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The Wisconsin engineer

January, 1949

In This Issue:

15¢

World's ***first***
Continuous Seamless Tube Mill

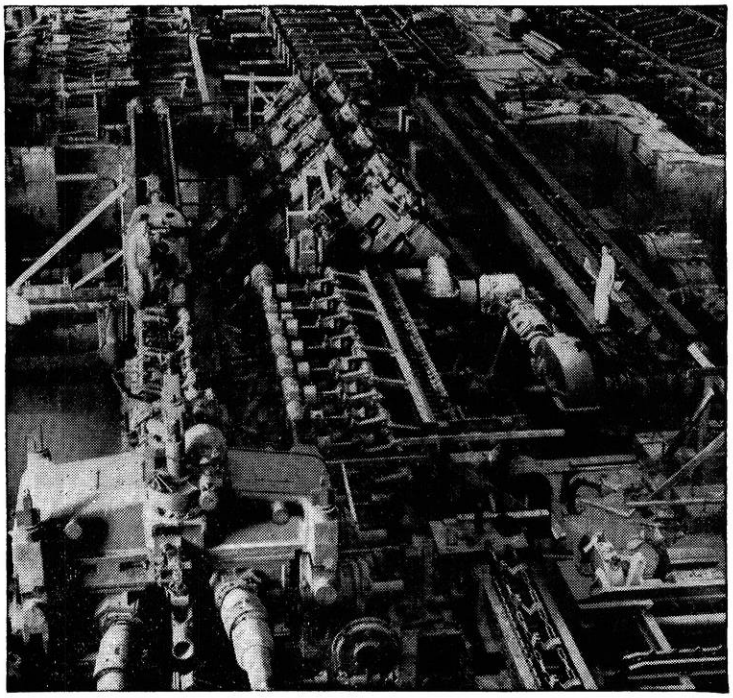
—National Tube Company
develops revolutionary new mill design

2,000 feet of seamless pipe a minute! That's what the world's first continuous seamless pipe mill will turn out upon completion.

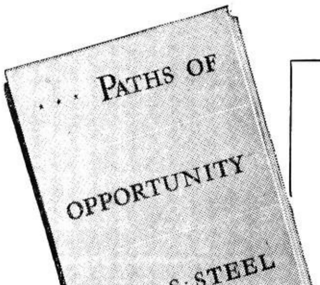
Developed by National Tube Company—U.S. Steel Subsidiary—at its Lorain, Ohio Works, the mill has already been referred to as "one of the greatest advances in the steel industry during the past 50 years."

The new continuous process it features will eliminate several steps in the conventional method of making seamless pipe and will be comparable to that of continuous strip and sheet mills. Designed to produce sizes ranging from 2 inches to 4½ inches OD, the mill not only will provide quality products at lower cost, but greater service to the consumer.

This revolutionary seamless mill design is another demonstration of National Tube Company's position of leadership in providing industry with both quality and quantity products.



Construction view showing 9-stand Rolling Mill and Inlet and Outlet Conveyors.



Opportunities

The spirit behind this latest National Tube Company development typifies the spirit behind projects being conducted in all United States Steel Corporation Subsidiaries. It is a pioneering spirit—one that requires qualified men in all branches of engineering. See your Placement Officer for a copy of "Paths of Opportunity in U.S. Steel" if you would like to take part in these fascinating and important developments.

AMERICAN BRIDGE COMPANY · AMERICAN STEEL & WIRE COMPANY · CARNEGIE-ILLINOIS STEEL CORPORATION · COLUMBIA STEEL COMPANY
H. C. FRICK COKE AND ASSOCIATED COMPANIES · GENEVA STEEL COMPANY · GERRARD STEEL STRAPPING COMPANY
MICHIGAN LIMESTONE & CHEMICAL COMPANY · NATIONAL TUBE COMPANY · OIL WELL SUPPLY COMPANY · OLIVER IRON MINING COMPANY
PITTSBURGH LIMESTONE CORPORATION · PITTSBURGH STEAMSHIP COMPANY · TENNESSEE COAL, IRON & RAILROAD COMPANY
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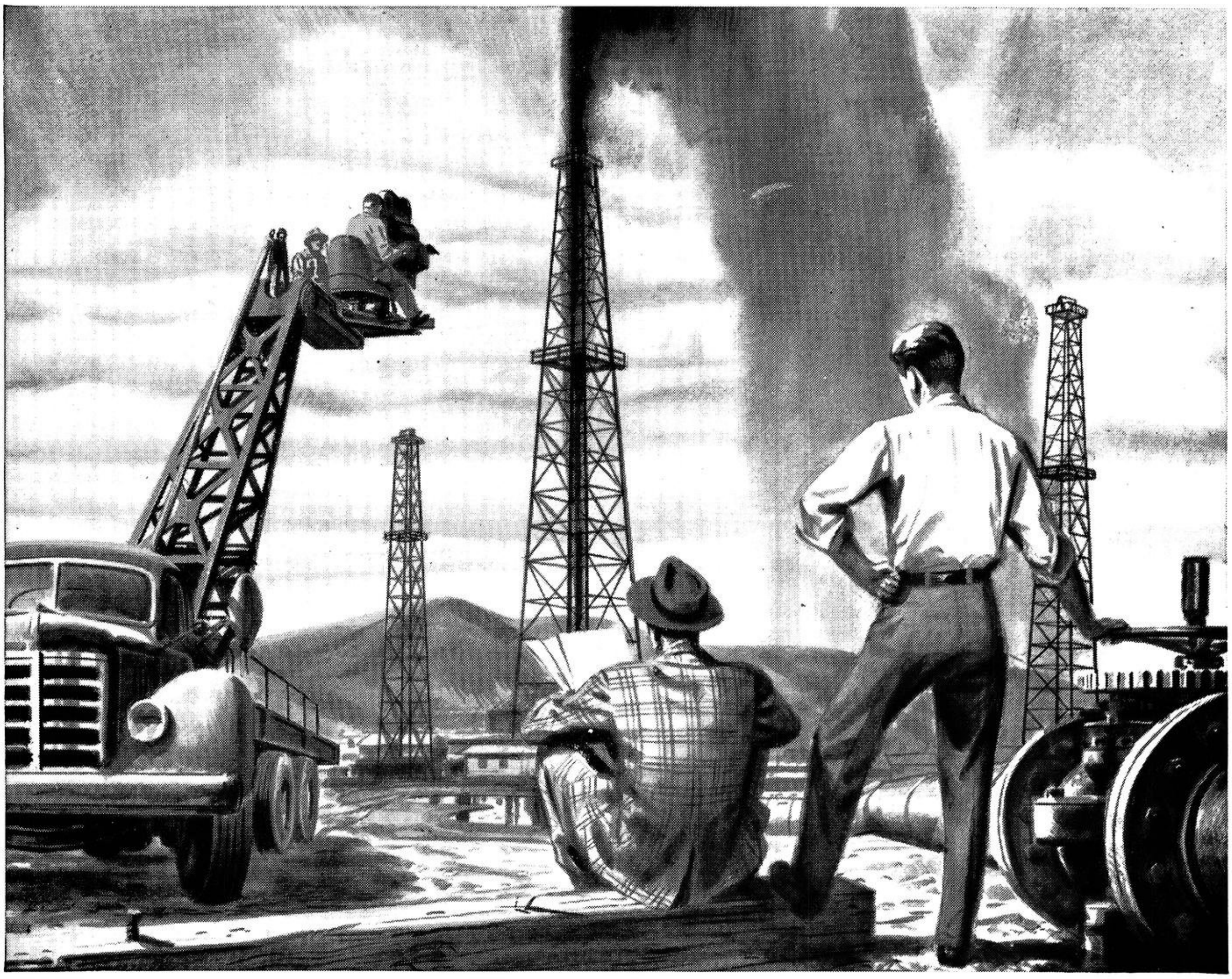
UNIVERSAL ATLAS CEMENT COMPANY · VIRGINIA BRIDGE COMPANY

USS

UNITED STATES STEEL



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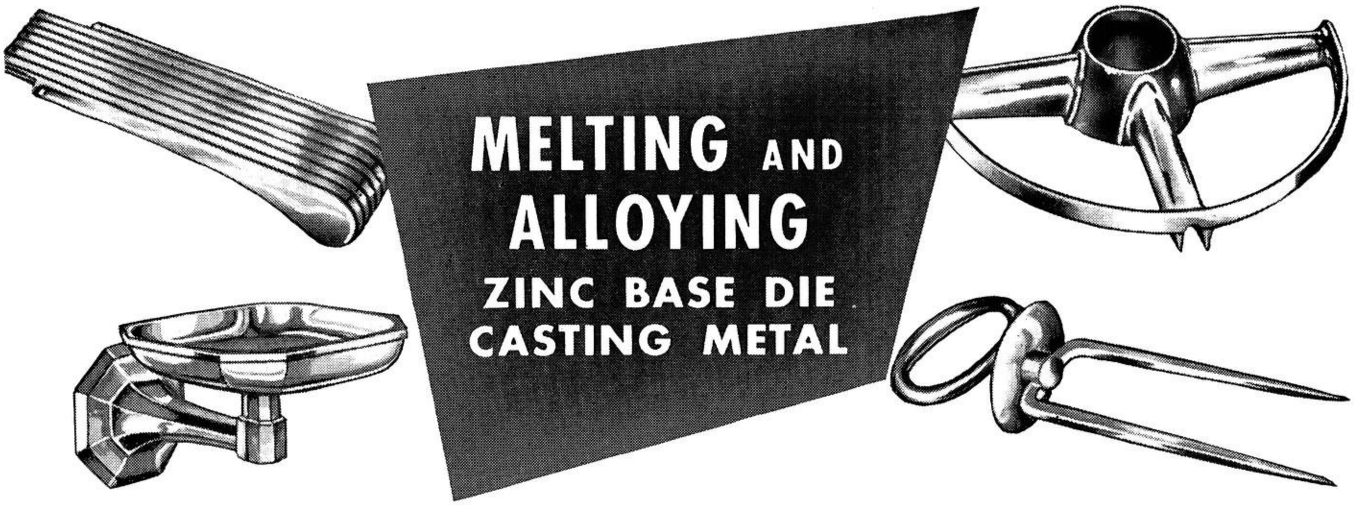
In This Issue . . .

COVER: (*Cut courtesy Westinghouse*)

"Greased skids" for lightning are the three 29-foot-high legs of this gigantic "tripod"—actually the world's largest lightning arrester—built by the Westinghouse Electric Corporation.

Articles:

Departments



Reverberatory Furnace Operations

GERITY-MICHIGAN CORPORATION

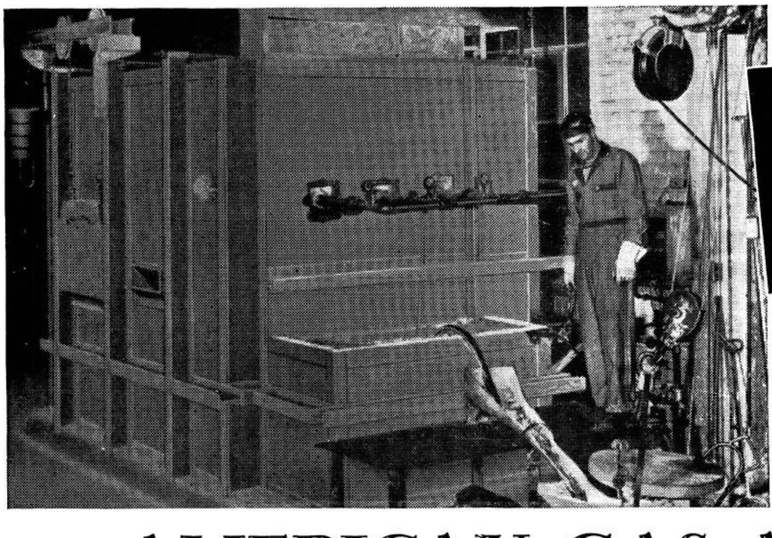
Demonstrate High Temperature GAS Firing Technique

REVERBERATORY FURNACES designed to increase the production of zinc base die casting alloys have expanded melting and alloying capacity almost 50% over conventional pot melting. At Gerity-Michigan Corporation, Detroit, these Gas-fired furnaces operate on practically continuous schedules with savings of 35% to 40% based on time-saving methods and more efficient fuel utilization.

This application demonstrates the flexibility of GAS for industrial heating processes in high temperature ranges. But it also emphasizes the role of GAS in the development of production-line equipment for non-ferrous metals.

R. L. Wilcox, metallurgical engineer and Vice President of Gerity-Michigan Corporation describes the furnace and its application—**"This 18-ton Gas-fired reverberatory furnace has the advantage of extended service life, more efficient fuel utilization, closer temperature control, simplified alloy analysis."**

Regardless of the type of heating operation or heat-treating process, GAS is the ideal fuel for any temperature requirement, or any production-line application. The characteristics of GAS—speed, flexibility, economy, controllability—are useful features for every industrial heating need. In view of rapid developments it's always worthwhile to keep your eye on what's new in Modern Gas Equipment.



MORE AND MORE...

