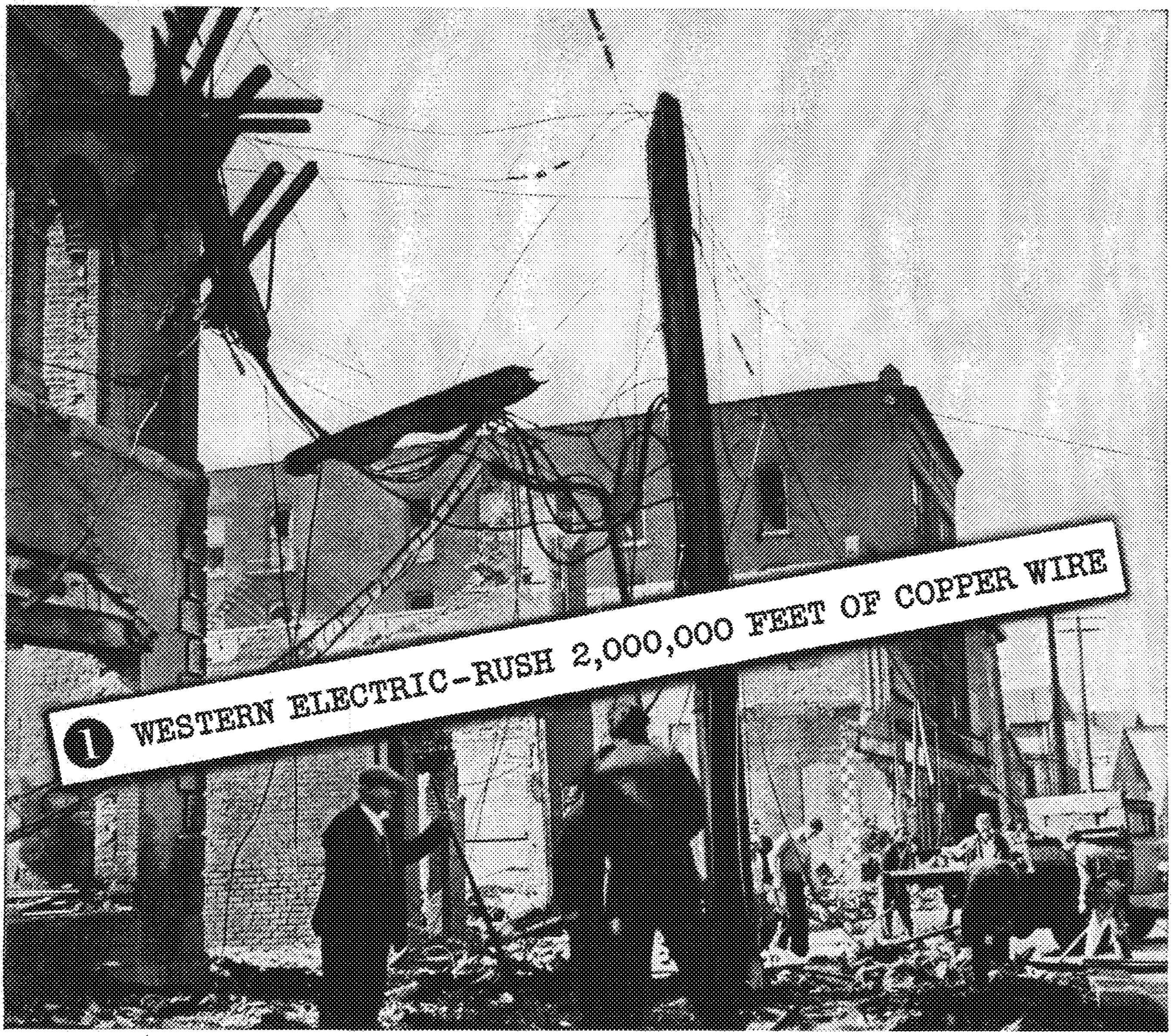
A.S.C.E. Sees Slides

Slides on aerial mapping were shown by Don Martin, civil engineering senior, at the A.S.C.E. meeting on February 18. Gordon Lundin, C.E. '41, presented motion pictures on moving earthwork.

Joel I. Connolly, assistant commissioner of public health for the city of Chicago, was guest speaker at a special open meeting on February 24. He spoke on the subject, "Public Health in Relation to National Defense."

A.S.M.E. and A.I.E.E. Meet Jointly

Super-high-speed movies taken at Massachusetts Institute of Technology were the feature attraction at the joint meeting of the A.S.M.E. and A.I.E.E. in the physics auditorium Wednesday evening, February 19. Professor O. William Muckenhirn, instructor in electrical engineering, explained the equipment and methods used in making these unusual movies.



2 *Damage to telephone lines* by storm and fire. Then an urgent call to Western Electric for supplies. And a quick answer—deliveries by truck, train and plane.

3 *On the weather front,* repair crews find everything they need at an emergency supply depot and go into action fully equipped. Geared to render such supply service to Bell System companies, Western Electric aids these telephone men to restore service quickly . . .

4 . . . so that the telephone subscriber can say:

"YES, THANKS,
MY TELEPHONE'S
WORKING AGAIN."

Western Electric

. . . is back of your **Bell Telephone service**

Tech Commission Choose Drinkwater As Engineers' Day Chairman

Dale Drinkwater, an aeronautical engineering junior, has been selected as chairman of the 1941 Engineers' Day by the Technical Commission. He plans to select his executive committee within the next two weeks.

On February 25, the Tech Commission heard the report of the 1940 Engineers' Day chairman, Charles Scott, and read the platforms submitted by candidates for the 1941 general chairmanship. The candidates were interviewed by the Commission on March 6. Platforms were submitted by: Dale Drinkwater, Aero; Arthur Brickman, M.E., and Robert N. Peterson, M.E.; John F. Elliot, Mines; LeRoy Gullings, Ch.E.; Tom Matteson, Aero; Gene Selmanoff, Mines; and James Stodolka, E.E. Only juniors are eligible for the general chairmanship.

Cederstrom Wins Coffin Foundation Award

The *General Electric News* of February 21 announces the presentation to Curtiss M. Cederstrom, B.M.E. '29, of the Coffin Foundation Award for outstanding achievement. The citation reads as follows:

"**Curtiss M. Cederstrom**, assistant to the manufacturing superintendent, Power Transformer Department, and **Alanson U. Welch**, engineer in the Power Transformer Engineering Department.

C. M. Cederstrom

"These men, with keen perception of a vital need and unusual resourcefulness, successfully developed and produced a new type of large stranded conductor such as required in the manufacture of current-limiting reactors and power transformers. Within four weeks they designed and supervised the construction of complete equipment in time to produce the new conductor for use on an order with a definite commitment of shipping promise. Advantages of their accomplishment include increased efficiency, reduced size of product, a wide variety of application, and important savings."

The Charles A. Coffin Foundation was established in 1929 in honor of the founder and first president of the General Electric Company, for the recognition of outstanding contributions to the progress of the company and the electrical arts. Each award includes a substantial cash prize.

Mr. Cederstrom has been with the General Electric Company continuously since his graduation.

Du Pont Fellowship Awarded

Dr. Richard T. Arnold, assistant professor of organic chemistry, has recently announced the awarding of his du Pont Research Fellowship to R. Winston Liggett. Liggett will receive his Ph.D. from Northwestern University in June.

Final M.E. Building Rally Held

Aeronautical and mechanical engineering students planned their final drive for a new building at a joint mass meeting held in the main engineering auditorium on February 27. Chief speakers at the rally were Harry Garrish, president of the Institute of Technology Alumni Association, and Don Heng, chairman of the Aeronautical Engineers Alumni Association.

REVIEWS BY HAGA

Of Human Freedom

By C. I. Haga, Instructor in English

IN MY last review I introduced you to a book, *Engines of Democracy,* which tried to prove that many of the benefits of a democratic society like ours stem directly from a great and general control of power in machines and natural resources. The result is that the individual American, by and large, enjoys a greater degree of freedom than anyone else on the globe today. Everything that we read and hear emphazies that fact by its fearful picturing of the threats now facing that freedom. We are, therefore, increasingly interested in analyzing this concept of freedom, just as a man threatened by a serious illness soberly reckons up the blessings of health and energetically guards them.

For these reasons I find Jacques Barzun's *Of Human Freedom,* published over a year ago, a most stimulating and encouraging kind of reading. A brief and informal book, it states concisely the problems we face in attempting to define such common terms as democracy, freedom, civilization, and culture, and shows how their meanings may be given concrete form in ideas and action.

Democracy, Barzun keeps repeating, has both its origin and its end, in a "diversified and vigilant culture"; its goal is civilized life, and it is animated by a desire for a free culture. Ideally democracy is "a civilized society that tries to establish diversity in unity through the guarantee of civil liberties." Using these encouragingly familiar assumptions as a point of departure, the author goes on to examine the dangers and failures that thwart or destroy democracy, and, ultimately, human freedom.

The body of the book is a rapid and sketchy review of the various aspects of human life—moral and intellectual values, art, education, and government—and furnishes illuminating hints and insights. The great power of democracy is that it is a culture, a set of ideas, and it is one of the virtues of Barzun's exposition that he makes vivid and concrete this world of ideas. Since it is the intellectual life—nourished by knowledge and stimulated and refined by the arts—that gives validity to the claims of democracy, the discussion of popular education is worth careful reading. And since the growth and development of this culture can be maintained and encouraged only by certain political institutions, the chapters on government should be read with special interest.

It may be shocking to some readers to view through Barzun's eyes the familiar picture government offers of obviously exemplary principles and obviously unexemplary practices. The result of this combination is corruption, but we must recognize it as only an expression of the practical, human talent for compromise. These exemplary principles and institutions Barzun calls a facade; the governing goes on behind this facade. We are mistaken if we think the facade mere hypocrisy, albeit is the necessary cause of corruption. Government, what goes on behind the facade, is necessarily corrupt "because corruption is the short cut taken to make things work." Anyone who has read Lincoln Steffens' *Autobiography* appreciates Barzun's point of view; and if he wishes more evidence than either Barzum or Steffens offers, he need only read Thurman Arnold's *Symbols of Government.*

If one should try to summarize the fluent and informal argument in *Of Human Freedom,* it would be to repeat a phrase quoted above, "diversity in unity" and in that paradox find condensed all the practical consequences of living and thinking in a democracy: tolerance, compromise, evolution. As for the dangers threatening democracy, Barzun has this to say: "That it is a culture means that we individually possess the power to uphold it; we cannot win or lose it all at once."

Wit or WITOUT

Marvin Diers M.E.B. '42 Arthur Templin E.E. '41

"Oh doctor," said the young lady, "will the scar show?"
"That, madam," said the doctor, "is entirely up to you."

★ ★ ★

Take your house number and double it. Add 5. Multiply by half a hundred. (Drop that slide rule!) Then add your age. Add the number of days in a year. Subtract 615. The last two figures will be your age; the others, your house number. Good gravy, it works!

★ ★ ★

Prof.: "Have you been through calculus?"
Freshman: "Not unless I passed through at night on my way here, I'm from Kansas you know."

★ ★ ★

There was once a deaf and dumb husband who wore boxing gloves to bed so that he wouldn't talk in his sleep.

★ ★ ★

"I guess I'm clumsy at milking this cow."
"Yes, you have no regard for the feeling of udders."

★ ★ ★

Young Fry: "I can't see how you get into that little bathing suit."
Beach Siren: "You're darn right you can't."

★ ★ ★

"You brute, where did you kick that dog?"
"Ah, madame, thereby hangs a tail."

★ ★ ★

"I'd like to be cremated, but I'm sure my wife wouldn't like it."
"Why so?"
"She's always complaining about my leaving my ashes around."

★ ★ ★

First Bottle of Milk: "Let's Neck."
Second Bottle of Milk. : "O. K., let's go curdle in a corner.

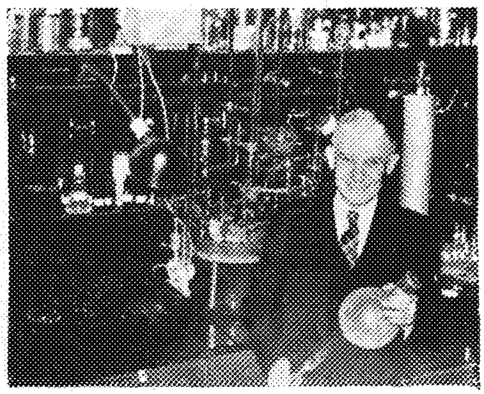
★ ★ ★

Judge: "What is the charge against this man?"
Cop: "Stealing nine bottles of beer, your honor."
Judge: "Discharged, I can't make a case out of nine bottles."

★ ★ ★

We'd like to spring one about a mouse trap—but it's too snappy.

We Present . . .



Professor Lee I. Smith

Chief of the Division of Organic Chemistry

By Donald S. McClure, Ch. '42

Professor Smith, Chief of the Division of Organic Chemistry, is a man of many interests and constant activity. Organic chemistry is, of course, his main interest, and his achievements in this field have made him world famous. Dr. Smith is best known for his work on the structure and synthesis of vitamin E and related substances, but to the scientific world, he is known for much other work in organic chemistry. In addition to research in his chosen profession, Dr. Smith is a member of the editorial board of *Organic Syntheses* and the *Journal of Organic Chemistry*, and is an associate editor of the *Journal of the American Chemical Society* and of *Chemical Reviews*.

Photography, in which he is an expert, is Dr. Smith's favorite hobby. Some of his photographs have won prizes in the *Tribune* contests. Most of the photos are of the mountains and lakes of western United States and Canada. During the summer Dr. Smith hikes through the Selkirk range in British Columbia, or through Estes Park, Colorado, taking pictures in these scenic regions. Another interest is symphonic music. Every Friday night finds him at the concert in Northrop Auditorium. At home, he listens to the radio concerts, or to selections from his large collection of recorded music.

There are many other things which keep Dr. Smith a busy man. Although he says he hasn't lifted a test tube in years, he has the job of keeping 35 graduate students busy with research problems. Several of these problems are ones related to vitamin E and the other tocopherols. Once every quarter, Dr. Smith leaves his teaching duties and research to act as consultant on research for Merck & Co. Visiting other schools for the American Chemical Society accrediting program also keeps him traveling. The national defense program includes Dr. Smith as a consultant on research for the National Defense Research Committee.

Dr. Smith's early training included undergraduate work at Ohio State University, where he got his A.B. in 1913, and graduate work at Harvard, where he got his A.M. in 1917 and his Ph.D. in 1920. While at Harvard he was a teaching assistant and then an instructor in chemistry. In 1920, he came to Minnesota and a year later was made assistant professor. He succesively became associate professor, professor, and, in 1933, Chief of the Division of Organic Chemistry.

During his active life, Dr. Smith has joined many organizations. He is a member of the American, British, German and Swiss Chemical Societies, Phi Beta Kappa and Sigma Xi honorary fraternities and several academic and professional fraternities. In addition to his editorships, he is a contributor to the *Journal of Organic Chemistry* and to *Science*.

The Modulus of LAUGHTICITY

By William N. Campbell

and John Lambert EE '41

OTHER BOOKS
READ
BY
William Campbell and John Lambert
The Grapes of Wrath
Gone With the Wind
Candide
The Decameron

One of our friends, whose name is Legion, has asked that instead of printing this material in the *Physical Review* we give it first to the TECHNO-LOG. Because school spirit courses through our veins like tin cans down an elevator shaft, we have bought off our contract with the *Physical Review* and the *Scientific American* in order to present this research first in the LOG:

• • •

Below is a list of engineers who have never spent an evening in spring on the river banks:

....
....
....

• • •

Then there's the fellow who sent his gal a brassiere for her birthday present. She sent it back and said she'd rather have the money because she was flat busted.

• • •

Don Heimes, E.E. Senior, wants all men with oversized members such as heads, feet, epigastrium, hands, etc., to get in touch with him. He will procure sure-fit clothing for them from such men as Governor Stassen, President Roosevelt, Clark Gable, Charlie Chaplin, Jim Farley, and other friends.

• • •

A hunter, lost in the north woods, came upon a country clod in a field.
"Say, where am I?" the hunter asked.
"I dunno," mumbled the rustic.
"How far is it to the nearest town?" asked the hunter.
"I dunno," repeated the clod.
"Say, do you know where Minneapolis is?"
"I dunno."
"God, do you know who President Roosevelt is?"
"I dunno."
"Do you know who God is?"
"Sure, last name is damnit."

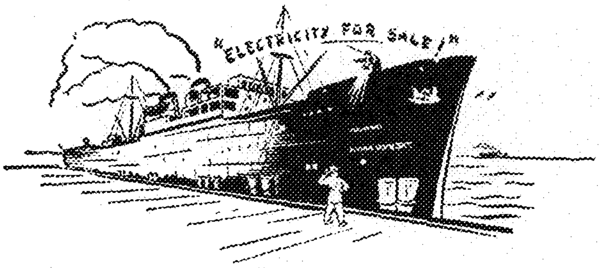
• • •

Dental Surgeon: "I'm sorry, but I'm out of gas."
Girl in Dentist's Chair: "My gosh! do dentists pull that old line too?"

• • •

A farmer was once phoning a Veterinarian. "Say, Doc," he said, "I've got a sick cat. He just lays around licking his paws and doesn't have any appetite; what shall I do for him?"
"Give him a pint of castor oil," instructed the vet.
Somewhat dubious, the farmer forced the cat to take a pint of castor oil.
A couple of days later the vet met the farmer on the street.
"How's your sick calf?" inquired the vet.
"Sick calf! That was a sick *cat* I had."
"My God, did you give him a pint of castor oil?"
"Sure did."
"Well, what did he do?" asked the vet.
"Last I seen him," said the farmer, "he was going over the hill with five other cats. Two were digging; two were covering up; and one was scouting for new territory."

G-E Campus News



FLOATING POWER

BACK in '29, when the water supply in Tacoma, Washington, was so low that the hydroelectric stations could not generate enough electricity for the city's requirements, the U.S.S. *Lexington*—a turbine-electric drive airplane carrier—supplied the power necessary to tide the city through the emergency.

A year later on the opposite side of the country, the *Jacona*, a ship built during the last war, was made into a floating power plant by installing two 10,000-kw turbine-generators in its hull. It is at present in service on the Piscataqua River near Portsmouth, N. H.

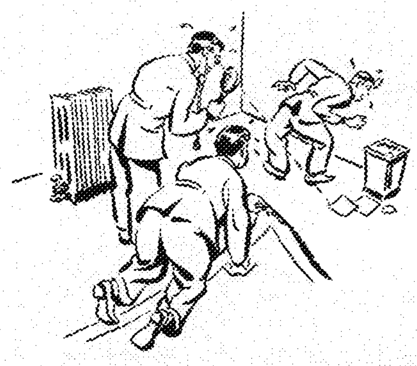
General Electric is now studying the possibilities of a 50,000-kw floating power plant, which could be towed through America's coastal and inland waterways and hooked up to regular distribution lines to generate electricity in emergencies. Such a generating station could be housed in a hull similar to that of a lake freighter.

GIANT ATOM SMASHER

SO powerful that its atom-smashing beam of ions would melt an ordinary brick as fast as a blowtorch would melt a pound of butter will be the U. of California's new 100,000,000-volt cyclotron. The 4900-ton giant—16 times more powerful than the present outfit—will generate atomic energies greater than any now in existence except in distant stars or elsewhere in cosmic space.

Atomic particles will be fed into a circular chamber where they will receive successive "kicks," whirling them around in continually widening circles until they reach a window or port on the side of the chamber. The element to be bombarded will be placed over this window where it will receive the full force of the ion beam.

For this machine General Electric is building electric equipment, which will occupy the space of a two-story house. The chief function of this equipment will be to make ordinary electric current capable of operating the giant atom smasher.



DETECTIVE STORY

ALBANY HOSPITAL was in an uproar. The technicians in charge of the hospital's radium supply had lost a radium "needle"—only 3.3 milligrams to be sure, but enough to burn a person seriously if the needle were caught for long in his shoe or clothing.

An appeal for help was sent to the General Electric Research Laboratory in Schenectady for a "Geiger Counter"—an electric "ear" which detects and amplifies the otherwise inaudible "explosion" of the radium as it breaks down.

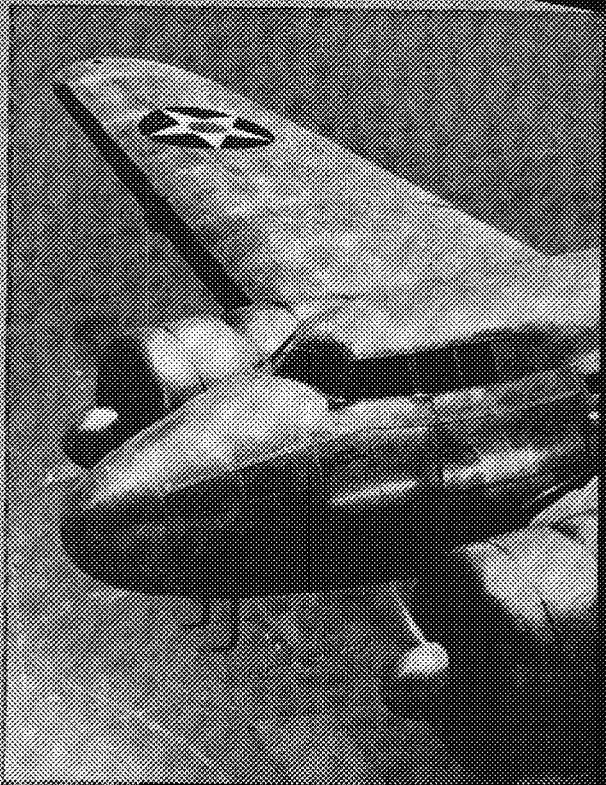
When Dr. C. W. Hewlett (N. C. State, '06) of the G-E Research Laboratory entered the suspected operating room, the counter immediately began to "cluck" its warning of radioactivity nearby. After a false start, the counter took to the trail like the Hawkshaw it is, and eventually, as Dr. Hewlett lowered it to the floor in front of a radiator, the clucks became barks. And there, snuggled against the wall under the radiator, was the missing radium.

GENERAL ELECTRIC

558-59

THE TECHNO-LOG

OF MINNESOTA



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APRIL, 1941 VOL. XXI N


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Authors . . . Staff. . . .

By Richard Opland, C.E. '43

For the real lowdown on the building construction outlook for 1941, turn to the article by **Axel B. Algren.** Mr. Algren,

Assistant Professor of Mechanical Engineering and Assistant Director of the Engineering Experiment Station, is well qualified to write on the subject. He, in collaboration with Professor Frank B. Rowley, has authored many publications dealing with heat and vapor transmission in building structures. Mr. Algren received his B.S. degree at the University of Minnesota in 1925 and acquired his M.S. degree in 1931. While in school, he was a member of the University's first golf team, and he still enjoys the game for its social as well as its competitive merits. Mr. Algren is a member of Pi Tau Sigma and Sigma Xi fraternities and belongs to a number of other organizations which include the American Society of Heating and Ventilating Engineers, the Society for the Promotion of Engineering Education, the Minneapolis Engineers' Club, the Association of University Professors, and the Campus Club.

●

Don Martin, C.E. '41, writes on "Aerial Mapping" for his second article of the year. Don gave a talk before the A.S.C.E. on

the subject recently, and they liked it so well that he has consented to write it up for the TECHNO-LOG. Don is looking forward to being a graduate civil engineer, come June, and he hopes to land a job that involves some form of exploration. At present, he is dickering with a petroleum company for field work. Don is a rugged fellow who likes hiking and being out of doors. A year ago last fall, he packed some supplies, got a hold of a canoe, and struck off by himself for two weeks on the Canadian border. Needless to say, last summer was a happy one for him at at the civil engineers' camp. Don is also sports minded; he was out for varsity football for two years, and he likes to play hockey and diamondball. Besides belonging to the A.S.C.E., he is a member of the Explorers' Club of Saint Paul.

●

Harold Wray took a round-trip airplane ride to Duluth way back when he was a junior in high school, and that flight aroused

in him a desire to follow aviation. Thus, we find him a Senior in Aeronautical Engineering and the author of our article on high altitude flight. Wray, who plans to get his Master's Degree, is very interested in stress analysis and in the possibilities offered by high altitude flying and "pressurized" cabins. Harold was the envy of the engineers last summer when he worked at a local brewing company. In his spare time, Wray enjoys watching a good play or stage show. He also likes dancing and popular music, and, at present, thumps a piano with a dance band. Harold is a member of the I.Ae.S., and, last year, he worked for the TECHNO-LOG on the business staff.

●

Louis Schaller graduated from civil engineering in 1929. Since then he has been in a position to keep in contact with many graduates from the institute. His story on success is based on the advancement of engineers he has known.

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The editorial policy of the TECHNO-LOG is to present material for technology students which it is hoped will strike a happy medium between the superficial and the highly specialized.

The MINNESOTA TECHNO-LOG is published monthly, October through May, by the students in the Institute of Technology of the University of Minnesota.

The purpose of the TECHNO-LOG is two-fold: First, to put in the hands of TECHNO-LOG subscribers highly worth-while and interesting reading material; second, to offer technology students an invaluable opportunity to get writing, selling, and working-with-others experience.

THE MINNESOTA

Techno-Log

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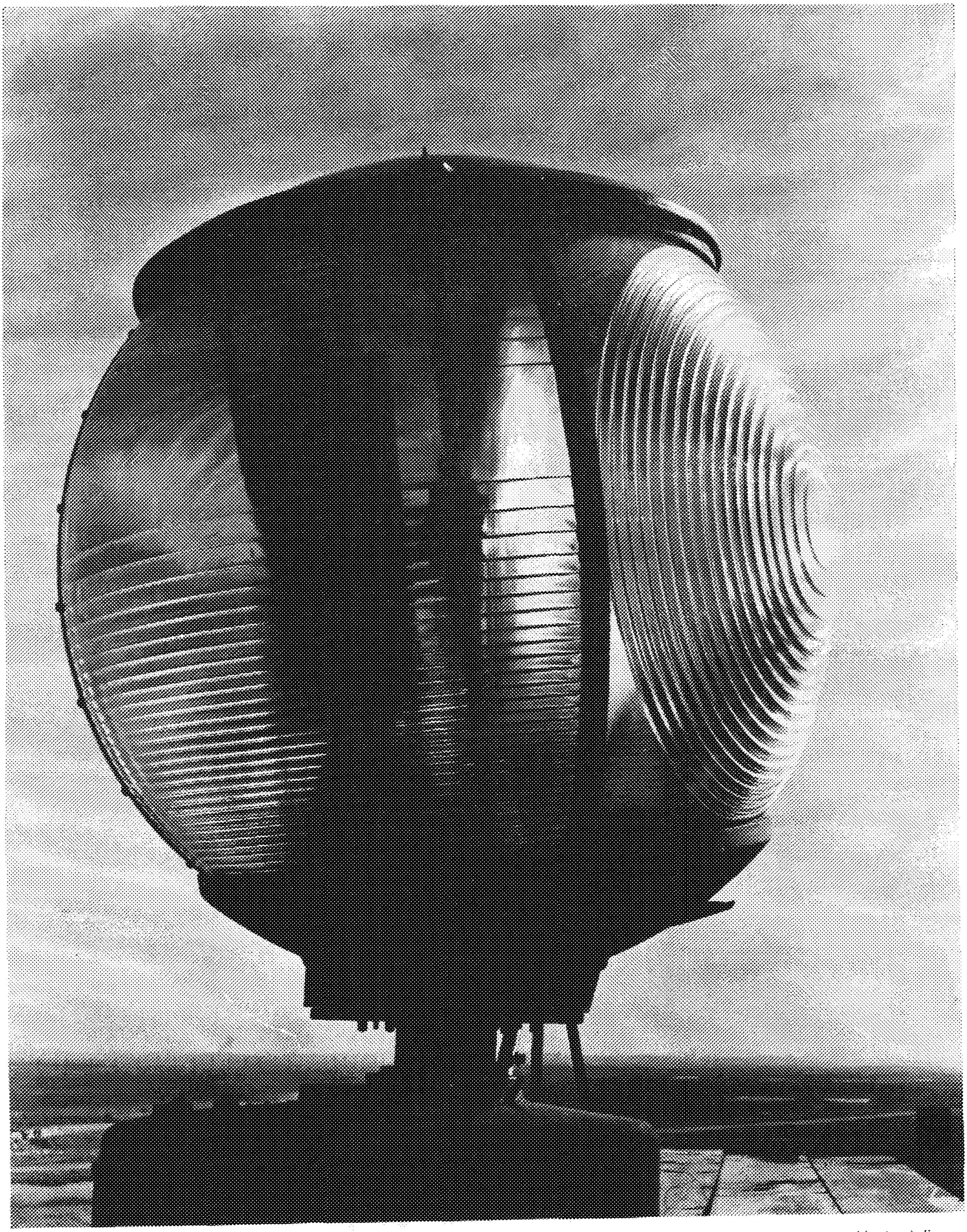


Courtesy Architectural Forum

Revolving Airport Beacon

AN EDITORIAL

Education vs. Specialization

THIS JUNE several hundred engineers will graduate after having completed four or five-year courses in engineering. Very few of them will be educated men, although there will be many fine engineers in the group. This unfortunate situation is not the fault of the students themselves nor is it directly the fault of the faculty or of the University. It is the result of circumstances which have arisen only in comparatively recent times.

Specialization is the circumstance most to blame, and yet specialization is a necessary thing. A man is no longer just an engineer; he is a chemical engineer, a mechanical engineer or an aeronautical engineer since it is nearly impossible to know more than one of these branches thoroughly. The engineer out on the job must limit himself to even smaller portions of his field. This increasing specialization means that people are learning more and more about the world and for this reason it is an indication of highly desirable progress. But at the same time it becomes easier and more dangerous for a person to see only his world and nobody else's. Such a lack of understanding between the various groups in the nation can only lead to discord. Fortunately, there are enough people with the clearness of vision and the foresight to preserve coöperation in most respects. On the other hand, the present current events prove that there are too many people having the opposite characteristics.

This narrowness could be overcome by reshaping the engineer's education along certain lines, while retaining for the most part a specialized course. The engineering sequences listed in the bulletin are full of two and three credit courses, some lasting only a quarter, which seem to have no apparent relation to each other. This observation is confirmed on taking one of the sequences; or if there is some such relation, it is not made clear.

Instead of this type of sequence, suppose all freshmen were given a real orientation course wherein they were required to do some work. This course would outline for them the future course work in their own branch of engineering, it would then give outlines of the other engineering courses, the scope of the freshman's particular branch in industry and the relation of the other kinds of engineering to this. Leaving engineering for awhile, the course could cover some of the other professions and finally it would show how the whole mosaic forms the pattern of society. A big difficulty would be to make the freshman remember that the University isn't just an advanced high school. A good professor could handle such a course to the great profit of all the students. The rest of the engineering sequence could be given in the same spirit. Each course would be dependent upon the ones which came before it. The instructors would know thoroughly what had been taught in the other courses so that repetition and the introduction of material with no background would be avoided. Thus, the entire structure of a particular branch of engineering would be built up for the student in a clear, logical fashion while its bearing on the rest of engineering and that of engineering on the rest of society would be kept constantly in mind. It would be a simple matter to include a few courses from the arts school in this curriculum but only a course lasting five years could supply the most desirable balance between engineering and arts.

The engineering courses which are amenable to it could be taught as sciences and not as sets of rules. The mind of the student drilled in the fundamentals of a science is much more flexible and therefore more useful than the one which remembers the rules—the rules don't always work. An engineer really starts to learn what his profession is all about on his first job, so he won't suffer much loss if theory is given the emphasis over detail in his undergraduate work. On the other hand, it will be much easier for him to learn and use this new material if he has a good foundation in theory.

This rather idealistic engineering education would leave some engineers cold, but it would supply the missing element in the present system for the more thoughtful type. The latter ones are those who will become truly educated in their four or five-year courses. They will not forget their ideals as soon as they start working for a company. If enough of such men rise to influential positions, they will certainly contribute to the building of a better world.

