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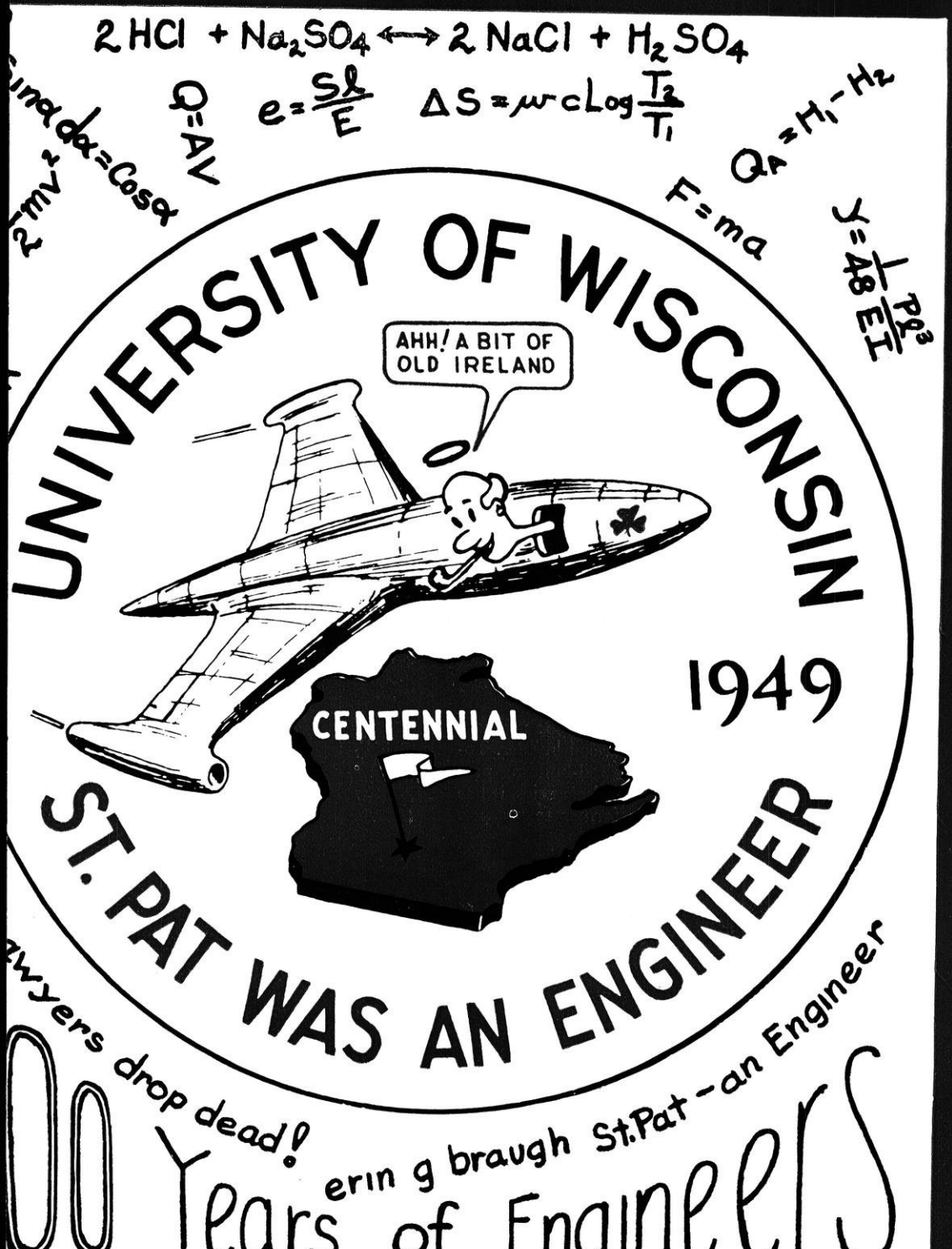
The Wisconsin

engineer



March, 1949

In This Issue:

15¢

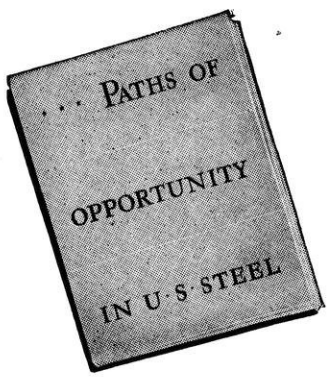
Thousands of Acres of Southern Farm Land Revitalized

Tennessee Coal, Iron and Railroad Company plays important role in task

FOR years, the devastating "one-crop system" robbed vast acreages of southern soil of the vital mineral elements which support plant growth. Cotton or tobacco raised in the same fields year after year had reduced the fertility of many southern farms to the point where the annual yield hardly paid for the seed and labor that went into production.

Among the things that agricultural leaders found in their efforts to build up southern agriculture was that Basic Slag —a by-product of open hearth steel, as manufactured at the Ensley (Alabama) Works of the Tennessee Coal, Iron and Railroad Company, a subsidiary of United States Steel Corporation — contained several important minerals, including phosphorus and lime. These elements are needed to grow bountiful crops and high beef and milk producing pastures.

Today, Basic Slag is in wide use as a convenient, economical soil builder. Together with the other soil-building programs of the agricultural agencies, it has helped the southern farmer to prosper.



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UNITED STATES STEEL

YOU CAN BE **SURE**...
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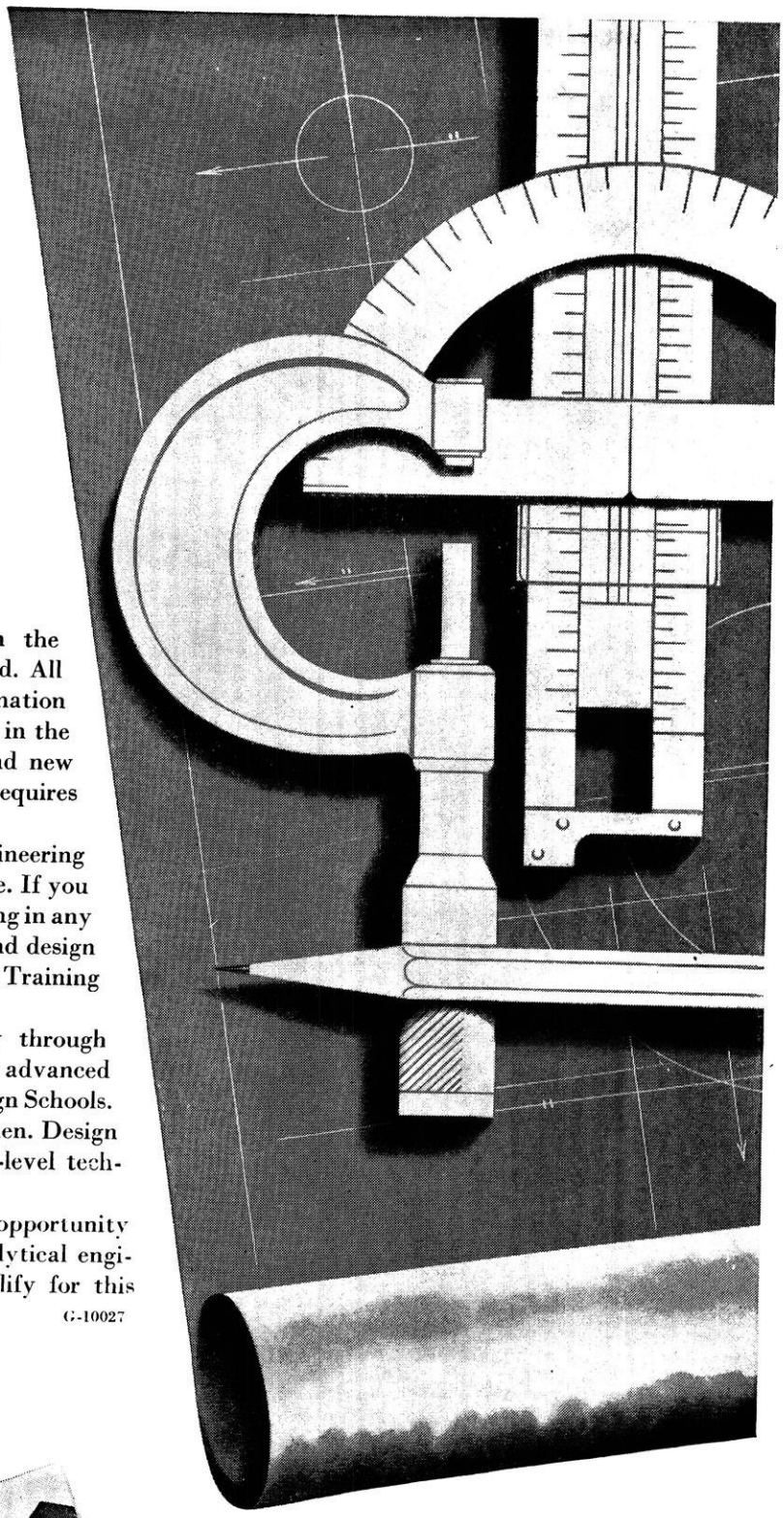

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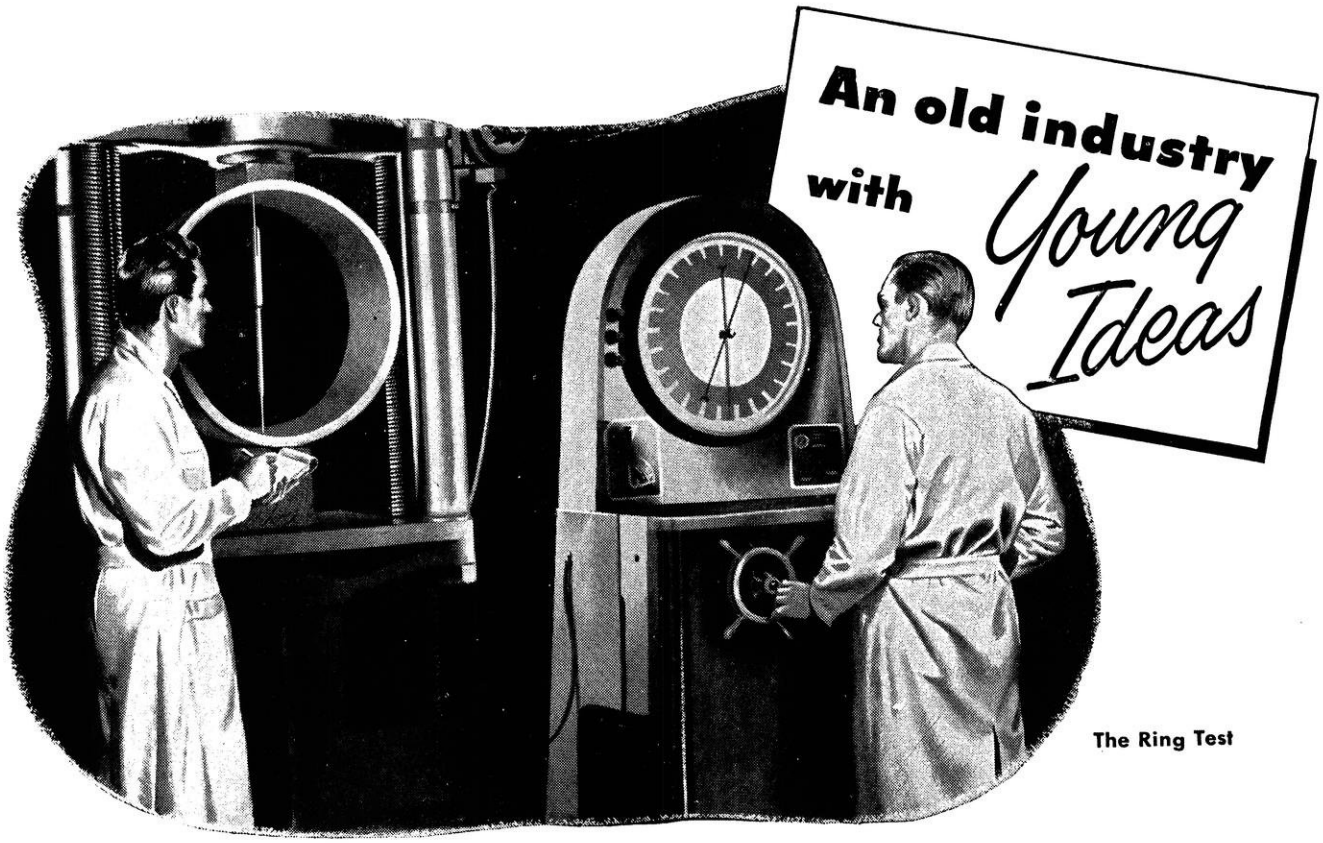


The Ring Test

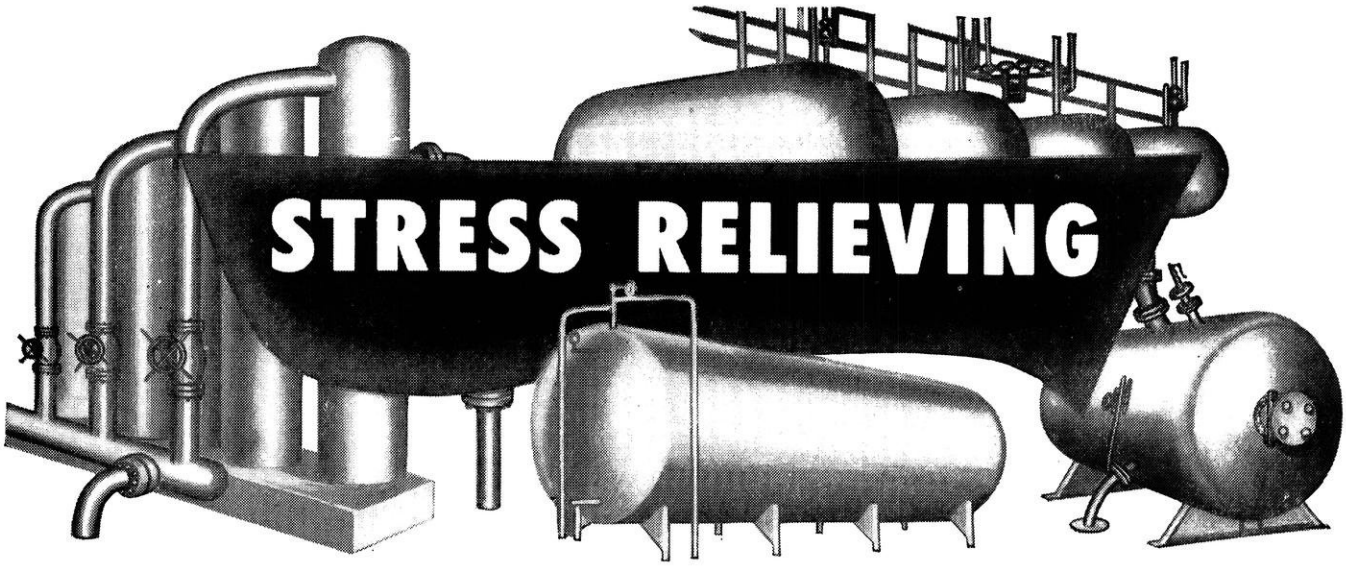
The ring test, shown above, is a scientific method for determining the modulus of rupture of pipe. It is not a required acceptance test but one of the additional tests made by cast iron pipe manufacturers to ensure that the quality of the pipe meets or exceeds standard specifications.

A ring, cut from random pipe, is subjected to progressively increased crushing load until failure occurs. Standard 6-inch cast iron pipe, for example, withstands a crushing weight of more than 14,000 lbs. *per foot.* Such pipe meets severe service requirements with an ample margin of safety.

Scientific progress in the laboratories of our members has resulted in higher attainable standards of quality in the production processes. By metallurgical controls and tests of materials, cast iron pipe is produced today with precise knowledge of the physical characteristics of the iron before it is poured into the mold. Constant control of cupola operation is maintained by metal analysis. Rigid tests of the finished product, both acceptance tests and routine tests, complete the quality control cycle. But with all the remarkable improvements in cast iron pipe production, we do not forget the achievements of the early pipe founders as evidenced by the photograph below of cast iron pipe installed in 1664 to supply the town and fountains of Versailles, France and still in service. Cast iron pipe is the standard material for water and gas mains and is widely used in sewage works construction. Send for booklet, "Facts About Cast Iron Pipe." Address Dept. C., Cast Iron Pipe Research Association, T. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3, Illinois.

Section of 285-year-old cast iron water main still serving the town and fountains of Versailles, France.

CAST IRON PIPE SERVES FOR CENTURIES



Temperature Ranges Required for Pressure Vessels at BLACK, SIVALLS & BRYSON, Inc. Demonstrate Controllability of *GAS*

Safety codes govern many of the manufacturing and testing methods for pressure vessels. One of the most important processes, stress relieving, requires precise control of temperatures throughout the cycle—just the type of temperature control to be found in thousands of industrial applications of GAS for heat treating.

Specialists in the manufacture of pressure vessels depend on GAS for heat processing of all types. The pioneering firm of Black, Sivalls and Bryson, Inc., Kansas City, uses GAS in the manufacture of tanks, valves, pressure vessels and safety heads. President A. J. Smith says,

"Throughout the past 25 years we have depended on GAS to provide the exacting temperatures for our work. In many of our plants we have developed special GAS equipment; our large stress-relieving furnace at Oklahoma City is a typical example."

In this large furnace the GAS control system is arranged to provide temperatures up to 1200° F. for any time-cycle required. Automatic regulators and recording pyrometers assure maximum fuel efficiency while the flexibility of GAS is an important factor in maintaining production schedules on vital equipment.

