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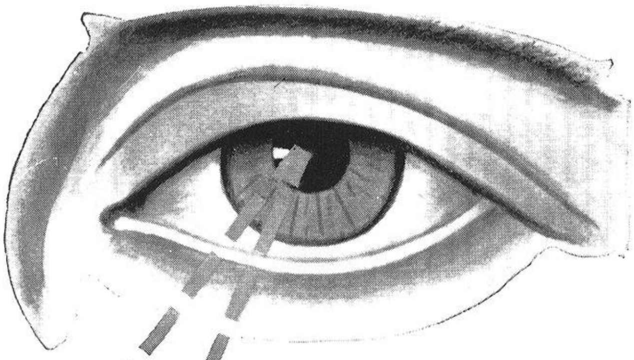
WISCONSIN ENGINEER

January, 1943

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED



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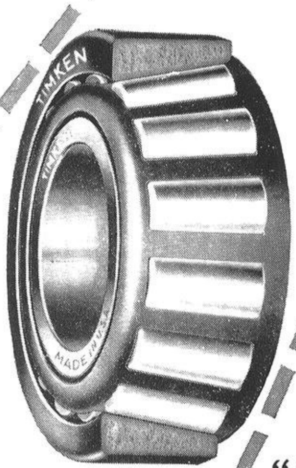

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TAPERED ROLLER BEARINGS

99.98% pure

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APPROXIMATELY 30 billion kilowatt-hours of electricity will be consumed to produce all of the aluminum and magnesium we shall need for warplanes and other uses during 1943.

And every kilowatt of this vast amount of power must be *converted from A.C. to D.C.* before it can be used in the production of these metals.

Most of this conversion will be done by the Ignitron . . . *a new and more efficient mercury rectifier* that is a direct result of Westinghouse "know how" in electronics research.

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Few chemists have the skill, knowledge, and special equipment to solve such a problem of almost absolute chemical purity. For this reason, Dr. E. Bruce Ashcraft . . . micro-chemistry expert of the Westinghouse Research Laboratories . . . was assigned to the job.

Dr. Ashcraft lives in a Lilliputian world of chemical analysis. Tiny test tubes, doll's-size beakers and retorts, polarizing microscopes, spectrographs, a balance that measures the weight of a *millionth of a gram* . . . these are the keys he employs to unlock the invisible world of matter.

With the help of micro-chemistry, Dr. Ashcraft has made possible the control of the extraordinary purity of all graphite and mercury used as electrodes in Ignitrons.

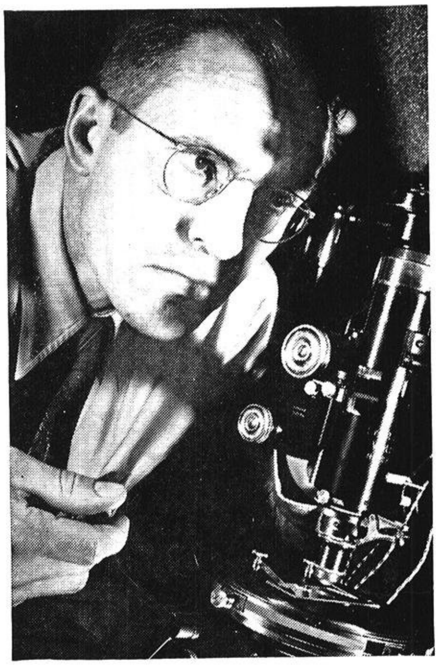
And now, *electronics at work* are bringing victory closer every day . . . for Ignitrons with a rated capacity of more than 3,000,000 kw are turning out the thousands of tons of aluminum and magnesium upon which our Arsenal of Democracy depends!

* * *

WE SALUTE DR. ASHCRAFT and the other thousands of scientists who are working for victory in research laboratories all over America.

We also salute the scientists of tomorrow . . . the engineering students now in college who will be called upon to rebuild a war-torn world.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pennsylvania.



TOM THUMB CHEMISTRY . . . Dr. E. Bruce Ashcraft examines a specimen weighing less than a microgram . . . approximately 1/50th the size of a grain of ordinary table salt. Dr. Ashcraft received his B.S. at Texas A & M, and his Ph.D. at Cornell University in 1937.

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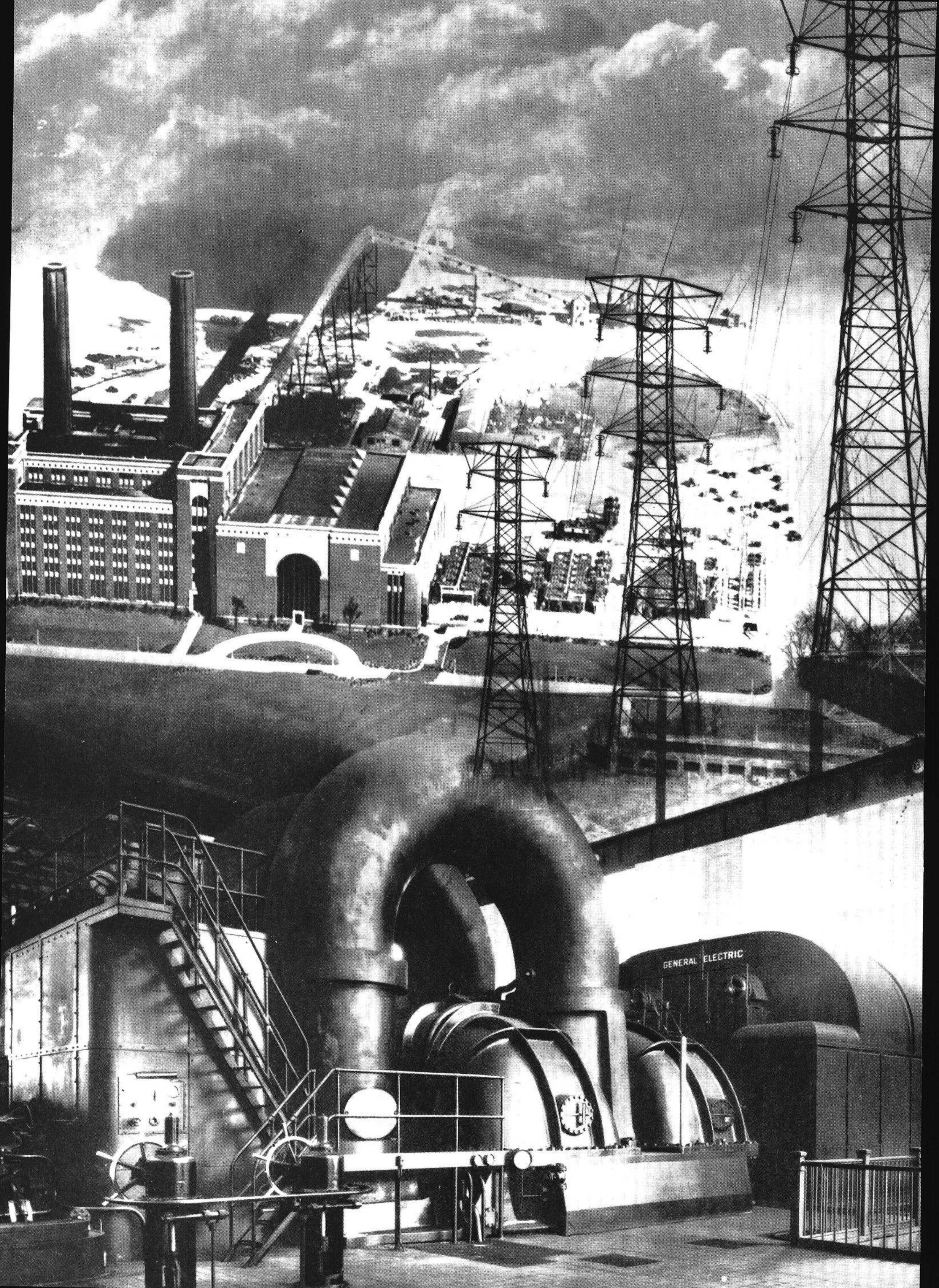
GENERAL ELECTRIC

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In This Issue . . .

ENGINEERING ORGANIZATION

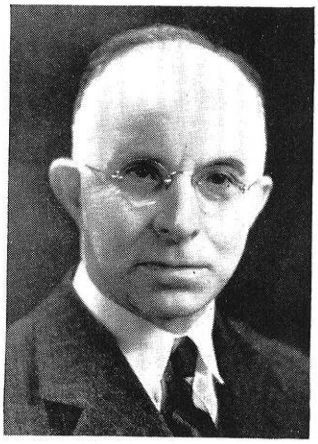
of a Large Industrial Business

by Dr. R. C. Muir, e'05

An address delivered at the American Institute of Electrical Engineers' summer convention of 1942 by Dr. Muir, who is executive vice president of General Electric Company

AS THE basis of this description of an engineering organization for a large industrial business, I shall use the General Electric Company, with which I have been associated for 37 years. The business of this company embraces more than 50 lines of products, which vary greatly as to type—for example, measurement instruments and steam turbines. The policy of the company, favored by the newness of the art, has been such that no product has been frozen for any great length of time, and there has been a constant flow of new or improved products to meet the ever-expanding uses of electricity.

With this background it is apparent that the engineering branch must be supported by a strong research organization, a strong sales and sales engineering organization, and a versatile and able manufacturing organization.



DR. R. C. MUIR

There are several forms of engineering organizations which could be designed to take care of an operation such as this; but before putting any one of them in a one-line diagram it might be well to set down a few principles which seem to be quite fundamental in the organization and management of the engineering activities of a large industrial organization, such as this. The problem is one of obtaining directness of action and, at the same time, freedom of action, without conflict.

Fundamental Principles of the Organization

We may view the form of organization as a mechanism or structure through which management functions; and, as with a well-designed machine, it must be simple if it is to be efficient and direct in action. It should clear the path of obstacles, allowing to the individual engineer freedom to do, rather than specifying what he cannot do.

We are in a business; and the engineering organization, being a part of that business, cannot be considered by itself—it must be designed into the fabric of the whole organization. Engineering should be tied into almost every phase of the management of the business, from the top engineering executive to the engineer in charge of any one line of products.

The form of organization at its best should be subordinate to personnel. It should be shaped to meet the particular qualifications of the men rather than to shape the men to meet a specific or exact form of organization. This is the principal difference between industrial and military organizations. E. W. Rice, Jr., former president of the American Institute of Electrical Engineers, once said that you could give him the most perfect form of organization in the world and it would fail unless it was supported by an adequate personnel, but that a very good job could be done with the right people even though the form of organization was quite inefficient.

Central Staff, Departmental Engineers, Consultants

The central staff should be small and compact, and insofar as possible it should confine itself to the broad direction of the work. The individual engineers who head the various departments should be built up by placing upon them complete responsibility for the engineering of the line of products to which they are assigned. Responsibility should always carry authority. No one in the engineering organization should be more than one or two men removed from the central head of the organization, whose door should always be open to any engineering employee.

The service of consultants, experts, and free lances should be available to those carrying the responsibility for the product, but they should not be in authority. It is preferable to carry these specialists in the laboratory or laboratories where they can serve the entire engineering organization rather than to duplicate these talents and facilities in each engineering department that is responsible for a specific product.

The over-all engineering department should be supported generously by engineering committees on materials, practices, applications, or technical problems common to a number of the product engineering departments. Engineering conferences are helpful.

Personnel Requisites

It is most satisfactory if you can develop your own men, choose a wide variety of talents from a wide variety of schools, plan the development of your men fifteen years or more ahead, and keep the age line healthy—that is, always have new talent coming along and plenty of reserve. Always have a runner-up for every important position so that embarrassment cannot result from the loss of any one man. Constant vigilance should be exercised to see that no one is kept too long in a position which does not tax his ability. Educational courses are tremendously important. Loyalty, spirit, and morale cannot be legislated —these qualities must be cultivated and developed; and, above all, exemplified.

Form of Organization

The foregoing principles seem the most important of those we try to follow in the organization and management of engineering in the General Electric Company. We may now return to the consideration of the form of organization itself.

Engineer Executive's Staff, Functions and Operation

There should be an engineer executive in charge of design or product engineering. He should have staff members who concern themselves with operations, budget making, expense control, and other administrative matters; staff members who know the products and who concern themselves with quality control, the research and development program, and the personnel and the personnel requirements; and staff members who obtain and train the personnel for all the departments. It is preferable to have a number of the staff members broadly trained so that they know something of the business, the development program, and the personnel. These members would be able to carry on with less dependence upon the executive in charge and at the same time would be making larger jobs for themselves.

The commercial-engineering organization and the research organization could also report to this engineer executive, but in an organization as large as the one under consideration it has been found desirable to have an engineer executive in charge of the commercial-engineering organization (which includes the field organization) and another executive engineer or scientist in charge of research. The latter two report directly to the president of the company but are closely coordinated with the design-engineering organization.

