Spartan ENGINEER

SCHOOL OF ENGINEERING
MICHIGAN STATE COLLEGE
January 1949
Vol. 2 No. 2

World's first Continuous Seamless Tube Mill

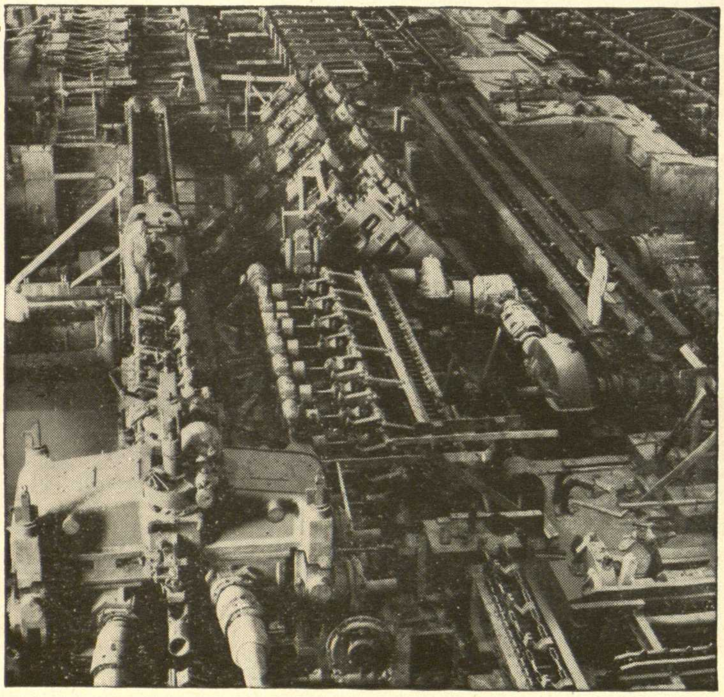
—National Tube Company develops revolutionary new mill design

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

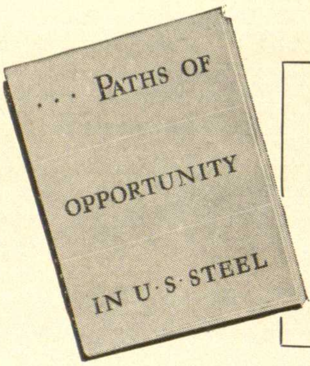
Developed by National Tube Company—U.S. Steel Subsidiary—at its Lorain, Ohio Works, the mill has already been referred to as "one of the greatest advances in the steel industry during the past 50 years."

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.

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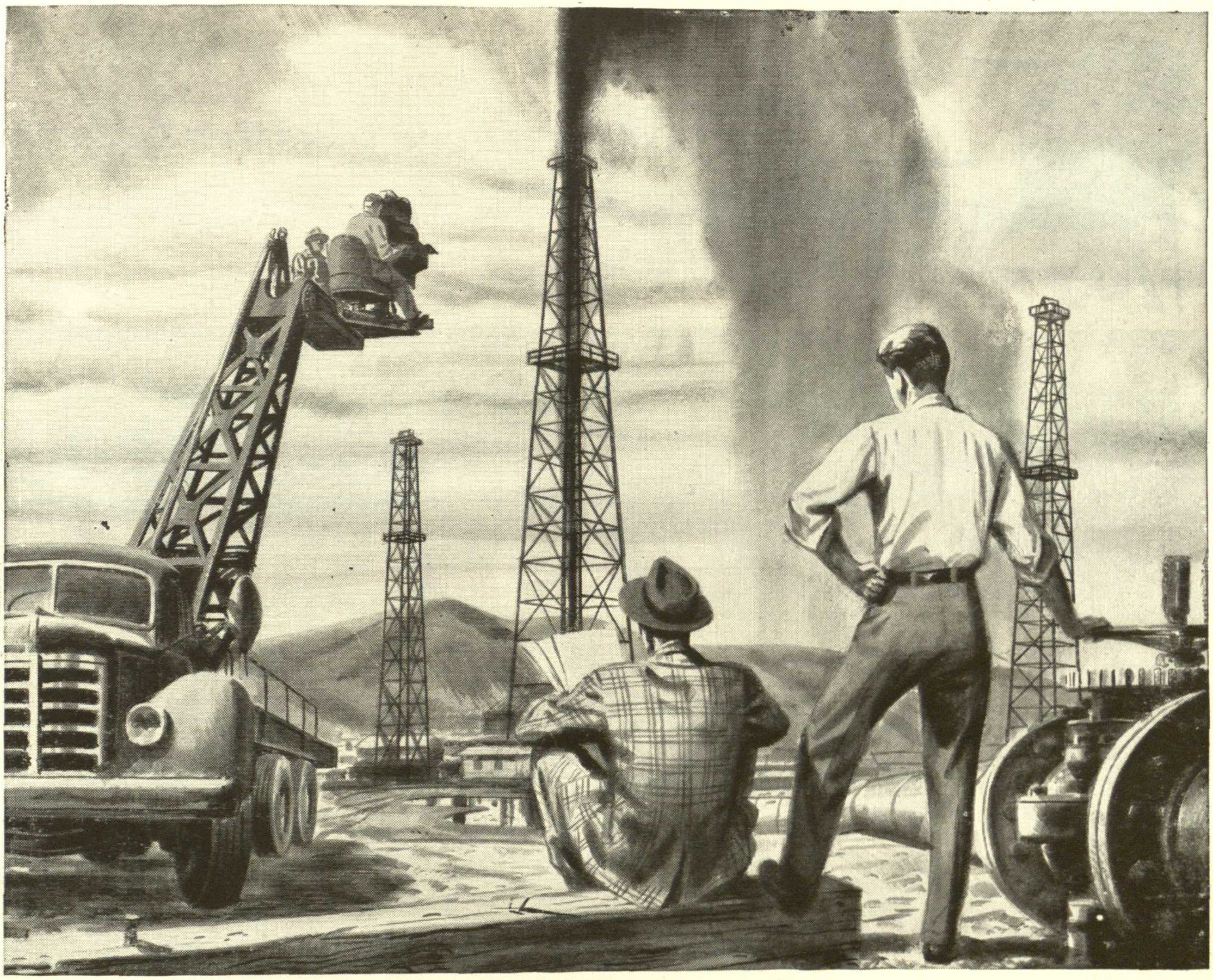
UNITED STATES STEEL



Methocel goes Hollywood!

Recently the movie people filmed an oil gusher scene, using Methocel (Dow Methylcellulose). This unusual material thickens water, giving a solution which, with the right color added, resembles oil. Why go to such lengths? Because, Methocel solutions are non-inflammable, harmless to actors and are readily washed off with water.

This, of course, is not a vital use of Methocel. But it does indicate Methocel's great variety of applications. Countless industries, including paper, paint, leather, textiles, drug and cosmetics, utilize its widely applicable properties as a dispersing, thickening, stabilizing, emulsifying, binding and coating agent.

Dow research is continuous in all divisions. This is only one chemical of many chemicals vital to American industry and agriculture that Dow has developed.

Dow produces more than five hundred essential chemicals from plants located in Michigan, Texas, California, and Canada. These include major industrial chemicals, germicides and fungicides, agricultural chemicals and "special" chemicals—new products which especially reflect Dow's constant efforts to raise still higher our standards of living.

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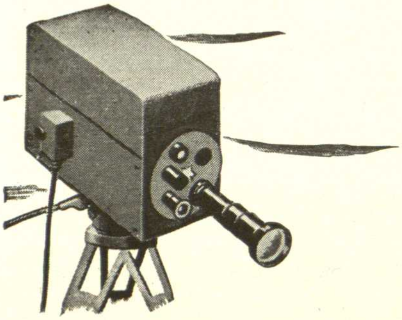
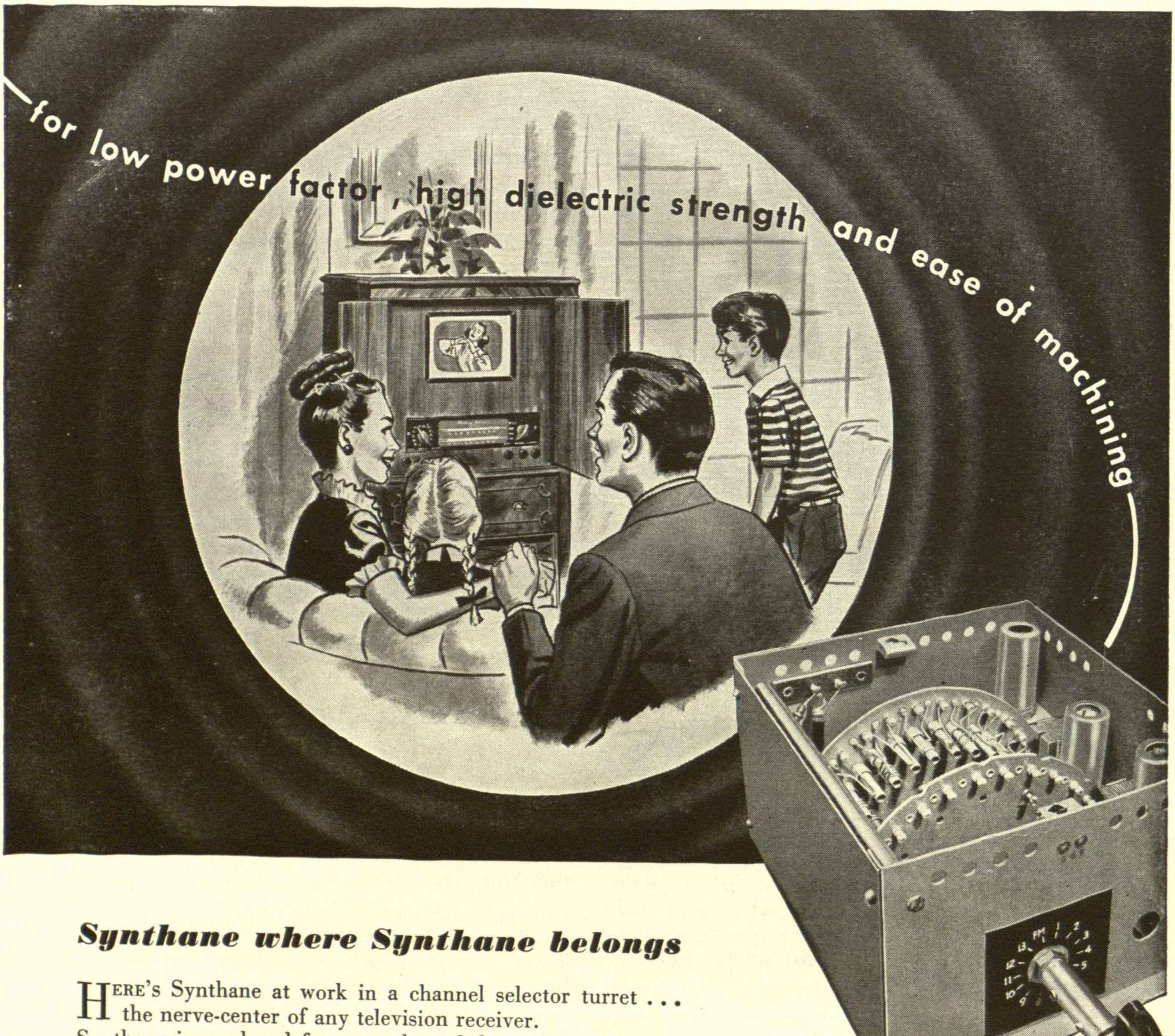


