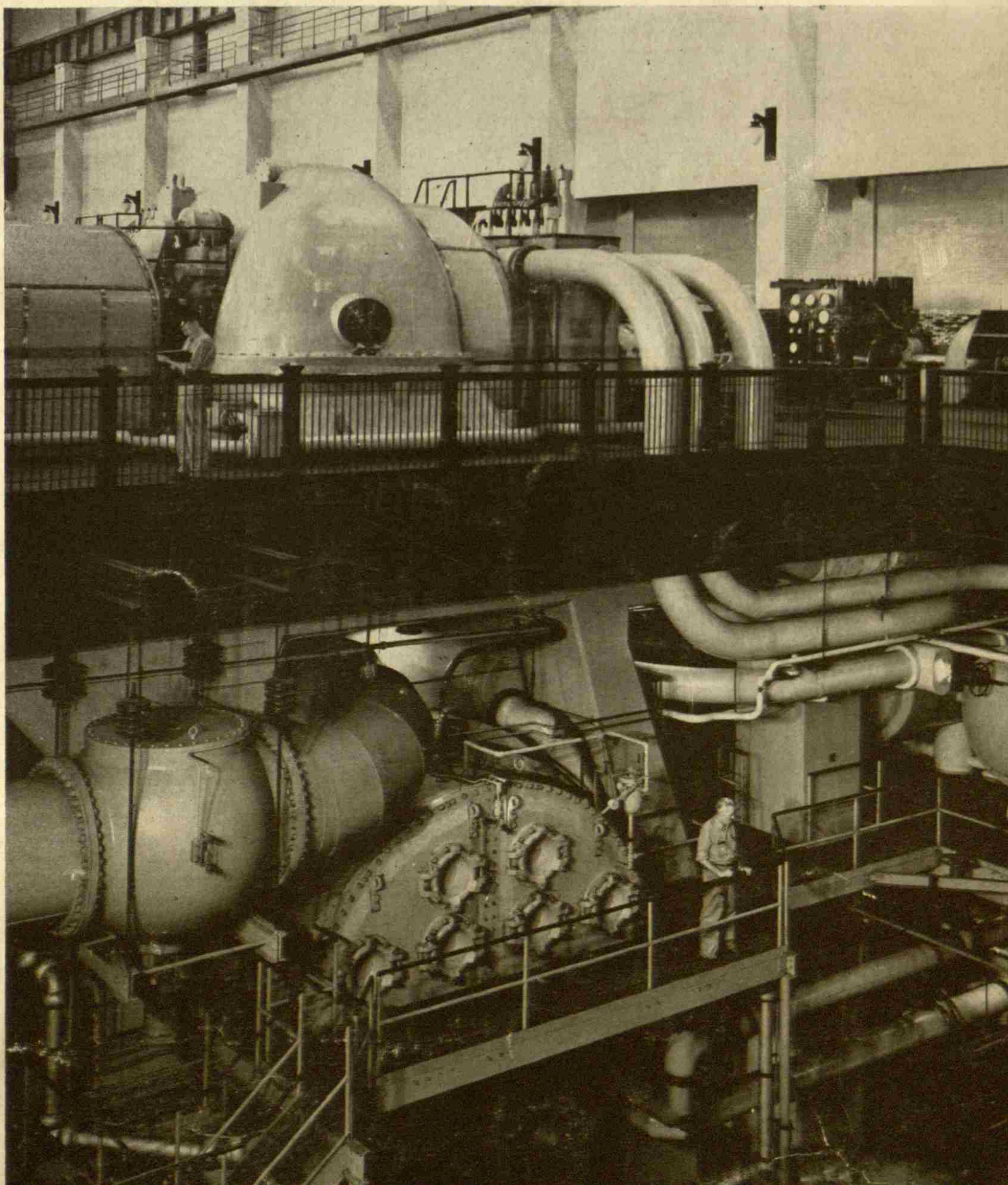
Spartan ENGINEER



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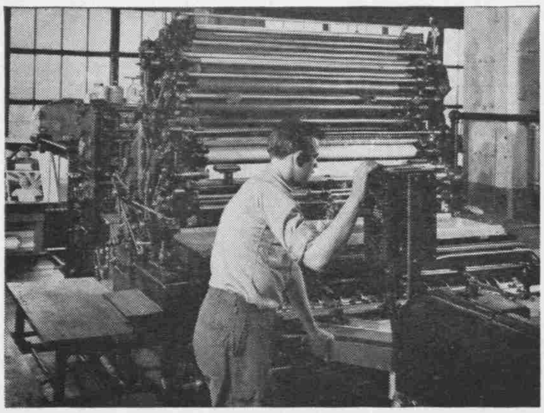

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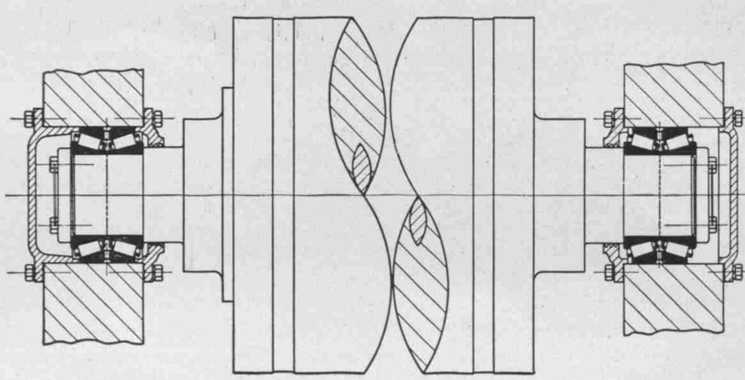

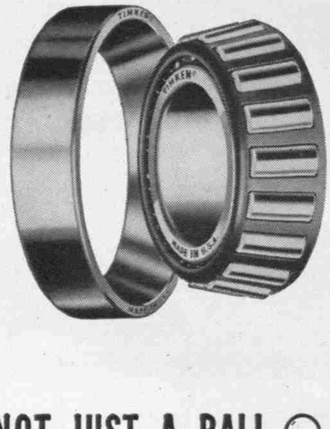

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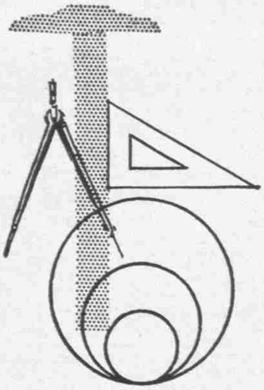

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". . . contributed most to the advance of chemical engineering in industry . . ."

Seventy of the nation's leading chemical engineering authorities independently voted this honor to Phillips for a two-fold achievement: First, Phillips development of high abrasion carbon black; second, Phillips major contribution to the success of cold synthetic rubber.

Credit for this success goes to those who make chemical dreams come true in our laboratories and plants. Over 2,000 of our nearly 20,000 employees are scientists and engineers. That is why Phillips offers opportunities for technical men to distinguish themselves in many ways in the broad field of petroleum chemistry.

We work vigorously with nitrogen fertilizers, atomic energy, sulfur compounds, synthetic fiber materials and many organic chemicals. And, of course, we are in our third decade as large producers, refiners and marketers of fuels and lubricants.

Previously this award has recognized such great endeavors as the Atomic Bomb Project and the war-time Synthetic Rubber Industry.

It is a privilege for us to be honored with these groups and with the other important chemical companies which have also earned this high distinction for outstanding chemical engineering accomplishments.

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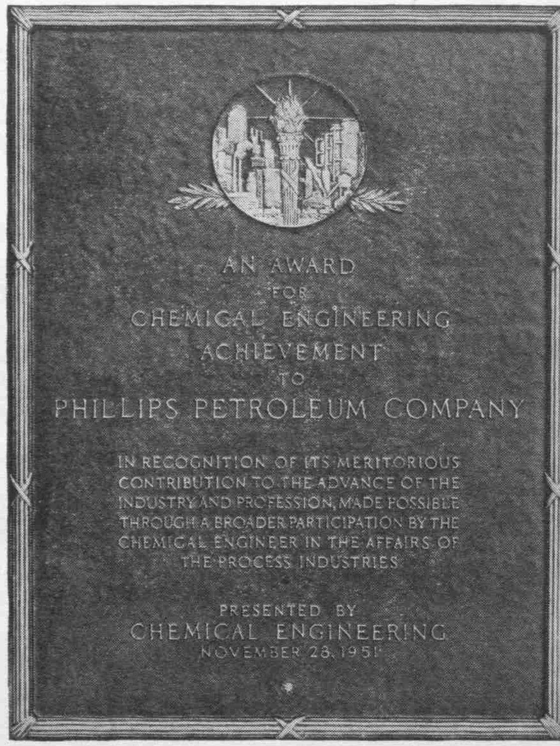

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SPARTAN ENGINEER

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COVER —

Two floor level view showing the turpo-generator and condenser at a power plant of the Detroit Edison Company.

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What decides wages?

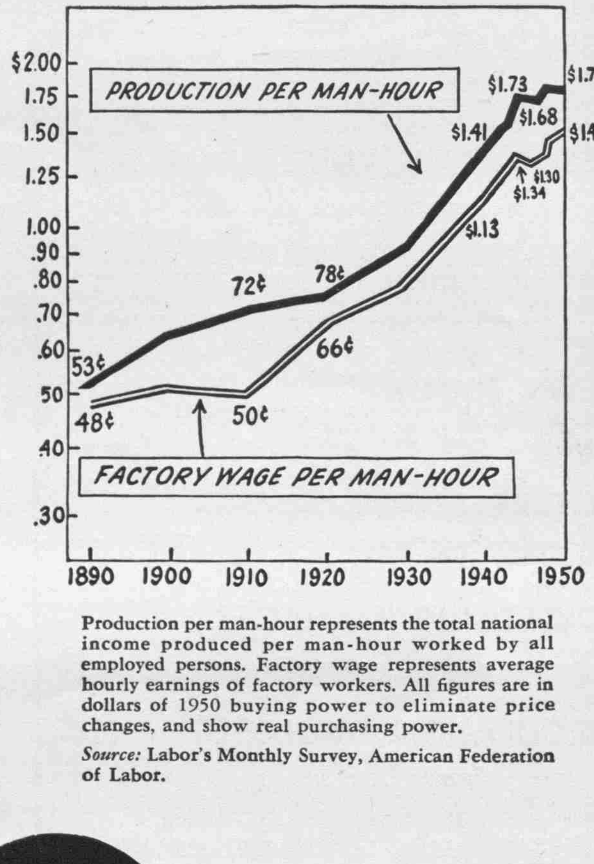
What you and I produce

THERE IS ONE RULE OF NATURE that all the governments, laws, unions and contracts cannot change: a man can be paid *only* out of what he produces, and the more he produces the more he can earn.

AND, that line "Factory wage per man-hour," shown in the chart at right, has gone up and up only as American business has put better and better *machines* to team up with American workers. *Machines* help the worker produce more and so earn more.

And *machines* can come only from the savings of investors—the savings made out of investor profits.

So—profits plus machines plus workers who use them well, equal constantly rising savings and standard of living. Whoever attacks *profits* is attacking *you*, and your family. Never forget it.



Production per man-hour represents the total national income produced per man-hour worked by all employed persons. Factory wage represents average hourly earnings of factory workers. All figures are in dollars of 1950 buying power to eliminate price changes, and show real purchasing power.

Source: Labor's Monthly Survey, American Federation of Labor.

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WHY, SURVEYING?

By LEO V. NOTHSTINE

Associate Professor of
Civil Engineering

Surveying in our Universities and Colleges is taught by Civil Engineers for the purpose of supplementing the Civil Engineering Curriculum. This is a natural operation as engineers require the knowledge of engineering Surveying and Layout as a tool in their profession.

Surveying is a required subject in most engineering curricula throughout the country and is an important part of much engineering work. Many engineers engage in surveying, or work closely associated therewith, especially as part of their early career after college. Other engineers are so engaged in subsequent practice either directly, indirectly, or in a supervisory capacity.

Many times, surveying has served to introduce the engineer favorably to influential persons who are undertaking expensive projects. Desirable professional and business connections often grow out of such introduction. A considerable portion of those engineers who become top engineering and management officers of corporations and governmental enterprises began their careers in surveying.

These arguments are not presented to promote the idea that one needs only to know his surveying for engineering success to be assured. Rather, they are intended to impress the student engineer of their importance in his course of study.

By many, surveying is considered as an antiquated tool in the kit of an engineer. However, this is a poorly founded impression. The various phases of surveying have been advancing at a rapid rate in spite of much academic neglect in most Universities. The developments in the surveying field now are so numerous that it is with difficulty that some are only briefly discussed in our classes.

The tendency in all curricula is to stay with the times, keep up to date, and include more and more in the material covered. This is as it should be. But as such, the tendency is to reduce time spent in some other areas.

Consequently, the area of surveying is one of these which must be studied for streamlining to better fit the requirements of various engineering curricula. This continuous process obviously is creating a stockpile of residual material that can no longer be included. Further, new processes and advancements in the surveying field are not likely to be included. This results in a fixed amount of given material being offered in the curricula.

Actually, the field of surveying is developing at a rapid rate. New optical reading transits and theodolites are rapidly coming into the picture. Photogrammetric surveys now are coming into international prominence in very wide scope. Research in linear and angular measure is being done. More and more the opportunities in the field of Professional Surveying are occurring as the demands are made upon it.

Some measure of the prominence of the surveying field is to consider the Professional Societies associated solely therewith. They are as follows:

(Statewide)
Michigan Society of Registered Land Surveyors

(Western Hemisphere)
American Congress of Surveying and Mapping

(Continental)
American Society of Photogrammetric Engineers

(U. S.)
Surveying and Mapping Division of A.S.C.E.

Another measure of the field of surveying is to consider those individuals, companies, and agencies engaged in the practice, such as:

- Registered Land Surveyors in private practice
- County Surveyors
- State Highway Surveyors
- Other State Agencies—Conservation—Lands Div., etc.
- City Surveyors
- U. S. Coast and Geodetic Survey
- U. S. Geological Survey
- Military Uses
- Industrial Surveying and Layout Departments
- Aerial Survey Corporation
- Public Utility Surveyors
- Construction Layout and Control

To supply properly trained surveyors to meet the requirements which will be developing, and is already felt, it is necessary to offer more course material in this field. This can be offered as electives in undergraduate work as well as graduate. Thus, it will be available for men interested and will not be a burden to those majoring in other areas of engineering.

MORE POWER TO YOU

By PAUL W. THOMPSON
Vice-President
Detroit Edison Co.
Detroit, Michigan

PAUL W. THOMPSON

Paul W. Thompson, Vice President in charge of Engineering of The Detroit Edison Company, was born December 7, 1887 in Oxford, New York. He attended Oxford Academy and graduated from Cornell University in 1910 with a degree in mechanical engineering. From 1910 to 1913 he was instructor in senior engineering subjects at Cornell University. He was employed by Detroit Edison in 1913 as experimental engineer at the Delray Power Plant. Since that time he has held the positions of Technical Engineer of Power Plants, Chief Assistant Engineer of Power Plants, Chief Engineer of Power Plants and in September, 1943, was elected Vice President in charge of Engineering of The Detroit Edison Company.

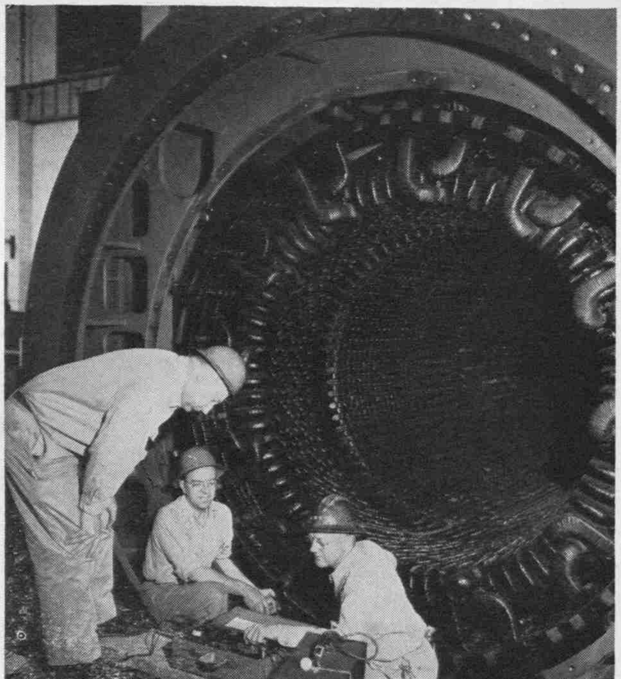
During the first World War he served progressively as First Lieutenant, Captain, and Major with the United States Army Ordnance Department, and was in charge of inspection of material manufactured in the Cleveland area. He also served as United States Army representative on the Cleveland District Ordnance Claims Board.