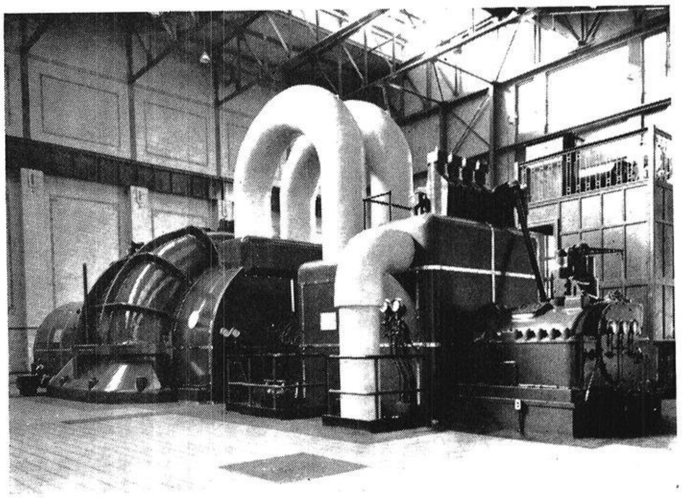
The executive in charge of engineering is a member of the president's advisory committee or the committee on general operations; therefore, we have at the top a tie-in for engineering from the business and policy points of view. He, his staff, the research laboratory, the commercial-engineering department, and consultants are functional, operating as it were across the entire organization.

The executive in charge of engineering who has a good staff has little occasion to worry about day-to-day operations, because the organization carries these out very well. He should keep well informed, however, on the operations in all departments. This he can do through short quarterly reports backed by frequent contacts with his staff members. Only in this way can he give broad supervision to the work and make wise decisions in those matters which come to his attention every day. This familiarity also enables him to show an interest in the work of any department, and this has a marked influence in improving spirit and morale.

If the specification of a strong central engineering staff is met, the executive in charge and his staff are looked to as one by most of the organization. The staff carries the management load, largely leaving the executive in charge sufficient time for the consideration of major projects, changes, or matters which only the executive can handle.

Design Engineers, Committees, Laboratories

Since the products vary greatly, it would seem that each product might support its own design-engineering organization. In some of the more comprehensive lines—such as motors, transformers, switchgear, or turbines — where types or sizes make natural division points, two or more engineering departments are preferable to one.



Typical modern turbine installation

Each design-engineering department is headed by an engineer who functions in management through a committee of three: one representing manufacturing, one representing sales, and one representing engineering. These three are responsible for the business in that line under the broad supervision, of course, of executives higher up. The engineer also has representation on the product committee which plans the product for the future, and on those coordinating committees that have to do with such general problems as heat transfer, lubrication and bearings, insulation, etc., which are of interest to him. He is responsible for the design, development, and production engineering, and must have an organization commensurate with the job.

Each of the more than 50 engineering departments vary somewhat in the form of organization because of variations in product and the men who make up the department. The engineer does not attempt to carry on his payroll highly specialized men whose full-time service he does not require; these are carried by the laboratories or the central staff. On all technical matters he reports directly to the engineer executive in charge (or his central staff), but this is not practical in the case of administrative and production matters in a wide-flung organization that has many plants in different parts of the country.

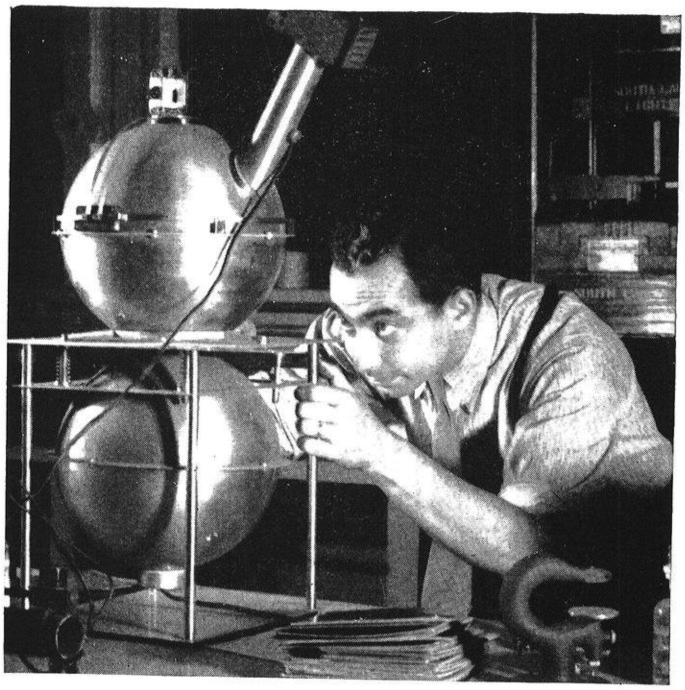
Policies covering manufacturing and engineering personnel housed under the same roof must be harmonized; and this duty, and the operation of the plant at large, is performed by a work or plant manager, who also carries the intermediate responsibility for engineering operations in his plant. This is a full-time job for a high-grade man; so the plant manager is supported by an assistant who assumes this responsibility.

Each plant also should have a laboratory for material testing, process control, and such other work as may be carried on better by a laboratory than by a manufacturing or engineering department.

Specialized laboratories, such as those dealing with plastics, high voltage, etc., should be maintained by those departments that can justify them. A research laboratory should serve the entire group of laboratories and engineering departments.

The functioning of the engineering organization, then, is directly from the office of the executive in charge of engineering to the various engineering department heads on technical matters, and through the works managers to the various engineering-department heads on administration and production matters.

Except in very special cases, the executive in charge of engineering is not brought into the matter of engineering of orders for production. This is handled directly by the individual engineering department head. He cooperates with the factory in the planning of manufacture and test. He is responsible for the suitability of the product and has the authority to pass or hold it until he is satisfied that it meets the requirements. It is his responsibility to obtain such outside assistance from consultants or laboratories as he may require. The executive in charge of engineering always has the opportunity to review the designs or engineering of any specific order and to hold engineering conferences on such orders when they are sufficiently new or outstanding to warrant it, or when they depart radically from former practices.



Research chemist at work

Production engineering, therefore, of any product is direct and there is no pyramiding of approvals or responsibilities. But there must be a constant check from the head office and from the works manager on the meeting of schedules and on the quality and the cost of the product.

Development and Research

Each engineering department carries on a very active development program in which the engineer is guided through his product committee and the commercial-engineering group. A budget of projects to be taken up, with periodical reports as to progress, is always valuable; and frequent check on them by the central office is helpful and stimulating. It is in development work that engineering conferences and coordinating engineering committees are particularly valuable. We find that even though business in a particular line of products is extensive and the engineering department is capable and well supported by its own testing and development facilities, talent from outside that department is helpful.

A reasonable proportion of the personnel of each engineering department should be of the development or research type, as it is only with those who have such abilities that development work can be carried out successfully.

However, in addition to the development work carried on in the established departments, we find it well to encourage research and development in our research laboratory and other General Electric laboratories, as well as by consultants and free lances, quite independently of any specific objectives set up by the design-engineering departments.

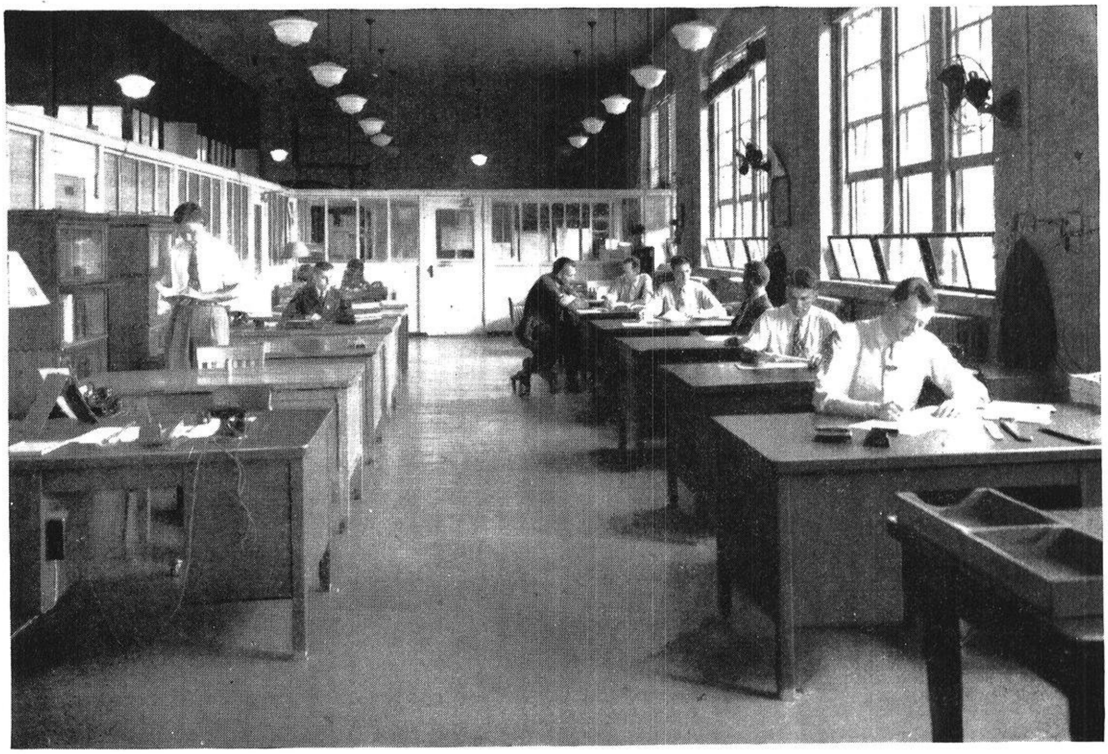
Recruiting and Training of Personnel

It has been the policy of the company to recruit technical students from graduating classes and to train them for the various positions in the engineering department, the commercial department, and the manufacturing department. Inbreeding is automatically avoided by the practice of recruiting from a wide number of schools, by deliberately choosing different types of talent, and by means of a test training course which requires the student engineer to obtain experience in several testing departments or laboratories before he is assigned to a specific engineering department. About 10 to 15 per cent of the newly graduated engineers entering the service of the company have the opportunity of participating in a three-year course in advanced engineering, during which period they have assignments in several different departments.

These provisions, in addition to a generous policy of participation in sponsor and trade-society activities, and the numerous customer contacts made in the normal course of business, all tend to prevent narrowness and to train men who know the organization and know how to work collectively in it. They also develop in the man a spirit of loyalty and cooperation that goes a long way toward making management's job easier.

The development of personnel comes closer to the central office than any other operating function, and this is as it should be. For this reason, it is well for the executive engineering head and all the other members of his staff, as well as those who give their entire time to engineering personnel, to be thoroughly interested in and collectively acquainted with those in the various engineering

Graduate students taking advanced engineering courses in industry



departments. In this way not only can the various departments be manned with adequate talent, but the men can be moved around and more broadly developed for more important positions than those for which they would otherwise be qualified.

Departmental Divisions of Company

There may be many variations in the organization setup or in the method of functioning just described, but the principles underlying the form of organization and its functioning remain substantially unchanged. As a matter of fact, as the business of the General Electric Company has expanded both as to variety and volume of products, we have found it advisable to make modifications in our form of organization from time to time. Such changes have seemed desirable from the business point of view rather than from the engineering viewpoint.

At present there are four main departments of the company. The largest, which covers apparatus lines in general, is in itself organized and operated very much as has been here described, the engineer in charge being an executive officer of the company. The managers of the other departments are executive officers of the company. These departments do not have an executive officer in charge of engineering, but this may come about should they grow in size or complexity. The president of the company has on his staff an executive officer of the company who has the responsibility of coordinating and supervising broadly the engineering of all of the departments of the company. He also is responsible for the coordination of research and engineering. Hence, the overall operation or effect is the same as has been outlined.

Concept of Ideal Engineering Organization

In conclusion I should like to present a concept of an ideal engineering organization in operation.

Imagine the form of organization to be an edifice or workshop, a structure of offices or functions where men do useful things; a structure stable as to framework but flexible as to partitions.

Then picture the living or mobile part of the organization, a continuing, never-ending flow of men through this structure, who work as they go and progress according to their contributions.

All through the structure there is a moving up or rearrangement of men, often accompanied by the moving of a strut or a partition to give the new incumbent more freedom. Sometimes new partitions or rooms are added to take care of expansions or new work. The decisions as to which men shall move and to which office they shall move are made by the men at the top of the structure, assisted by the men in the various pinnacles, all of whom have been encouraging, guiding, and directing the men who are now ready to move up to higher positions.

The men in these top positions will also move on when their time comes; and one measure of their success is how wisely they have chosen, and how well they have trained, those who are to succeed them.