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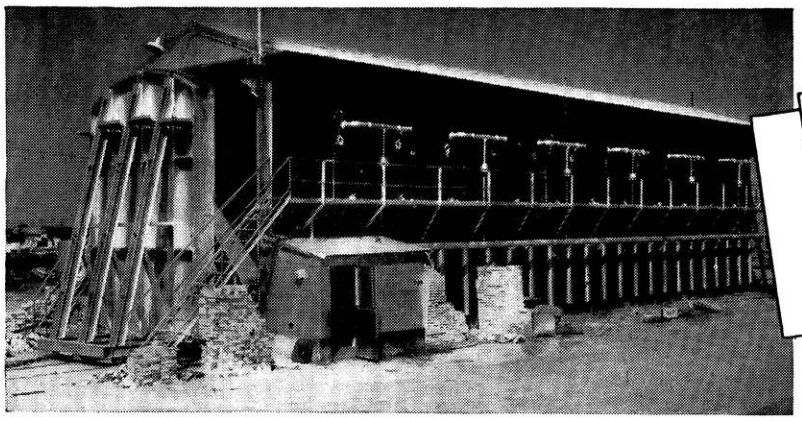

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WISCONSIN ENGINEER

Founded 1896

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In This Issue . . .

COVER:

Raymond Crupi, m'50, took time out from the formulae to enter a design in the annual Button Contest. His entry took first place, and the WISCONSIN ENGINEER is proud to incorporate it in this month's cover.

(*Background by Henke*)

Articles:

Departments:

DU PONT Digest
For Students of Science and Engineering

PRODUCING METALLIC TITANIUM FOR INDUSTRIAL EVALUATION

Du Pont group research developed a pilot plant with daily capacity of 100 pounds

Du Pont research has just made available to industry what may become one of America's key structural materials, titanium metal. Midway in density between aluminum and iron and with an especially high melting point, silvery-white titanium offers an extraordinary combination of strength, lightness, corrosion resistance and hardness.

Titanium is the ninth most common element. But it has been slow in coming into its own as a metal because of the difficulty of separating it in pure form from its ores.

Men pictured *on this page were members of titanium research team. E. L. Anderson, A.B.Ch., Brigham Young '40; J. B. Sutton, Ph.D.Phys.Ch., West Virginia '35; A. R. Conklin, M.S.Phys.Ch., Georgia '40, are shown inspecting 300 lbs. of Du Pont titanium metal sponge.*

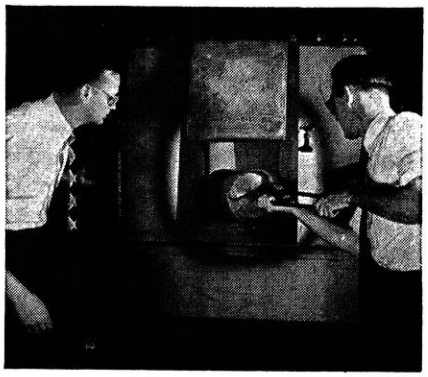
Du Pont scientists first began to probe the possibilities of metallic titanium in the course of their long experience with the titanium oxide pigments. Their research was interrupted by World War II. Meanwhile, the U.S. Bureau of Mines laboratories succeeded in producing the metal for research purposes.

After the war, Du Pont scientists developed a process for the production of ductile titanium metal that can be scaled up to meet commercial demands. The research team that mastered the complex problem consisted of chemical engineers specializing in design and production, as well as chemists and a metallurgist. In September 1948, a pilot plant was opened with a daily capacity of 100 pounds. Titanium metal is now being produced in sponge and ingot form. Samples are available to industrial and college laboratories with research projects in related fields. Studies of methods for forming, machining and alloying are under way.

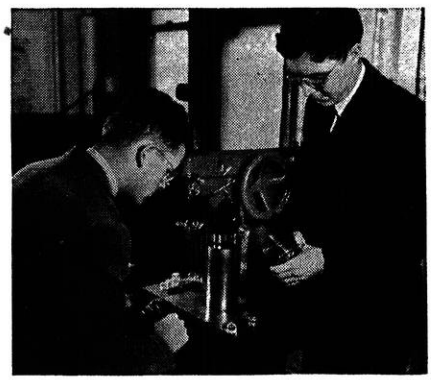
Exhaustive studies will be necessary before the many possibilities of titanium metal can be known. Because of its high ratio of strength to weight, early uses may be in airplane power plants and structural parts. Its hardness and rust-resistance recommend it for railroad transportation equipment, marine power plants and propellers, and food packaging equipment. Its high melting point suggests use in pistons, and its resistance to electric currents points to electronics. Titanium wire may be used for springs and titanium sheet for such highly stressed parts as microphone diaphragms.

Your Opportunity in Research

The commercial development of titanium metal is a typical example of Du Pont research in action. However, the Pigments Department, which worked out the process, is but one of the ten Du Pont manufacturing departments. Each conducts continuous research. Each is operated much like a separate company. Within these "companies"—whose interests range from heavy chemicals to plastics and textile fibers—college trained men and women work in congenial groups where they have every opportunity to display individual talent and capabilities. Who knows what their contributions will mean in the future to science and the world!



C. M. Olson, *Ph.D.Phys.Ch., Chicago '36, and C. H. Winter, Jr., B.S.Ch.E., Virginia Polytechnic Institute '40, removing 100-lb. titanium ingot from furnace in heat-treating study.*



R. C. Reidinger, *B.S.Ch.E., Princeton '47, and T. D. McKinley, B.S.Ch., Worcester Polytechnic Institute '35, making a test of the hardness of ingots of Du Pont titanium metal.*

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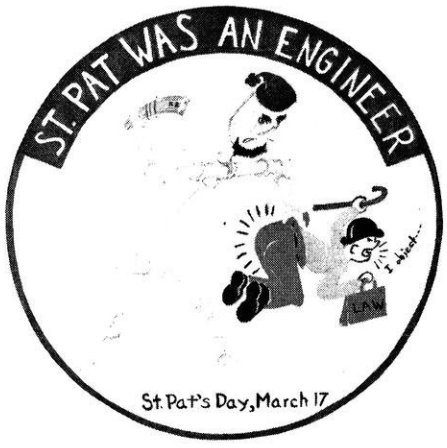
WRITE TODAY for "The Du Pont Company and the College Graduate"

(Photo by Mitchell)

Above: Shades of the House of David, as candidates for the beard growing contest measure up. Below: Two runner-up entries for the St. Pat's Day Button design.



St. Pat was an Engineer, ARE YOU?

by Chuck Strasse e'50

BACK in the good old days of 1903 some student engineers at Missouri got a bad case of early spring fever and decided to do something about it. They therefore banded together and took a day off from school using St. Pat's day as an excuse. The idea seemed good, grew, and gained in popularity as other engineering schools in the country picked it up. Wisconsin recognized St. Pat as the first engineer in 1912 when the seniors of that year paraded the streets with a piece of the original Blarney stone.

Since Wisconsin's first celebration the importance of the occasion has increased and decreased from time to time. The basic idea has remained, however, so that now St. Pat's day is probably the oldest tradition of the university.

In the past besides parades there have been expositions as well as verbal and physical fights between the engineering and law students. At present it seems the lawyers have given up and the engineers have become self-satisfied in their position of supremacy.

This year's celebration started with a button designing contest in January. First prize of fifteen dollars was won by Raymond Crupi, M.E. The runners-up who received dance tickets were Russell W. Henke, M.E., Robert M. Cotts, E.E., and Charles E. Klotz, Ch.E.

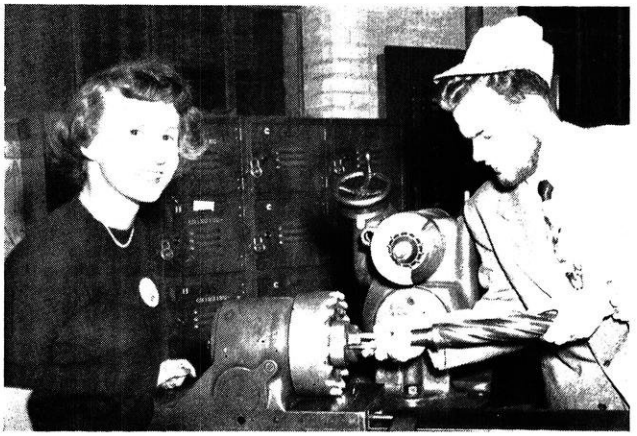
The official time for the start of the beard growing contest was January 20. All contestants will register at a certain date before the dance. The beards will be judged on their respective merits by the Badger Beauties at the dance. The best ones of course will bring prizes to their owners.

St. Pat himself is chosen by the student purchase of buttons and dance tickets. Each engineering society elects its own hopeful candidate for St. Pat. For each button or ticket a candidate sells he receives a number of points. The number of points per button per candidate is proportioned according to the enrollment in the different engineering courses. Be sure you buy a button or ticket from someone who is selling for your candidate.

(Photo by McKeon)

The C.E., M.&Me. and M.E. candidates getting their buttons from Ray Wilhelms of Polygon Board.

The St. Pat hopefuls this year are:
C.E.—Robert "Red" Craig '50
Ch.E.—Dick Humphrey '50
E.E.—Fritz Kohli '50
M.E.—Robert B. Wilson '51
M.&M.E.—Charles H. Pitt '51



(Photo by McKeon)

Beauty and the Beard
(M.E.'s Joan Schumway and Bob Wilson)

The culmination of the efforts of Polygon Board this year will be the St. Pat dance. If the dance is to be judged by the events leading up to it, it will be a grand affair. This year the dance will be semi-formal and in the usual place, Great Hall. The date is March 19, and the price $2.40 per couple. Throughout the evening, dreamy dance music will be provided by Lou Rene and his orchestra. The music will stop, of course, during intermission when the winning St. Pat candidate will be installed in his exalted position. St. Pat will be attended by a court of some 25 odd looking characters with beards. The members of the court will be knighted and receive the proper certificates of identification. Rumor has it that St. Pat and his court will be required to kiss a piece of the original Blarney Stone before things recommence.

Don't be surprised if you see a few well known people at the dance for the following have been invited as honored guests: Governor Rennebohm, President Fred, City Manager Howell, and our own Dean Withey.

At the time of publication, plans were in process for a Lawyer vs. Engineer basketball game. The time and place have not yet been set although a challenge has been made.

This dance is just for you—fellow engineers! It is the only source of revenue for Polygon Board and for many of the societies. Show your appreciation for the Centennial Smoker, and all the good speakers you have been able to hear. Get a ticket now! It's not too late.

St. Pat was an ENGINEER. Are YOU?

GROUND-WATER RESOURCES OF WISCONSIN

by Edward Bryan c'49

IT IS DIFFICULT to estimate with much accuracy what part the availability of an adequate supply of water has played in the development of any particular region; however, it is generally agreed that its part has been most important. Early civilizations were centered about adequate water supplies and many failed when their supply of water failed.

Before building their first aqueduct, the Romans depended upon the Tiber River, wells, local springs, and rain water stored in cisterns for their water supply. As their civilization became more complex, pollution of the surface and ground water near their concentrations of population forced the Romans to build lengthy aqueducts for the purpose of bringing sparkling pure spring water to their people.

The ancient Persians built extensive systems of shafts and tunnels (kanats) for the purpose of developing ground-water supplies for domestic uses and irrigation. The tunnels supplying Teheran (pop. 275,000) numbered thirty-six, were eight to sixteen miles long, reached a maximum depth of 500 feet below the surface, and were dug by human moles working over long periods of time. The Egyptians, in developing their water resources, constructed tunnels which reached under a hundred miles of desert to intercept seepage from the Nile.

In ancient times, springs were considered as miraculous gifts. Temples were built at their sites and superstitions were founded regarding the curative powers of these springs. Some of these superstitions have continued to the present day.

Many theories were proposed regarding the origin of ground water, and it wasn't until the latter part of the 17th century that the science of ground-water hydrology was born. Our present century has seen remarkable refinements in methods of field investigations and interpretation of data collected, field and laboratory methods of investigating the properties of water-bearing materials, and the development of methods for measuring the ground-water supply. The economic importance of ground-water has reached the point where its development is a major industry.

The recent period of active ground-water development began about 1915 when the introduction of the turbine centrifugal pump and great advances in the methods of casing wells to shut out intermediate pollution made the use of ground-water more practicable. Many public institutions, hotels, factories, power plants, canneries, and dairies are finding it more economical to develop their own ground-water supplies for air-conditioning and other purposes.

Wisconsin is very fortunate in having extensive supplies of water. The state is not only amply supplied with surface water from lakes and streams for the use of bordering communities, but its ground-water resources are among the finest in the world. This is a result of the proper combination of an adequate rainfall to replenish the supply used, and rock formations of the proper character to act as underground reservoirs.

There are two general rock structures which act as ground-water reservoirs for Wisconsin's supply—sedimentary beds of sandstone and limestone, and sand-gravel deposits in glacial drift. During the Cambrian period, when the Wisconsin region was under a sea, beds of sandstone and limestone were deposited which are now the source of deep-well artesian water. After these beds were uplifted and eroded over millions of years, the northern and eastern portions of the state were periodically covered by huge glaciers. Upon receding, these glaciers deposited huge quantities of unconsolidated, unsorted material and much sand and gravel, forming the "drift" areas of the state. The uncemented sand and gravel deposits form ideal reservoirs for the storage and recovery of ground-water.

Wells in glacial drift are usually comparatively shallow, while those reaching down to the Cambrian sedimentary layers, as those supplying Madison, Waukesha, and Wauwatosa are moderately deep. (See sketch.) Deep well water has had a greater period of contact with soluble constituents in the rocks of the earth and consequently contains more salts in solution than does the water derived from shallow wells in drift materials and thereby normally gives rise to a "harder" water.

The fundamental source of all this ground water is precipitation in the form of rain and snow falling to the earth's surface. It has been estimated that 16,000,000 tons of water are falling to the earth's surface every second of the day. Of this water, from 30 to 50 per cent eventually becomes ground-water. Its passage under the influence of gravity is affected by the structure and texture of the formations it encounters. A very permeable material, as a loose gravel, will allow the water to percolate rapidly while a relatively impervious stratum will halt the downward progress of the water. Upon reaching such a layer, the water will flow laterally. The downward and lateral motion of the water is normally at an equilibrium and the upper limit of this zone of saturation which may vary considerably is called the water table. It has been estimated that some of the water being pumped from Madison's wells today fell as rain some 2,000 years ago over the outcrop of the Potsdam sandstone formation.

The use of ground-water has increased tremendously since 1915. It has been estimated that over 50,000,000

people in our country depended upon either public or private wells for their water supply in 1939; therefore it is important to maintain our supply. Although it is not difficult to demonstrate that water must be replaced in a surface storage reservoir in order to keep it from becoming empty during use, the public is quick to resent any regulation of their use of ground-water since they feel the supply is inexhaustible. Through unregulated use of ground-water, the water table in the Santa Clara Valley of California dropped 90 ft. in less than 15 years. On Long Island, it became necessary to require approval by the state for wells whose capacity was 100,000 gallons or more per day. In some instances, water used for air conditioning was returned to the ground for re-charging the ground supply.

In 1935, the total use of ground-water in the United States amounted to about 10 billion gallons a day. Development was accelerated by the war, so that by 1945, the total pumpage had nearly doubled, and there has been no decrease in consumption since then. Both surface and ground-water are being used in greater quantities than ever before. As the use of water approaches the limits of available supply, water resources investigations will be needed with ever increasing urgency.

The Wisconsin legislature has found it desirable to require the application for a permit from the State Board of Health for the construction of every new well with capacity of 100,000 gallons or more per day. A permit may be denied only if the new construction would interfere with the water supply of a public utility. Although the ground-water supply in a particular region may be adequate, mutual interference by adjoining wells too closely spaced may reduce the yield from each. Madison's wells originally were free flowing artesian wells in which the hydraulic head was great enough to bring the water to the surface. Although the pressure has remained fairly constant since then, the rate of pumpage has increased to the point where it is necessary to install pumps at greater depths. The water in Madison's newest well, however, rose to that of the original well before pumping began.

Because Wisconsin has had the fortune to possess adequate supplies of ground-water, little research was done and few records kept of withdrawal. This contrasted to the extensive regulation practiced by states such as California and Texas where water of any sort is at a premium. Recently, however, alarm has been expressed over the comparatively rapid drop in pumping levels, especially at points of population concentration with their resultant industrial developments such as at Milwaukee and Green Bay.

As a result, the Wisconsin state legislature passed a bill in 1945 authorizing the expenditure of funds "for the purpose of investigating the underground water resources of the state, determining the present use and depletion thereof and recommending to the legislature such action as may be deemed necessary to conserve these underground water supplies as a public resource."

Ground-water studies were started in February, 1946, under terms of a cooperative agreement between the United States Geological Survey and the University of Wisconsin, represented by three staff members, A. T. Lenz, Noble Clark, and State Geologist E. F. Bean. All the work has been under the immediate supervision of F. C. Foley, district geologist of the United States Geological Survey.