Mr. Thompson has taken an active part in technical society committee work and various civic activities. During World War II, Mr. Thompson served as coordinator of the Detroit area for the National Fuel Efficiency Program, and handled special assignments with the National Defense Research Committee with the Office of Scientific Research and Development.

He has been the author of a number of miscellaneous engineering articles published in the technical press, and has presented several papers at the American Society of Mechanical Engineers' annual meetings.

In 1910, when my professional life began, the electric power industry was still a fledgling. Today it stands high in comparisons with many industries of our country.

The birth of the industry occurred but 68 years ago, when Thomas A. Edison's work with electricity and his invention of the incandescent lamp resulted in the establishment of the Pearl Street Station in New York City. In the short space of a man's lifetime, the electric industry has advanced amazingly from that beginning and is now a cornerstone of our modern civilization, providing an essential service to every segment of American life. Our unparalleled standard of living, our ability to produce goods, and our high hopes for even greater progress in the future depend in no small way on the use of electrical energy.



Detroit Edison engineers testing a new generator

There are 300,000 employees working in the investor-owned electric companies that operate 80 percent of the installed capacity in the United States. It has taken 17 billion dollars—over $50,000 per employe—to provide the plant used by them for the production, transmission and distribution of electric energy.

A list of owners or stockholders would have the names of 3 million people from every walk of life who have pooled their savings to make this business possible. There is also an unknown number of people who have provided capital through the purchase of bonds. In addition, an estimated 100,000,000 people who as life insurance policyholders or depositors in mutual savings banks have an indirect financial interest through the holding of investments by their respective institutions.

This 17 billion dollars of investment is 39 percent of the amount invested in manufacturing plants of all kinds thrown together. It is four times that invested in primary iron and steel production plants—and eight times that in automobile and parts manufacturing.

While the product measured at a customer's meter is energy in the form of kilowatthours, we utility employes are continually aware that what we really sell is "service." The customer thinks of electricity in terms of the things it does for him. He judges its quality in terms of continuity and reliability of service, and of good voltage regulation.

An interesting thing about a kilowatthour that is an advantage over the usual manufactured product is that its design doesn't change. Production facilities do not, therefore, suffer the rapid obsolescence of plant resulting from such change.

The following table gives several national statistics for the years 1920 and 1950 that show the developments during that period:

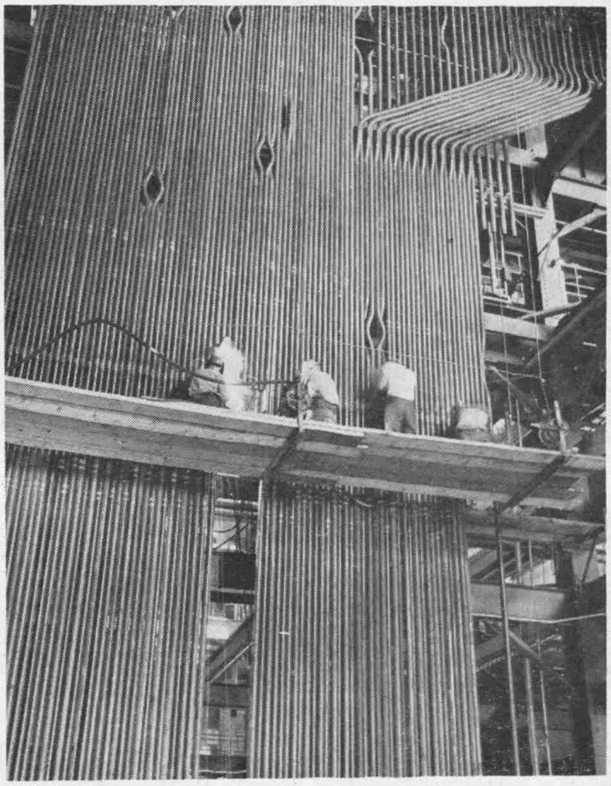
	1920	1950
Energy in kilowatthours produced per capita	500	2500
Average kilowatthours used by a residential customer	350	1830
Power assisting each production worker in horsepower	1.3	8
Energy assisting each production worker in kilowatthours	3000	13000
Standard work week in hours	60	40
Percentage of farms electrified	4%	90%

Engineers have developed many new uses for electric energy, making it possible to do many jobs today that could not be done in 1920 or to do them much more economically than they were being done by other methods. The 13,000 kilowatthours energy per year for each production worker is equivalent to the physical efforts of 75 to 200 men (depending on method of calculations) working 40-hour weeks for one year. But the cost of electricity used for manufacturing accounts for only ¾ of 1 percent of the selling price of the factory products.

Had anyone told me forty years ago that the industry would grow as it has I would not have believed him. But I have seen it and have personally experienced many of the problems associated with that tremendous growth. If you don't mind I shall reminisce a little and review some of the accomplishments that have made this great industry what it is today.

All the generating capacity needed for Detroit Edison load just prior to World War I could be supplied by one of the turbine-generators most recently installed. It has a capability of 125,000 kilowatts, and is but one of thirty of varying sizes in the Detroit Edison system. It is obvious that needs for electric energy have grown much faster than the population itself.

In my time, generating plants have improved so that we have reduced the number of pounds of coal needed to generate a kilowatthour from approximately 3 pounds to less than ¾ of a pound in the most efficient plants. It costs much more to build each kilowatt of plant capacity, and the price of coal has risen, but the cost of electrical energy has been reduced. For example—in 1915 when coal burned by The Detroit Edison Company cost an average of $2.21 per ton, a residential customer paid an average of 6.04c per kilowatthour; in 1950 when coal cost $7.89, the customer paid 3.08c.



Workmen constructing a new steam generator

The increased efficiencies of thermal plants have been largely due to improvements in materials and methods that allow the use of higher steam temperatures and pressures. Today 2,000 psi pressure and 1,000 degrees Fahrenheit are not uncommon. As better materials and methods are devised, you will see still higher efficiencies. In a Company such as ours that uses 4.2 million tons of coal a year, the engineer who can show how to increase the average efficiency of its power plants by 1 percent would effect a saving of $350,000 a year.

You can be sure that our engineers are continually looking for ways and means of reducing costs or improving service. Several of them in a cooperative development (one a young man who came to our Company in 1946) have shown how to make an annual dollar savings that runs into six figures. We now make summer weather in the winter for our stoker fired steam generators by introducing steam into the combustion process. Through some phenomenon that we are not yet sure about, this reduces slag formation on

(Continued on Page 22)

ELECTROSTATIC DUSTING

By PETER HEBBLETHWAITE — Graduate Ag.E.
and PAUL KLINE — Senior Ag.E.

This is a part of the war between man and the enemies of plants; the war man is constantly fighting to control those ever present enemies of his crops, the insect and the fungus. To combat these pests, enormous quantities of insecticides and fungicides are applied to crop plants each year. For applying these chemicals the farmer has two methods to choose from: either dust them on dry or dissolve the chemicals in water and apply this solution as a spray.

At the present time, dusting has taken a back seat in relation to spraying as a means of application. However, dusting would be more popular, and many growers would like to switch to dusting if it were not for its two serious shortcomings. The most important of these is the poor coverage of the plants obtained by present day methods of application. It is especially difficult to get dust onto the underside of the leaves. Inefficient use of the material is the other disadvantage, there being more dust in the cloud that blows away than ever reaches the plant. In fact, tests made this last summer at Michigan State College indicate that considerably more than half of the dust which leaves the duster never reaches the plant. Thus it is especially difficult to apply dust in a wind.

In its favor, dusting has the all important factor of cost. It is much cheaper to apply dust because a much smaller and lighter machine can be utilized, and no other carrier is needed to the extent and weight of the vast quantity of water that is required for spraying. A sprayer requires frequent refilling with water, which is difficult and time consuming to haul, and when filled may weigh several tons. Due to its weight its use in certain soils, such as the Michigan muck, is limited whereas in the same soil a duster can be readily used.

From the tests already carried out, the following can be listed as the advantages which it is hoped will be achieved with the Electrostatic Precipitation (E.P.) of Agricultural Dusts on Plants.

1. An improvement in the amount of dust deposited on the plant. It is anticipated that the extent of this advantage will vary according to the circumstances.
2. A better coverage of the plants; that is, a more even distribution of dust between the upper and lower surface of the leaf and upon the surface itself.
3. A greater percentage of the small sized dust particles can be made to adhere to the leaf surfaces than is normally possible, and thus a more efficient coverage from the fungicidal standpoint can be obtained.
4. Dusting will be somewhat less susceptible to meteorological conditions; the necessity for dusting at 4 a.m. or 9 p.m. (this is common practice at present) will be obviated, and also it is hoped that the operation will be less susceptible to the wind.

The studies of the electrostatic precipitation of agricultural dust at Michigan State College are now being carried on by the Agricultural Engineering Department under a grant made by the Rackham Research Foundation. The original work was initiated by Henry Bowen for his M.S. degree during the winter term of 1950. The original object was that of charging a tree so that the dust particles would be attached to it. This objective was found to be impractical, but the present work is the outcome of these experiments.

In September 1950, the senior author was also assigned to this project; and at the present time he and Henry Bowen, under the direction of Dr. W. M. Carleton, are carrying out experimental work with E.P.

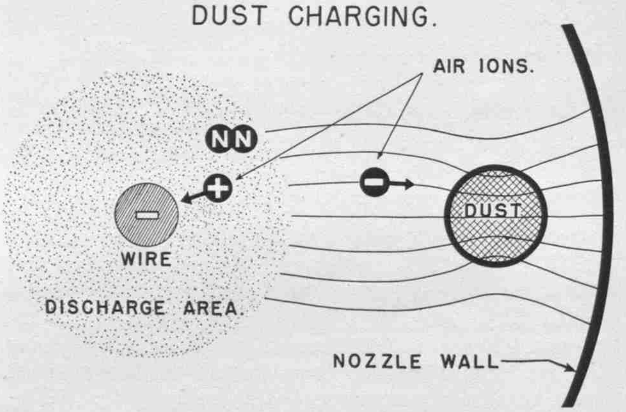
At the start of this work, it was thought to be a new field; but as the work progressed several projects of a similar nature were found, particularly that of Cottrell and Westinghouse who developed fly-ash collectors. Later it was also found that a French worker (P. Hampe, Institute Truffant, Versailles) has been carrying on somewhat similar experiments in the field of Electrostatic Dusting of Plants.

The forces of attraction of electrical charges have been known for a long time. Even the Ancient Greeks were familiar with the way in which an amber rod will attract. These electrostatic forces are the basis for E.P.

There are actually two forces acting in the precipitation.

1. The individual charged particle.
2. The electric field resulting from the cloud of charged particles.

DUST CHARGING.



Let us first consider the charged particles. Suppose the charged particle is at a distance "d" from a conducting surface, a leaf for example. It can be demonstrated that the charged particle is attracted by the leaf in the same way as if a similar charged particle of opposite sign was situated at a distance "d" symetrically behind the surface. This is known as the image force effect. It can also be shown that the force of attraction for a particle carrying a charge Q is given by $F=Q^2/4d^2$. Thus it can be seen as d decreases, F increases as d^2. However, the magnitude of the term Q is such that the trajectory of this particle is only drawn appreciably towards the leaf if the distance between them is very small, less than 1 cm under normal conditions. This means that when considering only the image force, the duster for use in electrostatic work must still be efficient from a mechanical standpoint in order to get the dust cloud in close proximity to all plant surfaces.

The conventional duster will usually surround a plant with a good cloud of dust but due to the minute film of still air which covers all surfaces, only the larger particles have sufficient momentum to reach the leaf surface. Under normal conditions the small particles are blown past the leaf and are lost; it is these small particles which it is hoped will be recovered by E.P.

The situation is very different when the charged particles are passing through an electric field. We know that a particle with charge Q passing through an electrical field E is subjected to a force $F = EQ$. The important fact is that this force acts throughout its path from the nozzle to the leaf. The relative magnitude of these two forces, however, is not at present known, and work is under way to determine these important facts.

There are several methods by which particles can be charged. They are contact, photo-electric, friction, and ionized field; but only the last two of these methods have been used in E.P. experiments.

High charges can be obtained by friction, but this method used alone is uncertain because the amount of charge depends on several factors. These factors are:

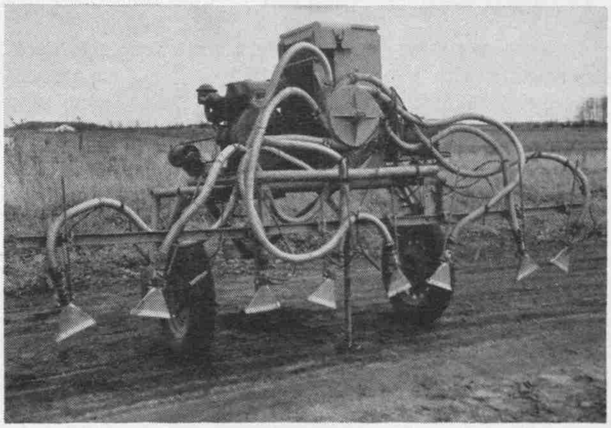
1. Humidity; when high only a small charge can be obtained.
2. Size of particle.
3. Different constituents of a dust mixture often take a different sign, and thus may nullify each others effect.
4. Chemical composition; variable charge.

The method of charging used at Michigan State College, and the most dependable method, is the ionized field. To produce an ionized field a high tension wire is connected from a continuous source of high voltage electricity to a thin needle which is placed at and parallel to the axis of a duster nozzle. This wire enters the nozzle by way of a plexiglass insulator. Each of the several duster nozzles are similarly adapted. The nozzle is large enough to prevent sparks jumping to the wall of the nozzle, and therefore, an ionized field is produced. In this ionized field there is a constant flow of negative air ions from the negative needle to the grounded wall of the nozzle. Particles of dust in passing through this field are struck by these ions and thus take on a negative charge. This action is so rapid that a large percentage of the dust particles can be charged in this way. When the machine is in operation small luminous plumes can be seen around the high tension needle; this is known as the corona effect.

At Michigan State College the main test machine is a conventional duster unit (Niagara) which was built onto a high clearance trailer, and was fitted with a high tension power supply. The only other additions necessary were the high tension leads and the short nozzle extension containing the high tension needle.

Up until recently a method of producing the high voltage necessary has been the largest problem to overcome. At Michigan State College the high voltage is obtained from a 6 volt battery connected to a Dynamo-motor which steps up the voltage to 300. This in turn is passed through a high voltage supply which produces the necessary 15,000 volts. This voltage sounds alarming from the point of view of operator's safety; however, there is no real danger involved because of the small current used, only an unpleasant shock similar to touching an automobile spark plug. The current is only 100 microamps per nozzle.

The high voltage supply is the most expensive part of the E.P. unit, and it is believed that the cost of converting a large field duster to an E.P. duster should be around $300.00. This amount, however, is small compared with the large savings that are hoped for, and it would seem that the adaption should be economically feasible.



The complete dusting unit

This last summer extensive field tests were carried out on a variety of crops. Experimental work was done on celery, peas, potatoes, onions, and beans. An improvement in the deposit was apparent to the eye in all of these tests, but due to the absence of pests and diseases on most of the test plots, the effect of E.P. could not be determined biologically with any degree of certainty. The results which have been obtained, however, do give encouragement for the future.

It is believed that E.P. will be a special asset in dusting certain types of vegetables. Onions, for example, are more suited to dusting because spray droplets do not adhere to their waxy leaf surface.

Work was done at 100 per cent relative humidity without difficulties from the machine. The relative efficiency of E.P. is reduced under these conditions, but the coverage produced was still well in excess of that produced by conventional methods.

For the future it is planned to analyze the forces acting and get all the known factors: current, voltage, particle size, air velocity, and volume to the optimum. Even in conventional dusting the complete answer to these last two questions is not known at present.

There is no fundamental reason why we should not charge any particle of matter, spray for example, but before this is possible there are difficulties of insulation which would have to be overcome in order to use the high voltage which is necessary. This again points the way for future work.