By DONALD S. McCLURE
ASSOCIATE EDITOR

SCIENCE GIVES AMERICA

Better Housing

By Axel B. Algren

Asst. Prof. of Mech. Eng.

Typical roof installation

All cuts courtesy Wood Conversion Co.

THE year 1941 finds the world in a state of greater upheaval and the United States in a condition of growing unrest. How will this affect residential building? With people wondering about our national security, are they in a mood for providing for their personal security and comfort? If they are, the home construction and equipment trades have much to offer them in the way of increased value and comfort for their investment.

However, this improvement in residential construction is only the result of careful studies and investigations. The costs of different types of structures have been determined; and the comparative values of steel, wood, stone, concrete and brick as building materials have been analyzed. Studies have been made on the relative merits of the different types of heating plants, on the application of different types of fuels, and on automatic heating appliances.

Following these studies came investigations to determine the best insulating materials, experiments to test the use of vapor barriers in building construction, and other experiments to improve ventilation and introduce humidification and summer conditioning of the home. All of this work has been done so that the prospective home builder may select the type of structure which will insure him maximum value and comfort from his investment.

Let us look at what statistics have to say about the building prospects for 1941. Seldom, if ever, has there been a period when residential building has shown as many years of constructive gains as it has experienced from 1933 through 1940, and when one considers the rapid advances during the past few months in our National Defense Housing Program, it is quite evident that the year 1941 will also show a marked increase in residential building.

In the January, 1941, issue of *Heating and Ventilating*, a very complete summary of construction statistics for the coming year is given by Mr. L. Seth Schnitman. Mr. Schnitman has been for years in intimate touch with the building industry and is at present a consulting economist in New York, specializing in construction and allied fields. In his article he estimates that approximately $3,550,000,000 will be spent in the United States during 1941 for residential and nonresidential building. This figure excludes all heavy civil engineering projects. Of this amount, more than one half, or about $1,950,000,000, will be spent for residential building.

Mr. Schnitman further cites that, in 37 states, about 206,000 one-family houses will be built. Of these, only 17 per cent will have a unit building cost, exclusive of land, under $4,000, while the remainder will have a unit cost of $4,000 or more.

Closeup of ceiling installation

The part that the National Defense Program plays in the building outlook is shown in the report of C. F. Palmer, Defense Housing Coördinator. He states that funds have been allocated for 185 projects in 40 states and territories which will include 54,283 family dwelling units. These projects will provide homes for 30,689 civilian workers and 23,595 enlisted personnel. The rapidity with which defense housing is moving is shown by the fact that out of a total of 185 projects, contracts have been awarded for 107 with nine already completed.

With this extensive building program in mind, the question arises as to what type of building construction will be used. To this question there appears to be no immediate answer, for when one considers the United States as a whole, with its wide range of variable climate, distribution of skilled labor, methods of construction, availability of materials, and comfort requirements of the population, no single type of construction is evident or should be expected.

Wood Frame Construction

One of the older types of construction is that having a wood frame with wood lap siding. This construction can be classified as an all-wood house and at present consists of lath and plaster, vapor barrier, insulation, 2x4 in. studs, sheathing, and building paper and lap siding. Two other types of wood frame construction, namely the stucco exterior type and the brick-veneer type, likewise have these features.

The use of reinforced concrete has become more accessible to the home builder because of the lower cost resulting from inexpensive or reusable forms. The walls are reinforced concrete with floors and roof of concrete joists and concrete slab. The inside can be vapor-proofed, furred, insulated, and finished with plaster, or can have the insulation fastened directly to the concrete and then plastered. One type of building employs concrete or cinder block for the walls with the other phases identical with the reinforced concrete type.

Another method which incorporates some of the features of each type discussed is one employing brick-veneer and tile. The walls are of 8 in. back-up tile and face-brick with floors, roof, and partitions similar to wood frame construction. Insulation, vapor-proofing, and inside finish are similar to reinforced concrete construction.

Prefabricated Buildings

Steel has been coming to the fore as a factor in residential building. The use of steel in house construction has generally been to replace the wooden structural members. The walls and roof are of panel construction, prefabricated in the shop and ready for erection at the site. The panels are filled with insulation.

Many point to prefabricated buildings as the modern way of construction. This type of house can be manufactured in a shop and erected on site with a minimum amount of field labor. These are not necessarily low-cost units but should be sold in a sufficient quantity to obtain the economic advantage of mass production. The unit can be dismantled and moved from one site to another.

Of special interest and importance at the present time, however, is the low-cost prefabricated house of about $1,500 for a two-family unit, or less than $1,000 for a one-family unit. The wall and roof panels are of the same general design and materials. A high salvage value must be considered in the design of this type of structure. The house must permit being dismantled in one day and reassembled again with no loss in value of the structure itself.

The National Defense Program will undoubtedly call for a large number of prefabricated units that can be readily dismantled and moved to some other location whenever the present emergency has been met. Likewise, the need for low-cost units is very urgent, especially near large manufacturing centers, near various dam building projects, and in the slum clearance projects in many of our larger cities. The outlook for residential units in 1941 does not only indicate an increase in business volume but also presents a rather encouraging picture dealing with our country as a whole. An analysis of world conditions shows that in the totalitarian nations the home and the family have almost ceased to be the fundamental units of society. In our country they remain fundamental, and the perpetuation of this condition is being encouraged by the increased number of dwelling units that are being built year after year.

The number of homes built each year is augmented not only by our form of government but also by man's desire for adequate shelter and comfort. The home should include proper provision for insuring comfortable living conditions at all seasons of the year. In order to provide these provisions, proper attention must be given to those important factors such as insulation, heating, cooling, humidification, and ventilation. The extent to which each one of these factors should be considered is dependent upon what standards of comfort are required.

The first factor that should be considered is insulation as this is one of the primary needs in home construction. An analysis of climatic conditions compiled from U.S. Weather Bureau records shows that every one of the forty-eight states have at some time or other experienced temperatures of zero degrees or below. Likewise, the Weather Bureau records show that all forty-eight states have recorded temperatures of 90 deg. fahr. or over during the summer months.

	Insulated	*Uninsulated*
Heat loss, B.t.u. per hr.	69,156.00	139,335.00
Sq. ft. radiation (160 B.t.u. /sq. ft.)	432.00	870.00
Boiler size	69.20 MBH	139.4 MBH
Cost of heating (Stoker coal) eff. 60%	$83.00	$166.00
Cost of heating (Oil) eff. 75%	108.00	218.00
Cost of heating (Gas) eff. 75%	152.00	308.00

Comparison of heat loss calculations for an eight-room house.

Insulated Homes

The most practical thickness and best kind of insulation to be used is that which will pay the greatest return per year in comfort and fuel savings and still return a large dividend on the original investment. Economy and comfort are the two outstanding reasons for installing insulatoon in the home. On cold days comfortable conditions can be maintained at reasonable cost, and on hot summer days insulation helps to retard the flow of radiant, solar heat through the roof and wall structures.

In cold climates savings are effected by the reduction in size of heating plant and by lower fuel costs. If cooling is required in hot weather, the size and operating cost of air-conditioning installations is reduced.

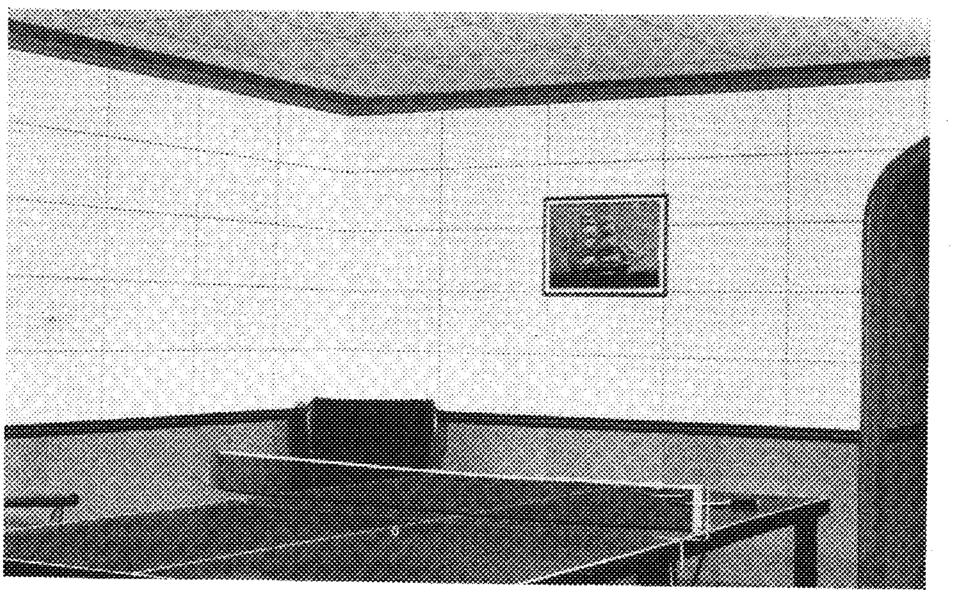
A typical example of the fuel savings and reduction in equipment due to insulation is best shown by a comparison of heat-loss calculations for an eight-room house, insulated and uninsulated. The residence to be located in Minneapolis where the average total degree day per heating season is taken as 8000 (for one day there exists as many degree days as there are degrees fahr. difference in temperatures between the mean temperature for the day and 65 deg. fahr.). The insulating material used is batt type, 3⅝ in. thick.

The reduction in required radiation is approximately 50.5 per cent between the insulated and uninsulated house. The savings due to this reduction, together with the decrease in boiler size and piping, would depend entirely upon the market cost and could best be determined at the time of construction.

The savings per season using a coal fired stoker installation based on $9.00 a ton coal would be $83.00. Likewise the savings for oil at $.075 per gallon would be $110.00, and the savings for gas at $.62 per 1000 cu. ft. would be $156.00. On the basis of these calculations we see that the insulation would pay for itself regardless of the kind of fuel used. The length of time or number of years required would of course depend upon first, the size or number of rooms in the residence; second, the efficiency of burning; and third, the initial cost of the fuel.

The savings in fuel and equipment should be welcomed by any prospective home owner, for it indicates that in a majority of cases he can insulate his home

A modern playroom lined with insulating wall-board.



and realize a premium in fuel savings on his investment and also reduce his initial cost. But these are not the only inducements offered the builder or home owner to insulate. The comfort conditions are also of importance. Bodily comfort, which depends upon proper room temperature, proper humidity and wall-surface temperatures, can best be realized when insulation is used. By reducing the heat losses through the structure, large temperature variations between floor and ceiling, frequently found in uninsulated houses, can be reduced approximately from 50 to 70 per cent. Likewise, as the wall-surface temperature would be increased when using insulation, a greater sensation of comfort would be experienced due to the reduction in radiation-losses between the body and the surrounding walls. The use of insulation, therefore, results not only in a savings but also in promoting comfort and health.

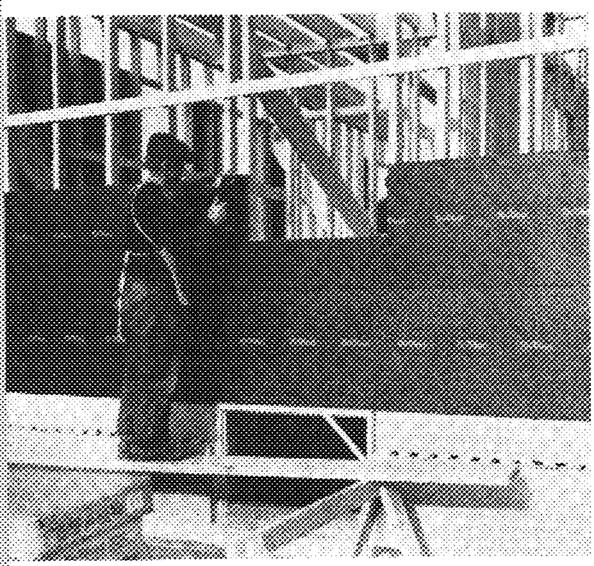
Condensation

The advances in residential building both in materials and equipment in recent years has been primarily due to man's desire for both comfort and health in the home. These changes or improvements have brought about condensation problems that must also be considered.

Much has been written about the low relative humidities found in the average residence in cold climates and its possible effect upon health, comfort, and interior furnishings of residences. This has led to the common practice of increasing the indoor humidities and has resulted in the installation of devices expressly designed for the purpose of increasing the relative humidities. Many of these devices operate without any degree of control, and sometimes are of a type which operate to excess in the coldest weather.

The results of research conducted at the University of Minnesota in coöperation with the National Mineral Wool Association on vapor transmission and moisture control, indicate that condensation troubles can be eliminated by carrying reasonable humidities within the home, or by the application of vapor barriers on the warm side of the wall. The reduction of humidity within the home in many instances requires ventilation, while the use of vapor barriers requires the application of some vapor-resisting membrane on the warm side of the wall. In general there are two types of barriers which are effective in preventing the passage of vapor through to the inner section of the wall. First, those barriers which are built in the form of a self-supporting membrane or as an integral part of the insulation, and second, those barriers such as paints which can be used as surface coatings on the warm side of the wall.

Exterior Application of Insulating Board



Heating and Cooling

Regardless of how attractive the design or how beautiful the furnishings of the home may be, the lack of proper design and installation of the heating plant will result in disappointment to the home owner.

In the field of residential heating the owner is least protected by adequate specifications, architectural and engineering advice. Here the contractor or builder finds it advantageous to avail himself of the opportunity to save money or reduce costs. This frequently results in reduced efficiencies, inferior quality of equipment, and increased operating costs. When these conditions exist, the home owner, not being familiar with heating problems, most generally considers the type of heating plant as the contributing cause rather than those factors such as installation, design and equipment.

Practically every known system of heating has been used and each one has served its particular function when properly engineered. These systems have included everything from the most simple form of circulating heater to the fully automatic year-round heating and air-conditionong system, and includes all kinds of fuels, together with automatic fuel-burning equipment.

The fundamental principle of any heating installation is to provide comfort for those individuals doing the least amount of work, without causing undesirable changes in the rate of heat generation, or in the body's heat-regulating mechanism. The primary object of radiant heating is to maintain the surface temperature of the surrounding surfaces as will be conducive to comfort without needlessly heating the air. In convection heating as used in warm air heating, hot water and steam, the heating medium maintains the required air temperature to give comfort under the existing conditions of humidity, air motion and surrounding surface temperatures. The difference between radiant heating and convection heating is therefore partly physical and partly physiological.

A complete air conditioning plant for maintaining a healthful and comfortable temperature and desired humidity condition the year around requires equipment that will filter and properly distribute the air, cool and dehumidify the air in summer and heat and humidify the air in winter. At present the majority of residential air-conditioning systems are limited to winter air-conditioning only. Usually the volumes of air circulated in the winter air-conditioning system is not sufficient in quantity for summer conditioning. The cost of cooling installations which have sufficient capacity to cool a moderate-sized residence are still beyond the reach of the majority of home owners. Again, the amount of cooling required is variable, depending upon individual preferences. Some home owners would desire a system that will cool all the rooms of the house. Others are satisfied to cool only two or three rooms such as the living room and bed room, while others are satisfied to cool only one room. There are also many ideas as to how much the temperature of the cooled rooms should be below the outside temperature.

These requirements have restricted to some extent the possibility of reducing the cost of summer-conditioning systems. To be successful, a home cooling plant should be practically noiseless in operation. The equipment must be arranged in a compact manner, require very little attention or servicing, be fully automatic and ready for operation at any time.

The rapid advances made in dehumidifying equipment the past few years promises to meet the requirements for a low cost summer-conditioning system.

Ventilation

Although complete summer-cooling of residences has not shown any marked progress, there is still a great demand for more comfortable conditions in the home during the hot, summer months. To meet this demand inexpensive equipment is available that will provide a high degree of comfort.

Attic ventilation has been very successfully employed for this purpose. The type of fan selected depends somewhat on the exhaust system to be used. A propeller type fan exhausting directly through louvres located in one of the attic walls with ceiling openings to the occupied rooms would be the simplest installation. The summer temperature records for most cities show that the outdoor temperature after sundown drops from 10 to 12 degrees below inside air temperature and stays there approximately 12 hours. The most effective method then would be to open the windows at night circulating the outdoor air through the house and discharging it through the attic by means of an attic fan. Fans should have sufficient capacity to change the volume of air in the residence from 20 to 30 times per hour.

All in all, the building horizon presents a rather encouraging outlook for 1941. The upward trend in construction the past seven years, and the large number of National Defense and other public projects indicate a fairly sizeable volume of business for the builder for the coming year. The improvements in all building equipment will perhaps give the manufacturer an increased number of sales in modernizing old houses as well as in new construction. For the prospective home owner, progress has provided more efficient heating systems, better ventilation, and more economical air-conditioning equipment. He has access to everything that will guarantee him greater personal health and comfort.

YOUR FUTURE DEPENDS ON

Ambition - Key to Success

By Louis M. Schaller, C.E. '29

DURING the past nine years it has been my pleasure to know several hundred Institute of Technology graduates. Each one of these men has left the University bent on making a success in the world. Reviewing the progress of these groups has prompted me to make some of the following observations.

Success is difficult to define generally or specifically. Webster defines it as "that which comes after, hence, consequence, outcome or result of an undertaking" or "the favorable or prosperous termination of anything attempted."

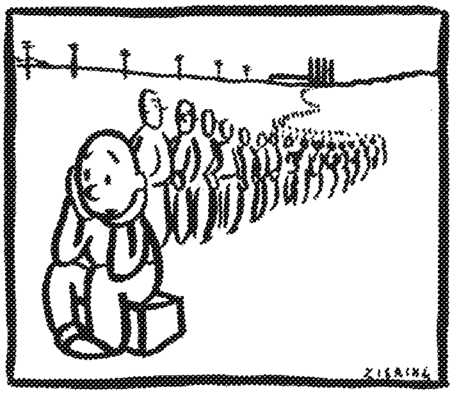
Each senior is striving toward obtaining his degree, and at the same time he is thinking about getting a job. This desire is coupled with a feeling deep in his heart that he is going to make a success of himself. Too often he finds himself lost—almost hopelessly lost—in a sea of competition—competition for a job; competition with his associates after he does get a job.

I have heard rumblings before and after by some of these men or by their parents and relatives that the University is probably at fault; that the University does not properly prepare men to cope with this competition factor. Recent study of this, however, has proved to me that everything that any man needs in preparing himself for success is taught, made available, and reviewed time and time again while he is working for his degree. Now, why is it then that so few men achieve this intangible thing called success?

Let me qualify any further statements by stating that there are exceptions to every rule or general statement. Success is obtained by thousands who never greatly prosper financially. Industry's ability to absorb and economic conditions often govern financial success. There are innumerable men who succeed in their respective spheres of education, research or development work. They are happy, contented, and secure. They are successful.

I wish to confine my remarks to the prosperous termination of anything attempted. Most of the men graduating dream of better jobs, more responsibility and a succession of events in their future lives resulting in better salaries and financial security.

We all have been told by our parents, guardians, professors, preachers, and many well-known business men that the secret of success is hard work. This is not entirely true. I have seen men work hard without achieving any semblance of success, and others who succeed apparently without



working hard. Then what is this denominator for success?

The best defin'tion I have ever heard or read was given by Mr. A. E. N. Gray of New York who has inspired me on many occasions. I quote: "The Common Denominator of Success—The secret of success of every man who has ever been successful lies in the fact that he formed the habit of doing things that failures don't like to do." That statement explains to me why some graduates are Tau Beta Pi's, Sigma Xi's, and others not. It explains why some men are chief engineers and others not. It explains why some men are recognized authorities in their respective fields and others not.

Let us analyze this further and see what those who fail do not like to do. Success is achieved by such a minority of men that it can be considered unnatural. It cannot be achieved by following natural likes and dislikes. It would be almost impossible to discuss generally what failures like to do, but bear this in mind: Successful men are like failures, but they cultivate the habit of doing the things they really do not like to do. By doing these things they can accomplish the things they want. Then, they must have a desire for objective results. The influence of this purpose is strong enough to make them develop or form the habit of doing the things they at first do not naturally like to do.

Look around you in class and analyze the best students. Their work seems easier for them than it does for yourself. Two chances to one you will find that they have formulated good study habits, and because of these habits they have built a reservoir of working fundamentals that makes their work appear easier.

Because work in industry or business is so completely foreign to that which most students are accustomed, the successful student may fail to command the succession of events toward further responsibility and better jobs in the future. This is probably due to the fact that his desires, objectives or purposes might not be strong enough for him to cultivate the new good habits required. I have seen men who were top students in school fall behind supposedly poorer classmates in the business world, and the answer lies in this one point: Their purpose and desires were not strong enough to overcome the easier natural habits.

Make your purpose practical and objective. Needs are logical, while wants and desires are driving, emotional and sentimental. Needs will push a man just so far, but when they are satisfied they will stop pushing.

The problem of practically every one of the seniors graduating in June is to "get a job," which seems to me should be an objective as strong as getting the degree. It should be stronger, because it is the first step in the succession of events towards a prosperous and happy life. Do not forget, too, that you must be wholeheartedly interested and happy in your work.

What are you doing about getting your job? Have you decided what kind of work you really want to do? Do you know the companies who furnish employment in this work? Have you sorted these companies out as to which you would prefer to work for? Do you know your Placement Service director? Have you read "Preparation for Seeking Employment" by H. L. Davis, which can be purchased at your bookstore? Have you ordered your Personnel Sheets? Have you used them or made plans for using them?

There are many other questions like these, but their main purpose is to warn you that June, 1941, will be here before you know it. Only those who have done the things that most young men keep putting off "until next week" will be ready. They will be jumps ahead of those who leave it until the last minute to do. Many men have already accepted positions, but don't forget that when you hear of "Johnny Jones" getting that good job with the X Y.Z. Corporation, it will be a better than even bet that Johnny prepared himself for that "break." Be sure to read and study the bulletin "Seniors—Be Prepared for That Job" by Professor A. S. Levens, and spend some of your leisure hours and week ends between now and June preparing yourself for making a success.

A NEW ERA

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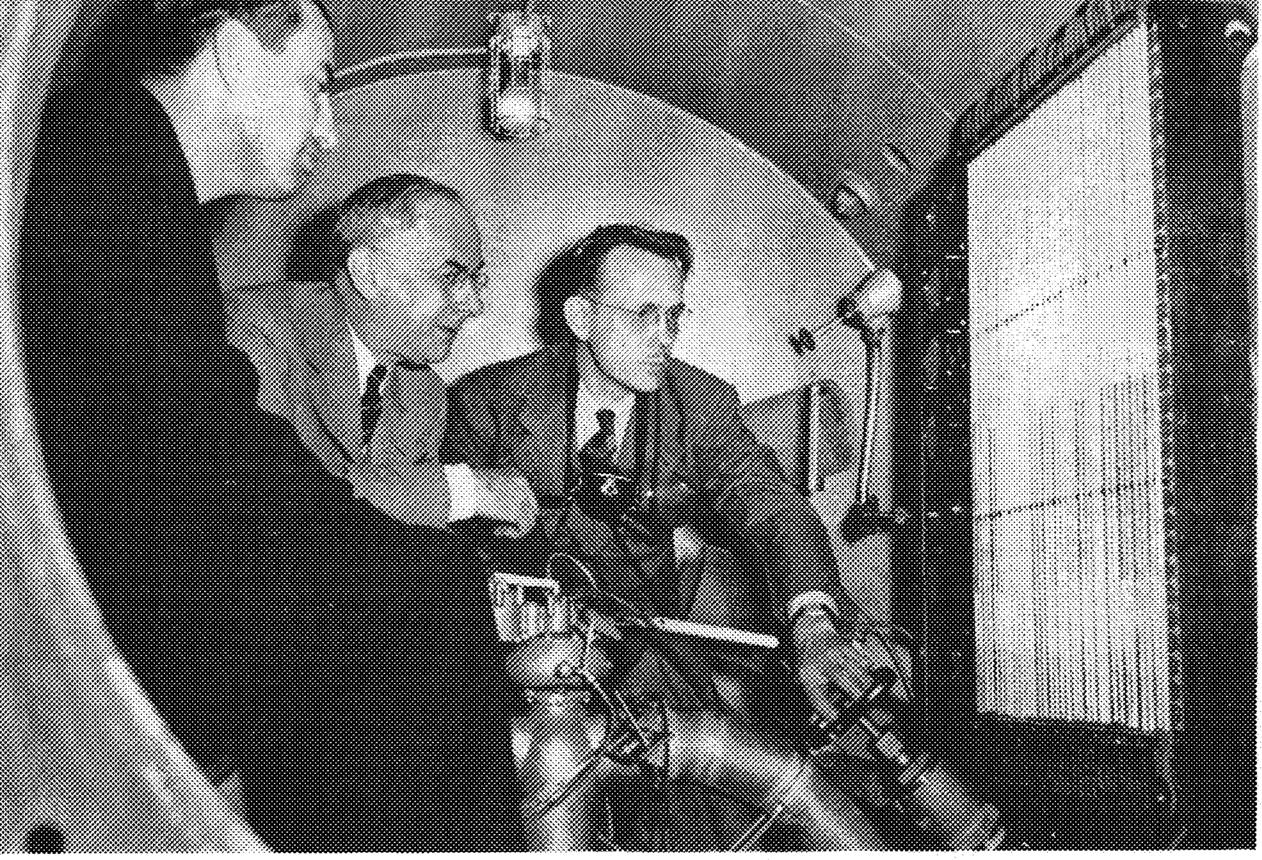


Courtesy Boeing Aircraft

Portion of the strato-chamber which simulates the interior of a high-flying plane.

AN article appearing in a local daily paper a few weeks ago brought to mind again a new era in the development of aviation, commercial as well as military. This article concerned a school at Wright Field, Dayton, Ohio, which the Army Air Corps has established to instruct its officers in the technique of high altitude flying. Wright Field Officials stated that observations from the present European war indicated a trend toward the upper levels of the air by bombers and by the interceptor planes which must fight them off.

From the military standpoint, there are the dual advantages in higher level operations of speed increase and a possible freedom of the bombardment types of aircraft from harassment by ground or air defense units. Recognition of these facts has been the incentive for such work on necessary equipment for aircraft and the training of personnel. Research has been conducted for over twenty years, mostly by the Air Corps at Wright Field, culminating in their experimental airplane, the Air Corps Model (Lockheed) XC-35. The success of the XC-35, which has been flying regularly as a practical passenger airplane for service at 30,000 feet, has undoubtedly been the impetus to the present commercial design trend toward higher level operation.

High Level Operations

Up to the present time, most of our airplane operations have been confined to levels below about 12,000 to 15,000 feet, chiefly because at greater elevations than this atmospheric pressure and temperature become so progressively lower that humans begin to experience some physical discomfort. At 12,000 feet the atmospheric pressure is about two-thirds that at sea-level, and since air constituents remain in the same proportion, there is but two-thirds of the normal oxygen available. Then, too, the average air temperature drops about 34 deg. fahr. for each 1,000 feet, so that at 12,000 feet an average of 16 deg. fahr. can be expected. This decrease in temperature continues until 36,000 feet, beyond which level the temperature remains fairly constant at an average of approximately —67 deg. fahr. This level is known as the tropopause, and will vary in this country between an altitude of 30,000 feet and 36,000 feet. The region below is called the troposphere; and that above, where the temperature remains constant, is called the stratosphere. The term substratosphere, as it is popularly known, is roughly that region of the atmosphere between the altitude of 20,000 feet and 36,000 feet. High level operations in the present and near future will be defined as flights within this arbitrarily called substratospheric range.

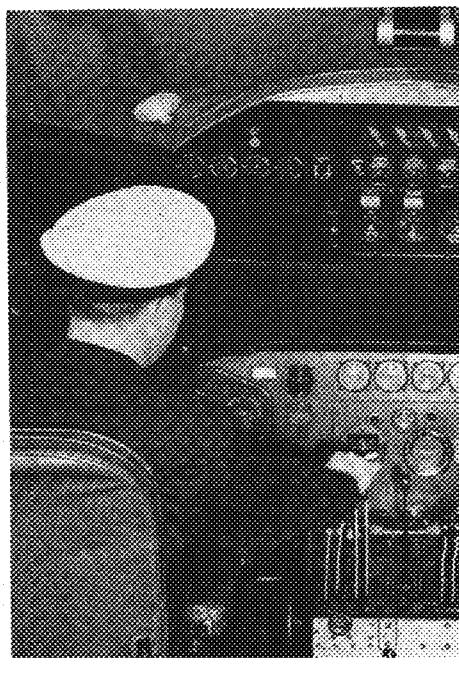
From the standpoint of airline transportation, there is much to be gained by operating at higher altitudes. The comparative freedom from the hazard of striking mountains and running into bad weather promotes safety and security necessary in the transport of human cargoes. Storms ordinarily do not extend to above about 25,000 feet and, as altitude is increased, the frequency of fog, ice formation, and inclement weather diminishes, resulting in improved riding qualities.

Higher cruising speeds are also possible. To explain this increase in speed would entail considerable discussion of aerodynamic principles. It is sufficient here to say that at higher altitudes, the air, having a lower density, offers less resistance, or aerodynamic drag. Another gain in speed can be realized through the possibility of greater vertical range to permit the pilot to select a favoring, or, at least, a more favorable wind.

To make practical use of the advantages offered by higher level operations, complicates the problems of airplane design. Not only do special mechanical and structural difficulties arise, but consideration of the physiological effects of high altitude flying must be made. The majority of the ill effects of high altitudes or low atmospheric pressures are due to the diminished partial pressure of oxygen. As oxygen absorption by the lungs depends on the pressure of this gas within them, the reduction of this pressure hinders the passage of oxygen from the lungs into the blood stream and the body suffers from lack of oxygen, or "oxemenia." This oxygen privation produces many of the effects of alcoholism, and in extreme cases will cause death by suffocation. It is absolutely necessary, therefore, to maintain a normal supply of oxygen in the lungs because the energy which runs the brain as well as the moving parts of the human machine is activated entirely by the burning of food by the oxygen carried in the blood stream to every cell of the body. Head cavities, the inner ear and the sinuses are sensitive to pressure changes and can cause great discomfort.

Obviously the solution to this problem in commercial air transport is to provide a sealed compartment in which the necessary oxygen partial pressure and total barometric pressure are kept at values which are consistent with health and comfort. In military airplanes, however, this sealed

Pressurized control co



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By Harold M. Wray, Aero.E. '41

compartment would be vulnerable to enemy bullets so the airplanes are equipped with oxygen masks which permit breathing of needed oxygen from an auxiliary supply.

Research has shown that the air pressure compartment, in which an adequate partial pressure of oxygen and total barometric pressure will be maintained at all levels by forcing outside air through the compartment under pressure, is the most desirable from the standpoint of weight, cost, and versatility of operation. This type of sealed compartment will maintain a reasonably normal environment with an adequate supply of oxygen, and will be free from harmful effects of sudden changes in barometric pressure due to rapid ascents or descents.

Ventilation requirements further complicate the design conditions, and will depend to some extent on the type of operation for which the aircraft is intended. Air conditioning science has established certain comfort levels with respect to temperature, humidity, and ventilation; and the requirements of these items must be maintained in the pressurized cabin. No carbon monoxide from the motors is to be tolerated as concentrations which are harmless on the ground become dangerous with a decrease in barometric pressure.