Plastics where plastics belong



Synthane where Synthane belongs

HERE'S Synthane at work in a channel selector turret . . . the nerve-center of any television receiver. Synthane is employed for a number of the intricate parts to insure extreme electrical and mechanical precision and rugged operation. It's an appropriate job for useful, hard-working Synthane . . . a timely example of plastics where plastics belong.

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These and many other properties—combined—make Synthane adaptable to countless chemical, electrical and mechanical applications. Synthane Corporation, 14 River Road, Oaks, Pa.

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Spartan ENGINEER

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Frontispiece: Storage tank at the General Electric Chemical Department's new silicone plant at Waterford, N. Y.
—Courtesy of General Electric.

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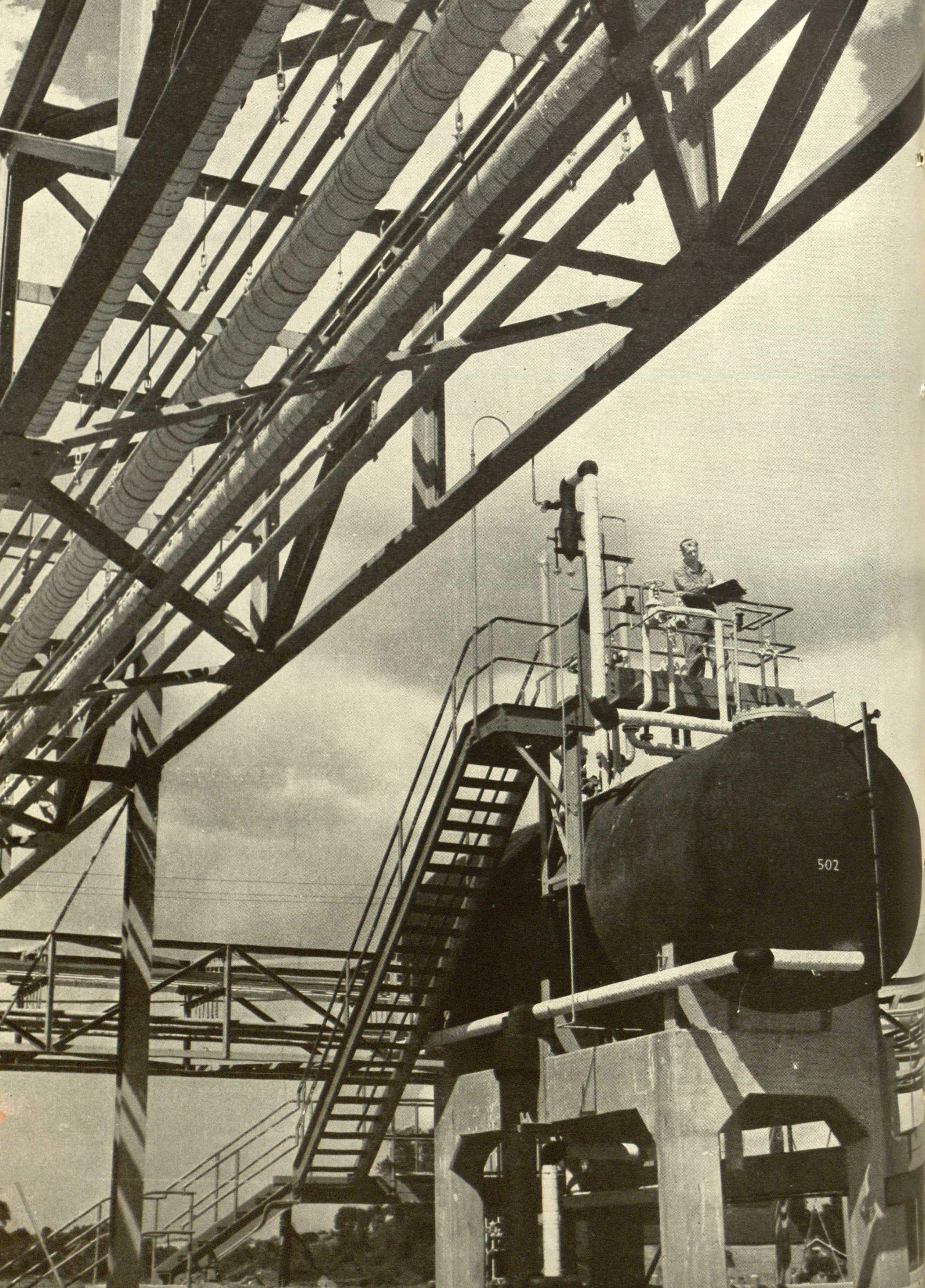
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Professor C. L. Allen

THE CIVIL ENGINEER

Professor C. L. Allen

ENGINEERING

"It has lengthened life; it has mitigated pain; it has extinguished disease; it has increased the fertility of the soil; it has given new security to mariner; it has furnished new arms to the warrior; it has spanned great rivers and estuaries with forms unknown to our fathers; it has guided the thunderbolt innocuously from heaven to earth; it has lighted up the night with the splendor of the day; it has extended the range of the human vision; it has accelerated motion; it has annihilated distance; it has facilitated intercourse, correspondence, all friendly offices, all dispatch of business; it has enabled man to descend to the depths of the sea, to soar into the air, to penetrate securely into the noxious recesses of the earth, to traverse land in cars which whirl along without horses, and the ocean in ships which run against the wind.

". . . It is a philosophy which never rests, which has never attained, which is never perfect. Its law is progress."

—Lord Macauley's Essay on Bacon, 1837

THERE WAS A TIME, a long while ago, early in the history of the human race, when there were only two kinds of engineer. One was an integral part of the armed forces of those days and did all their engineering. He was called a military engineer. The other one did all the many kinds of engineering needed by the civilian populations of ancient times whether they were at peace or at war. He was called a civil engineer to distinguish him from his colleague in the service. There were just the two kinds of engineer, civil and military, military and civil.

As the years went by and the centuries rolled past into history, the needs of mankind became more numerous and more diversified, especially in the field of the civil engineer. And so numerous were these needs and of such widely different characteristics that no civil engineer could hope to have a detailed knowledge of all the branches of the profession. And so after a while engineers specialized in some of the many kinds of civil engineering.

There were those who specialized in machines and mechanical devices, and they were called mechanical engineers. James Watt, for instance, specialized in pumps powered by steam. He devised the steam pump because the coal mines of Cornwall had reached such a depth that they were flooded by ground water and couldn't be worked any more without the help of better pumps than were then in use.

Somewhat later the engineer and scientist, working together, discovered how to use the force of electricity to run machinery, and the profession of electrical engineering was born.

In recent years engineers worked out a system for using the explosive power of gasoline to run an engine, and automotive engineering came into being and Detroit grew from a small town to a metropolis.

Mankind has always been fascinated by what might happen when two substances were brought into intimate contact, and by the fact that the resulting compound could have, and frequently did have different properties from its ingredients. The engineer who collected facts from the science of chemistry and applied them to manufacturing on a large scale for the use and convenience of mankind was called a chemical engineer.

The list is a long one, of the different kinds of engineers who today play their part in our modern way of life. To name only a few, there are agricultural engineers, mining engineers, metallurgical engineers, aeronautical engineers, petroleum engineers, naval enginers and so on through a list of engineers all of whom are the children or grand children of their progenitor, the civil engineer, who in the beginning had no other colleague than the military engineer.

But although the ancient profession of civil engineering has been divided and subdivided and divided again, the field of the civil engineer is still a large and important one and the practitioner of the profession need never be fearful that "civil engineering" will vanish and he'll be out of a job.

The City Council of "Smallburg" assembles as usual for its Monday night meeting. The Council has important business to transact tonight. The members have heard rumors that a new factory of a big corporation is to be built near the west city limits and there is an air of expectancy in their bearing and a suppressed excitement because the coming of the factory will mean more wealth for Smallburg. It will mean more population, more weekly payrolls, more business and an increase in the value of taxable property.