In conclusion it can be said that although the field results were not very spectacular, (due largely to the lack of disease to test the work) the tests showed well to the eye, and there is no doubt of the effect of E.P. There is, however, a discrepancy between laboratory and field tests which still has to be accounted for and in this it is believed that particle size may be a very important factor. Finally it is hoped that the reader is left with the impression that here is a promising "baby" which should repay further work; it is not, however, motive enough at this time for unqualified adoption in the field.

RUBBER ROADS

By BERNARD VOELZOW
Senior C.E.

Ed. Note: This article was one of the prize winners written for the Recent Tau Beta Pi initiation.

The use of rubber in paving surfaces is a fairly recent development in the field of highway and airport engineering. The columns of leading newspapers and periodicals are publishing with greater frequency items with captions such as the following: "Rubber Roads Stretch," "Rubber Coating Tested on Roads," and "Airport Builds Rubber Runway." This is a good indication of an awakening interest on the part of those in the engineering field and the general public in the potential use of this material. The possibility of the use of rubber in low cost bituminous paving for airport landing strips is being investigated, but developments of this nature are not as recent as rubber-asphalt roads at the present time.

A rubber road has great appeal in the mind's eye of the public, and particularly to the pocketbook of the taxpayer from the financial conclusions reached in the present early experiments. The initial cost of construction is much the same as in conventional asphalt surfaces but the need for continual maintenance is less. This appeal is of paramount importance as a selling point for the initial beginnings of rubberized surfaces in a community. There are numerous advantages in favor of rubberized roads. They include the fact that a more durable road surface is provided, foundations are better protected, maintenance charges are lower, there are far less traffic hold-ups due to repairs, the road surface has better anti-skid properties, and a more hygenic condition exists as dust is practically eliminated.

The theory behind the use of rubber in its various forms in asphaltic pavements is somewhat vague. Present concepts are centered primarily along the line of thought that the rubber swells in all liquid hydrocarbons, such as, gasoline, benzine, and mineral oils. A crude unmilled rubber swells to a more or less definite maximum, absorbing oils in much the same manner that a sponge absorbs quantities of water. The rubber is not thought of as dissolving since tests have shown that after swelling takes place it still retains some of the physical properties of unswelled rubber.

As asphalt is composed principally of liquid hydrocarbons, it produces a swelling effect on rubber and its oily constituents are thus absorbed by the rubber. This is considered to be one of the principal reasons why rubberized pavements are more of a non-skid nature than standard practice produces without the use of rubber. The oil has been absorbed and, therefore, more resistance to the tires of the vehicles using the roadway is provided. This fact, along with others, which will be discussed later in this report, was brought out in many laboratory tests on the subject.

Most of the early work and experimentation on the use of rubber in paving surfaces was done by the Dutch, both in their native Holland and in the Netherlands East Indies. Their investigations were made on rubber asphalt mixtures during the years 1936 to 1938 at the request of the Netherlands Indian Government to serve as a preliminary report on the use of rubber in road construction. This report was submitted to the Eighth International Road Congress held at Scheveningen, Holland in 1938. A summarization of the report as submitted was made by G. J. Van der Bie and P. Th. Wynhamer in 1941. The conclusions at which they arrived were favorable enough to warrant an awakening of interest in the application of rubber to road surface construction throughout most of the world.

There were many questions raised, however, such as —how much rubber to use, what form of rubber should be used, how to mix the rubber into the asphalt, would standard application methods have to be changed to provide for the incorporation of the rubber. These queries were quite natural and necessary, for intensive investigation was needed for this new idea.

A great amount of research work by the various rubber companies in the United States has been concentrated on answering these questions, if at all possible. State highway departments all over the country have conducted tests and laid experimental roadways using various admixtures of rubber in an attempt to answer some of the practical problems arising out of this new use of materials. New products have been appearing regularly, such as, "Ucrete Rubber Concrete," which the manufacturer claims combines properties of both concrete and rubber and is waterproof and not brittle when molded. It is manufactured by F. Hulse and Company, Ltd., Woodlesford, Leeds, England.

According to an article in the November, 1950 copy of the "American City'" magazine, Massachusetts is apparently leading the nation in the adoption and use of rubber in asphalt streets. There is a five and a half mile, four-lane rubber highway located in that state which is claimed to be the longest of its kind in the world. Quite recently it was completed and opened to traffic.

The new rubber highway is on the old Boston Post Road, now U. S. Highway 1, the main route running from Maine to Florida. It was put down at a reported cost of $200,000 over a concrete base, which was old and badly patched. A combination of asphalt and a new compound called Surfa-Sealz, manufactured by the United States Rubber Company, was used in the construction.

The weather during the first winter of the new road's existence was recorded as being the most severe in Massachusett's history. The new pavement developed no signs of frost damage, cracking, or buckling, whereas, a test strip or ordinary straight asphalt laid next to it showed considerable signs of wear.

The City of New York has also experimented with rubber in road paving, and are waiting to show some results of their tests. An asphalt-natural rubber powder mix road surface was laid over an area of 1500 square yards in one of the busiest sections of the city. An estimated 60,000 cars per day drive over the new pavement section. New York City engineers are anxiously watching their new project, although they should be able to rest assured that the results will be good, because they used the same type of natural rubber for their tests as the City of Rotterdam, Holland did in an experiment of theirs which had excellent results.

Roads of Tomorrow

The Rotterdam road has been in operation for over twelve years and has had no repair. This is especially unusual and outstanding, because during those twelve years the Nazi military traffic used that road for their invasion of Holland. The Allies also used it in reversing the process of invasion. Military traffic of this nature gives a road or highway considerable punishment and can be deemed a better test than the normal traffic to which a highway is subjected.

The City of Akron, Ohio, sometimes considered the rubber capitol of the nation, has been conducting experiments on their streets by using synthetic rubber provided by the Goodyear Tire and Rubber Company.

They have found that a good mix to use with the synthetic rubber is 1200 pounds of finely powdered rubber to 3000 gallons of asphalt, plus the crushed rock ordinarily present in the standard hot mix. It is stated that 180 tons of the material was rolled down to surface Exchange Street, one of Akron's busy thoroughfares. The rubber was blended with the asphalt at a temperature of about 300 F., then left in the mixing tank overnight, and finally transported to the job. The officials of the city expect a more resilient surface that is longer wearing and more resistant to temperature changes without resultant cracking. To date the results have been very satisfactory.

The increasing use of experimental rubber-asphalt type pavements was instrumental in starting a complete laboratory investigation by the Michigan State Highway Department late in 1949. A systematic study was made to determine the effects of rubber on the highways which normally include bituminous materials in their construction. Particular concern was given to the effect on durability, safety, and riding comfort.

Relatively low concentrations of natural rubber, synthetic rubber (supplied by Goodyear Tire and Rubber Company), and also scrap rubber were used. Results of the investigations indicated that the addition of either of the three types of rubber mentioned to an asphalt cement increased its elasticity and resistance to deformation, and decreased its temperature susceptability. Natural rubber was found to give the best results in practically all of the tests used.

Standard ductility and penetration tests for asphalt cements and the Marshall stability test for bituminous concretes were used. A special torsion test was developed to measure resistance to deformation, and also for measuring the amount of elastic recovery after a specimen was twisted. The increases in twisting time and elasticity and the decreases in temperature susceptability over that experienced by a straight asphalt cement test specimen were all considered as improvements, since a cement with these properties would be likely to produce a concrete having similar characteristics.

The tests definitely showed that natural rubber had more effect on the properties of asphalt concrete when incorporated as part of a rubber-asphalt cement rather than as a separate addition to the mix. This effect might be explained by the fact that the rubber has more opportunity to absorb and swell in the asphaltic oils when preblended in the cement. The concretes prepared using these natural rubber-asphalt cements showed increased stability, and a higher asphalt content was possible with a resultant lowering of costs. When concretes were prepared by a direct mix process, no increase in stability due to the rubber additive was noted. These determinations and the testing methods used in arriving at the conclusions are being tried throughout the State of Michigan in various experimental locations. One such experimental rubber road is in test service at the present time in Detroit.

It is interesting to note that the first airport runway in the western Hemisphere incorporating natural rubber was laid recently in Canada. The Royal Canadian Air Force has put down a strip of natural rubber asphalt paving at its St. Hubert Airport near Montreal. Royal Canadian Air Force officials in charge of the project believe the use of natural rubber in the air strips surfacing will aid its life of runways while reducing maintenance requirements to a minimum. The tests mentioned previously have shown that natural rubber paving is less affected by temperature changes which cause ordinary asphalt mixtures to become soft and distorted in summer weather and brittle and cracked in winter freezes.

Of additional importance in the airport application is that the tests reveal that natural rubber paving has other advantages that would improve airport pavements. They are less susceptible to sun rays and other deteriorating weather conditions; and the volume of traffic normally required to maintain the flexibility or life of the bituminous surface is not necessary. This alone should be of great value to airport engineers since it has been a problem of considerable magnitude in the past.

Rubber roads made from the addition of powdered natural rubber to asphalt cement are becoming quite common, at least in the experimental stage. The positive results, to be conclusive, have to wait for the normal passage of time, but every indication is for smoother roads, less repair, and a safer non-skid surface. These facts seem to be the rewards received so far for the years of study and patient research expended in this particular phase of highway surfacing. The use of rubber for surface paving in the highway and airport engineering field is still in the embyronic stage but appears to have a great future.

UHF Television

Permission Granted by R. C. A.

A new combination of three letters—UHF—is being added to the vocabulary of television viewers. They stand for Ultra High Frequency, which is radio engineers' language for a certain band in the radio spectrum. To the average American they mean more television stations and better television service.

Demonstrating the new UHF converter

At the present time, despite the phenomenal growth of television, and its impact on millions of people, television is not a nation-wide service. There are now only 109 television stations in the United States operating on 12 channels. These stations all operate on what is known as Very High Frequencies (VHF).

But television channels, like radio channels, can become crowded. If two stations on the same frequency are too close together, one interferes with the other. Fearful that this situation might develop in the very high frequency band, the Federal Communications Commission in 1948 "froze" construction of new television stations. Licensing of new stations is still frozen, but FCC proposals, if adopted, will open the VHF band to some 450 more stations. When these are all on the air, FCC figures the VHF band will be just about full.

The only place to find space for new television channels was to move up—into the UHF band. And it is in this band that the FCC has proposed opening up 70 new television channels, which would provide space for 1,357 UHF stations.

WHAT UHF MEANS TO THE PUBLIC

The opening of the UHF band, in the words of Dr. C. B. Jolliffe, Vice President and Technical Director of the Radio Corporation of America, which pioneered in the exploration of this field, "means the advent of a truly nation-wide television service, with more than 2,000 stations from coast to coast."

Extensive tests by RCA and NBC prove the following points about UHF:

1. Television reception on UHF can be just as clear and stable as on VHF. In some instances it is even better, for UHF pictures are not bothered by nearby x-ray equipment, auto ignitions, neon signs or home appliances, which have been known to play hob with VHF pictures.

2. Present television sets made by RCA Victor and other manufacturers can be readily adapted to receive both UHF as well as VHF telecasts. Many television manufacturers, including RCA, have already demonstrated simple converters which can be readily attached to present sets.

3. Actual construction costs for a UHF broadcasting station will be about the same as for a VHF station. But capital outlay can be kept to a bare minimum by operating the UHF station as an auxiliary of the major VHF station; in other words, the UHF station could receive the big station's telecasts by coaxial cable or radio relay, and rebroadcast them. This would eliminate costly studio equipment and extra personnel. RCA Victor has already announced a compact UHF transmitter for station owners.

4. Color television can be broadcast on UHF frequencies.

BACKGROUND

To understand the difference between VHF and UHF, and to understand the importance of UHF, it might be well to look for a moment at the radio spectrum, as designated by the Federal Communications Commission:

Very low frequencies	10 to 30 kilocycles
Low frequencies	30 to 300 kilocycles
Medium frequencies	300 to 3,000 kilocycles
High frequencies	3 to 30 megacycles
Very high frequencies	30 to 300 megacycles
Ultra high frequencies	300 to 3,000 megacycles
Super high frequencies	3,000 to 30,000 megacycles

In terms of actual wave lengths, the higher the frequency, the shorter the waves.

Thus, down in the very long wave band, which is used for transoceanic wireless service, radio waves are up to 10 miles in length.

In contrast, the wave length of television channel 2 in the VHF band is just under 18 feet. Channel 13 runs about 4½ feet. And in the UHF band, the wave lengths vary from two feet down to 13 inches.

An interesting phenomenon occurs in the radio spectrum at a point around 25,000 kilocycles. Just below this frequency, extremely long distance communication is possible; and these are the bands used for transoceanic radio broadcasts.

But just over this range, in the VHF band, communications become limited to a distance just beyond the horizon as seen from the top of the antenna tower.

The cause of this is in the stange actions of the ionosphere, which lies about 200 miles above the earth's surface. The ionosphere plays a big role in long distance short wave broadcasting, for as the short waves are flashed into space they are reflected back to the earth's surface—thousands of miles from their point of origin—by this layer.

Waves in the VHF band—and higher—on the other hand are so short that, instead of being turned back by the ionosphere, they pass right through it. Thus, as far as engineers are concerned, the only important waves transmitted via VHF are those that travel in a straight line. This is why the range of telecasts is limited—depending on the height of the antenna tower and the power of the transmitter.

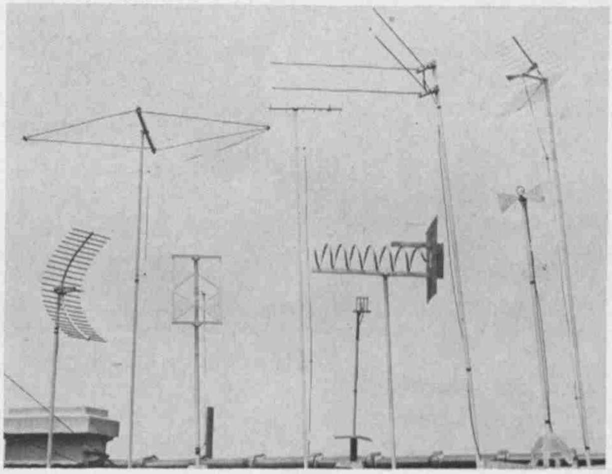
The extreme shortness of the waves also accounts for television pictures being susceptible to "ghosts" or reflections from nearby buildings or hills.

HISTORY

Even before Marconi flashed his first wireless signal across the lawn of his father's estate in northern Italy in 1896, men were curious about the action of electrical waves in the atmosphere.

Famous scientists like James Clerk Maxwell, Edouard Branly, Sir Oliver Lodge and Heinrich Hertz were pioneers in the field. It was Hertz, for example, who first learned how to create these waves.

Since then, scientists have probed deep into the mysteries of how these waves are generated, propagated, radiated and detected.



UHF antennas shown left to right are: cylindrical parabolic reflector, rhombic, double fan dipole, UHF Yagi, a variation of UHF dipole, helical, stacked "V," fan dipole and corner reflector.

Following in the footsteps of the very early pioneers have been the scientists and engineers of the Radio Corporation of America. Among them are such men as Dr. H. H. Beverage, Dr. H. O. Peterson, Dr. George H. Brown, Dr. Irving Wolff, of RCA Laboratories, who are recognized authorities in the field of radio wave propagation, and O. B. Hanson and Raymond Guy of NBC, who have done much on the practical engineering side of the field. These men and the teams working with them are constantly working to find ways to get the fullest and most efficient use from the radio spectrum as a means of communication and an aid to navigation.

The earliest wireless transmissions were made on very long waves (although nobody in those days paid much attention to exact frequencies). But as radio and wireless service kept expanding, we had to move to higher frequencies to find unoccupied bands.

It was Marconi himself, during the early twenties, who explored the short wave bands, and proved their adaptability to long distance transmissions.

EXPLORING UHF

"Up until RCA engineers began looking into it," according to O. B. Hanson, Vice President and Chief Engineer of NBC, "the UHF band was the Antarctic of the air waves. Everybody knew where it was on the map of the radio spectrum, but nobody had much practical knowledge about it."

In fact, it was largely the result of RCA research which made possible the application of frequencies above 30,000 kilocycles to commercial service. In 1931, RCA engineered and installed the first commercial high

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NEW DEVELOPMENTS

THE SUN MOTOR

Sunlight is power.

To illustrate this fact, General Motors has put on display (see Fig. 1) a Sun Motor, a device that will convert sunlight into electrical energy. Although the machine's efficiency is only about one percent, it will operate on ordinary daylight coming through a window.