The output or contribution of the collective group is governed by many factors—the ability of the men, their supervision or direction, the structure in which they work. These factors might be likened to the carbohydrates, proteins, and fats in our diet. Fully as essential, however, are those intangible factors, loyalty, morale, cooperative spirit, pride of heritage, an intense desire to serve mankind well, which might be likened to the hidden vitamins in our food, without which we languish and fall victims to disease and ill health. These intangible factors are developed by the opportunities and the traditions of the engineering profession and of the company of which the engineers are a part.

Presenting Members of . . .

POLYGON BOARD

The six senior members of Polygon Board have worked diligently in planning activities of the engineering campus for the past year. Following are short biographical sketches of five of the members. Ed Dickinson, the representative of the American Institute of Electrical Engineers, is also president of the society, and was covered along with the other society presidents in the November issue.

•

HAROLD HOLLER

As president of Polygon Board, Hal is probably one of the best known engineers on the campus. His early life was spent in Milwaukee with his high school career ending in 1936. One year later, he received his degree from the Milwaukee Business University and then decided to have a look at industry. He obtained a position with the Milwaukee Welding Division of the General Electric Company and promptly worked his way up to office manager. After three years of this work, he decided to further his education and came to Madison to study mechanical engineering.

HAROLD HOLLER

As a sophomore, Hal was initiated into Triangle fraternity. The following year he became treasurer of the organization and in his last semester was elected steward. In the meantime, Harold worked on the Engineering Exposition of '41, was elected Polygon representative of A.S.M.E., became a second lieutenant in the Engineer Corps of the R.O.T.C., and found time for his favorite sports of skating, handball, bowling, and baseball. All this, of course, was capped with his election to the presidency of Polygon Board. Subsequent to this was his chairmanship of the Engineers' Dance to which he escorted Dorothy Teude —fiancee from Milwaukee.

We also can readily appreciate that summers did not prove to be breathing spells for Hal when we realize (according to his own words) that he has been 105% self-supporting while at school. Two summers were spent at Vilter Manufacturing Company in Milwaukee and C.P.T. flying was added to his schedule during the past summer.

However, Hal graduates this January and in short this means the Army. He awaits orders.

•

JOHN MEIGS

John Meigs is the Society of Automotive Engineers' representative on Polygon Board. His home is in West Allis, and he attended Milwaukee Extension for two years where he participated in basketball, track and swimming. He is secretary of Polygon, chairman of the National Debate Committee of S.A.E., and member of Phi Kappa Sigma, social fraternity.

John's hobbies include a home work-shop, hunting, boating and fishing. Four of his summers were spent as an operator of a stern paddle-wheel excursion boat on a fair sized inland lake. He installed a gasoline engine in this 36 foot boat and made trips around the lake picking up passengers at their cottages. Although last summer he was a machinist's helper at Le Roi Motors, Milwaukee, he found time, with the help of Mr. Buroker of the machine design department, to re-design and rebuild the paddle-wheel of the boat so that it would operate more efficiently.

His primary interest is the design of internal combustion engines. Next June he is going with the National Advisory Council for Aeronautics in their Aircraft Engines Research Lab at Cleveland. His ambition after the war is to go on a cruise down the Mississippi to South America in an auxiliary powered sail boat with his buddy, who is now in the Air Corps.

JOHN MEIGS

•

MICHAEL DUNFORD

Mike, senior chemical from Appleton, represents the American Institute of Chemical Engineers on Polygon Board. As publicity chairman for the Board during the past semester, he has done an outstanding job of publicizing engineering activities and especially the last engineers' dance. He is a member of Alpha Chi Sigma, chemical fraternity, and is coaching their hockey team this year. Ice skating and swimming are his hobbies.

After graduation from high school Mike spent three years in the laboratory of the Kimberly-Clark Paper Company before coming to the University. During the summers he has gone back there and worked on mill production and special problems about the plant. One of these problems was to run a water balance on the entire plant to determine the amount of water that came in, how it was utilized, and where it was disposed of. He went to the six weeks' session last summer to take the required course in industrial operations. After this he headed for Merrimac where he was employed as a carpenter's helper. Mike declares it was good experience working with skilled labor although it

MICHAEL DUNFORD

was a contest between brawn and brain most of the time.

He has no plans for industrial employment since he is a flying cadet in the Air Corps Reserve and expects to enter training upon his graduation next May.

•

EARL MAAS

Earl, representing the American Society of Civil Engineers, has served on the Board since last fall when he was elected to fill a vacancy. He is probably more familiar to undergrads as the man who passes out keys for surveying equipment in the basement of the Education and Engineering building. In his capacity as student assistant in the surveying department he also checks hand-books, corrects quizzes and helps freshmen throw their metal tapes into neat coils. He was promotion chairman for the last Polygon dance.

Earl graduated from Watertown High school, where he played football and basketball, and was secretary of the senior class. He enrolled in the architecture course at the

EARL MAAS

University of Illinois for one semester, but architecture did not agree with him so he transferred to Wisconsin and became a civil engineer. Last summer he was employed in soil mechanics work for the runways at Truax Field, Madison.

Building construction is his foremost interest and he has worked five summers as a carpenter's apprentice for his father, who is a building contractor. His work took him all over the state and one of his jobs was assisting in the construction of the Carillon Bell Tower on the University campus. He expects to go into the service next June and obtain construction experience with the Navy or the Seabees.

•

WILLIAM WILCOX

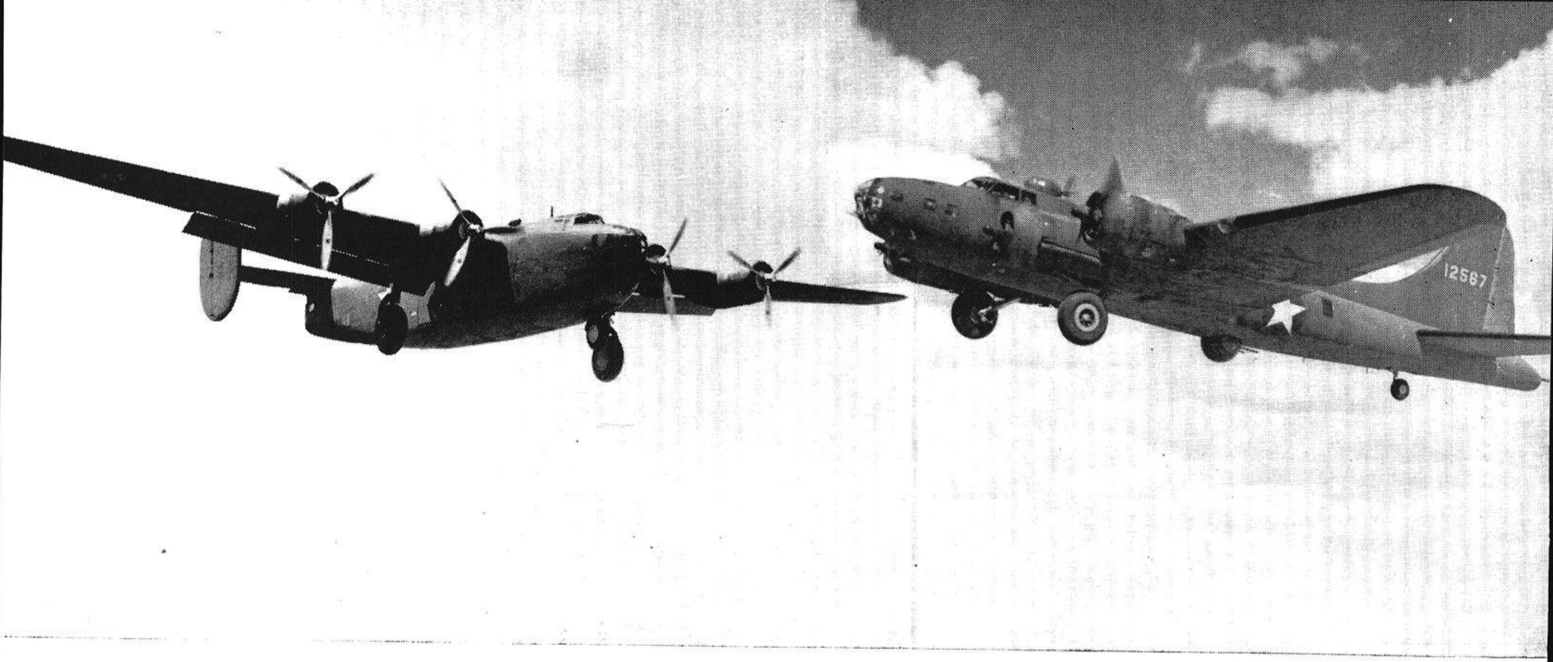
Bill Wilcox, the chef of the Mining Club, is the American Institute of Mining and Metallurgical Engineers' representative on Polygon Board and holds the position of treasurer. Football, debate, and cornet playing occupied his high school days at Stanley, Wis. He enrolled in the Journalism School but dis-

WILLIAM WILCOX

covered the error of his ways after a year and became a miner.

Bill has been entirely self-supporting throughout his college career. He spent two years doing clay research for Prof. George Barker. This past year he has held a W.A.R.F. research apprenticeship and has worked on Flotation. Dr. Daniels' nitric acid research has also claimed his efforts. He is a member of Pi Mu Epsilon. As chef of the Mining Club Bill has done a wonderful job of preparing luscious hams and turkeys for their monthly meetings.

Five of his summers were spent in a cheese factory and he has become an expert in the art of making American cheese. He has also worked as a drafter and surveyor for the Highway Commission. Wilcox attended the twelve weeks' session last summer and will graduate next May. He is signed up with the Army and will take their meteorology course.



Consolidated B-24 "Liberator"

Boeing B-17 "Flying Fortress"
Courtesy Automotive War Production

DEMOLITION...KING SIZE!

by Roger Lescohier, ch'43

IT IS DUSK in England. The sky is starlit, but the moon is down. All is quiet save for the occasional drumming of patrol planes. The crickets are out and the frogs are croaking in the ponds.

Suddenly the stillness is shattered by the coughing roar of a heavy engine coming to life; then another and another. At more than a score of airfields scattered over England the behemoths of the air — the bombers—are preparing for a raid. Six thousand men have been getting last minute instructions, 16,000 men and women of the ground crews have made the ships ready. Inside the sleek hulls are 600,000 gallons of gasoline, 1,500 tons of bombs and thousands of pounds of ammunition for slugging through defenses. It is the start of a mass raid upon the industrial and armament centers of Germany, 500 miles away. An even 1,000 planes are participating. They rendezvous, then pass over the cliffs of England in a giant formation more than a mile wide. They will be gone five or six hours, the actual attack lasting about two hours.

This is war. The war of giant bombers. These air-giants are in reality the last word in siege guns. They are guns capable of delivering a four ton projectile to a target 500 to 1,000 miles away with accuracy enough to make the expression, "Here come bombers," a synonym for, "Run for cover." They have revolutionized warfare in a way never dreamed of a generation ago.

Looking at the receiving end, what kind of results may be expected from a raid carried out on such a scale? "If I could send 20,000 bombers to Germany tonight, Germany would not be in the war tomorrow. If I could send 1,000 bombers to Germany every night, it would end the war by autumn." These are the words spoken last summer by Air Marshall Arthur Travers Harris, C.B., O.B.E., A.F.C., chief of Britain's Bomber Command. Of course, Air Marshal Harris can not yet assemble the reserves necessary to send 1,000 bombers every night. That time may come, however, when President Roosevelt's program of 60,000 planes in 1942 and 125,000 in 1943 is achieved and the U. S. commands the most powerful concentration of air power the world has ever seen. At that time, results such as were achieved in last April's raids upon Germany's Baltic port of Rostock will become every night affairs. On April 24, 1942, Rostock was a prosperous city of 115,000 people; it supported the huge Heinkel airplane factory and the vast Neptune submarine yards. Between the 24th and the 27th the RAF dropped three times the weight of high explosives on Rostock as were dropped on Coventry, or a total of 800 tons. By the 27th Rostock had been pulverized in a way to re-define the term. Flames were visible 250 miles away, smoke rose nearly two miles in the air. Between 7,000 and 8,000 people were killed, and the city was abandoned except for emergency workers and wounded.

Dec. 1—"Allied bombers continued an around-the-clock bombing of Bizerte, Tunis, and Tripoli, with Bizerte heaviest hit in aerial warfare said to be approaching a scale unequalled since the Battle of Britain in the autumn of 1940."

The British raid upon Cologne, the capital of the Ruhr, carried out May 31st was an even better example of Harris' plan. More than 1,000 bombers, carrying 2,500 tons of bombs in their racks roared over Cologne and dealt it a knockout blow in 100 minutes. At six-second intervals bomb-bays opened and dropped their "eggs." Explosives and incendiaries rained upon the stricken city at the rate of 50,000 pounds per minute. In less than two hours the proud city of Cologne was reduced to an utter shambles. Such is the power of the modern bomber.