So when the prosperous appearing stranger rises and asks permission to address the council, the mem-

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PRODUCTION LINE AT MSC

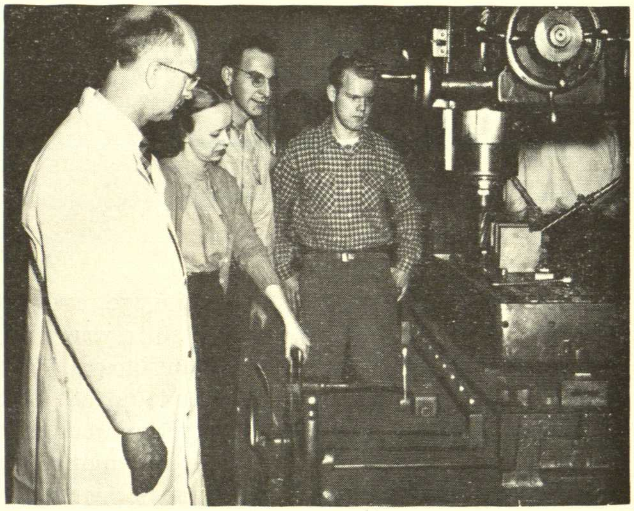
LEONARD KARBER, M.E. '49

EVERYONE LIKES TO BRAG once in awhile. Here at MSC we are proud of the fact that to our knowledge we have the only machine shop production line at an accredited university in the country. How did this come about? Let us tell you the history and why a production line was adopted.

In 1946 after attending a mechanical engineers' conference at St. Louis, Mo., Dean Miller brought back the idea that some sort of production line set-up should be installed in the machine shop at MSC. The basic idea would be to accommodate a larger number of students taking the machine courses and to acquaint the students with the more modern methods, benefits, and problems of production. After due consideration in which the pros and cons of the situation were discussed by Professors Miller, Price, and Vanderslice, an air compressor was chosen as meeting all the requirements set forth during discussion in the best possible manner. Included in the discussion were ease of change-over dependent upon production machine availability, benefit to the school and to the students, cost and disposability of the finished product dependent upon the demand for the product. A program of change-over was started in which the help of Mr. Posthumus was enlisted in making the patterns for the crankcase, cylinder, cylinder head, flywheel, crankshaft and breather. All patterns were made with an eye to long life and production. For example, the cylinder heads are cast by the use of a match plate. Professor Sigerfoos in the foundry modified the shop floor and installed regular casting lines for high production.

Setting up the Machine Shop

In the winter and spring terms of 1947 soon after Dean Miller returned, the manufacturing methods course, ME 387, was revised and taught with the idea of designing jigs and fixtures for set-up of the machining operations for the air compressor. During the summer of 1947 many problems were settled, so that by the time the fall term came around serious consideration could be given to the designing and adoption of certain jigs and fixtures. Many senior students elected the making of dies, jigs, and fixtures as their senior problems to help get the air compressor production started. There were also available by the end of spring term the jig and fixture designs of two more ME 387 classes.



Facing the breather side of the crankcase with a No. 5 Reed-Prentice vertical mill. Watching (left to right), Professor Vanderslice, M. M. Josephonson, E. L. Clark, and E. L. Bell.

During all this time Prof. Vanderslice had been getting and arranging war surplus machinery specifically to help with production. Individually powered lathes replaced the older belt drive models. Turret lathes were obtained. A large vertical milling machine supplemented by smaller horizontal mills completed the necessary power tools. Rearrangement of all tools was necessary to get the maximum benefit of the limited floor space. With no machine shop courses being held during the summer of 1948, the time was used to complete many of the jigs and fixtures necessary to start the classes for fall term and to complete the rearrangement of machinery. Professors Vanderslice, Flory, McCurrey and a number of students worked on the jigs and fixtures while Mr. Watt made the gages. The heat treat department was called upon to harden many tools and gages and, later, the piston pins when the compressors went into production.

Manufacturing Fits of the Compressor

The tolerances used on the air compressor are in general about the same as used in commercial production in an automobile engine or in a regular piston displacement air compressor. The closest fit is on the bronze main bearing bushing having a tolerance of +0.0005″ and —0.0000″. Other tolerances range from —0.001″ to +0.005″.

Material of the Compressor

The compressor was designed with simplicity and ease of maintenance as the keynote but without the sacrifice of reliability. The crankcase is one piece of cast iron with the top milled flat to receive the cylinder, also of cast iron. One side of the crankcase is of heavy section to hold the main bearings. Bronze bushings are pressed into the crankcase for the crankshaft. On the opposite side of the crankcase is an aluminum breather. The breather is of the open type in which a tortuous passage is incorporated to reduce loss of oil. Four drilled ears are cast on the bottom of the crankcase, one on each corner, as a means of bolting to a frame. The crankshaft is single throw with a two-inch stroke and made of cast iron. It is supported by the main bearings in the crankcase. The bearings are lubricated by a wire ring which dips into the oil in the crankcase and carries it up to the crankshaft from where it flows to the bearing. The rod is locked into place on the overhung crank and is lubricated by a drilled dipper which strikes the oil in the crankcase and forces it up to the rod bearing. The rod, a forging, is given special attention during machining to maintain the center distances between pin and crank holes when boring these components. The cylinder is fastened to the crankcase by four bolts screwing into tapped holes in the crankcase. The aluminum piston, carrying two compression rings, is lubricated by oil mist thrown up by splash created by the rod dipper striking the sump oil. The cast iron head and cylinder are generously finned for cooling. The head is fastened to the cylinder by four Allen head screws. Into the head are screwed the brass valve inserts which are formed from hexagon bar stock on a Bardons and Oliver turret lathe. The valves are small steel disks stamped out in a punch press. Atmospheric air pressure is used to open the inlet valve and compression pressure operates the exhaust valve. The valves are held against the seats by small wire springs. All parts except piston rings, sealing gaskets, bolts and screws are made in the machine shop by regular class students. Standard piston rings are purchased from a ring manufacturer and used on the pistons.

Inspection and Assembly

Each individual part is inspected by the student during the machining operation. The student has near the tool a number of "go—no go" gages which are applied to the part if possible. The finished part from a certain operation has a choice of two routes. If the machining operation is the last one the part goes to the assembly table. If there is still work to be done on the part such as drilling or tapping the part goes to the next machine to be worked upon. For example: let us take two steps in the machining of the cylinder. From the rough cast state the cylinder goes to a Reed-Prentice lathe. The cylinder is held in place by an expanding bushing which is forced against the rough cored hole in the center of the cylinder. The base of the cylinder is then machined perpendicular to the cored hole and a slight counterbore machined on the bottom of the bore to start the piston and rings in the cylinder. From the Reed-Prentice lathe the cylinder goes to a Warner and Swazey turret lathe where the squared base is now used as the locater and the cylinder is bored to size with the assurance that the cylinder bore and base are perpendicular. Other machine work dependent upon locating from the base may be performed in the turret lathe thereby saving a number of different setting-up operations.

Three MSC students perform final assembly work in the manufacture of air compressors under the supervision of Professor Ralph Vanderslice (second from right). Students (left to right) Richard Waggoner, Lester Pond, and Thomas Antzack add parts which go together to make up the finished compressor at far right.

Efforts for Improvement

To make a better product, continuous research is carried out by the school staff and students. Almost any day if one passes the machine shop, he will find a compressor being test run for oil tightness, long life, and the best point of operation. Some senior students have the problem of finding the optimum operating speed of the compressor and also to experiment with varying rates of valve springs and operating pressures. Continuous research is also being carried on as to the best jigs and fixtures to use to get better and more accurate products with quicker set-up and tear down times. Improvements are continuously being sought as problems come up during class periods.

Sale of the compressors is limited to students only. In this way engineering students who have worked on and helped design a product have a chance to use it at home.

The engineering staff and those associated with the work feel that they have a good product and that most of the aims originally proposed by Dean Miller have been carried out.

DETROIT TELEVISION

SAM BERBERIAN Mth GRAD

Early in 1943, the Evening News Association, parent of radio station WWJ and the Detroit News, became interested enough in television to spend some time and money on a survey of its commercial potentialities. Having already pioneered the first commercial AM broadcasting station in the country, and the first commercial FM station in Michigan, WWJ was fitted, at least by precedent, to pioneer in television.

After a short pause for nation identification, World War II, WWJ put its plans in writing. The first orders for TV equipment were placed early in 1946. Delivery delays prevented completion of the installation until March 4, 1947, when WWDT (later changed to WWJ-TV) began broadcasting experimentally on a limited, but regular schedule. The early programming was limited to test pattern, with a musical background. WWJ-TV began its adult life as Michigan's first commercial TV outlet on June 3, 1947. The first day's menu included a telecast of a Detroit Tigers' baseball game at Briggs' Stadium. WWJ-TV has since maintained a minimum broadcasting schedule of 28 hours per week, which is a condition of its operating license.

The Installation

WWJ-TV uses two studios, one located in the Detroit News Building at Second Boulevard and Lafayette; the other is located in the WWJ Building across the street. Each studio has its own control room, where the pictures from three floor cameras are monitored; if a scene is being televised simultaneously by several cameras, which is the usual case, it is the job of the director, who is located in the control room, to select the picture from the camera whose perspective is most suited to the sequence being presented. The selected picture signal, and its associated sound signal, are piped by coaxial cable to a master control panel in the main control room, located also in the Detroit News Building. One end of the main control room is devoted to film televising equipment, which is also connected coaxially to the master control panel.

The transmitter and transmitting antenna are located atop the Penobscot Building, rated at 588 feet above street level.

WWJ-TV also operates an RCA remote-pick-up truck, used to televise its out-of-studio programs. The remote installation includes two cameras, and auxiliary equipment. A power system is built into the truck, so that the entire equipment can be operated in the absence of an external power source. The selected picture from the remote cameras is beamed by a microwave relay transmitter to the top of the Penobscot Building, where it is received, and piped by coaxial cable to the master control panel in the main control room.

Paul Williams and the remote cameras follow the puck at a Red Wing hockey game.

Still another video cable connects the master control panel to the Bell Telephone Building, which supplies WWJ-TV with shows from the Midwestern television network.

The final step of the selection process takes place at the master control panel, where the video control engineer has, at his fingertips, pictures from either of the two studios, the film projection equipment, the remote-pick-up truck, or the network line. The final selected signal is piped coaxially to the transmitter in the Penobscot Building, where the program is "put on the air."