When sunlight is not available, the heat of a candle or light from a 150-watt lamp will set the Sun Motor in motion. It in turn will spin a balsa wood wheel on the shaft of another small motor.

In using the 150-watt lamp to operate the Sun Motor, light from the bulb falls on a series of photovoltaic cells. A chemical reaction takes place in the cells, and induces the flow of D.C. electricity to the motor. When a candle furnishes the necessary power, heat from the flame actuates a thermopile which converts that flame heat into electrical energy.

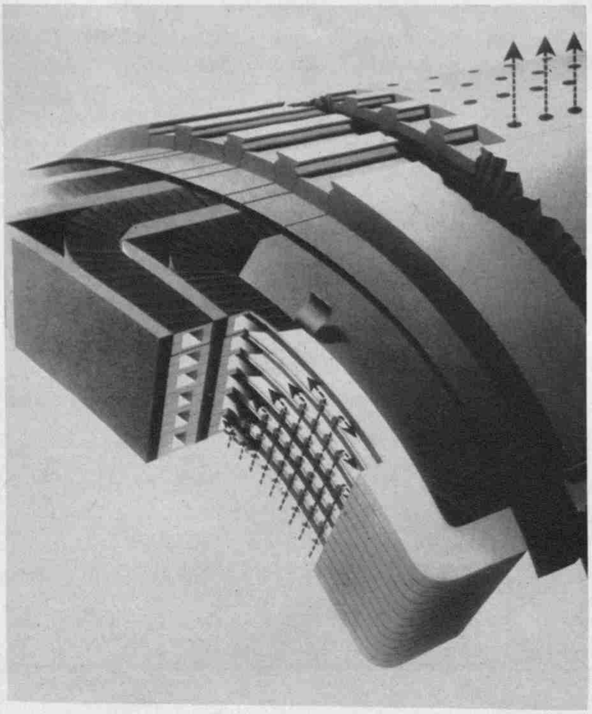

Fig. 1

The efficiency of the machine is such that when power comes through the photovoltaic cells, energy from the 150-watt lamp held six inches from the cell, will lift the Sun Motor's output to only one-one hundredth of a watt. When the thermopile source is used, the Sun Motor has an estimated efficiency of one half of one percent. The only reason it works at all is because of the high efficiency design of the motor.

Despite the low efficiency, engineers say that the Sun Motor does illustrate that someday enough power can be converted from the sun's rays to run all the everyday chores of the home. In fact, they say that in a half-hour enough sunshine hits the roof of an average one-family dwelling to run all the electrical appliances in that dwelling for a year.

★ ★ ★

PLASTIC BLOWERS

Plastic has found another use in the electric motor field—replacing aluminum and bronze for blowers in small, totally enclosed, fan-cooled AC motors.

The blowers consist of a polyester resin reinforced with glass fibers. Glass fiber is used for reinforcement, rather than organic fiber, because it has greater resistance to chemical attack and increased strength.

The plastic, although only a replacement for aluminum and bronze, makes a blower that is superior in several ways to blowers made with the critically needed metals. Unaffected by the chemical agents that attack the metals, the plastic blowers are especially adapted to refineries, chemical plants, and process industries where corrosive atmospheres may be present.

In addition, the plastic blower is as much as one-third lighter than its metal counterparts. While the difference may be just a few ounces, it reduces the inertia where frequent, rapid reversals are required. A third advantage is that the plastic blower has better resistance to abrasion than its predecessors.

★ ★ ★

VAPOR-COOLED TRANSFORMERS

Using high molecular weight fluorocarbons to cool a transformer is the basis for development of a vapor-cooled, vapor-insulated transformer that is approximately ⅓ lighter than liquid-immersed units of equivalent rating and performance.

Fluorocarbons constitute a new family of synthetic compounds which are highly desirable for vaporization cooling because they have a suitable boiling point and heat of vaporization, and a high dielectric strength and high impulse strength at low pressures. In addition to these advantages, the vaporization-cooled transformer is safer than both liquid and dry-type transformers in that fluorocarbons are non-flammable, even possessing fire-extinguishing qualities.

"HEAT SEER"

An electric eye unit that "sees" heat helps produce electronic tubes for defense uses in General Electric's Schnectady, New York plant.

The device is trained on small graphite crucibles used for fusing together small tube parts. When a crucible is heated to a temperature of 3,500 degrees Fahrenheit in the process of fusing the parts together, its color changes from a cherry red to a glowing white, too intense to be safely seen by the human eye.

The electric eye, however, will detect minute changes in color and intensity at high temperatures. As the crucible's color reaches a glowing white, the electric eye sends an electrical impulse to a relay which instantly cuts down the heat of the crucible by shutting off current flowing through it.

The electric eye unit can be used to control temperatures ranging upward from 2,000 degrees Fahrenheit, with only a 15 degree leeway in accuracy by adjusting it to register graduations in color from a dull red through the "hot color" spectrum to the brightest white.

★ ★ ★

INTERNALLY COOLED GENERATOR COILS

A new method of cooling large turbine generators will make it possible to increase ratings by as much as one half.

The new cooling technique consists of blowing hydrogen gas at high velocity through specially-constructed hollow generator coils. This brings the hydrogen, the cooling medium, in direct contact with the copper in which the heat is generated.

Since this cooling method reduces to almost zero the heat flow through the coil insulation, the temperature of the copper coils is determined by the temperature of the hydrogen gas and the heat transfer coefficient from the copper to the hydrogen. Therefore, for a given maximum temperature rise, it will be possible to pass more current through the coils, since the additional heat that results can be quickly dissipated.

Internal cooling is particularly applicable to units of 90,000 kw and above. The improved cooling makes possible the construction of ratings much larger than now possible with conventional hydrogen cooling. Ratings of 3600 rpm single unit generators of 250,000 to 275,000 kw now appear possible at power factors and stability characteristics suitable for the large electric utility systems.

The increase in copper losses due to higher current densities is more than offset by the reduction in bearing losses resulting from the smaller bearings required for the smaller rotors, and the reduction in rotor surface losses resulting from the appreciable increase in the radial length of the air gap and the decrease in rotor surface area.

Under present conditions, the reduction in physical size of generating units for a given rating is of paramount importance since it results in the conservation of the nation's two most necessary critical materials—copper and steel. Higher costs per unit weight offset any possible savings resulting from the use of smaller amounts of copper and steel.

Large capacity turbine generators units of this type, even at present costs, however, should result in lower overall station capital and operating costs without any sacrifice in efficiency performance.

SPIRAL LIGHTNING ARRESTER

Shown here (see Fig. 2) is a model of a new high-voltage lightning arrester. Only half as tall as former high-voltage arresters that required large structural steel supports, the new type SV station type arrester features a zig-zag arrangement of the arrester units that eliminates the need for such supports. Lightning surges are carried groundward through a series of arrester units that spiral down between the three vertical columns.

The arrester is 10 feet high, and is used on 230-kv. lines.

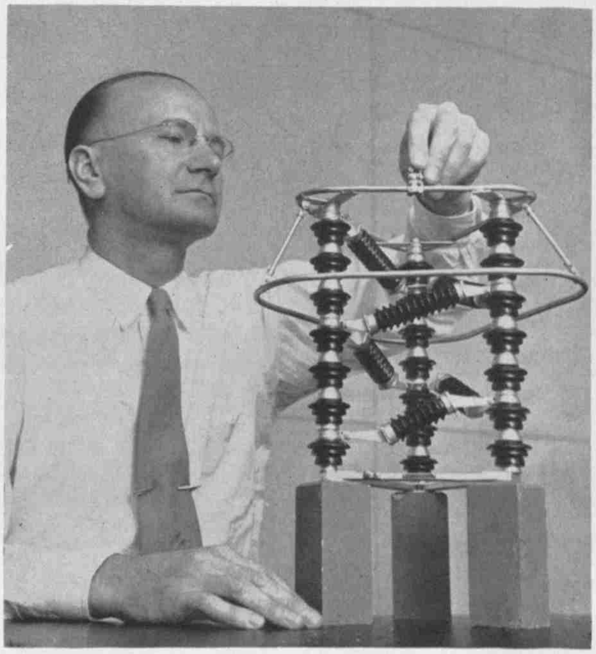

Fig. 2

SENSITIVE CRANE CONTROLS

Crane controls so sensitive that they can regulate the movement of a 250-ton load to within one-thirty-second of an inch have recently been tested by US Army Engineers.

The controls are attached to cranes which raise and lower the 126-ton spillway gates at McNary Dam on the Columbia River. When a gate is raised, the load on the crane approaches twice the weight of the gate because of the downward pressure of the water running under it.

Each crane is 60 feet long, 42 feet wide and 77 feet high. Each one runs on 16 wheels along rails placed 34 feet apart.

The adjustable voltage control on the cranes uses speed-torque characteristics that inherently cause the motor to slow down in both the hoisting and lowering cycle when the load is increased, without change in the setting of the control. The control measures the load on the motor, and adjusts the speed accordingly. The system provides a stalling torque, limiting maximum mechanical and electrical stresses.

The DC motors for the main hoist, trolley, and bridge drives are powered through a four-unit motor generator set mounted in the machinery house on the main trolley atop each crane. The set converts 440-volt AC power to DC. For simplicity of design and operation, the DC voltage is controlled by the generator fields, rather than by resistors in series with the motor. DC solenoid brakes assist in spotting the load and in holding the trolley and hoist drives.

Despite the heavy loads carried by the cranes the main hoist motor is only 60 horsepower. This power, trans-

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ALUMNI NEWS

(Contributions to this feature are welcomed. Send to Alumni News Editor c/o Spartan Engineer)

Robert K. Phelps, C.E. '23, called at the Dean's Office recently. He is manager of the Illinois Inspection Bureau, 309 West Jackson Blvd., Chicago, Illinois.

Seth E. Giem, C.E. '27, is in the construction business and his company is known as Seth E. Giem and Associates, 801 Roland St., Memphis, Tennessee. Their territory covers the area from the Mississippi Valley, Texas, to the Eastern Tennessee area.

Herbert Walworth, Ch.E. '31, is director of Industrial Hygiene for the Lumberman's Mutual Casualty Co., in Chicago 40, Illinois.

John H. Pomeroy, C.E. Sanitary '35, formerly with the Public Health Department at Kalamazoo, Michigan, will go to Araraquara, Brazil, in December where he will work at the University of Brazil, in the development of a field training center for public health engineers. At present he is taking special training in Washington, D. C. Mrs. Pomeroy and their two boys will go to Brazil at a later date.

Raymond J. Cully, C.E. '44, is Sales Engineer for Frederick B. Stevens. His work is in the field of glazed tile. He reports that Gilbert Diefenbacher, C.E. '44, recently had a successful operation on his hip at Harper Hospital.

Richard H. Jones, C.E. '44, is Senior Engineer—Technical Service for the Standard Oil Company and lives at 4517 Lilac Road, South Euclid, Ohio.

F. Earl May, Ch.E '44, is a salesman for the Sealtest Ice Cream Company at Scranton, Pennsylvania. He says he still officiates at high school basketball games and runs around the tennis courts. He is married and has two sons.

Thomas D. Stein, C.E. '44, has returned from California and is Structural Engineer on the design of school buildings for Warren S. Holmes Company in Lansing, Michigan.

John E. Allen, E.E. '44, has left the Philco Company and is now with the General Electric Company, Syracuse, New York. He is in the TV Development Department. He reports that they have a two-year old son.

George W. Betker, Jr., M.E. '44, is Research Engineer for the Ethyl Corporation, Detroit, Michigan. He is married and has a daughter one year old.

Rev. Bettison A. Morse, M.E. '44, is now Associate Minister for the First Baptist Church at 111 W. Monument Avenue, Dayton 2, Ohio. He was graduated from the Divinity School, Yale University in 1949.

Frederick Buttner, Mt.E. '44, received his Doctors Degree from M.I.T. this past June and is now Instructor and Research Associate at M.I.T. His residence is at the Graduate House.

William S. Coleman, M.E. '45, is Research Engineer with General Motors Company in Detroit, where he has been for the past five years. He lives at 2807 Manchester, Birmingham, Michigan.

Edward J. (Terry) Lobdell, M.E. '45, is Sales Engineer for Bradbury-Kenrick in Detroit. He was married on March 24, 1951. Congratulations, Terry.

James Van Haften, M.E. '45, is a Design Engineer for Dow Chemical Company at Midland, Michigan, and lives at 3404 Dartmouth Drive, Midland, Michigan. He and Mrs. VanHaften were homecoming callers at the Dean's Office.

Walter Mischley, C.E. '46, formerly City Manager for Manistee, Michigan, has accepted a position as Chief of Municipal and Commercial Facility Branch of the Atomic Energy Commission.

Wesley Carlosh, Ch.E. '46, is Technical Compounder for the B. F. Goodrich Rubber Company at Akron, Ohio, and lives at 918 Copley Road.

John H. Douma, M.E. '46, is Project Engineer for the Ford Motor Company at Dearborn, Michigan. He is doing experimental development on drive line components.

Charles E. Fiske, Ch.E '46, is Chief Control Chemist for the Leonard Refining Company at Alma, Michigan.

Stuart A. Hath, M.E. '41 and '46, is Air Conditioning Engineer for the S. S. Kresge Company with headquarters in Detroit. He is in charge of all air conditioning and maintenance in the U. S. and Canada and has been with the company for the past five years.

Gerald R. Smith, C.E. '46, is Design Engineer for Hamilton, Weeber and Ward in Grand Rapids, Michigan. His work is in the field of Power Plant Construction, Water, Sewage and Municipal building.

Edward S. Humenny, Ch.E '47, is Plant and Resident Manager for the Synthetic Rubber Products Company in Los Angeles, California. He, Mrs. Humenny and Edward, Jr., live at 508 North Princeton Circle East, Fullerton, California.

Keith L. Hunt, Ch.E. '47, has left Ternstedt in Detroit and is now living at 811 N. Scott St., Wheaton, Illinois. He is Office Manager for the Inter-Varsity Christian Fellowship, located in Chicago. He and Mrs. Hunt, the former Gladys M. Schriemer, '48, have a 9 months old son, Mark Earl.

Everett R. Windahl, M.E. '47, is District Sales Manager for the Northwest Engineering Company in the Philadelphia area and lives at 76 Meade Road, Star Route, Amber, Pennsylvania. He has recently moved his family into a new home at the above address and would enjoy having any M.S.C. alumni drop in to visit with them and see his two boys—one 6 years old and the other 3.

Howard Pridmore, C.E. '47, whose home is at 2216 Pinecrest Drive, Ferndale, Michigan, will receive his law degree from the University of Michigan in February.

Charles W. Bachman, M.E. '48, is Engineer for the Dow Chemical Company at Midland, Michigan. He is doing economy studies in power generation and fuel evaluation. His present address is Box 150, Midland. He is working on a home which he expects to get started in the Spring and which will be in Dow Homestead No. 3.

Roy L. Benfer, Ch.E. '48, is Technical Representative for Dow Corning Corporation, 600 Fifth Avenue, New York City, and lives on Normandy Parkway, Morristown, New Jersey.

Fay L. Cunningham, Ch.E. '48, is Chemical Engineer for the Upjohn Company at Kalamazoo, Michigan. He is assigned to the Pilot Laboratory.

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RADIANT HEATING

By LEE MAH — Sophomore E.E.

The necessity of heat to keep our bodies in comfort has been a problem of human beings since the beginning of time. Undoubtedly, early man first relied upon the sun's radiation for warmth. With the discovery of fire-making man begins his attempt at artificial heating. Since the early man lived mostly in caves, many of them were overcome and succumbed to the poisonous gases. Later, an opening was formed in the room through which smoke could escape. Then the idea evidently came to these primitive men to form a hood for collecting the smoke and, eventually, a chimney was made for conveying the smoke and creating a draft which would draw away the smoke and gases. Our present open fireplaces and chimneys are undoubtedly heirlooms coming down from these age-old methods.

The Romans were one of the earliest to develop the art of heating. More than 2,000 years ago they showed prudence and ingenuity by building the hypocaust systems. These were made by constructing the floors of their buildings on a series of supporting piers about twelve to eighteen inches high, made with flat tiles about one-half inch thick and eight inches square. These piers were placed about two feet apart and the floor was supported by them. Hot gases from a central fire were fed into the spaces formed under the floor until they were finally led to a flue in the wall. The floor surfaces were usually covered with beautifully designed patterns of mosaic. Well preserved artifacts may be seen today at the Roman Baths in Bath, England, and at the Baths of Caracalla in Rome. However, the walls were discolored by the burning charcoal used to make the fire. This is the earliest record of man-made radiant heating.