The Italian arsenal city of Turin is one of the cities now receiving the RAF's steel calling cards. Turin is, or was, a bustling city of 622,000 people. It has long been the principal automobile and truck manufacturing center of Italy, it was second in importance only to Milan as a railroad center, and large airplane factories had been situated there in recent years. The British have attacked Turin five times in the past thirty days. They have dropped small bombs, medium sized bombs, two ton "block busters," so called by the Germans because they can level a city block; and scores of thousands of incendiaries. They have in fact dropped nearly everything except their galoshes on the once-proud city of Turin. The result has been that Mussolini has ordered "urgent evacuation" of the entire civilian population. It is reported that more than 300,000 have already fled the city. Damage has been so extensive that when the British returned twenty-four hours after the December 5th raid to attack again, the Italians had not yet finished counting the casualties from the previous visit, and fires were raging apparently unchecked.

Dec. 9—"The raiders again blasted Turin, with two-ton bombs, the biggest in the RAF's arsenal of explosives—as well as with many one-ton bombs and thousands of incendiaries."

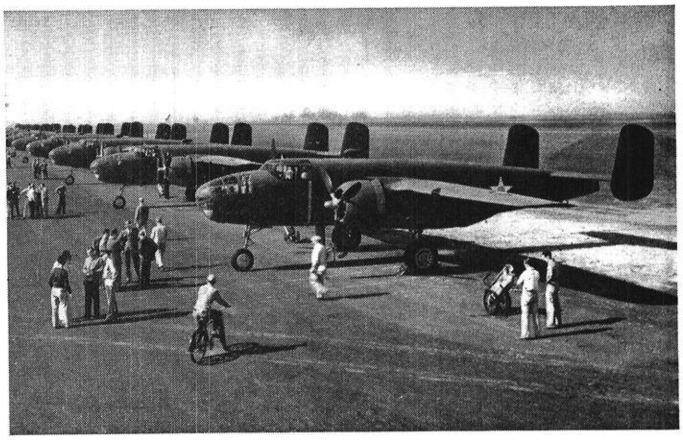
It is evident that the bomber is today a devastating power. He who rules the air wields a mighty weapon indeed. The race for air-supremacy is a life-and-death affair and Uncle Sam has his track shoes on. The United States' bomber program can be truthfully described as one of the greatest industrial projects ever launched, bigger than any dam or canal. At the peak, it will absorb at least two out of every five, or 420,000 of the million workers projected for the aircraft industry by 1943. The big bombers alone will use up close to 180,000,000 pounds of aluminum a year, equal to 30% of the nation's present capacity. And they will have priority over an estimated 3,200,000 horsepower of the probable 12,000,000 monthly horsepower output of the aircraft-engine manufacturers this year.

Dec. 1—"Heavy United States bombers, some of them British flown, have destroyed or heavily damaged six merchant ships in Tripoli and have smashed the Spanish and Karsmanli Moles so severely in the Axis' only remaining Libyan harbor that their use has been impaired, a U. S. Army Headquarters communique said today."

These are terrific figures. If they seem fantastic, it is because the four-engine bomber itself is fantastic. It is to air power what the battleship is to sea power, naked striking force. The gross weight of a Flying Fortress (including fuel) is 52,000 pounds; the Consolidated B-24 runs 4,000 pounds heavier. This compares with a fighting weight of 6,800 pounds for the P-40 pursuit. A four-engine bomber is the product of from 100,000 to 140,000 man-hours, compared to around 15,000 man-hours for a fighter; it costs between $300,000 and $350,000 to build. This is another figure to chew on. To produce 500 such bombers a month means an outlay of $175,000,000 a month—$2,100,000,000 a year, which is sixty-four times as much as was appropriated for the entire air corps procurement program the pre-war year.

This is the true magnitude of the drain on a nation's wealth and productive powers involved in achieving what has been described as "air-superiority." According to OPM the total aircraft orders placed in the country since the start of the war, including lease-lend diversions for Britain, are in the neighborhood of $9,500,000,000 or about one-third as much again as we are now spending on the entire naval program. If we include the appropriation for the twin-engine medium bombers (the Martin B-26 and the North American B-25) which are also to be produced at the rate of nearly 500 a month—if we also add the government outlay for new and reconditioned plants — the bombardment side of the aircraft program alone will cost the taxpayer an estimated four billions, not million, but billion, per year. This is enough dollar bills to pave a sidewalk three and one-third feet wide all the way around the earth at the equator.

This bomber program is staggering, its cost almost incomprehensible. One hesitates to think of the destruction which will be wrought by such an air force, but perhaps the day will soon come when the airplane can again be used to bring pleasure to man, instead of death and demolition.



A row of North American B-25 bombers, one of the fastest bombers we have sent to England.

International Nickel Co.

Bibliography:
(1) Fortune Magazine—October, 1941.
(2) Fortune Magazine—July, 1942.
(3) Fortune Magazine—August, 1942.
(4) The Capital Times — December 1, 4, and 9, 1942.

Studies and Activities in . . .

CIVIL ENGINEERING

by Wilbur M. Haas, c'45

WHEN ONE hears the term "civil engineer," he usually thinks of those unfortunate fellows who plow around in the December (and sometimes January) snows to complete their profiles. However, surveying is really only one of the many tasks that the civil may be called upon to do, as we shall attempt to show.

In the beginning here at Wisconsin, engineering was either **military** or **civil** (non-military). It is from this rather broad field, then called civil engineering, that the present several engineering courses have developed.

Civil engineering, as we use the term today, consists of several varied activities. These include: The design, construction, and maintenance of structures, and of channels of transportation, surveying, river and harbor improvements, the reclaiming of waste lands, sanitary engineering, water supply, city planning, and testing the materials of construction.

Labs

The various branches of the department of civil engineering are well scattered over the campus. The hydraulic and sanitary laboratories are located in a building down by the lake. The hydraulic laboratory is equipped with powerful pumps for delivering large quantities of water for experimental problems. There are several types of water-wheels in the laboratory. Facilities are available for the study of losses in pipe systems. In case you have wondered just what that big concrete tank up on the bluff near the ski slide was, it is a 220,000 gallon reservoir, used in tests requiring a large flow of water under a steady head.

The Sanitary Laboratory has the equipment necessary for analyzing sewage and trade wastes. Research work is done by the student in helping with the solving of many current problems in stream pollution and waste disposal.

The Surveying Laboratory, located in the Education-Engineering building, has a wide variety of instruments, including equipment for topographic, hydrographic, and railroad surveys. There are calculating machines, compasses, current meters, levels, plane tables, planimeters, sextants, sounding apparatus, transits, and many other articles of surveying equipment. After four semesters of surveying in the classroom and within a few miles of the campus, the students go to the summer camp at Devils Lake for an intensive six-week course in topographic and hydrographic surveying and in railroad location.

The laboratory of the Wisconsin Highway Commission is located on the campus, and is available for the use of University students in testing both bituminous and non-bituminous road materials. There is ample equipment for all standards tests.

The materials testings labs, located in the Education-Engineering building, are equipped with a great variety of testing equipment. Included are: A 600,000 pound universal hydraulic testing machine, designed in the laboratory, for the tension and compression specimens up to 29 feet long; a 100,000 pound Johnson beam machine taking beams 22 feet long; various torsion machines; hardness machines for fatigue tests of metals; a refrigerator for freezing tests; a room equipped with humidity and temperature control; an automatic electric furnace; and much other equipment.

The Wisconsin Alumni Research Foundation has set up several research apprenticeships, with the intention of developing research talent that might otherwise never be discovered. This foundation, as you may recall, is the same one that promoted Steenbock's process of irradiating foods. Two civil engineering students, Robert Munson and Jesse C. Saemann, have been selected as apprentices. Both are doing work of strategic importance. Munson is doing research in the field of mechanics, and Saemann is working on a project at the Forest Products Laboratory.

Other seniors are also working on interesting theses. Harvey Buntrock and Roger Van Vechten are working on the design of an experimental water treatment plant. The effect of moisture content on the strength of plywood is the subject of the project Clay Ashton and William O'Brien have. George Williams and Richard W. Wilke are conducting a hydrologic investigation of air mass maps.

A.S.C.E.

There is a strong student chapter of the American Society of Civil Engineers here at the University. This society is the center of activity for the student civils. Besides serving as a laison with the parent society, the student chapter brings to the student both off-campus and University speakers, who are prominent men in their fields. It provides a chance for the student to express himself while serving on various committees, and an opportunity to know his fellow students better.

Faculty members have been doing work that is of current importance. Prof. L. H. Kessler is now on a leave of absence while with the federal government. He is working on water supply and sanitation facilities for the army camps. Capt. E. C. Wagner, who was an instructor in surveying, is with the Army Engineers. Also on leave is Prof. L. F. Rader, who taught highways at Wisconsin. He now holds a commission as lieutenant-commander in the Navy. Jesse Dietz, formerly an instructor at the Hydraulic and Sanitary lab, is now overseas with the Army Engineers.

Expansion and Contraction Joint for Tanks

by R. T. Logeman, c'99

This paper by Mr. Logeman, a consulting engineer in Chicago, won an award in the recent James F. Lincoln Arc Welding Foundation contest and should be of special interest to students writing contest papers.

THIS PAPER relates to an improvement in the design of steel storage tanks to prevent failures due to over-stressing certain portions that become definitely and critically vulnerable when subjected to a drop in temperature. Engineers are too prone to take for granted any type of construction that has been in use for a long period of years, even though they recognize that all is not perfection, and even in view of the failures that bear evidence of faulty design. The writer realizes such an attitude and anticipates a certain measure of negation to the proposed design, but on the other hand, is encouraged by the favorable reactions and suggestions received from associates and others, which are hereby gratefully acknowledged. This improvement is not just an over-night notion. It is the result of many years of experience gained while on the staff of the American Bridge Company, covering in addition to other matters, the design and fabrication of tanks as well as the investigation and study of failures. The two pictures attached show the failure of one of a number of 80,000 barrel oil storage tanks,—40 feet high by 120 feet in diameter,—and are presented merely as an exhibit that should and can be avoided if all factors in the design are understood and provided for.

The general practice has been and still is to provide for the hydrostatic forces and nothing more. Dead load stresses in the shell from column action are passed by except in a high tank, likewise wind pressure unless the tank is narrow and high.

Foundation Important

A very important feature in the design of tanks, as well as all structures, pertains to the foundation. Unless the foundation is made so that the weight of the shell and the liquid contents exert a uniform and direct downward pressure on the bottom, additional stresses are set up in the shell plates and provision must be made for this. Such a condition is created in a riveted tank where angle shoes are used to splice and caulk the ends of the corner angle connecting the shell sides with the bottom. In such a case there results a concentration of loading at the shoes, especially if the tank is set directly on a concrete foundation, the tank shell being subjected

R. T. LOGEMAN

to girder action, and this may add quite an item to the hydrostatic stress.

Temperature Stresses

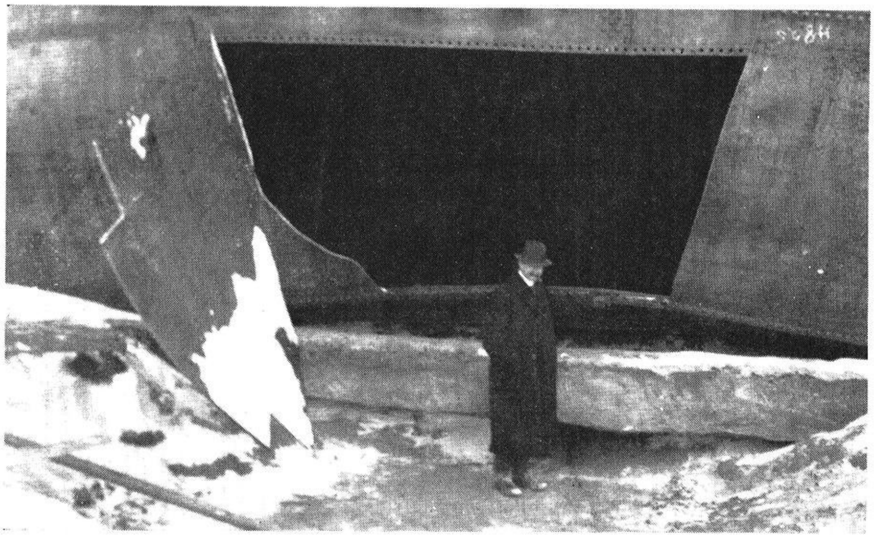
In this paper the writer assumes that the hydrostatic forces, as well as the dead load, wind pressure, and foundation conditions are properly provided for, so that the only remaining force is that resulting from a drop in temperature. Temperature stresses in tank design have in the past been entirely disregarded. In a measure this may be due to the omission of any treatment or reference to this matter in any text book on tank design, or more likely it may be the result of precedent established by conventional practice in a specialized industry motivated under a pressure of low cost and therefore not expressive of safe design and construction.