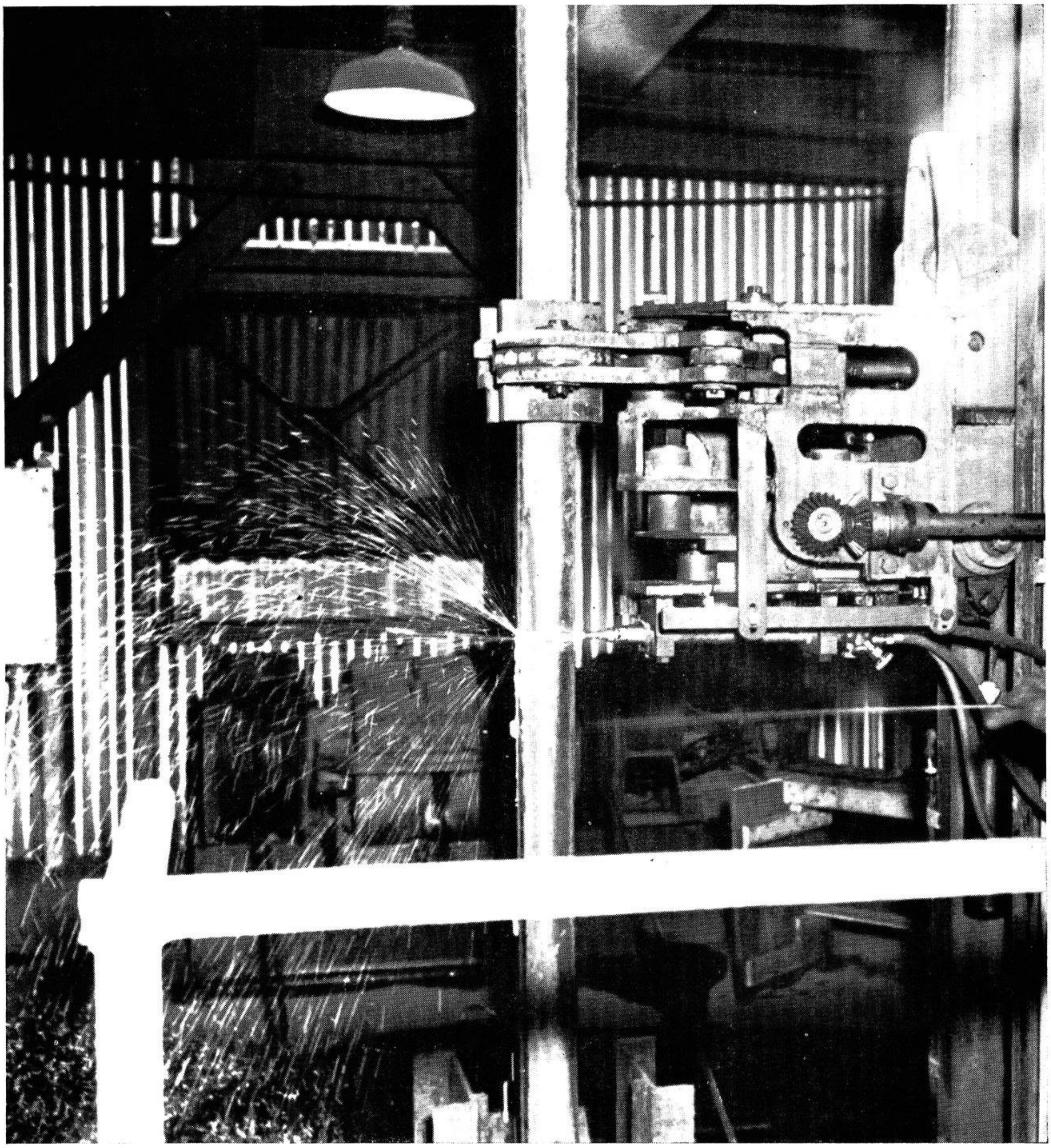
THE TREND IS TO GAS

FOR ALL
INDUSTRIAL HEATING

Gas-fired reverberatory furnace designed and constructed especially for melting and alloying zinc base die casting alloys at Detroit Die Casting Division.

AMERICAN GAS ASSOCIATION

420 LEXINGTON AVENUE NEW YORK 17, N. Y.



A view of the last operating device in the series used for the continuous casting of steel. Below the mold, pinch rolls control the rate of travel of the casting to the cradle. When the lower end reaches the cradle, the oxy-acetylene torch shown cuts the casting to the desired length, moving along with the casting until the cut is complete.

Continuous CASTING

by Russell Pipkorn m'49

From molten steel to semi-finished steel billets in a simple inexpensive machine at the rate of 400 pounds a minute is the story now being enacted at the plant of Babcock & Wilcox Tube Co. at Beaver Falls, Pennsylvania. All of the operations take place in a 75 foot tower taking up approximately 1100 square feet. This development, a joint project of Babcock & Wilcox and Republic Steel Corporation, has opened new paths of solution for the objectives of the steel industry—greater decentralization and increased productivity.

The first carload of rolled bars made from continuously cast billets was shipped March 18, 1948—a date which no doubt will be remembered in the steel industry for a long time. This first batch consisted of 45 tons of 0.15 carbon steel. It was not, however, the first that had been cast, since several years of research and development had gone into this plant, and many experimental runs of both carbon and alloy steels were tried.

Advantages of New Method

The greatest gain in this method is the reduction in capital required for equipment. In the conventional method, ingots are first cast and allowed to cool. A sizable discard is removed and the ingot reheated in soaking pits where millions of B.t.u.'s are absorbed. Then the ingots are hammered, pressed or rolled into semi-finished shapes requiring gigantic blooming or slabbing mills. All this equipment requires acres of floor area for casting and semi-finishing. The continuous casting setup requires only a small space and a very much smaller investment in equipment. Thus this development fills the requirements of low capital, particularly in these days of doubled or tripled costs, and low operational costs.

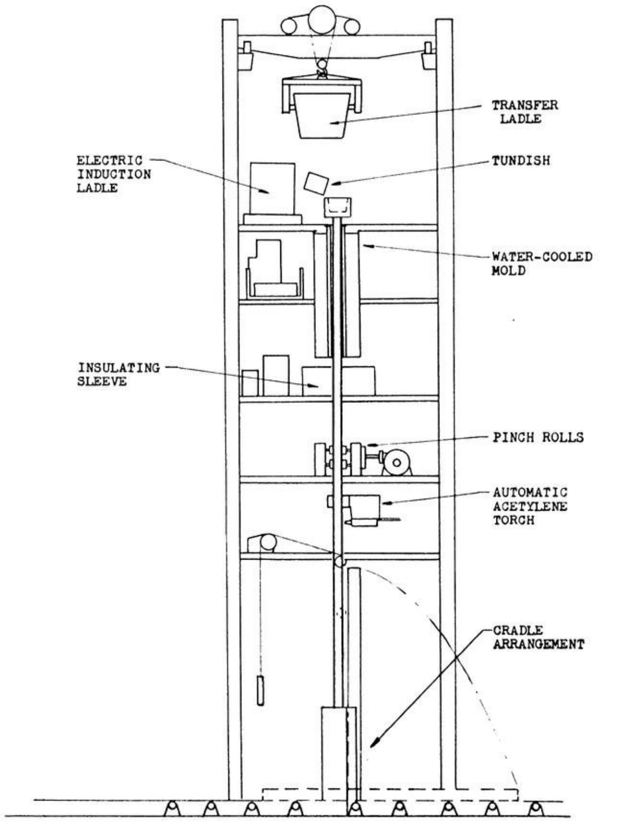
Economic pressure on the steel making industry has influenced this idea of smaller local units serving a particular area. Mr. T. W. Lippert of Iron Age has illustrated this idea. "Population areas of some two million people normally can consume in small-section products—flats, wires, rods, shapes, etc.—from 7,500 to 15,000 tons of steel monthly in the immediate locality. This would be an attractive load for a small mill. Furthermore the scrap generated in the same area would normally be quite sufficient to sustain operations in the same plant." Continuous casting fulfills this need of decentralized operation.

Continuous Casting Not New

Continuous casting is now being successfully used in production for casting non-ferrous metals, and has been a routine industrial practice for the past ten years. The art began over one hundred years ago, in 1843 when J. Laing received a patent on a machine casting soft metal tubing in a mold containing a vibrating mandrel. Its success is doubtful, but the idea was there to be carried on. Through numerous developments and ideas, some successes and many failures, today's simple, fast and foolproof continuous casting machines for non-ferrous metals are available. These machines have progressed from massive complex machines to those used today, relatively inexpensive and very simple.

The heart of the entire operation is the mold into which the metal is poured. Because of the low melting temperatures and relative prices the continuous casting process first developed for production in the non-ferrous field. Solids of many cross sections and many materials are cast today—from one inch copper rods to 6 x 24 inch aluminum slab ingots. The non-ferrous machine casts the metal through a short water cooled mold usually not over a foot in length. Water is sprayed on the billet below the mold to prevent the billet from softening again due to the still molten interior some distance below the mold.

This operation is generally performed on a 24 hour basis. It is clean and orderly as compared to old methods. The metal is actually of superior metallurgical quality and

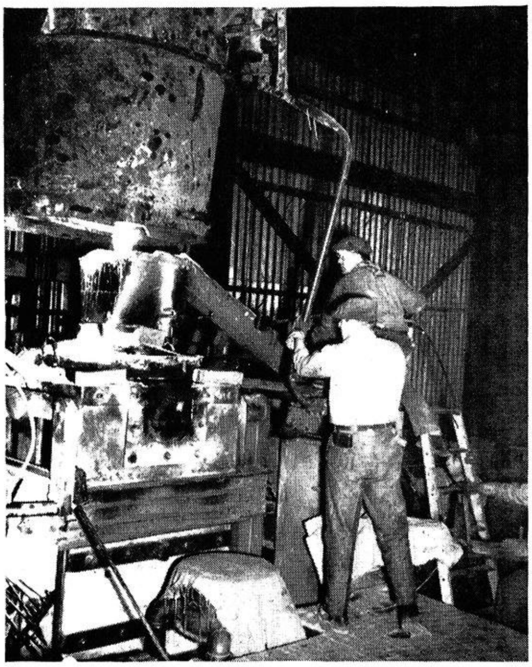


Schematic drawing of the main elements of the continuous casting equipment as now set up.

its surface finish requires only light finishing operations.

Evolution of Continuous Steel Casting

The actual beginnings of the successful continuous cast steel operation began about six years ago, when the Republic Steel Corporation began its development work under the Williams Patents. In 1944 the Babcock & Wilcox Company and Republic began their discussions which led to a formal agreement in 1946. Then came the experimental plant at Beaver Falls which was established to experiment with standard commercial sections. From this plant came the first successful commercial steel billets.



Molten steel being transferred from the regular electric furnace by transfer ladle to the inductively heated holding and pouring ladle.

Because of the possibilities, and necessities, other companies have entered the field in the experiment. Many developments, however, are either dormant at present or of little success. The Babcock & Wilcox-Republic combination has been successful because of the knowledge and experience of the former company in the field of heat transfer at high rates and the latter company's knowledge of the steel industry.

The British, too, because of the necessity to modernize their facilities, are investigating its possibilities and have continued on their own rather than depend on the American efforts.

Successful Process

The Beaver Falls plant casts an eliptical section of about thirty square inches at a rate of 400 pounds per minute. Casts are made two or three times a week.

The operation begins at the top of a 75 foot tower where steel is delivered from the company's regular electric furnaces by transfer ladle to an inductively heated holding and pouring unit. The usual supply is 5,000 pounds per cast.

The molten metal is poured from the holding ladle into a tundish which is designed to strain out the slag, and then enters the water cooled mold. The important factor for the successful operation of the mold is that it must not be wetted by the steel. To accomplish this the steel must have a strong negative meniscus (like mercury). This is an indication that the mold is clean and the process is properly functioning. This condition is checked by a mirror arrangement above the mold.

A small amount of hydrocarbon is introduced in the mold to eliminate free oxygen above the mold, because any oxide present promotes wetting. Argon, because of its high density and inactivity with iron, is introduced above the liquid to prevent oxidation. The steel is in contact wth the mold for only a few inches since, as it cools, the metal shrinks away from the mold. The steel loses heat by conduction only while it is in contact with the mold and by radiation and conduction below the shrink point. This latter process is aided by the gas which fills this gap between steel and mold. This gas has been analyzed and found to be about fifty per cent hydrogen. The steel must get its strength to withstand further movement and surface quality while in contact with the mold.

From the mold the metal passes through an insulated chamber which arrests and controls the speed of further cooling. Below this chamber is the mechanism which controls the rate of withdrawal of the steel billet. The billet passes an oxy-acetylene torch which moves along with the billet for a short distance while the billet is being cut to a specified length which could be as long as 35 feet. The cut-off section of the billet is then lowered into a horizontal position by a special cradle arrangement. The billets are then ready to proceed to the finishing operations.

Problems Encountered

The mold, as was mentioned, is the basis for a good billet. The mold surface must be smooth and remain clean throughout the operation. A number of metals have been tried and successfully used. The thicknesses of the material, however, depends upon the rate of heat conductance. One-sixteenth inch steel, one-quarter inch copper and three-sixteenth inch brass have been used. Stainless or heat resisting steels, seemingly logical choices, were unsuccessful because they have wetting characteristics. Brass has been found to have the best structural and fabricational advantage. Cooling must be supplied to the mold in such a manner that the coolant is in contact on all surfaces. In order that proper cooling was obtained—no deterioration of the mold and reasonable casting speeds—water flows as high as 500 gallons per minute were used, giving only a few degrees of temperature rise. A special system of flow design was required to prevent cavitation in the mold.

Slag influences the quality of the steel. To eliminate it the tundish was placed between the pouring ladle and mold. Originally a preheated tundish was used, but with this type the metal has a tendency to begin freezing since the slower it moves through the tundish, the better is the slag elimination. A new electrically heated tundish will solve the freezing problem and increase slag elimina-

(please turn to page 20)

Flame-Cut Gears

by Russell Henke m'49

One of the most interesting phases of industry is the constant changing and improvement of methods and processes which constitutes progress in the field of manufacture. It is by such advancement that we have progressed from the model T to the modern automobile; from the old battery radio sets to modern television.

Again, by technical advancement, the gear and sprocket industry has been presented with a method of manufacturing their products which differs as much from the old techniques as did the model T from the new car, or the battery radio from television; namely, flame machining. Flame machining, as developed by Glenway Maxon, Jr., of Milwaukee, Wisconsin, is simply the process of cutting gears and sprockets from steel plate to a high degree of accuracy by means of oxy-acetylene cutting torches.

Before going into a more detailed description of the flame machining process, let's look at the general procedure for making a gear or sprocket by the methods now employed.

Since most gears and sprockets are cast into blank shape before being machined, a foundry is necessary with all its incumbent processes. First the pattern must be made for the blank; then the mold is rammed up and the necessary cores made and baked. Following this the mold and cores are assembled, moved to the pouring floor, and the metal, which first must have been melted, is poured into the mold. After this the blank must be shaken out of the mold and cleaned to remove sand and other extraneous material. Then the risers must be cut off, and finally the gear or sprocket blank is ready to go to the machine shop.

The use of all this equipment in the foundry presupposes the initial cost of purchasing the equipment, upon which is superimposed the maintenance costs.

In the machining of the gear or sprocket any one of several methods may be used, such as, hobbing, milling, or shaping. It seems odd that the actual operation of machining, which is ordinarily thought of as **the** making of a gear or sprocket, should actually constitute only a fraction of the total operations.

Now we can take a look at the flame machining process, keeping in mind the preceeding description for comparative purposes.

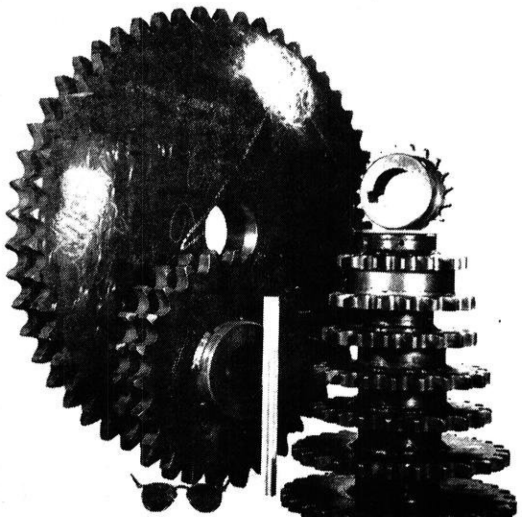
The flame cutting machine itself consists of a bed upon which the driving and cutting components are mounted. The cutting device is an oxy-acetylene cutting torch held in a bracket mounted on rollers running on a track, allowing back and forth longitudinal motion of the torch relative to the gear or sprocket blank.