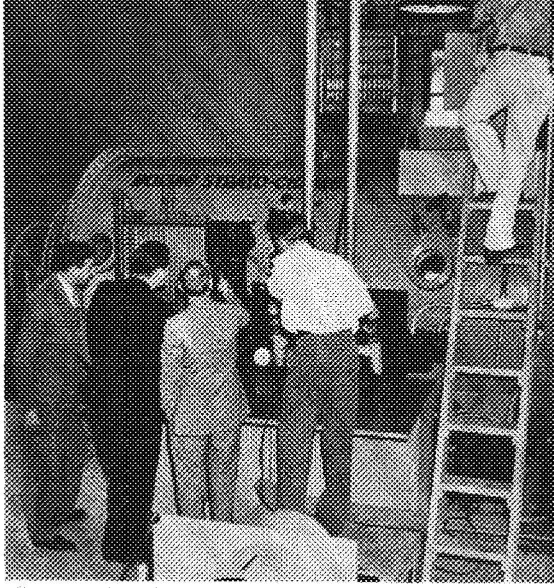
Carbon dioxide which is a waste product of body metabolism, must also be under careful control. This includes the elimination of the excess and the regulation within certain limits depending on the pressure in the cabin and the rate of production. The presence of this gas in the lungs and blood is vital to breathing for it regulates the rate and depth of the respiratory movements. A reduction of the carbon dioxide concentration in the lungs by only 0.2 per cent below normal produces a suspension of breathing while an increase of 0.3 per cent triples the normal ventilation. It is possible, therefore, to partially counteract the effects of oxygen want by increasing the percentage of carbon dioxide in the inspired air, the accelerated breathing causing an increase in oxygen pressure in the lungs.

Boeing Aircraft Company of Seattle, Washington, is the commercial pioneer in the opening of this new era in air transportation with its Model 307 *Stratoliner* which is now available for use over scheduled airways. The Boeing *Stratoliner* was built for use as a transport airplane capable of operating non-stop between North and South America, or over a practical trans-Atlantic route range, at speeds in excess of 200 m.p.h. and at an operating ceiling of 20,000 feet. Tests have proved that the Boeing will not only meet its specifications, but the automatic pressure regulating air-conditioning system have exceeded expectations.

Automatic Control

As the *Stratoliner* climbs, its mechanical superchargers and pressure regulating apparatus automatically begin to function to preserve the proper pressure inside the cabin. Through openings in the leading edge of the wing, air is drawn into the air-conditioning system, and by means of a pump driven from one of the four engines is put under pressure, heated, and driven through the cockpit and cabin by forced-circulation fans. Spent air is exhausted through a sensitive diaphragm valve in the tail of the aircraft. Duplicate pressurizers, also automatic, are installed to insure constant, dependable operation of the system.

This latest marked rise in operation levels by a commercial airplane on scheduled flights is a realization of the many years of research and tests on high level operations. An increase in production of



Courtesy Aero Digest.

Strato-chamber used in high-altitude research.

this type of aircraft will necessitate a commercial standardization of the equipment needed. As the work is carried on, there will be a steady increase in operation levels until somewhere, in the not too distant future, the stratosphere itself will be invaded by commercial transport airplanes.

The solution of the physiological problem by maintaining a normal atmospheric pressure within the cabin throughout the operating range of the aircraft must, however, be compromised with other factors. Structural limitations determine the maximum allowable differential pressure between the sealed compartment and the external atmosphere. The ideal condition is that of sea-level pressure at all altitudes, which would require a differential pressure of about ten pounds per inch for altitudes of 25,000 to 30,000 feet. In the interest of structural safety, this should be reduced to a maximum differential of 5 lbs. per sq. in., which is sufficient to maintain 10,000 to 12,000 feet conditions at 25,000 feet.

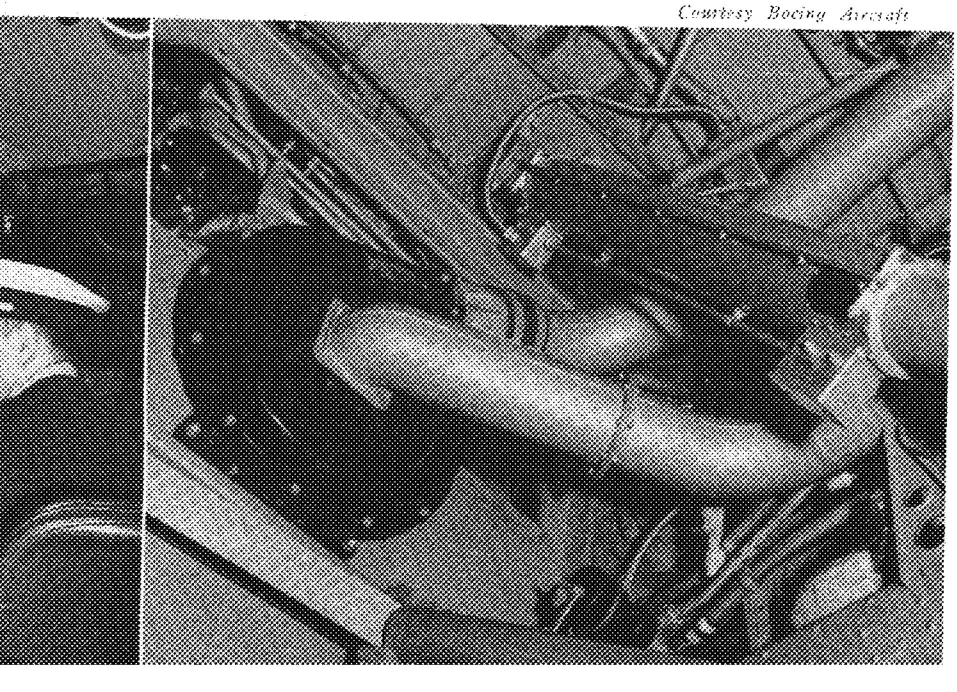
Sealed Cabins

The principal mechanical problems are concerned with the sealing of the compartment so as to permit the necessary functions of an airplane cabin: that is, provision must be made for the control of the airplane and engines from within the cabin. Doors, hatches, emergency exits, and windows must also be provided, and regulated ventilation must be available. Air-tight glands permitting rotational and transitional movement are often used for the passage of control wires and tubes to control surfaces and engines. The doors and emergency exits should have no manual difficulties and must form an air-tight seal easily when closed. A unit consisting of an inlet valve which will regulate the flow of ventilating air from the blower to the cabin at a predetermined rate and an outlet valve to control the discharge of air from the sealed compartments must be provided to maintain the cabin pressure at the desired value.

The simplest and lightest form of pressure compartment is the cylindrical type with the hemispherical heads. The stresses in such a structure are all tensile except for certain bending stresses at the junction of the cylinder and the heads. The present standard semi-monocoque construction of fuselages is quite suitable for this construction.

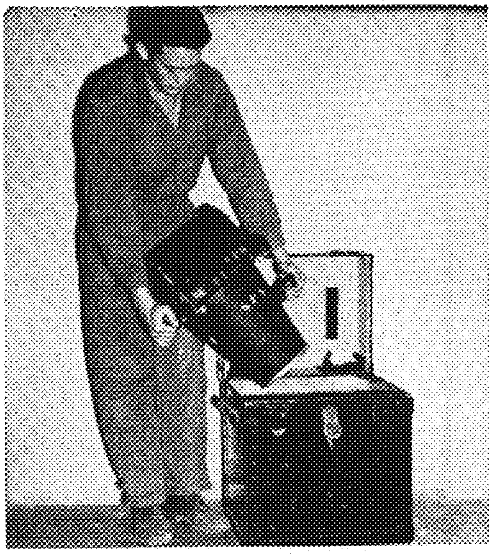
One of the engine driven supercharger units.

Courtesy Boeing Aircraft



Sky Eye

By Don Martin, C.E. '41



Courtesy Minicam Photography Magazine.

Above: The camera is used in this position to take oblique aerial photographs.
Below: The "8-P-S" aerial mapping camera of the U. S. Air Corps.

SINCE the days of John C. Fremont, America's pater of surveying, surveyors have been traversing lands with an ever-growing incentive. They have carried on an intensive search for a key to a method, other than climbing tall Norways, which would improve reconnaissance surveys and in turn would lessen the labors of the topographer. Has aerial photography, proving to be the desired method, come up as friend or foe? Rivalry would be the natural outcome of such an innovation; but in this case, the opposite situation exists, and a strong partnership between the aerial division and the "ground" man has appeared.

Beginning of Photography

In 1886, Dr. Deville of the Canadian Surveyor-general's office introduced ground photography in America as an aid in field control. The development of this innovation was the phototheodolite. This valuable instrument is really a surveyor's camera made to fit interchangeably on the same tripod supporting the transit or plane table. Before the surveyor enters the field with such a device, camera stations are located either by triangulation or by traverse; this gives positions for plotting on the map. The elevation of each station is also determined. Then a series of photographs are taken and thus is obtained a panorama from each station. There should be enough overlap of views so that any one panorama shows each adjacent station. From such a series of perspectives an orthographic plan is constructed in the computing shack or office. Necessary information for such a plan includes focal length of camera lens, plotted position of each camera station, map scale, known direction to some object pictured in the photographs, and elevation of the camera. Further office operation include the centering of negatives, stereoscopic examination, reprojection, contouring, plotting, and tracing.

Aerial photograph of the University of Minnesota campus.

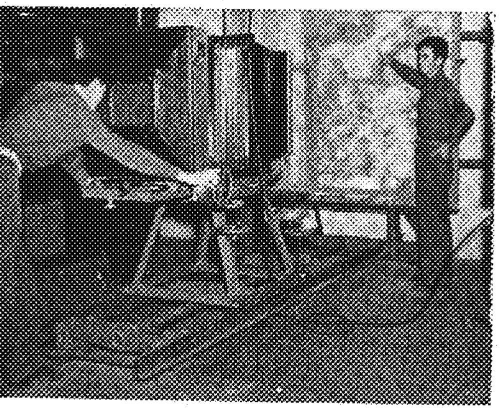
With the entry of the airplane, photographic surveying was given a new impetus. Two things must be remembered, however, concerning aerial surveys. First, though most any type of land is "surveyable," aerial surveys have their greatest advantage in country of rugged topography or rough surface. Second, aerial photographs can be taken in two ways: through cabin windows or over the side of open cockpits, or vertically down through the fuselage floor. The first method, "oblique," produces pictures used largely in advertising, real estate promotion, and the like. Canada, however, has done much mapping, especially of lake country, by using these oblique photographs. The vertical photographs provide the bulk of the information that finally results in contour maps for studies in power developments, soil erosion, railroads, highways, timber counts, and transmission lines. "Verticals" boast such assets as speed in production, accuracy in results, and detail in the finished maps. With the application of such vertical projections, the best plan of attack of a particular survey can be easily determined and thus time-consuming preliminaries are eliminated. Accurate maps are produced by this method with horizontal scales of 200, 300, 400, 600, and 1200 feet to the inch, and contour intervals of 5, 10, and 20 feet can be easily located. Generally, however, 50 foot intervals are used. Let us follow the course of a typical aerial survey.

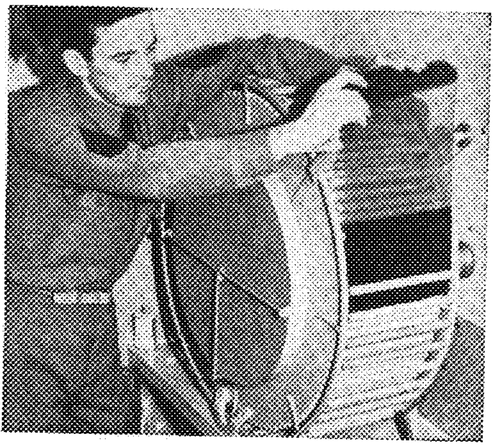
The flight crew consists of but two men, the pilot and the photographer. The pilot is first given a general map of the area to be photographed, and he then superimposes a grid system or stripping effect upon the map thus enabling him to follow a specified and accurate route. Notations are also made on the map of easily distinguished guide points from the air such as water towers, grade crossings, windmills. Knowing this information, the pilot takes off and the cameraman goes to work. The area is traversed in straight lines representing photographic strips with overlap strips and tributary lines as needed.

Inside the Camera

Timing devices on the camera itself eliminate excessive overlapping of consecutive exposures. Little will be said here of the actual photography paraphenalia. However, for the camera fans it can be stated that the film is usually a roll 180 feet in length, giving 225 exposures. Each negative produces a 9x9 in. print. Cameras used by the Mark Hurd Air Mapping, a Minneapolis concern, have either 8¼ in. or 10 in. lenses (F 6.8) with shutter speeds ranging from 1/65th to 1/150th of a second.

Fluctuations in map scale arise from variations in drift, speed, altitude of the plane and tilt of the camera. Since photographs are conical projections, a vertical dimension on the ground causes a horizontal displacement on the print. As mentioned earlier in the article, ground control is essential. If the process of producing a series of aerial maps is made to extend over too long a period of time, changes in volume of foliage will result in an incorrect picture of the terrain.





Top: The original aerial mosaic map, composed of individual shots pasted together, is duplicated by copying. Bottom: 75-foot roll of aerial film being wound on drying drum.

Courtesy Minicam Photography Magazine

Mosaics are nothing more than a group of adjacent aerial photographs placed edge to edge; thus is produced a full picture of an area as viewed from the air. Unless ground control is first applied however, mosaics are subject to severe scale variation. Errors due to tilt can be greatly reduced if the tilted negatives can be so reprojected as to be horizontalized before making prints.

Note the sharp detail which is obtained in aerial photographs.

Let us now follow a typical surveying assignment and see how the application of aerial photography lightens the work. A petroleum company has sent a crew into an area to complete some plane table topography. A triangulation party had already set up a control system by establishing signal stations and determining their elevations. First, railroads, streams, roads, transmission lines, etc., are transferred onto the plane table sheet from the accompanying set of photographs. After these transfers are made, the stage is set for topography shots. By constantly referring to the photographs, the rodman can save time and labor. He does not have to wade through the seemingly endless swamp to determine where it ends, or whether or not there are any hidden creeks in the thicket off in the distance. Via one of the photos, it is clearly shown that behind the distant hill to our left is a small lake. Thus to get shots behind the hill, necessity demands a circular approach and a wasteful trek is eliminated. The reader can easily see the saving of energy and time that surveyors derive by the utilization of aerial photos. It must yet be stated here that it is also possible for the photos to show too much detail. Heavy foliage, as viewed from the air, can obliviate brooks, trails, and certain landmarks from the camera's view. Further, smoke and clouds are naturally a hindrance to aerial mapping. Work accomplished recently in northern Minnesota averaged 1.6 photographic days per week.

Ground Control

Too much cannot be said about the importance of ground control; it is the essential link between the cameraman and the topographer. Horizontal control is brought about by establishing a base line, usually about 3000 ft. long, near each end of a proposed network of photographs. In the case of a long, relatively narrow strip of land, base lines are measured every fifteen or twenty miles. Vertical control constitutes the determination of differences in elevations of several points to be included on each exposure. Distance between these points is not needed. The number of field points per square mile depends upon the size and shape of the area plus the photographic scale:

$S = H/f$

S = scale

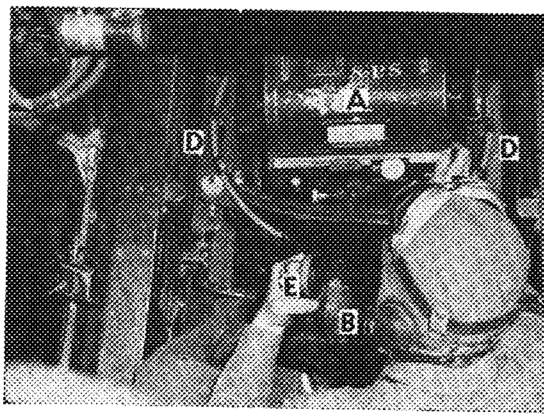
H = flying altitude in feet

f = camera focal length.

It can be concluded beyond any doubt that the camera can never supplant the theodolite. Further, the picturesque and nature-loving topographers will never disappear but will form with the aerial surveyors an alliance that will be of the greatest benefit to all countries.

The aerial photographer at work. The camera (A) on its mounting ring (D) is directly in front of him. His left hand holds the telephone (E) by which he guides the pilot to the object to be photographed which can be seen in the ground glass at (B).

Courtesy Minicam Photography Magazine



ALUMNI NOTES

Featuring In This Issue Institute Graduates

In The Field of Civil Engineering

By Ward M. Hanson, Ch.E. '42 and Allen Polson, Ch.E. '42

Star Journal Photo.

George Zuckman at his desk.

'27 George Zuckman

Like many others whose lives are being affected by world conditions, George Zuckman has left his position in the Minneapolis Park Board Engineering Staff to accept an offer made by the government. He is now stationed at the Panama canal where he is working on new living quarters for Canal Zone officers.

Graduating in 1927 from the College of Civil Engineering, Mr. Zuckman was employed by the Illinois State Highway Department in the bridge division. In 1933, he came back to the Twin Cities with the United States engineers in St. Paul where he met Mrs. Zuckman who was then employed as a secretary. Mr. Zuckman worked later on the Twin City sewage disposal system where he did a great deal of work on the grading of the sewage system in St. Paul.

Being with the Minneapolis park board since 1935, George has made a lot of friends in the department both by carrying out his work in splendid fashion and by taking an active part in various forms of athletics. A southpaw, Mr. Zuckman is an excellent handball player, a golfer with a score to be proud of, and a rabid bowling fan. Although he is now officially on a six-months' leave of absence from the department, his friends are not expecting him back, for he went to Panama with the intention of working on the new canal for which Congress has appropriated $275,000,000, a canal large enough to accommodate even the largest military vessels being considered. He has not enlisted but is being employed as a civilian.

Mrs. Zuckman has left to visit her folks in Los Angeles and will leave by army transport the first of May to join her husband in the Canal Zone.

'29

Frederick L. Hovde, Ch.E., well known as assistant to the president of the University of Rochester, is now on a leave of absence for the rest of the academic year. He is now in England as one of the members of the Research Committee of the National Defense Program.

'35

C. Gale Patterson, C., has been temporarily transferred from Chicago to Los Angeles, where he is industrial sales representative of the plastics department of du Pont de Nemours and Company. Mr. and Mrs. Patterson have been visitors at the Sigma Nu fraternity chapter at the University of Southern California, and at the University of California at Los Angeles.

'40

Paul Triplett, E.E., who has been working for the Allis-Chalmers Company in Milwaukee, has been granted a year's leave of absence to serve a year in the 54th Signal Battalion at Fort Ord, California. With him at Fort Ord will be a classmate, George Kullberg, E.E., '40.

'06 Walter H. Wheeler

Within Minneapolis we have, in the person of Walter H. Wheeler, a graduate of the University Mines School who has, since he graduated, become a great success. Even before he had left high school, Mr. Wheeler had begun working as a member of a logging company. During his summer vacations he spent his time in our northern woods where he worked in both the logging and milling departments of this industry. Mr. Wheeler's health broke after his freshman year at the University. This resulted in his accepting a job as a rod and chain man for the U. S. Reclamation Service in New Mexico instead of returning to the University for his sophomore year. The following year he returned to the University and continued his studies until he graduated as a mining engineer.

After graduation, Mr. Wheeler went directly to Denver, Colo., in search of a job. Within three days after his arrival he had obtained a job as the division mining engineer for the Colorado Fuel and Iron Company. After a year in this capacity he left for Old Mexico as the chief engineer for the American Smelting and Securities Company in charge of the reopening of silver and lead mines which 100 years before had been mined by Spanish adventurers. Mr. Wheeler soon decided that Old Mexico is no place for the young engineer so he left to return to the U. S. In a short time he had obtained a job as the assistant construction engineer for the Dawson Fuel Company, a subsidiary of the Phelps-Dodge Company. He became the chief engineeer on this project when his superior left. This left him in charge of the designing and construction of a new coking plant. When he had finished this job, he returned to Denver, Colo., where he and two associates established an engineering and contracting service. After four years he took over the entire business, dropped the contracting part, and transferred his offices to Minneapolis. Since that time his business has expanded very rapidly. His accomplishments are many; probably his most notable in this area is that of the design for the Fort Snelling Mendota Bridge. Within the last year Mr. Wheeler has designed 18 large buildings throughout the U. S.

At the present time Mr. Wheeler is busy drawing up plans for a $2,000,000 bakery in Cincinnati, Ohio, a 10-story department store in Denver, Colo., and a 2,000,000-bushel granary in Canada.

'37

Myron Leslie, E.E., formerly an instructor at the University of Minnesota, is now on the faculty of Wayne University in the Department of Electrical Engineering, in Detroit, Michigan.

Stanley C. Hellman, Aero.E., engineer for the Northern Aviation Company of Inglewood, California, was married to Minnetta Reuter of Flat River, Missouri.

'39

Everett Paul Taipale, C., is working with the Atlas Powder Company at the Giant Division, Giant, California.

The E.E. Show

By John Lambert, E.E. '41 and Charles Scott, E.E. '41

THE Electrical Engineering building will go wholeheartedly on display when the 14th Biennial Electrical show opens at 7:30 p.m. May 2. The show is designed to interest people of all ages, to be instructive as well as entertaining, and to demonstrate a few of the unlimited applications of electricity in modern life.

Arrangements will be made this year for more efficient handling of the crowds so that spectators may move along as fast as they like and see all of the exhibits.

To meet increasing demands, an improved personality meter has been developed. A series of regenerators, oscillators, and inverters analyze the personal magnetism, excitation, and nervous tension of anyone holding the electrodes of the meter. Then they solve a group of equations using these values, recording the result on an indicator. Are you a Constance Bennett? Are you a Minnie Schmaltz — a Mr. Milque-toast — a potential Hairless Joe? Come in and have your hormones analyzed!

One of the E.E. seniors has built a frequency-modulation radio set, and the efficiency of this modulation system will be demonstrated. In the near future several local radio stations will start transmitting frequency-modulated signals, since this method is practically noise-free. Show visitors will be particularly interested in this exhibit.

A small automobile, controlled entirely by radio-operated relays, is being built by students, and is known as "the car with the high I. Q." A look at this remote-controlled vehicle will alone be worth the dime that admits you to the entire show.

An apparatus, successor to the ever-popular "kissometer" of former shows, will balance contact potentials against resistive moments when one of the fairer sex partakes of labial communion with a member of the more unfair sex. Here is your chance, girls, to find out just how many city blocks could be lighted by the energy wasted each time your OAO gives you the smackeroo. Any couple who can ring the bell will receive one free round-trip ticket to Minneapolis.

Demonstrations of the stroboscope will be held at specified intervals. This instrument is used for scientific study of bodies in motion such as propellers, water drops, and chorus girls. Short flashes of light intermittently illuminate the object or objects, and when the speed of these flashes is synchronized with the speed of the motion, the object will appear to stand still.

Two-and-a-half-million volts jumping a gap is old stuff to most of us by now, so the electrical engineers are going to add some new tricks with their super-juice this year. A high-voltage, high-frequency shock will be given to Miss Hysteresis Switchgear, synchronous sweetheart of the E.E.'s (Double Ease). She will appear in fluorescent mystery, sit in the executioner's chair, and take the crackling charge without a quiver or scream!

Here is your chance to see television in actual operation. A camera as well as receiving set will be used so that all spectators will have a chance to see the fidelity obtainable with modern equipment.

These are only a few of the many things to be seen. The four floors of the electrical engineering building will be full of exhibits of fluorescent lighting, inverted speech, singing arc-lights, a color organ, arc welding, voice pictures, mystery motors, and magnetic cannons. The Physics building will be open for demonstrations of atom smashing and electro-physical phenomena.

Engineers' Day - 1941

By Dale Drinkwater, General Chairman

The 1941 Engineers' Day committee chairmen

THE 1941 celebration of Engineers' Day on Friday and Saturday, May 16 and 17, will be the largest and most colorful affair in the history of this event. More buildings will be used for open house than ever before, and a new event has been added to the customary program.

The innovation in the 1941 program is a bowling tournament, which is already under way. Teams have been organized which are made up of men in one department. A preliminary tournament between teams in the same department is being held to determine the high scorers. These men will make up the team which will battle for the departmental trophy. The high scorers in the tournament will receive individual awards.

Friday, May 16 will be the first day that festivities begin. In the morning the opening and knighting ceremonies will be held; at noon, the parade; in the afternoon, the dansant; and from 2:30 to 10:00 p.m., the open house. Field events will be held Saturday morning and afternoon, and the brawl in the evening.

Open house this year will be a gala affair. Exhibits will be shown in the Armory, the Oak Street laboratory, Mechanical Engineering, Electrical Engineering, Main Engineering, Engineering Experiment, Chemistry, and Mines buildings, Physics for the first time. Open house is our opportunity to show our parents, friends, and the general public the work we do in the Institute.

The dansant (or sunhte) will be held in the main ballroom of the Union. Dancing will be done to recorded music. In order to make the dansant truly an engineers' dance, all button holders will be admitted free.

The main campus engineers will try to capture the diamondball trophy that the Ag engineers won last year at field day. The trophy was put up for the first time last year, and it looks as though the game between the city slickers and the farm boys is already a tradition. There will be other diamondball games, and lots of contests and races. Prizes galore will be awarded to winners, and everybody will be served refreshments.

Engineers' Day will wind up in grand fashion at the brawl in the newly redecorated Flame Room of the Radisson Hotel. Swifty Ellickson's orchestra will play.

The real criterion of the success of the 1941 Engineers' Day will be the participation in the various activities by the loyal members of the fraternity of St. Patrick, which leaves it up to you, fellows, whether or not our predictions become reality.

Tech News

Tau Beta Pi informally initiated 16 members on Tuesday, April 10, in the mechanical engineering pattern shop. The initiates were: Omer Blodgett, LeRoy Kelman, Ward Hanson, John Elliott, Elton Jacobson, Arthur Dienhart, Robert Eustis, Ralph Doty, Wiley Souba, John Dittfach, Robert N. Peterson, Arthur D. Brickman, Robert Livingston, Edward Cisek, Walter Sargent, and Clarence Schultz.

Dr. Tomsicek, instructor of chemistry at St. Thomas College, will talk on "Patent Medicines" at the meeting of the M.S.C.S. on Tuesday, April 22. The meeting will begin at 7:45 in room 325 of the Chemistry building. Election of officers for the coming year will also be held, and refreshments will be served.

On Sunday, March 31, one of the world's greatest scientists died. He was Dr. Herbert Freundlich, distinguished service professor of colloidal chemistry, and the foremost man in his field. Although Dr. Freundlich had only been with the University for four years, he was well known in the department and well liked by everyone who knew him.

During most of his life, Dr. Freundlich lived and worked in Germany. He had the privilege, in his student days, of being a pupil of Wilhelm Ostwald, another great chemist. Dr. Freundlich did much of the pioneering work in the special fields of colloid chemistry, such as the application of ultra-sonics to colloid chemistry, the precipitation of sols and gels, and coagulation. He has written several books and among them the one which is recognized as the most important book on colloids, *Capillary Chemistry*. He had published over 200 papers.

During the 14 years prior to 1933, he was an associate director of the Kaiser Wilhelm Institute. He resigned in 1933, disagreeing with the Nazis, and became a research professor at University College, London. In 1937, he came to Minnesota. Dr. Freundlich received one of the greatest honors accorded to scientists last year when he was made a fellow of the Royal Society of London. This honor is rarely accorded to a foreigner.

To those of us in chemistry who knew him, he was friendly, helpful and easy to approach. Dr. Freundlich's passing has created a place which will not easily be filled.

The A.S.C.E. will enter a diamondball team in the intramural tournament. Interested civil engineers should contact Prexy Bob Nystrom as soon as possible. The society is also planning a number of plant inspection trips for spring quarter.

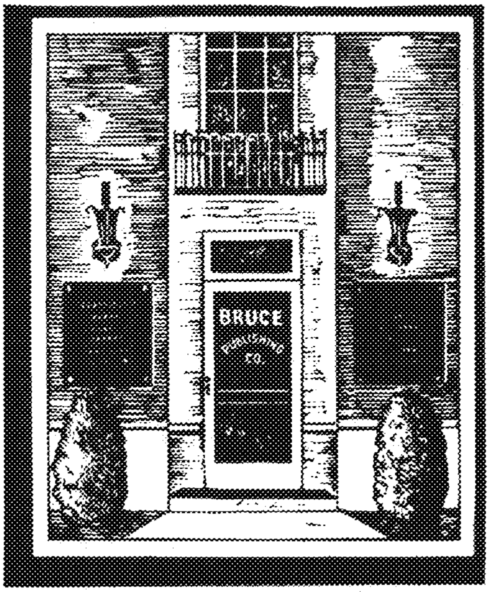
Beans were served to all paid-up members of the A.S.M.E. on Tuesday night, April 8, at the Union. Number 1 entertainer of the evening was Charles F. Shoop, professor of steam engineering, who baffled mechanical engineers with an amazing display of magic.

Recent additions to the membership in the A.F.A. are Gilbert Falck, Kenneth Geist, George Pearson, and Harold Reierson.

Prof. John Ackerman showed the first motion pictures of the new helicopter at the meeting of the I.Ae.S. on Wednesday, April 2, in the chemistry auditorium. He also showed motion pictures of the new Douglas DC-4 and the Pitcairn autogiro.

Prof. Arthur Schwantes, chief of the division of agricultural engineering, and Mr. Andrew Hustrulid, A.S.Ag.E. advisor, were guests of the society at their dinner meeting on March 4 at Anne Unger's Tearooms. Chief speaker of the evening was Jim Cranston, who spoke on problems facing the graduating agricultural engineer. Jim graduated from North Dakota State and is now employed by the International Harvester Company.

The society voted to appropriate $5.00 for the Mechanical and Aeronautical Engineering building fund.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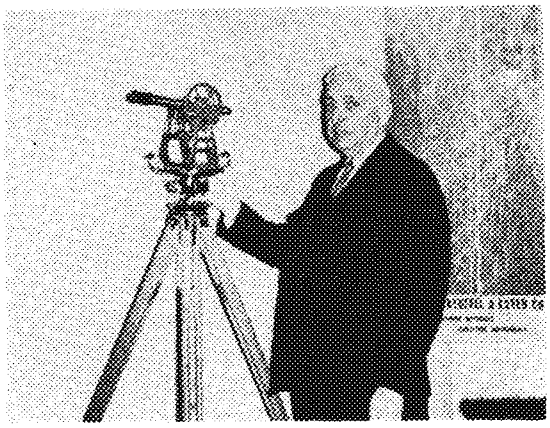

Alvin S. Cutler

Professor of Railway Engineering

By Richard Opland, C.E. '43

A veteran of the Department of Civil Engineering is Alvin S. Cutler, professor of railway engineering. Stockily built with a brisk manner and a powerful voice, Professor Cutler's patient teaching and open-minded fairness have won the respect of every C.E. student.

A native of Pittsford, Michigan, he attended Hillsdale High School and Hillsdale College where he took an arts course. He later came to the University of Minnesota, and, after a break of three years between his junior and senior years, he graduated as a civil engineer in 1905. While in school, he played baseball on the engineering college nine in the days when rivalry was strong between the colleges.

A man with a great deal of practical experience is Professor Cutler; indeed it would be hard to name some type of railroad engineering work which he hasn't pursued at some time or other. After his junior year at the University, he was employed by the New York Central Railroad at Toledo, Ohio, where he was assigned to location and heavy construction work. After graduating, he went to the Erie Railroad in New York City where he worked in the chief engineer's office on bridge design and bridge construction. In 1907, Professor Cutler came back to the University as an instructor, and thereafter confined his railroad work to the summers. With the Minneapolis and Saint Louis Railroad, he was, at different times, a member of a survey party, a resident engineer in charge of work, and a division engineer in charge of valuation. Construction work on yard layouts and the erection of bridges kept him busy while he was with the Grand Trunk Railroad. He also was employed by the Great Northern and Northern Pacific Railroads on valuation.

Studies that are most interesting to Professor Cutler are those involving the economics of railway location and operation. On this subject, he has done committee work for the American Railroad Engineers' Association. He has also served on a committee of the Society for the Promotion of Engineering Education investigating transportation. The rearranging and reconstruction of Minneapolis' railroad terminals was the subject of committee work in which he took part for the Minneapolis Engineers' Club.

A highlight of Professor Cutler's summers is the annual summer camp for civil engineers. He has attended every camp since its inauguration in 1911. One of the most interesting camps, he believes, was conducted in 1920 at Lake La Croix on the Canadian Border. The party had to make their way through 75 miles of wild country by road and by portages to get there.