Steel is without question the strongest and best building material in universal use, but too often under a false economic urge, is much abused and taxed beyond its safe limit. It is an elastic material, much like a rubber band, only to a much less degree. It deforms to load at the rate of about 5/8 of an inch per 100 feet for a unit stress of about 15,000 pounds per square inch, and responds to temperature at the rate of about 1¼ inches per 100 feet for a change of 150 degrees.

Temperature is not a force. It is merely a measuring stick with which to determine the stress that steel is subjected to under certain conditions. For all practical temperature ranges, if free to move, steel will continue to carry its steady design load without requiring any increase in section, but under severe cold it becomes definitely vulnerable under any sudden force or impact.

On the other hand, if steel is held or restrained, then any temperature change acts like an external force, and at a rate of about 200 pounds per square inch for each one degree change, and under such restrained condition, an increase in temperature relieves the stress, while a decrease in temperature increases the stress, and provision must be made for the temperature drop in the same manner as for the hydrostatic force or any other force.

In the conventional tank design the shell plates take the hydrostatic pressure, while the bottom plates merely form a seal and transmit the weight of the liquid uniformly over the foundation. This, however, re-

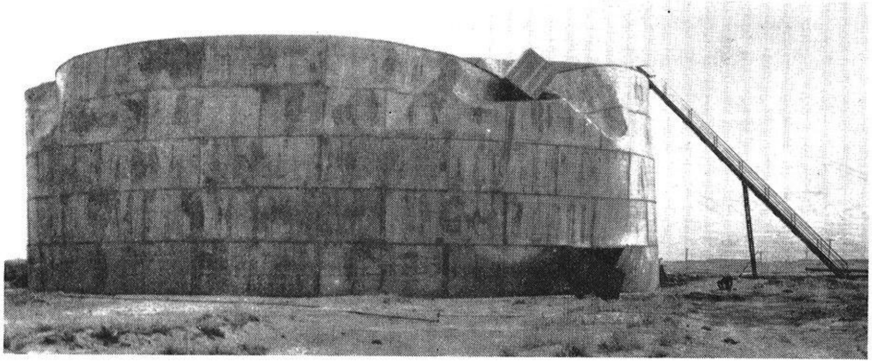


A closeup of the tank below showing the enormous hole that resulted from unexpected contraction stresses

gardless of conventional assumption or current practice, does not take care of certain conditions that may become a serious factor in the safety of the structure. With the bottom plates connected to the shell plates, with or without a corner angle, and bearing in mind that there can be no stress without a deformation, it follows that some of the deformation in the shell plates must be transferred to or be restrained by the bottom plates and bottom angle if one is used. This condition prevents freedom of movement of the shell plates under the action of hydrostatic pressure.

Just above the bottom plates, or above the bottom corner angle, the restraint is lessened, permitting a fuller deformation, but with a resulting tendency to bulge or crimp the shell plates. This bulging, while small, may, nevertheless result in quite an item when considered as additional stress.

To a lesser degree there is restraining action at each horizontal joint of the shell plates, due to the change of plate area and a different unit stress above and below the joint. This is aggravated in case the shell plates are lapped, the double thickness restraining to some extent the deformation of the single thickness plates, and more especially above the horizontal joint where the unit stress is greater than below the joint.



A severe cold spell caused the collapse of this 80,000 barrel oil storage tank

The liquid in the tank and the foundation below establish the temperature of the bottom plates, without much if any modifying influence from the outside temperature. Even though steel is a good conductor of heat and cold, it would be a slow process for a sudden below zero temperature drop to penetrate very far into the bottom plates. This condition restrains freedom of movement of the shell plates where they connect to the bottom plates in the conventional tank design. An increase in temperature, as already stated, relieves the hydrostatic tensile stress and therefore is of no particular concern, but, on the other hand, a drop in temperature adds to the hydrostatic stress and must be recognized and provided for in order to produce a safe structure.

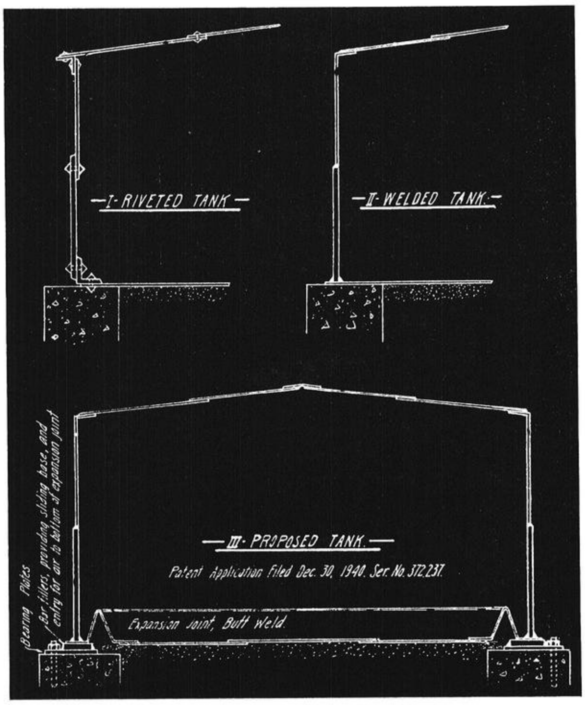
The bottom plates, in restraining the contraction and inward movement of the shell plates when subjected to a drop in temperature, are held in alignment so that they can function as a compression element by the weight of the liquid above and the foundation below. In conformity with Pascal's law the same unit pressure that tends to tear the shell plates also acts on the bottom, and in accordance with this law the bottom plates can and do restrain in tension an outward movement of the shell plates due to either (a) hydrostatic deformation or (b) an increase in temperature, and restrain in compression an inward movement due to a decrease in temperature.

Removal of the restraint and provision for movement is the key to avoiding temperature stresses, and is the essence of the proposed improvement in tank design.

Drawing I illustrates the general type of construction prior to the advent of welding. This merely indicates a typical riveted type. The shell plates are lapped for the horizontal seams, with lapped vertical seams for the thinner plates, and butted vertical seams for the thicker plates. The connection of the shell plates to the bottom plates is by means of a rather thick corner angle. The material is either bevel sheared or bevel planed for caulking,—preferably arranged for down caulking. All seams and connections are riveted.

Drawing II illustrates the typical welded tank. The shell plates are butt welded for both the horizontal and vertical seams, while the bottom plates and the roof plates are lapped for welding.

The important feature to note in drawings I and II, illustrating the conventional riveted and welded type tank, is that no provision is made for expansion and contraction between the shell plates and the bottom. The drawings also illustrate



Diagrams of the old and the new in tank construction. Note the expansion joint in Diagram 3 to take care of the strains caused by extreme cold weather.

the restrained type for which temperature stresses must be taken by the steel as internal stress.

Drawing III illustrates the use of an expansion joint between the shell and the bottom, thereby removing the restraint, and avoiding internal stress due to temperature changes. An arrangement whereby the outside temperature, acting on the shell, can at the same time act on the expansion joint, will insure a more effective movement. A drop in temperature, causing a contraction of the steel, will then act on the shell plates and the expansion joint at the same time and with the same intensity, and thereby aid in the better functioning of the expansion joint. Such an arrangement is obtained, as indicated on the drawing, by a bearing under the shell plates that will take care of, (a) the vertical load; (b) horizontal sliding; (c) passage for entry of air to the under side of the expansion joint.

Drawing III merely illustrates the scheme whereby the free passage of air from the outside of the shell to the underneath surface of the expansion joint is obtained. As indicated, the shell is supported on steel bar fillers, about 1½ inches in height, and about 18 inches apart, depending on the resulting bearing on the foundation. These bar fillers should preferably be made of non-corrosive steel, and welded to the base plate. The top surface should be smooth and level to permit a ready and unrestrained breathing of the shell plates as they expand or contract on the bar fillers due to any change in temperature. This breathing, or expansion and contraction, is confined to the shell plates and expansion joint. On the other hand, the entire bottom beyond the expansion joint is held in restraint and prevented from moving by the friction on the foundation, and if necessary could be definitely anchored to insure such restraints.

As a further aid to an unrestrained breathing of the shell plates, the expansion joint itself should be made of a pliable material, such as fire box steel. Furthermore, in this connection, the superiority of a butt welded over a riveted expansion joint should be self evident. The welded joint results in maintaining a uniform thickness of material with a uniform resistance to movement, a feature impossible to obtain in a riveted joint due to the added material required at the splices. Not only is the butt welded expansion joint more uniform and efficient in its action to movement, but it is also less expensive.

Difference in temperature between the outside and inside restraining portions may at times be very great, and may also occur at frequent intervals, with sudden below zero drops accompanied by a strong chilling wind, tending to repeated over-stressing. A storage tank equipped with heating coils, for the purpose of maintaining a certain temperature of the liquid or to guard against freezing, is apt to be subjected to greater temperature differences between the outside and inside and therefore more vulnerable than a tank without such equipment. Considering a temperature change of only 50 degrees results in a unit stress of 10,000 pounds per square inch, and with a unit stress for hydrostatic pressure at 20,000 pounds per square inch, the combined stress comes within the elastic limit range of 30,000 pounds per square inch. In other words, the effect of temperature in a restrained structure steps up too fast to be neglected, or to be allowed to build up as an internal stress.

In the design of a bridge, retaining wall, dam facing, or similar structure, provision is made for movement due to temperature changes, and the same provision should also be made in our tank construction. This would be a long delayed step in the direction of proper and better design and definitely guard against the all too frequent cold weather and tank failures.

Summary and Conclusions

1. The conventional type tank, whether riveted or welded, is definitely vulnerable to extreme cold weather, because no provision is made for temperature stresses. Only hydrostatic stresses are considered in the conventional design. In a very high tank dead load stresses may be given some consideration; likewise some consideration may be given to wind stresses in case of a high and narrow tank.

(continued on page 28)

ALUMNI NOTES

by Arne V. Larson, m'43

Electricals

LILJA, EDGAR D., '24, is manager of the development department for Barber-Colman Co. of Rockford, Illinois.

FISHER, MAJOR R. R., '25, is now a Signal Officer in the U. S. Army Signal Corps, stationed at the Army Air Base at Santa Maria, California.

ANDERSON, MELVIN K., '39, who is working for the Gisholt Machine Co. at Madison, was married in July to Helen Ruth Shain of Madison.

Mechanicals

ROSE, R. A., MS '29, PhD. '37, who has been granted a leave of absence from the Mechanical Engineering Department to serve in the Navy, has been promoted to the rank of Commander.

HOYLE, ROBERT L., '32, is assistant chief engineer in the Acoustic Division of the Burgess Battery Co. at Chicago.

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Civils

GILMAN, JAMES M., '04, is principal construction engineer with the Federal Works Agency at Washington, D. C.

MANN, FRANKLIN H., '05, died very suddenly from a heart attack on October 29. He had been with the Iowa State Highway Commission for many years as assistant chief engineer in charge of all road and bridge construction work in the state.

MOOTS, ELMER E., CE '11, formerly professor of mathematics and engineering at Cornell College, Mount Vernon, Iowa, has been appointed associate director of research on sound control at Cruft Laboratory, Harvard University. He will be in charge of personnel and technology.

NATHAN, WALTER S., '18, is Wisconsin representative for C. W. Haering & Co. of Chicago. His headquarters are in Milwaukee.

SHUMAN, E. C., MS '26, is with the War Department Corp of Engineers. He is chief of the concrete station at Mount Vernon, New York.

ERICHSEN, FRANK P., '32, has been advanced to the rank of captain in the Corps of Engineers, USA, and is at present engaged on the Ore Docks Project at Escanaba, Michigan.

KAYSEN, JAMES P., '38, has been promoted to the position of Assistant Superintendent of Signals for the C.M. St. P. & P. R.R. at Milwaukee.

MICHALOS, JAMES P., '38, associate structural engineer for the T.V.A. is working in the design office of the Department of Chemical Engineering at Wilson Dam, Alabama.

SAXER, EDWIN L., '39, resigned his position with the Babcock & Wilcox Boiler Co. and began training as an aviation cadet at Chanute Field, Ill., on November 27. He expects to be an engineering officer in the Air Corps, engaged in maintenance work.

MILLER, MALCOLM A., '40, announces the arrival of a son, Alan Scott, on November 8 at Kansas City, Mo.

FELDHAUSEN, GORDON J., '42, was married on November 7 to Marian Napstad of Madison.