The blank is positioned on a spindle which rotates at the same time that the torch is moving back and forth, the two motions being coordinated by a set of cams and driven through a set of back gears on the machine. It is the combination of rotation of the blank and longitudinal motion of the torch that produces the proper tooth contour.

There are two cams in the set which help to control the tooth shape; the contour cam and the speed cam.

The contour cam is accurately plotted from the shape of the gear or sprocket tooth itself. The torch bracket is indirectly connected to the contour cam by means of a pantagraph lever arrangement which rides on the cam. As the cam revolves, the cam rider roller imparts the motion to the pantgraph arm which, through the pantagraph linkage, causes the back and forth motion of the torch carriage.

In order that the tooth surface be smooth and not burned in some places while uncut in others, the torch should cut at constant speed. This function is performed by the speed cam, which is plotted from the gear tooth contour in such a manner that as the torch moves back and forth radially in relation to the blank and the blank revolves, the net relative motion of the torch along the cutting line is constant. In order to accomplish this feat the speed cam arm is connected to a constant speed motor drive which varies the speed as required.



(Photo courtesy Cogmatic Co.)
Flame-cut gears.

The pantagraph linkage mentioned previously is adjustable to permit the machining of an infinite number of sizes of teeth, within the limits of the machine. Furthermore, it is marked so that the exact pitches for sprockets or gears which are standard today can be set immediately. This increases the utility of the machine, since the machining device for large size teeth is the same as that for a small size tooth.

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Alumni Notes

by Al Nemetz e'50

Alumni! We haven't had as many reports from you as are needed to make this department a truly representative cross-section of alumni activities. In order to keep abreast of as many engineering grads as possible more information is required. So if you yourself, or any Wisconsin engineering graduate known to you, engages in any activity, receives a position, or accomplishes anything that you feel would interest our readers please drop us a line. A postcard will do. The address is "The Wisconsin Engineer", Room 352, Mechanical Engineering Building, University of Wisconsin, Madison, Wis.

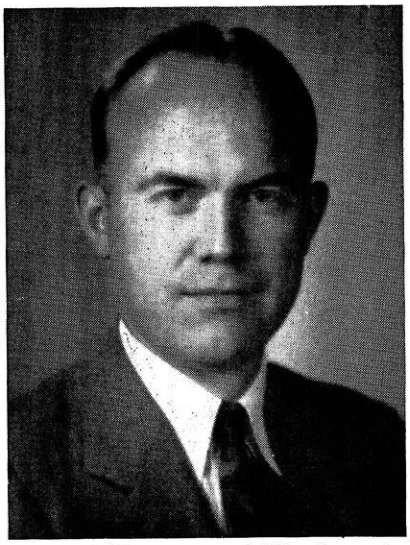
With full alumni cooperation we hope to make this department of more vital interest to all our readers.

E.E.

Harold Goldberg, who received his Doctor's degree here in 1937, was recently appointed chief of the Ordinance Research section of the National Bureau of Standards, Washington, D. C. He was formerly principal research engineer of the Research department, Radio division, of the Bendix Aviation Corporation, Baltimore, Md. Dr. Goldberg is widely known for his work in communication systems and microwave research.

He is a senior member of the Institute of Radio Engineers, a member of the American Association for the Advancement of Science and the American Physical Society, and belongs to Tau Beta Pi and Sigma Xi fraternities.

Dr. Goldberg holds four patents and has a number of others pending. He did important work in radar during the war, including the development of the SCR-66T5-2 radar set.



(Cut courtesy of Wis. Alumnus)
Murray G. Crosby

Murray G. Crosby ('27) recently started his own firm, Crosley Laboratories, at Mineola, N. Y. He was formerly associated with the firm of Paul Godley Company, research engineer for RCA.

W. F. Keen, ('41) has been appointed sales manager of the Andrew Corporation, Chicago, Ill. He was formerly head of the Broadcast Consulting division.

He is well known as a radio engineer and authority on broadcast installation. In his new capacity he will be responsible for all sales policies and contracts of the corporation.

C.E.

Milton A. Nero, ('42) is now a structural designer with the architectural firm of Foeller and Associates of Green Bay.

James H. Lippert, ('43) is a structural designer with the Rust Engineering Company of Pittsburgh. He was married on July 3 to Doris Jean Miller.

William D. McCoy, ('46) is with H. Turner & Sons, Contractors, of Boscobel, Wis.

Richard B. Birkett, ('47) who is employed by the Illinois Central Railway, has been made assistant supervisor with headquarters at Waterloo, Iowa.

Richard J. Breuer, ('47) has given up his position with the General Engineering Company of Portage to join his father in the Bahr Construction Company at Manitowoc.

David C. Knoerr ('47) is a building inspector with the Illinois Central Railway at Waterloo, Iowa.

Caesar A. Stravinski, ('47) received his Master's degree last June and is now employed by the State Board of Health with headquarters at Rhinelander.

Claus W. Korndoerfer ('48) is now with the firm of Davy & Son, engineers, of LaCrosse.

J. Rexford Vernon ('18) is now sales promotion manager of Johnson Service Company, and is in charge of their training school.

Donald O. Walden, ('23) has been unable to continue his work with the US Corps of Engineers because of ill health.

Ch.E.

John J. Chyle, ('24) director of welding research at A. O. Smith Corporation, has been elected a director of the American Welding Society.

Elmer H. Koll, ('28) has been appointed assistant technical director of the Milwaukee Paint division of the Pittsburgh Plate Glass Company. He is a member of the National Society of Professional Engineers, the American Chemical Society, and the Engineers Society of Milwaukee.

Research, Unlimited

by E. H. Haupt m'49

The Engineering Experiment Station of the University of Wisconsin serves as the coordinating agency for all research work performed by the School of Engineering. All research in the College of Engineering has been placed under the general direction of the station. In addition, all researchers in the school are members of the experiment station. During the War the teachers and graduate students—who do the major part of the station's work—were taken for use in the armed services and essential industries; seriously curtailing the work of the station.

The station has recently been revitalized by the 1947 state legislature, with an annual sum of $40,000. The dean of the College of Engineering, Morton O. Withey, is director of the station, and Professor Kurt F. Wendt, professor of mechanics, was recently appointed associate director.

At the present time Professor Wendt is investigating the state's resources in industrial laboratories and engineering specialists. The station will aid manufactures with specific problems by being able to guide them to specialists who are capable of solving their problems.

Although there are a large group of expert consulting engineers in Wisconsin, there are only limited laboratory facilities for general research and commercial testing operations.

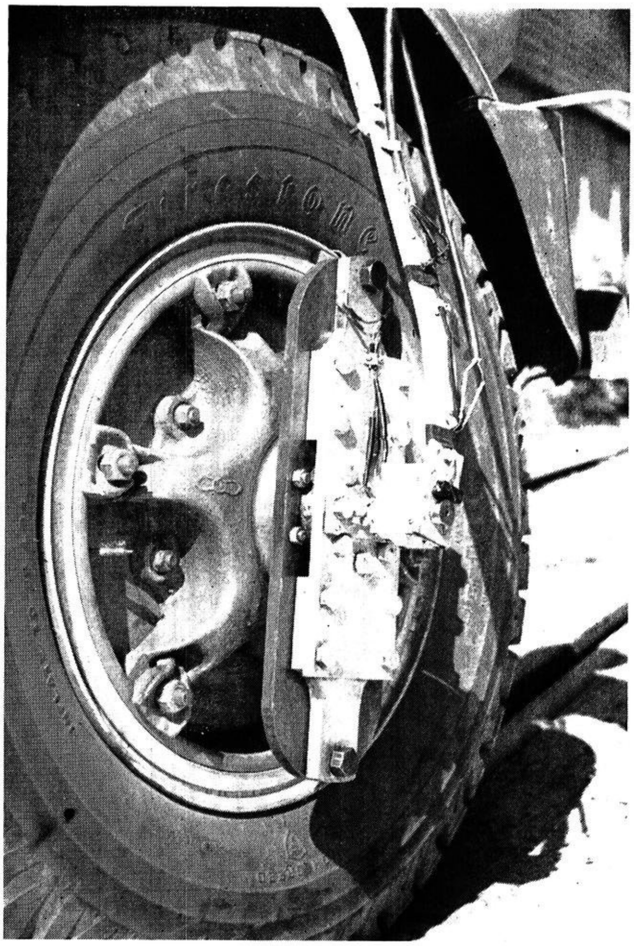
Laboratories for development and control are operated by many of the large industries in the state. Among the laboratories turned over to routine testing and some fundamental work are the laboratory at Marquette University, the Wisconsin Electric Power Co. laboratory, the Oshkosh Industrial laboratory, the Research Products Corp., the City of Milwaukee, and the Twin Cities Testing and Engineering laboratory in Minnesota, sometimes used by Wisconsin firms.

In addition, every industrialist in the state has the multimillion dollar laboratories of the station for research into fundamental problems of all phases of engineering. The station's program of research is intended to benefit all industries in the state, by furthering general knowledge. All projects undertaken must have sufficient general interest to benefit a number of firms or an entire industry, as care is taken not to create competitive advantages. The findings and results of the station's research are published in the station's bulletins. Eighty-six of these bulletins have been published since the station was organized in 1914. In addition, 137 reprints of articles first appearing in professional journals have helped broaden the scope and spread the station's work.

Recently, the Precision Gage laboratory and the Electrical Standards laboratory, which were formerly part of the College of Engineering were turned over to the station.

The $50,000 worth of equipment for the Gage laboratory, one of 20 anticipated in the nation, has been loaned to the university by the Federal government. Its 1375 items of precision equipment are used for instruction in methods of industrial inspection and can handle an infinite variety of work.

The Electrical Standards laboratory has cooperated for many years with the Wisconsin Public Service Commission in maintaining and calibrating basic standards for electrical instruments and meters used by the states' public utilities.



Front-wheel torque-meter developed at the University of Wisconsin. Note the strain gages just below the upper cap screw.

Services of these laboratories are available to industry for a fee based on hourly labor costs. Wisconsin is indeed fortunate to have master gages available to help check and maintain the standards of industries precision instruments, gages, and methods.

Industries interest in the experiment station can best be seen by noting the extent to which they have used the station's facilities. Of the 83 research projects now under

(please turn to page 22)

Science Highlights

by Howard Traeder m'48

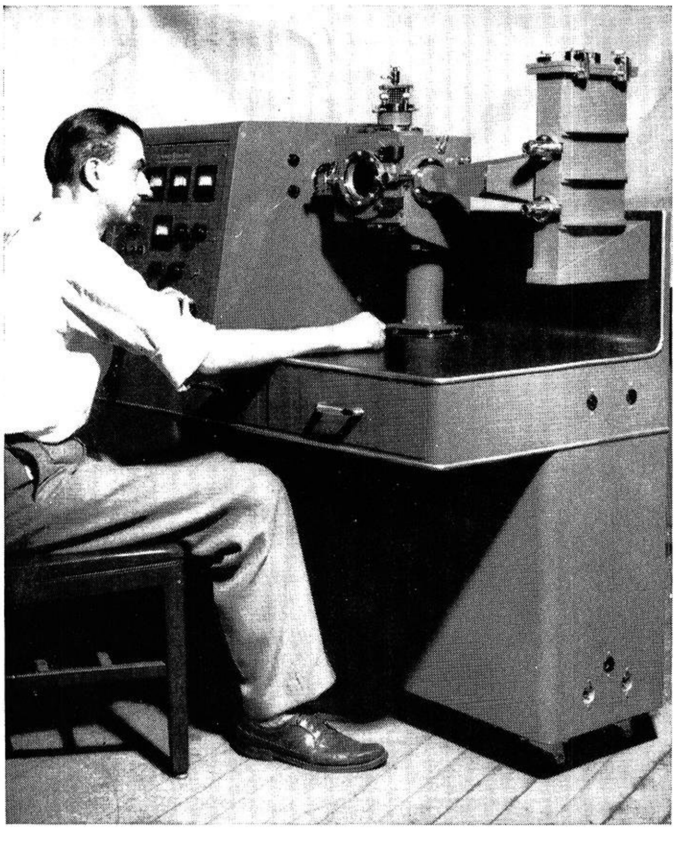
ELECTRON DIFFRACTION INSTRUMENT

This new General Electric device utilizes electrons to study a surface layer of metal less than a quarter millionth of an inch thick. The instrument either shoots a beam of electrons through the extremely thin sheet of metal, or it diverts the beam at an angle to the surface of the metal. This enables engineers to determine a variety of surface conditions, including corrosion and crystal structure of the molecules.

During operation of the instrument, a beam of electrons is "boiled off" a white-hot tungsten filament and focused by means of a magnetic "lens" in much the same manner as a beam of light is focused with a glass lens. The chamber in which the electrons travel is evacuated to a high degree, since electrons would be quickly dispersed by molecules of air or dust. The pressure inside this chamber is approximately 1/8,000,000 the pressure of the atmosphere.

In one application, the electron beam is passed through a two-millionths-inch-thick section of metal and produces an image on a fluorescent screen, or on a strip of ordinary photographic film if a permanent record is desired.

In other applications, the beam, directed at an angle to the metal surface, passes through tiny surface projections which bend the beam and direct it at a screen or film. The image produced is a series of concentric circles, which differs for each type of crystal structure. Engineers can readily determine from the photographs both the nature of the corrosion on the surface and the crystal arrangement of the molecules of metal.



(Cut courtesy General Electric Co.)

The new GE electron diffraction instrument.

CERAMIC-METAL BOND

Radio tubes of ceramic materials, recently developed by General Electric scientists, offer many advantages in producing tiny radio waves a few inches in length. Obtaining a tight ceramic to metal seal was the chief problem in making such tubes. In the new technique, the materials are joined by an alloy of silver and titanium. This is so strong that if the bonded piece is broken, the break occurs in the ceramic and not in the bond. The method may also be used for joining two pieces of ceramic together.

The soldering process is done in a vacuum at high temperatures which drive out gases in the metal and ceramic parts, thus simplifying final evacuation of the tube.

RCA DEVELOPS NEW FINE MESH SCREEN

The Radio Corporation of America was recently confronted with the task of producing a copper screen with 250,000 openings to the square inch in conjunction with the development of the sensitive-image orthicon television camera tube now in wide use in the nation's television studios. Since the electron image of the scene to be televised is focused on this screen, the mesh must be extremely fine to prevent its being visible in the picture when viewed at the receiver.