For many years the art of heating a house, or building, was considered so simple that it did not require scientific study. It was probably for this reason that technical developments in heating lagged many years. In order to develop a good heating system, one must understand the factors involved in providing heat to create conditions of warmth and comfort. It has been found that the minimum normal heat developed by a human being is approximately 500 Btu per hour. Of this amount, about 100 Btu per hour are used up in maintaining the body in operation. The remaining 400 Btu have to be dissipated in one way or another. Otherwise, the body would overheat and trouble would develop as in an internal combustion engine. Under normal conditions nature maintains a proper balance in dissipating the excess heat in the following manner: 190 Btu per hour by radiation; 110 Btu per hour by convection and evaporation; 100 Btu per hour by exhalation.

The objective of any heating system is to maintain the body heat loss at a level where the individual will not feel cold by losing too much heat. Most conventional heating systems control this by supplying heat to the individual by increasing the air temperature around him. This makes up the individual's heat lost through radiation by gaining heat through convection. Obviously, the most ideal heating system is the one which provides for the body's heat loss rate in proper balance among the three channels of heat output which are radiation, convection and evaporation, and exhalation. A person is more comfortable in a room of relatively lower air temperature than wall temperature. The radiantly heated room most nearly approximates this condition. Radiant heating is directed toward the control of comfort by influencing the radiation component of bodily heat output rather than by the convection method.

In radiant panel heating the heat is transferred from the heated surfaces of the wall, floor, or ceiling and is radiated to the individual by means of heat rays. These heat rays are comparable to the sun's rays which transmit the heat directly to the individual without heating the air around him.

When the ceiling is heated to a temperature above that of other objects in a room, the heat will be radiated from the ceiling to the objects, wall, or floor in an attempt to bring these parts to the same temperature as the ceiling. The air in immediate contact with the ceiling will also be heated to approximately the same temperature by conduction. There will be only a slight amount of convection, however, since the hot air is already at the top of the room.

With heating panels mounted in the floor the amount of heat transferred by convection is greater than that transferred by the ceiling panels because the hot air will be at the very bottom of the room. Convection caused by wall panels is less than that of the floor panels but greater than that of the ceiling panels. Following is a table of the relative percentage of heat transfer by radiation and convection:

Type of surface	Heat transfer by convection, %	Heat transfer by radiation, %
Floor	50	50
Wall	43	57
Ceiling	30	70

There are many advantages which radiant heating has over the conventional systems. First, because of the relatively large areas of low temperature panel surface, a panel heated room will usually have a very uniform distribution of warmth and the reduction of air currents. In a radiator heated room the radiator is usually placed below a window. Thus air coming in through the window will be warmed by the radiator. At this point will occur the greatest heat loss since the air being warmed by the radiator is coming from a low outdoor temperature. The rising warm air will then circulate up to and along the ceiling and down toward the floor at points most distant from the radiator. This will result in a noticeable difference of air temperature between the ceiling and the floor. Radiant heating, being independent of air temperature, will not create this problem.

Secondly, since the panels are imbedded in either the ceiling, floor, or wall, they will not interfere with the interior designs and decorations of a house and decrease the available floor space. For example, the amount of space taken up by a conventional radiator, 12 inches wide and 4 feet in length, will be at least 32 cubic feet. In a room 12 feet by 14 feet with an 8 feet 6 inch ceiling that will mean about 3 percent of the room area.

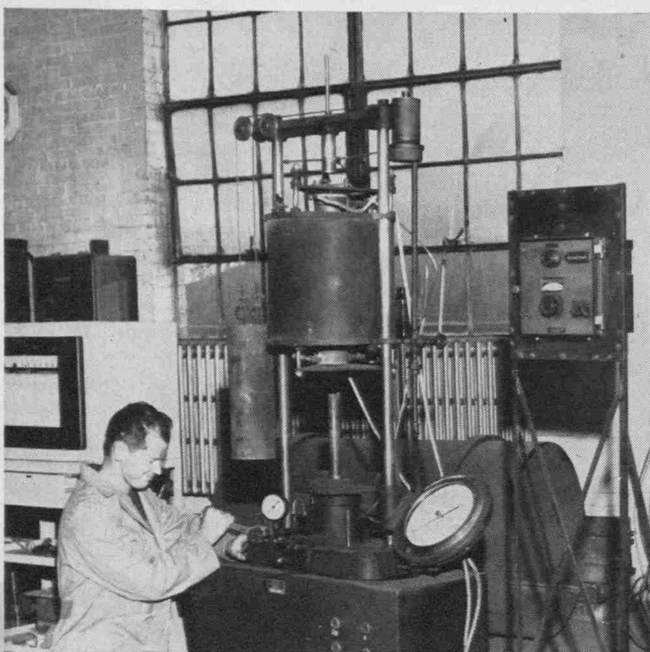
(Continued on Page 32)

ENGIN

"Miss Engineer" and Court

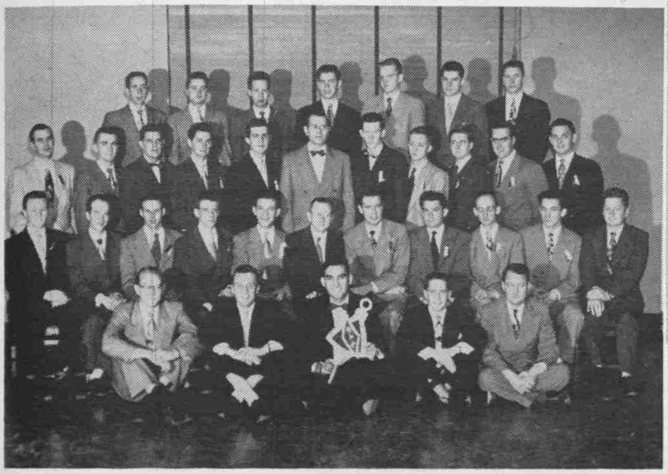
Casey's sister at the bat. Picture taken during intermission at Engineers' Ball.

Recently acquired Dilatometer used for high temperature molding sand testing in the foundry.

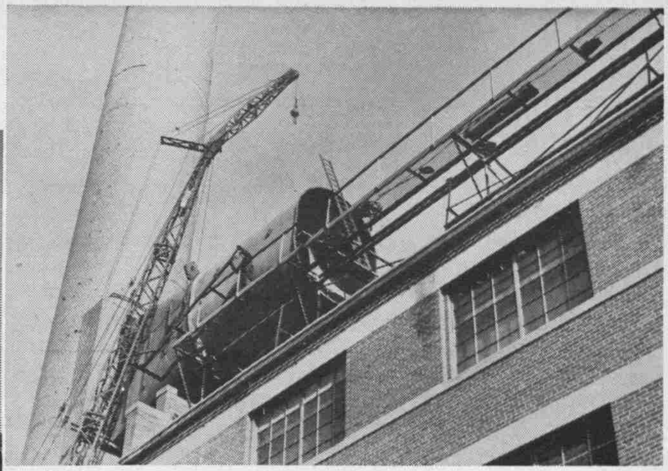


Shell-mold demonstration at an A.F.S. meeting.

-PICS



Pi Tau Sigma after recent initiation.



Entrance duct of new smokestack at power plant on South Campus.

Welding a steel entrance duct on new smokestack.

The new smokestack in its entirety — 250 feet of brick.

MORE POWER TO YOU

(Continued from Page 9)

tubes, thereby improving heat transfer. Additional savings result from reduced maintenance and shut-down time. I am sure that there will be other improvements in operation of existing plants that will show worth-while savings.

I have seen boiler feed pumps as they came from the manufacturer wear out in two years. In our Research Laboratory of forty engineers and scientists who wrestle all kinds of utility problems, there is a metallurgist who went to work on this one. Suppliers have been assisted in developing alloys that will wear five times longer when used in their high pressure pumps.

When our urban load was 100,000 kilowatts and the distances not very great, we could transmit efficiently at the generator voltages, but as the load increased it became necessary to operate at higher voltages. Years were spent in developing insulation, underground cables and circuit breakers that would give good service at a transmission voltage of 24,000. As the loads grew, the 1200 miles of 24,000 volt cable had to be augmented with higher voltage transmission. We now have fifty miles of a 120,000 volt three-phase cable capable of carrying the output of two 100,000 kilowatt generators.

It is a long story—citing all of the problems and developments that brought into successful operation this new high-voltage underground cable system. The cables are buried in 8-inch steel pipe covered with a coating to prevent corrosion. The pipe is filled with 200 pounds of nitrogen pressure to improve the insulating qualities of the cable. The oil impregnated paper around each conductor is about the same in thickness as on the conventional 24,000 volt cable. This makes for more efficient dissipation of I^2R losses.

Special joints and terminals had to be developed as well as methods of installation. The operating and maintenance problems that continually arise with equipment of this kind require the training and ingenuity of our best engineers for their solution.

For a long time the surburban transmission system handling bulk power has been a steel tower line operating at 120,000 volts. We foresee the time when that voltage may have to be increased to 220,000 or 287,000 volts. Introducing such a change into an existing system always brings with it new problems.

In the Detroit Edison service area of 7,500 square miles, 23,000 miles of transmission and distribution lines are carried on 579,000 wood poles. At one time the life of a pole was at best about 15 years. Today poles are treated with chemicals that inhibit fungus growth. If pole life is only doubled, the savings are tremendous when you consider that it costs $150 to replace each old pole.

Then every so often comes a problem that makes the day-to-day ones seem small. Since 1946 the load has grown faster than any of us predicted at that time. When the Korean War hit us, we had plans for rebuilding a portion of an old plant. Removing some of the less efficient generators to make space for new ones meant reducing our capacity at a time when the load predictions made that seem unwise. New trends in automatic operation and defense considerations also favored the construction of an entirely new plant at another location. Suddenly plans were shifted to build a new fifth plant—the first new location in over 25 years.

But it takes 3 years from the time you decide to build a new plant until you have it in operation. Economic studies were quickly made to decide where to locate it —fortunately we had already purchased land at two different places. Other important decisions related to temperatures and pressures that give the highest economy . . . to sizes of generators and boilers . . . to reheat cycles . . . to unit operation of boiler and turbine-generator . . . to 3600 rpm vs 1800 rpm and to an almost completely automatic type of plant.

Building a new power plant means changes and additions to parts of the transmission and distribution system. For every $1 spent for the new plant, $2 will eventually be spent in new lines, switching stations and substations that deliver the power to the customers.

I could go on citing a number of examples of engineering problems that at times appeared insurmountable, but now let's take a look at the future.

Electricity has become almost as essential to modern living as food and clothing. It keeps production going in the factories, milking machines on the farms, and deep-freezes and furnaces in our homes. Engineers will keep on developing new uses which will build more electric load, and therefore more challenges for the electric utility industry.

In the United States the industry has doubled in size during the last ten years. Engineers and managers are making their plans today for a rate of growth in the next twenty years as great as that of the past twenty years. Under those estimates, the grand total United States capacity of approximately 80,000,000 kilowatts today will reach 200,000,000 by 1969. Property and plants will be worth $65 billion, and annual revenues $11.5 billion.

I believe that it is no secret that there are now under way long-range studies on applications of atomic energy to production of electricity. If and when that happens, methods of steam generation will be changed and there will be new engineering and management problems. Of more immediate interest is the use of radioactive isotopes as tracers. Industry is on the threshold of a new method of solving many of the engineering problems, and it will be a young man's field.

Future growth and changes will bring opportunities and achievements greater than I have experienced during my 40 years in this business. Some of our engineers today feel that the engineering problems associated with the design, construction, operation and maintenance of power plants and electrical systems may grow even faster than the load. Opportunities for thinking up new ways of getting jobs done, and of improving service and reducing costs will go on and on.

This is an engineer's business. The job of making and selling kilowatthours depends on the engineering science all the way from the source of energy to the customer's meter. Even the problems that are of an economic nature are associated with either materials or methods that require an engineering knowledge and background for their solution. The majority of top management positions will be filled by engineers.

In planning your career, keep in mind also that the place you work and the people you work with will have an influence on your success and happiness as well as what you do. The utility industry has long been a leader in employe relations and can point with pride to its achievements in that field.

If you are looking for a challenge for your abilities, and an opportunity for a lifetime of professional growth, those of us who are about to pass on the torch to younger men commend for your careful consideration this great industry. Along with glamour, there is security, and with progress—stability.

CONFERENCE IN THE CLOUDS

Among the undergraduates on any college campus, you'll find the talk reaching up to the clouds. And once in a while—in a classroom, around a study table, or even in a bull session—a really big idea is born.

Big ideas come, too, from the men and women in laboratories, business offices, shops. But often these professionals are exploring a path first glimpsed in college.

How do we know? Because of the many college people who have come into the Bell System, where big ideas and a lot of dreams have taken their place in progress. The human voice, carried along a wire, first across a town, then a state, a nation, and now the world. Music and pictures and things happening delivered into cities and hamlets all across the land by radio and television networks.

We're always looking for the men and women who get big ideas—whether they're about people, or machines, or ways of doing things. It's the only way the Bell System can keep on giving this country the best telephone service in the world.

BELL TELEPHONE SYSTEM

UHF TV

(Continued from Page 15)

frequency network anywhere in the world, for the Mutual Telephone Company in the Hawaiian Islands. In 1936, RCA completed a two-way microwave link for commercial operations between New York and Philadelphia.

In the course of their work, RCA scientists and engineers have published well over a hundred technical papers on their findings in the UHF field. Much of this research has become basic information for the entire radio industry.

World War II greatly speeded up the exploration of the higher frequencies—for radar, and direct-line, static-free communication links.

But it took television—and the great postwar rush to expand radio service—to bring the higher frequencies to the fore.

Because a television picture requires much more information than a sound broadcast, television stations are big users of spectrum space. A television station takes 600 times as much room in the ether as a broadcast station; it requires a band width of 6,000,000 cycles (6 megacycles) compared with 10,000 cycles for standard broadcast.

The first step was into the VHF band.

But because the FCC must also satisfy demands from such services as government wireless, maritime radio, air navigation, general navigation, radar, airport control and commercial broadcasting, even space in this band began to get crowded.

It was apparent that the only place to move again was up.

That was why the FCC as early as 1944 set aside the UHF band, from 475 to 890 megacycles for television broadcasting.

To prove the practicality of the UHF band for television broadcasting, RCA scientists, under the direction of Dr. George H. Brown, launched a number of tests starting in 1946.

They wanted to find out what kind of tubes and transmitters would be needed to send out a good signal for broadcast use. They wanted to know what kind of transmitting and receiving antennas would be needed, what kind of circuits would be needed for home television sets.

One field test the RCA engineers conducted was held in Washington, D. C., under actual broadcast conditions. The results of this test led RCA officials to decide on a full-scale test in a city not adequately served by VHF. The idea was to make the station a custom-built prototype of future commercial installations so that the results would show the true possibilities of UHF television.

THE BRIDGEPORT TESTS

The final selection was Bridgeport, Connecticut. A city with a population of just over 200,000, it was on the fringe reception area for both New York and New Haven television stations. The hilly countryside also produced the most difficult possible conditions for commercial telecasting. The equipment was designed and installed by engineers of the RCA Victor Division, under the direction of D. F. Schmit, and operated by technicians from the National Broadcasting Company, under the direction of O. B. Hanson.

The station was located in a small, white Cape Cod cottage in Stratford, on the outskirts of Bridgeport, on a hill whose name the RCA-NBC engineers hoped augured well. It was called "Success Hill."

In the meantime, engineers from the RCA Victor Division had been applying their know-how to designing and building 50 experimental UHF television sets, and 50 converters to permit present sets to receive both VHF and UHF broadcasts. The RCA Service Company placed these sets and converters in various homes in the Bridgeport area, picked so that they would give a fair sampling of reception conditions. Regular daily records on the performance of these sets are kept.

On January 11, 1950, operating under the call letters KC2XAK, the station inaugurated regular test pattern and picture program transmission. It is the first and only UHF television station to operate on a regular daily basis, a fact which was duly noted by the FCC in its 16th annual report.