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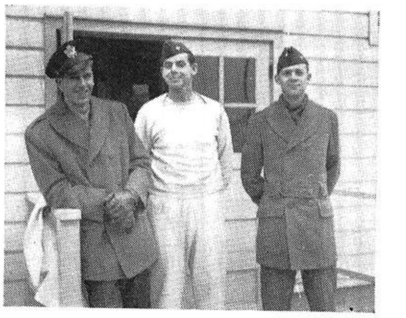
Miners and Metallurgists



2nd LT. ROBERT SCHROEDER, '41, **PVT. ROBERT HENDY**, '41, and **PVT. ROBERT KRON**, ex'43, are pictured at Chanute Field, Illinois. Schroeder was commissioned November 28 and is now at Great Falls, Mont. Hendy, who is about to "fall in" for calisthenics, and Kron, who had "Charge of the Quarters" for that day, are roommates and have several weeks of training left. In a letter to Prof. E. R. Shorey they declare they are getting fat on the excellent food in spite of the strict routine and long hours of work and duty. In his undergraduate days Schroeder was the Miners' candidate for the 1941 St. Pat, while Hendy was the Mining Club steward the same year.

FRED KRENZKE, MS '42, is now located at Freeport, Tex., with the Dow Chemical Company.

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Chemicals

GREENE, ERNEST W., PhD. '32, is in charge of research and development work for the Coronet Phosphate Co. of Plant City, Florida.

MAX, A. A., PhD. '37, is Assistant Professor of Chemical Engineering at the University of North Dakota at Grand Forks.

A representative of the Standard Oil Co. of Louisiana visited the Department of Chemical Engineering recently and brought news of several Wisconsin graduates. **JOHN F. WRIGHT**, '36, **GEORGE H. COOK**, '36, **NEWELL C. DUNN**, '41, **JOHN N. BRANN**, '42, and **WILLIAM V. ARVOLD**, '42, are all engaged in work closely allied to the war. Wright was recently promoted to the post of assistant to the Chief of the Chemical Products Division. Cook will be remembered as a former editor of the WISCONSIN ENGINEER.

KOVACS, BEN E., '39, is Assistant Coke Plant Test Engineer for Inland Steel Company of Indiana Harbor, Indiana.

GEHRKE, WILLARD, '42, employed by Monsanto Chemical Co. of Dayton, Ohio is now working on synthetic rubber raw materials.

ROBERTS, ENSIGN ARTHUR J., '42, was killed in action in the Pacific War Area.

ON THE CAMPUS

SOCIETY MEETINGS

A.I.Ch.E.

W. E. Phillips, Chicago sales manager of the Mathieson Alkali Works, spoke on chemical sales work at the A.I.Ch.E. meeting in the auditorium of the Chemical Engineering building on December 9. He first described the place of the alkali industry in our national economy, particularly in the chemical industry and told of the processes and products of the alkali industry. He explained the trade practices of the industry and described encounters with various aspects of them in his sales work. He enumerated the qualifications of a successful chemical salesman and told in detail how the various techniques of selling are used. Refreshments were served after the meeting.

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MINING CLUB

The Mining Club held its annual Christmas banquet on December 9 in the library of the Mining and Metallurgy building. Chef Bill Wilcox cooked up 35 pounds of delicious turkey with all the trimmings to whet everyone's appetite.

A $25 war bond was purchased in the name of the club by Treasurer Walter Wollering. The money had been voluntarily contributed by the members during the past several months.

Mr. C. L. Miler of the State Industrial Commission spoke on "The Industrial Safety Picture." He told of the leadership of the state of Wisconsin in protecting workers from industrial accidents and in providing workmen's compensation wherever accidents occurred. He declared that although the state has one of the lowest industrial accident rates in the country, at least 85% of these accidents occurring daily are preventable. The education of employees to do things the safe way is one of the foremost obligations of all employers.

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A.I.E.E.

The A.I.E.E. invited the A.S.C.E. to a joint meeting in the Memorial Union on December 9. Prof. Max Otto of the philosophy department gave an interesting talk on "What's the Good of Philosophy?" He pointed out the functions of philosophy and its importance to engineers.

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A.S.C.E.

On Wednesday evening, December 16, 1942, the A.S.C.E. held its annual Christmas party in the Top Flight room of the Union. Featured on the program were Korpady's Korines, imitations of several members of the civil faculty, and then, as turn-about is only fair play, the faculty held a mock meeting, panning several of the students. Refreshments were served after the program.

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M.E.'s UNDER TABLE

After the civils' Christmas party, several mechanicals from another party downstairs challenged the civils to a beer-drinking bout. When it was over, the capacious civils returned to finish what was left at their own party, while the M.E.'s are still under the table, the Union janitors report. (Ed. Note—Written by a C.E.).

ACTIVITIES OF POLYGON BOARD

By Harold Holler, President

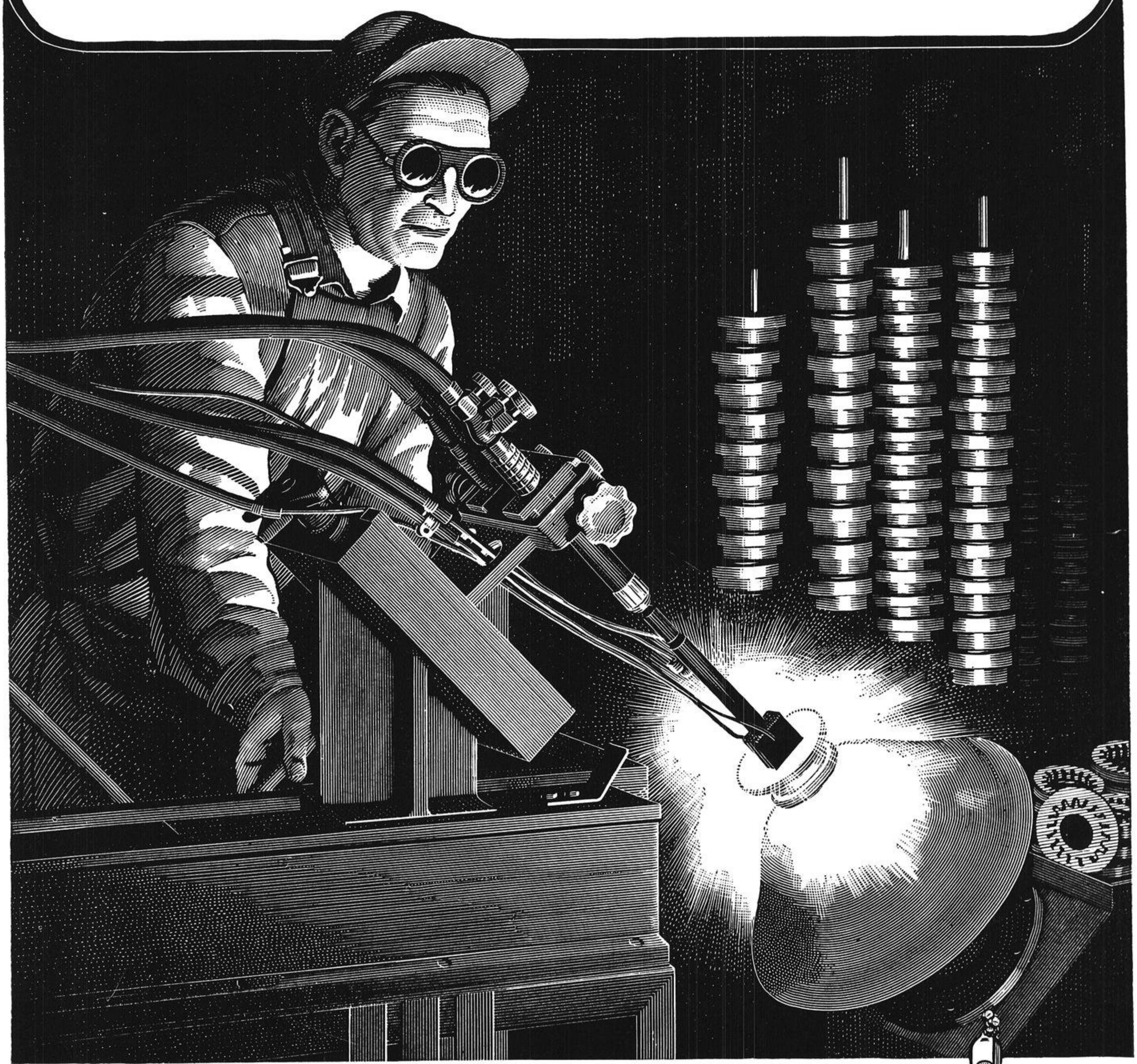
POLYGON BOARD is the central coordinating body in charge of certain special activities of the engineers, such as smokers, dances, expositions, and St. Pat elections. Its members, who represent each branch of engineering, are elected by the student societies.

Polygon Board wishes to announce to the societies that elections of representatives to the Board are to be held at the end of this semester. Each Board member is elected at the end of the first semester of his junior year and serves for the remaining three semesters. In this way, the Board is composed of six members the first semester and twelve members the second semester of each year.

The junior members of the Board serve for one semester on committees headed by the senior members. The election of officers and the selection of committees for the next school year are then made at the last meeting in the spring. The offices and committees are: president, secretary, treasurer, program chair-

(continued on page 26)

GEAR TEETH HARDENED IN 8 SECONDS



IN only a few seconds the oxyacetylene flame adds greatly to the service life of this internal gear. Teeth and other surfaces subject to wear are rapidly hardened by the modern oxyacetylene flame treating process. The depth of hardening is easily and accurately controlled, without affecting the inherent toughness of the core metal.

Airco Flame Hardening gives all the advantages of other surface hardening methods plus speed and ease of application. Simple arrangements using one or more torches permit flame hardening of a large variety of metal parts on a production basis.

Many other applications of the oxyacetylene flame are finding ever widening application in speeding and improving production of ships, tanks, guns, rolling stock and planes. This versatile tool slices through steel with remarkable speed—welds metal into strong, light units—sweeps surface rust from metal structures to extend the life of paint jobs—gouges steel and iron quickly and accurately.

To better acquaint you with the many things that this modern production tool does better we have published "Airco in the News", a pictorial review in book form. Write for a copy.

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Presenting . . .

ENGINEERS IN ACTIVITIES

. . . About the Campus

FRANCIS BOUDA

Good natured Fran is the mechanical engineer who has been vice president of the Memorial Union for the past year. Early in his college days he realized that extracurricular activities are just as important as studying in the education of an engineer, and he soon delved into many activities outside the class room.

He was elected vice president of Phi Eta Sigma, freshman honorary

FRANCIS BOUDA

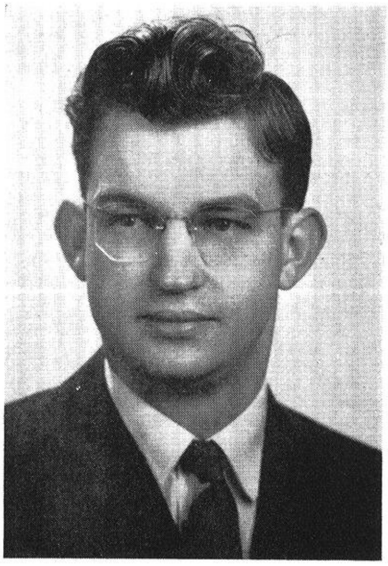
fraternity, and is senior advisor of that group at the present time. As a sophomore he was chairman of the banquet committee for the Parents' Week-end, helped with freshman orientation, and was a reporter on the **Wisconsin Engineer.** Francis served as a sub-chairman of the Snow Ball a year ago, and is at present a member of the Student War Council and the Union Directorate. He lived at the dorms for three years and was secretary of the house presidents' council, but now is a member of the Chi Psi fraternity. He estimates he has earned one-third of his expenses while at school.

Although Fran comes from Two Rivers, Wis., he has seen little of his home town since he first arrived in Madison. The last two summers he has stayed on the campus to pick up extra credits. After graduation this month he will be doing design and development work for R.C.A. at Camden, N. J. He expects to eventually get into engineering personnel work.

•

WALTER SPIEGEL

Walter Spiegel will be missed by the **Wisconsin Engineer** upon his graduation at the end of this semester, for it was he who directed its



WALTER SPEIGEL

financial fortunes through the past year.

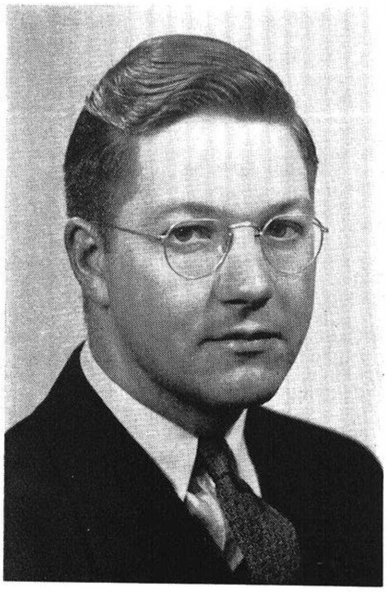
Walt hails from Oconto Falls, where he was particularly active in high school. Football, tennis, dramatics and speech occupied much of his time there, with football taking the major role. He has studied chemical engineering here, and has given some time to photography and music. He was a member of the Concert Band until the business affairs of the **Engineer** began to consume too much of his time. Walt is a member of Alpha Chi Sigma, chemical fraternity. His senior project consists of work with Dave Shilling, research assistant, on industrial drying operations.