The finest mesh screens available before the war were woven wire screens, or electrolytic screens, with about 400 holes per linear inch, or 160,000 openings to the square inch. These screens were non-uniform in the arrangement of openings, however, and passed less than 40% of the electron image. For a transmission of 50%, the best screen then available was made of woven wire with only about 200 mesh. It was soon realized that the non-uniformities and relatively coarse mesh

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The SULFUR STORY

by W. I. Thisell c'50

Small boys smitten with spring fever probably take a dim view of the sulfur n' molasses supply each year, but Americans as a whole appreciate the fact that sulfur (usually after first being turned into sulfuric acid) is applied in various ways in most of our industries, for example: textiles, rubber, fertilizer, soap, plastics, aircraft, paint, steel, paper and cosmetics.

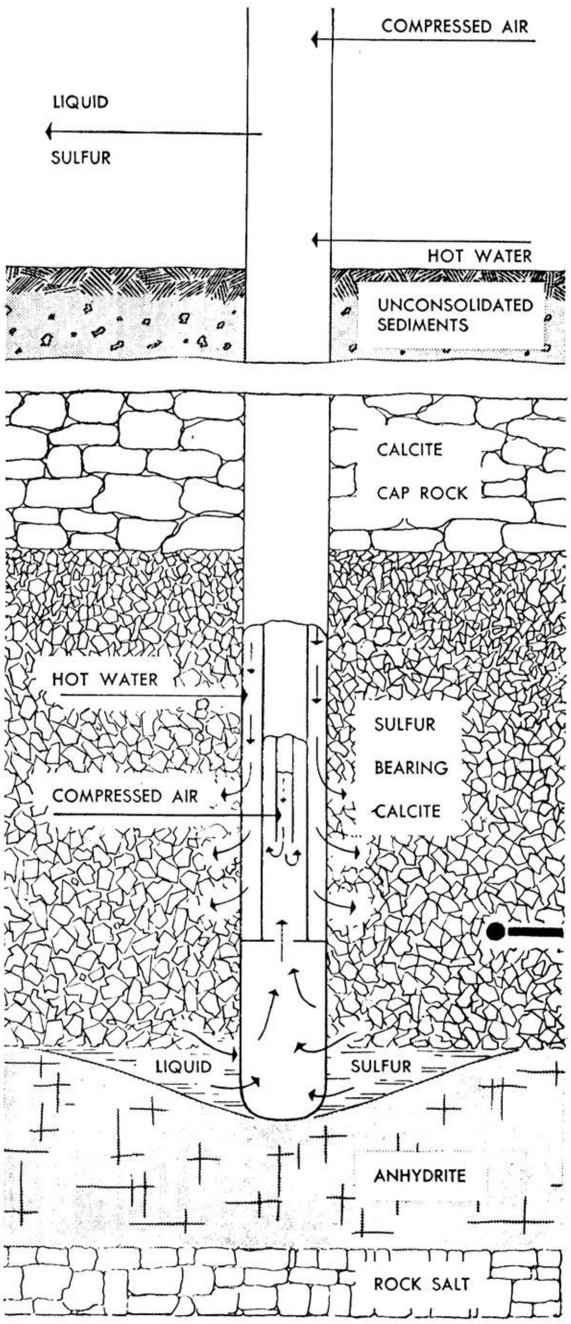
The United States is the world's largest producer of sulfur. We use more of this mineral than we do of copper, rubber, tobacco, or nickel, and at a cost of less than a cent a pound. Sulfur can be mined profitably in only a few places, such as in Java where sulfur is collected from the edges of volcanoes or hot springs. In Sicily, it has been dug from shafts for centuries. At the present time, the majority of the mineral mined comes from the formations overlying the Texas and Louisiana salt domes.

If one were to look at a cross-section of a typical dome, it would look like a massive finger of rock salt sticking straight upward into the gumbo and rock from unfathomed depths to about 500 feet from the surface. Its top is about three miles in diameter and is covered with barren caprock of limestone. Under this cap is a second layer, a stratum of limestone impregnated with pure crystalline sulfur. Under this is found anhydrite, and last of all is the rock-salt, extended pillar-like downward for thousands of feet. It has never been determined how far it does extend.

In the late 1860's petroleum exploration in the Calcasieu salt dome of Louisiana showed a great deposit of sulfur buried nearly 500 feet underground. After several attempts at tunnel mining were blocked by quicksand, the deposit remained untouched until 1890 when Herman Frasch, an oil company research director, discovered a method of bringing the sulfur to the surface. His process simply involved pumping superheated water underground to melt the sulfur so it could be pumped to the surface.

Essentially the method of mining today is the same as Frasch's first attempt. A ten inch casing is driven to the top of the deposit. Through this is put a six inch pipe, perforated at its end, and extending to the bottom of the deposit. Through this six inch tube, a three inch tube is placed, it rests on a collar set a few feet from the bottom of the six incher's terminal performation.

Water heated under pressure to a temperature higher than the 240 degree Fahrenheit melting point of sulfur is pumped down the six inch pipe. The hot water enters the porous limestone from the perforations above the bottom collar. The melted mineral flows downward to form a pool at the lower end of the pipe. From there it rises up the inner tube, rising spontaneously to about 300 feet from the surface. To bring the sulfur up from the 300 feet level, compressed air is sent down a one inch pipe which is inside the three incher. The compressed air bubbles up through the sulfur, lowering its specific gravity and thus allowing it to rise to the surface, and the brownish liquid

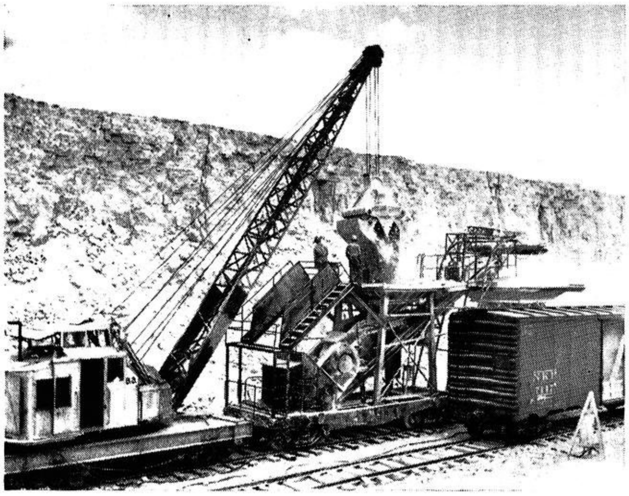


A cross-section of typical sulfur producing ground.

flows into open ground vats where it solidifies.

Although this process sound simple enough, it took many years of experiment and development to perfect it. The first well was tapped in 1894, but it was not until 1912 that the United States overtook Sicilian production. We now produce over two million tons annually—more than twice the combined production of the rest of the world.

Herman Frasch was no novice in the fields of sulfur or invention when his process was proven sound. For years he had worked in chemistry. His de-sulfuization process, as it was called, was one of his most valuable discoveries, but he did notable work in many other fields.



(Photo courtesy Elwood Payne)

Here sulfur is being loaded on railroad cars for shipment.

Up to the time he was forced to retire due to ill health, the United States had granted him sixty-four different patents, most of which were commercial successes. Many of them involved huge operations, so that his transactions amounted to millions of dollars in value. In both petroleum and sulfur, two of the nation's most important chemical ray materials, his discoveries were conceived and executed upon a grand scale and added literally billions of dollars to the national wealth.

Some of the difficulties which still cause trouble are caused by subsidence—the caving in of the porous limestone when the sulfur is drained out of it. Subsidence sometimes makes the upper ground levels sink as much as twenty-five feet. This ground movement bends and shears off the well casing after three or four months of operation. When the wells do gasp and die, pumping crews pull up all except the outer casing, then "cat" the portable drilling platforms and derricks to the next site. As this occurs about eight times a month, 90 to 100 times a year, the drillers leave behind a weird forest of sealed-off well stumps rising out of the sunken land.

The crushing of the limestone by the subsidence prevents hot water from wandering into barren exhausted rock. If it were not for this saving of heat and water, a miner's profits could easily be pumped away in the form of fuel and water costs.

"Salt, lime and sulfur—and the greatest of these is sulfur." Thus did James Muspratt, the famous British chemical maufacturer, once summarize the chief raw materials of his business. This yellow brimstone, the stone that burns, was no doubt the very first chemical found and used by the cavemen. Today we use it in some form in all our industries. In some way it enters into all our wares and mechanisms. Sold for less than a cent a pound (1942) for the 99.5% grade, sulfur is the cheapest chemical element now available in such purity, and we have ready on hand the largest stockpile ever amassed of an elemental material. These are important chemical assets.

Here in the United States we consume each year close to two-million tons of sulfur; thirty pounds plus for every man, woman, and child; twice as much as we use of copper; three times as much as of rubber; five times as of tobacco; thirty times as of nickel. Hardly a pound of that vast tonnage is imported. Indeed, we supply most of the rest of the world with most of their sulfur supplies. Like coal and iron and petroleum, sulfur is one of the essential materials of our modern civilization, which we may be thankful is not in the United States a critical material.

Yet, most Americans know little about this vital mineral. They know even less about the ingenious American process that melts sulfur a thousand feet underground and pumps it to the surface; a process that broke an ancient world-wide monopoly quite as important, though less publicized, as Chili's monopoly of nitrates or Japan's of camphor; a process that gave us new industries, that is vital to our chemical independence, that has created nearly a billion dollars of new wealth for the American people and brought to our use more than 50 million tons of sulfur which, save for this clever invention, would have been locked, useless, deep in the earth.

The story of sulfur mining is far from dull. It is a story of men and machines and the earth itself. A story of the old Union, of the Brazos Syndicate, of the Mound Company; of "shoestrings" and "blowouts," of hurricanes that piled derricks and piping into heaps like jackstraws. But most of the story is of men: of Frasch, the clever persistent inventor; of the forceful Swenson; the persuasive Pemberton; the quiet-spoken Seeley Mudd; of smart traders in mineral rights, of rugged financiers who backed sulfur against long odds; of dogged, resourceful engineers who built plants in a sea of sticky gumbo miles from town or railway. A thrilling story of struggle and achievement, the story of the American sulfur industry.

The production of sulfur requires smooth operation assisted by steam turbine-generators, turbine driven pumps, motor operated pumps, and suitable control equipment. The power supply must be kept steady to maintain an even flow of molten sulfur as it is pumped from the well heads. Thence it goes to collecting dumps, measuring vats and finally to enormous collecting vats. There it is hardened and stored, later to be dynamited off, loaded into railroad cars or boats and shipped all over the world.

So goes the story of sulfur. Probably the first chemical found and used by the cavemen and more assuredly one of the foremost materials affecting the existance and advancement of our civilization.

ON *the Campus*

THE NEW BUILDING

There is a happy note to be sounded this month, though, especially for underclassmen. The new engineering building has germinated and the steam shovels (hats off to all mech. engineers) have dug in on the Randall Avenue site. It's pleasant to think that within a fairly short time a student will be able to reach for the oscilliscope without bumping into twenty others like him all reaching for the same 'scope.

S. A. M.

We welcome to the campus a new society this month, the Society for the Advancement of Management. We understand that this is a cooperative venture between the Engineering and Commerce schools, and certainly hope that the bunch sits down and makes themselves to home. More details next month on the SAM's.

ASME

"Job Opportunities for the Engineer" was the topic discussed at the December 15 meeting of the American Society of Mechanical Engineers. The panel discussing the question was headed by C. W. Gamerdinger, Firestone representative. T-16 was the scene of the action.

IRE - AIEE

A joint meeting of the Institute of Radio Engineers and the American Institute of Electrical Engineers heard Dr. Warren Gilson speak on "Electronics in Medicine" Tuesday, December 14 in room 105 of the ME building. To keep the audio men happy a little was thrown in on the philosophy of sound reproduction.

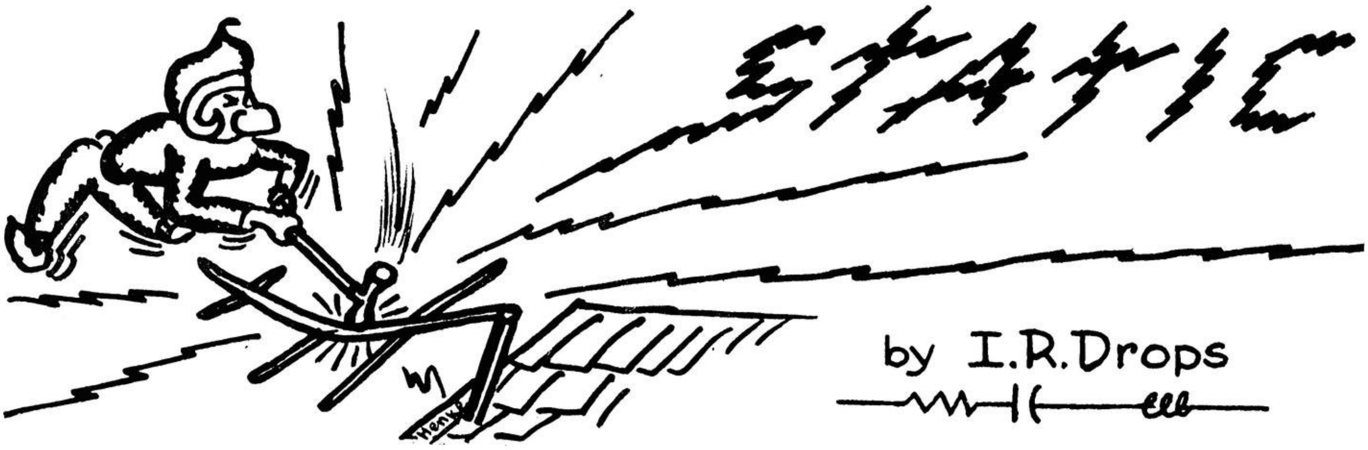
S.A.E.

The fall plant inspection trip of the Society of Automotive Engineers was made on December 11th to the Gary, Indiana plant of the Carnegie-Illinois Steel Corp. Eighty members of the organization made the trip, which was arranged and partially financed by the SAE Milwaukee Section. Arriving around 11 AM by chartered buses, the students were welcomed to the plant by Mr. Ken Turman during dinner in the executives' dining room. Since Carnegie-Illinois is far too large (the world's largest steel mill) to be seen in one day, the trip was confined to the more spectacular operations. Among the highlights were the charging and blowing of the Bessemer converters, open hearth operations, the hot-rolling mills, which handled a 35 ton ingot like it was a quarter pound of butter, and the wheel mill, where railroad car wheels were formed in a 10,000 ton press. The general conclusion after the trip was that you actually have to see steel mill operations to appreciate them. As the buses were pulling into Madison (near the end of a basketball game), one engineer who rode the second bus home, remarked, "if I didn't learn anything else today, I learned never to get aboard the second bus on a field trip—everytime our driver lost track of the bus ahead, they made a beer stop while we caught up."