Professor Cutler thinks an ideal way of spending some spare moments is tinkering in a garden; he spends quite a little time on his flower garden at home during the summer. When he's not at his cottage at Cass Lake during vacations, he likes traveling by auto to meetings of various organizations of which he is a member.

LAUGH!

It's Humor

By Ralph Hill, Ch.E. '41

A couple of engineers we know of have a novel method of deciding what to do on these leisure nights. They flip a coin, and if it comes up heads they play cards; if it comes up tails, they go to a show; and if it stands on edge, they stay home and study.

* * *

SHADY VERSE

The shades of night were falling,
When for a kiss he asked her.
She must have answered "yes" because,
The shades came down much faster.

* * *

Here's what happened to one of last year's seniors:

After a heated argument with his younger brother, the elder one sought to prove his point.

"I ought to know, didn't I go to the University, stupid?"

"Yes, and you came back the same way."

* * *

"I'm going to love you till the cows come home, darling."

"Okay, but never mind petting the calves in the meantime."

* * *

They tell of the girl who learned her virtues on her mother's knee, and her vices in other joints. (Editor's note: It's not always wise to quote professors' jokes, but this one seems harmless.)

* * *

As we painfully found out recently, money does not grow on sprees.

* * *

Sign at a bar:

Wives, if you drive your old man to drink, drive him in here.

* * *

The senior chemicals received quite a setback in Chicago while they were on their recent field trip. Several of the boys were conversing with a native Chicagoan, and telling him what a wonderful place Minnesota was.

After listening for awhile, the gentleman said "Yes, a great place Minnesota. Any time you get tired of the United States, you can always go back there."

* * *

Height of optimism: A senior trying to borrow two dollars from anyone in the senior class after a field trip.

14th Biennial

✶

May 2-3

✶

E.E. Building Open

Friday Evening

and

Saturday Afternoon

and Evening

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- Over 100 entertaining and educational exhibits.
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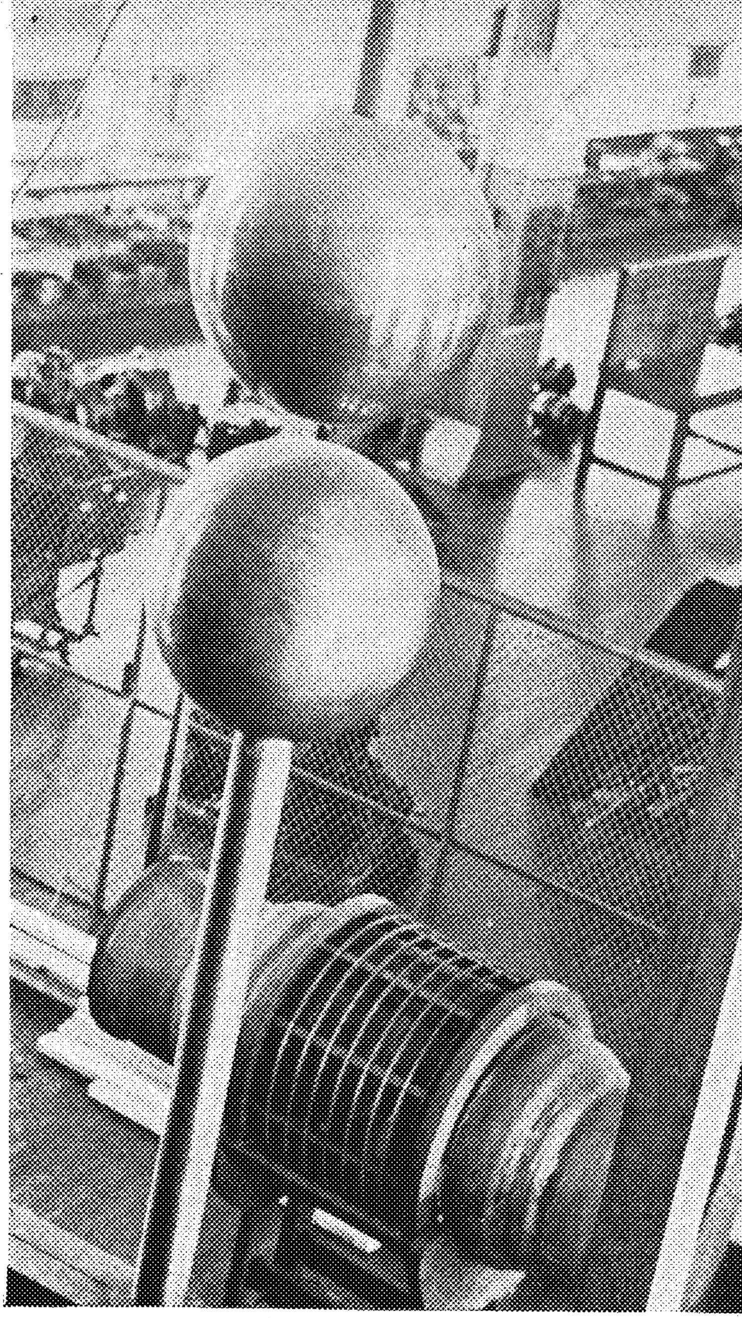


The

"HIGH-TENSION HOP"

Friday, May 2

Union

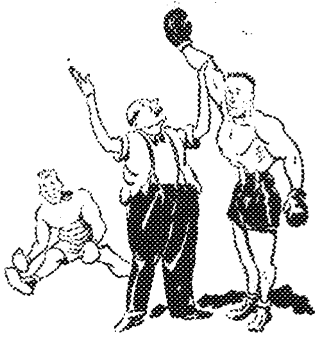
SEV OLSEN'S ORCHESTRA

Dancing, 10 to 1

Advance 85c—At Dance $1.00

All dance tickets include 2 admissions to the Show.

G-E Campus News

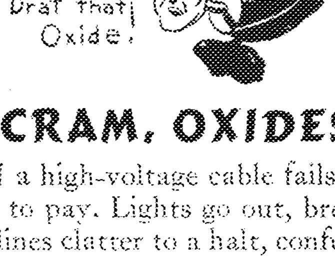


INTRODUCING . . .

A NEW champion! The world's largest and most powerful industrial X-ray unit, packing a wallop equivalent to $90,000,000 worth of radium, is now at work in the General Electric plant at Schenectady.

Stronger by 600,000 volts than others in its class, the 1,000,000-volt monster clips down to two minutes the old record of an hour to take a picture through four inches of steel.

The machine is housed in a special building, with 14-inch concrete walls plus 12 inches of exterior brick to absorb stray radiations. Another safeguard for X-ray technicians is the X-ray safety "wrist watch"—a leather case, worn on the wrist, carrying a small piece of unexposed X-ray film. This, when developed at the end of the day, will show up any scattered X-radiation to which the wearer may have been harmfully exposed.

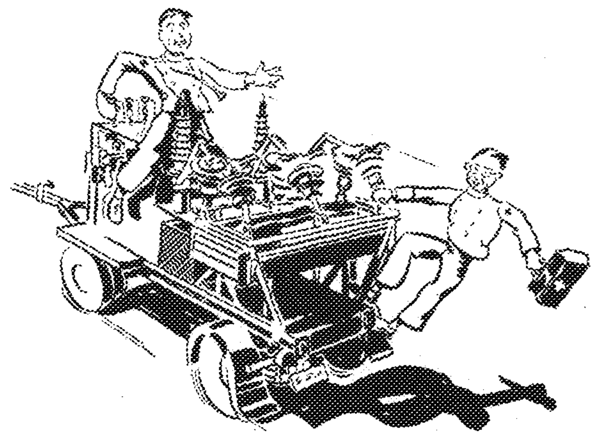


SCRAM, OXIDES!

WHEN a high-voltage cable fails, there's the devil to pay. Lights go out, breakers blow, production lines clatter to a halt, confusion reigns! Most cable troubles are caused by moisture, which seeps in through a break in the waterproof (lead sheath) covering.

Oxides are lead sheath's Enemy No. 1. They are born when the cable is being made; i.e., when the lead press is being charged. The lead is then molten and has its greatest affinity for oxygen.

General Electric engineers have solved this problem with the new "nozzle-swirl" process. In charging the lead press, any oxides present are collected, swirled to the center of the molten lead, pulled to the surface, and scooped off with a ladle. The nozzle—the secret of the whole process—was developed and patented by a graduate of the G-E Test Course, C.A. Piercy, Ohio State, '16.



TO THE RESCUE

WHEN Mother Nature goes berserk, and whole towns are cut off from electric power, that's when repair crews go into sudden action to find the break and fix it.

In the past power companies have had transformers mounted on small trailers to be rushed to location to restore power. Now General Electric has announced a completely factory-built 1000-kva mobile substation, first of its type.

This unit, mounted on a huge trailer, can be towed along at 40 miles an hour. It can take power from high-voltage lines of almost any voltage and transform it to service values. When an outage occurs, the substation is whizzed to the spot, parked, grounded, and tied in. It can also be used to by-pass regular substations during repairs or maintenance work. General Electric Company, Schenectady, N. Y.

GENERAL ELECTRIC

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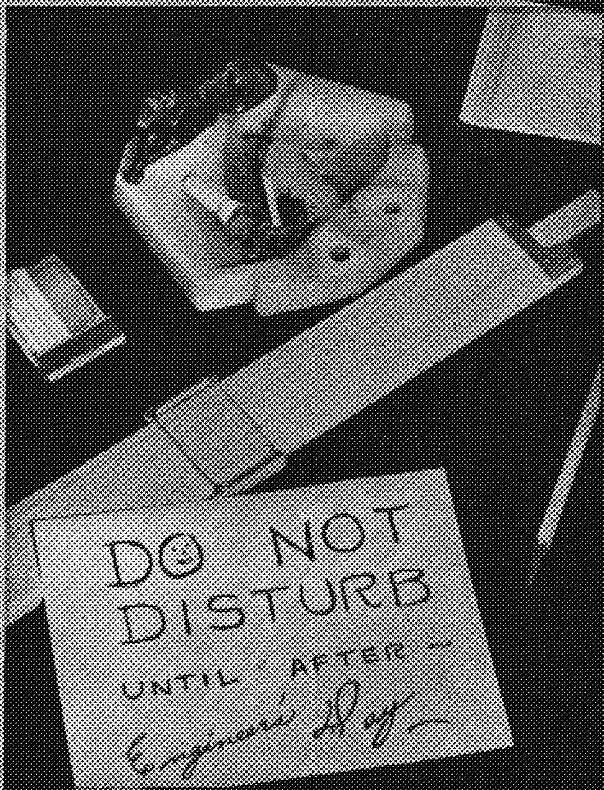
THE TECHNO-LOG

OF MINNESOTA



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NORTHWEST ARCHITECT
THE NATIONAL GRAIN JOURNAL
THE JOURNAL
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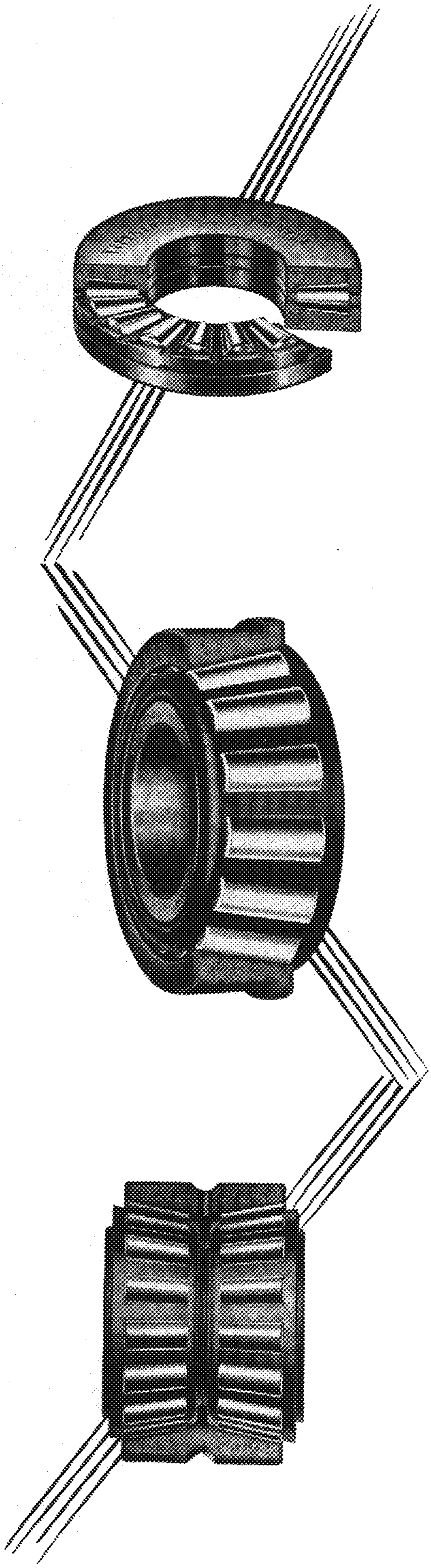

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Authors . . . Staff . . . .

By Richard Opland, C. E. '43

Russell L. Nielsen and **Orville A. Beckland**, co-authors of the television article, have a lot in common. Both are on the E.E. teaching staff, both are recent graduates of the University of Minnesota, and both are photography "bugs"; they also ride home together every night.

Mr. Nielson, of the class of '36, is in his third year as a teaching assistant in electrical engineering. For a hobby, he likes taking pictures and developing them. He also has been interested in radio building and has constructed a few radios. Several years back, Mr. Nielson was quite a wood craftsman and won two Minnesota first prizes for building coaches in the Fischer Body Contests. He is a member of Sigma Xi, Eta Kappa Nu, Tau Beta Pi, and the I.R.E.

Mr. Becklund, after graduating in 1937, worked for one year at General Electric as a student engineer. While there, he took an advanced course in engineering to which he was admitted after surviving a competition for entrance. Mr. Becklund then accepted a position as instructor at the Case School of Applied Science at Cleveland, Ohio, which he held for two years before coming to Minnesota last fall. He is a member of Sigma Xi, Eta Kappa Nu, Tau Beta Pi, Plumb Bob, and the A.I.E.E.

●

John Wilhelm's article on bowling is right in the 1-3 pocket for snappy humor and crisp reading. Well, he should be good; he's a senior in journalism, and has worked for the *Minnesota Daily*. From 1936 to 1938, he was employed by International News Features, a news syndicate for which he wrote publicity in the southern part of the country. John started out to be a lawyer but wound up taking the sophomore, junior, and senior journalism courses in one year. He claims the distinction of being the first student to complete a course in Murphy Hall. Wilhelm sees a lot of bowling from behind the cash register in the Union and likes to roll a line once in a while himself. He also thinks bridge is quite a game, and he entered the University duplicate bridge tournament.

●

Fred Jackson, music critic for the *Minnesota Daily*, discusses music for the engineers. Fred not only enjoys playing music, but he also has tried his hand at composing. This is done on the piano which he has played for many years. He is a member of the Student Symphony Committee, an organization that plans and improves the student concerts. Fred is a senior Geological Engineer and likes nothing better than to get out in the open, do a little hiking, and study some geology on his own. He already has a position as a metallurgist waiting for him on graduation. In his spare moments, when not at his music, Fred likes to dabble in astronomy. He belongs to Theta Delta Chi, academic fraternity, Sigma Gamma Epsilon, professional fraternity, and the A.I.M.E.

●

The Cover

This month's cover, by Jack Rockwell, is symbolic of the spirit prevalent among engineers during engineer's day. Incidentally it is the slide rule and the pencil that are not to be disturbed. The engineer who owns them will probably be plenty disturbed before the day is over.

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The editorial policy of the TECHNO-LOG is to present material fo technology students which it is hoped will strike a happy medium betwee the superficial and the highly specialized.

The MINNESOTA TECHNO-LOG is published monthly, Octobe through May, by the students in the Institute of Technology of th University of Minnesota.

The purpose of the TECHNO-LOG is two-fold: First, to put in th hands of TECHNO-LOG subscribers highly worth-while and interestin reading material; second, to offer technology students an invaluable oppo tunity to get writing, selling, and working-with-others experience.

THE MINNESOTA

Techno-Log

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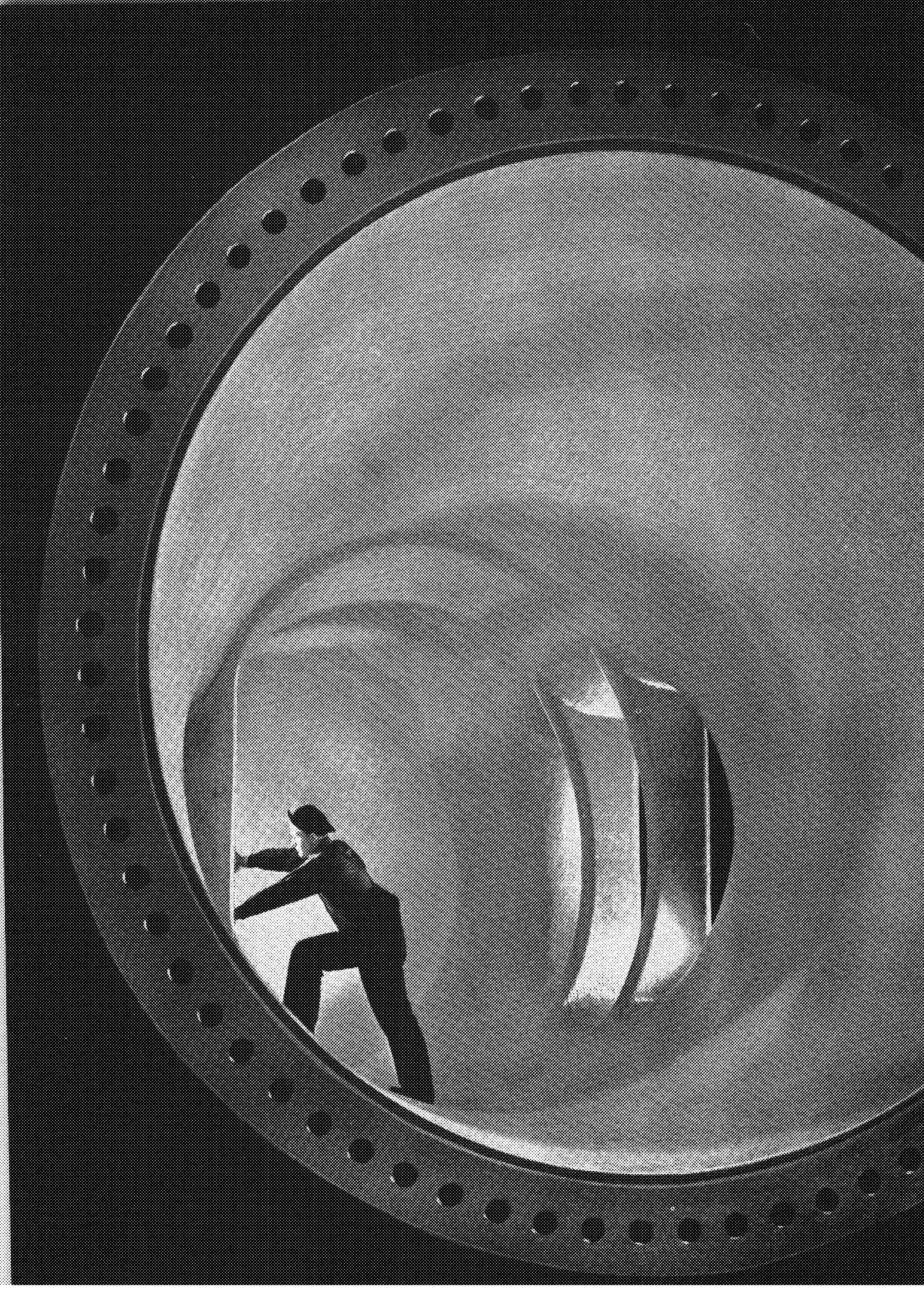


AN EDITORIAL

Erin Go Braugh!

ERIN GO BRAUGH, ST. PATRICK WAS AN ENGINEER! That is the interpretation that the discoverers of the original Blarney Stone made of the famous inscription found thereon.

Had these engineers been true sons of Erin their interpretation might have been different. Had they been good "Svensk" engineers they probably would have interpreted *Erin Go Braugh* to mean *All goes well with the Engineers.*

Indeed, all is going well with the engineers. With a new world of scientific exploration constantly opening before us; with consumers demanding that prices beat all competition; with the defense and offense demagogues shouting, "Produce, produce more, produce at any price," the need for technical men to discover, to develop, and to produce becomes more and more acute.

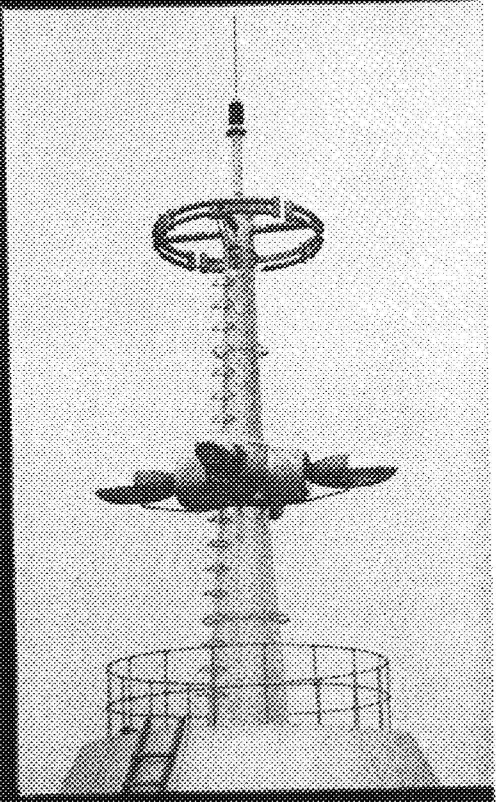
Not only does the engineer of today find that he is being wanted as well as needed, but he is also finding himself on a distinctly better social plane. The engineer is no longer just a glorified workman; he is graduating into a distinct and separate status and classification. His duties have become so diversified that to class him with any particular group would be futile. He may be a vice president; he may be a salesman; he may be a shop foreman; or he may be a research man. Whatever job he holds, he is holding that job because with his training as an engineer he is better at that job than anyone else available.

Even undergraduate engineers are spreading out in the scope of their activities. With their better organization they are gradually sifting into the better all-university extracurricular positions. They are ushering at symphonies. They are winning intramural sports trophies. They are begging, borrowing, or stealing formal clothes in order that they may be properly dressed at very proper occasions. Truly, the engineer is beginning to see that all of life is before him and that his engineering education is behind him pushing all the way.

But engineering and science are only beginning to rear their heads and assert the power of their position. Maybe H. G. Wells was right when he predicted that only through science would man be able to triumph over chaos and discontent.

The world is before us. The challenge is to the Engineers. Engineers, let's accept that challenge.

By WALLACE K. BELIN, EDITOR



Television IS IT HERE?

By R. L. Nielsen and O. A. Becklund,
Electrical Engineering Faculty

All Cuts Courtesy R.C.A.

WHEN will television be here? Why has it not emerged from the laboratory and become a commercial reality? One has heard these questions asked for ten years or more, and still no definite answers are available. Any attempt at discussion requires qualification of the terms. Just what do we mean by *here?*

In one sense television *is* here now. Its technical perfection is such that it could be offered commercially tomorrow with no complaint about picture quality. It is much more advanced than most developments are when they make their commercial debuts. Consider for example the radio or the automobile. The first imperfect models were offered for sale, and the public was made, and rightfully so, to stand the expense of further research. However, it is seemingly different with television. It has been held back despite the fact that observers agree as to the excellence of the pictures. The time at which a considerable part of the population of this country will be able to enjoy television broadcasting is a long way off. But such is the case with television.

There is a universal fascination about witnessing events at a distance, and it is probably this one point more than any other that first fired popular enthusiasm. The fact is that people are now ready and willing to purchase television receivers, but broadcasts are just not available.

Television broadcasting in the United States got its real start in April, 1939, when receivers were made available to the public and the opening festivities of the New York World's Fair were telecast. The two years since the real introduction of television have not been wasted. Not only has engineering improved the picture quality and reduced the size and cost of pickup and receiving apparatus, but invaluable experience has been gained in programming, production studio technique, budgeting, the legal aspects of copyright clearance, receivers' preferences, and numerous other items all of which are as important to commercial television as is technical excellence.

Present-day television is all electronic. The scene to be transmitted is optically focused on the photosensitive mosaic plate of a large evacuated tube called the *iconoscope*, or image viewer. It is the function of the iconoscope to convert the image, element by element, into electrical impulses which are then transmitted, *in a definite sequence*, to the receiver. At the receiver a somewhat similar tube, the kinescope, reconverts electronically the electrical impulses into an image on a luminescent screen in one end of the tube. *Scanning* of the picture, in both iconoscope and kinescope, is accomplished line by line much as the lines on a printed page are followed by the eye in reading. The greater the number of scanning lines to the picture, the greater is the detail that can be conveyed. Early mechanical systems had to be content with 60 or 120 lines, and pictures had much the appearance of newspaper halftones. The electronic system, with its *inertia-free* scanning, has allowed the number of lines per picture to be progressively increased to 180, 240, 343, and finally to 441, which is the present standard in the United States.

Picture Size

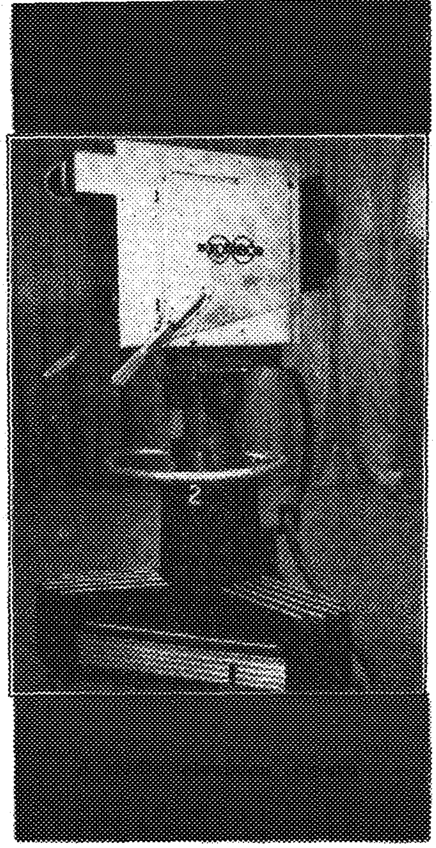
Picture quality of the best transmissions is judged by most viewers to be about the equal of 16 mm. movies, but not quite so good as the large 35 mm. commercial films. Screen dimensions at present are limited by the size of the kinescope tube. The factors of cost and difficulty of housing in cabinets have dictated a maximum practicable picture size of about 8 by 10 inches. Many methods of projection on a large screen are being tried, but no method is as yet satisfactory.

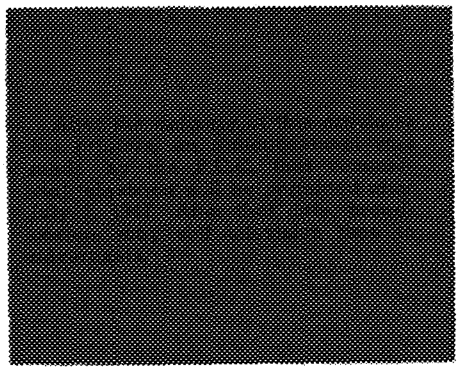
Luminescent phosphors have been greatly improved so that images are bright enough to be viewed in only a moderately darkened room. Also the sickly green or blue has been eliminated, yielding pictures in black and white. Whereas early tubes were color blind, the best new tubes reproduce tones as faithfully as panchromatic film emulsions. Even that, it seems, is not enough. At a recent I.R.E. meeting in New York, a demonstration of full-color television was given. In the scheme used at that meeting, a disc carrying three color filters rotates in front of the kinescope screen and causes the viewer to see successive *frames* first through a red filter, then a green, and finally a blue filter. A similar filter combination rotates synchronously in front of the pickup. The retina of the eye "remembers" each color image long enough so that the three blend, giving the illusion of a complete color picture.

Engineering Difficulties

As we have mentioned before, picture quality can be improved by increasing the number of lines in the picture, which, of course, amounts to an increase in the number of frequency components that must be transmitted. Now it is quite commonly known that as the frequency *band* becomes wider, the space occupied by the modulated carrier in the radio frequency spectrum becomes larger. To be specific, suppose that a transmitter in the ordinary broadcast band (550 to 1600 kilocycles per second) operates at 1000 kc and is capable of transmitting all audio sounds below 5000 cycles per second. Then the space occupied by that signal is the region from 995 to 1005 kc. If an improvement in fidelity is desired to reproduce faithfully 10,000 cps tones, the space required becomes 20 kc from 990 to 1010 kc. Now one of the fundamental difficulties in television engineering becomes apparent. It is found that with present accepted standards of picture quality, the enormously wide radio frequency band of *six million cycles* (6 mc, the present U. S. standard) is required to transmit the picture signal together with its associated sound. Comparatively, *a single television station occupies more than six times as much space* in the ether spectrum as that which is required *by the entire broadcast band* used by all the broadcast stations in the United States!

Now the reason becomes apparent for the use of high frequencies (50 to 108 mc) in television. There is nothing inherent in the signal itself which requires it to be transmitted at high frequencies; it is just that the space necessary for the wide band can be more economically had in this region. In the first place, the frequency spectrum below about 30 mc is pretty well filled up at the present time. Secondly, it is not desirable to use these lower frequencies for certain technical reasons. Obviously if the six mc channel is placed at a higher frequency, the *ratio* of channel width to mean carrier frequency is smaller. This ratio is an important factor in the design of band pass filters, antenna arrays, and other equipment; and in general the smaller it is the better the operation of these necessary devices. On the other hand the frequencies cannot be pushed too high at present because of our limited technical knowledge of the ultra-high frequencies





Limited Coverage

Probably the chief disadvantage of using the frequencies above 50 mc is the limited *coverage*, that is, the geographical area over which a transmitter provides sufficient signal strength for satisfactory reception. The problem arises from a characteristic of these short waves which prevents their reflection from the layer of ionized gases high above the earth known as the Kennelly-Heaviside layer. It is principally by virtue of this ionized layer that longer wave transmissions are heard across country and even around the world. In the absence of "sky wave" reflections, the only signal reaching the receiver is that which travels along the ground, and, of course, a little beyond the horizon even this signal is higher above the ground level than receiving antennas can reach; hence the distance to the horizon is roughly the radius of a television transmitter's service area—a distance of about 25 to 50 miles.