Programs do not originate at the Bridgeport station. The images reproduced on experimental UHF television sets are those of the regularly-scheduled programs of station WNBT, New York. They reach KC2XAK over a 2000-megacycle beam from a transmitter on the 85th floor of the Empire State Building. After the signals are picked up by a 6-foot parabolic antenna located on the 180-foot level of the Success Hill tower, they are led downward to receiving equipment in the transmitter building, processed there, and then retransmitted on KC2XAK's assigned frequency of 529-535 megacycles. The combination of transmitter output and a high-gain, slot-type antenna radiates the picture signals with a power of approximately 14,000 watts.

To test signal strength throughout the Bridgeport area, NBC engineers also installed receiving equipment and a portable antenna in a station wagon and a truck. This mobile unit—often accompanied by a police escort provided by the State of Connecticut—has moved up and down highways and parkways testing the UHF signal strength in every location.

Graphs, charts and diagrams, proving the capabilities of UHF and comparing its performance with VHF, were prepared by the engineers. As fast as information was collected, RCA officials made it available to the FCC, which in turn made this information available to the entire industry and broadcasters from all parts of the country. Members of the Commission also visited the Bridgeport station to observe the tests first hand.

In addition, RCA's competitors in the television manufacturing business were invited to use the Bridgeport signals to test their own experimental receivers and converters. Already 64 manufacturers have taken advantage of this opportunity.

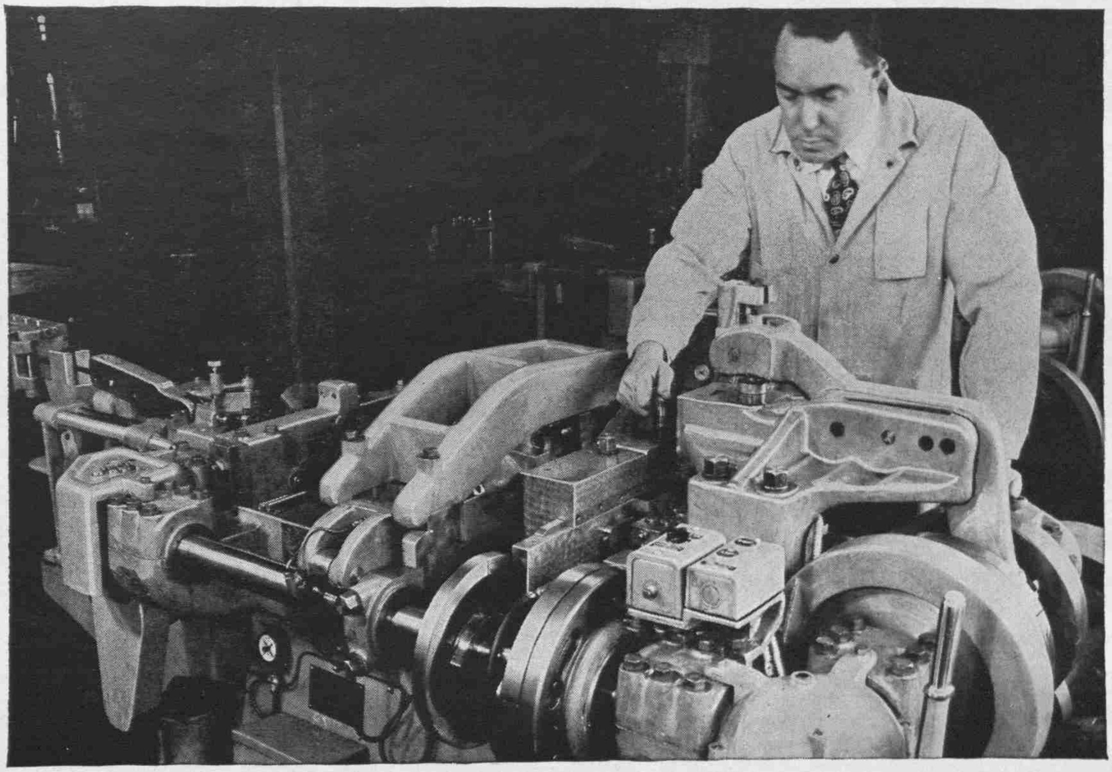
THE FUTURE OF UHF

RCA officials, the FCC and the television industry generally agree that the Bridgeport field experiment has proved eminently successful. Dr. Jolliffe says: "This pioneering station proves beyond doubt that UHF television is a practical means for extending television service to communities now without it.

"And make no mistake, Main Street is just as anxious for television as Broadway—perhaps more so. For Broadway has its shows and its lights. But for the living presence to be brought to the sitting room in a lonely farmhouse miles from the nearest city—that is truly pushing back the horizons of entertainment and education.

"We feel that the Bridgeport test, conducted by RCA as a public service, points the way to a truly nationwide television network."

FLAT SPRING STEEL



Manufacturers count on Roebling for absolutely uniform quality

FOR FLAPPER VALVES, shoe shanks, measuring tapes! For steel rules, curtain springs, snap springs, lock springs, drop wires, sinker steel and a thousand and one other exacting uses, Roebling high carbon flat mechanical spring steel is unsurpassed.

Roebling has one of the largest specialty wire mills in America, and our complete facilities for producing flat spring steel give us positive control over every phase of production. The final product is dimensionally and mechanically uniform . . . cuts down machine stoppages . . . minimizes rejects. And Roebling flat spring steel is made in a wide range – annealed, hard rolled untempered; scaleless tempered; tempered and polished, blued or strawed.

Roebling technicians are always glad to help choose the *right* flat spring steel for top efficiency in any given application. John A. Roebling's Sons Company, Trenton 2, N. J.

ROEBLING

Atlanta, 934 Avon Ave ★ ***Boston,*** 51 Sleeper St ★ ***Chicago,*** 5525 W. Roosevelt Rd ★ ***Cincinnati,*** 3253 Fredonia Ave ★ ***Cleveland,*** 701 St. Clair Ave, N.E. ★ ***Denver,*** 4801 Jackson St ★ ***Detroit,*** 915 Fisher Building ★ ***Houston,*** 6216 Navigation Blvd ★ ***Los Angeles,*** 216 S. Alameda St ★ ***New York,*** 19 Rector St ★ ***Odessa, Texas,*** 1920 E. 2nd St ★ ***Philadelphia,*** 230 Vine St ★ ***San Francisco,*** 1740 17th St ★ ***Seattle,*** 900 1st Ave, S. ★ ***Tulsa,*** 321 N. Cheyenne St ★ Export Sales Office, ***Trenton, N. J.***

SOCIETIES

SOCIETY PRESIDENTS:

Do not forget to send your elected representative to a Spartan Engineer meeting in the Spartan Engineer office on Jan. 30 at 8:30 p.m.

S. A. E.

A dual field trip was the main activity for S. A. E. members in November. The members journeyed to Detroit on November 14 to take tours thru two Detroit plants, the Chrysler plant and the Ethyl Corporation.

The trip was capped off by having dinner at the Chrysler plant.

More field trips are being planned for the future.

★ ★ ★

A. I. Ch. E.

Two meetings were held during October and November.

At the October meeting plans were discussed for the arrangement of a field trip sometime in the near future. Entertainment was furnished by a representative of the manufacturers of Unibestos insulation. He covered two topics in the course of the evening, the first was "Industrial Insulation," the other was on the situation facing the chemical engineering graduate.

Mr. H. B. Skamser, of the Engineering placement office was the speaker at the November meeting. Mr. Skamser covered the employment prospects for engineers and answered questions from the members concerning placement.

Refreshments were served after the regular meeting.

★ ★ ★

A. S. C. E.

The American Society of Civil Engineers has been very busy during the months of October and November. At the October meeting they were enlightened with a talk by Mr. H. E. Sponberg of the M.S.C. placement bureau on the method of obtaining jobs and the present job opportunities.

"Employment in the Construction Industry" was the subject of a talk at the November meeting. The speaker was Mr. George Combs, Secretary of the Association of General Contractors, Michigan section.

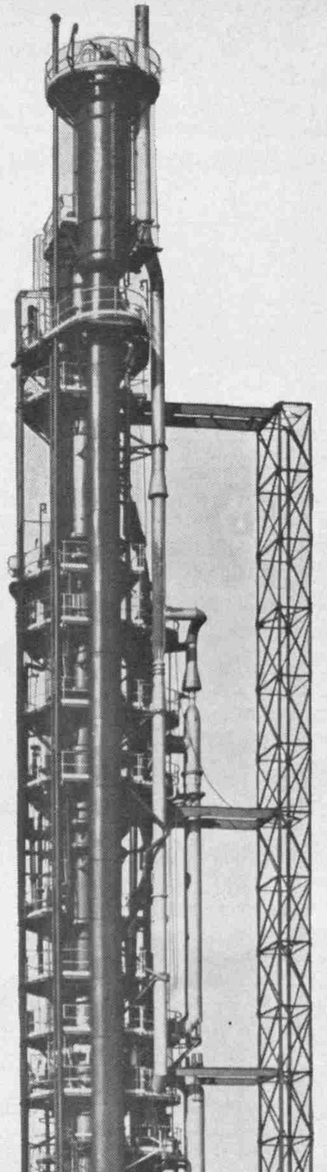
Following the talk by Mr. Combs a movie depicting the construction of the United Nations building was shown.

Plans have been made for the future to arrange for a man from the Michigan State Highway Department to speak on the opportunities for civil engineers with the highway department.

GIGANTIC

NEW HYPERSORBER

for hydrocarbon separation

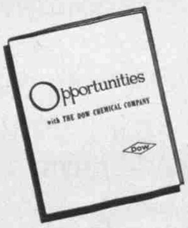


Towering high above the many pipes and towers that dot the Midland, Michigan horizon is one of Dow's newest additions to its vast supply of technical equipment . . . the new 207 foot, 400 ton Hypersorber. Erected in April of 1951, it is used for the separation of light hydrocarbon gases.

Because of its huge size, transporting it from Cartaret, New Jersey, where it was made, to Midland was a difficult problem. Finally it was decided to transport it in two sections, on specially built, low slung rail cars. It was transported only in the daytime and moved no more than 100 miles per day.

For the erection of this tall tower, special 190 foot vertical steel columns were employed, as well as two hoisting steam engines controlling ¾ of a mile of cable, eight sheaved blocks and 17 one-inch cables.

The largest single drum ever erected in one piece, the Dow Hypersorber is part of the continual program of development and expansion of technical and plant facilities taking place at The Dow Chemical Company . . . expansion necessitated by growing demands for its high quality chemicals by industries throughout the world.



Dow's booklet, "Opportunities with The Dow Chemical Company," especially written for those about to enter the chemical profession, is available free, upon request. Write to The Dow Chemical Company, Technical Employment, Midland, Michigan.

THE DOW CHEMICAL COMPANY

Midland, Michigan

DOW
CHEMICALS
INDISPENSABLE TO INDUSTRY AND AGRICULTURE

ALUMNI NEWS

(Continued from Page 18)

Merthyn E. Evans, E.E. '48, is Electrical Engineer for General Electric Company and lives at 2205 Brooklyn, Fort Wayne, Indiana. He has one daughter two years old.

★ ★ ★

ENGINEERS IN SERVICE

2nd Lt. Carl E. Christenson, '49, is stationed at the Lackland AFB in San Antonio, Texas. He may be reached through his home address, 22919 Hayes, East Detroit, Mich.

Lt. William W. Covey, '49, is with the 11th Airborne Division in El Paso, Texas. Called into the army in October of 1950, he is assigned as a platoon leader.

Lt. George A. Custer, '49, is executive officer of Co. B, 351st Inf., APO 209, New York, New York. Believed to be located in Trieste.

Lt. j. g. Downing L. Jewell, '49, is a naval aviator. His work, varying from flying in hurricanes to administrative, will carry him to VP 23 in Miami, Florida. Lt. Jewell suggests that there are many openings in his "company" for those interested.

Edward Lan, '49, is in the U. S. army. He gives no address on the card returned to the Dean's Office.

2nd Lt. Donald T. Lowe, '49, is doing work on an aeronautical power plant project for the U. S. Air Force. His work includes developing engine lubrication systems and working with the contractors on the project. He may be reached at 623 N. Stadium Drive, Xenia, Ohio.

Lt. j. g. William E. Pearson, '49, is stationed on the Gen. U. S. S. Mann (T-AP-112). His work is in the field of propulsion engineering, and his home is at 646 Mandana, Oakland, California.

Pfc. Theodore V. Seling, '49, is employed by the Signal Corps' Evans Laboratory. His address is 9471st TSU, Evans Signal Lab., Belmar, New Jersey.

2nd Lt. Charles J. Stahl, '49, is also in the Signal Corps. He is now stationed in Japan.

1st Lt. Theodore E. Thompson, '49, was recalled to active duty March 26, 1951. He is now stationed with Btry. B, 235th F. A. Obsn. Bn., Camp McCoy, Wisconsin.

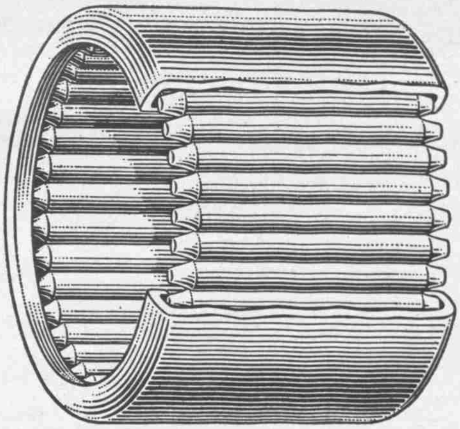
Robert L. Tripp, SN, '49, is on leave of absence from the Ford Motor Company. He is presently stationed on the U. S. S. Siboney, CVE, and working with radio communications.

Lt. Donald L. Welling, '49, is a battery commander, Btry A, 2nd Tng. Bn., FARTC, Fort Sill, Oklahoma. He works as an instructor for basic trainees and survey specialists.

Lt. Mark M. Frimodig, Ch.E. '50, Co. L., 35th Inf. Reg., A.P.O. 25, San Francisco, California, was seriously wounded in the neck in Korea about Oct. 26. His parents report that they have heard from him recently and that he is recovering satisfactorily.

2nd Lt. William G. Clemons, M.E. '50, Hq. FEAF, A. P. O. 925, San Francisco, California, has just informed the Dean's Office of his new address.

2nd Lt. Jack Marsh, Ch.E '50, is also enroute to Korea. He called at the Dean's Office during the Thanksgiving holidays. His wife and young son will live at Ravenna, Michigan.



This is a Torrington Needle Bearing

Designed for Today's Needs and Tomorrow's Trends—
Needle Bearings Offer A Unique Combination of Advantages

The Torrington Needle Bearing has two component parts—the full complement of relatively small diameter, thru-hardened, precision-ground rollers and a case hardened retaining shell by which they are held.

The bearing is a complete unit in itself, and is easily pressed into position in a bore machined to proper dimensions. The advantages of this unit construction in simplifying installation and speeding assembly are readily apparent.

High Radial Capacity

Of special importance is the high capacity of the Torrington Needle Bearing. This efficient anti-friction unit can carry a greater radial load than any other bearing of comparable outside diameter due to the large number of rollers. The small cross section of the bearing allows a large shaft which permits a rigid design with minimum shaft deflection.

Efficient Lubrication

The method of lubrication is another feature of the Torrington Needle Bearing. The retaining shell with its turned-in lips provides a natural reservoir for the lubricant. Thus the needle rollers turn in an oil or grease bath and continually bring up a fresh film of lubricant—insuring rotation of all moving members on a fluid film.

Low Cost

The size of the Torrington Needle Bearing, coupled with the simplicity of its construction, makes it a comparatively inexpensive anti-friction unit. Its compact size encourages simplified design which requires less material in surrounding components. This also contributes to further cost reductions.

The shaft serves as the inner race in the majority of Needle Bearing applications and therefore should be hardened and ground to proper dimensions. However, where it is desirable to use an unhardened shaft, an inner race can be supplied.

For Modern Design

Where the efficiency of anti-friction operation is desired, and where space, weight and cost are vitally important considerations, Needle Bearings provide a logical answer. That's why you will find them used in an ever-growing list of applications.

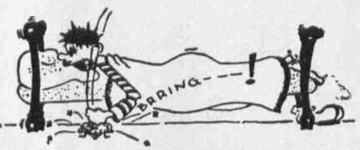
This is one of a series of advertisements designed to give you the latest engineering information on Needle Bearings. Should you have occasion to work with bearing design or wish more information, write our engineering department.