THETA TAU

Xi chapter of Theta Tau was host chapter at the national convention of the fraternity, which was held on December 29, 30, and 31 at the Knickerbocker hotel in Chicago. David Mickelson was the official delegate to the convention.

(*Photo by Hull*)
The big day finally arrived. Here a power shovel is removing dirt for the basement of the new engineering building.



by I.R.Drops

"How far is it to the next filling station?" the driver asked the farmer.

"Nigh onto two miles as the crow flies."

"Well how far is it if the damned crow has to walk and roll a flat tire?"

* * *

Every man likes to see a broad smile, and some of them do.

* * *

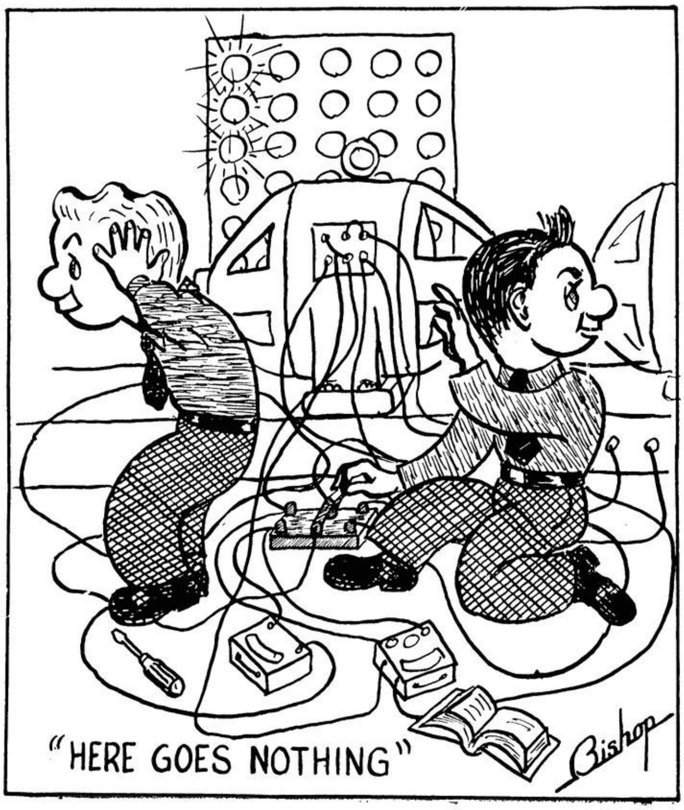
Doc: "How is that little boy doing who swallowed the half dollar?"

Nurse: "No change yet."

* * *

She: "I'd love to be kissed but you'll have to shave first."

He: "Yeah, there's a suction pump over in the heat power lab. I'm entering the St. Pat beard growing contest."



"Last night my girl finally said 'yes'."

"Good, when's the wedding?"

"Wedding? What wedding?"

* * *

"How about a date?"

"Can't, I've got to study, got a blood test in the morning."

* * *

Never let success turn your head—you might wring your neck in the process.

* * *

"Damn," said the ram, as he hurtled over the cliff, "I didn't see the U-turn."

* * *

St. Pat was an engineer. Are you?

* * *

He kissed her on her ruby lips—
It was just a harmless frolic
But though he kissed her only once,
He died of painter's colic.

* * *

Then there was the guy that winked at the elevator girl. She took him up.

* * *

"I'm losing my punch," said she as she left the party in a hurry.

* * *

Then there is the girl who has a special dress. She always wears it to teas.

* * *

Did you hear about the fellow who gave his girl a past for Christmas instead of a present.

* * *

You'll have more time for exams, if you grow a beard.

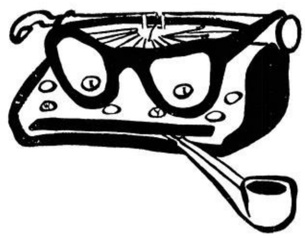
* * *

E. E.: "Can I borrow your dress bow tie?"

Room mate: "What's the matter, couldn't you find it?"

* * *

Imagine the newsboy's embarrassment when he opened the wrong door in the depot waiting room and yelled: "Extra paper."



The Way We See It

HOUSEKEEPING

Just before the Christmas vacation, Polygon board placed a series of signs in the lobby of the Mechanical Engineering building. It appears that this campaign for tidiness paid off to some extent, as we noticed an improvement in the appearance of the engineers' front parlor. There weren't so many butts on the floor, and the scrap paper from the prodigious efforts of the slide rule sharks somehow found its way into the new waste containers that have been installed.

Then the men with the steel scaffolds and the big brushes came and took possession of the lobby for a while. As we watched them work, we noticed that the lobby began to take on a brighter look, and the general atmosphere became more cheerful. And the new paint covered a multitude of sins, too; sins in the form of pencil marks on the walls. Just how these streaks of graphite came to be on the walls is a mystery, but they ran the range from cartoons of professors to derivations of intricate and involved formulae.

Now we called the lobby the front parlor of the engineering building . . . it is more than that. It is also the reception room, where we receive the men who come to interview us for positions in the world of industry. They might be impressed by the derivations, and amused by the cartoons, but then again, they might also be impressed by our inconsideration and untidiness. Do you suppose that they want to hire someone who will draw pictures on the wall of their offices, or who will prefer stone and plaster as a medium of calculating, rather than the more conventional paper? We do not think so.

It should not be necessary for Polygon to put up signs, and it should not be necessary for us to editorialize on this matter. We think that the men who are training to take responsible positions in industry should realize that these activities are no recommendation for them. If the cartoons are poor, they shouldn't be made. If they are good, the ENGINEER will print them. And if the derivations are right, they should be handed in to the instructor, on paper.

Let's keep the lobby, as well as the whole building, bright and clean!

W.M.H.

WHY ACTIVITIES?

Jobs appear to be tightening up; more and more of our engineering graduates are having a difficult time finding the job and type of work they desire. Companies are being more selective in hiring men fresh from school, and nearly every survey shows that by 1950 there will be many more engineers than jobs.

What does this mean for those of us still in school? It is a challenge we will have to meet. It shows that we will have to employ all of our faculties and training to the best advantage, and that we will have to seize every opportunity to broaden our educational background and technical training. The engineer graduating in 1950 will have to **offer** very definite assets to his prospective employers or he will be out of luck.

The engineering profession is expanding rapidly and is constantly improving its own standards. A professional engineer is no longer a mere technician, he is a truly cultured and mature individual distinguished by many qualities of a non-technical nature. To be sure a man must have a sound grasp of engineering fundamentals and an up-to-date knowledge of the recent developments in his own and related fields, but these factors alone will not ensure a job offer or future advancement in business or industry. Human or personal relations are the things which count very heavily whether you are in production, sales, research, or development work.

College is the place to develop these personality traits, and the best method is through extracurricular activities. Men with engineering degrees show promise of being the leaders in industry and business in the future, and they will have the technical knowledge controlling vast projects influencing all political and social considerations. Why should these men not have the social training and psychological understanding necessary to get along with all types of people? They should have it, and we who are in college will have to see to it that we develop these qualities within ourselves.

ALL engineers should take part in student activities! Student government, professional and social activities, and student functions like the **Cardinal** and the **Wisconsin Engineer** are activities designed mainly for the benefit of the participants. They will help the students themselves and improve their college transcripts. Take note of this, for many employers place considerable emphasis on personality traits and not merely grades.

R.R.J.

Flame-Cut Gears . . .

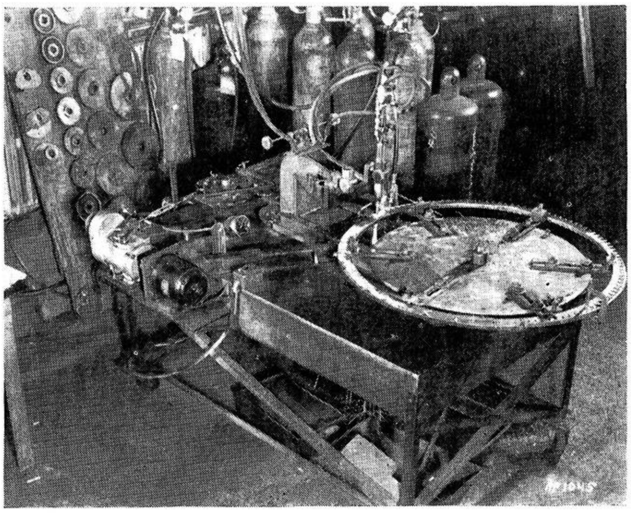
(continued from page 9)

In the present machine the set of back gears used permits cutting of gears and sprockets from 7 to 50 teeth in intervals of one, and from 50 to 100 teeth in intervals of two. Other combinations are possible if the demand is sufficient.

Gears and sprockets from 6 to 64 inches in diameter can be cut on the machine without attachments and an auxiliary spindle is on the boards which will permit the cutting of gears or sprockets up to 20 feet in diameter. The face width of the gears or sprockets is limited to about 3 inches with those of greater width being laminated from several thinner plates after cutting.

It can be seen that the process is far simpler than the one outlined for a cast gear or sprocket, and that the equipment and maintenance costs would be lower just judging from the simplicity of the machine and process. As an illustration of this, note that with 6 or 8 cams the machine is capable of producing over 5000 different types of sprocket tooth forms. No firm manufacturing sprockets by the casting method would probably want to carry that many patterns in his pattern warehouse. Again, consider a widely used standard chain, such as No. 62, detachable. This machine can make any of 90 different sprockets for use with this chain.

Now that we have taken a look at the machine itself, let's look briefly at the product and its uses.



(Photo courtesy Cogmatic Co.)

The machinery for flame-cutting gears.

When one ordinarily thinks of flame cutting, he thinks of a rather ragged edge with prominant drag lines marring the cut surface. This is a characteristic of hand cutting, but when the job is done on the machine the surfaces are perfectly smooth and are held to amazingly close tolerances. The designer claims tolerance of .003" on the diameter of a flame cut gear or sprocket. This is done without any subsequent machining operations after the prod-

(please turn to page 32)

Newsworthy Notes for Engineers

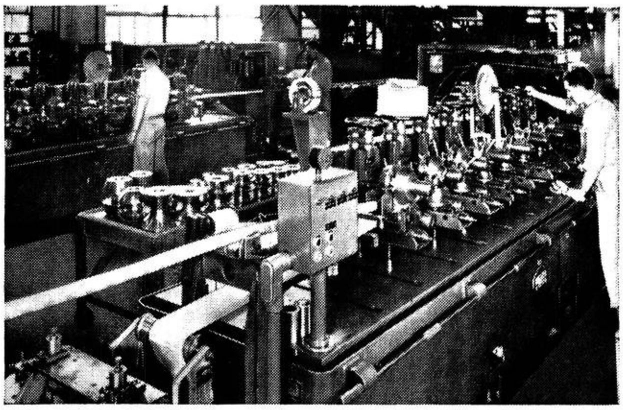
PROBLEM:

How to put a new type of covering on telephone cable

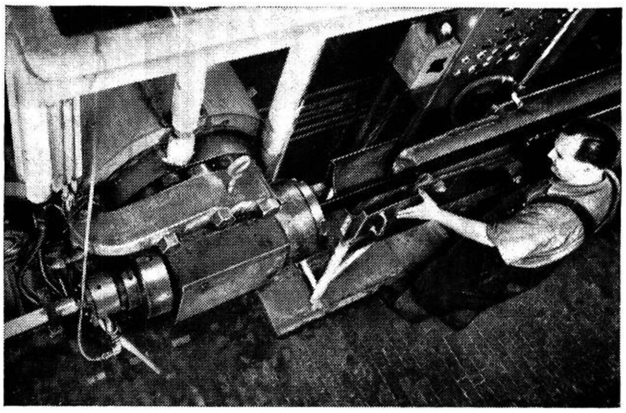
Make a new type of cable sheath no one has ever made before—make it to rigid specifications—make it fast! That was the challenge put up to Western Electric's manufacturing engineers.

The new type of cable sheath—developed through cooperative research at Bell Telephone Laboratories and Western Electric Company—is a valuable alternative to the traditional lead covering for telephone cable. It is called Alpeth. "Al" stands for an inner shield of aluminum; "peth" for the outer coating of the plastic, polyethlene.

To produce this new cable sheath, Western Electric engineers developed the Alpeth production line—a combination of new machines and new manufacturing techniques—which turns out finished cable in a fast-moving, straight-line operation.



From the desert-dry 125° F "hot room" where thoroughly dried cable cores are stored, the core moves into this machine. An aluminum strip is fed from a supply reel underneath. After being corrugated to provide flexibility and strength, the aluminum strip is wrapped around the core and flooded with a sticky protective compound.



The aluminum-clad cable then passes into this machine and comes out seconds later with an extruded coating of flexible, impervious, gleaming black polyethylene. Finally, after a 100-foot bath in a cooling trough, the finished cable is wound on reels and readied for shipment to Bell Telephone companies.

Engineering problems *are many and varied at Western Electric, where manufacturing telephone and radio apparatus for the Bell System is the primary job. Engineers of many kinds—electrical, mechanical, industrial, chemical, metallurgical—are constantly working to devise and improve machines and processes for production of highest quality communications equipment.*

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

CASTING . . .

(continued from page 8)

tion by allowing a slower rate of travel. The tundish reduces the velocity of the metal by reducing the distance which the metal must fall into the mold. It also minimizes turbulence.

Refractories were also an important consideration. Accurate flows of metal are required with little slag, so a refractory was required which would not erode under constant operation. The refractory problem has been met but some improvements are expected.

Optimum casting conditions are affected by several conditions. The more rapid the casting rate the better the surface of the billet. The more rapid the rate the less time the metal is in contact with the mold when rapid heat extraction can occur. To obtain best results the metal should enter the mold at optimum viscosity. To accomplish proper cooling for a more rapid casting rate the heat conductivity of the mold could be increased and the effectiveness of the coolant increased.

Advantages of Continuous Casting

Continuous casting meets the established requirements of sound steel making practice, in many cases better than conventional practices. The following have been summarized from Iron Age:

(1) A truly sound ingot solidifies progressively from bottom to top. This is accomplished in continuous castings more ideally because of the flexibility of the heat withdrawal pattern.

(2) Fast cooling minimizes ingotism and segregation of minor constituents. Continuous cast steel results in fine and uniform crystalline structure and surprisingly little segregation.

(3) The best steels are cast in big-end-up ingots to minimize pipe and segregation. Continuous casting almost ideally meets these conditions.

(4) The surface of the ingot should be relatively free from cracks and checking and the interior should be free of entrapped slag. These conditions also cause difficulty in continuous casting but it violates these requirements far less than conventional casting.