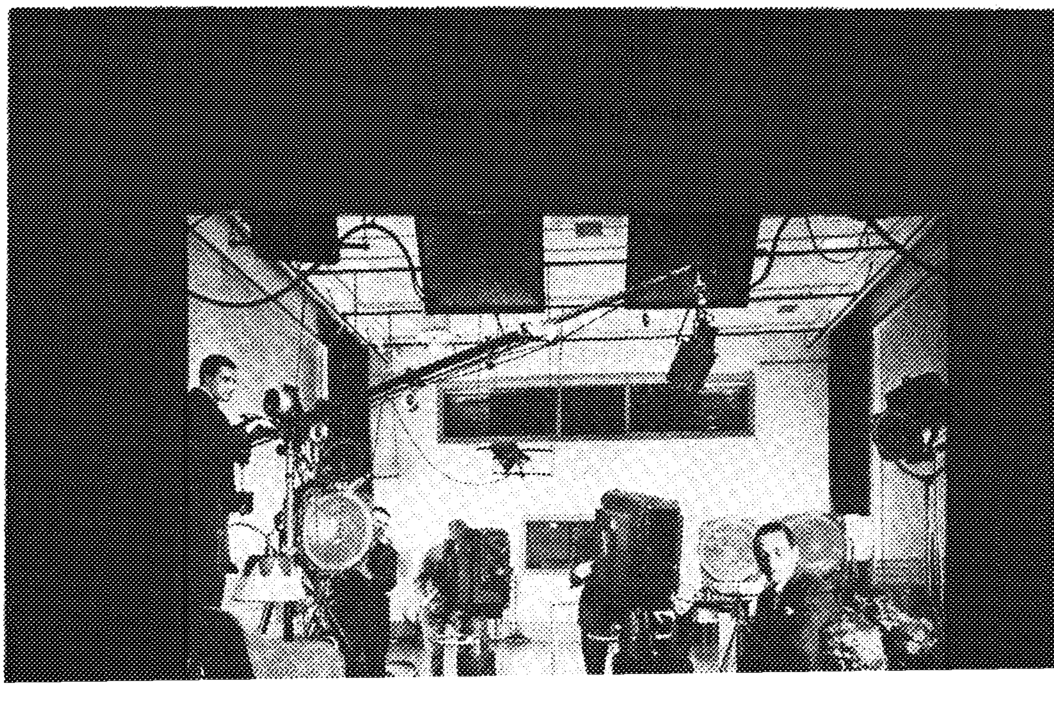
But the limited coverage should not be thought of as an unmitigated disadvantage; in fact, time may prove it to be a blessing. It means that stations with the same frequency assignment can be located closer together geographically without interfering with each other's programs. As is now the familiar occurrence in the standard broadcast band at night, two transmitters several hundred miles apart may interfere so severely that reception from either is impossible. We can tolerate that situation in the broadcast band because it has a sufficient number of channels (approximately a thousand on the basis of the present 10 kc separation) so that frequency duplication in a limited geographical area can be avoided, and everyone is assured good reception from at least a few stations. It is quite different with television. In the range from 50 to 108 mc there are only *seven* six mc channels (the entire range is not set aside for television, and if duplication had to be avoided in each part of the country, only a few dozen stations at most could operate; however, with their limited coverage the geographical separation of transmitters operating on the same frequency need not be greatly in excess of 100 miles.) If and when the new development known as frequency modulation is used for picture transmissions, the interference problem will be still further reduced.

Limited coverage for each station presupposes, if the entire country is to be supplied with video entertainment, some sort of distribution network. The use of long distance telephone lines, as with aural broadcasts, is out of the question because they cannot handle the enormously wide video-frequency band. Two solutions to the problem have been suggested, one a network of concentric cable lines and the other a system of radio relay links. Concentric cable is in itself expensive to manufacture, and in addition these lines would require an elaborate relay station every ten miles or less to make up for line loss and distortion. The radio link system would make use of unattended ultra-high frequency receiver-transmitter combinations situated along the route every 25 or 50 miles as necessary. The radio link system is slightly less expensive, but the cable would be more reliable. The cost of either is estimated at upwards of ten million dollars for a network connecting the 100 largest cities in the United States.

With its technical excellence reinforced by the more intangible fascination of seeing distant events as they happen, why do we not all have television apparatus in our homes? Let us investigate some of the fundamental factors that account for the present undeveloped state of television application.

Advertising Absent

If one considers the problem superficially, he may well come to the conclusion that the Federal Communications Commission is to blame for all our backwardness in television. From the rules of that body governing television broadcast stations, dated June 18, 1940, we read, "Sec. 4.74. *Charges.* No charges either direct or indirect shall be made by the licensee of a television station for the production or transmission of either aural or visual programs transmitted by such station." We are, of course, aware that without some sort of government subsidy such as that employed in England, broadcasting of any kind is dependent for



its funds upon advertisers. As one considers the fundamental facts, however, he realizes that the action of the F.C.C. is consistent with a policy for the public good.

Preliminary to a general use by the public of a new development, it is becoming increasingly common to have certain standards agreed to by the manufacturers and sometimes enforced by law, the latter instance being well exemplified by the rigid specifications that must be met by the present broadcasting stations. A set of Radio Manufacturers' Association Standards has been adopted by the television industry, but it cannot be said that this code of rules has the unanimous approval of all the potential producers of television equipment; in fact, grave doubts exist in the minds of many authorities, a minority to be sure, as to whether the present television R.M.A. Standards are tending in the right direction at all. It is largely upon these doubts that the F.C.C. bases its decision not to permit commercial sponsorship of visual radio programs. The necessity for the most ideal standards possible before the public buys a single set for home use becomes apparent when one realizes that once put into commercial practice, *the present standards cannot be changed basically without making every television receiver obsolete that is operating under those standards.*

Standardization

If commercial television were to go into practice tomorrow, the first inevitable improvement in the technique of picture transmission would pose an exceedingly difficult question to the members of the television industry. Should they ignore the improvement, or should they take the immense responsibility of forcing the public down to the last man to replace existing receivers by new ones? With the first choice they would be stopping further development in the science, and with the second they might be endangering the acceptance of the whole industry by the public.

What possible solution is there to this apparently unsolvable problem? It is conceivable that television will be developed to such a high state of perfection in the laboratory that at some future time it will be generally conceded that the art of picture transmission may well be frozen for some years to come.

Even after the matter of standardization is settled, other problems exist that must be solved before television can come into common use. The most important of these problems concerns the expense to whoever will have to pay the bill for putting on programs. As we have mentioned before, the financial success of television will be dependent upon large-scale advertising. Perhaps our best yardstick for television is its most closely related industry, present-day radio broadcasting. The costs in these two industries are of two general types, program production costs and technical operating costs.

Operating Costs

Program production, or programing, promises to be a problem even of accomplishment, to say nothing of the cost. Let us be hypothetical. Radio stations now handle about sixteen hours of program material each day. Suppose that to get sufficient use out of more expensive equipment than is now used in radio operation, television stations decide to be on the air only six hours a day, exclusive of the time spent on news and sports events. Conservatively speaking, we should expect that there will be at least two competitive chains giving the public different programs. That will mean that there will be the need for eighty-four hours of program material each week, which are equivalent to about forty-two Hollywood productions of two hours each a week! This is a tremendous requirement when one reflects on how few really good moving pictures are produced in a *year*. It can hardly be hoped that much less than a Hollywood production will warrant the great complication of television over radio.

In general, television will demand "photogenic" artists as well as good vocal performers. It necessarily follows that television talent will be higher paid than radio talent since the former must have the accomplishments of the latter and more besides. Furthermore, it is generally agreed that more time will be taken to rehearse for visual broadcasts than for those based entirely on sound, thus providing another tendency for greater cost.

It is generally believed by broadcasters that the cost of visual-aural programs will lie some place between the costs of moving picture productions and radio shows. A Class B moving picture requires the expenditure of from \$200,000 to \$300,000. The cost of talent on good radio programs is from \$5,000 to \$30,000 per hour. When everything is considered, there is general agreement in the radio industry that the advertiser pays from one-third to one-half cent per radio receiver, per hour, for evening time.

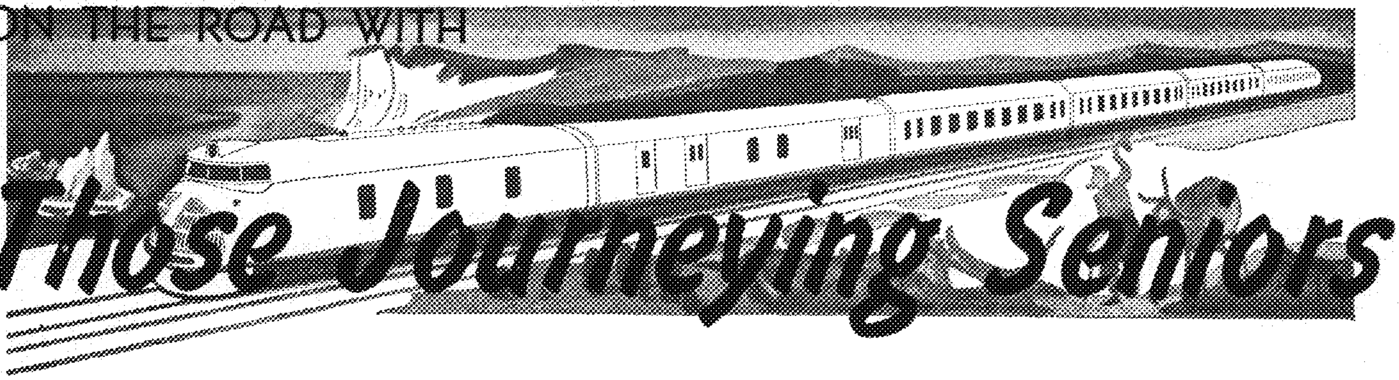
It is estimated that television broadcasting will cost about three times as much as radio broadcasting. This means that television advertising will have to be three times as effective as radio advertising.

The effectiveness of television advertising will depend upon how much attention the advertiser can command from the watcher. It is evident that television will demand *more concentration on the part of the audience* than radio does. Will this cause the casual listener to ignore visual entertainment altogether because he would rather not observe the program than stop all his other activities? Some experts say, to the contrary, that the tendency will be for most people to attend broadcasts more closely as a result of the requirements of a television observer. Whatever the answer, this psychological reaction on the part of the public will determine in a large degree what can be done with television when it does come.

Merchandising Problem

Once all the problems so far discussed have been solved, there will still remain the tremendous job of getting television broadcasting going on a large scale. Receiver manufacturers and broadcasters will feel it their right to begin to realize a return on their large investment in development and research, this investment being, at present, from \$15,000,000 to \$25,000,000. While making a profit, receiver manufacturers will still have to sell their product cheaply enough so that the public will buy in large quantities. The approximate cost of receivers during the past year has been from about \$150 to \$700. At this rather high cost, enough receivers will have to be put into the field to induce the advertiser to sponsor programs. Because of the probable low number of receivers at first, compared to radio, the advertiser will probably hesitate to pay the high rates asked by the broadcaster, who is thinking of his own development investment and the price that he had to pay for his studio. It requires the expenditure of several million dollars to build a complete television studio on low cost land. Unless he is well supported financially, the broadcaster will not be able to put on as many or as good programs as the average person will expect if the latter is to invest in a receiver. Then the whole circle begins again. Who will solve this problem has not been determined.

ON THE ROAD WITH Those Journeying Seniors



Electrical

IT BEING well known throughout the Northwest that good electrical engineers aren't made in a day—and not even in four years of local drudgery, the about-to-be-lost class was sent on a week's rampage through Milwaukee, Chicago, and points too numerous to mention. The trip this year was therein thoughtfully planned for the last week of spring vacation, so that the double E's wouldn't spend it in ease or in removing incompletes.

Fifty-two students were deported from the E.E. building on Sunday at 9:52 a.m., C. S. T. aboard two large Greyhounds. Les Steele and Paul Hogland kept the hounds nosing up the right lane and Messrs. (yeh, you read it right) John Kuhlman and Henry E. Hartig stood guard to buzz for stops in case of emergency.

As we neared Milwaukee, all hands pulled their schedule sheets from their pockets and started reviewing the instructions for course E.E. 100, which are given here in abbreviated form:

2. Wear clothes . . . look respectable . . .
3. . . . keep clean.
6. Eat . . . sensibly. Drink . . . cautiously.
10. Do not filch things in plants which give us a free lunch.

With the cold sweat still streaming from our brows, we checked the bags at the Wisconsin Hotel and then proceeded to go out and dismantle the town that was made famous by certain stuff.

Because the workmen at the Allis-Chalmers plant had decided to take advantage of their prosperity by going on a vacation, we went through the Allen-Bradley switchgear plant instead. Here we saw an electroplating generator capable of producing 8,000 amperes at 12 volts. Another interesting set-up was their Bonderizing process—the largest west of Detroit. This process is used to etch metal switch-boxes to prepare them for painting.

In the afternoon we visited the Kearney and Trecker milling-machine plant. Here we saw a modern plant in which mass production is on a precision basis. We observed an eight-stage Bouillard-Dunn steel-descaling process in operation and also several penzoisol furnaces.

Bright (?) and early Tuesday a.m. we visited the A. O. Smith company, and saw their automatic assembly line on which 400 auto frames are assembled per hour with scarce a touch by human appendage. We weren't allowed to see the pressure-vessel department because it was said they were busy making beer-tanks for the Army.

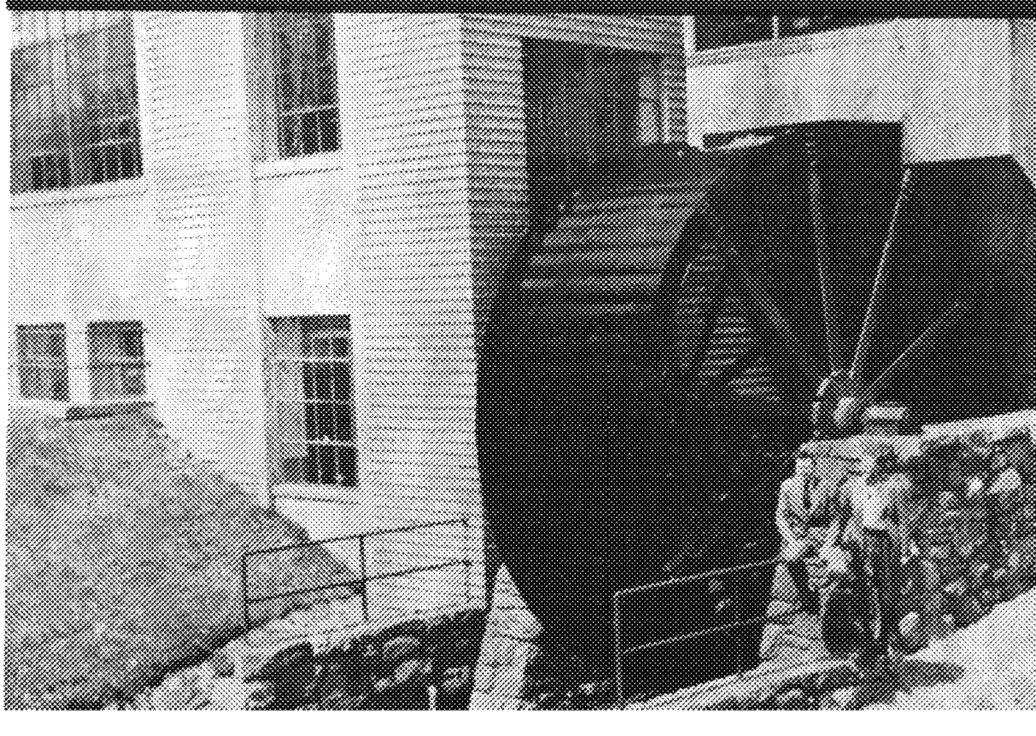
Then we took a hasty, tasty look through the Schlitz brewery. Power for the plant was supplied by two Vultan Generators; and Norberg equipment was used in the refrigerant compressors. We weren't allowed to see certain sections of the plant which were apparently busy with defense orders. Then we all went into their basement cafe and had hot dogs and Coca-Cola on the house, after which we repaired to to lunch.

The Cutler-Hammer Company turned out to be somewhat of a repetition of Allen-Bradley. The plant was old, however, and many line-shafts and belt-driven machines were in evidence. The moulded plastics department was large. Heat-resistant arc shields were being made of a cold-moulded gilsonite plastic loaded with asbestos. Many thermo-setting plastics of urea- and phenol-formaldehyde and synthetic rubber were being formed. There was apparently no thermo-plastic building.

So, with heavy hearts we started for Chicago, slowing only once to keep up with a Pontiac full of twitches. The Stevens Hotel welcomed us with very little prejudice, and all E.E.'s scattered to various and variable amusements. Pappenfus spent his evening riding the elevator from the 29th floor to the sub-basement and vice versa. Doeiz stopped at the desk and told them to light the heater so he could take a bath.

As longing glances were being cast at the luxuriously soft beds at the Stevens, phones began to ring, and a disgustingly cheerful voice warbled, "Good morning, it's 6:15, time to be up, the temperature may be had for a small consideration."

Crawling on all fours, we made it to the busses. Mandeen was a little late—zipper



trouble, he said. Soon we were at the Carnegie-Illinois steel mill in South Chicago.

We were lucky to find the plant in full operation. We saw a blast furnace tapped, the Bessemer converters in operation (truly an appalling sight), electric furnaces started and "barred" (slag raked off), and an open-hearth furnace discharged. Twenty-eight hearths were installed in two 1,800-foot buildings at a cost of about a million dollars per hearth. Largest building was the 2,100-foot roller-mill unit. Most unique sections of the plant were the power generating stations. One contained nine Allis-Chalmers reciprocating furnace-gas engines which drove 7,060-kva generators.

That evening we went to Fred Harvey's Cafe for dinner with the Chicago Alumni. Contrary to predictions, the speakers were entertaining and we enjoyed the meeting very much.

Sidewalks swayed, rain beat an ear-splitting tatoo on the parkway, and busses were clothed in an indefinite mist as Chermack and Froland marched aboard Thursday.

Thursday and Friday we visited the well-lit, roomy plant of the Western Electric Company, the older, less systematized, but very busy plant of Automatic Electric, the modern Electromotive Corporation, and the Wells-Gardner radio plant. Points of interest were the extrusion presses for making lead sheaths at Western, injection plastic moulding, ingenious flexible-cord braiders at Automatic, and fabrication replacing casting of deisel blocks at Automotive.

All E.E.'s regretted seeing Saturday morning come. As predicted, however, it did come, and we checked out (those of us who hadn't checked out Friday night) and headed homeward.

We stopped at Beloit to look through the plant of Fairbanks-Morse, which was a dandy establishment. We watched the forging of a large crank-shaft in a 1,000-ton press. The forged crankshaft for a ten-cylinder deisel (about 30 feet long) is worth $14,000 when finished! We also observed their spun copper process for casting squirrel-cage rotors.

So amid tears, songs, shouts, and snores (Smythe) we hit the home stretch, feeling contented with the unforgettable week which had been so expertly arranged for us by Professors Kuhlmann and Hartig.

Chemical

THE day we had all been waiting for had finally arrived. On the morning of March 19, we gathered, 73 strong, with bags and baggage at the Chemistry building and boarded two large Greyhound busses preparatory to leaving for points east. With us were three members of the faculty: Professors C. A. Mann, G. H. Montillon, and C. S. Grove, Jr. To make sure that the trip would start off in the

usual manner, Bostrom overslept, so that someone had to rout him out of bed. In spite of this, we were underway a little after eight.

We reached Wausau, Wisconsin, by noon, and were served an excellent lunch donated by the Minnesota Mining and Manufacturing Co. In the afternoon, we started an inspection by first visiting Rip Mountain, where the company has an unlimited supply of quartzite, which the company prepares for roofing and sandpaper.

Of interest was the kiln in which the roofing granules received a microscopic film of glass. The finished products are shipped to roofing manufacturers all over the country. The company itself does not make sandpaper or roofing.

Leaving the plant, we started the long hop for Appleton. En route, most of the boys played cards or slept, as was the case during most of the trip. Bridge proved to be very popular, with four games going in each bus most of the time. Upon arriving in Appleton, we checked in at our respective hotels, and prepared for our first night on the road.

The next morning, we started at eight for the Institute of Paper Chemistry. This institution is devoted solely to graduate work in paper technology and related subjects, and is affiliated with Lawrence College in Appleton. It is supported by an association of paper and pulp companies which in turn receive the benefits of any new discoveries or developments. The institute is divided into three main parts: (1) library, (2) laboratory, and (3) semi-works plant. An example of a recent development by the institute is the use of soy bean protein in the sizing of paper.

The rest of the day was spent inspecting pulp and paper mills in Fox River Valley. In the Kimberly-Clark Paper Mill, we watched the manufacture of sulfite pulp and ground-wood pulp, as well as paper from these two types of paper pulp. In the ground-wood department, the large grindstones attracted our attention. All the water in this department is heated by means of the heat of friction of the wood on the grinders.

The Fox River plant was next on our itinerary. It is engaged in the making of high-grade bond and drawing papers. They also make rag content ledger-paper. Here we all received a package containing samples of all the types of bond paper made at the plant.

We then went to the Kimberley-Clark Lakeview Mills in Neenah, Wisconsin. Here they manufacture highly absorbent cellulose from wood. This plant was the most sanitary plant that we visited on the entire trip. A distinctly different type of machine was the paper-making machine, which produced the highly absorbent crepe. The pulp was put onto a screen which traveled at a speed of 2,600 ft. per minute. Before leaving, we were all given a box of Kleenex, which came in handy later on, since almost everyone developed a cold by the time we arrived in Chicago.

That evening we arrived in Milwaukee, and checked in at the Hotel Wisconsin. Although Gypsy Rose Lee was playing at one of the theatres there, the boys confined their social activities to other things. The next morning we visited the Koppers Products Company in Carrollsvile, Wisconsin. This plant produces tar products from coal tar which is shipped in from coke plants in other cities. Following this, we traveled to Racine, Wisconsin, for a trip through the Eisendrath Tannery, which is engaged in making high-grade leather from calf skins. This leather is used in the making of shoe uppers and ladies' handbags. The smell in the hide house made several of the party wish they hadn't had any breakfast, and to top it off, the company treated us to a free lunch—fish. As if that wasn't enough, we next visited the Milwaukee Sewerage Disposal plant on Jones Island, in that city. This plant treats 100 million gallons of sewage per day, containing 130 tons of dry material. The treatment effects a 95 per cent reduction of suspended matter as well as bacteria. The suspended material is high

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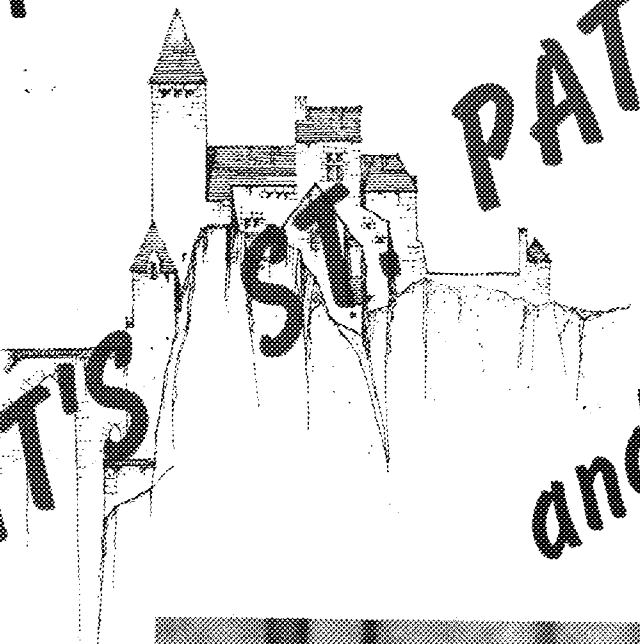
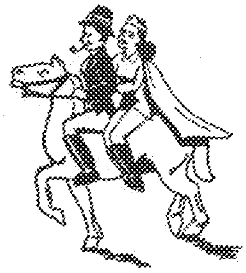
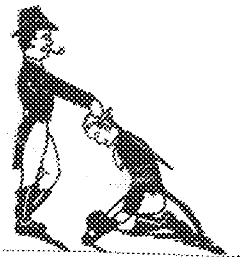
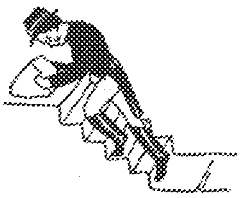
Begorrah! IT'S ST. PAT. and His QUEEN









Courtesy Halseth and McBrady

OPEN HOUSE

OPEN HOUSE will be one of the *big* features of Engineers' Day. Every department in the Institute will have displays ranging from routine work to spectacular demonstrations.

Open house will begin on Friday afternoon at 3:00 p.m. Demonstrations at the various exhibits will go on from 6:30 to 10 p. m. Each large exhibit will have a public address system to explain the demonstration to visitors. Many departments will hand out souvenirs representative of the work done in their department.

At the School of Mines the assaying laboratory will be in full operation. Assayers will be making quantitative determinations of gold and silver ore and distributing assaying "buttons" containing these precious metals.

In the Mechanical Engineering building the foundry, forge, pattern, and machine shops will be producing souvenirs.

Every visitor to the Civil Engineers' show in the Experimental Engineering building will have a chance to test his driving skill on the Aetna Insurance Company's "Steerometer."

Visitors to the Chemistry building will best spend some of their time at the "Chem Cabaret," an interesting chemical magic show.

At the Aeros' show in the Armory, visitors can experience the sensation of high altitude flying.

Up-to-the-minute weather reports will be available in the meteorology laboratory.

Every department will feature entertaining and interesting exhibits. Be sure to come to Engineers' Day open house!

KNIGHTING

FRIDAY, May 16 at 10:00 a. m. is the time, and the flagpole behind main engineering is the place. Trumpeters, on the rear steps of main engineering, will herald the beginning of the event. St. Pat and his Queen will come out the doors and walk to the platform that will be erected at the flagpole. Dean Lind and St. Pat will speak briefly. The Queen will respond to St. Pat's speech, and her closing words will be, "I now proclaim the 1941 Engineers' Day open!"

St. Pat and his Queen will mount their horses and lead the assembled crowd to the steps of Northrop Auditorium. Then the Queen will command St. Pat to kneel before her and kiss the Blarney Stone. As he does so she will touch him with her sword and dub him, "St. Pat, patron saint of all engineers."

St Pat will make a short speech and invite all senior engineers to come forward, kiss the Blarney Stone and become "Knights of the Order of St. Pat." As each senior engineer does so he will be handed a certificate signifying his membership in the Order.

BUTTONS

AS YOU have probably discovered, most anything you do requires capital. Engineers' Day is no exception—it needs money, too. Principal source of revenue is the sale of Engineers' Day buttons. If Engineers' Day is to be a financial success, the backing of every engineer is needed. So let's coöperate, buy a button!

In order to meet the expenses of Engineers' Day at least 1700 buttons must be sold, according to Bob Peterson, button sales chairman. As an added inducement to stimulate the sale of buttons, Bob has drafted several Arts college cuties to serve as salesgirls. Those of you who are allergic to buying things from men can take your pick and buy your button from a woman.

BALLAD

1

St. Patrick was an engineer,
He was, he was, he was,
St. Patrick was an engineer,
He was, he was.

For he invented electric lights
So engineers could study nights.

Erin Go Bräugh, hurrah for the engineers,
Erin Go Bräugh, hurrah for the engineers!

2

For he invented the calculus
And handed it down for us to cuss.

3

For he invented the monkey wrench
To screw the lawyers to the bench.

4

For he invented the slide rule too
So we could multiply two by two.

5

He ran his slipstick up in high
And guessed at the answer as you and I.

6

For he invented the aeroplane
To supplement the railroad train.

7

For he invented the davenport
So engineers could have their sport.

PROGRAM

FRIDAY

10:00 a.m.—Engineers' Day opened by Dean Lind at the flagpole behind main engineering.

10:30 a.m.—Knighting of senior engineers on Northrop's steps; crowning of St. Pat and his Queen.

11:30 a.m.—Parade starts from parade grounds. Circles campus and downtown Minneapolis.

3:00-10:00 p.m.—Open house. Exhibits in armory, Oak Street lab, mechanical, electrical, main, and experimental engineering buildings, physics, chemistry, and mines buildings.

3:30-5:30 p.m.—Dansant in main ballroom of Union. Dancing to the best in recorded rhythm. Admission free to button holders.

SATURDAY

10.00 a.m.—Field Day starts at Riverside Park. Diamondball, novel games and contests. Free refreshments. Prizes.

9.00-12:00 p.m.—Brawl in the Flame Room of the Radisson Hotel. Music by Swifty Ellickson.

BRAWL

SOFT lights and smooth music will be featured at the Saturday night wind-up of Engineers' Day—the Brawl. This year, engineers and their glamorous dates will enjoy the finest in music and surroundings as they dance out their annual celebration. Swifty Ellickson, who is unequalled in the Northwest for his superb arrangements, will lead his eleven-piece outfit to new heights in the swank new ballroom of the Radisson Hotel. No need for the crowd to worry about enough room or sultry weather, for the Radisson ballroom is delightfully cooled.

The Brawl constitutes *the* social affair of the season for all Tech students. As a fitting climax to the hectic celebration of Engineers' Day the annual Brawl provides an atmosphere of congeniality that is never overlooked by true engineers; and this year will be the finest, most carefree session of them all.

Tech men wearing Engineers' Day buttons will be given a free opportunity to limber up for the Brawl at the Friday afternoon Dansant (sunlight). Recorded swing and multitudes of coeds will prevail in the Union ballroom for the occasion.

FIELD DAY

THIS year, as in the past, most of the events on Field Day will be held at Riverside Park both Saturday morning and afternoon. The main difference will be that this year's festival will be more stupendous, more collosal, more gigantic and more breath taking. In short, at the 1941 Field Day you'll have more fun than you've ever had in the past.

There will be contests of all types and varieties. Greased pole contests, egg throwing, a three-legged race, a tug of war, and diamondball games, plus regular field events will fill the day.

If you like your recreation with lots of spills and tense moments, try climbing a greased pole, or playing catch with a fresh egg. Of course it's in the shell, stupid. The three-legged race will also give out with lots of spills and laughs. For all you men who boast of your physical prowess there will be a tug of war to make you back up your boast.

Diamondball will occupy a good bit of the day with teams from each department competing for straight, place, and show honors. After battling their way to victory, the departmental winners will take on the Faculty team. All you professors and students (?) who have grudges can settle them here with "bean" balls and home runs. The Engineers' All-stars, picked from players on the departmental teams will battle the Ag's for possession of the trophy which the Ag's carried off last year.

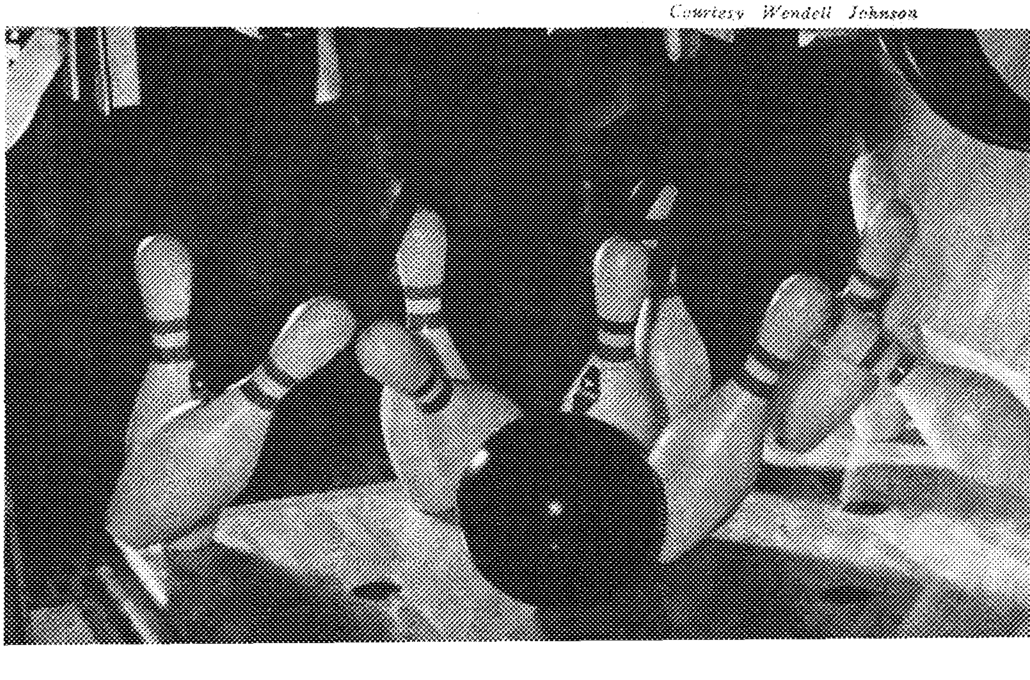
Teams made up of the five high men from each department in the Institute will roll for top place in the bowling tournament. The finals will be held on May 16

PARADE

THe parade this year is going to be a "humdinger," to quote Chairman Leigh Morrow. There are going to be floats galore, beautiful girls crusing contentedly 'cross the campus and covering the commercial center (downtown Minneapolis to you) at a cool and cautious clip in colorfully covered, classy, convertibles. The parade motto is "At least one girl for each engineer." So you can't afford to miss this day of days. Many of the floats will stress the national defense theme and the absolute necessity of a new mechanical and aeronautical engineering building. There will be about 30 floats in the parade lineup. Floats are being made by the freshman math classes, technical societies, and professional engineering fraternities.