Although some wells have extensive records, such as most municipal wells and those at a few forest ranger stations, the necessary material for a complete and com-

(*please turn to page 28*)

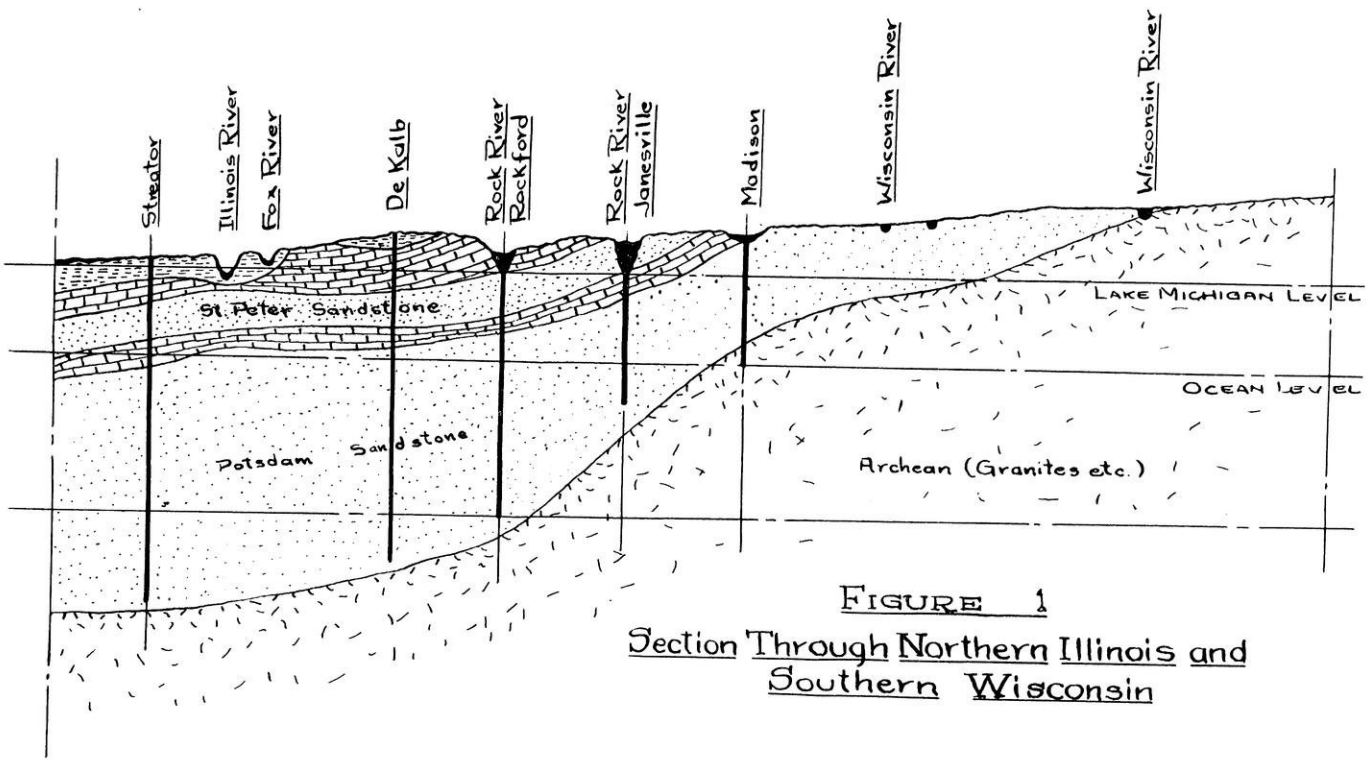


FIGURE 1
Section Through Northern Illinois and Southern Wisconsin

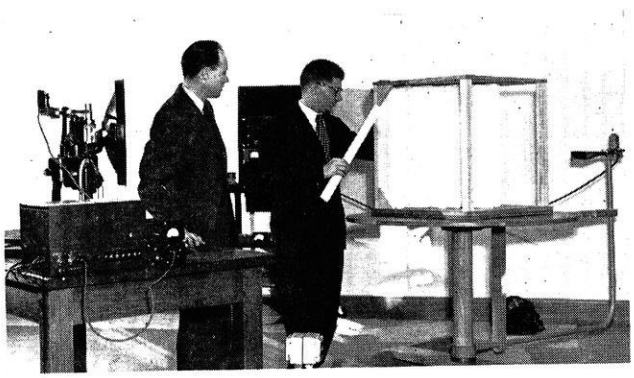
MICROWAVE PRISMS

by Robert Johnson e'50

This article was written as an introduction to one of the many research projects now underway at the University. There are many such activities included in the expanding programs of the Engineering College, and excellent opportunities for graduate research are rapidly increasing. Mr. Jerry Estrin, who is working on this particular experiment, has a very outstanding record. Graduating in February, 1948, at the top of his class, he listed among his undergraduate activities a membership in Tau Beta Pi, the vice-presidency of Eta Kappa Nu, a WARF undergraduate scholarship, and an undergraduate teaching assistantship in both physics and electrical engineering. He is now a WARF research assistant, and will complete the work for his Master's Degree this spring.—Ed. Note.

RESEARCH at Wisconsin is a growing activity, especially in the engineering schools. One project which is of great interest to both physicists and electrical engineers is the microwave experiment being carried out in T-23 under a Wisconsin Alumni Research Foundation fellowship granted to Mr. Jerry Estrin. Working under the guidance of Professor V. C. Rideout, Mr. Estrin has built an artificial dielectric prism for use in studying the behavior of microwaves.

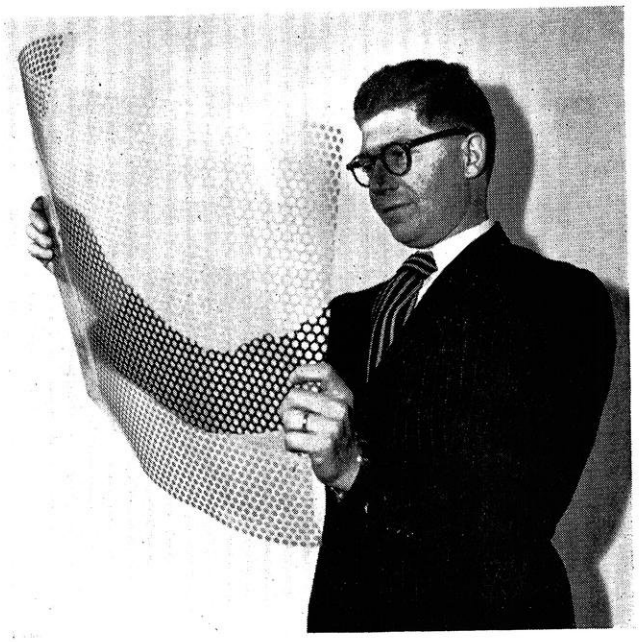
Both Mr. Estrin and Professor Rideout are shown in Figure 1 inspecting the experimental setup, which essentially consists of the wave generator, the prism and the waveguide pickup with its associated amplifier equipment. Nearly all of the time spent so far on the project has been on the design, development, and construction of the apparatus. Even with the beginning of the project last fall, difficulties were encountered in the design of the prism. It had to be built precisely. No metal parts whatsoever could be used in the mounting frame, and the rotating table upon which it is placed had to be accurately graduated. The waveguide pickup horn had to be designed and built. The radar reflection antenna had to be converted for use as a stationary microwave antenna, and most of the amplifier equipment in use had to be converted from war surplus stock.



(Photo by Wahlin)

Figure 1.
Professor Rideout and Mr. Estrin inspecting the microwave prism.

The design of the prism is relatively simple. It consists merely of many thin sheets of solid polystyrene spaced with half inch slabs of polystyrene foam. This white, lightweight material, which is now being used as artificial Christmas tree snow and for many other household and industrial uses, has a dielectric constant equal to 1.02. Hence it can be used as a supporting material without complicating the experimental analyses. Small disks 5/16 inch in diameter are painted on the thin sheets of solid polystyrene with a conducting silver paint. These thin sheets are then inserted between the foam spacers to form the prism. Mr. Estrin is shown in Figure 2 with one such sheet.



(Photo by Wahlin)

Figure 2.

Wave Guide Principles

The function of these disks, the behavior of microwaves when thrown toward the prism, and the uses of the experimental results obtained from the disk prism will be better understood after a short description of the development of its predecessor, the wave guide antenna.

It has long been known that radio waves with a very short wave length behave just like light waves. These

radio waves may be bent, focused, reflected, dispersed, and diffracted in much the same manner as light waves. Parabolic wave guides have been used in radar installations, for example, to reflect these microwaves in exactly the same way a parabolic headlight on a car reflects light waves from the filament into a parallel beam.

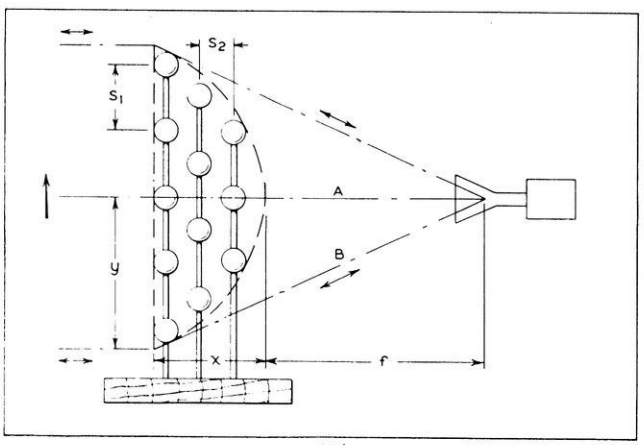
Microwave lens antennas are now constructed, on wave guide principles, to focus microwaves. These lenses were originally built to overcome the weight, tolerance, and shielding problems encountered with reflector antennas, especially in the larger sizes needed for repeater or relay systems. The first lenses consisted of rows of conducting plates acting as wave guides, the focusing effect being based on the principle that the velocity of electromagnetic waves is increased when they pass between two conducting plates. Hence lenses could be designed to focus these microwaves by increasing the wave velocity at the outside rim of the lens.

Because the velocity of the microwaves can be determined both in free space and between the wave guide plates, the index of refraction, n, of the lens is simply the ratio of the velocity in free space to the velocity between the plates.

Delay Lenses

The development of these original wave guide lenses, and their application to repeater station networks has shown the desirability of lenses exhibiting a constant index of refraction over a large band of frequencies. This led to the development of the so-called delay lens. This type of lens operates by delaying the velocity of the transmitted waves, and hence is very similar to optical lenses which also delay the light waves passing through them.

The delay lenses may be constructed to have a constant index of refraction over any desired wave band. They are light in weight and easily constructed to sufficiently accurate tolerance to permit accurate focusing, and they possess certain shielding advantages over reflector antennas. Reflectors are generally quite heavy. They require very precise machining operations, and they have many undesirable shielding and matching problems.



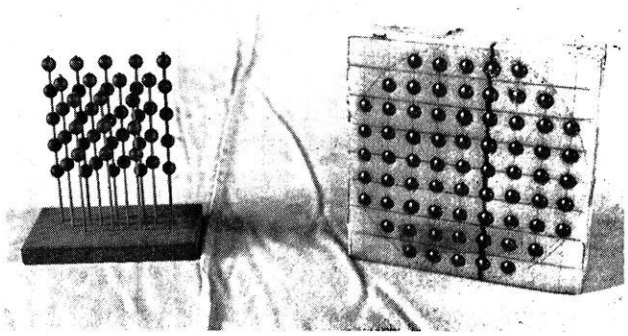
(Photo courtesy Dr. W. E. Kock)

Figure 3.
The diagram of a simple sphere array arranged in the form of a lens designed to focus microwaves.

Delay lenses consist merely of insulated conducting elements arranged to stimulate the molecular construction of real dielectrics. These lenses therefore refract electromagnetic waves. Such lenses are pictured in Figures 3 and 4. These two types of lens utilize conducting spheres and disks to obtain the desired focusing effect, but ordinary plates of conducting materials have also been designed and used with polarized waves.

Fundamental Principles

The theory behind the operation of these delay lenses requires further development. Since the latter part of the nineteenth century the behavior of very short radio waves passing through artificial dielectrics has been studied. Heinrich Hertz used the refraction of spark radiations passing through a pitch prism as one of his early experiments. However, during the last few years, there has been an intensification of the theoretical study done on this subject. Dr. W. E. Kock of Bell Laboratories has led in much of the work that has been done in the use and study of artificial dielectrics used for microwave experiments. His results have led many other researchers to study the possibilities of obtaining a method whereby a prism, lens, or other device can be constructed having any desired dielectric constant. This material would therefore be capable of matching any impedances merely by construction and design.



(Photo courtesy Dr. W. E. Kock)

Figure 4.
Two forms of support for microwave lenses.

Ordinary dielectrics such as polystyrene have been used in radio lenses, and they give good broad band performance. For the sizes required in radio relay stations, the weight and bulk of these solid plastic dielectric lenses was too great. As a result, metallic dielectric delay lenses were designed to operate on electromagnetic waves in the same manner as ordinary dielectrics like polystyrene, or pitch.

The dielectric constant and index of refraction of any substance is dependent upon the ease with which its molecules may be polarized. A molecule is polarized when it is placed in an electric field and its shape distorted by the redistribution of the charges within the molecule. This distortion occurs because the plus charges in the molecule are attracted to the negative portion of the surrounding

electric field, and the negative charges are pulled toward the positive portion of the field. This is exactly what occurs when insulated, metallic, conducting bodies are placed in an electric field.

If these metallic conductors are arranged in a three dimensional lattice structure similar to the molecular structure of an ordinary dielectric, a lens or prismatic shaped array of these particles will exhibit the same focusing and refraction effects observed with a similar optical system, or in a similar microwave setup with a true dielectric. The free electrons in the metal elements composing the structure oscillate under the action of the alternating electromagnetic field imposed upon them. These elements thus form oscillating dipoles which function in exactly the same way as the oscillating molecular dipoles of a true dielectric subjected to a radio wave.

In order to avoid any variation of the dielectric constant, two limitations are placed on the artificial arrays acting as dielectric media:

1) The inter-element spacing must be below the wavelength of the incident wave.
2) The size of the elements must be small compared to the minimum wavelength.

If this is not observed, diffraction and resonance phenomena will occur.

Dr. Kock and other researchers have done considerable experimental work, and they have obtained much data and some good, yet still approximate, design formulae. Mr. S. B. Cohn of Speery Gyroscope has, for example, recently announced a more exact mathematical treatment of artificial dielectrics. There is nevertheless much fundamental knowledge still to be obtained.

Wisconsin Experiments

The research work here at Wisconsin is primarily intended to be of a fundamental nature. The first phases of the project have involved the construction and assembly of all of the required equipment. The second phase will be the experimental, data taking stage; and then there will remain the complex problems involved in the analysis and interpretation of the experimental results.

The studies are to be based upon the use of the previously mentioned artificial dielectric prism. The basic ideas involved in the design and operation of the prism experiment are shown in Figure 5. The fundamental analogy to the optical experiments on prisms is very clear, and one of the objects of the project is to determine just where the optical similarities cease to exist.

A prism rather than a lens was chosen since the prismatic array is a simpler optical system, and it is hoped that the results will have a clearer bearing on the fundamental problems encountered. Disks are used since the sphere array affects the effective permeability of the array. That is, the spheres have a dimension in the direction of propagation of the electromagnetic wave. This alternating magnetic field cutting the conducting sphere sets up eddy currents on the surface which decrease the resultant magnetic field strength, and consequently diminish the effective permeability. This increases the losses in the wave passing through the prism.

Since the painted disks have no dimension in the direction of propagation, there are no eddy currents; hence the change in permeability is negligible. In general, the index of refraction, n, of the dielectric is given by:

$$n = \sqrt{Er\,Mr}$$

where Er is the relative dielectric constant and Mr is the relative permeability. If Mr is essentially constant and equal to one, the index of refraction is simply:

$$n = \sqrt{Er}$$

This greatly simplifies calculations.