About WXYZ — TV

Station WXYZ-TV, owned and operated by the American Broadcasting Company, began its commercial life on October 9, 1948. It has carried programs from the ABC network since its inaugural day, which featured the MSC-Notre Dame football game.

The station operates one remote-pick-up truck, equipped with three cameras, and micro-waved to the top of the Maccabees Building. All other equipment, including transmitters and two complete studios, is located in the Maccabees Building.

The WWJ-TV remote cameras will bring the State-U. of M. football game into your home next fall.

The Voice of Experience

In a recently televised panel discussion of TV employment conditions, Mr. Harry Bannister, general manager of WWJ, WWJ-FM, and WWJ-TV, was asked this question: "Why is it that after years of college training, leading to a B.A. or M.A. degree, the young announcer still has difficulty in securing a position with a TV station?" "Experience!", answered Mr. Bannister, and went on to explain in detail what he considered were essential attributes of a good announcer. At the end of the discussion, the camera was switched to the studio announcer, who, in his most professional monotone, and with a perfectly straight face, made his stock closing statement:

"The opinions expressed on this program do not necessarily reflect the views of the management. . . . This is station WWJ-TV . . ."

What's in It for Me?

"Most New Yorkers who buy television sets do so primarily to see sports events." (Market Research Service, quoted in the *Detroit Free Press*, October 8, 1948.) Anticipating a similar reaction in Detroit, WWJ-TV and WXYZ-TV have made sports events an important part of their programming. WWJ-TV has presented: horse racing at the Fair grounds, baseball at Briggs' Stadium, U. of M. football at Ann Arbor, Red Wing hockey at the Olympia, stompin' at the Savoy, basketball, bowling, midget auto racing, swimming, wrestling, boxing, in short, just about everything except a crap game. WXYZ-TV, showing excellent taste by televising, as the feature of its opening day, the football game between Michigan State College and a well-known independent operating out of South Bend, has gone on to present wrestling from Fairview Gardens, Detroit Lions fotball from Briggs' Stadium, World Series baseball from Cleveland, the Catholic Youth Organization football games, etc.

In the future, Detroit can be sure of enjoying outstanding baseball games from just about any major-league city; all Notre Dame home football games; all U. of M. home football games; ditto for the Detroit Lions. In particular, barring the unforeseen, this year's MSC-U. of M. game will be telecast to the Detroit area.

Sports, of course, haven't been the only fare. Films, puppet shows, election returns, variety shows, symphonies, panel discussions, plays, sports demonstrations, Michigan State College football, newscasts, MSC football, and many other exciting events have been televised with more or less success.

The location of WJBK-TV's studios in the Masonic Temple will bring Detroit's outstanding musical events to the video audiences.

As for film, we quote from the October 8 *Detroit Free Press*: "Hollywood's present decree is that no feature films may be used on television until they have had seven years of theater distribution."

Father Flannegan of Boystown was one of Ted Grace's guests on the WWJ-TV evening news program.

Educational TV of the future will not very likely include college students, owing to make-up difficulties. The *Detroit News*, in its February 11, 1948, issue states: "Circles under the eyes are greatly exaggerated."

The Telegenic Correspondent

An amusing illustration of the sharp difference between radio and television techniques cropped up at the Democratic National Convention in Philadelphia.

The American Broadcasting Co. had arranged for a combined radio and video broadcast from the lobby of the Bellevue Stratford Hotel at noon on opening day. Gordon Fraser, veteran ABC war correspondent, had been stationed at the microphone in front of the television cameras.

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MUCH ADO ABOUT RUBBER

HENRY L. McFALLS CHE JR

It can be said that chemistry's greatest war-time achievement was that of fabricating the synthetic rubber industry.

1940 WAS A CRITICAL YEAR in the history of free-thinking men, for it was at this time that the Office of Rubber Reserve instituted and guided the stockpiling of rubber in the U. S. In 1940 we had 125,000 tons in excess of our immediate needs. By December 7, 1941, we had stored up 634,000 long tons of that precious material. Now 634,000 tons of rubber does not sound like much to start a war with, but it was hoped that it would be sufficient to carry the country's need until such time that synthetic could be produced in quantity. The realization of that goal was to result from the largest industrial undertaking ever attempted by man. Fortunately, the rubber industry had done considerable "test-tube" experimentation and some small scale production, but the job of expanding to large scale production was a colossal undertaking. Whereas the automobile industry came into its own in about 25 years, mass synthetic rubber production was afforded no such leisure. Three years was the limit and that deadline was met to the extent that in 1944 the new industry was producing 850,000 tons annually. America's rubber independence had become an accomplished fact. Most of the rubber produced during these war years was of a single type labeled GR-S (Government Rubber-Styrene) and by mid-1945 production of this famous formula marched to the tune of one million tons a year. GR-S wasn't a perfect rubber by any means, but it was the best to be had at the time for general purpose. Other specialties appeared as their need was felt.

Problems of the Industry

Since the war's end, the main interest within the synthetic rubber industry has shifted from solving production quantity problems to that of perfecting and diversifying the products. To be more specific, tire manufacturers are looking for special polymers for particular uses, such as treads, heavy duty carcases and inner tubes. White sidewall tires have always presented a particular problem in that the wall stock has had a tendency to crack and check in service. This latter difficulty can be overcome by the use of antioxidants, but the present available antioxidants when used in sufficient quantities to overcome cracking cause the white stock to turn brown. This was one of the first problems taken on by researchers after the war.

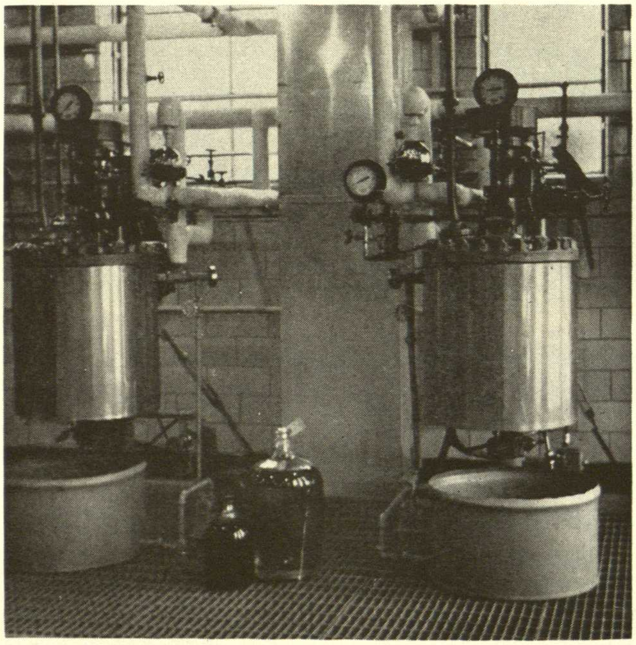
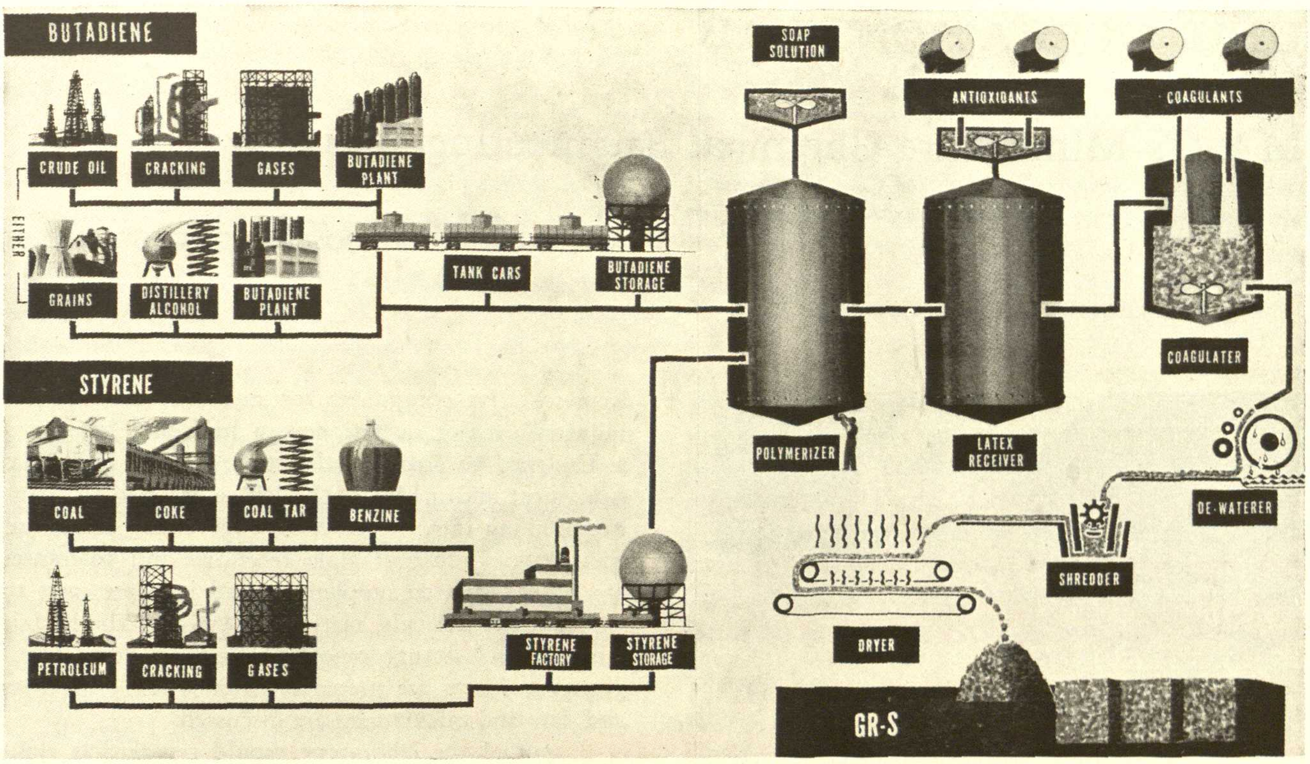


Figure 1. Two pressure reactors used in copolymerization of GR-S synthetic rubber.