THE TORRINGTON COMPANY
Torrington, Conn. • South Bend 21, Ind.
District Offices and Distributors in Principal Cities of United States and Canada

TORRINGTON *NEEDLE* BEARINGS

NEEDLE • SPHERICAL ROLLER • TAPERED ROLLER • STRAIGHT ROLLER • BALL • NEEDLE ROLLERS

A Day in the Life of an Engineer



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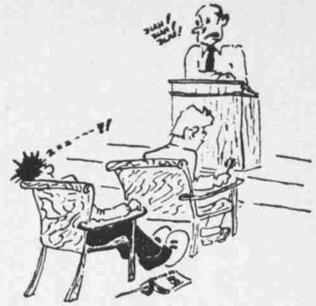

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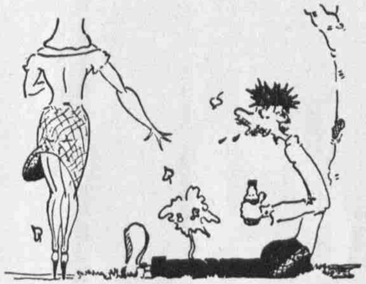

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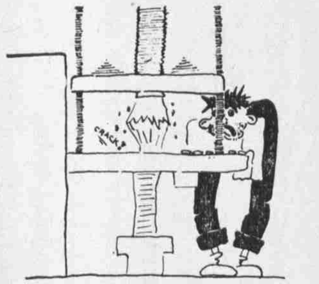

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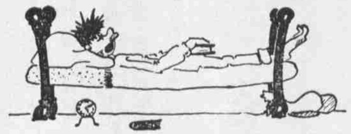

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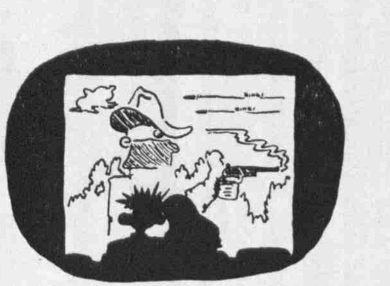

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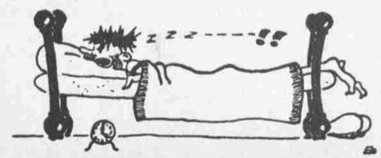


4:00 A.M.

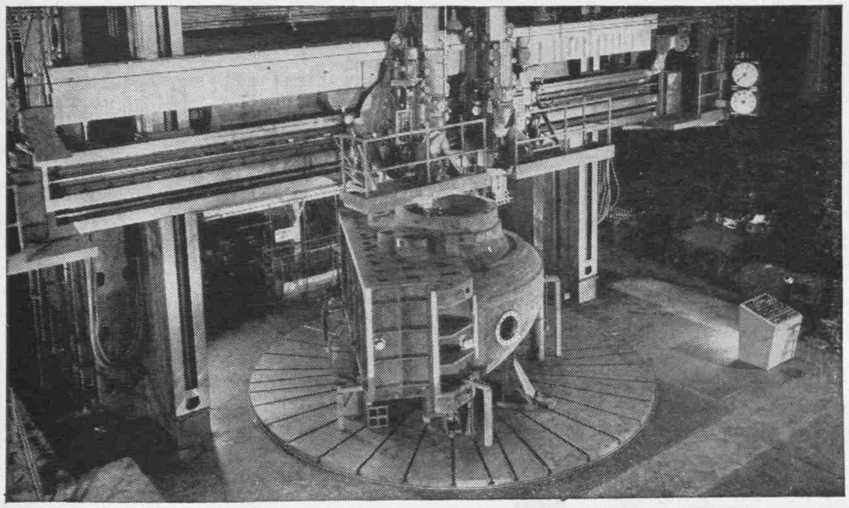
STOLEN FROM THE IOWA ENGINEER.

Behind Every Success There's PLANNING

H. V. FULLER

by H. V. FULLER, *Supt. Time Study and Planning Dept.*
General Machinery Division, ALLIS-CHALMERS MANUFACTURING COMPANY (*Graduate Training Course 1939*)

PLANNING is an important part of manufacturing machinery—and of building a career, too. This planning, however, must be based on information and experience. You don't always have all the facts about industry that you need at the time you leave engineering school and start planning your own future. At least, that's the way it was with me when I got my degree in Mechanical Engineering at University of Wisconsin in 1936.



New 30-ft. boring mill now operating in Allis-Chalmers' West Allis shops. It supplements older, slower 40 ft. mill, and greatly increases capacity on big, heavy work. Both mills are scheduled practically around the clock, seven days a week.

I took a job with a big manufacturer, but within a year the work I was doing ended, and my employers referred me to the Allis-Chalmers Graduate Training Course. I enrolled in 1937—and then my knowledge of industry really began to grow. There was the usual round of the plant—shops, offices, various departments—where I saw a wide range of work at first hand. I worked with steam turbines, pump testing, and on the electrical test floor. About half way through the two-year course I got really interested in the manufacturing side of the business. After four months of plant layout work I went to the Time Study and Planning Department, and finished out my course there in 1939. In 1945 I became Superintendent.

This Is the Starting Point

In this department we really start the manufacturing operation. We're given the engineering drawings and material specifications. And from this data we plan the sequence of manufacturing operations—determine the equipment and tooling required, and set up time standards for each operation.

You can get some idea of the volume of work from the fact that our West Allis Machinery Division shops ship an average of eight million pounds of finished machinery per month—representing a range of products from small V-belt sheaves to massive crushers, steam and hydraulic turbo-generating units, cement kilns, sewage pumps, motors, flour mills, and power transformers.

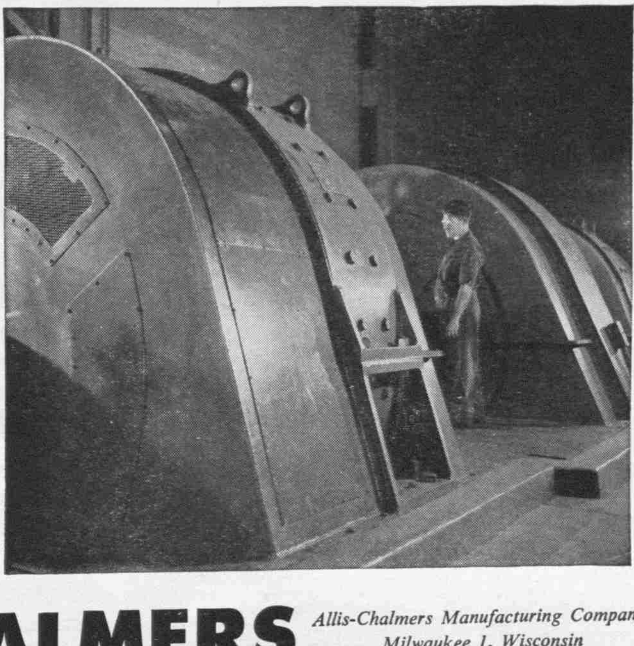
Look Before You Decide

As a Graduate Training Course engineer here you may become interested in manufacturing. There's a great need for trained engineers in this work. Or, you may find your interest lies in some other field—designing, research, sales, personnel, service and erection. In any case, the Graduate Training Course gives you a chance to look them all over, gain practical first-hand experience, plan your career on a sound basis of knowledge.

Do Your Own Planning

The course is flexible—you help plan it yourself and can change it as new interests or opportunities develop. There's no other spot in industry that offers such a wide range of experience—so many choices for a career.

If you want to get further details as to qualifications, salary and operation of the course, get in touch with any Allis-Chalmers district office. Probably the manager was a G T C himself. Or, write for literature.



One of the three 6000 kw 3-machine Allis-Chalmers motor-generator sets in large Eastern steel mill. These units provide direct current for motors driving 68-inch hot strip mill.

ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin

RADIANT HEATING

(Continued from Page 19)

In many cases, the radiator which uses up to as high as 7 percent of the room area, will interfere with furniture arrangement. Also, the low panel temperature (120° F maximum) allows full freedom of decorative treatment. Window draperies, and venetian blinds can be put up without the interference of radiators.

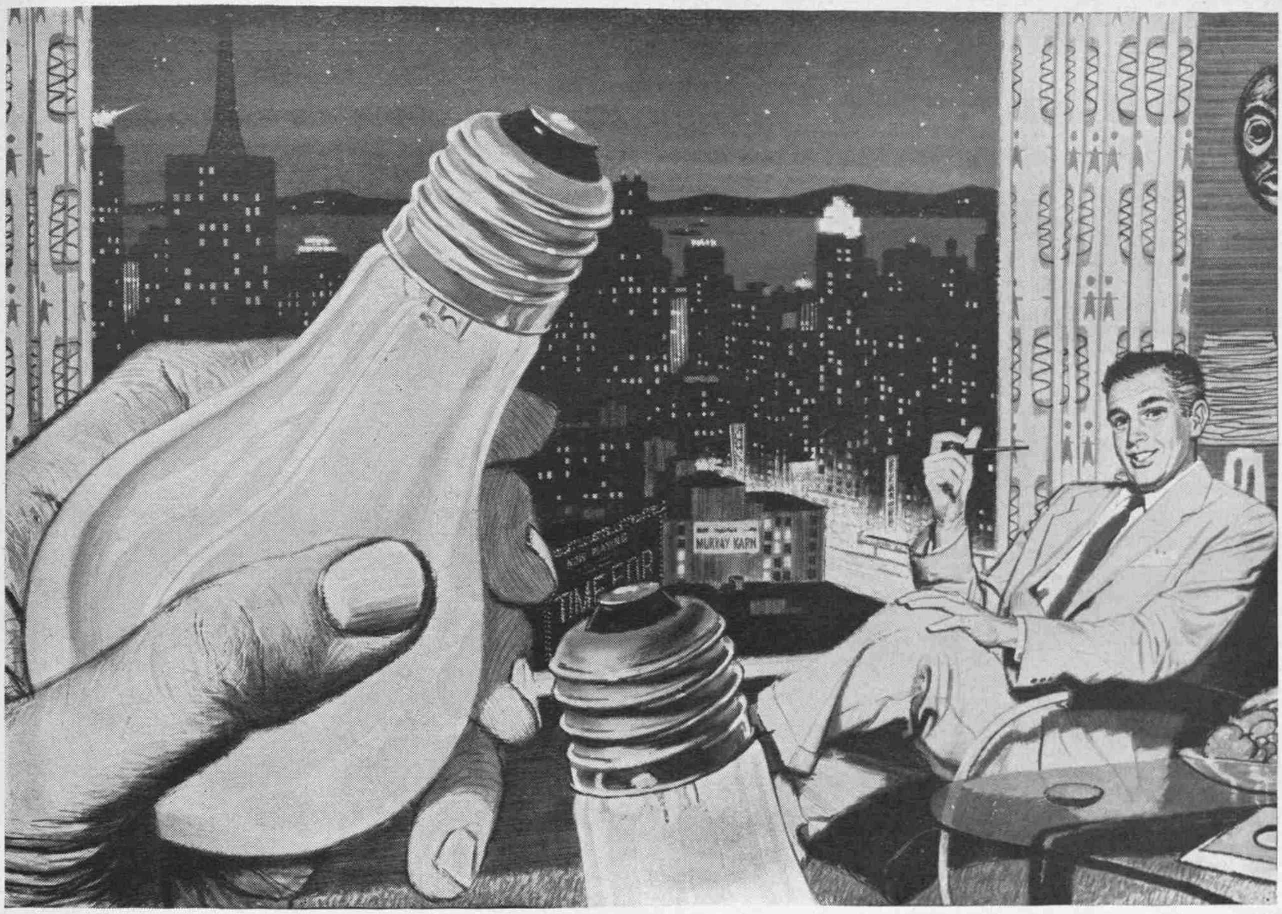
A third advantage of radiant heating resides in the fact that greater cleanliness in enclosed spaces is obtained. This is because with the lower temperature and greater areas involved in radiant heating, there are very low velocity convection currents. Everyone has noticed the discoloration that appears on walls and ceilings above conventional radiators. This effect is caused by convection currents resulting from the temperature concentration present in the radiators. The absence of these high convection currents entirely eliminates streaking and dust deposits on walls and the ceiling. With the elimination of the radiator under the window, the draperies are kept far cleaner, so that actually the time and expense involved in winter housecleaning can be reduced two-thirds with a radiant heating system.

The suppression of air currents throughout the room, as effected by radiant heating, has a direct bearing on health, not only from the stand-point of eliminating noticeable drafts, especially along floors, but also because there is far less tendency for germ-laden dust particles to be picked up from the floor and circulated about the house.

The disadvantages of radiant panel heating are, first, the high cost of installing the system. Since the conductors must be imbedded within either the floors, ceilings, or walls, suitable materials must be used to prevent the very serious condition which will occur if the pipes begin to fail because of corrosion or because of the breaking down of the material caused by strains set up by unequal expansion and contraction between the metal and the material in which it is imbedded. Heat may be carried in the form of hot air ducts, hot water pipes, steam pipes, or electric conductors. Secondly, any alterations or changes of design in the house will be either limited or become a problem after the panels are once installed.

However, the most important factor in the determination of a good heating system is in the comfort that it provides. What exactly is comfort as related to keeping oneself warm and what conditions provide for this comfort?

Comfort is defined as the condition to which an individual might be exposed which would render the temperature correcting elements of the brain quiescent. In other words, a condition that would coordinate with the body's natural heat output rate and not demand the nerves and muscles of the body to adjust to the lack of radiation or convection. Actually, no single heating system will satisfy completely this requirement. But radiant heating because of the fact that it influences the largest single component of bodily heat output, the radiation component, and because it operates with very little dependence on air temperature and, therefore, reduces air current only to that which is required for normal air circulation, is most in accordance with the three channels of bodily heat output, radiation, convection and evaporation, and exhalation. Radiant heating is, in fact, a distinctly different method of providing comfort from any of the now known systems.



Small Change adds up to Millions

Perhaps you've noticed that lamp bases, traditionally made of brass, now are being made of aluminum. There's a story behind this change and it tells a lot about the kind of jobs going on at Alcoa.

It started several years ago when engineers of two leading lamp manufacturers agreed with our suggestion that bases of aluminum would cost less. "But will they be as good . . . will we have to revise our methods?" they asked.

The potential savings, a few mills per lamp times the 830 million sold each year, made finding the answers worth-while. Together we started two long-range research projects. One, to test aluminum alloys in the weather, fumes and years of standing idle that lamps must endure. The other, to find the alloy that would take five progressive draws, then thread rolling and finally, the high temperature of the red-hot glass that is poured in the base.

We tested samples, changed alloys, varied tempers, rolled different thicknesses. Lamp manufacturers tried each, until one met all requirements. Our development men worked long hours to get the right solder and flux to join the side wire to the base. Adapted them to the high-speed, lamp-making machines.

All this time, the manufacturers had aluminum bases installed in seacoast and industrial atmospheres. Our laboratories ran other tests on lit and unlit lamps under corrosive conditions. After 1½ years the reports came in: Aluminum bases measured up in every respect: conductivity, corrosion resistance, ease of installation and removal.

This is typical of the research and development jobs now underway at Alcoa. And others are waiting for the men with the skill and imagination to tackle them. ALUMINUM COMPANY OF AMERICA, 1825 Gulf Building, Pittsburgh 19, Pennsylvania.

A business built on co-operation

ALCOA ®

ALUMINUM COMPANY OF AMERICA

NEW DEVELOPMENTS

(Continued from Page 17)

mitted through an extensive gear train, permits a maximum speed of four feet per minute when the main hoist is under full load handling the spillway gates.

Also there is an auxiliary trolley, with hoist that can handle 15-ton loads at approximately 20 feet per minute. Counter torque AC control with wound rotor motors is employed. This hoist will be used to pick up debris lodged against the up-stream face of the dam, and to service the deck.

★ ★ ★

STUDY OF RADIOACTIVE MATERIALS

Deadly radioactive materials, hidden behind a thick concrete wall, can now be safely studied and photographed under a microscope by atomic scientists, using a new instrument.

The instrument is a special microscope for examining the structure of metals, combined with camera, periscopes and an illuminating system, in such an arrangement that light can get in and out through the thick walls of the test chamber, but dangerous radiations from the radioactive specimens are completely blocked.

Operated by remote control, the instrument permits atomic researchers to work in complete safety. A system of remotely controlled "mechanical hands" are used to place the specimen in position, and to remove them after examination.