(*please turn to page* 40)

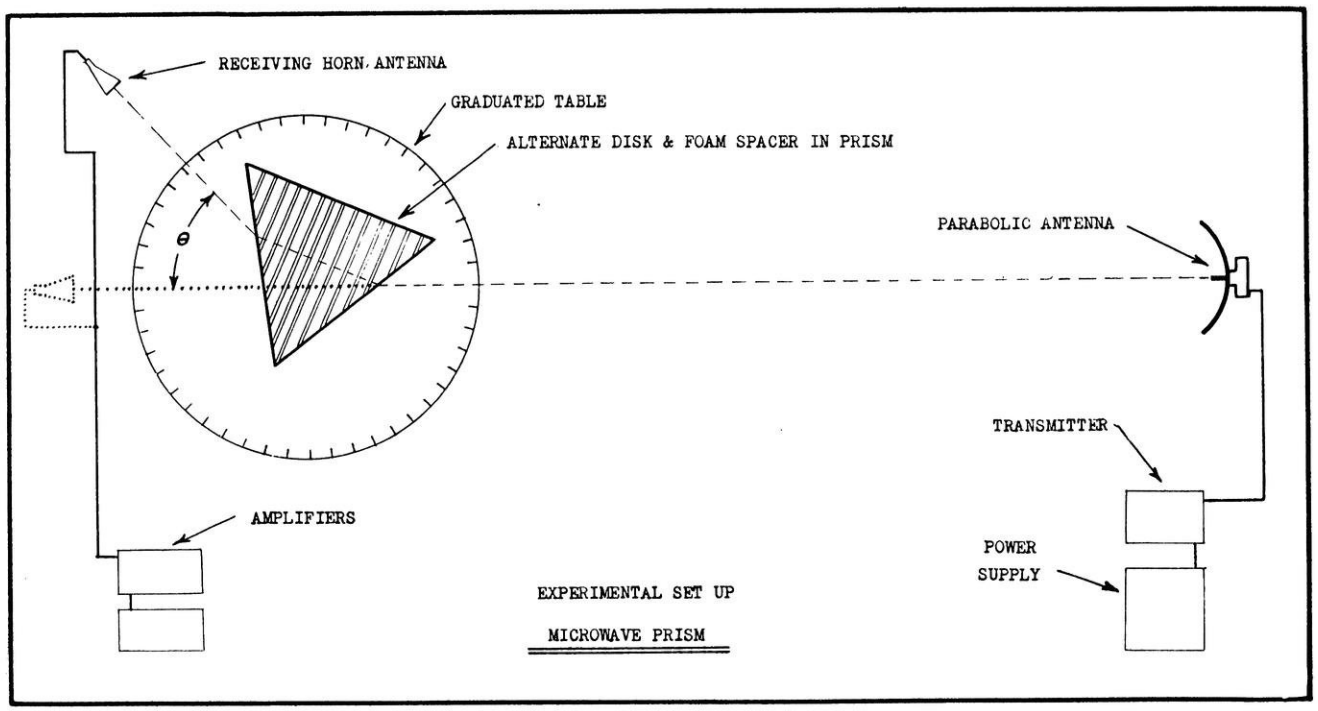
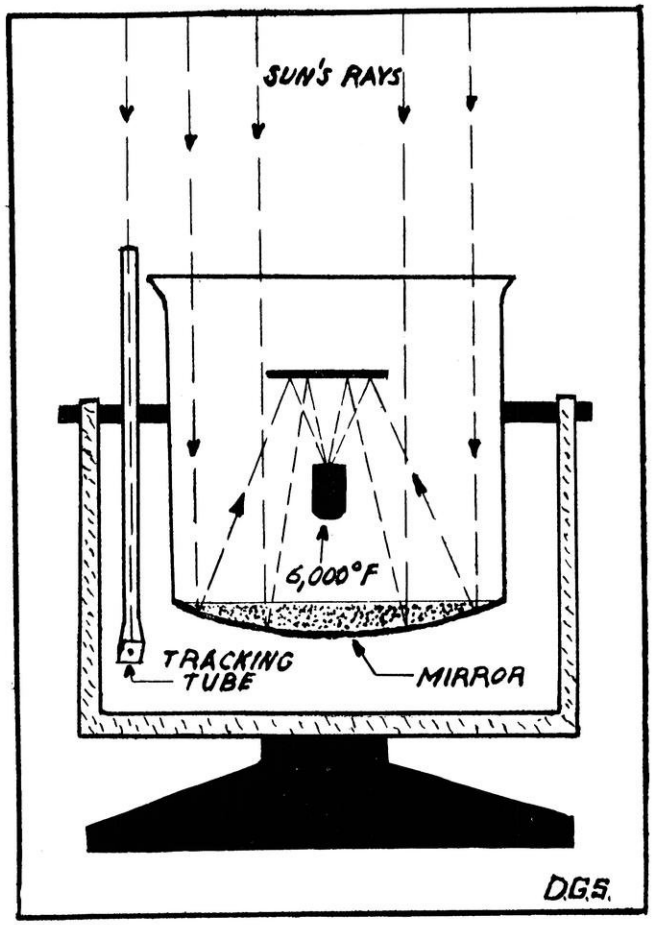


Figure 5.

The furnace is constructed from an army surplus searchlight two meters in diameter. The substance to be heated is placed at the focal point of the concave mirror reflector at the bottom of the searchlight bowl. The sun's rays, which concentrate at the focal point, produce a temperature in the neighborhood of 6,000 degrees Fahrenheit, while the surface of the mirror is hardly warm enough to warm a person's hand!



(Drawing from Newsweek, January 31, 1949)

Solar Furnace
An interesting use of solar energy developed in France to obtain very high temperatures.

The high temperature has enabled Trombe to melt many materials like thoria, zinconia, magnesia, alumina and oxides of the rare earths, which before this could not be melted. The furnace will melt about eighty pounds of iron in an eight hour day of sunshine while consuming two kilowatts.

Many interesting things occur in the solar furnace that are not found in ordinary high temperature furnaces. Black substances melt rapidly because they absorb much of the light that hits them. White substances melt slowly because much of the light is reflected from their surface. Transparent substances just don't melt, even in the presence of this 6,000 degrees of temperature. Fluoride crystals, for example, will not melt unless they are ground into a powder. In the powder form the many sides of the particles absorb enough heat to melt the substance. The extreme heat of the solar furnace has made it possible to combine the oxygen and nitrogen present in the air directly into nitric oxide.

In the future Trombe plans to build furnaces that will have capacity of 200 kilowatts and to heat a volume of two or three cubic meters.

Thermocouple Power

If one junction is hotter than the other, thermocouples will generate electricity. We could obtain power by placing one junction in the sunshine and the other one in the shade. The voltages obtained would be only a few thousandths of a volt, much too small for practical utilization. A series combination of these thermocouples would result in a resistance too high to be practical. The best commercial material available for thermocouples will give an efficiency of about 0.8%, under favorable atmospheric conditions.

Photosynthesis

Perhaps a partial answer lies with nature's method of using solar energy in growing plants. The little explored field of photosynthesis holds many possible solutions. The process of photosynthesis is about 20% efficient, that is, the chlorophyll in the plant's structure is able to utilize one-fifth of the sun's energy that falls on it. This green chlorophyll absorbs the sunlight and then passes on the energy of the sun to the series of complex reactions that combine carbon dioxide and water to form carbohydrates. Trees and quick-growing bushes and grasses can be grown on poorer land that is not suitable for standard foods. Sixty-five to seventy per cent of most woods can be converted into sugars by heating with diluted sulfuric acid to 120-150 degrees C. under special conditions developed at the U. S. Forest Products Laboratory. This material can then be used for producing alcohol, which can be used for liquid fuel. Other cellulose materials such as corn stalks can also be converted into alcohol at the rate of about sixty gallons per ton. New developments of the Fischer-Tropch synthesis of hydrocarbons strongly indicate that it will be possible to convert waste organic material into carbon monoxide and hydrogen, which can be converted into hydrocarbons and satisfactory motor fuels.

WIND POWER

Wind, as a source of power, has far less potentialities than solar energy, but at the present it is more practical. Wind has been used by man for many years to supply power in devices such as sail boats and farmers' windmills.

In 1941, on Grandpa's Knob in Vermont, the first wind generator, to feed directly into a high voltage transmission line, was put into operation. The generating apparatus was mounted on top of a 110 foot steel tower. The wind power was converted into rotational energy by two massive steel blades operating in propeller fashion. The blades were 11 feet wide, 65 feet long, and they weighed 15,300 pounds each. The three phase, 60 cycle generator operated at 600 rpm, through a gearing arrangement, on 2,300 volts and a power factor of 80%. It produced 1,000 kilowatts. The substation at the base of the tower transformed the

(please turn to page 34)

ON the Campus

by Robert Gesteland e'52

Number one attraction on the slate this month consists of a roaring welcome for St. Pat. We're all glad he's around to provide the engine school inmates with a happy time now that March 17 is imminent. The dance in honor of St. Pat's birthday is Saturday, the 19th, in Great Hall of the Memorial Union. Something doing about the beard growing contest that evening too, according to Polygon Board. See all of you there.

The next issue of your favorite magazine, this one of course, will have a new, improved version of the On The Campus column. Bob Consigny, ch'52, and John McNall, ee'52, will be pitching in to help your correspondent dig up enough interesting news to fill this space.

* * *

TRIANGLE—KHK

The Christmas holidays were the sign for the annual Christmas semi-formal held jointly by Triangle and KHK. On December 17, 75 couples danced away the evening to the music of Al Alverson and his orchestra at the Knights of Columbus Hall.

Guests for the evening were Professor and Mrs. P. H. Hyland and Professor and Mrs. V. C. Rideout.

Blackhawk Lodge was the scene of an informal party on the 12th of February. In keeping with the informality, the guests were requested to remove their shoes at the door and to dance in their stocking feet.

Appetites sharpened by the cold winter air were satisfied by an ample supply of cider, hot chocolate, and doughnuts. Chaperons were Mr. and Mrs. Howard H. Buer.

RESEARCH

On February 17, the second Engineering Research Conference was presented in Room 105 of the M.E. Building. The subject was the University of Wisconsin Naval Research Laboratory, a university research project subsidized by the Navy. Its director is Dr. O. J. Hirschfelder.

Two main fields are currently being studied and were briefly outlined by the men conducting the experiments. One field is that of "flame research," "the theory of flames and transport properties"; these were the titles of the talks by Dr. Lowell Olsen and Dr. Charles Curtiss, respectively. The second is the field of ultrasonics (high frequency sound) as applied to the diffusion and separation of materials. Dr. James Fitzgerald briefly explained the field and Dr. Charles Boyd related it to the latter study.

An interesting field which has entered into these studies is that of the solution of difficult problems through automatic calculation equipment. The laboratory now has a number of hand calculators for the simpler problems. A second method is that of solution through the use of punch cards, the IBM system. Dr. Hirschfelder stated that very shortly Wisconsin will have IBM equipment for the solution of much more difficult problems. Sometimes it has been necessary to resort to Eniac (electronic calculating equipment).

Following the discussion of the projects, the audience toured the laboratory, located just off University Avenue on the west end of the campus. Here is the equipment, including an optical interferometer for studying flame properties, the Schlieren camera, Ultrasonator, and other devices used in the research.

* * *

SAE—ASAE

Mr. C. E. Frudden, consulting engineer for Allis-Chalmers Manufacturing Corp. and national president of the Society of Automotive Engineers '47-'48, presented the program at a combined meeting of the student chapters of the Society of Automotive Engineers and the American Society of Agricultural Engineers on Tuesday, February 15. Mr. Frudden's speech concerned tractor development and opportunities for engineers in this field. An interesting film entitled "Horses to H.P. with Tractors" was also shown.

SAE is planning a field trip to the Chevrolet plant in Janesville in the near future and is looking forward to the joint dinner meeting and plant trip to be held with Milwaukee Section in May.

* * *

MINING CLUB

Mr. Chuck Nast, vice-president of the Chester V. Mulligan Co., was guest speaker at the February meeting of Mining Club. Eighty members heard Mr. Nast's speech on the foundry industry. The banquet was arranged entirely through the efforts of Mining Club members, with the excellent dinner prepared under the supervision of Bob Hueschen and his crew.

(*please turn to page* 24)

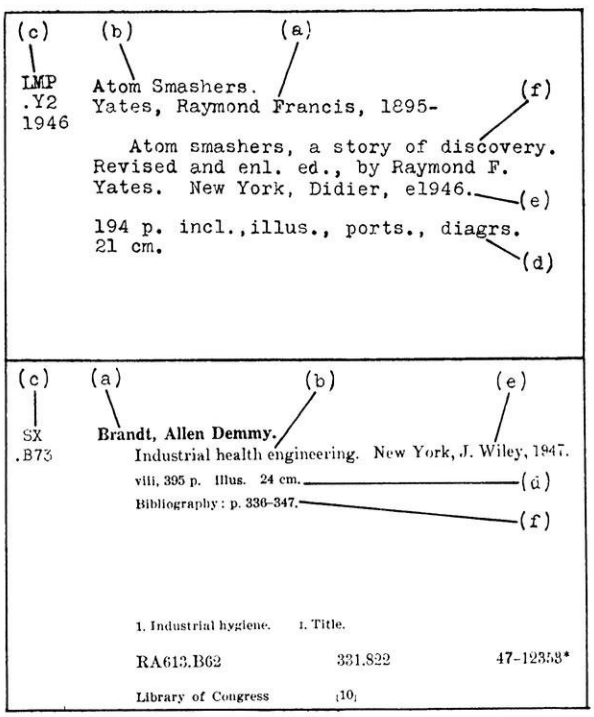
REFERENCE TOOLS

by Eugene Haupt m'49

WITH the rapid advances made in engineering during the past century, vast amounts of printed material have become available to the engineer for his use. This material is stored in books, periodicals, catalogues, and technical papers. Due to the large amount of material available it is impossible and not practicable for any one person to keep abreast with the publications in anything but a very narrow and restricted field. The question is, then, "How can we use and find the information we desire?" As any engineer will frequently be drawn away from his chosen field, it becomes imperative that he should be able to find information when he wants it.

Books are the primary sources of information and contain well established facts, information, and theories. They do not contain the latest information and seldom contain records of research, but are usually summaries of a particular field.

Books in a library are usually grouped together according to the subject matter contained. These systems of grouping are the Dewey Decimal, Library of Congress, Universal Decimal Classification, and the Bliss systems. These systems all involve classifying the books so that every book had a definite location on the shelves of the library.



The guide or index to the books in a library is the card catalogue. Card catalogues in engineering libraries are usually divided into three parts: author index, library subject or title index, and classified subject index. The catalogue cards are more or less standardized in form and information given. Standard cards are available from the Library of Congress at a nominal fee.

Each card whether for author, title, or subject matter, contains all or part of the following information: (a) author's full name, (b) title of book, (c) library call number, (d) collation information, (e) imprint data, and (f) notes.

When searching for information on a given subject from books, the following procedure is suggested:

1. Check the classified subject card index, paying particular attention to the notes for cross-references.
2. Examine bibliographies located by step 1.
3. Consult comprehensive reference works such as handbooks, encyclopedias, treatises, and recent textbooks. Incidentally, textbooks are usually outmoded in from 5 to 10 years.
4. If more thorough coverage of the literature is desired, consult the published bibliographical sources like the "Cumulative Book Index" and the "Bibliographical Index" to determine existence of books in the field. These books may be consulted at other libraries, borrowed through inter-library loan, or reproduced by microfilm or photostat.

By far the largest source of engineering information are the periodicals. These serial publications are perhaps the most important source of recent technical information. They range from reviews which are critical summaries within certain fields, through transactions, yearbooks, standard journals, and popular magazines, to trade journals which are sources for prices, production statistics and reports on market conditions.

These serial publications are important because they contain information long before it reaches book form, and also because they contain material much too limited for books. They are the principal source of current information practice and operational procedure.

Paging through periodicals does not pay unless one is merely looking for background material or knows the approximate location of the material. The far more efficient method of consulting indexes produces much better results. Frequently journals issue an index to each volume, but more important are the organized indexing services, such as the following:

The "Chemical Abstracts" furnish the largest source of indexed material for engineers. Although the "Chemical Abstracts" are published by the American Chemical Society principally for chemists and chemical engineers, engineers in other fields will find many familiar topics listed. In this atomic age artificial subject barriers are rapidly disappearing. "Chemical Abstracts" are handy because of their complete indexing system. Each abstract

(*please turn to page* 36)

Science Highlights

by Howard Traeder m'48

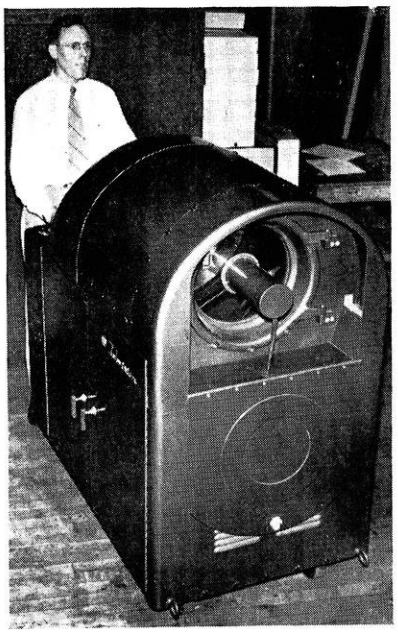
THEATER TELEVISION

Two basically different systems of large screen television are currently undergoing tests by the Radio Corporation of America. One form of theater television is the direct projection system by which kinescope images are projected through a reflective optical system; the other is an intermediate film system using standard motion picture projection technique, after the kinescope images have been photographed on motion picture film.

In the direct projection television system are three major elements: the special projection kinescope which is the source of the light image; the optical system which projects the image; and the viewing screen. Although similar in many ways to the direct viewing tube used in the conventional television receiver, the kinescope produces an image of much greater brilliancy because of the higher voltage applied to it.

Elements of the optical system, based on the Schmidt astronomical camera, consist of a spherical mirror and a correcting lens. The lenses are made of plastic by a cold-setting process. The largest system ever built consisted of a 42-inch mirror, a 26-inch lens and projection kinescopes of either 12- or 15-inch diameter, operating at 80,000 volts. The high cost of the 42-inch mirror system has indicated the advisability of concentrating on smaller optics and increasing the voltage capabilities of the seven-inch projection kinescope in order to make a compromise system which would be commercially successful.

The alternate system of large screen television projection is the intermediate film method which consists of three major units. The first is the television recording unit with a high quality kinescope tube and a special 35mm. motion picture camera. The second consists of a high-speed film processing machine and the third is a conventional 35mm. theater film projector. Such a system can be so integrated that the time elapsing between the appearance of the image on the kinescope and its projection on the viewing screen is less than one minute.



(Photo courtesy RCA)

Direct Projection Television Unit

FERROXCUBE

Patents on three new magnetic ferrite materials have been issued to the Philips Laboratories, Inc., Irvington-on-Hudson, N. Y. These materials have unusual properties which permit a considerable reduction in the physical size of electrical components such as inductors and transformers. These magnetic ferrites consist essentially of homogeneous mixed crystals of metallic oxides and iron oxide and have high magnetic permeabilities and low remanence and coercivity. In contrast with the usual magnetic materials, which are highly conductive, the new materials are essentially electrically insulating.

The materials were developed in the laboratories of the Philips Company in the Netherlands and will be manufactured and marketed in this country by North American Philips Company, Inc., under the trade mark "Ferroxcube."

FROZEN FILM

A new photographic emulsion developed in the Kodak Research Laboratories for tracking down atomic particles is so sensitive its producers are faced with the problem of how to prevent its pre-exposure by cosmic rays during shipment to research workers. The new emulsion is approximately four times as fast as the company's existing nuclear track plates. It has successfully recorded electron tracks which are ten times longer than those previously captured photographically.

Protection of the new material poses quite a problem. No sooner is the new emulsion made than it begins to record the bombardment of cosmic rays which strike all about us constantly from outer space. Dr. Cyril J. Staud, director of the laboratories, said that "about six electrons from cosmic rays strike each square centimeter of the emulsion every minute." This intense barrage peppers the emulsion so much in three days' time that, unless adequately protected, it is clouded with background streaks upon development.