(5) Steels of the best quality should not have planes of weakness due to columnar growth. Continuous cast steel solidifies to a finer grain because of rapid cooling. Satisfactory control, however, was obtained by using the best cross section combined with regulated cooling in the mold and below it.

(6) The best ingot is relatively long with little taper. Continuously cast billets may be as long as desired and there is no taper.

(7) A small ingot generally gives a better quality product. Continuous cast billets are of small cross section—an oval section of proportions satisfying the requirements of good casting and rolling practice.

Future Plans

Plans have been worked out for a plant of such a size as would provide 7,500 to 15,000 tons of steel a month. It would employ two 15-ton arc furnaces for primary heating. Five ton ladles would transfer the metal to holding and pouring stations on the pouring floor. The actual pouring arrangement would be the same as that now in operation—with refinements.

The Babcock Wilcox Company has established various improvements and changes to be made in the future:

(a) Experiment with more varieties of steel now that the physics of good casting is understood for .15-.20 carbon steel.

(b) Install arc-type furnaces of about 7 ton capacity with lip-pouring facilities to replace the present 5000 pound ladle.

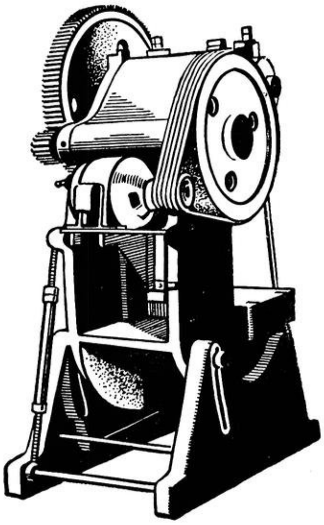
(c) Install a control, already being developed, to control the pouring now controlled by visual and manual means.

(d) Experiment with new shapes and sizes of cross sections. A cross section of 45 square inches has already been suggested.

These improvements will undoubtedly mean standardized commercial production of steel by continuous casting. In a year or two such facilities will undoubtedly be not uncommon in decentralized production of steel at lower production costs.

Note: Much of the information contained in this article was obtained from an article by Mr. Lippert of Iron Age.

Another page for **YOUR BEARING NOTEBOOK**



How to help a press keep punching

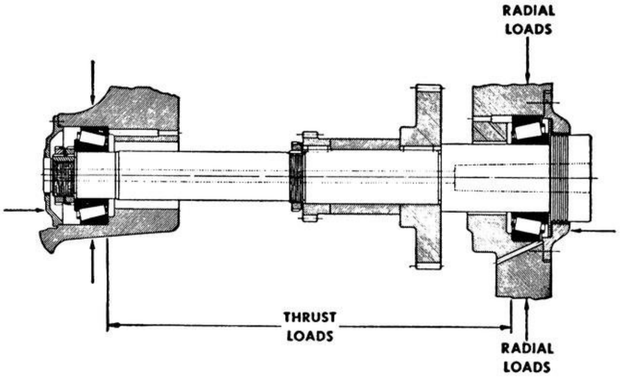
In a punch press, one of the engineering problems is to keep the flywheel and drive shaft in alignment and rotating freely in spite of terrific shock loads.

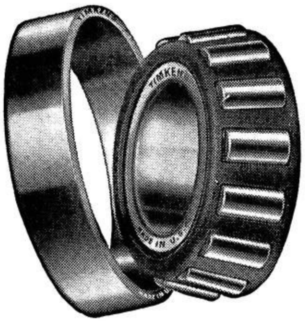
To solve this problem, engineers specify Timken® tapered roller bearings.

Timken bearings hold the drive shaft and flywheel of a punch press rigidly in line. There's no deflection, wobble, or end-play. Friction and wear are negligible.

Why TIMKEN® bearings hold shafts in alignment

The line contact between rolls and races in a Timken bearing means wider, more rigid support for the shaft. Due to their tapered construction, Timken bearings carry radial and thrust loads in any combination, eliminating deflection and end-movement. And since wear in Timken bearings is negligible, shaft rigidity is retained for long years of service.





TIMKEN

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

TAPERED ROLLER BEARINGS

Want to learn more about bearings?

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

NOT JUST A BALL ○ NOT JUST A ROLLER ⊂⊃ THE TIMKEN TAPERED ROLLER ⊂⊃ BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

Research . . .

(*continued from page* 11)

way in the station, 40 are sponsored by the Alumni Research Foundation and by private industry with $85,000 in funds allotted to these 40 projects. Grants for each project range from $250 to $25,000

Among the projects now under way in the station are the following:

The Truck Research Program is conducting experiments on four wheel drive and single axle drive vehicles to determine their effects on highways, safety, performance, and range of operation. In addition, in cooperation with the National Safety Council they are investigating the efficiency of brakes, effects of load distribution, type of drive and effect of skid chains.

The Diesel Combustion and Fuel Rating group are working to improve the operating efficiencies of diesel engines. They are using an instrument developed at the university—the electro-optical pyrometer. Results of their work may include new fuels for diesels so that diesel engines can compete with spark ignition engines on a weight per horsepower ratio.

The Gas Turbine project concerns itself with the determination of all the temperatures within turbo-superchargers. In the haste of war work when these machines were designed there was not sufficient time to determine the internal temperatures. It is hoped that from this work it will be possible to build safer superchargers, capable of greater temperatures, pressures and speeds.

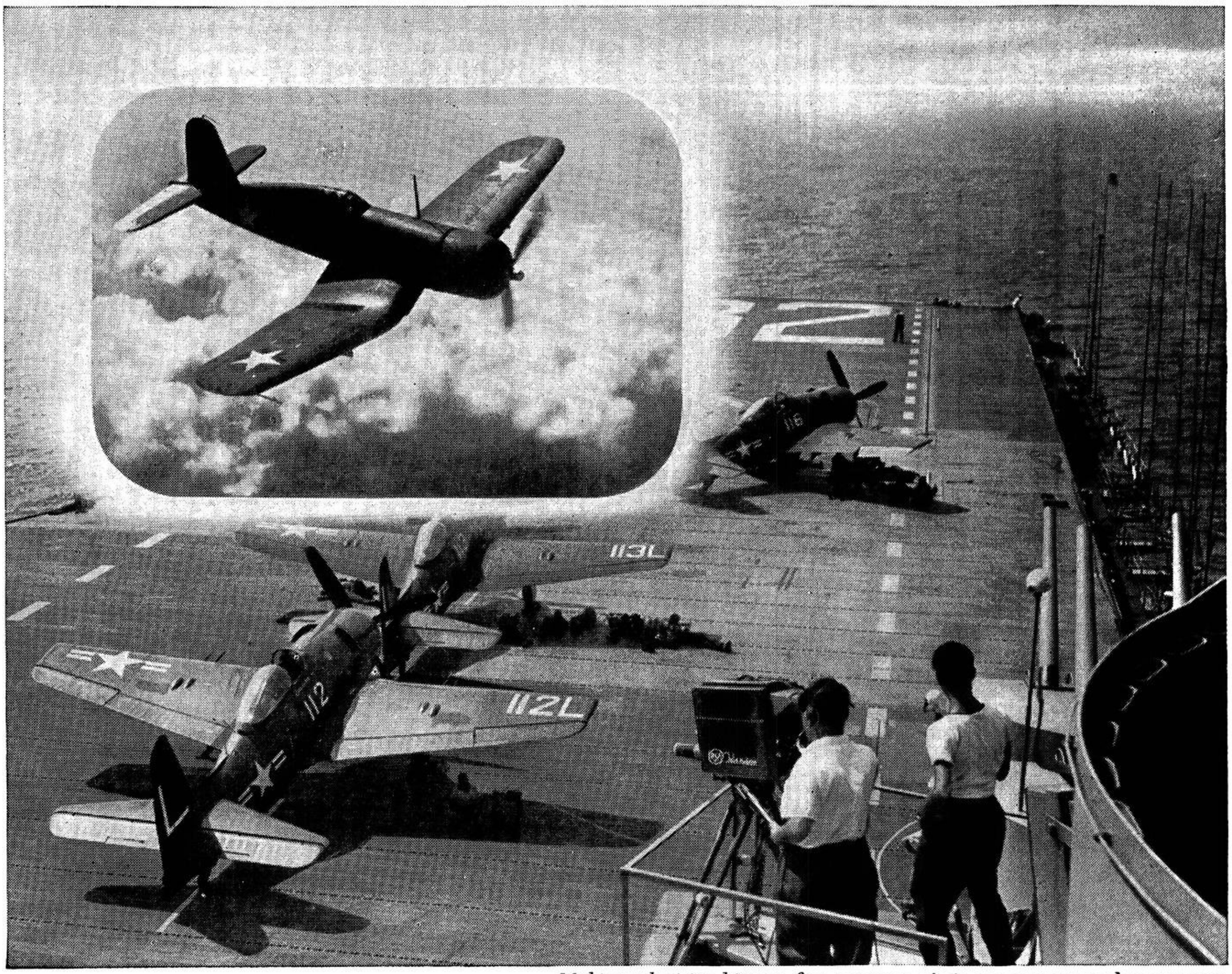
The Applied Kinetics and Catalysis project is a 10 year program which aided the synthetic rubber, gasoline and other industries during the war. It will continue the development of the fundamental principles of process design common to all products involving chemical transformations.

The ultimate objective of this work is to enable engineers to develop chemical production centers and to originate processes from a small amount of laboratory data, rather than the expensive and time consuming method of pilot plant studies.

With recently acquired information much more is known about the fundamental principles of catalytic reactions. This will assist engineers in determining temperatures, pressures, flow rates, and the most favorable compositions of the chemical reactants, all of which have a great effect on the quality of product, type and size of plant needed.

An interesting project involving fundamental hydraulics is the oil-water separation project sponsored by the American Petroleum Institute. This problem comes up very frequently in the handling of wast products. Its application includes separation of any two imiscible liquids having different specific gravities. This floatation process uses wax as a substitute for oil globules of a specific size. Wax is used as it is very difficult to control the size of oil globules in experiments of this type. The wax sus-

(*please turn to page* 30)



Making television history, first coverage of air-sea maneuvers demonstrates value of research by RCA Laboratories to our armed forces.

Now television "stands watch" at sea

Picture the advantage—in military operations—when commanding officers can watch planes, troops, ships maneuver at long range . . .

This new use of television was seen by millions when the aircraft carrier *Leyte*—as Task Force TV—maneuvered at sea before a "battery" of 4 RCA Image Orthicon television cameras.

Seventy planes — Bearcats, Avengers, Corsairs—roared from *Leyte's* flight deck and catapult . . . dived low in mock attack . . . fired rockets. And an escorting destroyer stood by for possible rescues.

Action was beamed by radio to shore, then relayed over NBC's Eastern television network. Reception was sharp and clear on home television receivers . . .

Said high officials: "The strategic importance of television in naval, military, or air operations was dramatically revealed" . . . "There is no doubt that television will serve in the fields of intelligence and combat."

Use of television as a means of military communications is only one way in which radio and electronic research by RCA Laboratories serves the nation. All facilities of RCA and NBC are available for development and application of science to national security . . . in peace as well as war.

• • •

When in Radio City, New York, be sure to see the radio, television and electronic wonders at RCA Exhibition Hall, 36 West 49th Street. Free admission. Radio Corporation of America, RCA Building, Radio City, N. Y. 20.

Continue your education with pay—at RCA

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

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

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

Also many opportunities for Mechanical and Chemical Engineers and Physicists.

RCA RADIO CORPORATION of AMERICA

Science . . .

(*continued from page* 12)

would not permit high quality pictures. Motivated by the possible military use of the image orthicon, intensive work was begun to find a way to make high transmission, uniform screen of 500 mesh or more.

In the process that resulted, screens are plated on a specially prepared glass "master" that contains grooves etched into the glass surface corresponding to the network of screen wires. The master is prepared for plating by sputtering the surface in air with a thin layer of palladium and then rubbing the metal from the glass surface while leaving the metal in the grooves untouched. Copper is then electroplated on the palladium remaining in the grooves to form the finished screen. After removal of the screen, the glass master is cleaned for reuse.

The "world's finest screen" is shown being manufactured at the RCA plant, Lancaster, Pa. (*Photo courtesy RCA*)

Techniques similar to those practiced in making half-tone screens on glass are used in making the glass masters. In general, a piece of plate glass is covered with a layer of acid-resistant material. Lines are ruled through this layer with a ruling engine of the type used for optical gratings. Then the glass is etched for a short time in hydrofluoric acid to form grooves where the lines have been ruled. In making masters for screens of 500 or more mesh, one problem is to keep the etched grooves very narrow in order to produce screens with more open area than metal area. Another is to obtain grooves with sharp edges and, at the same time, sufficient depth to withstand the abrasions of the rub-off process for a reasonable number of operations. The 500 line masters have a line width between 0.0003 and 0.0004 of an inch.

The unwanted palladium layer is removed by placing the master in a shallow dish of water and rubbing the surface with a small piece of rubber. A small strip of palladium is allowed to remain on one edge of the master to serve as an electrical contact during the electroplating. Since scratches show up in the final screen as extra wires, the utmost care and cleanliness is essential during the rub-off. Although a continuous layer of palladium is left on the grooves after the rub-off, its conductivity is too low to permit direct, uniform plating over the surface. Therefore it is necessary to place the plating contact under the solution and depend on a plating growth phenomenon. Deposition takes place

(*please turn to page* 28)

Her (at prom): "Wait for me here Dan, I'm going to powder my nose."

Her (Three dances later): "Been waiting long?"

Him: "No, but I've been looking for you to give you your compact!"

* * *

E. E. definitions

Copper Loss—The death rate in the police force.