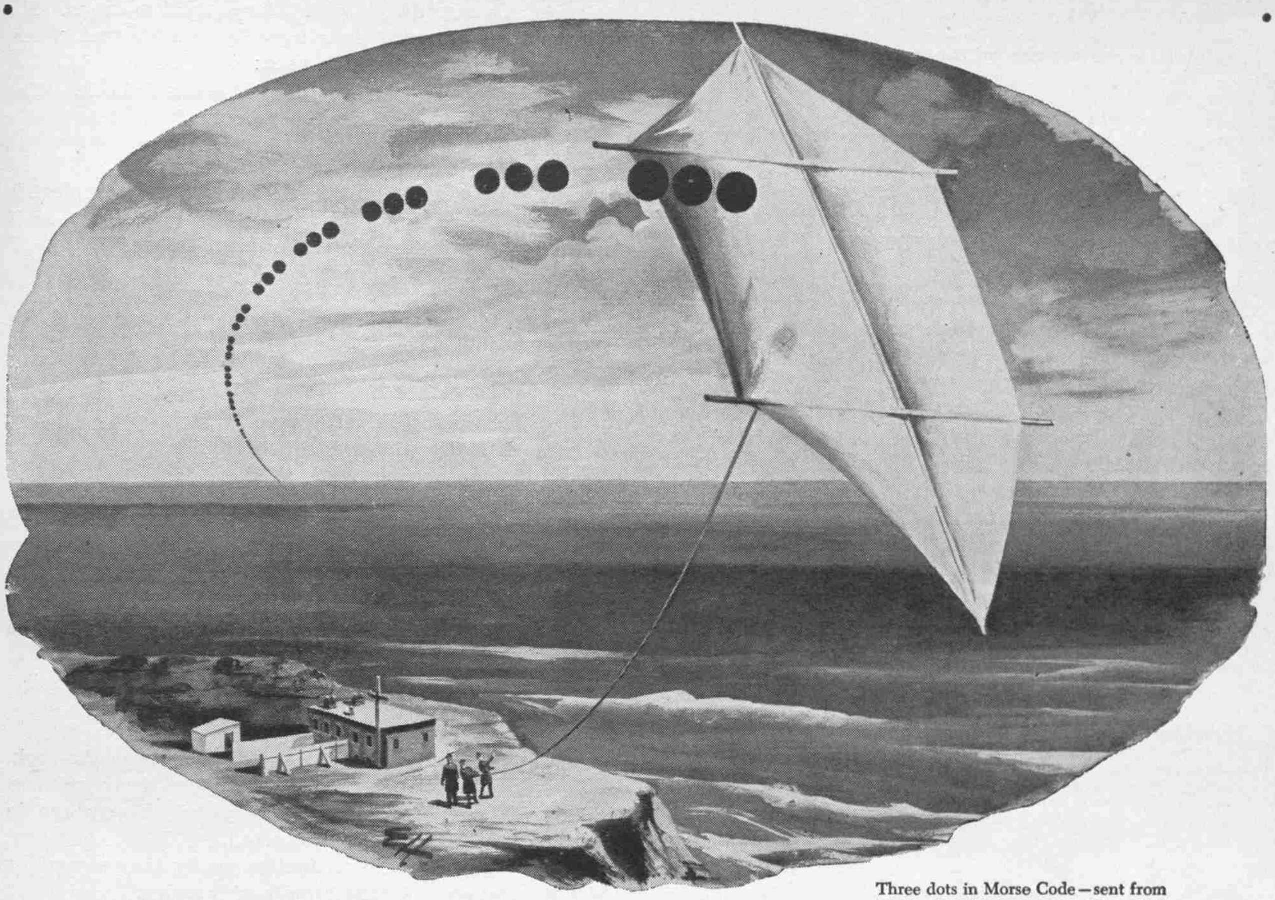
Light for illumination of the specimen comes from an arc lamp outside the thick-walled test chamber, and goes into the chamber through a lens system placed in a tubular hole through the wall. The light is reflected from the specimen, and comes out again through another series of lenses, to form the magnified image.

Both lens systems are offset by means of mirrors, which change the light path from horizontal to vertical, and then back to horizontal again. Radio-active radiations from inside the test cell are not reflected and cannot get around the offset. If the tube were straight, however, they might be able to emerge through the opening for the lenses.

In using the microscope, which extends into the test chamber, the specimen is placed on the microscopic stage. Looking through a single eyepiece, the operator employs the remote controls to get the specimen adjusted and properly focused. Then the visual eyepiece is exchanged for a photographic one, and the camera is swung into position to make the photograph.

At the lowest power, the instrument shows the specimen in its actual size, without any magnification, whereas 1,000 diameters magnification may be obtained with the highest power. These different powers are achieved by the use of several objective lenses for the microscope, which are mounted on revolving turret and can be swung into place, again by remote control, as desired. The objectives are so adjusted that it is not necessary to refocus when changing from one power to another.

Polarized light, consisting of vibrations in a single plane, as opposed to ordinary light in which the vibrations are in many different directions, is invaluable in the study of metals, and may also be used. This is made possible by a light-polarizing slide in the path of the light from the illuminator. By remote control the slide may be placed in or out of position as desired.



Three dots in Morse Code—sent from England and received by Marconi in Newfoundland—proved that wireless signals could span the Atlantic.

Three dots that opened a new era!

When Marconi, on December 12, 1901, heard a "3-dot" radio signal—the letter "S" in Morse Code—across 1,800 miles of sea, it was an experimental triumph that opened a new era in communications.

Before this historic event, wireless telegraphy had been limited primarily to communications between the shore and ships at sea. Marconi's success, however, was the forerunner of many other developments which led eventually to RCA world-wide radiotelegraph service that now operates more than 80 direct circuits to 67 countries.

As radio progressed, its usefulness was expanded by invention and development of the electron tube, the harnessing of short waves which made world-wide transmission a reality, and the automatic transmission and reception of messages at high speed.

Radio, with its magic of spoken words and music broadcast over the world . . . *television*, the miracle of pictures in motion transmitted through the air . . . these mediums of modern communications have added notable links in the chain of electronic advances first forged in 1901 from the mere sound of three dots.

* * *

See the latest wonders in radio, television, and electronics at RCA Exhibition Hall, 36 W. 49th St., N. Y. Admission is free. Radio Corporation of America, RCA Building, Radio City, New York 20, N. Y.

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 College Relations 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

SIDETRACKED

Skeleton—a stripteaser who overdid it.

★ ★ ★

Landlady: "A chemist formerly occupied this room, sir. He invented an explosive."

New roomer: "Ah! I suppose those spots on the ceiling are the explosive?"

Landlady: "No. Them's the chemist!"

★ ★ ★

An old Indian couple who had never been off the reservation before decided to have a fling, take a vacation, and stay at a white man's hotel.

Their first night there the old brave awoke and growled, "Ugh, me heap thirsty—go get water." The squaw obediently padded down the hotel corridor and disappeared; soon she came back with a little envelope of water. Satisfied, he returned to sleep but woke up later and made the same request again. The squaw uncomplainingly got up and went down the corridor again.

After a long time she returned empty-handed. The brave scowled at her, "Ugh, why no water?"

"Ugh, heap big white chief sitting on well."

★ ★ ★

Horatio: "We're not making any money on this amphitheater."

Nero: "Yeah, the lions are eating up all the prophets."

★ ★ ★

A street cleaner was fired for daydreaming—he couldn't keep his mind in the gutter.

While out of town, a stingy husband sent his wife, as a token of his affection, a check for a million kisses. His wife, a little annoyed that the gift wasn't a real check, sent back a postcard which read:

"Dear Jim: Thanks for the birthday check. The milkman cashed it for me this morning."

★ ★ ★

Lonely baby chick taking a look around the electric incubator full of unhatched eggs: "Well, it looks as if I'll be an only child. Mother's blown a fuse."

★ ★ ★

Answer to question on physics test: A meter is the distance between two bars in Paris.

★ ★ ★

Fie upon thee, little man
With thy slide rule in thy hand;
Seated at your work all day
While your roommates drink and play;
Throw away your cams and charts
Now's the time to switch to arts.

★ ★ ★

"You don't love me any longer. I'm going home to mother."

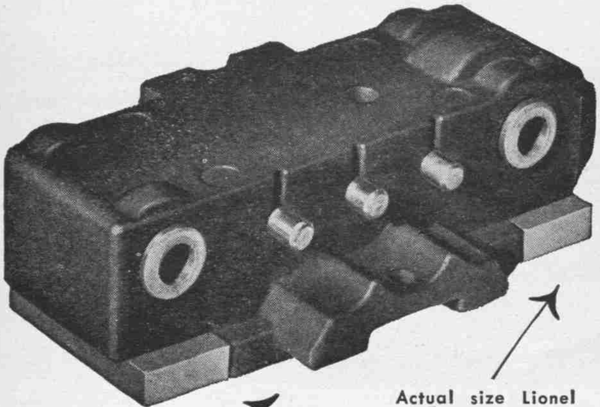
"Don't trouble yourself. I'll go home to my wife."

★ ★ ★

Just as the bus was about to pull away from the curb, a feminine voice was heard pleading, "Just a minute, please. Wait till I get my clothes on." Every eye in the crowded bus swivelled expectantly. What they saw, however, was merely an attractive young lady struggling onto the bus with a large bundle of laundry.

What's Happening at CRUCIBLE

about permanent alnico magnets



Actual size Lionel truck body showing two Crucible alnico bar magnets in place.

Lionel uses Crucible Alnico in new locomotive design

The Lionel Corporation, big name electrical toy manufacturer, has pioneered in the design of miniature locomotives for table-top railroading. One of the principal aims of this design is to achieve the highest possible degree of adhesion between the driving wheels and the track.

Lionel experimented with a conventional method of increasing the traction (i.e. load up the driving axles with ballast weights) . . . and then turned to magnetic materials.

Crucible alnico specialists were called in. Working in close cooperation with Lionel engineers, the Lionel "Magne-Traction" locomotive was born. As the name implies, "Magne-Traction" utilizes magnetic attraction between powerful Crucible alnico bar magnets placed in close proximity with the wheels.

By varying the number and strength of the magnets, almost any desired degree of adhesion can be obtained. In laboratory tests a light-weight plastic "Scout" locomotive whose normal train load is 4 cars, was able, after installation of proper magnets, to pull a train of 24 cars, an improvement of 600%. A heavy miniature locomotive

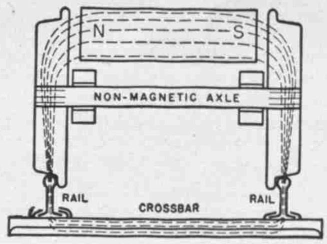


Diagram shows how magnetizing force is supplied by external stationary Crucible permanent magnet and non-magnetic axle. Wheels are sintered steel.

pulled 28 cars instead of its usual load of 7 cars. Then too, locomotives unable to start a normal 4 or 5 car train on greater than 1 degree slope were able with the special magnet assembly to pull them from a dead start up a 5° slope, while the new twin-motor Lionel Pennsy GG-1 scooted up a 15° slope (i.e. 37% grade) without any apparent difficulty.

Crucible's part was twofold. Not only were Crucible metallurgists and engineers active in the initial design, but Crucible production experts precision cast these bar magnets using plastic patterns. This is an innovation in alnico magnet mass production. Commonly, alnico is made in sand molds, and usually requires a great deal of finishing, but with precision-cast alnico magnets expensive machining is cut to a minimum.

Engineering Service Available

Your permanent magnet problem will receive the same experienced consideration from Crucible's unsurpassed staff of metallurgists and production specialists. Please give full details. Crucible Steel Company of America, General Sales Offices, Oliver Building, Pittsburgh, Pa.

CRUCIBLE first name in special purpose steels

52 *years of Fine steelmaking*

Midland Works, Midland, Pa. • Spaulding Works, Harrison, N. J. • Park Works, Pittsburgh, Pa. • Spring Works, Pittsburgh, Pa.
National Drawn Works, East Liverpool, Ohio • Sanderson-Halcomb Works, Syracuse, N. Y. • Trent Tube Company, East Troy, Wisconsin

Little Johnny, with a grin
Drank up all his father's gin;
His mother laughed to see him plastered,
Said, "Come to bed, you little darling."

★ ★ ★

A frosh was getting ready to go to a dance, and his house mother noticed that he got dressed in record time. "Son," she asked accusingly, "Did you take a bath?"

"No mom," came the reply.

"Now listen, son," she demonstrated. "You wouldn't go to a dance without taking a bath, would you?"

"Sure," replied the frosh. "It isn't formal."

★ ★ ★

Ohm to Amp—"Wire you so revolting?"

★ ★ ★

An enemy, I know, to all
Is wicked, wicked alcohol.
The Good Book, though, commanded me
To learn to love my enemy.

★ ★ ★

Bars are something which, if you go into too many of, you are apt to come out singing a few of, and maybe land behind some of.

★ ★ ★

Beginner at fishing: "Oh, I've got a bite. What do I do?"

Her husband: "Reel in your line."

Beginner: "I've done that, the fish is tight against the end of the pole. What do I do next?"

Helpful husband: "Hold it, I'll climb up the rod and stab it."

A woman surprised her husband in a bar, sampled his drink, make a wry face and demanded, "How can you drink such horrible stuff?"

"See!" exclaimed the husband with injured dignity. "And all the time you thought I was having fun."

★ ★ ★

Bride: "What's the best way to protect a wedding ring?"

Mother: "Dip it in dishwater three times a day."

★ ★ ★

"Has your boy friend's English improved any?"

"Well, he still ends every sentence with a proposition."

★ ★ ★

An Englishman was conversing with a clerk in the Ambassador Hotel. "Here's a riddle," said the clerk. "My mother gave birth to a child. It was neither my brother nor my sister? Who was it?"

"I can't guess," said the Englishman.

Clerk: "It was I."

"Haw! Haw!! Very clever—I must remember that."

The Englishman then told the story at his club: "Here's a riddle, old chap. My mother gave birth to a child who was neither my brother nor my sister. Who was it? What? You can't guess. Do you give up?"

"Yes."

"Haw! It was the clerk at the Ambassador Hotel."

★ ★ ★

Most of us make good money, but not enough of it.

★ ★ ★

Applicant: "I'm Gladys Zell."

Personnel Manager: "I'm happy myself. Have a seat."

We conducted a poll* of '41 graduates to find out

HOW HAVE THEY MADE OUT IN 10 YEARS WITH GENERAL ELECTRIC?

Here are the results:

1. TRAINING. On the average, college graduates who came with General Electric in 1941 have taken between three and four Company-run training courses. Some have taken as many as seven. These have included courses in business management and accounting, in sales, manufacturing, and in many phases of engineering. Graduates report that this training has been a big help in furthering their careers. As one expressed it: "These courses are essential to certain fields of endeavor—so essential I am still signing up for additional courses."

Other comments: "These programs are not the purely academic ones of school days. They are practical, interesting, enable one to do a better job and enjoy it more." "The G-E Sales Training Program was definitely instrumental in helping me find my present position." The training programs have been a very essential link between my college training and my present work." "I wish I could have known then how valuable these courses were going to be later." "They confirmed my original opinion that G.E. offered the best training for engineers."

2. EXPERIENCE. These graduates have had an average of three different rotating assignments in various phases of the Company's work. A typical example included assignments in radio test, in motors and generators, and in the industrial control development laboratory. Graduates express three main benefits derived from the G-E rotational job programs:

a. They provided opportunities for deciding on a definite field of interest. Typical comment: "I didn't know what kind of work I wanted to do. Rotating assignments helped me make up my mind."

b. They complemented college training with practical experience. "They helped me realize methods of manufacture and testing of different apparatus."

c. They provided valuable associations and contacts. "Changing jobs five times brought me a variety of friends and contacts I'm still grateful for."

3. PROGRESS AND ADVANCEMENT. 88 per cent reported that they felt their progress in General Electric has been satisfactory. Nine per cent described their progress as "average, so-so," with three per cent reporting "unsatisfactory."

Comments: "It's been no Horatio Alger success story, but I feel pretty good about it." "If next 10 years have the same trend, will be very happy." "Satisfactory and entirely fair." "I don't know anyone on the outside who has done any better in the same time." "Satisfactory. I've been a G-E salesman, field engineer, and am now group leader in a G-E design engineering department." "I have felt like a kid in a candy story owned by his father. There are lots of choices and his only problem is to pick out what he likes best."

***Facts and statements in this advertisement were compiled from a questionnaire submitted to '41 graduates still with General Electric. Participants returned questionnaires unsigned, enabling them to be full and frank in their answers.**

You can put your confidence in—

GENERAL ELECTRIC