Packing the emulsion in dry ice for shipment may protect it, Dr. Staud indicated, because the emulsion's sensitivity is reduced at low temperatures. On arrival, it could be refrigerated and later permitted to warm up just before exposure.

ROTOCHUTE

The pilot of the future may safely escape his disabled supersonic

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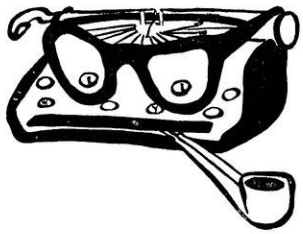


"ENGINEERING"

. . . Is It a Profession?

The Way We See It

FROM TIME TO TIME, the question arises among engineers, "Are we professional men, or are we not?" We affiliate with organizations we call professional societies. But there are some groups who do not believe that engineering is a profession, and they offer various criteria to demonstrate their point.

Webster's dictionary describes enginering as, "The art and science by which the properties of matter and the sources of power in nature are made useful to man in structures, machines, and manufactured products." When the broad scope of enginering as we know it today is considered, this is a remarkably concise, yet adequate definition.

But what about this profession matter? Again, from Webster, a profession is, "The occupation . . . to which one devotes oneself; a calling." Also, "The body of persons engaged in a calling".

Now we can begin to evaluate our position. How much are we "devoted" to our work? Has it been a "calling" to us? A "calling" suggests something high and noble; a position of trust and responsibility; a challenge. Do we feel that the problems of our day are a challenge, commanding the best of our abilities to successfully solve them?

In the past few decades, we have done much to "make matter and power useful to man." We have raised the standard of living. By careful and conscientious work, we have reduced suffering and death by typhoid to nil. We have taken the burden from man's back, we have made his house more comfortable in the face of summer heat and winter cold.

Our efforts, however, have not always been so completely successful. We have constructed sleek, powerful autos and thousands of miles of concrete ribbon to drive them on; yet we have not solved the human elements of traffic flow, as this combination kills nearly a hundred persons every day, and maims hundreds more. Our aircraft have released man and his commerce from the ground; but in less than fifty years air power has come to be the most formidable means of waging war against our fellow men. It is clear that we have not yet completely learned to control the social consequences of our inventions. Man is still suffering; there is our challenge. We must change that definition to, "The **profession** by which the properties of matter and the sources of power in nature are made useful to man **for his best interest** as structures, machines, and manufactured products."

Calling engineering a profession, or writing editorials about it, will not be enough. We will not be a profession in fact until we are recognized as such by all groups. We have come a long way, but there is much yet to be done if we are to gain this recognition.

Engineers are usually noted for their clear thinking. We must apply our methods of analysis to social problems, too, and not let prejudice or pride prevent us from making the best decisions.

We must not be secretive about our work, but must endeavor to make it understandable to everyone. We should forget technical nomenclature when talking to persons other than engineers, and use words they can understand. When a man does not understand, he tends to mistrust and belittle.

We must police our own group, to insure that only competent engineers are allowed to serve the public, either as governmental employees or private consultants. Proper and adequate registration laws will take care of this. We must discourage the use of the title "engineer" by tradesmen and technicians.

Engineers as a group should demonstrate a greater interest in government. The special abilities of the engineer permit us to correctly analyze problems, and to see through the subterfuge so often resorted to by politicians. By serving on citizen's committees, we can work for the best interests of our community.

Almost any decision that the engineer might make has its economic and social consequences. We must learn to know what these are, and allow for them when we choose a course of action. If a new machine will put a man out of work, we must consider how that man can be gainfully employed elsewhere.

Probably the most important interest the engineers should have is in education, both general and in our own specialized field. We should insist upon the highest standards, from the grammar school to the college. We must insist on adequate budgets and high quality teachers for these institutions, the very foundation of our way of life and civilization.

These suggestions may not fulfill or meet everyone's criteria of professionalism, but they will surely serve "for mankind's best interest." Can there be a better standard?

W. M. H.

Alumni Notes

by Al Nemetz e'50

—M & ME—

Clarence H. Loring ('24), in collaboration with R. R. Adams, has written a book entitled "Copper as an Alloying Element in Steel and Cast Iron."

Mr. Loring is now assistant director of the Battelle Memorial Institute. He is a Milwaukee man who, after graduation, took his Master's degree in 1924 and his Ph.D. in 1928, after which he went to Battelle Memorial Institute as a metallurgist.

Kenneth K. Tucker ('49) has taken a job with the Arcade Manufacturing Company, Freeport, Ill.

J. R. Dodge ('49) is now with the Shell Oil Company, Houston, Tex.

J. W. Mohr ('49) has accepted a position with the Kiekhaefer Corporation, Fond du Lac, Wis.

Herschel Kaufman ('36) is an assistant blast furnace superintendent with the Carnegie-Illinois Steel Corporation, Algonquin, Pa.

Charles D. Reiter ('48) has recently completed a portion of the training program of the J. I. Case Company, Racine, Wis., and has been transferred to Rockford for further training.

—ME—

Edward Drott, Jr. ('43), who was chief engineer of the Drott Manufacturing Company in Milwaukee, has moved his company to Wausau, Wis.

The following '49 grads have taken the jobs indicated below:

Robert C. Meyer is now with the Wisconsin Telephone Company in Milwaukee, Wis.

V. R. Floyd has accepted employment with the Buda Company of Harvey, Ill.

J. R. Dagenkopf has taken a job with the Firestone Tire and Rubber Company, Akron, Ohio.

L. F. Koonce is in the Electro-Motive Division of the General Motors Company, La Grange, Ill.

John E. Sheehan has been employed by the Ralston Purina Company, Circleville, Ohio.

John C. Rasmussen is with the Goodyear Rubber Company, Akron, Ohio.

C. E. Downham is employed by the Scott Paper Company, Chester, Pa.

R. J. Gerlach has taken a job with the Texaco Oil Company, Lockport, Ill.

—EE—

Frank K. Brainard ('08), who was a member of Allis-Chalmers motor and engineering section since 1909, died recently. Mr. Brainard was with Allis-Chalmers from 1909 until 1948, except for a period of two years, 1915 to 1917, when he served as professor of electrical engineering at Marquette University.

Mr. Brainard worked principally on synchronous machine design, especially in the field of smaller generators and motors.

Lee H. Kaiser ('40) has joined the Kodak Office division of the Eastman Kodak Company, Rochester, N. Y., as an attorney in the patent department.

Roy C. Muir ('05), who managed the General Electric's Nucleonics department, is again retiring after spending the year at Richmond, Wash., organizing and directing this new department of the company.

Robert W. Hacker ('49), former editor of the "Wisconsin Engineer," is now employed by General Motors in their electromotive division.

—ChE—

The following '49 grads have taken the jobs indicated below:

William E. Ellingen is now with the Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

Robert E. Vetter is employed in the Mid-State Products Lab., Minnesota Mining and Manufacturing Company, St. Paul, Minn.

William H. Peterson is with the Minnesota Mining and Manufacturing Company, St. Paul, Minn.

—CE—

Herbert B. Brown ('17) died on January 7 at the Wisconsin General Hospital in Madison. He was superintendent of water works for Milwaukee. He had been president of the Wisconsin section of ASCE and of the Association of Municipal Engineers.

Clement P. Lindner ('25), after many years at Vicksburg with the U. S. Engineers, is now at Atlanta, Ga., as chief engineer of the South Atlantic Division of the Corps of Engineers.

Boyd G. Anderson ('36), who has specialized in industrial design, has been made associate partner in the engineering firm of Amman and Whitney of New York and Milwaukee. He is the chief designing engineer of the company.

Ralph Gribble ('43), who has been engineer with the Kuehner Packing Company of Muncie, Ind., is returning to employment with Oscar Mayer and Company at Philadelphia.

John T. DeYoung ('49) is with the Milwaukee Road in the engineering and maintenance department of the Chicago-Terminal division.

Frank L. Grisa ('49) is with North American Aviation, Inc., at Los Angeles in design work.

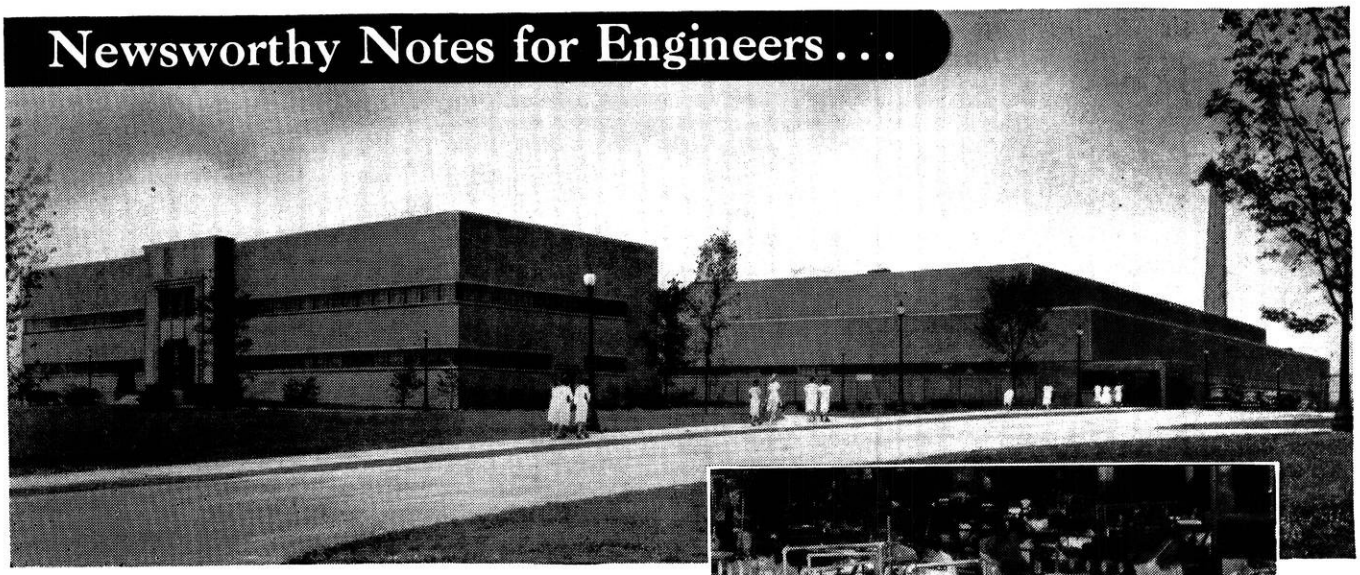
John G. Hahn ('49) is with the Omaha Dredge and Dock Company at Omaha, Nebr.

Sylvin R. Lange ('49) is with the Texas State Highway Department, Houston district.

Arthur J. Schallock ('49) is in Milwaukee with the engineering firm of Klug and Smith.

Lowell J. Tooley ('49) is full-time engineer-manager for the village of Shorewood Hills on the outskirts of Madison.

Newsworthy Notes for Engineers . . .



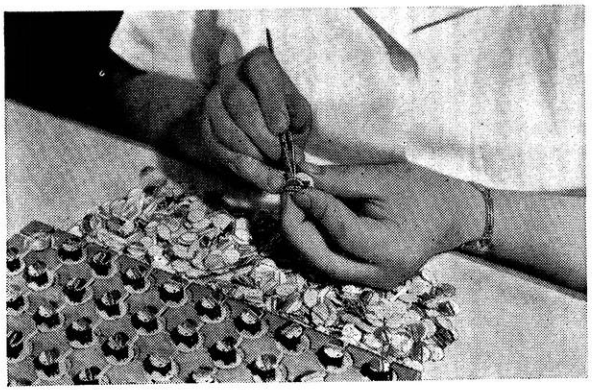
New electronics plant of Western Electric at Allentown, Pa.

Complex job for Engineers

Over 40 miles of pipes deliver 13 needed services to working locations. These are hydrogen, oxygen, nitrogen, city gas, city water, deionized water, soft water (cold, hot, cooling) high pressure air, low pressure air, process steam and condensate return.

This new "controlled atmosphere" plant, which produces electronic equipment for your telephone service, posed many interesting problems for engineers at Western Electric—manufacturing unit of the Bell System.

For example, a speck of dust or a trace of perspiration may seriously impair the efficiency of vacuum tubes, thermistors, varistors and mercury switches manufactured here. To meet these problems, the new plant is completely air conditioned, with strict control of temperature and humidity—sealed except for doors, and slightly pressurized to keep out dust.



Assembling miniature electron tubes—typical of the high precision work at Allentown—calls for finest lighting. It is provided by a scientifically designed system containing over 13,000 fluorescent tubes.

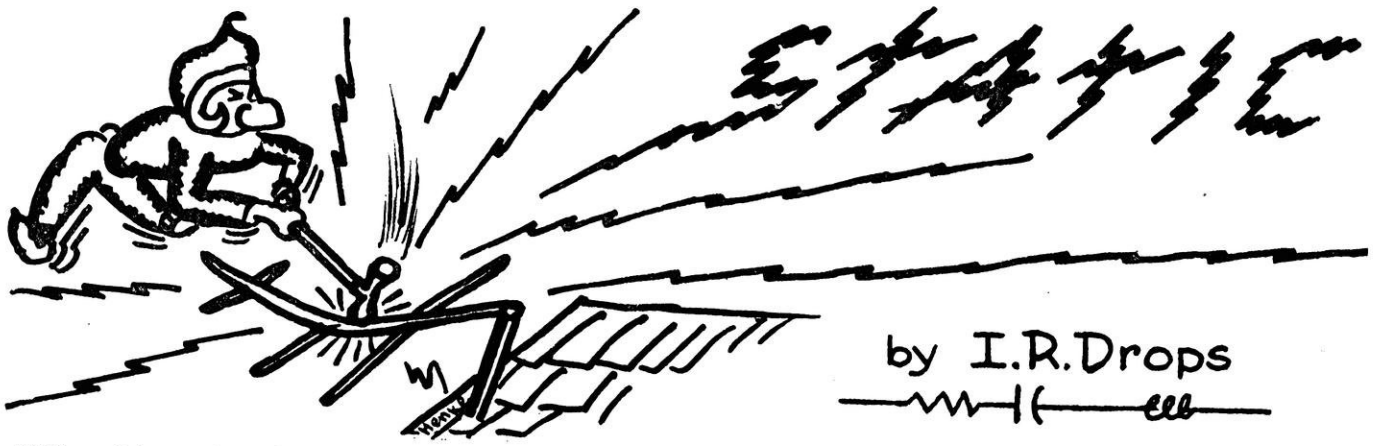
Other "musts" in planning included proper illumination for high precision work—a complex network of piping to deliver 13 needed services—a gas generating plant—a highly efficient chemical waste disposal system.

But beyond the problems solved in helping to design the plant itself, Western Electric engineers met many a challenge in working out highly efficient manufacturing layouts, machine design and production techniques to assure a steady flow of highest quality electronic devices of many types.

This new Western Electric Plant at Allentown is a measure of the ingenuity and thoroughness of Western Electric engineers—electrical, mechanical, industrial, civil, structural, chemical, metallurgical—who provide equipment that helps make Bell telephone service the best on earth.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882



"What did you do with my shirt?"
"I sent it to the laundry. Why?"
"Ye gods, woman! A whole semester of thermo was on the cuffs."

* * *

Even some of the brand new cars are crates, when they're packed full of peaches.

* * *

Co-ed: "You ought to take chloroform."
Frosh: "Who teaches the course?"

* * *

Geology Prof.: "What kind of a rock is this?"
Law Student: "Oh, I just took it for granite."

* * *

Just because a guy says he'll call you up doesn't mean that he'll give you a ring."

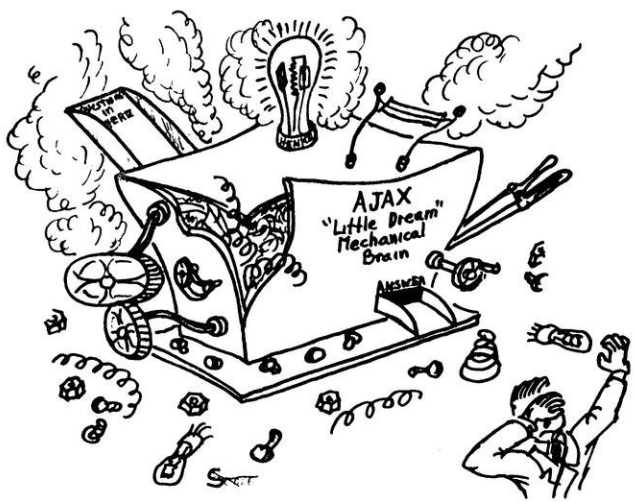
—Thanks, L.C.L. of L.W.

* * *

Math. Prof.: "If I start at a given point on a given figure and travel the entire distance around it, what will I get?"
Co-ed: "Chances are you'll get slapped."

* * *

He: "Why does Jean let all the boys kiss her?"
She: "She once slapped a law student who was chewing tobacco."



"I guess I should have stuck to law!"

When a freshman was told to give an example of three collective pronouns, he answered, "Fly paper, waste-basket, and vacuum cleaner."

* * *

"I call my girl Venus de Milo."
"Why?"
"Hands off."

* * *

"What is your daughter working for in college, an M.A.?"
"No, an M-R-S."

* * *

"Was it crowded in the Three Bells last night?"
"No, not under my table, it wasn't."

* * *

If you tell a girl time stands still when you look into her eyes she'll love you forever, but don't ever tell one that her face will stop a clock.

* * *

Can a dental parlor be classified as a drawing room?

* * *

In the days when the great St. Pat was still alive, two lawyers were brought before him with a petty grievance. "He's a dirty shyster," shouted one as the other retorted with, "He's a liar and a cheat." St. Pat with the wisdom and reasoning of an engineer calmly rapped with his gavel and said, "Now that the defendants have identified each other, we will proceed with the case."