In production it was found that one of the favorable characteristics of American made synthetic rubber was that it had less tendency to scorch in processing than did corresponding stocks of natural rubber. The manufacturing processes established during the war were on operating speeds best suited for the manufacturer of synthetic stocks. Since, however, the re-introduction of natural crude rubber has presented a problem in that the operating speeds have to be adjusted again to suit both types of raw material. Outsiders may find it surprising but there still remains a need for precision control of vulcanization processes. It has been estimated that this inability has cost at least one of the large rubber manufacturers in excess of a million dollars a year in material loss alone. Research must find better vulcanization retarders which will, in effect, inactivate accelerators, or sulfur, in such a way as to permit more precise control.

Another major problem research is attempting is the development of a pigment having all of the admirable characteristics of channel black, but lacking that very undesirable high hysteresis or heat build-up effect which so often results in blowouts.

In numerous other industrial products divisions, it has been found that rubber parts made from most



Above are shown the six major steps of GR-S production. The process beginning with the manufacture of the polymerization monomers.

of the commercially available rubbers change properties when subjected to temperatures below —10° F. indicating a need for more tailor-made rubbers. This deficiency has been especially prominent in the case of sealing gaskets for low temperature operations. Conversely, the trend in the industry to higher operating temperatures requires more heat-resisting adhesives, tank linings and allied products of sufficient quality to satisfy the growing demand.

Last, but not least, is the need for more tools so that the development engineer may better evaluate and make use of new properties not heretofore considered. Indeed, apparently simple questions such as these have come to the engineer's attention: What makes a fan belt squeak, and how can such a belt be tested to determine whether or not it will squeak? These and many other problems are uppermost in the mind of research chemists and engineers.

Goodrich Development

While these are examples of the more common variety of everyday problem, the rubber industry today has its main spotlight focused on an horizon of unlimited research. High-powered wartime research uncovered many new products and processes in the world of organic chemistry and syntheses which are encouraging and necessitating extensive research programs within many fields today.

B. F. Goodrich, alone, has invested a tidy 6,000,000 dollars in the future by building one of the most, if not the most up-to-date research center in the world. Its design is such as to accommodate multifarious exploitation in the field of natural and man-made elastomers, and any such adjacent sphere of chemical and engineering curiosity as may be thought worthy of investigation. The plans for this new laboratory were originally conceived in 1942, but before ground was broken in 1946 many vital considerations had to be taken into account. To mention a few of the major decisions will illustrate the layman's picture of how important proper planning is in such an undertaking.

1. Research at Goodrich was designed to be a long range proposition involving problems not necessarily pertinent to present, now immediate future, production, but none-the-less fashioned to anticipate the growth of the company into permanent and profitable activities.

2. Previously the research department was all too frequently called upon to go on bug-hunting expeditions along the production lines. To avoid this inconvenience as well as get away from the undesirable noise, dirt and vibrations born of the city, it was decided that the new center should be located somewhere outside of the city of Akron.

3. As to the exact location it was found that in order to avoid these vibrations, which might easily disturb supersensitive recording instruments, the buildings must be at least one mile from a railroad and 75 yards from any highway bearing heavy trucks.

4. Utilities such as water, gas and electricity had to be constantly available in large quantities and . . .

5. It was necessary to have a location affording

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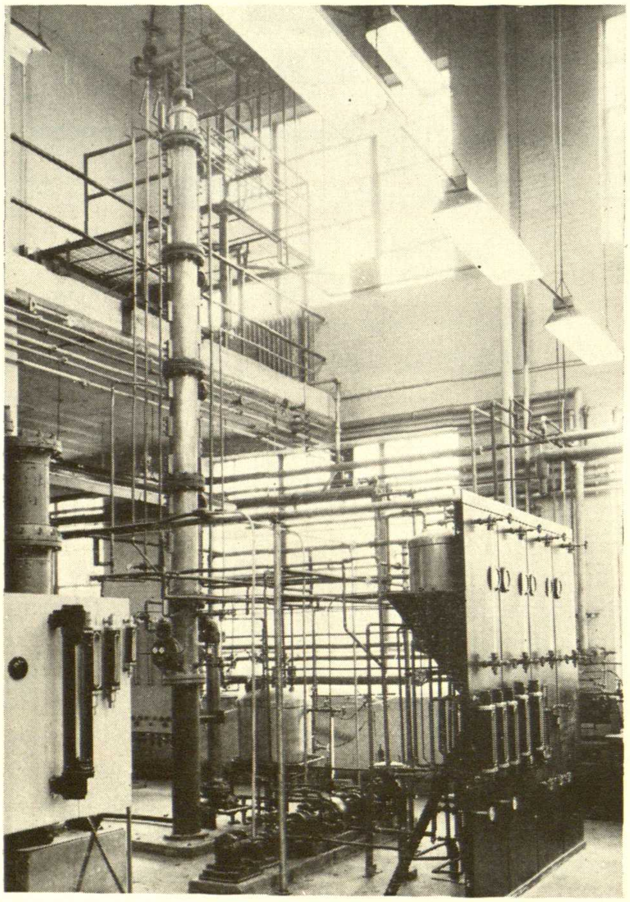
UNIT OPERATIONS LAB

M S C's Minerature Chemical Engineering Industry

JOHN S. GREGOR CHE SR



The new Vulcan 24 plate distillation column located in the Chemical Engineering building.

THIS IS A SECRET of the chemical engineers which we are now exposing. One of the reasons for the heightened interest in the unit operations laboratory north of the Electrical Engineering building is the new Vulcan fractional column.

This is essentially the same type of distillation column used in the alcohol industry to refine the product of fermentation. Although it probably won't produce bonded scotch, nevertheless there is a gleam in the chemists' eyes as they emerge.

The Vulcan 24 plate fractional column which operates upon the theory of separating a liquid mixture by vaporizing the various components at different temperatures and pressures, is only one of the many industrial units which comprise the laboratory. Representative equipment for most of the chemical industry's major operations can be found here.

Designed to acquaint the student with industrial equipment and methods, the lab serves also to channel thinking into the practical engineering aspects of chemistry. Industrial scale reactions and tolerances are learned here to supplement and in some cases to supplant the test tube methods learned in the Kedzie laboratories. Actual reports following general engineering forms are prepared from work done here and data and calculations are discussed.

A tour of the laboratory would reveal that eight of the major unit operations of industry are dealt with. They are: fluid flow, drying, heat transfer, filtration, crushing and grinding, evaporation, distillation, and gas absorption.

Fluid Flow

In the lab, studies are made of the loss of pressure due to friction in a pipe, the flow of fluid through an expansion and contraction, measurement of flow by a constriction in a pipe, and the measurement of gas flow with a pitot tube.

Practical applications of these problems concern every engineer. The simple acts of turning on a faucet, asking for 50 cents worth of gasoline, or ordering a draught beer at the local pub involve fluid flow problems. Manufacturing, delivery, and disposal facilities are all concerned.

Heat Exchange

Most people don't think of an automobile radiator as a type of heat exchanger similar to their new electric refrigerator, but in principle it is. Heat is taken from the engine by water and passed into the air through the walls of the radiator; whereas in the heat exchangers used commercially hot water or steam is used to heat cold water.

In the lab corner devoted to heat exchange units there is a Bell and Gossett multi-tube exchanger which fundamentally consists of several pipes surrounded by a jacket. Cold fluid passes through the pipes and is heated by steam condensing in the jacket.

Another type unit assisting in holding down this corner is an ammonia type concentric tube exchanger which is a small tube inside a larger pipe. Heat is transferred from a hot fluid in the larger pipe to the cold fluid in the tube. This process serves a double purpose: it serves to cool the hot fluid, as in a refrigerator, or it heats the cold incoming feed to process temperature.

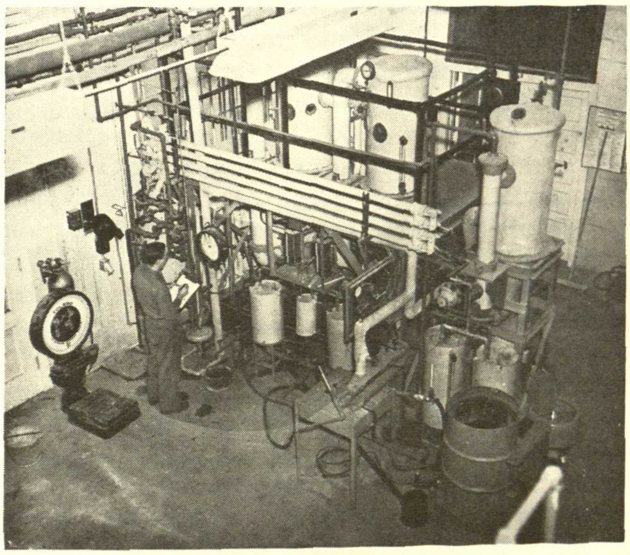
Evaporation

The principle of the multi-tube exchanger serves another purpose, evaporation. By passing steam through the inner pipe and surrounding it with a solution, a portion of the solution can be driven off by evaporation leaving behind a concentrated solution or a suspension of crystals. This is, in effect, what causes boiler scale when water is driven off and the less volatile compounds in the water remain behind.

A Vulcan single effect evaporator with a salt filter is used to boil down a liquid to the desired concentration after which it is drawn off. This type of evaporator is used when substances which crystallize out are involved.

A multiple effect evaporator, also in the lab, combines several single effect units to concentrate the feed gradually as it moves from one evaporator to the next. This type is used for many jobs which the single effect unit can not handle.

Differing from the evaporator in that it separates various liquids instead of a solid from a liquid is the distillation unit mentioned before.



Mr. Livingood, of the Chemical Engineering Department, taking data on the heat exchanger. In the background is the multiple effect evaporator.

Gas Absorption

So far, separation of a solid from a liquid and separation of liquids have been considered. A look into gas absorption, or the separation of a liquid from a gas or the separation of two gases is now in order.