The parade will form on the parade grounds 'midst much shouting and commotion about 10:30 or 11:00 a.m. After it has formed the parade will tour the campus and downtown Minneapolis in a blaze of glory and sunshine. xO!!X? that weatherman if he forecasts rain. The parade will go over Washington Avenue to Hennepin, up Hennepin to Ninth Street, across to Nicollet, down Nicollet and back to the University. This parade will put an end to all others, except engineers' parades. It will be so stupendous that it will completely overshadow every parade since Adam and Eve paraded out of the Garden of Eden.

Courtesy Wendell Johnson



Dale Drinkwater

Welcome

to all students in the Institute, their parents, and their friends from executive committee of the 1941 Engineers' Day. Speaking for the fellows working with me, I would like to have all of you participate in at least some of the many events which we have arranged for your enjoyment during these two days.

Upper classmen don't have to be urged to turn out en masse for Engineers' Day. They know from experience what a whooping good time everyone will have, but to put over Engineers' Day in a big way we need EVERY man in the Institute. And that means every one of you freshmen and sophomores.

Engineers' Day has meant a lot of hard work for the executive committee and all the other fellows working with us, but I know that we will all be amply rewarded for our labors if all of you loyal Patricks and Patricias turn out and have a good time.

Wiley Souba

Gene Selmanoff

John Elliott

Tom Matteson

Robert N. Peterson

Personnel . . . . .

Leigh Morrow

Robert E. Nelson

Arthur Brickman

Ralph Doty

General Chairman, Dale Drinkwater

Parade

G. Leigh Morrow, Chairman

George Engstrom, Truck chairman; Donald Sheldon, Contacts chairman; Richard Lebens, Contacts; William Van Kraak, Contacts.

Field Day

Robert E. Nelson, Chairman

Kenneth Casselman, Bowling Chairman; Robert Toit, Andrew McNicoll, Thomas Brown.

Brawl and Dansant

Arthur D. Brickman, Chairman

Gene Dugan, Brawl Ticket Chairman; H. James Bostrom, Aeronautical; Russ Ferguson, Chemical; Joe Heller, Electrical; Karl Dedolph, Civil; Jack Barstow, Mechanical.

Personnel

John B. Adams

Dave Loevinger, Sam Carlson, Robert Abrohams, Jack Custer, Robert Wasley, John Renler.

Office

Ralph Doty, Chairman

Bernard Marschner, Rella Jane Page, Dorothy Linman, Joan Whalen, Janet Fleischem, June Knowlton.

Knighting Ceremonies

Wiley W. Souba, Chairman

Burke Martz, Awards; Ed. Dyggett, Equipment; Bob Meyer, Program; Don Weideneller, Costumes.

Publicity Committee

Gene Selmanoff, Chairman

Tom Milton, Stan Loeffler, Jim Maltby, Harold Moskovitz, Robert Platt, Saxe Dobrin.

Finance Committee

John F. Elliott, Treasurer

William Jensen.

Buttons

Robert N. Peterson, Chairman

Walter Y. Fish, Electrical; Paul Anderson, Mechanical; Eric Nordlin, Civil; Donald Nutter, Chemistry; Robert Maltby, Architecture; Garth Crosby, Mines; Chester Furlong, Aeronautical; David Mattson, Agriculture.

Button Salesmen

Robert C. Pehrson, Paul Steenberg, Robert Pitts, Robert Nielson, Robert E. Exner, Walter Reid, Henry Doepke, Marshall Anderson, Jack Paulson, Stan Naughton, Doug Gilstad, Merle Gorder, Alan Brown, John Mitchell, Harry Dahlberg, Gordon Rouken, Ralph Severson, Robert Rebholz, Leo Brom, Eugene Flynn, Don Holmquist, Dick Mollison, Emil Behrens, Jerry Westlund, Herbert Lyon, Wayne Brock, George White, Terry Taylor, Phil Sauer, Cort Platt, George Murphy, Robert Widing, Charles Kunz, Robert Stiefel, Ervin Johnson, Harlan Anderson, Curtis Larson, Robert English, Harold Swanson, Art Laurence, Joan Whelan, Janet Beach, Rella Jane Page, Joe Morin, Don Knutson.

Open House

Tom Matteson, General Chairman

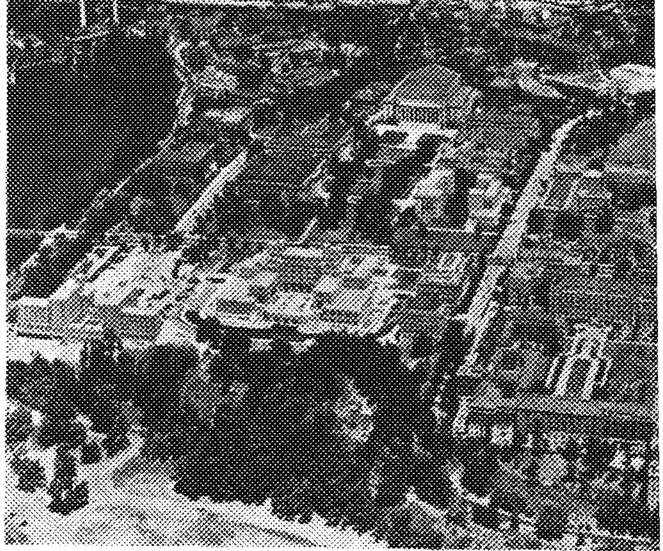
Aeronautical—C. Lawrence Carlson, Chairman; Joe Spiegel, Roland Dufrene, Robert Toft, Norman Martin, Gordon Roesler, Wilbur Tromley; Civil—Ivan Jensen, Chairman, Ralph Anderson, Adrian Stahl; Chemistry—Robert Kidder, Chairman, Harry Somermeyer, Jack Schofeld, Stan Remenesky, Arthur Anderson, C. P. Stanford, Gerhard Brauer, Donald Drukey, Russ Ferguson, Floyd Anderson; Mines—Marlowe Nelson, Chairman, Bob Lindberg, LeRoy Kelman, Garth Crosby, Rolf Preus, Bill Glenn, Robert Rebholz; Agriculture—Warren Brownell, Chairman; Mechanical—Warren Richard, Chairman, James Mitchell, Lin Power, James Anderson, Marvin Biers; Electrical—Eugene Eeklund, Chairman, Henry Sringer, Howard Sheldon, William Campbell, Maurice Gay, Victor Ziener, Richard Lebens, Leif Kovick; Physics—Edward Ney, Chairman.

A Visit

to open house this year will take the logman through a majority of the departments that make up the Institute of Technology.

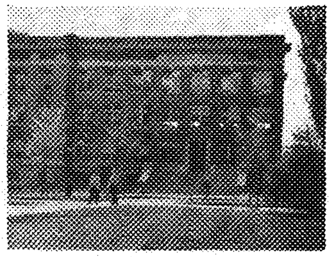
In the Mines building are located the departments of metallurgy, mining, and petroleum. All freshmen take inorganic chemistry in the Chemistry building. The rest of the building is devoted to quantitative, qualitative, organic, and research laboratories of the School of Chemistry, while in the basement is housed the department of chemical engineering.

In the Physics building, home of the atom smasher and the observatory, all engineers struggle through heat, light, mechanics, and electricity. The old Mechanical Engineering building contains the machine shop, foundry, and forge amid its maze of wooden stairways and partitions. The Electrical Engineering building, as its name indicates, is the domain of the electrical engineer with his study of electric power and communications and research in high voltage. In the Experimental Engineering building, laboratory courses in strength of materials, heat engines, and hydraulics are given.

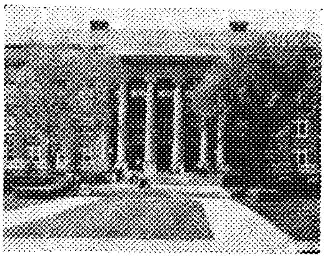


Courtesy Ph

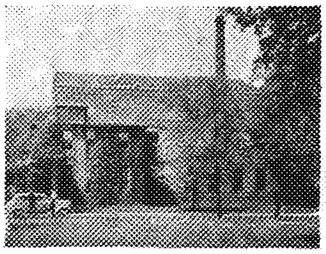
Aerial View of Campus



Mines

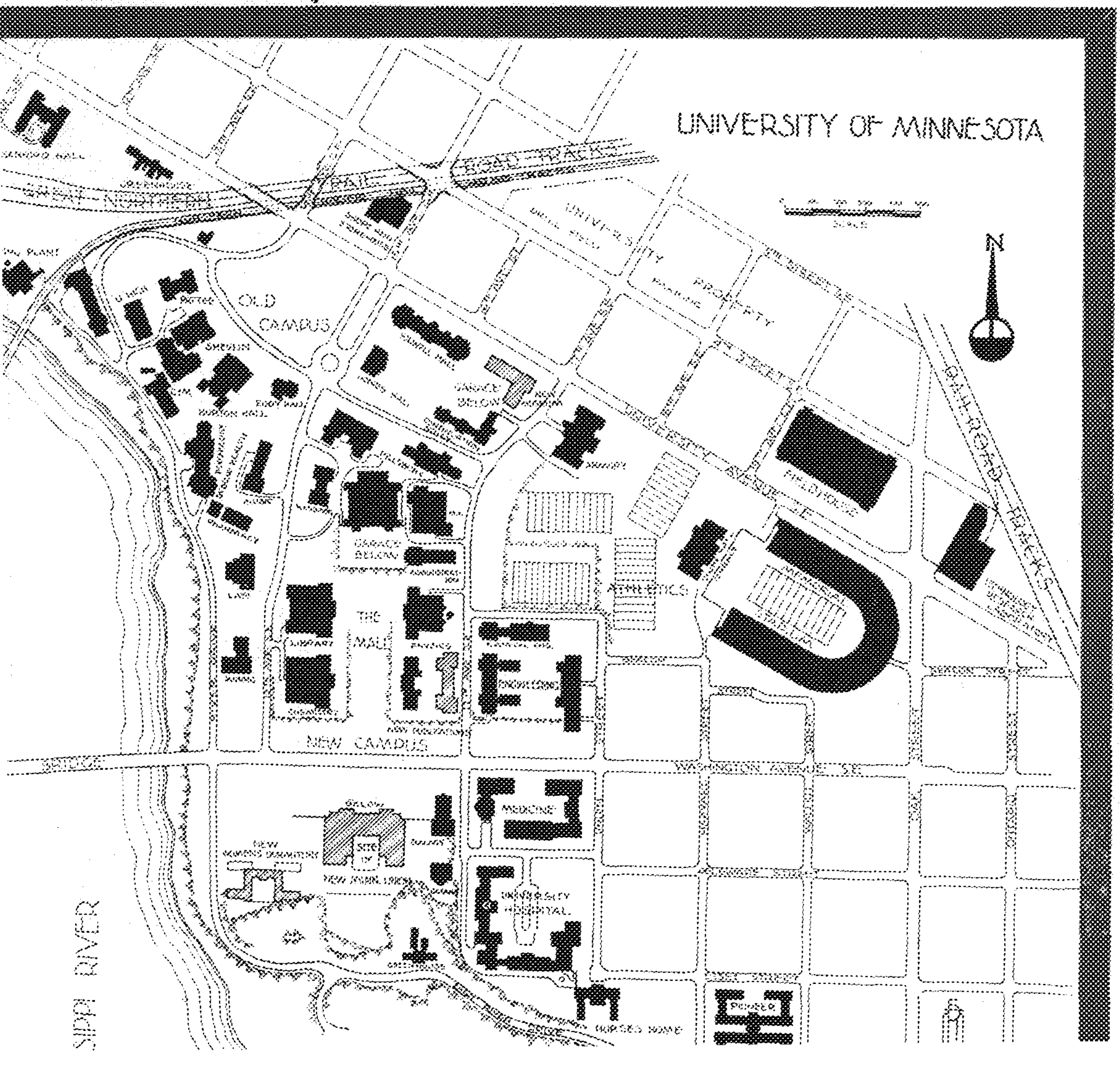


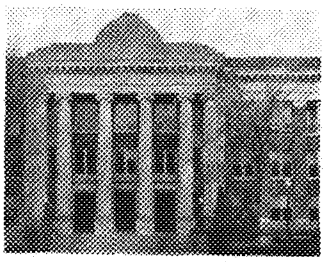
Chemistry



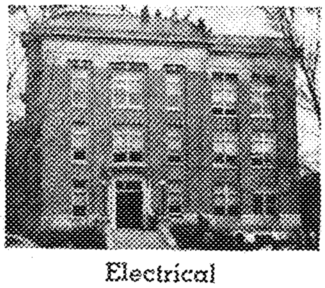
Mechanical

Campus . . . . . .

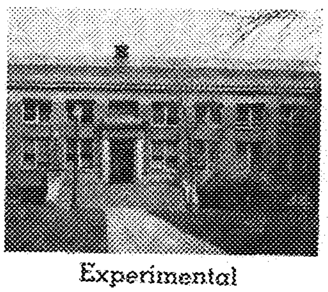




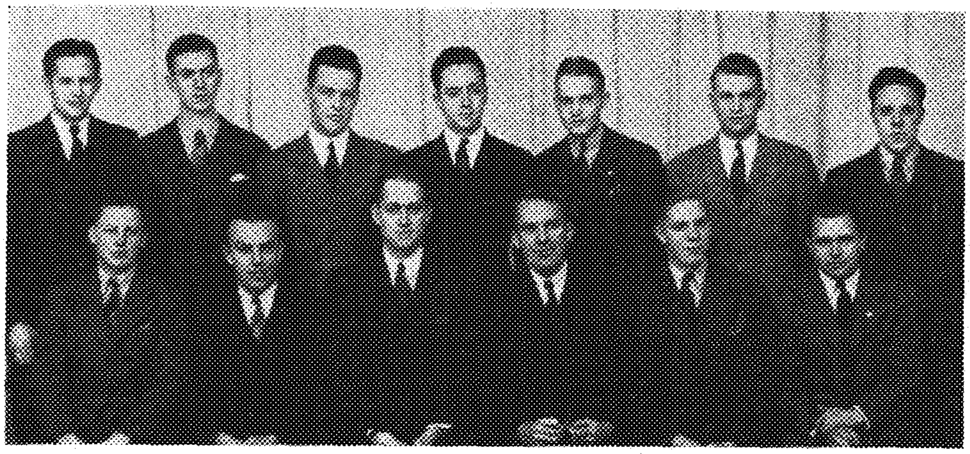
Physics



Electrical



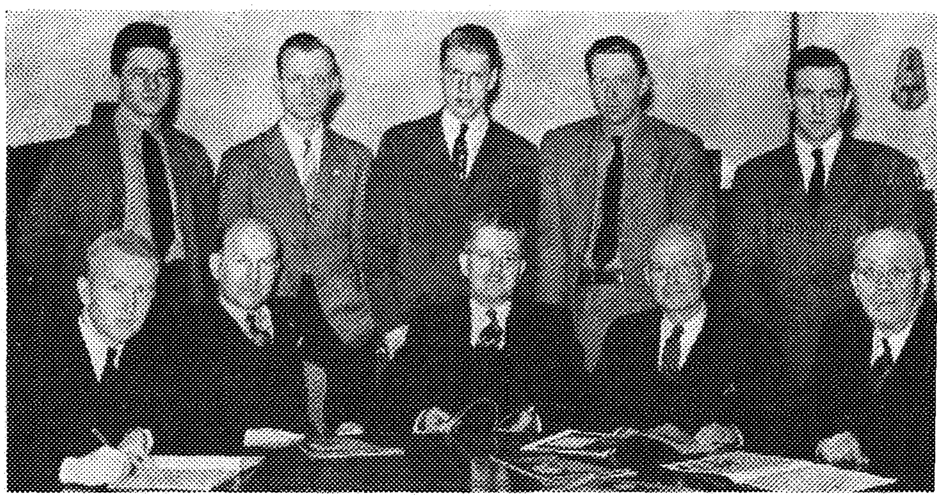
Experimental



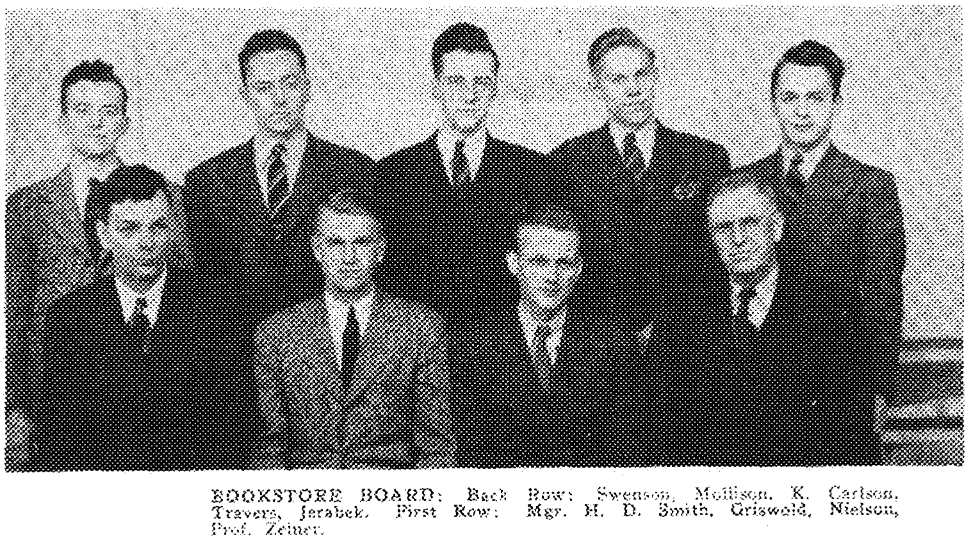
Technical Commission

TECHNICAL COMMISSION: Back Row: Belin, Borum, C. Olson, Mollison, Brattvet, Griswold, Nystrom. First Row: W. Johnson, Lyons, Ersted, Prof. Koepke, Travers, Wystrach.

Techno-Log Board



TECHNO-LOG BOARD: Back Row: Dahlstrom, Ringham, Lamb, R. Johnson, Donahue. First Row: Brickman, Dr. Straub, Dr. Dow, Prof. Richardson, Dean Comstock.



Bookstore Board

BOOKSTORE BOARD: Back Row: Swenson, Mollison, K. Carlson, Travers, Jerabek. First Row: Mgr. H. D. Smith, Griswold, Nielson, Prof. Zeiner.

The Techno-Log In Action


Martinson,
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Alpha Alpha Gamma

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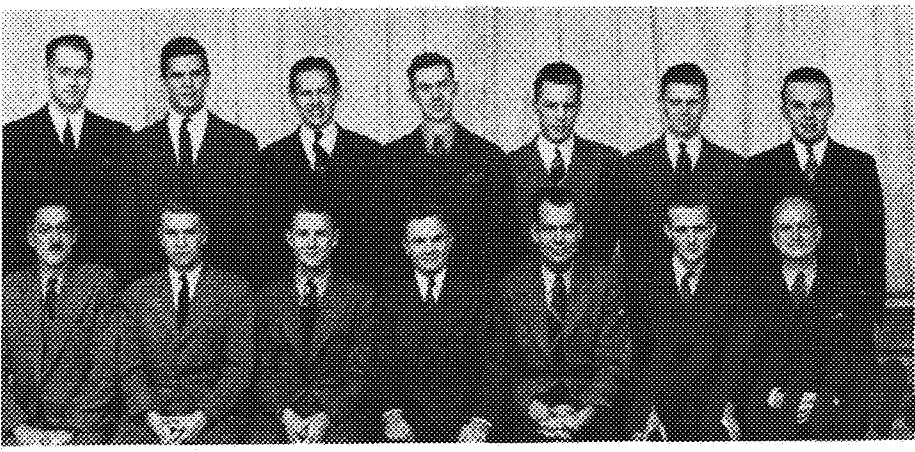

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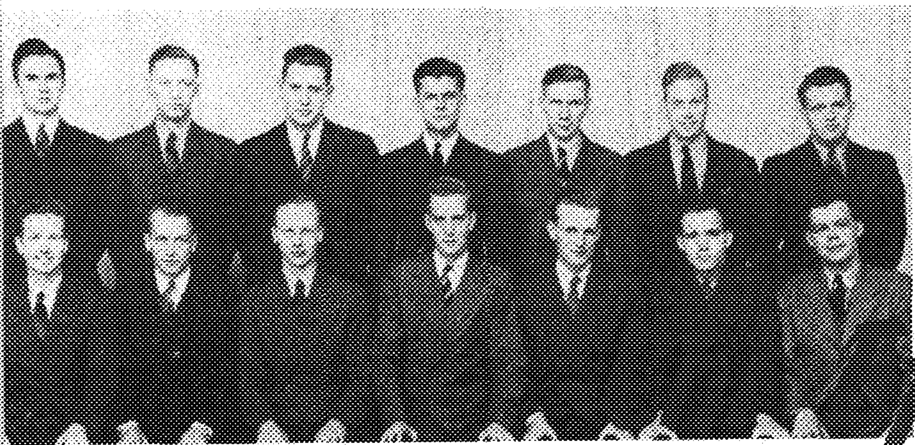

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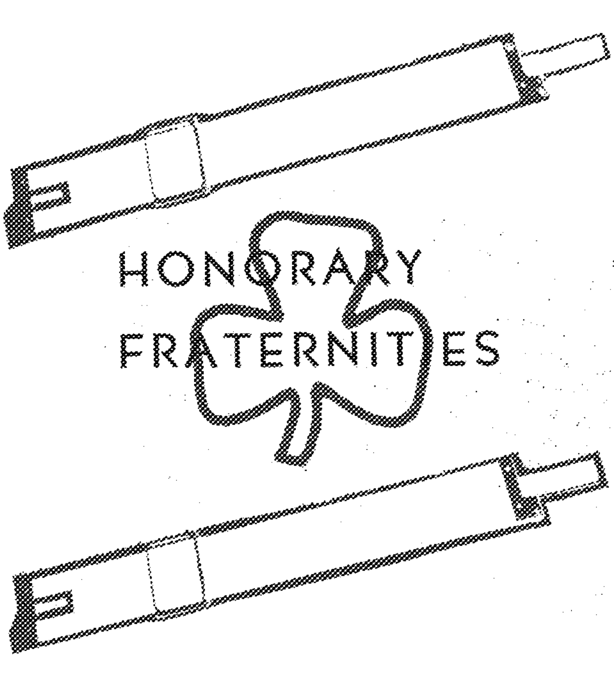


HONORARY FRATERNITIES

ALPHA ALPHA GAMMA: Second row: Hopkins, Lindsey, Simmons, Thomas, D. Hanson, Niles. First row: Freeman, Des Marais, Alrick, Kobbers, Howard.

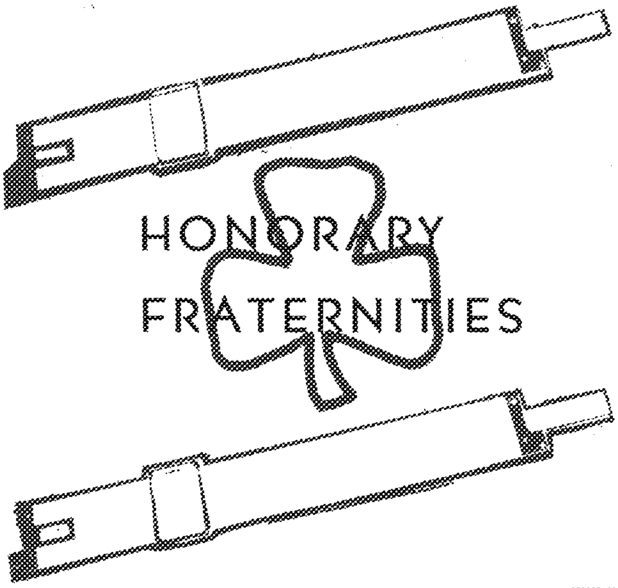
PLUMB BOB SOCIETY: Second row: Ersted, Andberg, Belin, Boyum, Vernon Olson, Montillon, Lyons. First row: Kuhlmann, Griswold, Finger, Schmestedt, Quist, Nielson, Richardson.

CHI EPSILON: Second row: Christiansen, Martinson, Dienhart, Hensch, Benson, Carlson, Young. First row: Silgen, Krogh, Laursen, Okerlund, Nielsen, Mythangen, Baker.

ETA KAPPA NU: Third row: Mandeen, Bockhoff, Lambert, Schultz, Lyons. **Second row:** Wulfsberg, Large, Gordon, Hays, Molde, Harkusen. First row: Storm, Carlson, E. Hartig, Ferguson, Doelz.

PI TAU SIGMA: Third row: Quist, Eustis, English, Bartelt, Behrens, Montillon. **Second row:** Dittfach, Albrecht, Lillenas, Brickman, Sauby, Lindeman. First row: Comb, Schonstedt, Teeter, Martenis, Flagg, Sandgren.

TAU BETA PI: Fourth row: Carlson, Boyum, Bockhoff, Ferguson, Hariu, Cane, Storm, Flagg, Okerlund. Third row: Baral, Mollison, Lyons, Elliot, Nielsen, Albrecht, Lillenas, Sauby, **Second row:** Molde, Efron, Severson, W. Johnson, Lindeman, Comb, Morken, Weber. First row, Markusen, Schonstedt, Jerabek, Weden, G. H. Montillon, G. D. Montillon, Stenborg, Sandgren.



ELECTRICAL

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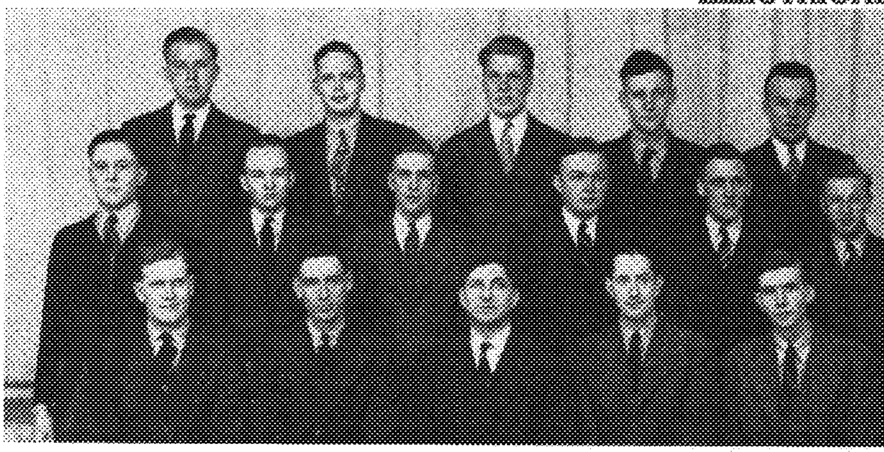
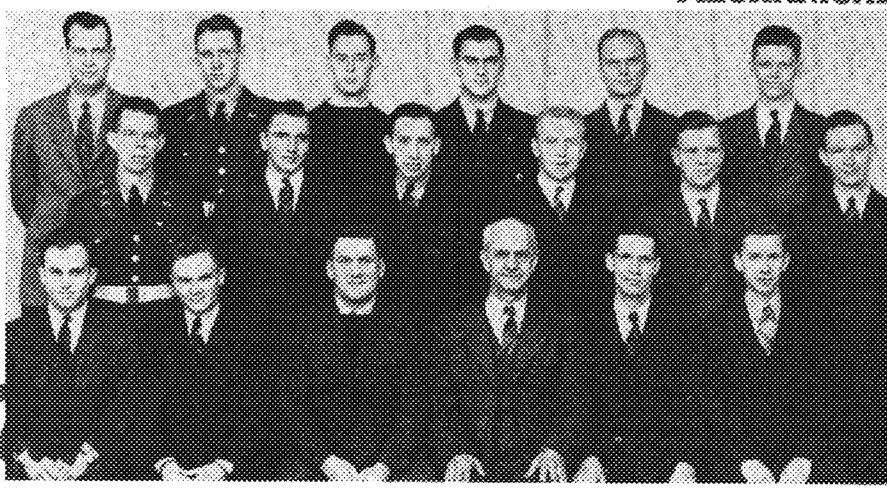
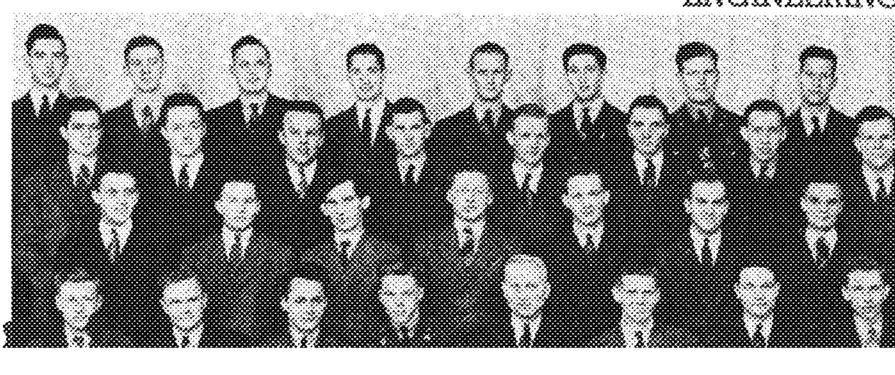


MECHANICAL

Pi Tau Sig



ENGINEERING



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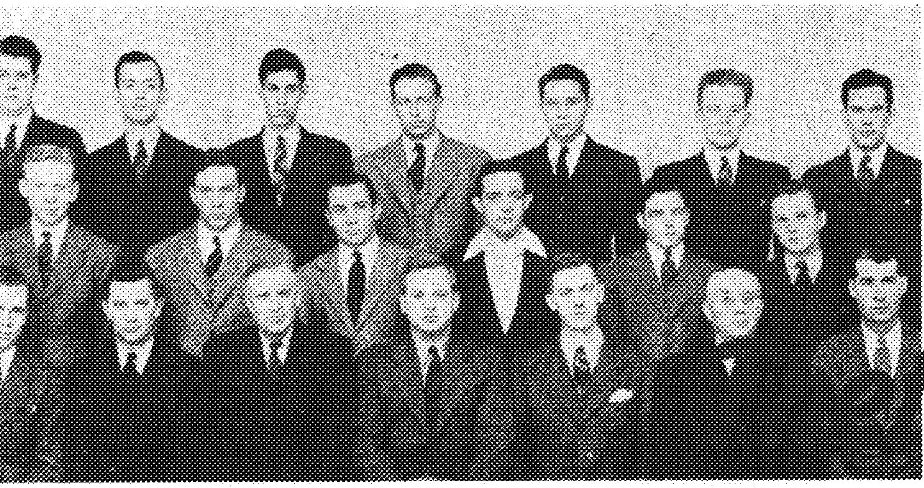

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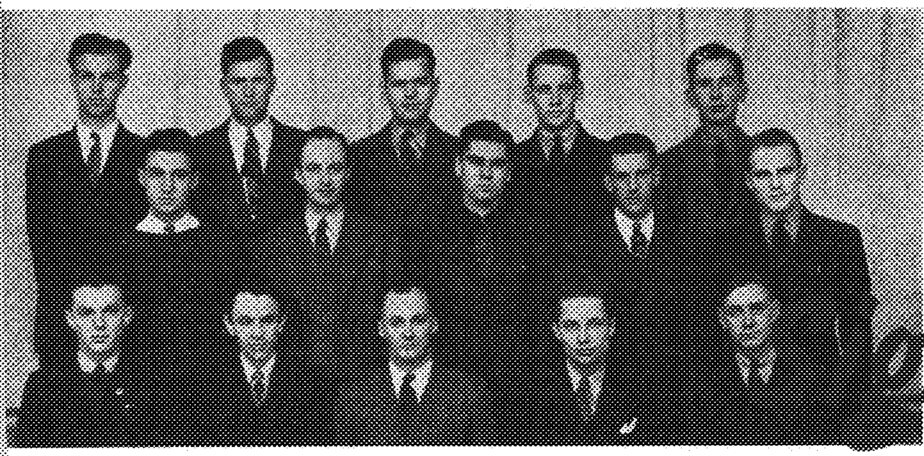

ma Rho

MINES

PROFESSIONAL FRATERNITIES

ALPHA RHO CHI: Fourth row: Kremer, Raun, Hillstrom, Johnson, Behrens, Field, Bergmann, Siems, Powers. Third row: Khalil, Manuel, Wright, Hoganson, Taylor, Johnson, Engebretson, Ackermann. Second row: Rafferty, Swedberg, Langan, Wiste, Whitlock, Hussey, Baker, Holes. First row: Wielde, Behm, Burton, Richardson, Lundgren, Arnal, Cerny, Dropping.