* * *

Did you hear about the artist's model who wasn't in the nude for work?

* * *

It's an ill wind that shows no pretty knees, especially with the new look.

* * *

As the maker of bathing suits once said, "The thigh is not the limit."

* * *

THE E.E. WHISKEY TEST

Connect 20,000 volts D.C. across a pint of the fluid. If the current jumps it the product is poor.

If the current causes a precipitation of lye, tin, arsenic, iron slag and alum, the whiskey is fair.

If the liquor chases the current back into the generator, it's darn good stuff.

"Why the black crepe on your door? Did someone die?"

"That's not crepe, that's my room mate's towel. He's a law student."

* * *

A certain law student had been having a rough time of it for the past two years and was tempted to quit school more than once. This semester, however, he took the train home for good, after going to biology and finding out that some microbes multiply by dividing.

* * *

"Want a ride?"

"No, thanks, I'm walking back from one now."

(*Photo by Mitchell*)

Having fun?
(M.E. W. Armstrong and E.E. W. Schoenoff)

Campus . . .

(*continued from page* 16)

ETA KAPPA NU

Eta Kappa Nu has been rather busy this last semester. At a regular business meeting on January 6, 1949, the chapter elected their new officers for the coming semester, saw a very interesting movie on telephones and telephone systems, and commenced planning their activities for this coming year. Val Herzfeld was elected the new president, and Merrill DeMerit, Jr., took over as vice president. The other new officers elected and installed in office at this meeting were William H. Nash, the recording secretary; Roy Hyink, treasurer; Albert F. Jones, the **Bridge** correspondent, and Robert R. Johnson, the corresponding secretary. Former president Robert Sagen conducted the meeting until the new president was elected. William Koppenaal, the former vice president, and Erwin Bergo, the previous recording secretary, are both numbered among the January graduates in E.E.

Two of the new officers are men who were initiated into Eta Kappa Nu on December 6, 1948. At this ceremony held in the Wisconsin Union building, some forty men were initiated. This is one of the largest classes ever initiated by Theta Chapter. One of the ceremonies performed afterwards at the initiation banquet in the American Legion Post's dining room was the individual introduction of each initiate:

Robert C. Allen, Warren J. Anderson, Walter O. Battau, Robert E. Benway, Oscar H. Bieck, Rame W. Bull, Robert C. Boyle, Sylvester J. Campbell, Robert M. Cotts, Louis S. Csepella, William B. Drewry, Bert K. Erickson, Arthur B. Fontaine, Alden P. Hendricks, Robert R. Johnson, Albert F. Jones, Arthur J. Kleefisch, Arnold P. Klimke, Frederic B. Kohli, James W. Maier, Charles W. McMullen, William F. Meggers, Jr., Richard Mendelsohn, George M. Miller, Harold W. Mueller, Charles Navratil, Jr., James A. Novak, Robert H. Oppenheim, James Peters, David L. Pickering, William J. Plummer, Glenn L. Purdy, George D. Raeburn, Roger D. Rulseh, Edgar O. Schoenike, Carl J. Schultz, Paul G. Spink, John Stark, Jr., Thomas S. Steele, and Frederick G. Timmel.

The program itself was headed by an excellent steak dinner; and afterwards Professor H. A. Peterson, the toastmaster, led the group through the evening's activities. The program included the introduction of Mr. Frank E. Sanford who is a member of the National Advisory Board of Eta Kappa Nu; a welcome to the initiates by Robert Sagen; and the initiates' response by Robert H. Oppenheim. Mr. Royce E. Johnson from Barber-Colman Company in Rockford, Illinois, gave the main address—the highlight of the evening. Mr. Johnson spoke on the problems confronting the graduate engineer in industry; afterwards he led a spirited and informal question and answer session in which the assembled men fired a good many questions for his interpretation. In one instance, Mr. Theron Brown, the vice president of Madison Gas and Electric Company, arose in answer to one question and presented some poignant ideas about engineering training in college. After the regular portion of the meeting was adjourned, the group broke up into small discussion sections centered around these engineers and the many

(*please turn to page* 26)

Mercury, "messenger of the gods," was slow compared with Ultrafax—which moves at the speed of light.

This messenger

delivers a million words a minute

Recently, at the Library of Congress, a distinguished audience saw documents flashed across Washington by a new means of communication . . . and reproduced before them in *facsimile.*

This was Ultrafax in action—a super-fast television communications system developed at RCA Laboratories. Reproductions of *any* mail—personal, business, or military . . . including police descriptions, fingerprints, bank drafts, government records—can travel at 186,000 miles a second!

Material to be sent is placed before an RCA "flying spot" scanner, and transmitted by ultra-high frequency radio signals. Miles away the pictures appear on a picture tube and are photographed. Negatives are ready for printing or projection in 40 seconds.

Eventually, when Ultrafax comes into commercial use, a complete Sunday paper—every word, and every single picture—may cross America in 60 seconds . . . a letter in the twinkling of an eye.

Science at work . . .

Ultrafax is but *one* of scores of major achievements pioneered at RCA Laboratories. This leadership in the fields of science and engineering adds *value beyond price* to any product or service of RCA and RCA Victor.

• • •

Examples of the newest developments in radio, television, and electronics may be seen in action at RCA Exhibition Hall, 36 W. 49th St., N. Y. Admission is free. Radio Corporation of America, Radio City, N. Y. 20.

Continue your education with pay—at RCA

Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

- Development and design of radio receivers (including broadcast, short wave and FM circuits, television, and phonograph combinations).
- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
- Design of component parts such as coils, loudspeakers, capacitors.
- Development and design of new recording and producing methods.
- Design of receiving, power, cathode ray, gas and photo tubes.

Write today to National Recruiting Division, RCA Victor, Camden, New Jersey.

Also many opportunities for Mechanical and Chemical Engineers and Physicists.

RADIO CORPORATION of AMERICA

World Leader in Radio—First in Television

Campus . . .

(continued from page 24)

ASME

The Student Branch of the American Society of Mechanical Engineers presented two interesting speakers in the field of Diesel engines from the Fairbanks Morse Company at their February meeting. Mr. Beadle talked on "Obtaining and Interpreting High Speed Diesel Indicator Cards" which was illustrated with slides. Mr. Newton gave some pertinent facts on "The Calculation, Testing, and Control of Torsional Vibrations." He also displayed some torsiograph equipment which is used in this type of work.

At their January meeting ASME presented the preview of the film "Steam for Power" currently being advertised by the Babcock & Wilcox Company, having been produced by them. It presents, in color, the progress made in steam operated power plants and steam generators through the use of animation and striking photography. The picture was well presented and readily accepted by the audience as a worth-while picture.

At this same meeting the new officers for the second semester were announced. They are: Tom Hubbard, president; James Austin, vice-president; Ben Thomas, treasurer; and Earl Kempka, secretary.

AIEE

Mr. Carl G. Miller will present his illustrated lecture, "Behind the Instrument Dial," at the regular meeting of AIEE on March 23 at 7:30 p.m. in room 116 of the Education and Engineering Building. The lecture will be illustrated with blackboard drawings and a large display of instruments in transparent lucite cases. Each person attending the talk will receive a booklet on Weston meters. Refreshments will be served after the meeting.

At the meeting on February 16 the student Branch of the American Society of Electrical Engineers had the pleasure of hearing Dr. C. E. Oetting of General Electric Corp. speak on "Facts and Fancies in Lighting for Seeing." The meeting was held jointly with the Madison section of AIEE and the Illuminating Engineering Society.

Jack McCoy, former vice-chairman of AIEE, is the new chairman of the group. Dick Krauss, chairman last semester, is now with General Electric in Schenectady. Robert Dickinson was appointed to fill the vacancy in the vice-chairman post.

THETA TAU

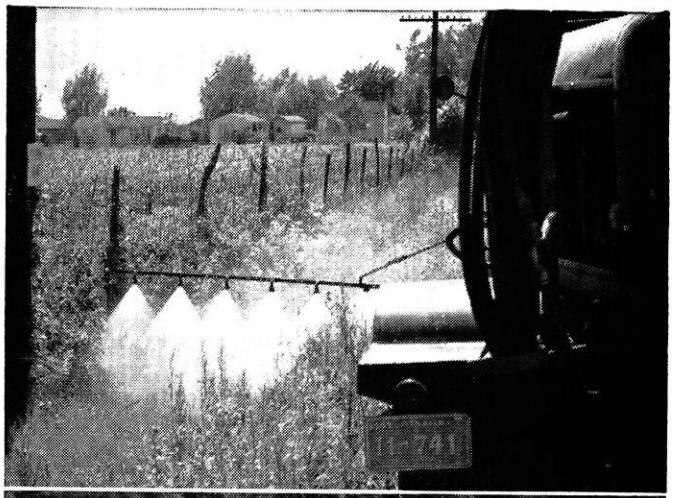
Theta Tau, at its January meeting, initiated nine new members and elected a new slate of officers. The meeting was held at the Park Hotel and the featured speaker of the evening was Prof. Dave Mack of the Mining and Metallurgy dept.

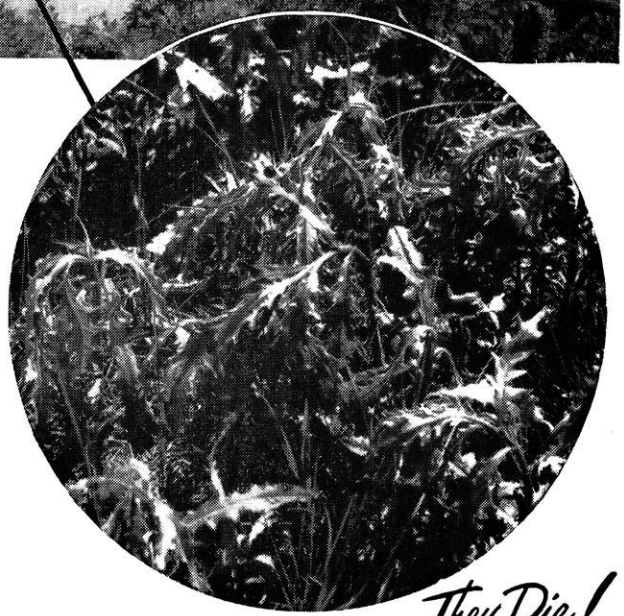
New initiates are: Hilbert Teske, David Zimmerman, Mark Wallesz, Charles Pitt, Frank Gerschke, Russell Roeden, Roger Thiede, Glenn E. Albert, and David R. Sawle.

The fellows doing the officiating for this semester are: Donald Plautz, regent; Robert St. Clair, vice-regent; George Zimmerman, secretary; Ferd Anderholm, treasurer; and Edwin Baugh, corresponding secretary.

Morton O. Withey, dean of the School of Engineering, became an honorary member of Xi chapter of Theta Tau, national professional engineering fraternity, on Saturday, February 26, at a special initiation. The ceremonies were held at the Union and were followed by a banquet in honor of the new initiate. Guests at the dinner included Dr. G. A. Rohlich, faculty advisor of the fraternity, Prof. H. A. Peterson, chairman of the electrical engineering department, and Prof. R. L. Moberly, director of the Industrial Management Institute. Professor Moberly later delivered a short, inspiring talk on "Personnel Relations in Industry."

liquid death!





THAT'S WHAT ESTERON 245 IS to tough, stubborn weeds and woody growth.

Weed and brush control along highways, power lines and other utility right of ways is important. Esteron 245, a close cousin of 2,4-D, was developed for weeds found resistant to that well-known compound. It is particularly effective against woody growth, osage orange, gum, brambles, hickory and oak.

An unusual feature of this plant hormone-type weed killer is that it kills by chemical action which accelerates the normal growth processes, resulting in death of the plant.

The development of Esteron 245, following Esteron 44 and 2,4-D, is indicative of the unceasing effort to better things that is characteristic of Dow research.

Dow produces more than five hundred essential chemicals from plants located in Michigan, Texas, California and Ontario, Canada. These include agricultural chemicals, the Dowicides (including PENTAchlorophenol—the chemical that increases the life of wood many years) plastics, which is becoming a by-word in everyday living, as well as major industrial and pharmaceutical chemicals.

They Die!

Esteron 245 destroys or inhibits herbaceous and woody growth, spares grass and allows the establishment of good sod.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

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St. Louis • Houston • San Francisco • Los Angeles • Seattle
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DOW

CHEMICALS INDISPENSABLE TO INDUSTRY AND AGRICULTURE

Ground-Water . . .

(continued from page 9)

prehensive study of ground-water conditions is now being gathered. Observation wells have been established throughout the state and some have been equipped with automatic recorders to keep an accurate record of the changes in water level.

A report of the results obtained from pumping tests on artesian wells in the Milwaukee-Waukesha area has been issued and it is expected that a more thorough report on this area will be ready this spring. The eastern and northeastern regions of the state have been covered quite thoroughly and a report on the situation at Green Bay will follow. Extensive studies are being carried on in the Antigo area where the use of ground-water for irrigation is becoming more prevalent.

Indications are that in general, Wisconsin is still in a favorable position with regard to its ground-water supply. In certain areas, however, where the demand has increased very sharply in the last few years, the water level and pressure show a decreasing trend. On the basis of only a three year study, it is not possible to predict accurately the ultimate ground-water supply of the state; however, the research program will continue until satisfactory recommendations may be made to the state legislature regarding future regulation of the use of ground-water.

It's a good thing he doesn't dress for every industry he serves

He's a Square D Field Engineer. There are others like him in Square D branches in more than 50 principal cities of the United States, Canada and Mexico. These men are liaison between Square D and industrial America. Their full-time job is contacting industries of every type and size. It is through them that we are able to do our job effectively. That job is three-fold: To design and build electrical distribution and control equipment in pace with present needs—to provide sound counsel in the selection of the right equipment for any given application—to anticipate trends and new methods and speed their development.

If you have a problem in electrical distribution or control, call in the nearby Square D Field Engineer. He makes a lot of sense in finding **"a better way to do it."**

For many years, ADVERTISEMENTS SUCH AS THIS ONE have appeared regularly in leading business magazines. Their primary purpose is to build acceptance for Square D Field Engineers, practically all of whom come to us from leading engineering schools such as yours.

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Science . . .

(*continued from page 18*)

craft at high altitudes where an ordinary parachute would be useless. He would be enclosed in a bullet-shaped metal "capsule" with a propeller on its tip. Developed by General Electric engineers, the new device, known as a "supersonic parachute" or "rotochute," is designed for use in rocket research and is capable of gently lowering delicate research instruments to the ground from rockets fllying at altitudes as high as 100 miles. Released from a rocket, the device slows gradually from supersonic speeds to about 27 miles per hour by means of its whirling propeller or "vanes" which act as an air brake.

Although not intended for use by humans, the rotochute might be redesigned so that it could carry a pilot and could be fired by an explosive charge from a rocket. The pilot then could guide the course of the rotochute by controlling the pitch of its vanes and land with greater accuracy than is possible with an ordinary parachute.

Great accuracy can be obtained when the device is launched from a helicopter or small plane. A package can be dropped within a ten-foot circle.

ATOM-SMASHER

A 3,500,000 volt electrostatic accelerator, a type of atom-smasher, is under construction by the General Electric Company for the Brookhaven National Laboratory at Upton, Long Island, N. Y. One of several electro-nuclear machines planned for the Brookhaven atomic research center, the accelerator will be used for a variety of fundamental studies of the atomic nucleus. In some experiments, high-energy particles from the accelerator will be employed to study the processes of "chipping" or "splitting" atomic nuclei into fragments such as the radioactive isotopes now widely applied in research.

Though the electrostatic accelerator has an output energy consider-

(*please turn to page 32*)

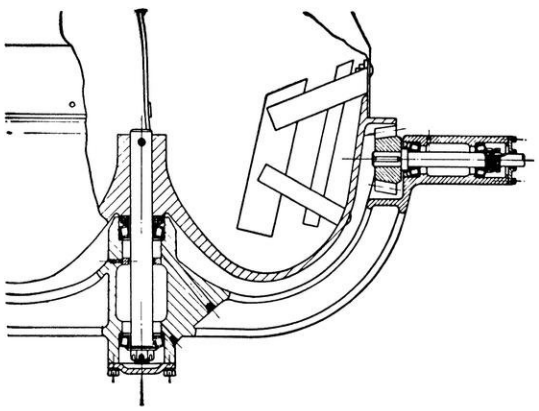
Another page for **YOUR BEARING NOTEBOOK**

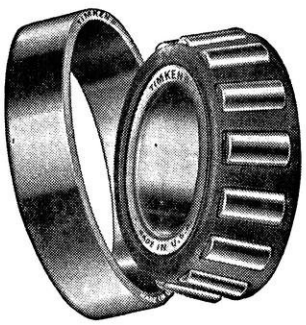
How TIMKEN® bearings pave the way for long life in a concrete mixer

Keeping concrete mixers from growing old too soon is the aim of construction equipment builders. That's why they use Timken® tapered roller bearings on drum shafts, driving pinions, and in the road wheels. Because Timken bearings practically eliminate friction and keep parts in rigid alignment, wear is reduced to a minimum.

TIMKEN® bearings keep gears meshing smoothly

This drawing illustrates how Timken bearings are used to insure smooth operation in a concrete mixer. Because of the tapered design, Timken bearings take thrust as well as radial loads. End-movement of shafts is eliminated and parts are held in rigid alignment. Timken bearings carry the heaviest loads with minimum shaft deflection. Gears wear longer—work better.





TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

Want to learn more about bearings?

Some of the important engineering problems you'll face after graduation will involve bearing applications. If you'd like to learn more about this phase of engineering, we'd be glad to help. For additional information about Timken bearings and how engineers use them, write today to The Timken Roller Bearing Company, Canton 6, Ohio. And don't forget to clip this page for future reference.