In industry it is often economically sound to recover certain gases from a process and sell them as by-products or use them in other reactions. Carbon dioxide, for instance, retails at sixteen dollars per hundred pounds. On the other hand, certain gases are undesirable in a product, and must be removed to make the yield commercially usable. Hydrogen sulphide, the familiar "rotten egg" odor, if present in gasoline, not only smells bad, but corrodes the cylinder walls and other parts of the engine as well.

A gas absorption tower works primarily like "Airwick" and other deodorizers now on the market. In order for a person to be able to smell something, the odor must be in the form of a vapor, and the Airwick selectively absorbs the objectionable vapor from the air to the liquid in the bottle.

In an industrial absorption tower this effect is achieved by spraying a liquid for which the desired gas or vapor has great affinity down the tower. At the same time the mixture of gases and vapors is passed up the tower, thus obtaining the desired transfer.

The absorption tower in the lab has been set up to remove carbon dioxide from other gases. The student is asked, through knowledge gained in working with this tower, to design an actual industrial tower of his own to meet certain given specifications.

When a solid substance is insoluble in a liquid, such as clay in water, mechanical separation by filtration can be accomplished. The action of this process is that of a strainer with the solid particles left behind as a moist "cake" and the liquid passing through the strainer or filter medium.

The laboratory experiment covering this operation is built around the economic aspect of engineering. As mentioned previously, three of the most widely used industrial types of filter press, the Oliver rotary drum type, the Sperry plate and frame, and the Sweetland leaf type are run by the student. With the data gathered, plus certain figures given concerning the initial cost of each machine, labor costs, etc., the student is asked to decide which press is best for a given set of conditions.

Here, as in all the operations, is a task directly related to the work that the chemical engineer is required to perform in industry. And, once again, the work required is practical as well as educational.

Drying, or the separation of a small amount of liquid from a large amount of solid by vaporization, plays a major role in many industrial processes. Soap chips and corn flakes are but two of many products which must be dried before they are ready for public use.

Commercially, a dry gas, usually air, is passed over the material to be dried and takes moisture from it. The main problem is to have the air at just the proper humidity so that the right amount of moisture will be removed and the product will be uniformly dry. Actually, drying is a specialized form of the evaporation principle.

The operation at Michigan State is performed with a Koch batch type duct electrically heated drying oven and is concerned with the drying of a sand

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THEN AND NOW

PROFESSOR M. M. CORY

Professor Cory

IT DOESN'T SEEM so very long ago, although it was 40 years this spring, that I started the General Electric Test Course in Lynn, Massachusetts. Having graduated from college the previous June, I had all of the late graduate's convictions about the amount of knowledge I had absorbed during the previous four years. My ideas soon changed.

The starting "salary" was 20 cents an hour and a week was 55 working hours. That was great—both the pay and the hours. Looking back six years before that, I started out as a machinist's apprentice earning seven and a half cents an hour and putting in 60 hours a week. The weekly "take home" pay was four dollars and a half, and in those days it wasn't just peanuts. But to get back to G. E., by working overtime my average pay was 12 to 14 dollars a week and once it was 19 dollars and 60 cents—riches!

The two years of the course, completed in 21 months by working overtime, were all spent on the test floor. We were taught all of the standard and many special tests on small (1 to 20 horsepower) motors and generators, railway motors, arc lighting and arc light photometry, meters and instruments, current potential and current transformers and finally turbines and turbo-generators. That covered nearly all of the main products of the plant.

Graduating from the test course my next job was with the Janesville Electric Company in Wisconsin. The salary was 75 dollars a month. The work was general, including the mapping of the transmission and distribution system, checking meter test activities, installing a water wheel, etc. It was good experience, but ended very suddenly when the manager and I had a disagreement—he won.

Two days after the disagreement I went to work as an investigator in the commercial department of the Milwaukee Electric Railway and Light company. A salesman would dig up a prospect and one of us would visit the prospect's plant, collect and analyze all the necessary data in order to find out whether it was feasible to convert from steam to electric power. The man under whom I worked, an Ohio State graduate, was a stickler for facts and wanted a true report even if it meant losing a prospective customer. The pay was the same as before but in those days (1912) that was not so bad. It was about this time that I thought seriously about teaching as a life work. I had had a little experience in that line while in college, substituting for the instructor in woodworking who resigned during the school year.

The foregoing was THEN.

The picture now is different. With the great advances in the theory and practice of electricity the content of the electrical curricula has undergone a decided change. The fundamentals are the same (it is MKS now instead of cgs) but the applications have increased by leaps and bounds, sometimes theory leads practice—sometimes trails. Our text books in the old days hardly mentioned the electron, complex quantities were just appearing and differential equations and hyperbolic functions were for math students, not us engineers, unless we took a P. G. course. As it is now, we are not bothered as to what to give the student, but what to leave out without doing too much damage.

Now our graduates (at least some of them) enter training courses which include some of the things we had, but in addition, electronics with all of the ramifications, radio, television, highly specialized motor control systems, transportation equipment for land, air and water, and so on to three decimal places.

And the starting salary expected by our graduates has gone through the same progressive development until now a mere $250 a month is almost an insult to a college-educated man, even though he does not know the difference between an ohm sifter and a pillar impedance. Of course, times and prices have changed; then, eggs 15 cents a dozen, now 80 cents; then, milk 6 cents a quart, now 21 cents, and so on. I even remember buying a mighty good suit in one of Boston's good stores for eight dollars and a half. You pay nearly as much for a necktie now.

I am nearly done rambling, but there are a few things our seniors should think about when they leave college and here are one or two of them.

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Annual Concrete Conference Held at MSC

The first annual Michigan Concrete Conference was held at Michigan State College December first and second. The conference was sponsored by the MSC School of Engineering in cooperation with the Michigan State Highway Department and the Portland Cement Co.

The conference, first of its kind held in Michigan, was designed for general contractors, road builders, architects, municipal and county engineers, ready-mix concrete dealers and consulting engineers.

The welcoming address was delivered by Lorin G. Miller, Dean of the MSC School of Engineering. Highlights of the Wednesday program were talks by William Lerch, applied research manager of the Portland Cement Association, on "History and Basic Principles of Air-Entrained Concrete." "The State Highway System as a Contributor to Education" was discussed by Highway Commissioner Charles M. Ziegler.

Included as speakers on the Thursday program were E. A. Finney, research engineer of the Michigan State Highway Department; Stanton Walder, director of engineering of the National Ready-Mixed Concrete Association, and Harry L. Concord, director of the Michigan Chapter of Associated General Contractors.

Well - - - Water!

In an experimental study of the ground water resources in the local area, conducted by Henry Schwabe, Sr. CE, it has been found that the piezometric surface has steadily declined.

Water consumers in this area, Lansing and East Lansing including MSC, have all greatly increased their pumping of this heretofore unlimited supply of well water. The steady decline of static levels tends to raise the question, is the area being overdrawn, is it unlimited, or has this tremendous increase in pumpage just lowered the static head locally?

Much interference in pumping has already appeared in the local pumpings, between stations. So, it is a condition that exists that should be met with and discussed by those concerned before it becomes a problem.

Engineers Now Have Own Radio Program

Every Monday evening at 6:30 over the college station WKAR—FM the School of Engineering presents a 15-minute radio program entitled, "Blueprint Record."

Sponsored in cooperation with the local chapter of American Society for Engineering Education, Blueprint Record presents news and scientific developments in the field of engineering. Each week some member of the Engineering school will discuss topics in his field. Prof. Chester L. Allen, head of the department of civil engineering, is supervising the program.

James T. Anderson, instructor in mechanical engineering, is representing ASEE in planning programs and assisting with supervision.

Noted Physicist on Campus

On Friday, Nov. 19, Dr. Joseph Kaplan, widely known physicist of the Institute of Geophysics, University of California, spoke on the subject "The Upper Atmosphere of the Earth" in the auditorium of the Kedzie Chemical Laboratory at Michigan State College. Dr. Kaplan is now head of the physics department at the University of California. In his lecture he discussed the physical aspects of the upper atmosphere and the role that the "V-2" rockets are playing in upper atmosphere research.

The appearance of Dr. Kaplan was sponsored by Sigma Xi, scientific research fraternity.

Illuminated "Announcements" Cabinet

An innovation in the form of a unique artistic announcement cabinet attracts attention on entering the Olds Hall of Engineering.

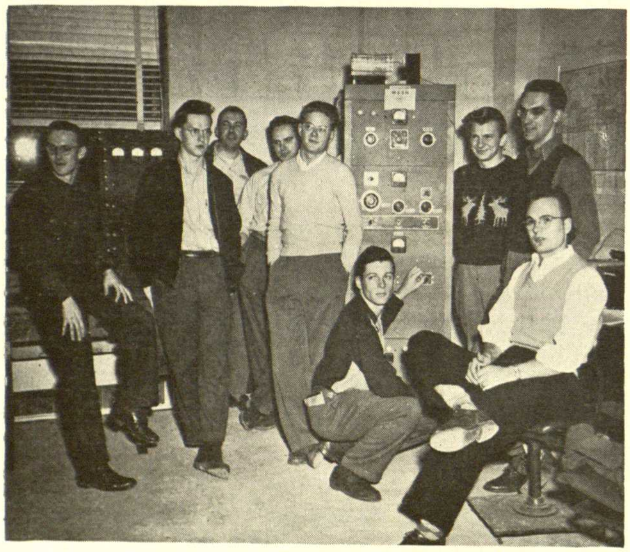
The illuminated announcement board will supply a definite need for publicizing various types of engineering meetings and facilitate the work of the College Placement Bureau in making announcements as to time and place of meetings with field representatives from the various industries and employers here to interview M.S.C. engineering graduates and seniors. According to Professor Stanley Radford, part-time Engineering Placement Counselor, the problem of "getting the word around" has always been a difficult one, especially since representatives from industry often come on short notice.