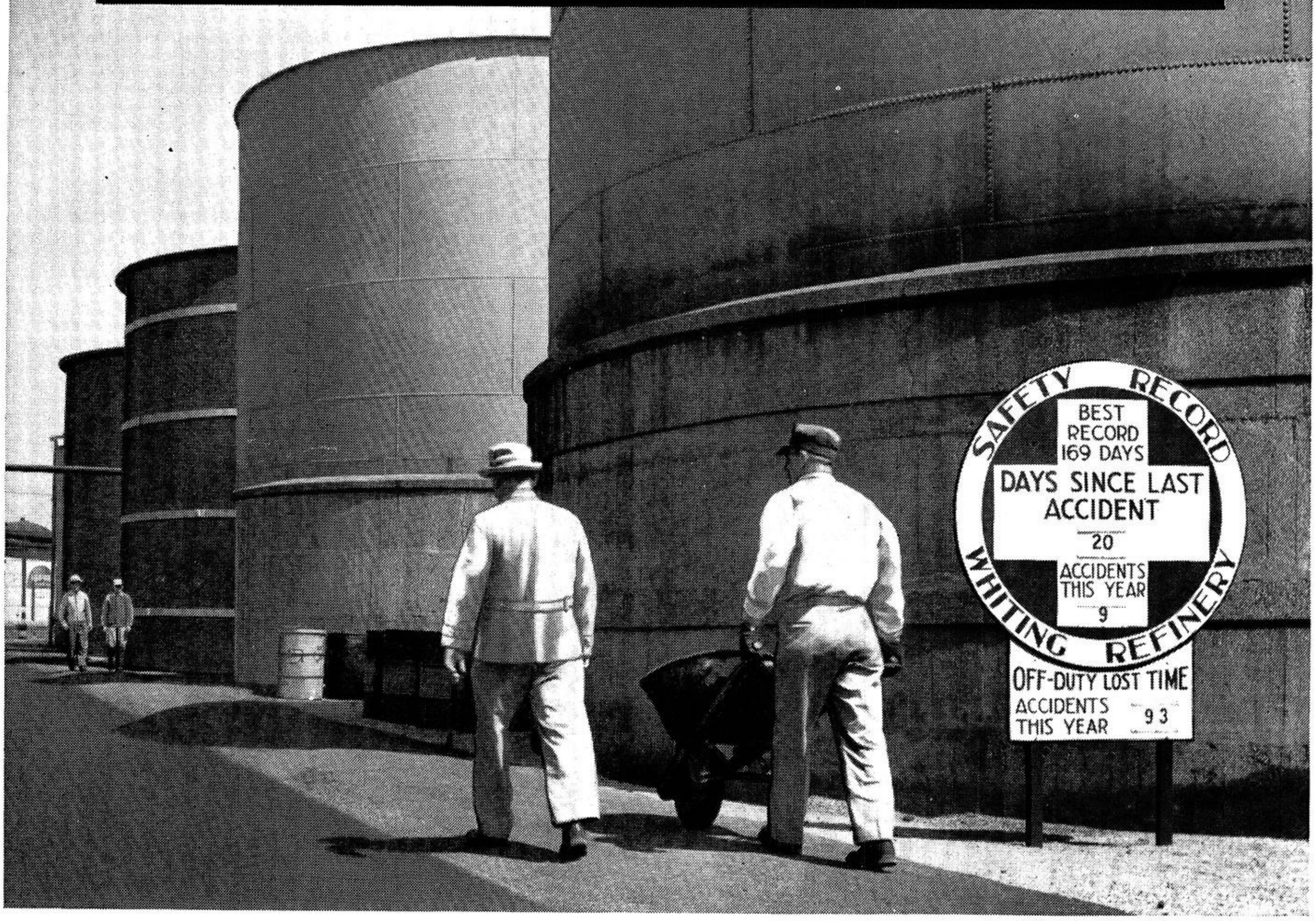
Screen Grid—Used for showing football movies.

Out of Phase—When you will and she won't.

* * *

I love my little sweater girl,
She snuggles when we waltz,
And any day I hope to learn
If it is true or false.

Be Careful . . .
the life you save may be your own



Standard Oil promotes this slogan of the National Safety Council as a reminder to the motoring public to drive carefully. In its own affairs, Standard Oil works and lives by the same slogan.

In the last twelve-month period reported (1948), our accident rates per million man-hours were 1.51 in the company's manufacturing department, 3.31 in our sales department. This compares with an average of 13.16 accidents per million man-hours in the entire petroleum industry, and 13.26 in all industry. It is a record we are at all times attempting to improve.

Because of our great interest in safety, we are glad to see the subject getting more and more attention every year in engineering colleges. Many mechanical engineering curricula now include courses in safety engineering.

We welcome the trend. We hope that students now being trained in safety engineering will soon be helping to make Standard Oil and thousands of other American companies better, safer places to work.

Standard Oil Company

(INDIANA)

STANDARD

STANDARD SERVICE

Science . . .

(continued from page 24)

on the palladium adjacent to the point of contact with the negative plating electrode, thereby causing the resistance of that part of the circuit to be lowered so that plating may take place further from the electrode. As a result, plating continues in an ever widening area until the full surface has been covered. In this way, a screen of good uniformity in thickness is obtained since the growth time is short compared to the total plating time.

Ease of removal of the screen from the master depends largely on the roughness of the etched grooves.

The new screens are very uniform because of the accurate ruling of the master. They permit high transmission because the lines do not increase in width during plating until the groove has been essentially filled. It is possible to make them of much finer mesh than by other means because of the skill that has been attained in ruling and etching extremely fine lines in glass.

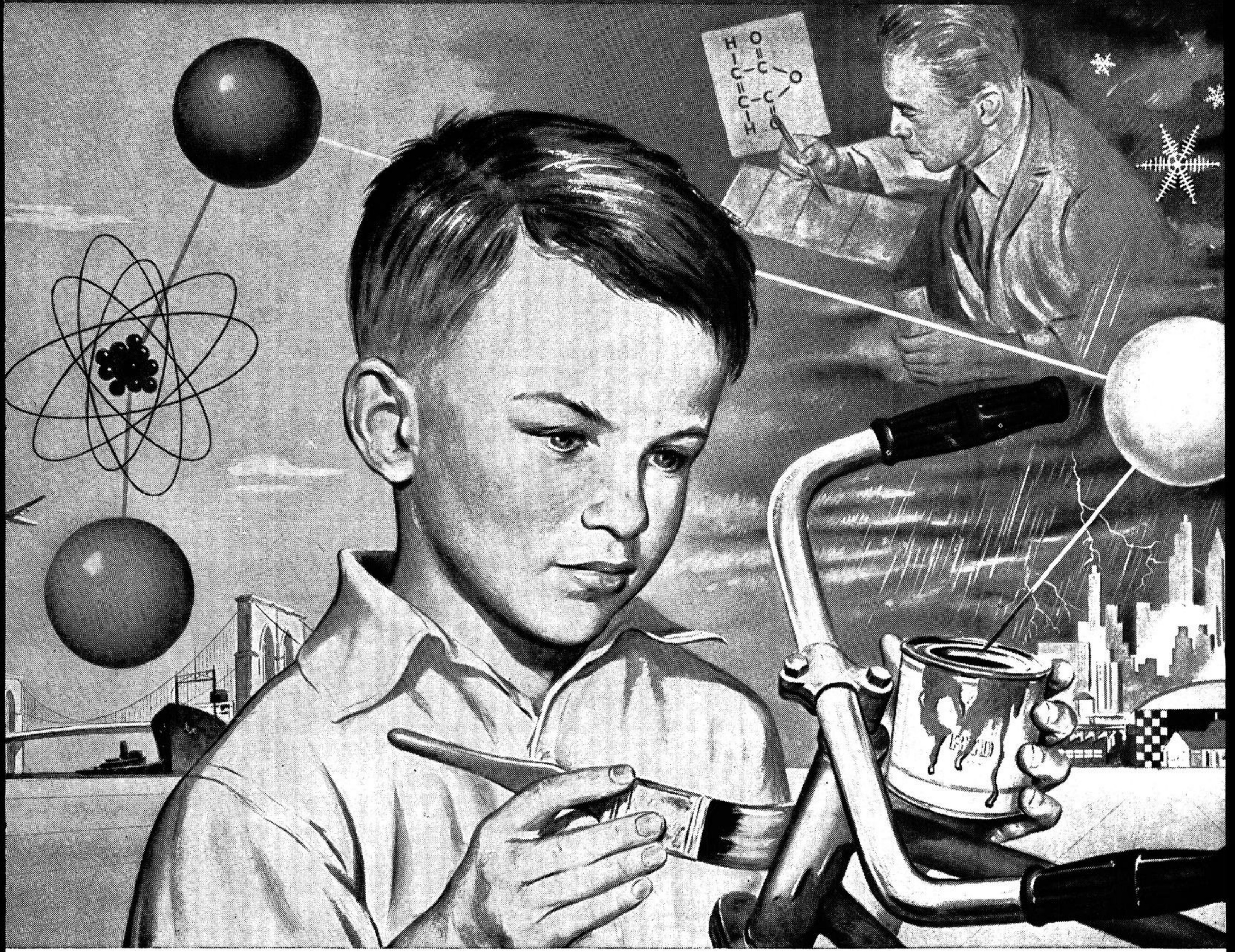
GLOBE MEASURES LIGHT

Seeing triple? That's just what engineers at Sylvania Electric Co. want to see when they study light patterns of lens-type lamps whose beams are too broad for screen projection. They place an opal-glass globe over the lamp to be tested and place mirrors behind it on both sides. This produces an arrangement of two reflected images which allows all sides of the globe to be seen simultaneously. The globe, graduated in degrees, shows at what angle and in what direction the greatest amount of light is concentrated.

FREQUENCY CONTROL

The latest result of scientific research has been the successful application of the ammonium molecule to exact frequency control. The frequency control is determined by the vibrations of the molecule.

"—In life, as in chess, forethought wins" —SIR THOMAS F. BUXTON



Why surfaces now last longer

SMALL BOY'S BIKE or great ocean liner . . . there are finishes for each so improved today that a one or two coat job holds up longer than did dozens before.

Heat and cold, acids and gases, water or salt air just don't crack and peel today's surface coatings as they once did. For our homes and cars, our great bridges, our machinery for farms and industry are now protected as never before.

Better materials—aided by research—bring us this better protection. New plastics and chemicals, for example, that go into quick-drying varnishes, lacquers, paints that keep a like-new finish.

Industrial gases help us, too. In flame-cleaning structural steel, the oxy-acetylene flame provides a clean, dry and warm surface into which paint "bites" instantly and dries quickly.

There's also stainless steel, the lustrous metal that needs no surface protection . . . that withstands wear and corrosion on equipment used outdoors or in . . . and keeps gleamingly clean year after year.

The people of Union Carbide produce many materials essential to today's superior surfaces and surface coatings. They also produce hundreds of other materials for the use of science and industry, to help maintain American leadership in meeting the needs of mankind.

FREE: *You are invited to send for the new illustrated booklet, "Products and Processes," which shows how science and industry use UCC's Alloys, Chemicals, Carbons, Gases and Plastics.*

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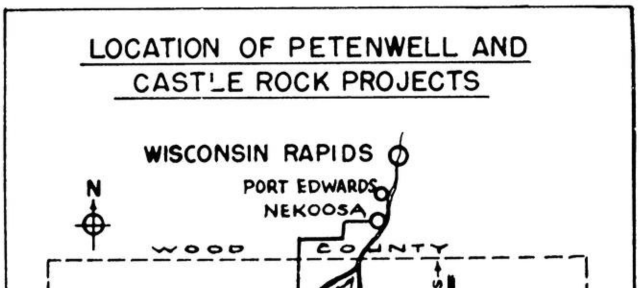
Research . . .

(continued from page 22)

pension of 200 microns diameter is conducted in various size and shape tanks in attempting to obtain the most efficient size and shape of tank.

And still another project in the hydraulics department is the removal of phosphates and nitrates from sewage effluent. Phosphates and nitrates are undesirable in sewage effluent because they greatly stimulate the growth of algae, seaweed and other aquatic plant growths. These plant growths eventually die and then decay, causing obnoxious odors. Chemical removal has been most successful to date. Iron sulphates and aluminun sulphates have both been used successfully to precipitate out the undesirable nitrates and phosphates. Ion exchangers using resins are also being tried. Experimentation is being conducted on the use of biological processes similar to the activated sludge process. In this process it is hoped to isolate certain plants that use a lot of nitrates and phosphates and then form a sludge. This last process has the most to offer if successful, but is also the most difficult task to master. This project is being carried on with the cooperation of the Public Health Institute.



The Wisconsin River Hydrological Studies is noting conditions in the Wisconsin river valley with its intentions of more efficiently utilizing the valley and soil conservation. This group has been concerned with the design of the $8,000,000 dam at Pentenwell Rock near Necedah. By working with scale models in the laboratory they determined the most efficient design to do the job at Pentenwell. This will help in making the Wisconsin river one of the hardest working rivers in the world.

Along the same line the hydraulics department has been concerned with the construction and design of the Castle Rock dam on the Wisconsin River. This dam is similar in construction and design to the Petenwell dam which will be 14 miles upstream from it. The Castle Rock dam is scheduled for construction as soon as the Petenwell dam is completed. It is interesting to note that these dams are only incidental to the main work of the Wisconsin Hydrological Studies which is primarily concerned with reservior levels and the flow of the Wisconsin River.

The majority of projects carried on by the station are of interest only to engineers, some of these are: spray drying, development of a differential analyzer, a study of plastic flow in reinforced brick masonry, a study of temper brittleness in alloy steels, treatment of packing plant wastes, air conditioning, and the durability of concrete.

Although the station does not have a building of its own, it hopes to expand its broad functions as more space becomes available in the various engineering departments. As projects reach completion they will be replaced by new ones to make the best use of existing facilities.

The following are the specific functions of the experiment station.

a. To promote engineering education by encouraging, fostering, and conducting scientific investigations and industrial research; by training and developing persons for the conduct of such investigation and research; and by acquiring and disseminating knowledge in relation to industrial and engineering problems.

b. To render public service by cooperating with the industries, manufacturers and professional engineers in the solution of broad fundamental problems of general interest to these groups.

c. To provide professional opportunities to the teaching staff for full-time work in the station in research and process development during an occasional semester's leave of absence or summer vacation.

d. To centralize the administration of various testing laboratories serving the general public, such as the Gage laboratory and the Electrical Standards laboratory.

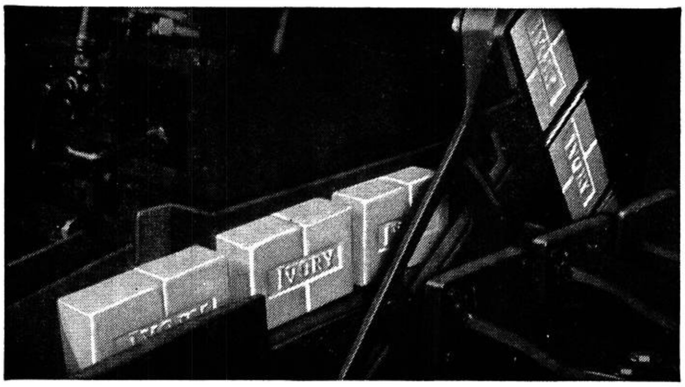
e. To provide opportunities for cooperation among the different departments of the College and with other departments of the University on research projects which demand collaboration in several professional fields.

f. To provide special buildings or space for experimental projects which cannot be housed properly in any one department or which for reasons of safety, magnitude of project, and convenience should be detached from classrooms and undergraduate laboratories.