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL ◎ AND THRUST →◎← LOADS OR ANY COMBINATION ✳

Science . . .

(continued from page 30)

abily lower than such machines as the synchrotron, betatron, and cyclotron, it has the advantage of supplying high-speed atomic particles at a uniform energy. Measurement of a fundamental constant is vital in studies of the nucleus of an atom. In the case of other particle accelerators, the velocities of individual particles are not uniform, making accurate measurements difficult.

A special building, with two-foot-thick concrete walls, will be constructed for the machine, which will be housed in a 30-000-pound steel tank, 18 feet long and eight feet in diameter.

SHIP STEERING RECORDER

A new instrument, which automatically and continuously records a ship's course, has been developed by engineers of the General Electric Company. The "ship steering recorder" marks the ship's rudder position and compass direction, and calculates any deviation from the set course on a moving roll of paper. Nine of the instruments have been delivered to the U. S. Navy for experimental installation in several destroyer and submarine chart rooms. G. E. engineers say the device, which takes up no more room than a table-model radio-phonograph, can detect an error in course of as little as two-tenths of a degree.

The record is kept on a 12-inch-wide roll of waxed paper, passing beneath metal points which are connected electrically with the ship's rudder and compass. Running at low speed, the instrument can make a continuous eight-day record without attention.

No permanent installations of the recorder have been made aboard ship as yet. The Navy is using the instruments at the present time to check the accuracy of experimental "automatic pilots" for ships.

FRICTION SAW

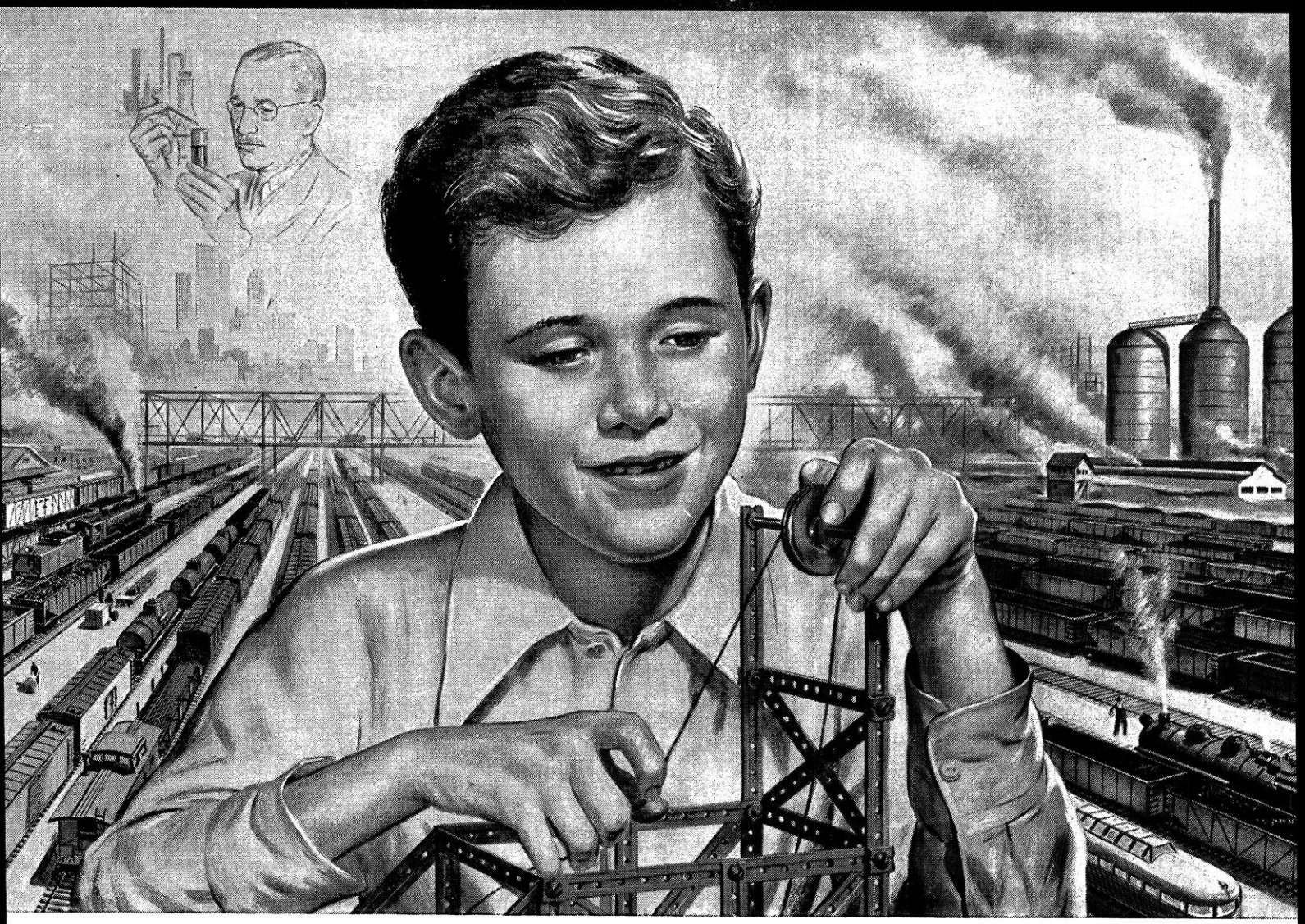
Whirling at 1,750 r.p.m., a new saw developed by U. S. Steel, makes square, burrless cuts across heavy structural steel at a rate of 13 feet per minute. Its blade is a disc of mild steel 60 inches in diameter and one-half inch thick, rimmed with teeth that travel 320 m.p.h. Friction against hard steel generates enough heat to melt it and the teeth carry it away. —PSM

RECORD CRYSTAL

The largest nearly perfect quartz crystal ever produced by man was "grown" from a solution under heat and pressure for the Army Signal Corps by the Brush Development Company of Cleveland, Ohio. Synthetic quartz crystals are used to control radio frequencies. They may end U. S. dependence on imports of natural crystals from Brazil.—PSM

READ YOUR ADS

"—The resources of civilization are not yet exhausted"—WM. E. GLADSTONE



Why greater strength weighs less and less

CAN YOU MAKE three pounds of steel do the work of four . . . and stay on the job longer? The answer is YES, with *alloy steels*—steels that are combined with small amounts of other metals, such as chromium, vanadium, and zirconium, to develop or increase desired qualities. For example, it's the element, *chromium*, that gives the stainless nature to steel.

So great is the improvement in steel, when alloy agents are used, that a freight car of alloy steel can weigh 25% less, haul heavier loads, yet stay in service much longer than similar cars of ordinary steel. Alloy agents not only increase the strength of steel, they also extend its life through reduction of destructive factors such as rust, corrosion, and wear.

The use of better materials to make steel go farther and serve longer is especially vital to all of us . . . with steel mills unable to catch up, and ore supplies dwindling.

Industrial gases have a big role in steel's better performance, too. Compressed oxygen aids in cleansing the molten steel . . . the oxy-acetylene torch cuts steel sections to size—and welds them together if desired. Finished steel articles are given a harder, longer-wearing surface through "flame-hardening." And carbon, in the form of electrodes, makes modern electric furnaces possible . . . with their output of high quality steels.

The people of Union Carbide produce these and related materials for improving steel. They produce hundreds of other materials for the use of science and industry—to the benefit of mankind.

FREE: *Let us send you the new illustrated booklet, "Products and Processes," which shows how science and industry use UCC's Alloys, Chemicals, Carbons, Gases and Plastics. Just write—*

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ACHESON Electrodes • NATIONAL Carbons • PRESTONE and TREK Anti-Freezes • EVEREADY Flashlights and Batteries

NATURAL ENERGY

(continued from page 15)

voltage to transmission line value. The blades rotated at 28.7 rpm, making the velocity of the tips 15,785 feet per minute. Despite the variable wind velocities encountered, the constant rotation is maintained by pitching the blades. The angle between the wind direction and the flat of the blade (pitch angle), could be automatically varied over a 99 degree range. Thirty degrees is the maximum necessary for normal operation; the extra range was for experimental reasons. Even with this pitching device the generator can only operate between certain wind velocities. Rotation of the blades starts at a wind velocity of 4 mph, generation begins at 18 mph, and the unit must be taken out of service when the wind velocity exceeds 60 mph.

Two other motions were provided for, yawing and coning. Yawing is the swinging, weather vane type of motion that allows the blades and generating appartus to remain headed into the wind at all times. Coning is precautionary motion that causes the blades to move down-wind when they are hit by a sudden gust of wind.

This generator's first period of service continued from October 19, 1941 to February 20, 1943. During this time it operated 695 hours on the line, and 192 hours off the line on test. It generated a total of 298,240 kilowatt hours. The main shaft bearing failed at this point and could not be replaced immediately because of war-time shortages. The unit was restored to service on March 3, 1945 as a regular generating station operating on the 440,000 volt transmission line. It remained in service until March 26, 1945, operating on the line 143 hours and producing 61,780 kilowatt hours of energy. One of the blades, weakened by corrosion, broke off; and the other blade was damaged by colliding with the tower. The unit has not, and probably will not, be restored to service again, at least in its original form.

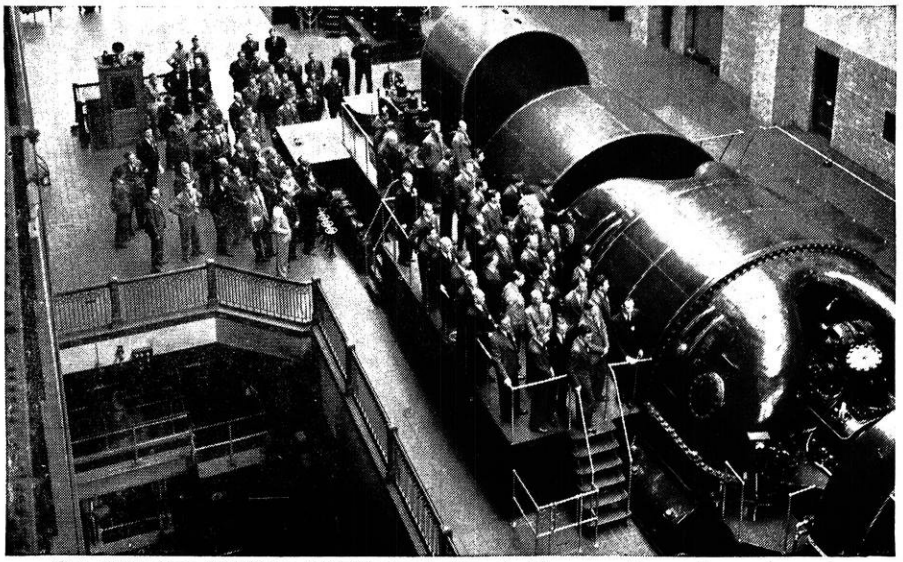
New plans and designs call for a 6,500 to 7,500 kilowatt generator to be mounted on a 475 foot tower. The generator would be a variable speed D. C. type, thus eliminating the need for pitching the blades. A. C. power could be obtained by the use of a rotary converter.

The variation in wind velocity is the greatest drawback to wind power. This makes it necessary to parallel the wind generated power with that of a more stable kind. It is interesting to note that a wind power plant can generate more kilowatt hours per year than most water power plants because the average wind conditions remain more stable from year to year than average water conditions. The present condition of water power potential in Wisconsin certainly substantiates this conclusion. Wind power is also a better deal from the economic standpoint. The development of water power costs about $300 per kilowatt of expected capacity, while wind power costs but $68 per kilowatt. A substantial utilization of wind power is quite possible in the near future.

Change Your Mind...

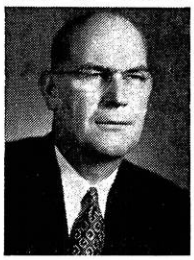
Most of us have, at one time or another

by J. L. SINGLETON
Vice-Pres. and Director of Sales, General Machinery Division
ALLIS-CHALMERS MANUFACTURING CO.
(Graduate Training Course 1928)



One of the three 80,000 kw Allis-Chalmers steam turbine generating units now in service in a big mid-western power plant. A fourth unit is being built, and a fifth is on order.

You may be one of those men who knows exactly the sort of work he wants to do when he finishes engineering school. I did. I was going into straight engineering work. But I became a salesman.



J. L. SINGLETON

I've noticed since that it's not unusual for Graduate Training Course students at Allis-Chalmers to change their minds. Here, opportunities have a way of seeking out a man according to his ability. Sometimes these opportunities are in fields that he had not fully understood or considered before. There are so many kinds of work to do here that a man is almost sure to end up in work that will bring him the most in personal satisfaction and advancement.

Opportunities in Selling

For example—sales. Not every engineer is a salesman, but at Allis-Chalmers every salesman is an engineer. Engineering plays a vital part in the sale of a big steam turbine, a cement plant—or even a multiple V-belt drive.

There's a thrill in landing orders—really big ones, such as two 115,000 HP generators for Hoover Dam—all of the rolls and purifiers for the world's newest and most modern flour mill—the world's largest axial compressor for use in a supersonic wind tunnel, or volume sales of small motors, pumps and drives. Orders like these come through teamwork of engineering, manufacturing skill, high-level salesmanship and merchandising. It's good to be a member of such a team.

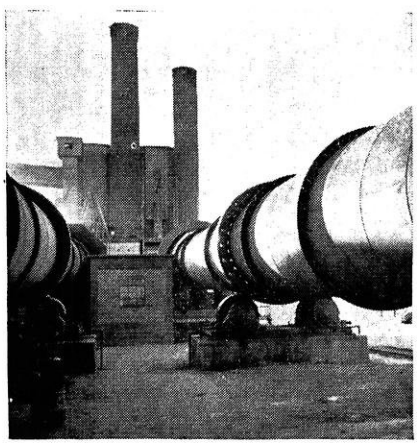
If you have ability and a leaning toward sales work, you'll have plenty of chance to test and develop it at Allis-Chalmers during your Graduate Training Course. Then you take your place in a Coast-to-Coast sales organization—perhaps even in a foreign office.

Many Fields Are Open

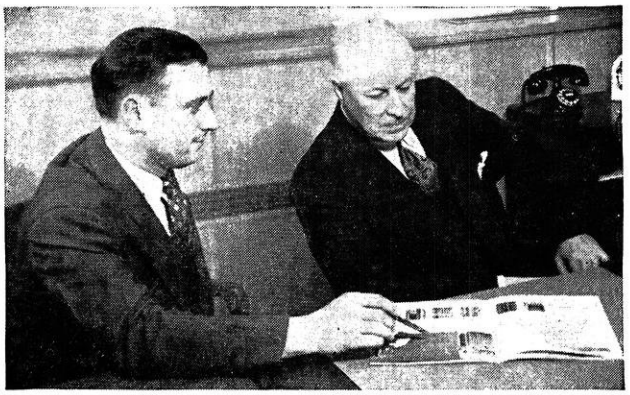
Or, maybe you'll change your mind. Research and development—or manufacturing—or design engineering may prove your field. The point I want to make is, all of these things are open to you at Allis-Chalmers. This company is in intimate touch with every basic industry: mining and ore processing, electric power, pulp and wood products, flour milling, steel, agriculture, public works.

The Graduate Training Course here doesn't hold you down. You help plan it yourself, and are free to change as you go along. You work with engineers of national reputation—divide your time between shops and offices—can earn advanced degrees in engineering at the same time.

Those are some of the things that appealed to me 23 years ago. They're still good.



Rotary Kilns are the most gigantic of all machines. Allis-Chalmers has designed and built kilns up to 475 feet in length, 12 feet in diameter—supplies all basic machinery for complete cement mills and processing plants.



Front-line man on the A-C team that designs, builds and sells basic machinery to all industry.

Write for details of the Allis-Chalmers Graduate Training Course — requirements, salary, advantages. Representatives may visit your school. Watch for date.