Spiegel is one of the few chemical engineers graduating in February, having taken the twelve-week summer session. He will be working for Lockheed Aircraft in California. Rumor has it that his engagement to Dorothy Barnum of Boscobel soon will culminate in marriage.

•

ARNE LARSON

Arne Larson is a busily occupied mechanical engineer who is in most of the activities on the engineering campus. He has been Alumni Notes editor of the **Engineer** for the past year, and his excellent work brought the column honorable mention at



ARNE LARSON

the E.C.M.A. convention last fall.

Arne comes from Scandinavia, Wis. He transferred here after a year at Waupaca Extension Center and has made an enviable record as a student and leader on the campus.

He is president of Pi Mu Epsilon, corresponding secretary of Pi Tau Sigma, social chairman of Tau Beta Pi and a member of S.A.E. He lives at Esquire Lodge, where he is house president.

In addition to all his activities and studies, he has been self-supporting during his entire college career. For three years he did general office work for Dean Millar. He supplemented this with meal jobs, typing, and drawing. The last two summers he spent at the Falk Corporation, Milwaukee, as a drill-press operator and jig-crib attendant. Knife-making is his hobby, and he has a large collection of fancy knives. This year Arne holds a W.A.R.F. research apprenticeship and has been doing work on low velocity air meters. He wants to go into design or development work along mechanical lines.

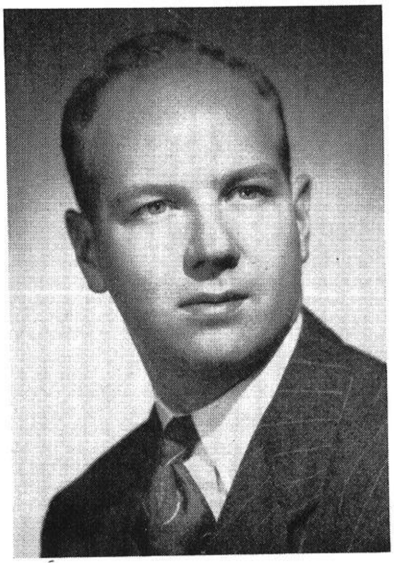
•

HERB STONE

Herb, the well groomed man from Gadsden, Ala., is one of the most active men directing social functions on the campus. Because his dad did a lot of traveling, Herb accompanied him to Europe in the early thirties. He attended high school at Rockford, Ill., before enrolling in the mechanical engineering course at Wisconsin.

He was elected to Student Board and is a member of their personnel committee. Last year he was Snow Ball king, and served as chairman of pre-prom tickets and the Union film committee, which reviews and selects films to be shown in the Union. Last fall he was in charge of all the pep rallies and was dance chairman at Homecoming. He has also held the chairmanship of the undergraduate dance committee that regulates all of the dances held on the campus for undergrads and is a member of the Union Directorate.

His numerous outside activities have not hampered his studying, for he is a member of Phi Eta Sigma, and Pi Mu Epsilon, honorary fraternities. He thoroughly enjoys all winter sports, and is a member of Delta Upsilon, social fraternity. Herb spent several summers with the John Barnes Corporation, Rockford, Ill., doing metallography and office work. He is interested in sales engineering and is going back there after graduation this month.



HERB STONE

STATIC . . .

by Dick Roth, m'43 and Bob Daane, m'43

The vacation is over and most of the Engineers have come back and are all set to rest up for the next vacation. Some of the boys had quite a time getting here due to poor transportation facilities. A checkup with the Chamber of Commerce revealed that a group of prominent senior Engineers were even seen coming in on one of the C. M. St. P. & P. handcars. Of course, none of us had any school work to do so we all accepted jobs in defense plants. The story is told of one poor freshman who was hired to work on an assembly line. First all he had to do was to thread on one nut. Then they thought he might as well put on a nut with the other hand. His feet were idle so they installed a punch release pedal under his right foot. Then one day the Superintendent came up to him and said, "Say, young man, it seems to me that if we installed a rivet press trip under your left foot you would be 100% efficient. He was greeted with the reply, "As long as you're at it, why don't you tie a broom to me and let me sweep the floor?"

o o o

DESIGNING DESIGNER

The designer bent across his board,
Wonderful things in his head were stored,
And he said as he rubbed his throbbing bean.
"How can I make this thing tough to machine?
If this part here were only straight
I'm sure the thing would work first rate,
But 'twould be so easy to turn and bore
It never would make the machinists sore.
I'd better put in a right angle there
Then watch those babies tear their hair.
Now I'll put the holes that hold the cap
Way down in here where they're hard to tap.
Now this piece won't work, I'll bet a buck,
For it can't be held in a shoe or chuck;
It can't be drilled or it can't be ground,
In fact the design is exceeding sound."
He looked again and cried, "At last!
Success is mine, it can't even be cast."

o o o

Young Brown got a job in a shipyard. The first morning the foreman gave him a two-foot rule and told him to go measure a large steel plate. Brown returned in twenty minutes. "Well," inquired the foreman, what's the size?"

The M. E. displayed a satisfied grin. "It's just the length of this rule," he said, "and two thumbs over, with this brick, and my arm from here to here, bar the fingernails."

She: "Does it make any difference which side of you I sit on?"

He: "No, I'm ambidextrous."

o o o

"The traps on the course are very annoying."

"Yes, will you please shut yours?"

o o o

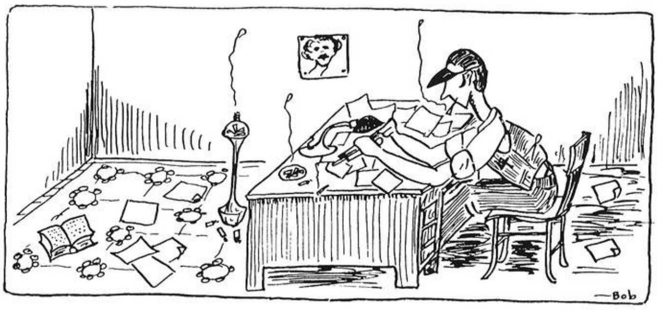
We hear some freshman engineers think that a neckerchief is the president of a sorority.

o o o

He knew a girl named Passion,
He asked her for a date;
He took her out to dinner;
And gosh; how passionate!

o o o

I am ready for my semester test,
My paper will be the very best.
I do not have brains nor do I have luck,
But, boy! oh boy! do I have the suck.



o o o

Professor: "Are you cheating on this examination?"

Student: "No, sir, I was only telling him his nose was dripping on my paper."

o o o

Then there was the engineer who took his nose apart to see what made it run.

o o o

Admiral Byrd leads a dog's life. He just travels from pole to pole.

o o o

And then there was the nudist who woke up in the morning fully dressed and yelled, "Help, I've been draped."

o o o

A wedding ring is like a tourniquet—it stops your circulation.

(continued on page 24)

The rat that went to college...

CHARLEY, the large and healthy white rat shown above, not only goes to college but he lives in a glass house!

For Charley is one of the thousands of white rats used for scientific research in American college laboratories. His glass house is a Pyrex animal jar, for a couple of good reasons: One, because of its exceptional mechanical strength. Two, because Pyrex glass can be sterilized in live steam without breaking or becoming cloudy, which makes it a favorite with laboratory men.

Pyrex laboratory ware, developed during the last war to replace imported glass, is just one of Corning's many research contributions to better living. Others are everywhere. The glass tubes in your radio. Beacons that guide American planes. Glass pumps and piping in busy chemical and food plants. Signal lights and insulators on our warships.

Corning knows glass. Knows how to make it resistant to chemicals and heat, strong and hard to withstand impact and abrasion, accurate to tolerances ranging as low as 0.00002 of an inch.

This knowledge is being put to good use today. A special sanitary glass piping, for example, has just been developed to ease the dairy industry's shortage of metal. The communications industry, faced with a sudden wartime demand for insulators in intricate shapes and with special electrical characteristics, is using glass insulators quickly developed by Corning. Design engineers who are licking this war's problems are finding ever new uses for glass. For tomorrow's engineers also, glass is the material with unlimited possibilities. Industrial Division, Corning Glass Works, Corning, New York.

CORNING
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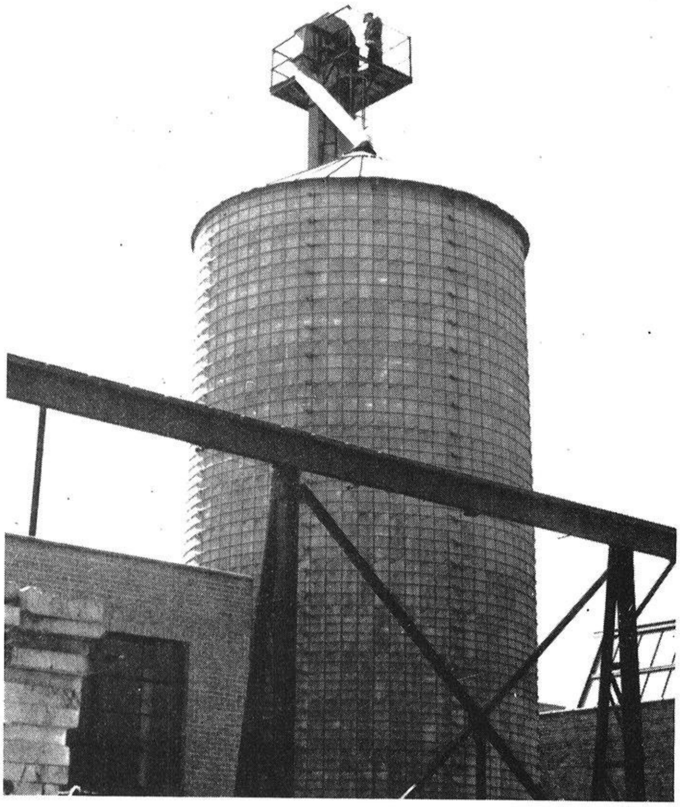
Research in Glass



Courtesy Westinghouse

Industry Builds a Barn

ADAPTATION of the silo type structure, long standard on farms for feed storage, to the industrial purpose of holding and handling coal, is returning unusual savings.

Of re-inforced concrete, the shell-like tower required no other framework or support than its walls, and the simplicity of design and construction kept costs down. With the main dimension vertical, and the floor sloping, the entire content is fed by gravity onto the belt supplying the bunkers. The fuel barn is loaded directly from the gondolas by a bucket elevator to the top, and thus the labor bill for coal handling is reduced considerably.

Less direct advantages in the present arrangement are: the reduced fire hazard; the smaller ground area required, and also in the matter of conserving essential war materials.

For all its industrial aptitude, however, viewed aside from the loading elevator, stacks, cranes, and locomotives, one could well believe that this tower were on a farm holding lunch for Daisy, the hay burner, instead of standing in a rushing manufacturing center doling coal to the powerhouse.

Static . . .

(continued from page 22)

Ouch! I've thrown by knee out of joint.

Aw, don't let that bother you. I've had my whole body thrown out of lots of joints.

○ ○ ○

"Sir, I am told that you have a barrel of beer in your room, which is contrary to all orders."

"That's true, sir," replied the student. "But the doctors told me if I drank this beer I should get stronger."

"And are you stronger?"

"Yes, sir, indeed I am. For when the barrel came in I could scarcely move it and now I can easily pick it up and carry it about the room."

○ ○ ○

Because the senior inspection trips are no longer possible, some of the senior M. E.'s were seriously considering taking a few kegs over to the Central Heating Plant basement and spending the equivalent time there. Hmm, not a bad idea!

○ ○ ○

A rookie paratrooper was receiving orders from his commanding officer just before his first jump.

"Remember," he was told, "your 'chute will open as soon as you leave the plane. If it doesn't, pull this emergency rip-cord. It will always work. A jeep will be waiting for you when you land. That is all."

The soldier jumped. Nothing happened. He pulled the emergency rip-cord. Still nothing happened.

"Damn," he muttered, "I'll bet that jeep won't be there either."

○ ○ ○

The latest addition to the women's auxiliary services, such as the WAVES and WAACs, are the WORMS. They're in the Apple Crop.

○ ○ ○

A negro was busily engaged in a cootie hunt. When asked by a sergeant as to what he was doing, he replied:

"I'se huntin' fo' dem 'rithmetic bugs."

"Why do you call them arithmetic bugs?"

"'Cause dey add to my misery, dey substracts from ma pleasure, dey divides my attention, and dey multiply like hell."

○ ○ ○

First M. E.: "What's up, Bill?"

Second M. E.: "I sent my girl two letters every day since I came to school, and now she's married the postman!"