THETA TAU: Third row: Strang, Olsen, Mitchell, J. Johnson, A. Johnson, Nelson, Tyler. Second row: Kabrud, Madsen, Hoerschgen, Bergquist, Mick, Goodman. First row: Tatty Schlechten, Zelmer, Duncanson, Boyum, Comstock, Tesko.

SIGMA RHO: Back row: Mattson, H. Glenn, C. Stainius, W. McNelly, P. Flynn. Second row: W. Turner, S. Stahlson, R. Brown, Shannon, J. Elliot. Front row: W. Turner, F. Beach, C. Felton, R. Larson, R. Nichols.

KAPPA ETA KAPPA: **Back row:** Carter, M. Erickson, Pramann, Semmer, Eckberg, B. Erickson, Knight, Stinger, Johnson. **Second row:** Rieland, Enquist, Schoonover, Lebens, Doetz, Smythe, Engstrom, Moran, Molenaar, Scott. **Front row:** Eidem, Pappenfus, Chalmers, Hayes, Fish, Sidfken, Gay, Albee, Lundahl.

TRIANGLE: **Fourth row:** Ersted, Hamel, Burrill, Winter, Lund, Otto. **Third row:** Sexton, Winker, Scott, Thompson, Larson, Reep, Frawley. **Second row:** Keegan, Fairbanks, George, Boemer, Morken, Kaercher. **First row:** Quist, Nolan, Nimlos, Gustafson, Pihlstrom, Hoglund, Schlenk.

ALPHA CHI SIGMA: **Fourth row:** Coe, Benjamin, Valenty, Jurgensen, Solsten, Hughes, Hansen. **Third row:** Toomy, Coyner, Staudenmeier, Huggett, Lindberg, Anderson. **Second row:** Boyer, Streed, Hanson, Carlson, Bolig, Craigo, Pahl. **First row:** Madden, Sontag, Befera, Nystrom, Belin, Lawson, Johnson.

PROFESSIONAL FRATERNITIES

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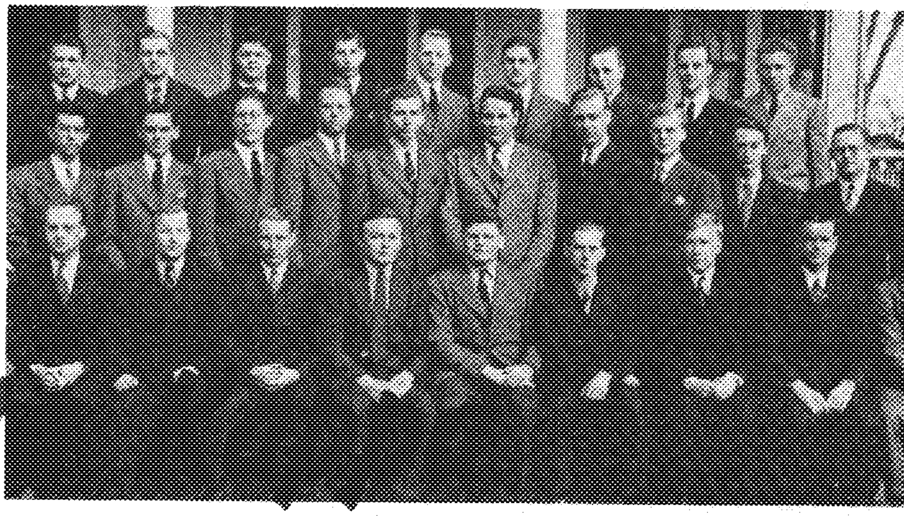

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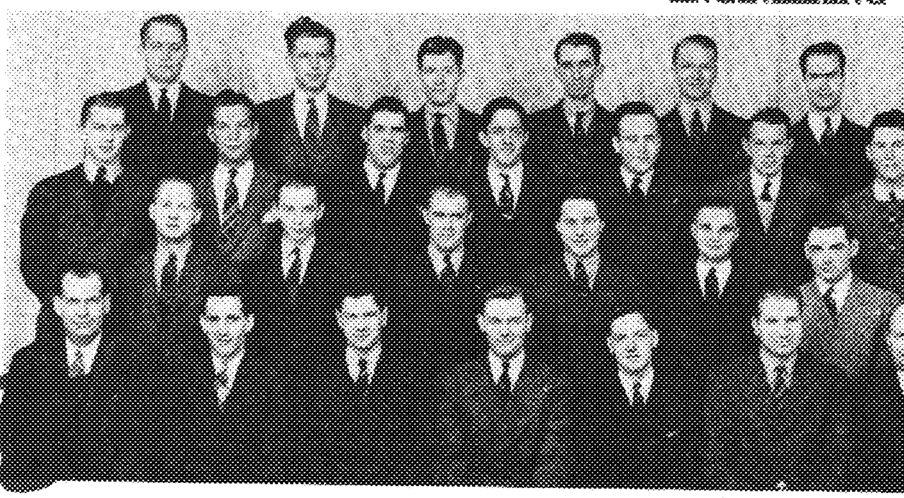

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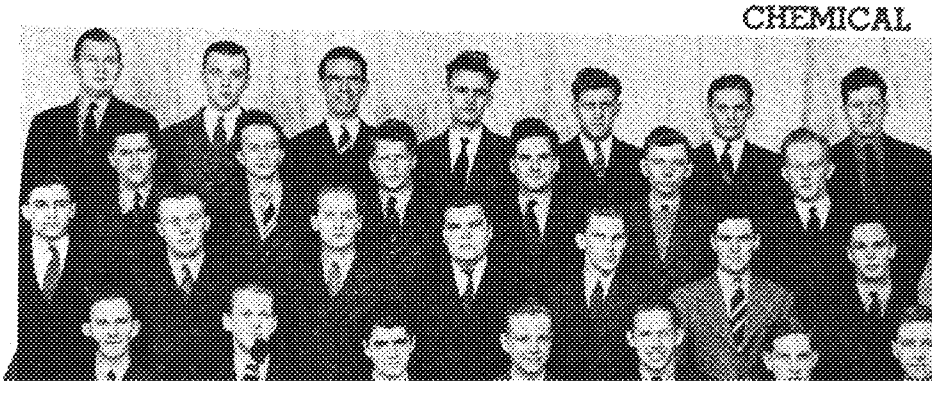

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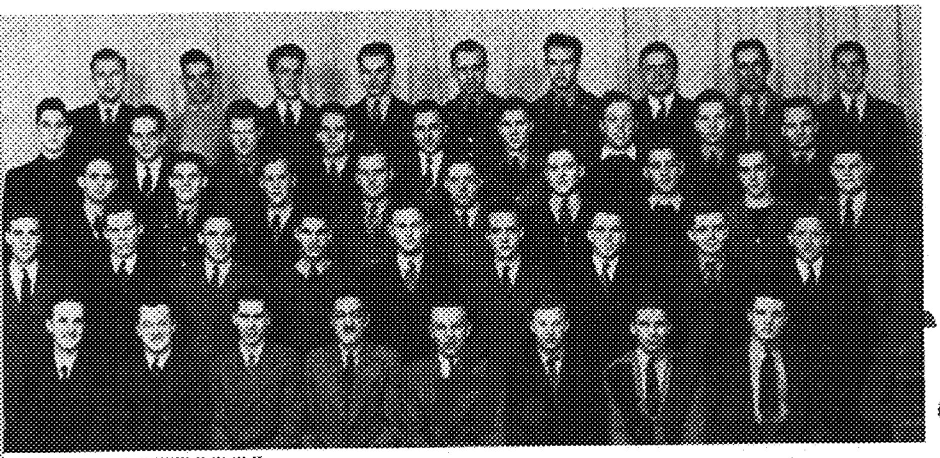

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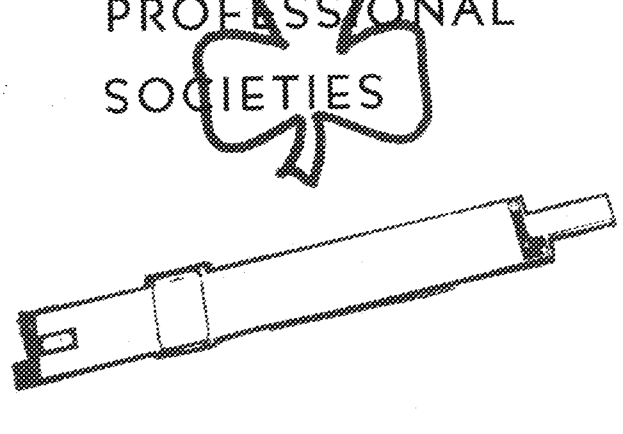


AMERICAN SOCIETY OF MECHANICAL ENGINEERS PICTURE I: Fourth row: Wilk, Bakken, Hammel, Naeseth, Lund, Otto, Moeller, Holm, Bevier. Third row: Lawrence, Cohen, F. Anderson, Mahle, Carlson, Thomson, Olson, Eklund, Gisvold. Second row: Eliason, Meyers, J. Gustafson, Black, Dickey, Blackmun, Herschbach, V. A. Anderson, Sather. First row: Beehler, Merchant, Holden, Syrovy, Oliver, Bartelt, Doyle, Diers.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS PICTURE II: Fourth row: D. Johnson, Palmer, Ericsson, English, Kiriluk, D. Christianson, Nesgoda Priess, Mathies. Third row: Herman Jones, Bloch, Saldoff, Lillenas, Lindsey, Sandgren, Sauby, Melgaard. Second row: Bushnell, Christofferson, Amacher, Tupper, Torell, Wanaka, Strauss, Bandli, I. Anderson. First row: Brickman, R. Peterson, Behrens, Winter, Ersted, Jacobson, Hauser, R. Anderson, Forrest.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS: Back row: Mandeen, K. Carlson, Lambert, Marakovich, Engstrom, Lebens, Heimes, Larson, Ferguson. Fourth row: Jaari, Shuler, Stone, Wilson, Stein, Paltin, Braddock, Brown, Large. Third row: Schreiner, Stodolka, Maenpaa, Van Ryzin, Kochevar, A. Wulfsberg, C. Wulfsberg, Morrow, Fish. Second row: Gordon, DesRosier, Molde, Dandgren, Scott, Orlando, Endahl, Erickson, Rendall. First row: Stinger, White, Eckland, Kuhlmann, Lyons, Markusen, Hedman, Carter.

AMERICAN SOCIETY OF CIVIL ENGINEERS: Back row: M. Johnson, Dahl, Christiansen, R. Johnson, Martinson, Carlson, Short, Schendel, Dienhart. **Fourth row:** Nelson, Getalder, Ryder, Dahlgren, Jensen, Stanley, Blaisdell, Anderson. **Third row:** Sahlman, Dahlstrom, Okerlund, Lien, Rood, Benson, Carlson. **Second row:** Hensch, Nielsen, Martin, Sutherland, Young, Silgen, Myrhaugen, Baker. **First row:** Krogh, Laursen, Brohaugh, Nystrom, Stahl, Terrazas, Zikan.

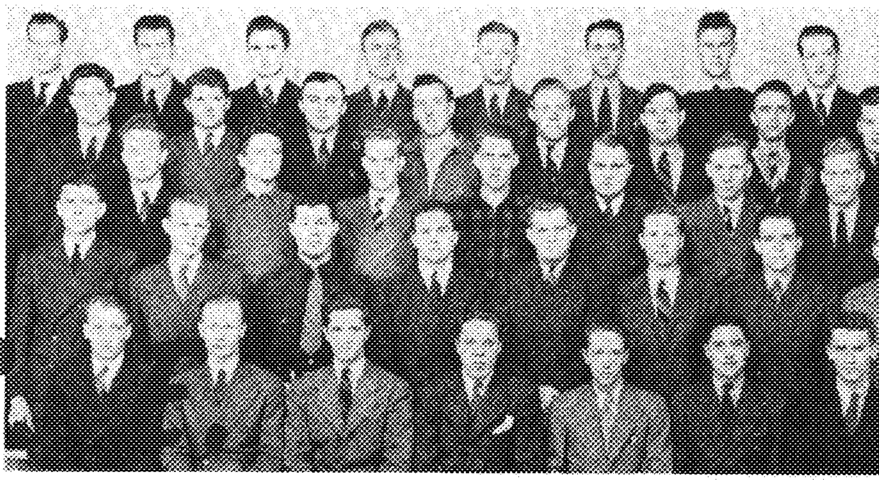
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS: Back row: Bostrom, D. Ryder, Finther, Shapero, Hall, Cane, House, Lund, Remeneski, Hariv. **Fourth row:** Hill, McDermott, McIver, Schott, Fontaine, Mitton, Solsten, Sutor, Dorsey, Braun. **Third row:** Bezanson, Anderson, Ledding, Masologites, Grande, Folt, R. Johnson, Walker, Flaherty, Stenberg. **Second row:** Platt, Haack, Kilpatrick, Levenson, Behrens, Heisig, Brauer, Severson, Bitsianes, J. Ryder. **First row:** Faukner, Zimmerman, Hanson, Valenty, Belin, Nystrom, Jerabek, Gullings, J. Johnson, Buttwinkle.

MINES SOCIETY: Back row: Hoerschgen, Baker, Hohenhous, Brown, Holmquist, Novak, Bowman, Prens, Crosby, Dicky. **Second row:** Church, Mattson, Stanius, Glenn, Fine, Johnson, Kendall. **Third row:** McNelly, Flynn, Rembold, Nelson, Benson, Satz, Kelman. **Fourth row:** Felton, Shore, Rebholz, Burgquist, Nelson, Beach, Turner, Tatkin. **Fifth row:** Silver, Brom, Erickson, Ronken, Blogett. **Sixth row:** Campbell, Casselman, Mollison, Brown.

PROFESSIONAL SOCIETIES

CIV

A. S. C



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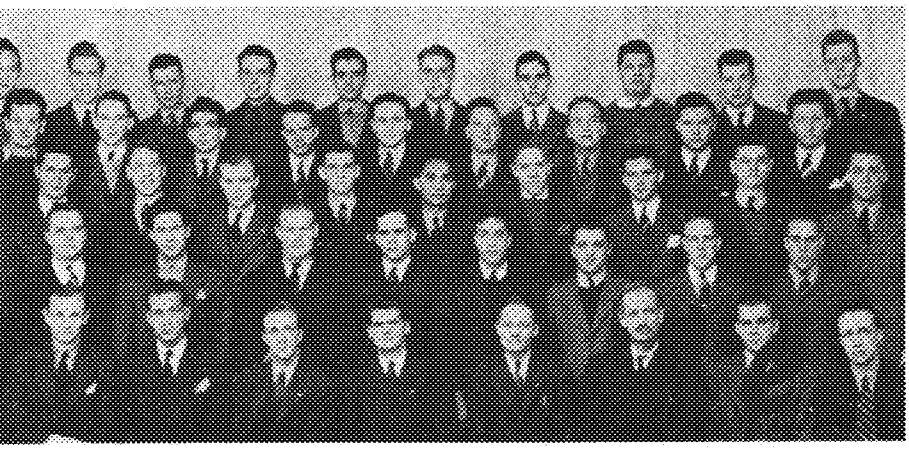

AERONAUTICAL

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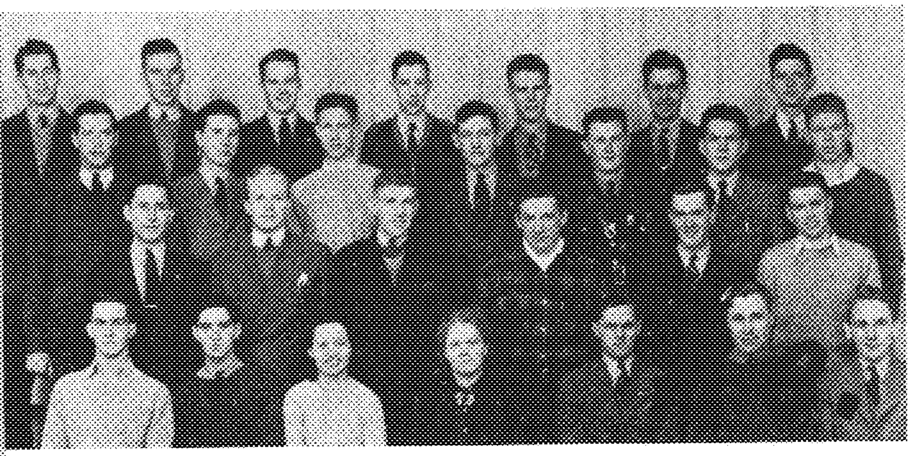

AERONAUTICAL

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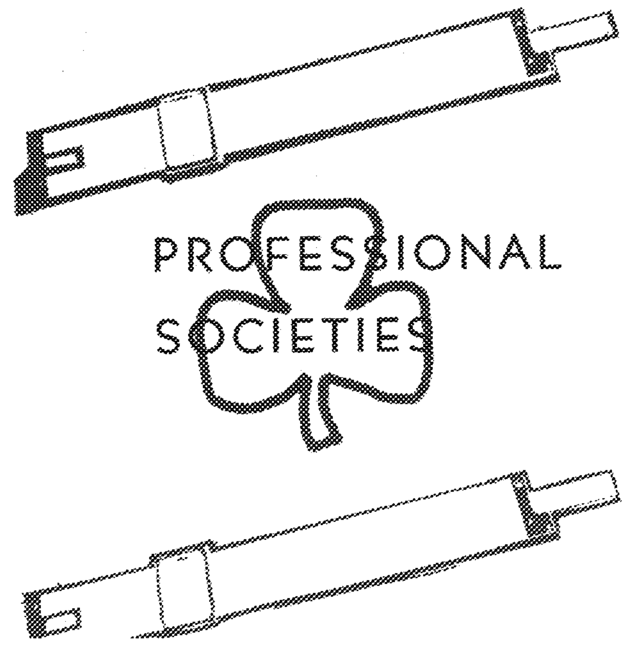


AMERICAN FOUNDRYMEN'S ASSOCIATION: Back row—left to right: Rudolph Schummer, George Pearson, Donald Johnson, Jarl Havnen, Asst. Prof. Fulton Holtby, LeRoy Kelman. **Front row:** left to right: Sidney Silberg, Kenneth Geist, Elmer Dinesen, Leo J. T. Brown, Instructor Herbert F. Scobie.

INSTITUTE OF AERONAUTICAL SCIENCES PICTURE I: Fifth row: Benn, Nestingen, Doyle, Linse, Botterworth, Larson, Trapp, Schneider, Schaeffer, Lilgren. **Fourth row:** Podolsky, Fay, Sutkowski, Peterson, Kreitinger, Engebretson, Schroers, Hoffman, Rahn. **Third row:** Weinberg, Grimstead, Butcher, Elliot, Mariano, Travers, Bogema, Tabaka, Lundstrom. **Second row:** Malmstrom, Lundy, Crowley, Holmes, Wray, Vaidich, McCollom, McCollom. **First row:** Akerman, Winker, Cone, Knies, Brattvet, Piccard, Stillwell, Foa.

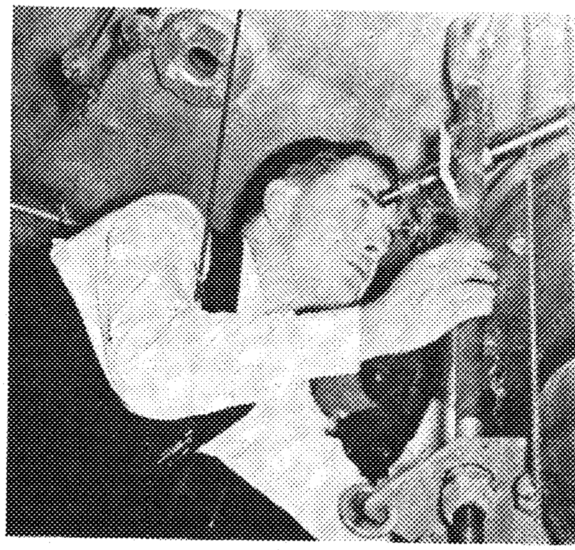
INSTITUTE OF AERONAUTICAL SCIENCES PICTURE II: Fourth row: Carlson, Jordan, Livagston, Blake, Champine, Morin, Wood. **Third row:** Dugan, Skong, Bratt, Durrenberger, Solvason, Buck, Krake. **Second row:** Klammer, Franz, Schulz, Weber, Ilelco, Nafstad. **First row:** Hay, Spiegal, Stickles, Krause, Berg, Tomren, Matteson.

Profs at Leisure

ASK anyone on the campus if he knows several instructors, and he is likely to say yes. We all "know" some of our instructors, but very few of us know very much about them outside of the classroom. On this page, we see a few of our better known instructors in moments of leisure and laboratory work. They're interesting people doing interesting things as these sketches will show.

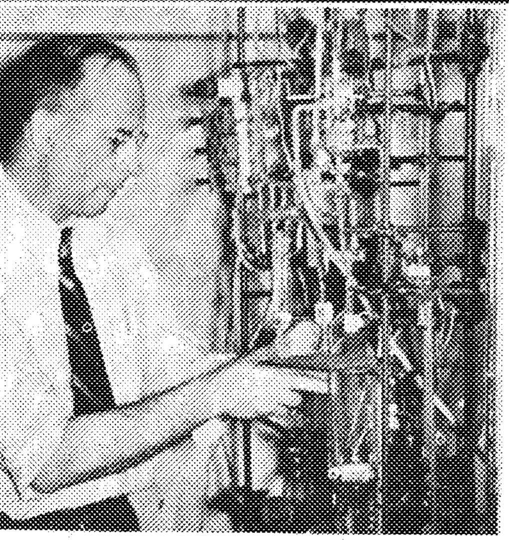
First man on the page is Dr. Heisig, associate professor of inorganic chemistry, working on the complicated looking glassware in front of him. The picture was taken in his laboratory where Dr. Heisig has recently begun some new experiments on complex inorganic compounds. He enjoys laboratory work and is quite an expert at it, although he doesn't have much time for it. His favorite outdoor sports are canoeing, biking and fishing. Put all three together for six weeks in the summer as Dr Heisig does and you have a really enjoyable vacation. He spends these six weeks during the latter half of the summer at his cabin on Woman Lake, about 190 miles north of Minneapolis. Incidentally, he did almost all of the work of building this cabin. Canoeing doesn't stop when summer is over, and it begins long before the first summer session is through, for Dr. Heisig has a canoe which he loads on top of the car on Sundays and holidays, and he and the family go out for a day on the St. Croix or the Minnesota.

Now we turn to a faculty member whom many of us have known from our freshman days. He is Professor Harlow Richardson, head of the engineering English department. He is shown here in his special easy chair in the Campus Club where he lives. Mr. Richardson characterizes the adage: "Travel broadens the mind." Always with a keen desire to see what is on the "other side of the mountain," he has made travel his chief hobby and recreation for many years. Patriotically, he saw "America First," visiting 45 states before he got the yen to travel abroad. He spent several summers camping out in the High Sierras of California and was a faithful member of the Canadian Alpine Club, an organization which admits only those active in climbing, hiking, and camping in mountainous terrain. Other trips have taken him to the Green and White Mountains, all of the national parks, and all the more famous canyons. Local places of beauty also attract Mr. Richardson. He has gone on numerous canoe trips through the St. Croix valley in Wisconsin and through the northern section of Minnesota.

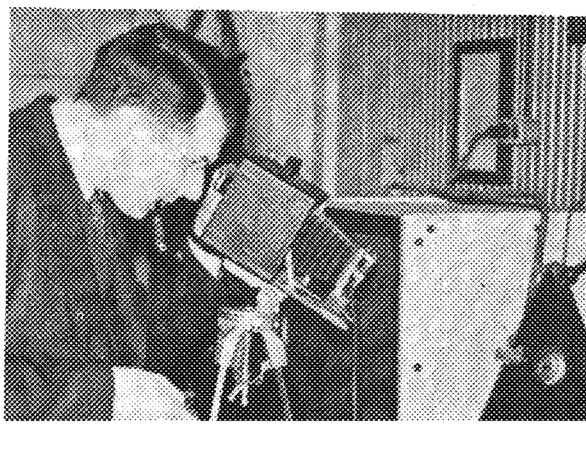


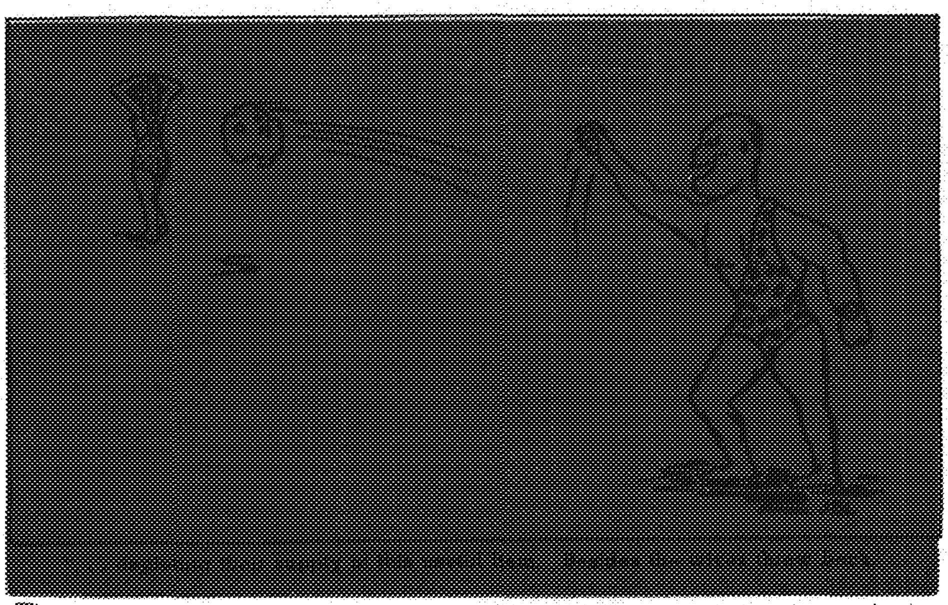
If you catch Professor Bryant daydreaming one of these fine spring days, he is probably thinking of some remote lake or stream of northern Minnesota where he'd like to be instead of here. Fishing and boating are his favorite vacation pastimes. He enjoys automobile trips and has taken several to New York and Texas. Now and then he goes out for a round of golf, but he emphasizes that he doesn't take this game seriously. In this picture he is shown looking at one of the gadgets in the E.E. show. Professor Bryant is a veteran instructor since he taught at the University of Illinois and the University of Texas before coming to Minnesota.

Here we see Professor Williams amidst the atom busting equipment where, it is reported, he lives. To be precise, he spends almost all of his spare time on it. Every once in a while during the day, he takes time out to deliver a lecture or to go over to the Campus Club to eat. But he comes right back after these little interruptions to adjust the ion beam or to make some radioactive elements for somebody. He has been working on the atom-smasher since 1935. Previous to this, he was a national research fellow at the University of Chicago. In spite of all this work, Dr. Williams does find time for a few diversions. Sometimes after lunch at the Campus Club he shoots a game of pool, and once in a while, he plays a game of golf or goes swimming. Every other year he takes a summer vacation with a couple of other physicists; usually they go fishing in Canada.



Professor Holtby holds the record for having the most hobbies. You can see three in this picture—his camera, his laboratory and his pipe. Another one is building furniture. He has built a complete set of maple furniture for his dining room and bedroom. Building model railroads and playing the piano complete the list to date. Mr. Holtby enjoys his research as much as any of his hobbies. He is one of the leaders in this country's foundry research. The piano playing, he confesses, is an art not wholly mastered. Mr. Holtby recently served as music chairman for a faculty dance. Nobody liked the band he hired and at the end of the evening he hadn't a friend left. But Holtby-like, he hired the same band under a different name for the next dance, and everybody liked it. Several interesting conclusions about faculty people could be drawn from this incident.



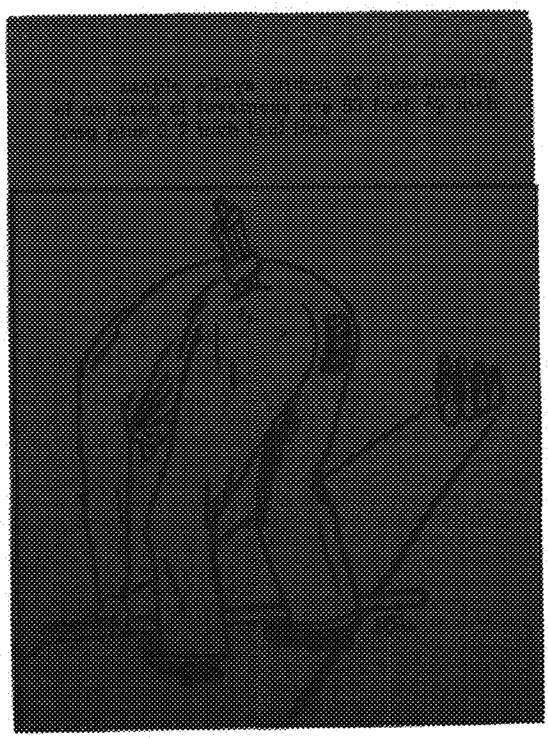


Pins Courtesy Alpha Chi Omega

BACK in the prehistoric days when elephants were called mammoths and tigers wore sabers for teeth, we are told that the cavemen used to amuse themselves by throwing things at their wives. This form of sport, however, did not last very long because the fun-loving citizens found they were damaging their wives, often depleting their supply of this useful item. Besides, the wives threw back. Thus it was rather reluctantly that these sportsmen took to throwing at objects less abject that didn't object or reject, but would only deflect.

The Thirsty Chap

A few thousand years later we find tweedy gentlemen having the time of their life rolling superannuated plum puddings at a lone bottle of grog set on a green lawn. Whoever knocked over the grog rushed down and drank it thereby eliminating the need for a pinsetter. One brilliant but thirsty chap (undoubtedly the engineering type) had a happy thought. Why use only one bottle of grog? Being a reasonable sort of fellow, he set the number at nine. This sport was then known as the game of nine pints (referring to the nine pints of grog) and their gentlemanly "brrr" made it sound like nine pin's.



But at this time the wives reëntered the picture. They had been sitting home twiddling whatever it is you twiddle while their husbands were tossing a mean hook at the old grog bottle. They held a torch-light parade demanding that the city fathers abolish this game of nine pin's before they abolished the city fathers. Some of the women carried signs saying "Stop this throwing at grog—what's the matter with us" while others of a technocratic nature had placards reading, "We are being replaced by the machine age—our pins are best." One little old lady just had a sign, "*Strike* if you must, this old gray head, but *spare* our country's grog!" it said.

Modern Lanes

Of course, after this demonstration the city fathers were forced to pass a law abolishing the game of nine pints. However, the pre-engineering engineer who had devised the game was not to be outdone. He merely added another pint of grog and to this day it is called ten pints or pin's, as you will.