ALLIS-CHALMERS MFG. CO.
Milwaukee 1, Wisconsin

ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment—Biggest of All in Range of Industrial Products

REFERENCE TOOLS

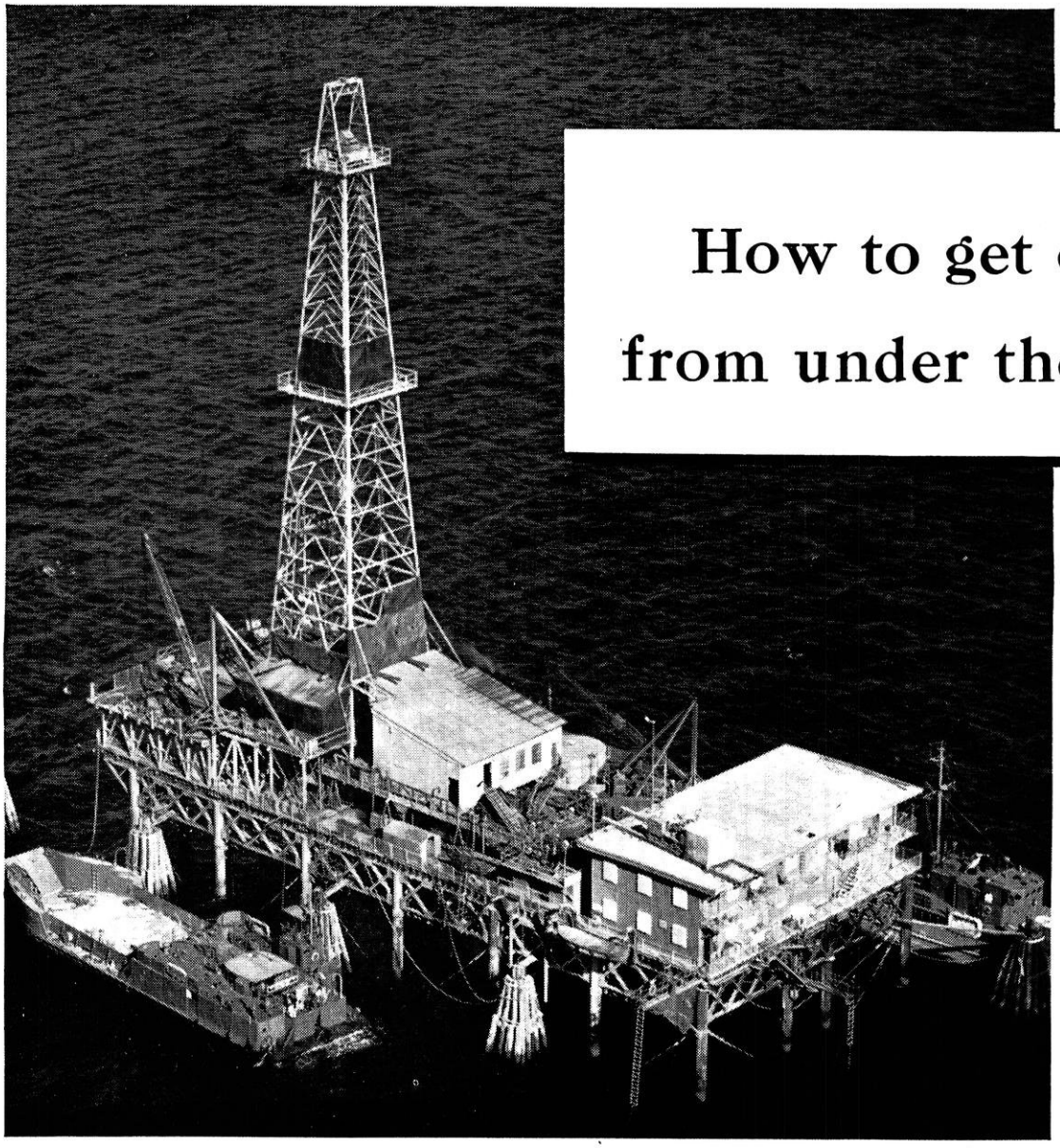
(*continued from page* 17)

is listed by author, subject, patent and formula indexes. The index refers one to columns and paragraphs of the abstract itself. "Chemical Abstracts" scans over a tremendous volume of periodicals; the complete list would fill 200 pages. Naturally the latest listings are to be found in the latest index. Four 10 year indexes are available covering from 1907 to 1947 and subsequent annual and quarterly indexes are available.

The "Engineering Index" is much simpler in form and arrangement. Originally this index was published by the ASME, but now is published by Engineering Index, Inc. This index selects items of engineering interest from 1,300 publications. Each entry including an abstract appears under only one subject heading, but is linked with others by cross-references. Due to the excessive cost of the weekly service most libraries purchase only the annual edition which is available several months after the end of the year. Articles are classified into general headings and these are then further sub-divided alphabetically.

The "Industrial Arts Index" covers only 250 periodicals, but does so completely rather than selectively and so compares favorably with the "Engineering Index." This index issues monthly indexes, with quarterly issues that combine all of the material contained in the earlier

(*please turn to page* 38)



How to get oil from under the sea

OUT of sight of land, miles offshore in the Gulf of Mexico, oil is now being brought from under the bottom of the sea.

Through its subsidiary, the Stanolind Oil and Gas Company, Standard Oil undertook to develop this new source of oil to help fill the growing need of Americans for petroleum products of all kinds. Offshore drilling presented our technical men with brand-new problems. These were solved so successfully that oil hitherto unavailable is beginning to flow to refineries, and products made from that oil are helping meet the public's huge demand. .

This is important news to an oil-hungry nation, now and for the future. It is also a tribute to the ingenuity and skill of the Stanolind Oil and Gas Company men who engineered the project. There are places in Standard Oil for other men who, in the research and operating departments, can help find new ways to provide more and better petroleum products.

Standard Oil Company

(INDIANA)

STANDARD

STANDARD SERVICE

REFERENCE TOOLS . . .

(continued from page 36)

monthly issues. This index lists entries alphabetically by subject; these entries may be duplicated under several subject headings.

"Science Abstracts" are divided into two parts: "Physics Abstracts" and "Electrical Engineering Abstracts." These abstracts are monthlies, with annual author and subject indexes. These abstracts follow the Universal Decimal Classification outlined in the frontispiece of each bound volume. Under this system an engineer interested in a certain subject such as Heating and Fuels need only turn to the entries labeled 662.6 to 662.9 each month to keep abreast of recent developments in this field.

The "Bibliographical Index" although broad in scope contains much information related to science and technology. Many other indexes are available for use. They are generally more restricted in scope and deal only in one specific field.

While using indexes to periodicals, it is wise to consult periodical lists to check on the availability of any publication. In searching periodical lists, the periodicals are listed alphabetically. This means the first word of the title disregarding articles, or the corporate name if it is included in the title. A few examples will clarify this, the bold face word representing the alphabetical arrangement: Transactions of the **'Faraday'** Society; **'Mechanical'** Engineering; etc.

When searching periodical literature, the suggestions given under books are followed with the necessary revisions. It is important to remember that again it is necessary to acquire sufficient background information to search intelligently. Then the watchword is to work backward so that the most recent information is uncovered first. It is highly probable that the search will lead to some comprehensive article that will end the need for further searching. Experience and good judgment will dictate when the search has gathered sufficient material.

Some experience will help familiarize one with systems of headings and cross-references. Any index chooses one form or another as an active heading to conserve space, with other headings under which no article is listed as "see" references. These "see" references serve to guide the searcher to the correct or accepted heading. "See also" headings, on the other hand, refer from one active heading to another which will provide additional data along related lines.

As an example, an article entitled "A Comparison of Some Elastic Properties of Tire Cords," by H. Wakeman, et al, "Journal of Applied Physics," vol. 16, July 1945, pp. 388-401, will be illustrated.

As can be seen, there is not any standardization of headings or cross-references. This table also shows the wide range of headings under which pertinent material can be found.

TABLE ONE

Variety of Headings Assigned an Article by Indexes

Possible Headings	Industrial Arts Index	Engr. Index	Chemical Abstract	Science Abstract
Automobile Tires	X	X	—	—
Cords	X	X	Art	—
Elastic Modula	—	—	—	Art
Elasticity	Art	—	Art	X
Modulus of Elasticity	—	—	—	—
Rubber Products	—	X	—	—
Rubber Tires	—	Art	X	—
Textile Fabrics	X	—	—	—
Textiles	—	—	X	Art
Tire Fabrics	Art	—	—	—
Tires	—	X	Art	—
Tires, Automobiles	X	—	—	—
Tires, Rubber	—	—	—	—

X: Cross-reference which assisted in locating the article.
Art: Means that specific entry was found under this heading.
—: Search not directly aided by this heading.

When using indexes, it is always necessary to search out all possible headings under which material may be found. When entries are found that are useful, it is always wise to note all information concerning the entry on cards of one sort or another. Be sure the information is complete or the entry may be useless. Information should include author, title of the article, title of the periodical, publication data (volume number, month, and year), and also the page numbers.

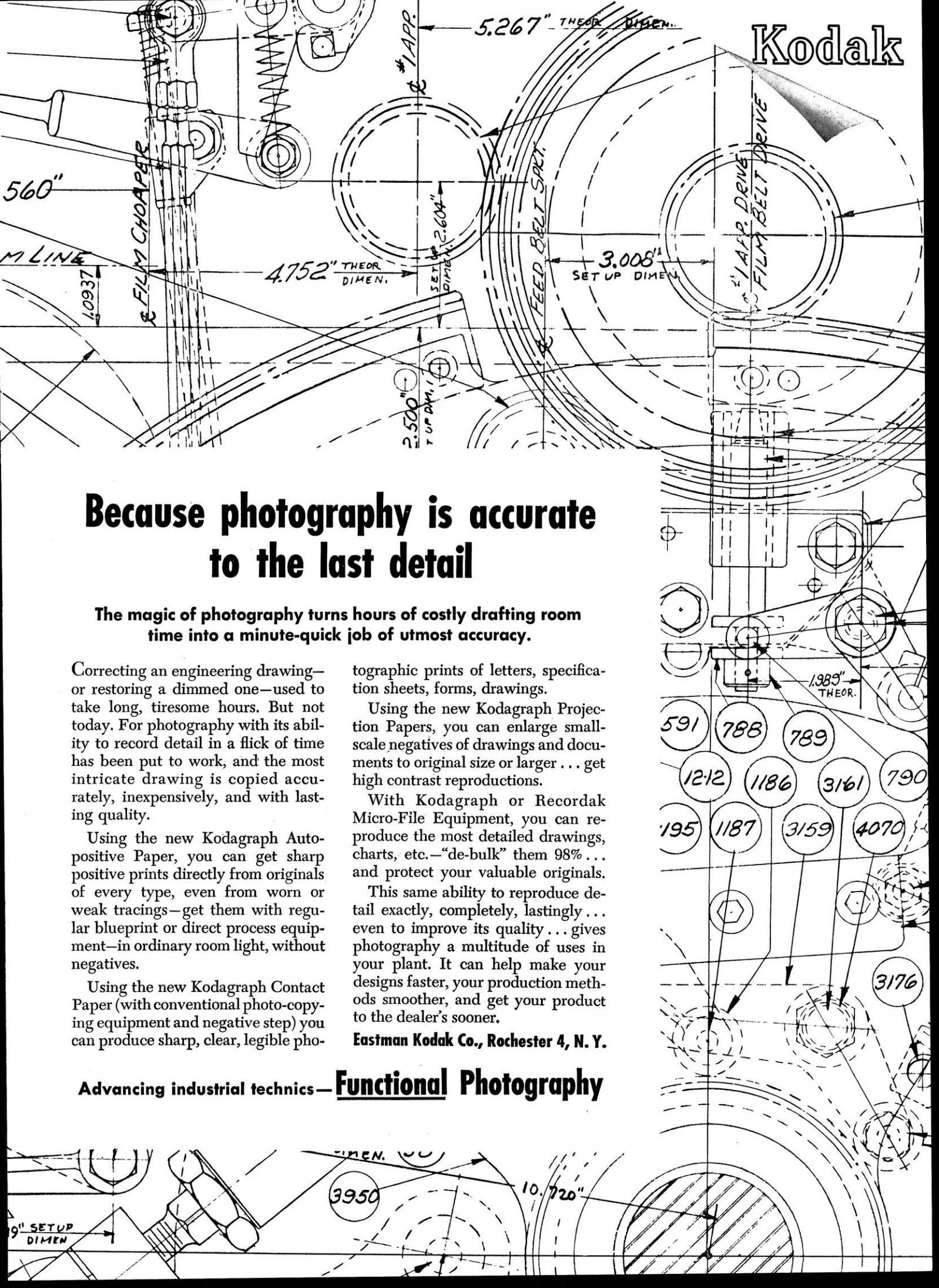
Trade literature is also frequently helpful for first-hand knowledge of current practice. But bear in mind that the trade literature is designed to sell the product. Likely consumers will determine the type of information available in the literature. Frequently, though, the trade literature will contain information in language familiar to the engineer.

Trade catalogues are listed in directories such as "Thomas' Register." These directories will be helpful in locating catalogues that may not be available on the library shelves.

"Collective Catalogues and Directories" are available for searching out manufacturers and their products. "Sweets' Catalog Series" is only one of the many catalogues for each specific trade or industry. The most comprehensive director is "Thomas' Register of American Manufacturers." All material in these catalogues is furnished by the individual firms and is necessarily brief due to space limitations.

This short article is not completely comprehensive since only a listing of indexes and catalogues would require several volumes. It is a guide to arouse reader interest to the material that is easily available.

Much of the information contained in this article is from an article by Mr. R. H. Whitford and Mr. J. B. O'Farrell appearing in the December 1948 issue of "Mechanical Engineering."



Because photography is accurate to the last detail

The magic of photography turns hours of costly drafting room time into a minute-quick job of utmost accuracy.

Correcting an engineering drawing—or restoring a dimmed one—used to take long, tiresome hours. But not today. For photography with its ability to record detail in a flick of time has been put to work, and the most intricate drawing is copied accurately, inexpensively, and with lasting quality.

Using the new Kodagraph Autopositive Paper, you can get sharp positive prints directly from originals of every type, even from worn or weak tracings—get them with regular blueprint or direct process equipment—in ordinary room light, without negatives.

Using the new Kodagraph Contact Paper (with conventional photo-copying equipment and negative step) you can produce sharp, clear, legible photographic prints of letters, specification sheets, forms, drawings.

Using the new Kodagraph Projection Papers, you can enlarge small-scale negatives of drawings and documents to original size or larger . . . get high contrast reproductions.

With Kodagraph or Recordak Micro-File Equipment, you can reproduce the most detailed drawings, charts, etc.—"de-bulk" them 98% . . . and protect your valuable originals.

This same ability to reproduce detail exactly, completely, lastingly . . . even to improve its quality . . . gives photography a multitude of uses in your plant. It can help make your designs faster, your production methods smoother, and get your product to the dealer's sooner.

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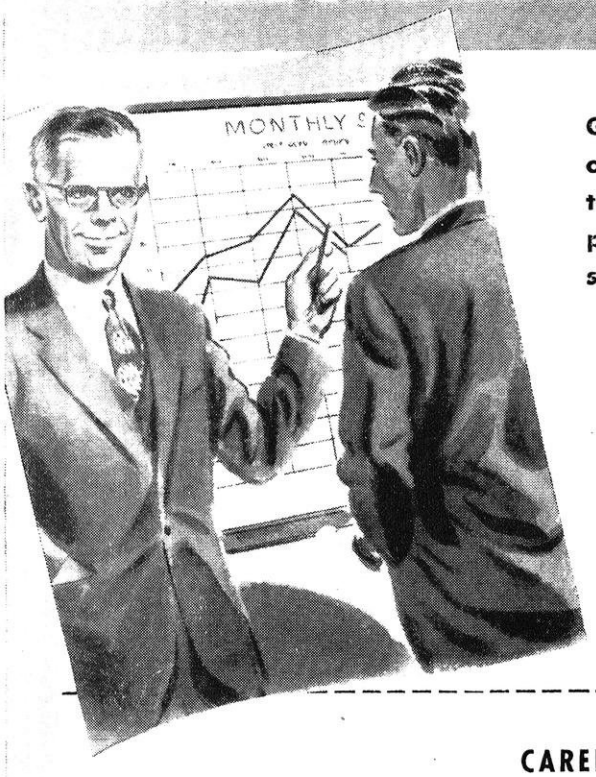
Advancing industrial technics—Functional Photography

CAREERS AT GENERAL ELECTRIC



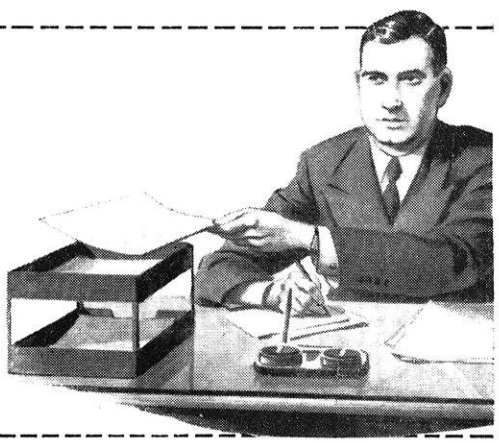
General Electric is not one business, but an organization of many businesses, offering opportunities in virtually all the professions. Here three G-E men brief the career-possibilities which the company offers to the marketing specialist, the accountant, and the manufacturing trainee.

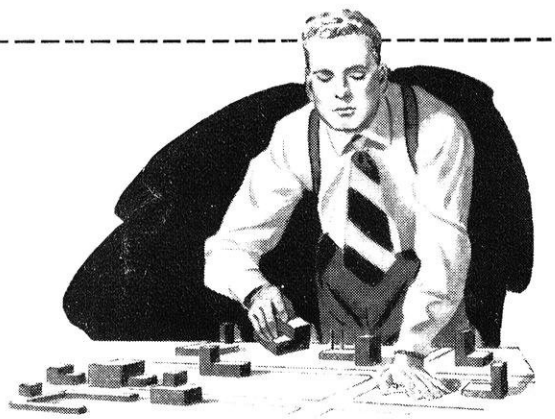
FUTURES IN MARKETING

C. H. Lang (Michigan), Vice President responsible for all sales activities of Apparatus Dept.: "I believe that the need for increased sales efforts to maintain the current high level of business activity provides new and greater opportunities in the marketing of industrial products. Extensive training is offered in all phases of our marketing program—selling, application and service engineering, market analysis, and advertising and sales promotion."

CAREER IN FINANCE

H. A. MacKinnon, Assistant Comptroller and member of Company Education Committee: "New products coupled with the company's growth are providing excellent openings in business management. Since 1919, our Business Training Course and travelling auditors staff have provided direct channels through which young men have progressed into all types of accounting and financial management positions with General Electric."





MANUFACTURING TRAINEE

Dick Saunders (Rochester): "As a member of the G-E Manufacturing Leadership Program, I'm getting the know-how of manufacturing through 'personal apprenticeships' to seasoned managers. These varied assignments have included sitting in on labor relations meetings, handling grievances, taking time studies, establishing production schedules, and operating machine tools. It's the best way I know to learn the working of a complex business."

For further information about a BUSINESS CAREER with General Electric, write Business Training Course, Schenectady, N. Y.—a career in TECHNICAL FIELDS, write Technical Personnel Division, Schenectady, N. Y.

GENERAL ELECTRIC