○ ○ ○

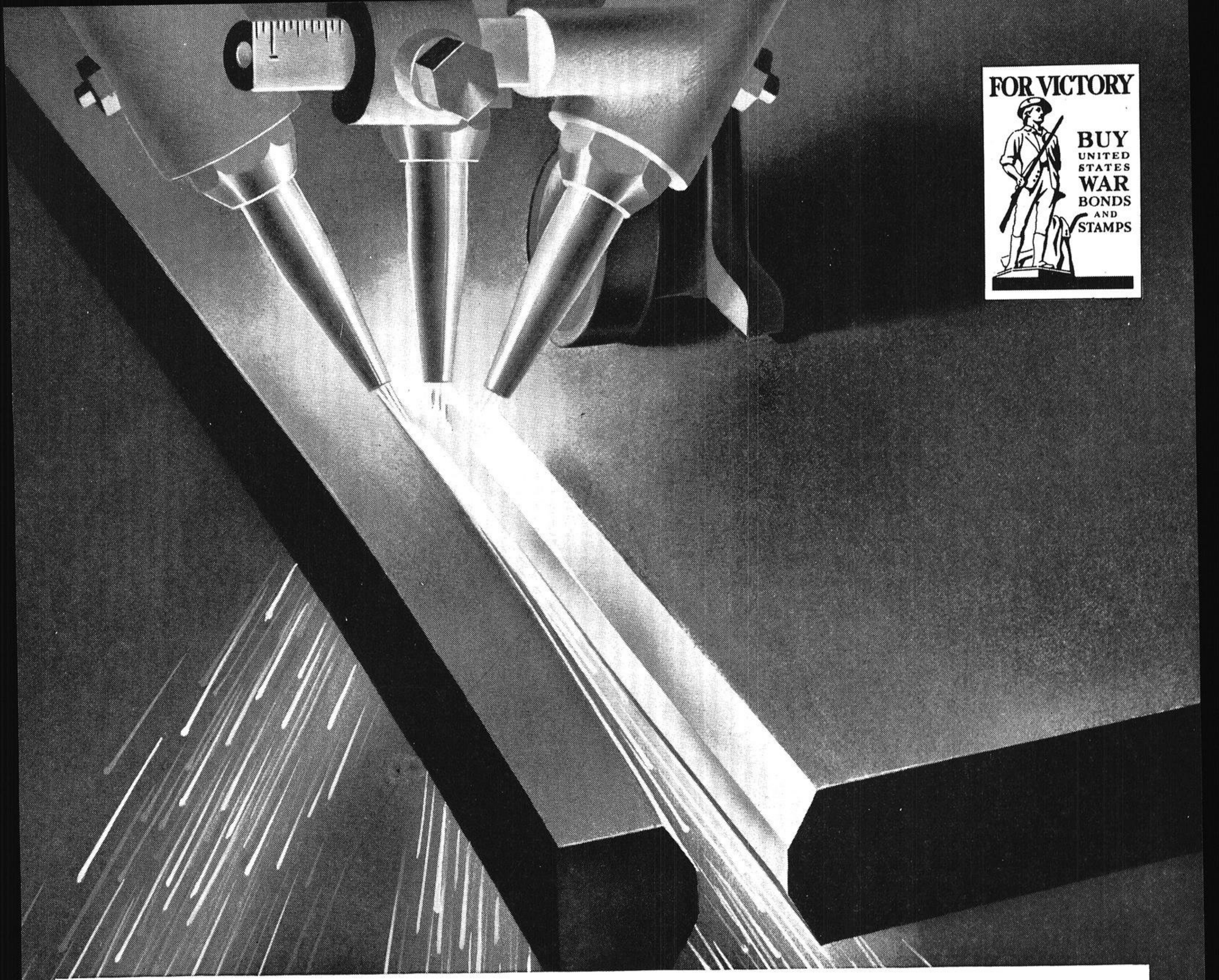
An Englishman heard an owl for the first time.

"What was that?" he asked.

"An owl," he was told.

"I know that," he cried, "but what was 'owling'?"

(continued on page 27)



FLAMES THAT CUT TIME!

TODAY, ships are needed as never before. And today, ships are being built as never before . . . and built faster, stronger, and with less steel . . . thanks to welding!

But before welding can take place, steel plates have to have their edges beveled and squared-up so that, when butted together, they look like this: or like this:

In the past, preparing plates in this manner was done by heavy machine tools. Cutting was slow and costly. Each plate had to be handled many times. Plate cutting on this basis could hardly keep pace with welding today.

Now, oxy-acetylene flames . . . *cutting in different planes simultaneously* . . . prepare the edges of steel plates of any commercial thickness *at one pass* . . . in a fraction of the time required by mechanical methods!

This Linde flame-planing method is as simple as ABC. It is economical . . . and easy to use. It cuts plates so smoothly and accurately that *no machining is necessary!* And it uses materials which can be produced in abundance.

On-the-job power requirements for flame-shaping are negligible . . . for the reaction of the cutting oxygen jet with the hot steel does all the work . . . and only fractional horsepower is required to move the cutting nozzles along the line of cut.

In conjunction with "Unionmelt" Welding . . . an amazing electrical welding process that unites plates of any commercial thickness faster than any similarly applicable method . . . like this . . . the Linde method of plate-edge preparation is working miracles in speeding up shipbuilding.

These two methods are also helping to break production records in other fields. Great pressure vessels . . . locomotive boilers . . . huge pipes . . . heavy chemical tanks . . . combat tanks . . . artillery mounts . . . and other vital equipment are being turned out faster because of them.

Linde research, intensified today, is constantly solving new problems in flame-cutting, flame-fabricating, and flame-conditioning of metals for war production.

The important developments in flame-cutting—and other processes and methods used in the production, fabrication and treating of metals—which have been made by The Linde Air Products Company were facilitated by collaboration with Union Carbide and Carbon Research Laboratories, Inc., and by the metallurgical experience of Electro Metallurgical Company and Haynes Stellite Company—all Units of Union Carbide and Carbon Corporation.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

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On the Campus...

(continued from page 22)

man, publicity chairman, and tickets chairman.

The activities of Polygon Board during the past semester have included a smoker on September 30 and the Engineers' Dance November 28. The second semester's activities include another smoker in February and the annual St. Pat's election and dance March 19.

During the past semester, Polygon Board has held several meetings with the newly formed Engineering Society Presidents' Council and many helpful suggestions were given to the Board. These, along with any other suggestions which any society member may have, are appreciated by the Board. Polygon is always looking for new ideas for engineering activities. If you have any suggestions, see one of the Board members or drop a line to the **Engineer**.

CONVENTION

Faculty members of the department played an important part in the Ninth Annual Chemical Engineering Symposium on Industrial Reaction Rates, sponsored by the Division of Industrial and Engineering Chemistry of the American Chemical Society at the Palmer House, Chicago, December 28-29. Prof. O. A. Hougen served as chairman of the Industrial Division Symposium, of which Prof. K. M. Watson was also a member.

Wisconsin men presented five out of the twelve papers given during the symposium. H. F. Hoerig, Don Hanson, and Prof. O. L. Kowalke reported on "Rates of Vapor Phase Esterification." Prof. Farrington Daniels of the Chemistry Department gave a report on "Prediction of Reaction Rates." Prof. K. M. Watson discussed the "Rate Equation for Heterogeneous Catalysts." J. du Domaine, R. L. Swain, and Prof. O. A. Hougen reported on "Rate of Exchange in Water Softeners." "Rates of Catalytic Hydrogenation" were covered in two reports, one by N. K. Anderson and C. A. Rowe on "Experimental Apparatus and Procedure," and the other by R. B. Beckmann, A. E. Pufahl, and Prof. O. A. Hougen on "Experimental Results."

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WEDDING BELLS

December 26 was the wedding date of Loella Frederick, Journalism student from Milwaukee, and Don Niles, Hartland, M.E. 3 and assistant editor of the **Engineer.** It was a wonderful day . . . it rained. The

Engineer staff members extend their best wishes to the happy couple, who will reside in Madison.

Go Easy on Equipment

ONE OF the age-old "traditions" of an institution such as this one is that equipment left in laboratories and classrooms is subject to appropriation by any student within reach. Reagents from the Chem labs, compasses and wire from physics labs, metal from machine shop, nothing is immune to the ravaging hordes of undergrads.

Partial cognizance of this is no doubt taken when the fees are established but they can never quite keep up with the loss—witness the fact that the university not only does not work at a profit, it does not even break even. (Let's not say it's a losing proposition, though.)

University President Dykstra sent a letter to all the faculty members warning them to keep labs, classrooms, and offices locked in order to guard equipment. Extra precautions are necessary now due to the fact that most equipment **can no longer be replaced.**

The university's priority rating is not high enough to enable them to replace all the equipment stolen by students. Even if it was, it would only be taking that equipment from some defense plant which could really use it to give it to some larceny minded student.

It does seem a shame that Mr. Dykstra had to ask the **faculty** to keep everything under lock and key, that he did not feel that the students could be trusted themselves. But when so many thousands of young people get together there is bound to be some who are careless about who owns the property he puts in his pocket.

Not only should students be careful about helping themselves to university property, but they should be careful of their own. Engineer's drawing sets are especially susceptible to the junior Daltons and Jameses. Twenty or twenty-five dollars' worth of drawing instruments is an awful lot of negotiable security to leave in an unlocked "locker." To anyone with an inclination to sticky fingers, finding an open locker generally means about twenty-five or thirty dollars from an out of town hock-shop in trade for the two drawing sets and freshmen aren't the only ones who present a target for this kind of larceny. This year, especially, with so many extra engineers who might be possessed of gooey digits and with drawing sets so scarce (and expensive), it is extra important to be careful. Lock your locker when you leave. Don't leave it for your partner to do, maybe he's leaving the job for you.

So for the duration of this war, at least, cooperate with your country by not taking what doesn't belong to you and by conserving your own materials.

•

More Static . . .

(continued from page 24)

Toasts were in order. The toastmaster arose to introduce a prominent elderly speaker, and said, "Gentlemen, you have just been giving your attention to a turkey stuffed with sage, now you will give your attention to a sage stuffed with turkey."

Scene: A Madison city bus. A young woman is vainly groping for her purse to pay her fare. A young man is standing nearby with anguish written plainly on his handsome features.

Young Man: "Pardon me, miss, but may I pay your fare?"

Young Lady: "Sir!" (Several seconds groping).

Young Man: "I beg your pardon again, young lady, but won't you let me pay your fare?"

Young Lady: "Why, I don't even know you and, anyway, I'll have this purse open in a minute." (Continued groping).

Young Man: "I really must insist on paying your fare. You've unbuttoned my suspenders three times."

○ ○ ○

Little Audrey and her sister Sue went dancing with two sailors. The nautical gentry were unfortunately guilty of B.O. and perhaps because of this or other causes, Sister Sue fainted. Someone in the crowd called for smelling salts, but little Audrey laughed and laughed because they were already there.

○ ○ ○

I tried to kiss her by the mill
One starry summer night,
She shook her head and sweetly said,
"No, not by a dam site."

Tanks . . .

(continued from page 15)

2. In any type design there must be a uniform distribution of the vertical load from the liquid contents over the foundation, otherwise additional stresses are set up in the shell plates from girder action that may be critical.

3. It is recognized that steel, even under the wide temperature range, if free to move, will continue to carry its steady design load without any increase in section.

4. It is also recognized that in extremely cold temperature, steel is definitely vulnerable to sudden shock or impact.

5. If restrained and not free to move, steel will be stressed at the rate of approximately 200 pounds per square inch for each one degree change in temperature.

6. To neglect temperature stresses in a restrained structure and permit a building up of internal stresses is not good engineering or correct economy.

7. The temperature of the liquid and the foundation establish the temperature of the bottom plates, and even though steel is a good conductor of heat and cold, it is a slow process for the outside temperature to penetrate very far into the bottom plates, in the conventional design, and balance the inside and outside temperature.

8. The bottom plates are held in alignment by the liquid above and the foundation below and restrain the free movement of the shell plates in the conventional design when they deform due to either, (a) hydrostatic stress, or (b) temperature stress, an increase in temperature relieving the hydrostatic stress, while a decrease in temperature adds to the hydrostatic stress.

9. In a bridge, retaining wall, dam facing, or similar structure, provision is made for expansion and contraction, and the same provision is necessary in a tank to remove the restraint and make for a safe design.

10. The economy and advantage of the welded tank over the riveted tank is today quite generally recognized, and likewise the same economy is quite evident in a welded expansion joint over a riveted expansion joint.

11. An expansion joint as herein described adds a nominal cost—about 2% to 3%—to either a riveted or welded tank, but produces a safer structure and the slight increase in cost is very materially offset by a lower insurance rate to cover loss of tank, contents, surrounding property and life, and this is a forward step towards sound economy and progress.

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ESSAY CONTEST

The James F. Lincoln Arc Welding Foundation announces a new contest with $6,750 in prizes for undergraduate engineers. The $6,750 is divided among 77 prizes ranging from $1,000 to $25.

Any student interested in entering a paper should see the head of his department for further details.