The idea for an "eye-catching" announcement board started with Prof. C. L. Allen, Chairman of the Engineering Publicity Committee. The design of the illuminated announcement cabinet was the result of "teamwork" by "Norm" Sedlander and "Stan" Radford, both teachers in the Engineering Drawing department. Mr. Sedlander contributed the artistic concept and Mr. Radford worked out the construction design of the cabinet by making the necessary working drawings and had general supervision of its construction and installation.

The construction of the cabinet was made possible by the fine workmanship and coperativeness of Mr. George Posthumus, Patternmaking teacher.

The M.S.C. Radio Club

The M.S.C. Amateur Radio Club has been enjoying some fine lectures and demonstrations immediately following the usually brief business meetings each Thursday evening. One of the demonstrations given by Mr. Mert Nellis on types of antennas, propagation, and polarization effects was thoroughly enjoyed. Recent interesting lectures have included a discussion of the frequency response and design of audio amplifiers by Mr. Frank Pelton, a lecture on the principle of the Clapp circuit by Mr. Reickord, and pulse modulation techniques by Mr. Kramer. Mr. Eibert has also given a talk on his C. W. keying monitor, which was published in QST last year.



Amateur Radio Club holds weekly meetings. Licensed members and officers are (left to right), Lee Kistler, W8ZCI; Jim Strang, W8YAP; Bud Chaney, W8UMI; Mert Nellis, W8CNC, Faculty Advisor; John Neuman, W8UEO, Club Station Trustee; Dick Goldfogle, SWL, Club Treasurer; Ken Kortge, W8AHT; Art Craig, W8AGJ, Club Secretary, and Ed Nessman, W8ZKU,

The club station, W8SH, is again on the air and open for transmitting *radiograms* to almost any part of the world. This is a free service on the part of all radio "Hams," the world over. Last year the club broke its previous records in originating, relaying, and receiving messages. Its latest has been the relaying of a message from Peru to a student at M.S.C. The "shack" is now located in the tower of the new E. E. building, and a fresh supply of radiogram blanks is available.

Due to enthusiastic response, plans are being made to continue the code and theory classes for those interested.

At present there is a 300 Watt, 75 meter phone transmitter in operation. A smaller 50 Watt transmitter is being used for 80 meter C. W. operation. This unit is a war surplus transmitter with a self contained variable frequency ocilator. The 40 meter code transmitter is similar to the 80 meter code transmitter. Jim Strang, a senior member of the club, has kindly loaned his 10 and 11 meter radio phone transmitter to the club. Preliminary reports indicate that its operation is quite good. The club's communications receiver is a war surplus BC—348Q on loan from the E. E. department.

The club doesn't believe in all work and no play—plans are now being made for the annual field day and picnic during spring term.

American Society of Agricultural Engineers

During Christmas vacation the club room was decorated and furnished. It will be a pleasant place where club members and Farm Machinery short course students can spend those hours between classes.

Farmers' Week will take place January 24-28. During this week there will be a display in the club room depicting the various fields in Agricultural Engineering, as well as some of the newer developments in those fields. Club members are going to serve as guides in the Agricultural Engineering Building; they will explain some of the new machinery and equipment to be displayed there.

At the November 23rd meeting a very interesting talk was given on Lubrication by Mr. Hinkle of the Standard Oil Company.

A movie on Sugar Beet Harvesting was shown to the club at their December 7th meeting.

Officers of the ASAE are (left to right), Robert Kleris, Reporter; James Boyd, Faculty Advisor; Donald Feather, President; Allen Gillette, Vice President, and Vernon Clark, Treasurer.

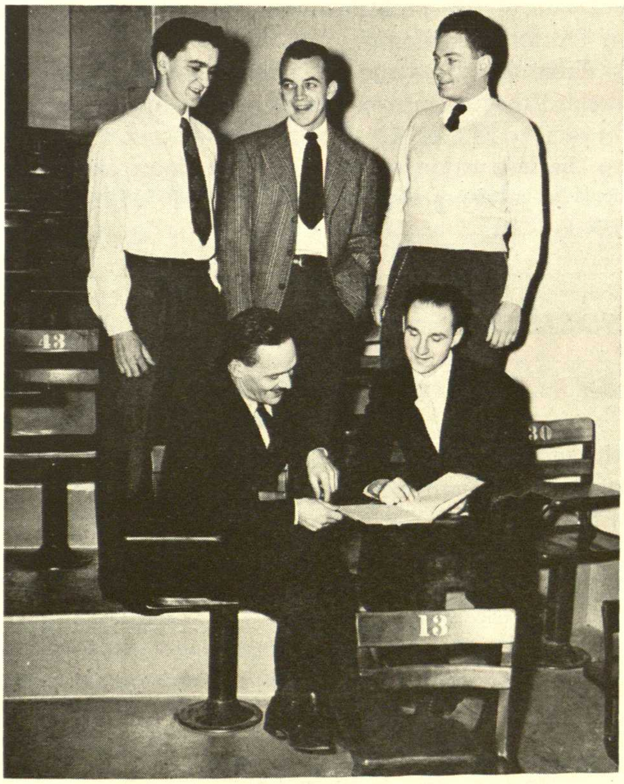
Pi Mu Epsilon

The National Mathematics Honorary Society at M.S.C. meets approximately every two weeks.

Officers this year include: President, James Powell; Vice President, Robert Houston; Secretary, Dale Hekhuis; Treasurer, Wendell Grove. Faculty advisors are: Dr. James H. Bell and Mrs. Barbara Houston.

Meetings for winter term will be held on the following dates in room 105 Berkey Hall: Tuesday, Jan. 18; Tuesday, Feb. 1; Tuesday, Feb. 15 (Banquet this date); Tuesday, March 1.

Meetings are open to all persons interested in the field of mathematics.



Officers of the AIChE: Standing (left to right), Reporter John R. MacKenzie, Treasurer William S. Springer, and Secretary Charles C. Sisler. Seated (left to right), Faculty Advisor Randall W. Ludt, and President Wilbur W. Kennett.

Tau Beta Pi

The Michigan State chapter of Tau Beta Pi, national engineering honorary, initiated thirty-eight new student members and two faculty members on Nov. 11. The requirements for admission are a 2.00 or better all-college average as well as high standards of personal qualifications. The two new faculty members are Lorin G. Miller, Dean of Engineering, and F. R. Theroux, widely known for his work in sanitary engineering.

A banquet was held at Hunt's dining room immediately following the formal ceremony. The speaker was Harry C. Coons, Deputy Commissioner and Chief Engineer of the Michigan State Highway Department. Mr. Coons spoke on "The Organization of the State Highway Department."

Sigma Pi Sigma

The National Physics honor society at M.S.C. now numbers 34 active members and is led this year by John Brinkman, President; Harry Macy, Secretary; Dick Kropschot, Vice President, and Robert Houston, Treasurer. Faculty advisor is Dr. Noble of the Physics department.

The SPS's held an outing at the WAA Cabin on Oct. 19 with the American Blue Plate special, THE HOT DOG.

On Nov. 2 a business meeting was held at which time recommendations were accepted for new members.

The new candidates were received into membership on Nov. 19. Those included as new members were: James M. Marnes, John L. Bottum, Chuan T. Hsiung, Yu Chi Lin, Marjorie R. Petersen, Mary E. Williamson, and Harlan V. Ogle.

In addition, at this meeting a lecture and demonstration was given of a Spark Source which is given birth from 110 volts via a transformer into 2,000 volts and whose gap is used for analytical work with the spectograph. The materials being tested is used as the electrodes. Mr. Weeks of the Physics department presented this lecture with the demonstration.

A meeting on Dec. 5 resulted in a demonstration by students John Bottum and Bill Warren of some of the more peculiar phenomena of liquid air in which

WE PRESENT

JOSEPH A. STRELOZZ

FROM THE BEGINNING Joseph A. Strelzoff, now Professor Strelzoff of the M.S.C. Electrical Engineering department, seemed headed for high scholastic attainment.

Born in Russia, his first academic stop was the Alexander III Institute of Technology in Charkow, the Russian equivalent of America's M.I.T. However, his stay there was not to be long. He was drafted for military service, and at the outbreak of the revolution he was in Odessa at the Prince Sergei Military School for Artillery Officers.

Strelzoff fought with the Imperial Army and participated in the last Russian offensive against the Germans during the premiership of Kerensky. This was followed by two years service in the White Army.

After the defeat of the White Army, Strelzoff fled to Turkey and from there gained admission to England. Staying in England a year, he went next to Belgium where he entered the University of Liege. Being a refugee without any funds whatsoever, he tutored his fellow students to pay his way; sometimes even tutoring students in his own classes.

After graduating from the University of Liege in 1923 with a degree in mechanical engineering, he took a position with Constructions Electriquer de Belgium, where his future looked very promising. By November, 1928, Strelzoff had been promoted to the position of technical secretary to the chief engineer.

Ten days after receiving this promotion, he was notified that his visa for entry into the United States had been granted. He had been told previously that it would be thirty years before his turn would come up on the Russian quota. The consul informed him that the regulations had been changed to let the consuls themselves decide who would make the most desirable citizens, and that Strelzoff had been picked for the next group.

Upon arrival in the United States, Strelzoff took a job with a Boston firm of consulting engineers. Later he worked in New York and then in Pennsylvania. While working for the Pennsylvania Power Co., he took graduate study in power transmission at Lehigh University. He worked on system stability problems while at the Pennsylvania Power Co., and becoming more interested in these problems, he accepted a fellowship at Cornell University. He wrote his master's thesis there on system stability.

Finishing that, he was assigned a problem by the General Electric Company on the undeveloped field of grid-controlled thyratron tubes. He presented his solution of this problem as his thesis for the degree of Doctor of Philosophy.

From there he went to Keystone College where he decided that he enjoyed teaching, and following this he came to M.S.C. Dr. Strelzoff now devotes his time to the instruction of senior and graduate courses as well as advising the local chapters of A.I.E.E. and I.R.E.