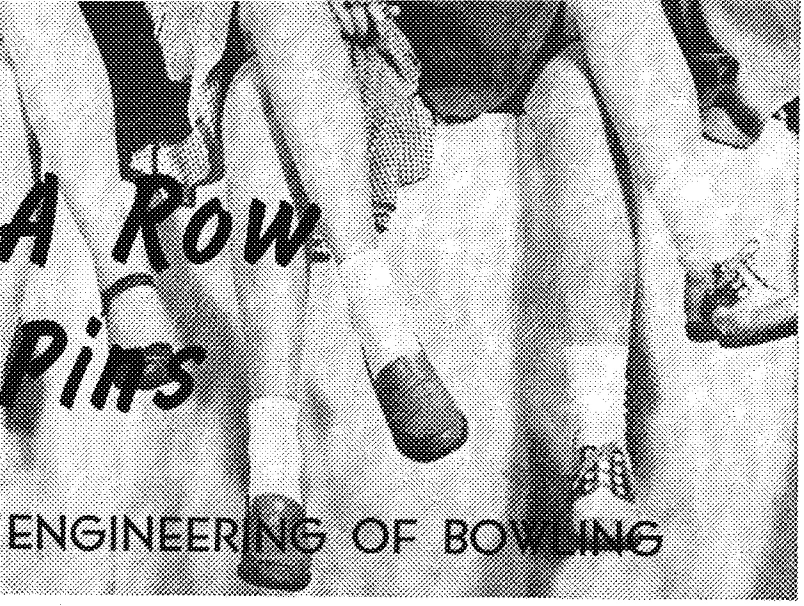
But enough of this history. Science has stepped in and really done wonders for this ten pin thing. Today we have super streamlined red-flash bowling "lanes." (The word alley offends the feminine sense of nicety.) Hard rubber balls with a deluxe Joe Blow grip weighing exactly 15 pounds, 15 ounces, and some odd grams are thrown down select Michigan maple alleys which have been set in place with the use of a transit and ground to within 40/1000th inch of leveiness. These regulations are fixed by an organization known as the American Bowling Congress. The A.B.C. is to bowling what the S.A.E. is to oil, A.S.T.M. is to concrete or the B.V.D. is to an unlucky strip-poker player.

Now, where the Neanderthal man used to throw at his wife at any range up to six city blocks, today's alleys set their target at precisely 63 feet and one-eighth inch. This doesn't include the foul line which adds another 3/7 inch, an important consideration when you are throwing a triple reverse, delayed action, quick-break hook. Speaking of quick breaking hooks, one ingenious kegler found that by placing a lead slug off center in his ball that it would not only hook but would turn around and come back for a second try at the pins—a decided advantage. This sort of ball is known as a dodo and is banned today. Then there was the case of another engineer that suggested the game could be made more intriguing by rolling an ellipsoid rather than a sphere, but this innovation would have limited the game to mathematics students who could figure out the locus of the curve. The proprietor, a hard-crusted old veteran of the lanes who hated to see his business go to pot, said bitterly, "Yah, ta bee sartain, ya could get a scooter and scoot down after da damn pins!"

But let's get to these pins which these scientific bowlers are trying so hard to knock over. The A.B.C. regulations state the heighth of each pin shall be 15 inches with a tolerance of 2/64 inches either way being permitted. Not stopping to puzzle out that "either way" phrase we go on to the shape and weight of the pins. The curves are specified more carefully than those for a fan dancer. For instance, among pages of specifications we find "at a point 8 and 5/8 inches from the base the diameter shall be 2 and 25/64 inches, while at a point 11 and 3/4 inches from the base the diameter shall be 2 and 35/64 inches."

Hand Set Pins

However, the American Bowling Congress has not taken advantage of all the mechanical achievements offered it. Though almost every alley in the country has a mechanical pinsetter, pins are still set by hand in the annual tournament which has been called America's greatest sports event. At this contest in which teams from every city in the country bowl against each other over a two-month period, a pinsetter projects a set of iron fingers through the spots where the pins are to stand by stepping on a lever. The pins, which have corresponding holes in their bases, are slipped on the iron fingers and then the lever is released and the pins stand in perfect alignment. This is supposedly more accurate than the



By John Wilhelm, S.L.A. '41

setting machine in which the pins are merely heaped in the top and fall through holes to their proper positions.

Because some energetic bowlers are inclined to "fudge" over the foul line and penalties must be called, the Congress employs referees to call these unfortunate actions. Two different automatic foul judges have been devised, using an electric eye or a frequency circuit to catch the offending foot, but both have been spurned by the Congress because they do not call one type of foul, in which your foot is over the line but not touching the floor, though some say you must throw a leg out of joint to commit this particular infraction.

A Moment of Glory and Then . . .

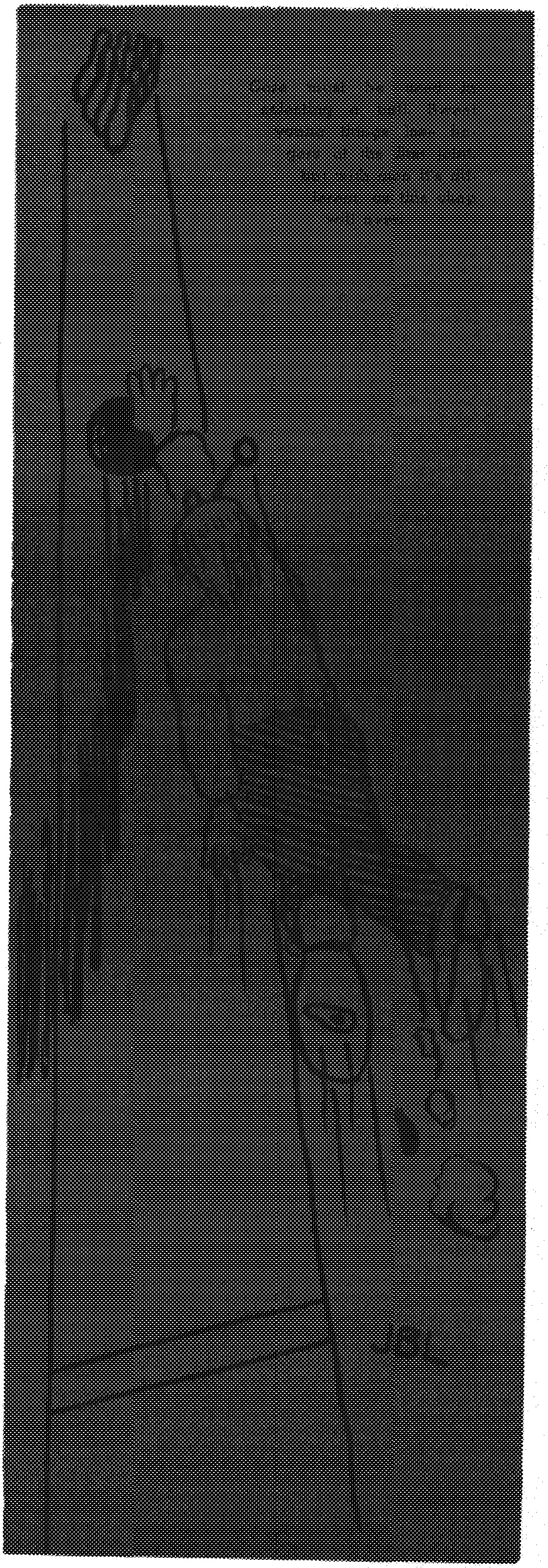
Engineers may find no end of good resulting from taking their *femme de coeur* down to the lanes; bowling lanes, that is, of course. Lest they labor under the impression that this is a hard, cold, mathematical affair, let us quote from a booklet, "Bowling for Beginners." (Distributed free by a manufacturer who will sell you one alley for $2,400 or else just a pin for a buck.) "For girls who are inclined to be shy, bowling affords benefits other than health and beauty. It gives companionship of the clean, constructive type that is the ideal of every American woman. It's equally difficult," we are still quoting, "to be self-centered and overly sensitive in an activity where each woman has her moment of glory, quickly succeeded by the next one up." This moment of glory stuff makes it sound as if bowling and engineers have a lot in common to offer American womanhood.

The booklet goes on to describe how bowling helps the process of desquamation, a good place to drop the whole subject before we are tempted to tell how we lost our skin on the alleys. We must, however, caution engineers who plan to take their girl friends bowling. Be careful about allowing the dear little thing to pick out her ball. They are inclined to pick balls as if they are buying shoes. Several have lost a finger at the first joint because of this.

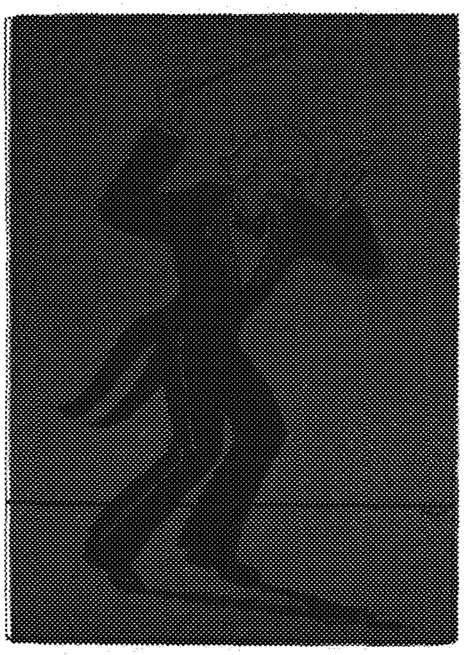
Don't make the mistake that one chemical engineer made recently, though. He, a bowler of considerable experience, decided in a weak moment to bring his O. A. O. with him when he went bowling. Inasmuch as she knew nothing about bowling, he gave her detailed instructions before he turned her loose with the fatal ball. She wound up and let go for a perfect strike, but—in the wrong alley. This should be avoided as it has been ruled illegal, and, moreover, it is highly disconcerting to the person whose alley you do the bowling in.

Release of Emotion

From this short dissertation it is evident that bowling is a highly sophisticated and mildly amusing sport. It has arisen from the rather humble pastime of sniping at one's wife with anything handy to a game wherein these two natural enemies can co-operate in scientifically smashing things. So try it if you haven't done it already. Go down some time when you have some steam to blow off and shoot cannon balls at the little pins. It's fun to watch the mess explode, and if you're lucky you can even sock your pinsetter.



UNCULTIVATED, NO! THERE IS



Music for Engineers

By Fred Jackson, Geol. E. '41

WE engineers are usually considered an uncultivated bunch of Yahoos. It is often wrongly assumed that we are uninterested in the arts. However, some of us assume that the arts are not meant for us, and, in that assumption, we, too, are in error. Beethoven wrote his symphonies just as much for Tech men as for Arts students.

My mention of Beethoven's symphonies has no doubt "wised you up" on the kind of music to be discussed, but that kind of music is hard to define. Is it "classic" music? No. Musicians prefer to reserve "classic" to refer to the period of Haydn and Mozart. Is it "serious" music? No. Much of it is even of a frivolous nature. Is it "great" music? Well, often . . . but not always. Any listener would tire of spending all his time on the Olympic heights. Is it "lasting" music? Perhaps that is the best term for it, though some pretty good stuff doesn't manage to survive. Even though the kind of music under discussion is undefinable, we all know what kind it is. Then, let's proceed.

On the worth of lasting music I need spend little time. To me, jazz, swing, and boogie-woogie bear the same relation to great music that True Detective and other dime novels bear to Shakespeare. Believe me, life is too short to go dribbling around with second- and third-rate stuff whether it be music, literature, or the graphic arts.

Much could be written on the powers of great music. I'll personally vouch for those powers, and I can produce other witnesses (unfortunately mostly male) if such are desired. I became so excited once while shaving to the spirited finale of a Haydn symphony that I nearly cut off my nose. On the other hand, other great works rest and relax me. At certain times such music is priceless.

As to all this talk about "understanding" music—forget it. If you enjoy music and get something worthwhile out of it, you have "understood" it just as the composer wanted you to. Don't be stumped by all the Italian and technical terms the musicians use. A knowledge of them isn't essential to the enjoyment of music. In order to enjoy the new Union one need not have the knowledge required to read the blueprints that were used to erect the building. Let the musician keep his technical terms and don't worry about them. Just enjoy the music he makes. The musician doesn't know our technical terminology either, but he uses and enjoys the bridges and cars we build.

There are several ways in which to hear good music. Each has its advantages and disadvantages.

Consider a phonograph and record library. After the initial expense of a phonograph there is the cost of records. Even though records cost only half what they formerly did and even though the cost is spread out over some time, the cost of a good record library is quite high. Often, however, it is possible to augment one's own collection by temporarily trading records with friends or getting records from record-lending libraries. With normal use and proper care, records show little wear, but both phonographs and records become obsolescent as technical advances are made.

The chief advantage of a record library is that you can hear the music when you want to and as often as you want to. Records enable you to get familiar with pieces that you might not enjoy on a single hearing. Also, a large variety of records are available, and it is possible to get records of some things you might never get a chance to hear in actual performance or even on the radio.

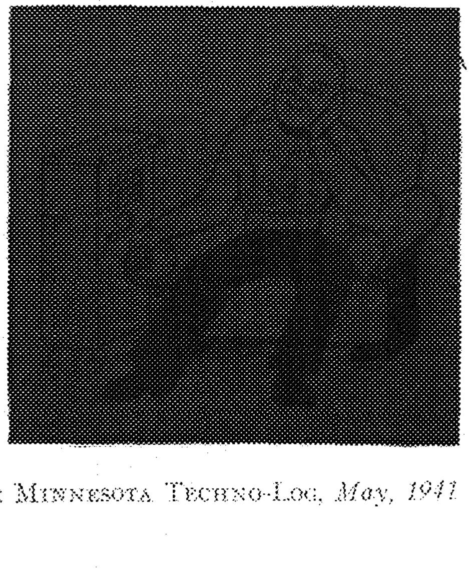
The radio has its ins and outs too. A long-awaited broadcast is apt to be cancelled while Hungry Hollow and Muddy Gulch vie for basketball supremacy. However, that seldom happens, and several excellent musical programs are regularly broadcast. Since almost everyone has a radio, a little time and a few cents on the electric bill are the only costs.

The radio and phonograph share some assets and liabilities as compared with the concert hall. Both of the former are so-called "canned" music. Even the best sets cannot reproduce music perfectly. For fidelity there are no substitutes for "the real McCoy." Furthermore, in the concert hall you can see the performers. As you settle down at home to enjoy the radio or the phonograph the 'phone rings, or the Gilhooleys drop in for a chat, or something else equally disrupting happens.

The concert hall isn't without disturbances either. There are late-comers, foot-tappers, whisperers, coughers, and the lowest of all species of snakes, program-rattlers. Furthermore, you can't be completely comfortable in the concert hall. At home you can take off your shoes and tie and sprawl out on the floor if you want to.

Of course, in many ways the concert hall has no substitute. The tones produced are heard undistorted by any means of reproduction. The performers can be seen by the listeners, and there is the thrill of seeing a great artist in person. Concerts are apt to be expensive, but many are priced very reasonably. Remember, the money paid out for tickets won't support a symphony orchestra, and when you go to hear one you are, in part, sponging off some generous donor. That donor is a music lover and is glad to have you sponge off him.

Nor are all music-in-the-flesh concerts expensive. Some are free. Brazenly cut third hour some Thursday and go over to Northrop Auditorium to hear Mr. Jennings play his weekly preconvocation organ recital. Drop in on one of the free concerts in the music building sometime. Exert yourself but a little, and you can hear an amazing amount of good music with little cost to yourself. After awhile you won't count the cost much anyhow. You will find music a wonderful servant, and—if worst comes to worst—a pleasant master.



The Modules of LAUGHTICITY

Lonely Hearts:

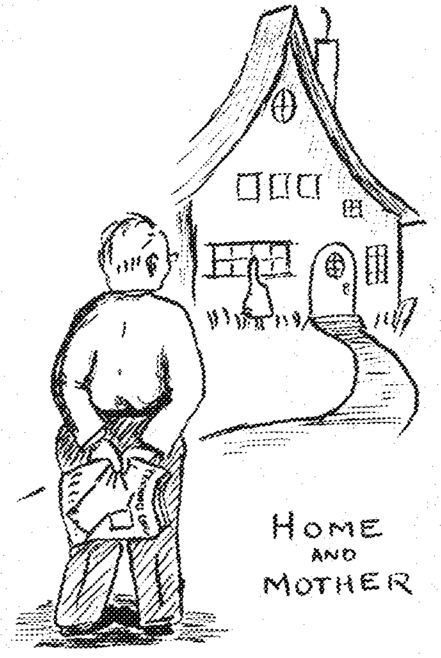
We hereby announce the formation of the CAMPBELLAMBERT DATING BUREAU, which will open its facilities to all comers. Our motto is: "We've got it; We'll get it for you; or it can't be made."

"Aren't those chimes beautiful? Such harmony. So enchanting."

"You'll have to speak louder. Those damned bells are making such a racket I can't hear you."

We are pleased at the success of our effort to elevate this column above the ordinary rank and vile of engineering humor, such as appears in the other pseudo-humorous columns in this mag.

And then there was the girl who was so lazy she wouldn't even exercise discretion.



Found in the application for a room in Ada Comstock Hall. *Residence for Women?*

Rooms: It is understood that double rooms are to be occupied by two persons. In case one of the registered occupants vacates the room, the woman who remains agrees to find another roommate at once or to move into another room on request.

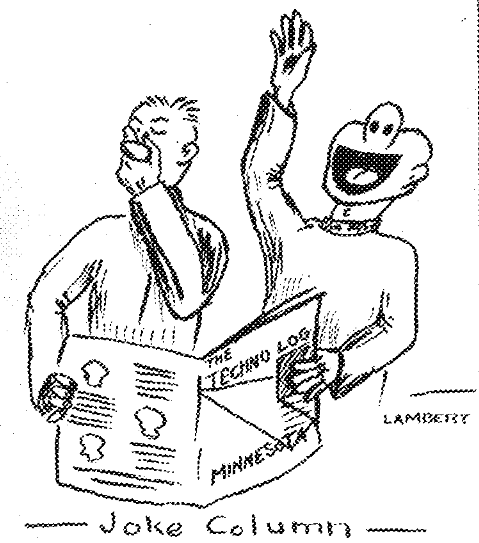
It is strictly understood that all rooms are for student residence only and that no woman is to use or permit her room to be used for any commercial purpose.

News item: "Statisticians find that nine out of ten women are knockneed." And for years we'd been thinking that statisticians never had any fun.

Police Sergeant: "What, you back again?"
Drunk: "Uh, huh. Any mail?"

A bachelor is just a fellow who has no children to speak of.

Gather your kisses while you may.
Time brings only sorrow;
For the girls who are so free today
Are the chaperons tomorrow.



A miss is as good as a mile, but who ever heard of dating a mile?

An old Southern colonel was making a trip through Turkey and one day hired a guide to take him on a personally conducted tour of the Sultan's harem. While wandering around through the halls he suddenly recognized a burly black negro attendant as a former hand on his Southern plantation.

"Well, Sam," exclaimed the surprised colonel, "what on earth are you doing away over here?"

"Well, suh, boss," replied the grinning negro, "Ah'll tell you. Ah has de best job in de worl'. Every day ah sits heah in front o' dish yeah do' way. Ah has a bowl o' watah in mah hand an' when dat long line o' beautiful gals wat belongs to de Sultan passes by, ah dips mah fingahs in de watah and trows it on 'em. When ah comes across one wat sizzles—ah is all done fo' de day!"

The nurse entered the professor's room and said softly: "It's a boy, sir."

The professor looked up. "Well, what does he want?"

These two jokes are not off color:

[redacted]

(Continued from Page 180)

in nitrogen and is dried, pulverized, and packed for distribution as fertilizer.

After leaving Milwaukee we journeyed to Chicago, getting there Saturday night. We checked in at the Stevens Hotel on Michigan Boulevard and made preparations for a big night in the "Windy City." Needless to say, a good time was had by all. The next day, Sunday, was a much needed day of rest, during which several of our party visited the museums and other places of interest.

On Monday we inspected the Sinclair Refining Co. in East Chicago. It covers miles of ground, as our feet soon indicated, and is located near several other refineries. Here they produce gasoline, lubricating oils, paraffin, and grease from crude oils piped in from Oklahoma. This was followed by trips through the U. S. S. Lead Refining Co. and the Grasselli Chemical Company. The former was engaged in the refining of crude lead to produce pure lead electrolytically, and also obtaining gold and silver slimes, from which the precious metals are recovered. The Grasselli plant manufactures various industrial acids and salts and looks like a lot of barns thrown around the equipment. Before being admitted to the plant, we all had to have hats or some other head covering, so several who did not have hats wrapped seat covers from the bus around their heads. They looked like a group of old maids.

Tuesday we inspected the Universal Atlas Cement Co. in Buffington, Indiana, and the Illinois Steel Co. works in South Chicago. The latter was such a big plant that we rode from unit to unit in the buses. A free lunch was given to us at the plant of Procter and Gamble in Hammond, Indiana. Here we saw the manufacture of soap, and received a box of samples.

On Wednesday morning we regretfully checked out of the Stevens and started for the Sherwin-Williams Co. This plant manufactures paints and organic and inorganic pigments. Here we also had a free lunch, which was very welcome, since many of us, after four days in Chicago, were having financial worries. In Argo, Illinois, we visited the Corn Products Refining Co., which is engaged in the processing of corn to produce starch, glucose, corn oils, and cattle feed. A very disagreeable odor in most of the plant made for a speedy trip through all but the packaging department, where some of the girls received more than a little attention. At Joliet, we visited General Refractories, where silica brick for furnaces is made.

That night was spent in Aurora, where exaustion forced many to get a good rest. The next day we travelled to Peoria, Illinois, where the Hiram Walker and Sons Distillery is located. This is the world's largest and most modern distillery, and proved to be the climax of the trip. It produces whiskey, neutral spirits, gin, and cordials. Grain residues are processed to be used in feed. The carbon dioxide formed as a result of fermentation is sold to a branch of the Liquid Carbonic Co. where it is converted to dry ice. Much hidden talent came to light at the distillery, when free "personality fluid" was given out.

The following day we visited our last plant, that of the Quaker Oats Company, in Cedar Rapids, Iowa. Oatmeal, Puffed Wheat, Puffed Rice, and Furfural are made here. The latter is made from the oat hulls, and is used as a selective solvent in oil refining. This is the world's largest cereal mill.

On Saturday we traveled home, arriving in Minneapolis at 4:00 p. m., tired and haggard, and happy to be home for a restful week end before the start of Spring quarter.

The trip afforded us an excellent opportunity to observe, first hand, things that we had studied for the last few years. The effect of national defense was noticable in many of the plants and by the general activity in the vicinity of Chicago and Milwaukee. Besides being very educational, the trip gave us a chance to really get acquainted with other members of the class, many of whom we hardly knew before. It was the general opinion of everyone, that Roger "the codger" Green was "the funniest kid on the bus."

A BLOW fell, on a bright and beautiful morning when Mr. Ford's trouble came to a head and the labor problem at River Rouge cast an impenetrable gloom over the afternoon lunch session. No longer was there a merry smacking of lips or jovial kidding. An ominous murmur held forth and gloom was as thick as pea-soup fog. Speculation ran rampant. There's not going to be a trip—— There is too—— It's going to be postponed—— It isn't either.

However, on a chilly, foggy, dark Friday morning we started off after the shoving, scrambling, pushing, and pulling had ceased and as soon as I got my head out of Doyle's vest pocket where it had been lodged by Prof. Koepke who gave me three black eyes, a bloody nose, and put my head in a very ungentlemanly position while he was trying to get settled in a front seat.

Such hilarity! You'd think the boys were going on a lark instead of an educational tour. I'm glad that I am the serious type who realizes the responsibilities of such an excursion.

Our education started at the A. O. Smith Co. in Milwaukee. They have a materials-handling set-up that puts anything that we had ever seen to shame. It should be, though, because they paid twelve million dollars for it. This outfit makes automobile frames for Packard and General Motors, and when I say makes them, I mean they put out more automobile frames than there were blown-out fuses at the Electrical Show. The thing that was most fascinating and also was most noisy was a jig in which they held the assembled frame while a complicated blower system put 120 rivets in place at one time. Somebody suggested that the fellow who designed it was probably standing on his head cutting out paper dolls. I really didn't believe this although Bartelet is usually an authority.

From the A. O. Smith Co. we started for Chicago. Here we visited one of the largest electrical companies in the world—Western Electric.

Western Electric is the place where they make all parts for the telephones and assemble them but forget to designate which end you talk through. While the rest of us were watching the wire-drawing process, a special searching party had to be sent out to find Galuska, Quist, and Lund, who had gotten lost while watching the assembly department where they hire upwards of two hundred women.

On the way back to the hotel the boys were all talking about the relatives they were going to visit, the symphonies they were going to hear, and the radio lectures they were going to listen to. I, not caring for any of these, agreed to go for a walk with Tom Carlson, Wick, Doyle, Christofferson, Eklund and a few others.

The next day we were off for Detroit and Henry Ford. There we stayed at the Dearborn Inn. At 7:00 p. m., when we arrived, we didn't have anything to do for ten minutes so we bathed, dressed, shined our shoes, unpacked, wrote letters in the remaining time before going, by special invitation, to the Ford Sunday Evening Hour.

Monday morning saw us up bright and early and started with a round of inspection that stopped at nothing and left us all with our mouths open.

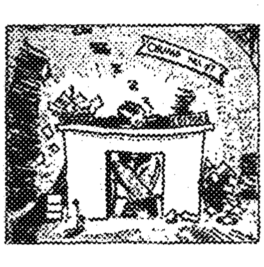
Most of us had never heard of Ford's village industries. These are small plants that produce everything from starters and generaters in the Ypsilanti plant to engraving, e.g. Ford's name on the hub caps and name plates for the Ford and Lincoln cars. Drills, dies, taps, gauges, and a host of other things—all are made at separate villages and are sent into the River Rouge plant in Detroit to be used. Our guides took us on special trips through the Greenfield village and the Ford Museum in which one of the finest collections it is anybody's pleasure to witness is assembled.

Friday morning we were allowed to go through the River Rouge plant itself and were able to compare body-making and materials—handling by Ford with that of the Fisher Plant of General Motors which we saw later in the day.

We left directly for Gary, Indiana, from Pontiac, Michigan, where Fisher is located, and arrived there on Saturday morning and went through the Carnegie Steel Mills where we witnessed the rolling of steel billets into "I" beams.

This was our last stop, and most of us headed home directly from the steel mill, arriving here at about 2:00 a. m., Sunday morning. One bus-load headed by "Esquire-I've-got-to-lug-the-wife-a-present" Algren, stayed over in Chicago. There was only one guy who was slighted. B. J. Robertson was all broken up because he couldn't stay and see the dog act he and Algren were so crazy about the previous night.

But regardless of the ribbing and regardless of the piled up back work we came back to, the M. E. department never gave the seniors a better break than making the inspection trip compulsory. You think you know the fellows in your class? No you don't, brother. They're a lot better bunch than that.



Off the Editor's Desk

By Wallace K. Belin, Ch.E. '41

In the Spirit of Engineers' Day • • •

the TECHNO-LOG breaks away from the policy of running a magazine full of technical articles. Except for the article on television the May issue is entirely devoted to the development of the cultural, social, and human qualities of the engineer. Engineers are not devoid of these attainments as many people would have us believe. They may not stray from their studies as often as other individuals, but when they do they are apt to do a much better job of it in a much shorter time.

Lest Some of the Visitors • • •

who read this eighth issue of the TECHNO-LOG are misled to believe all is fun and frivolity in the TECHNO-LOG, let us refer them to a full year of conscientious publication of a truly technical magazine.

Especially Noteworthy This Month • • •

was the way some of the boys extended themselves to make this issue super-deluxe and extra-streamlined. There was Rockwell with his camera and captions. His crowning achievement was that of the ten-pins pictured in the bowling article. There was Torell, the issue editor, who took most of the ranting and raving of the editor. His fertility of mind in page make-up drove at least three printers mad before censorship was clamped down. Don McClure again did his dependable job on getting the departments in on time. His combined rewrite and make-up work on the faculty page was superb. Ed Proszek tried to put an "e" in Haydn but otherwise largely took over the copy editor's duties and did a creditable job.

Everyone on the staff, and even George Johnson, the printer, and Ed Harding, the engraver, coöperated to the fullest extent.

To the Gopher • • •

and Lon Taylor the TECHNO-LOG extends a special thank you for the inconvenience that they were caused in lending us eleven of their organization engravings.

"For a Row of Pins" • • •

by John Wilhelm is the result of a four-month search for a suitable pseudo-technical article on bowling. John Uppgren made the last most determined attempt and some of his cracks are included in the finished story. The photographer and the make-up men seem to have gotten their pins and curves mixed up a bit, but we trust that the objections will be few and far between.

Congratulations • • •

to the new editor, Bruce Torell, and the new business manager, John Elliott. We wish good luck, good fortune, and even a better TECHNO-LOG than this year.

Off the Editor's Desk • • •

comes word that he has appreciated his staff more than words can tell. Probably the staff was more prankish than the average, but it was a staff that could be depended on to deliver in the pinches with the result that every issue was out on time.

STUDENTS . . . ***Let's Make Friends***

Many manufacturers and local merchants are offering their friendship to you in the pages of the **Techno-Log.**

Reading their advertisements will help to strengthen this friendship because it familiarizes you with them and what they have to offer you.

RING DOWN THE CURTAIN

on the

39th ENGINEERS' DAY

by attending the

28th ANNUAL BRAWL

NEW BALLROOM
9:00 - 12:00

RADISSON HOTEL
$1.25 Per Couple

SATURDAY, MAY 17

SWIFTY ELLICKSON'S ORCHESTRA

● ● ●

ENGINEERS' DANSANT (Sunlight)

UNION BALLROOM
PATRICKS 20c or Button

3:30 - 5:30
PATRICIAS FREE

FRIDAY, MAY 16

G-E Campus News

JUNGLE JIVE

MISSIONARIES working among a newly discovered tribe of savages in Netherlands New Guinea, which has many times been called one of the "earth's remotest spots," had a strange experience.

They invited natives into their bamboo hut and turned on their short-wave radio. The tribesmen looked at one another in frightened amazement. Rev. C. Russell Deibler, one of the missionaries, says this of what happened: "As they heard voices coming from the receiver, they crouched over close and jabbered back, utterly bewildered where the strange voice was coming from."

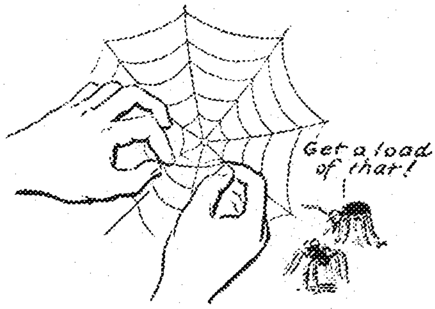
The missionaries wrote their experience in a letter to Station KGEI, G.E.'s short-wave station in San Francisco, which sends its radio signal into Asia, using special directional antennas.

PRESTO!

THREE tiny 1000-watt mercury lamps, mounted in the new television floodlight developed by G-E laboratory engineers, yield as much light as 225 ordinary 60-watt bulbs. For the same amount of illumination these powerful little lights produce only one-fourth as much heat as do incandescent lamps. Water cooling dissipates much of the heat and so makes possible the very small size.

The new lights are equipped with motors and gears for remote control, so that they can follow the movements of studio performers.

These tiny lamps were developed at G.E.'s Lamp Department at Nela Park, Cleveland, which each year selects promising young engineering-college graduates from "Test" to train them in the lighting game.



SPIDERCRAFT

COULD you spot-weld wire one quarter as thick as a human hair?

That's the problem G-E engineers faced in producing filaments for thermocouples, those little super-sensitive devices used in measuring high-frequency alternating currents or voltages. These dainty filaments are 1/2000 of an inch in diameter—so small that they are almost invisible—and have to be welded into a "K" shape.

The work is so fine that it must be done under a microscope, using a pair of tweezers to hold the wires.

At Schenectady there's a whole section of the G-E Industrial Department devoted entirely to welding. Practically all the men in this section are graduates of the G-E Test Course. General Electric Company, Schenectady, N. Y.

GENERAL ELECTRIC