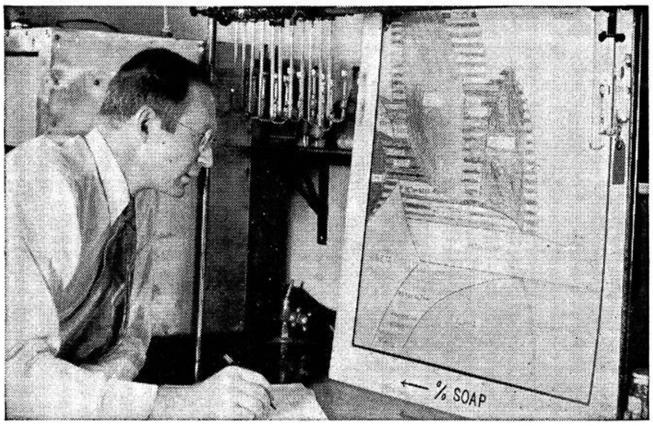
THE STAMP OF

TECHNICAL TEAMWORK

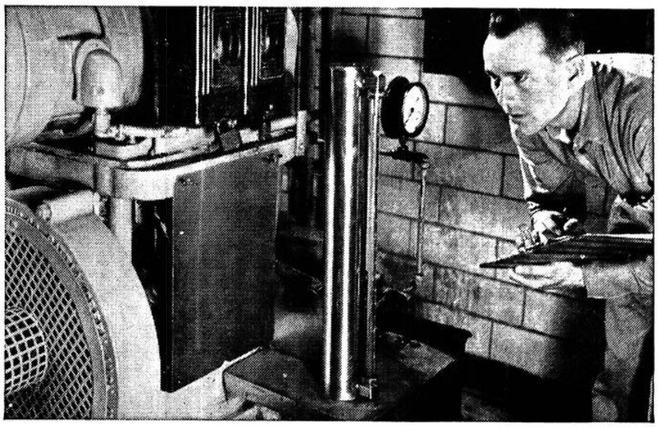
PROCTER & GAMBLE



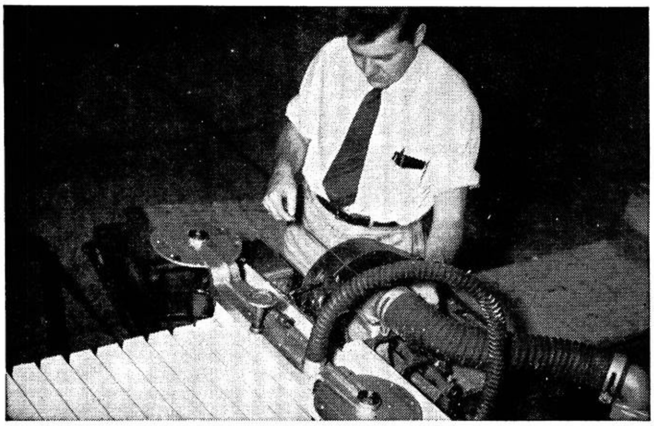
How close cooperation between chemists and engineers constantly improves this famous product



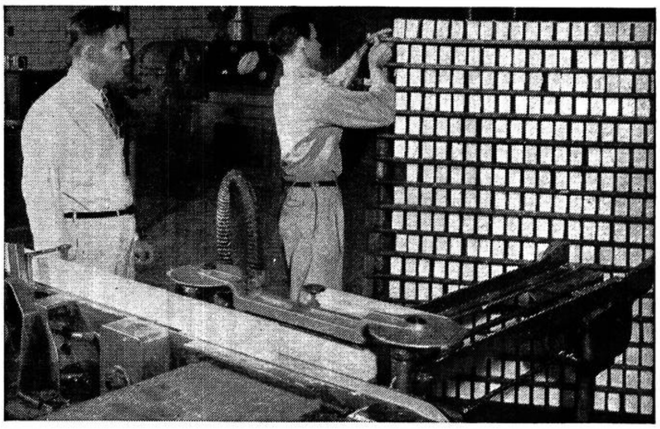
PHYSICAL CHEMISTS study the different phases of soap to define the conditions for improved Ivory bars.



CHEMICAL ENGINEERS make pilot plant studies like this flash drier, to translate these conditions into practical processing methods.



MECHANICAL ENGINEERS design equipment like this automatic vacuum "pickup" to improve methods of handling Ivory, and other soaps.



OTHER ENGINEERS (Chemical, Mechanical, Industrial) plan and supervise all phases of production operations.

This is just one example of P&G technical teamwork in action; similar developments in other fields call for additional men with technical training.

If you would like a copy of our booklet, "Information for Chemists and Engineers," write to Procter & Gamble, Industrial Relations Division, Cincinnati 17, Ohio. Also, if you'd like to talk to a P&G representative, ask your Placement Bureau to arrange a meeting.

PROCTER & GAMBLE

CINCINNATI 17, OHIO

Flame-Cut Gears

(continued from page 18)

uct has been flame cut.

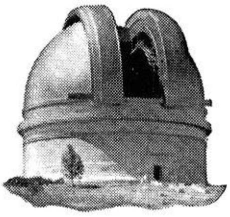
Another advantage which stems from the use of the flame gear cutting process is that the product is cut from steel rather than made from cast iron, as are a great many of the gears and sprockets now produced. This couples greater strength with much greater toughness to make the gear or sprocket less subject to failure under shock load conditions. It is true that any gear or sprocket can be made from steel, but at an increased cost over the cast iron product. Also the flame cutter produces, in effect, a hardened surface, for the suface of the gear is heated to high temperature during the cutting process and then is effectually air quenched.

Still another advantage of the machine is that while the gear is being cut from the blank, the machine is of necessity cutting an internal ring gear at the same time. As the torch moves radially and the blank revolves, the same tooth pattern that is cut into the external gear is also reproduced in the shroud that is left around the finished gear. The two pieces are separated only by the width of the kerf, the metal burned away in the cutting process. This shroud with its internal tooth pattern can be used as an internal ring gear on such equipment as concrete mixers and construction machinery.

As previously stated, the dimensional tolerances on these gears and sprockets can be held to .003" on the diameter. This is not close enough for such applications as transmission gears in automobiles or similar uses, but they are adequate for uses such as concrete mixers, agricultural equipment, road equipment, and similar heavy duty gear drives where extreme smoothness of operation is not essential. This machine will cut gears for these applications as dimensionally accurate as those now machined for those purposes.

The sprockets can be used in any applications where cast sprockets are now used; chain drives, conveyors, catapiller treads being a few examples.

Finally the extreme flexibility which a machine of this versatility offers to the designer should be pointed out. He need no longer make second or third choices in tooth form or sprocket types because the best form is not available or not made by his company. The designer may now work out the best possible form for his particular application, with the knowledge that it can be produced on the flame cutting machine at no greater cost than any other form.



Because photography can see a billion light years away

• Without photography this would be a small world. For even with the best optical instruments, the eye's range scarcely breaks the confines of the earth's back yard.

But with photography . . . ? That's different!

For years, astronomers have looked 500 million light years into space with photographic plates exposed in the 100-inch Mount Wilson telescope.

Now, they can "see" twice as far. For the big 200-inch Mount Palomar instrument—actually the world's largest camera—will bring in light from stars a billion light years away, about six sextillion miles.

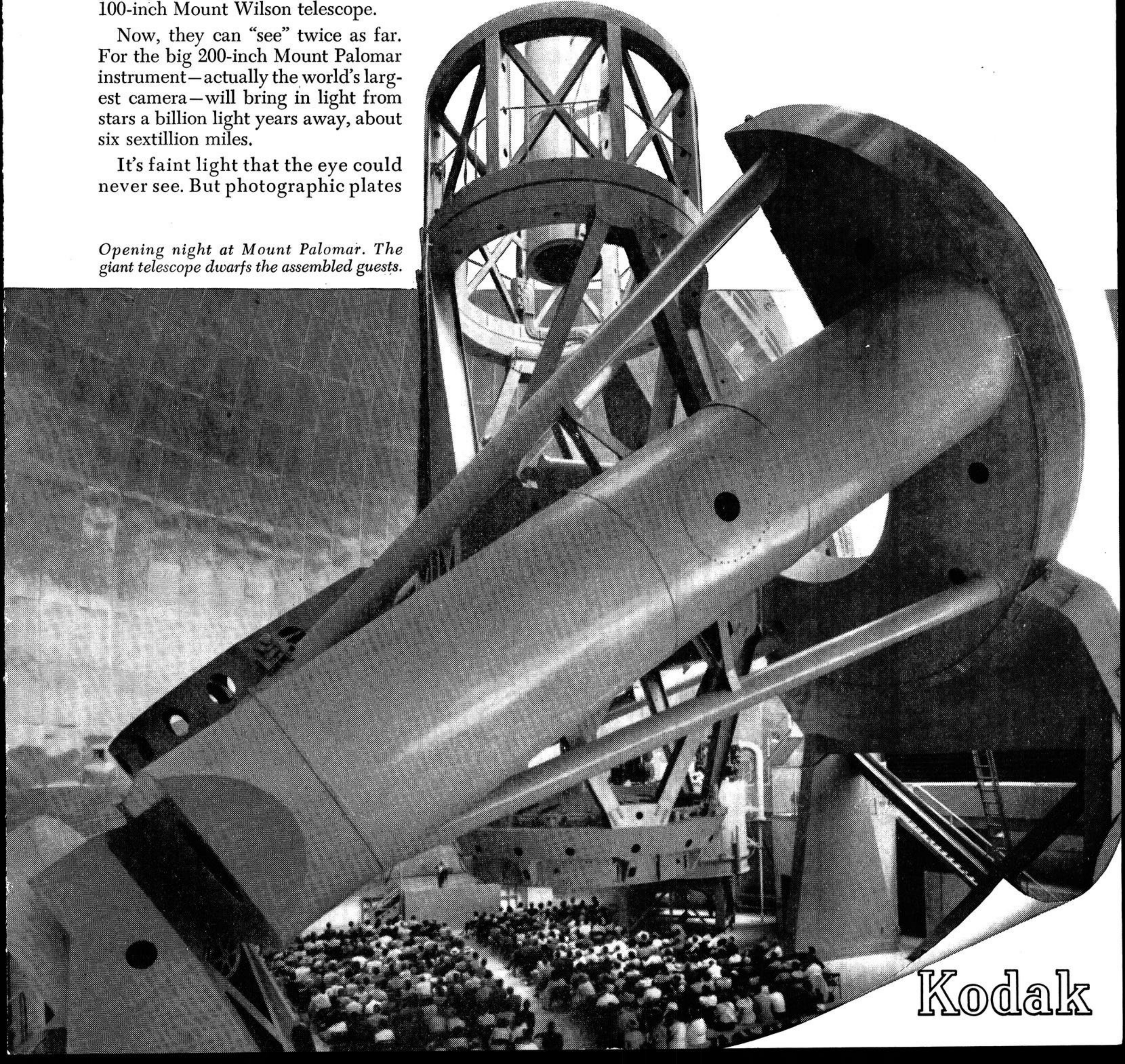
It's faint light that the eye could never see. But photographic plates build up images through long exposures and make visible new outer recesses of man's expanding universe.

Thus, science continuously makes spectacular use of photography in penetrating the unknown.

So too can industry. Radiography, photomicrography, x-ray diffraction, microradiography and other industrial functions of photography can reveal facts and conditions that will help make a product more durable and dependable, a manufacturing process more efficient.

Eastman Kodak Company
Rochester 4, New York

Advancing business and industrial technics—Functional Photography



Opening night at Mount Palomar. The giant telescope dwarfs the assembled guests.

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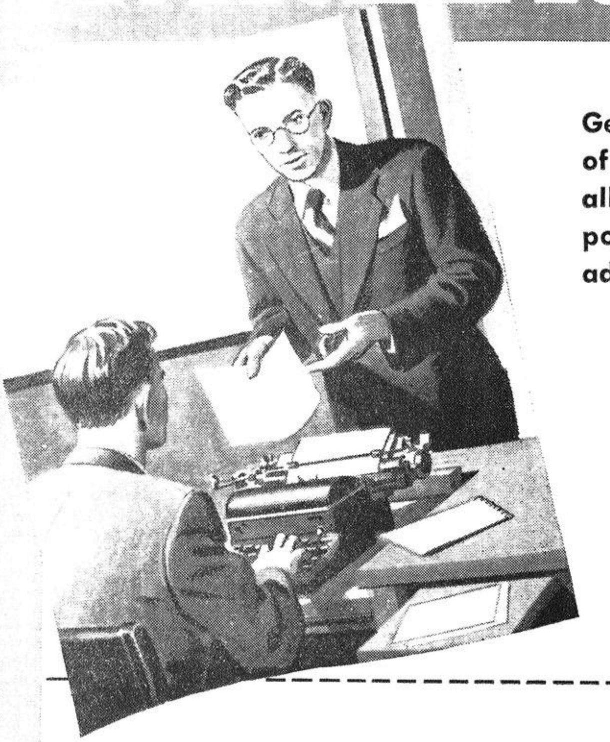
CAREERS AT GENERAL ELECTRIC



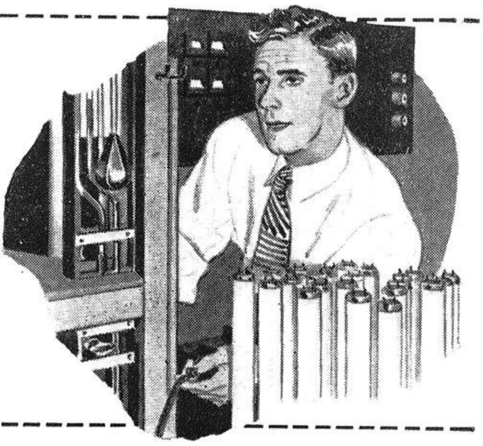
General Electric is not one business, but an organization of many businesses, offering opportunities in virtually all the professions. Here three G-E men brief the career-possibilities which the company offers to the student of advertising, the physicist, and the accountant.

FOR A FUTURE IN ADVERTISING

D. S. Mix (Yale), Manager of Personnel and Training Programs, Advertising and Publicity Dept.: Besides our A & P Department here in Schenectady, there are eight G-E operating departments, each with its own advertising staff. These provide the career-opportunities. Our Training Program, including six months' work and study here followed by a year on rotating assignments with various staffs throughout the company, opens the door.

PHYSICIST

August Binder (Carnegie Tech), of the G-E Physics Program: I've been one of the first group of physicists taking part in this program. We've changed assignments every few months, trying out interesting lines of work, and have chosen permanent positions in everything from research to sales. My assignments: nuclear instrumentation, research in cathode spot phenomena, quality-problems in fluorescent lamps, which I've selected as my permanent assignment.



TRAVELING AUDITOR

E. B. Murray (Princeton), Chief Traveling Auditor: After our business administration and liberal arts graduates finish the G-E Business Training Course, certain of them are transferred to the auditing staff as traveling auditors. It's my job to assign these men and co-ordinate their activities at G-E locations in this country and abroad. The varied experience acquired in this work fits them well for responsible accounting and financial positions.

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

GENERAL ELECTRIC