SOCIETIES

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the audience participated after the presentation. Some of these peculiarities include making a lead bell assume vibrant tones, and making a "spring" out of solder, or splintering a banana or a hot dog upon being dropped to the floor.

Plans for winter term are not complete but a banquet is planned for new members sometime in February.

American Institute of Electrical Engineering and The Institute of Radio Engineers

As acting secretary, Don Morgan, Jr., E.E., is replacing Mac Doolittle who recently shipped to England for an English bride. Mac is expected back sometime in March.

Present plans of the AIEE's and IRE's include:

Wednesday, Jan. 12—A film on COPPER at which time a regular business meeting was held. Chalmers Mfg. Co. of Milwaukee, Wisconsin, spoke on Common Misconceptions on Electrical Engineering.

Future plans will include speakers from RCA, Stewart-Warner, and Michigan Bell.

American Society of Mechanical Engineers

Mr. J. J. Edwards, who is General Methods Engineer for Oldsmobile, gave an interesting talk during the November 3rd meeting. Mr. Edwards explained the type of work his department was doing, which included the explanation of the Act Chart, Operator Training Sheet and the layout of the General Methods Department. A slide film was shown which traced a simple operation and then showed how it could be improved.

The speaker for the meeting of November 17th was Dr. Ernest J. Abbott of the Physicist Research Company of Ann Arbor. The topic was "Use of the Profilometer." The Profilometer is a direct-reading instrument for measuring surface roughness in definite inch units. With the aid of a slide film and one of the Profilometers, Dr. Abbott explained how it worked and how it was developed.

American Society of Engineering Education

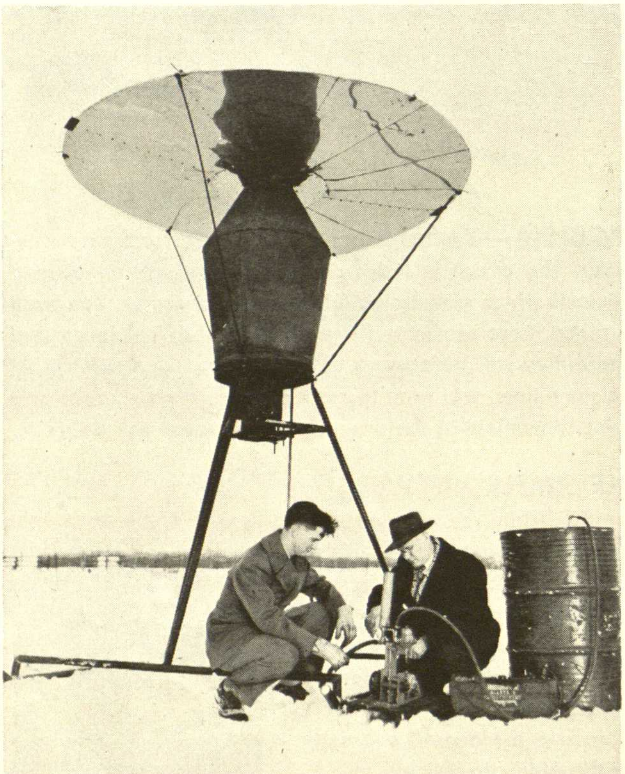
Professor Brattin, as State A.S.E.E. President, announced that M.S.C. would be host for the State meeting to be held here on May 7th. He stated that speakers are being arranged for, and that the local chapter will need to organize immediately to carry out the program.

At present the State of Michigan requires licensed engineers in all state engineering positions except those of lowest rank. Responsible engineers in positions involving public safety must also be licensed. The testimony of licensed engineers as witnesses in court cases is more highly respected than that of non-registered engineers. Mr. Hall expects a bill to pass the state legislature soon defining the engineering positions and ranks which henceforth must be held by registered engineers. In his opinion this bill will affect all responsible practicing engineers in a managing, planning, designing, supervisory, constructional, operational, or maintenance capacity.

Professor McGrady then led a discussion period during which questions on fees, examination procedure, and refresher courses were covered. Dean Miller stated that the college administration would likely sponsor a M.S.C. faculty group in a refresher course to the extent of furnishing space and instruction for the course for prospective licensees.

The second general meeting of the year 1948-49 for the local M.S.C. chapter of A.S.E.E. was held the evening of December 2, 1948, in the main auditorium of the new Agricultural Engineering building; approximately 50 faculty members were present.

Discussion of registration for professional engineering brought out the fact that an examination would be given next June and that it would be a good idea to hold an examination here at M.S.C. if a large enough faculty group prepares for it. It would be more convenient than an examination in Detroit and could offer better publicity.



Pat Hassler (left) explains details of the fuel system to Professor Farrall, head of Ag. Eng. Dept.

Evans Frostguard

The Evans Frostguard is a modern development which has been brought into the operational phase because of extensive frost damage, which in Michigan alone runs from 10,000,000 dollars to 20,000,000 dollars each year. The principle of the frostguard is to replace the energy radiated into outer space by the earth with heat from another source. The frostguard has been an effective way of replacing this lost heat without heating the surrounding air.

The construction consists of a sheet metal heat generator with one reflector which directs the rays in, out and downward, and gives the most efficient operation. One machine burning ten and one-half gallons of fuel per hour has proven very effective in keeping frost damage to a minimum in an area three-fourths of an acre when the temperature was 26° F. In the final analysis, oil and gas, under pressure and vaporized, were found to be the best fuels when used in the machine now in production.

During the past year, 100 of these units have been manufactured and shipped to all parts of the U. S. for testing and proving. The results from the areas were altogether favorable, despite different climatic conditions and geographical topography, and mass production of the machine has been started.

The existence of the frostguard is a result of scientific research at M.S.C. and at the Agricultural-Industrial Foundation of the Detroit Board of Commerce. The men who have done most of the research at M.S.C. are Pat Hassler and Clarence Hansen, both of the Agricultural Engineering department. They are continuing their investigation to find more efficient designs which may be used in later production. Although there is no schedule as yet for placement of the frostguards in a given acreage, engineers at M.S.C. and growers in the field have agreed that the most effective radii for protection is within approximately 100 feet of the machine. It has also been shown that four or more machines operate more satisfactorily, and are more efficient due to their overlapping radiation.

Testing is now being done in the citrus crop areas where the frostguard will be of great importance in replacing the smudge pots now in use.

In the past year the Evans Products Company of Plymouth, Michigan, has taken over the manufacture of the frostguard and production now is in full swing.

Improved Tunnel Lighting

The longest, continuous lighting installation in the world, is soon to be installed in the Brooklyn-Battery tunnel. This tunnel, when completed in 1950, will be one of the world's longest. Each of the tunnel's two tubes will carry two lanes of traffic and will be lighted by twin rows of white fluorescent lamps. A total of 5776 six-foot lamps, comprising the entire installation, will be housed in clear Pyrex "pipe."

This continuous lighting will prevent a succession of bright spots and shadows along the tunnel. Automobile drivers will not be dazzled by the flashing effect of intermittent lighting on other vehicles and on their own hoods and dashboards. Another aid to traffic is the higher intensity of light in the portal of the tunnel during the daylight hours. This will make it safer for motorists to drive from bright sunlight into the tunnel at normal traffic speeds, by allowing the driver's eyes to become gradually accustomed to the lower light level.

The supply of power to the lighting system is so designed that loss of any part of it will not leave any section of the tunnel in darkness. Twelve separate lighting circuits, all in continuous use, will serve each tube.

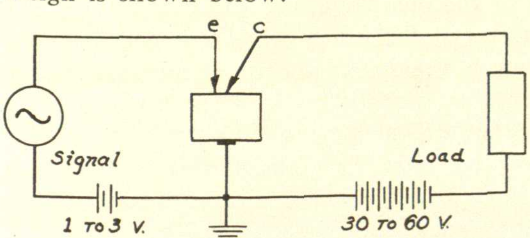
Obsolescence for Vacuum Tubes?

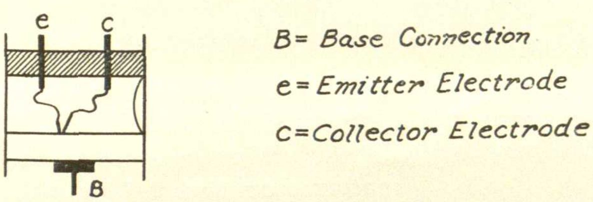
The Age of Electronics may forsake the vacuum tube in its maturity, something like losing one's hair in old age; not very much like it, though. In the Bell Telephone Laboratories, that maternity hospital for fundamental research, an object about the size of a Euphridean peanut has been under careful observation for the past few months. It is called a "Transistor," and it has been performing virtually all of the functions of a vacuum tube, without being a tube, and having no vacuum; we think this is doggone unethical.

The transistor is housed in the same type of cartridge as the germanium crystal diodes that became so famous during the war as improvised chessmen for midget chessboards, which meant a lot to the morale of those midgets. The transistor has been treated with varying shades of gusto in a number of magazines ranging from "Radio-Electronics" (September, 1948), to "Amazing Stories" (February, 1949). In case you should refer to the latter, you will find, on page 124, an excellent sketch of the surface of the moon.

The most conservative and unimpassioned discussion of the transistor we have located to date is contained in a report, by Mr. E. D. McArthur, to the General Electric Company. We have borrowed a copy of the report from Mr. Peterson (whom we thank) of the Electrical Engineering Department, and since there is no first hand evidence available, we are content to quote from this very nice piece of reporting:

" . . . The amplifier unit as used now consists of a germanium wafer .020″ to .040″ thick mounted in the usual microwave crystal holder. It has the usual base connection but carries two contact probes spaced .002″ apart on the opposite face. The general design is shown below.





" . . . The volt-ampere characteristic of the crystal is such that the input resistance (i.e., slope of the positive part of the characteristic curve) is 100 to 400 ohms. The output resistance (slope of the negative part) is 10,000 to 40,000 ohms. The crystal behaves as a current amplifier. If a signal be applied to the positively biased contact, there will be a current change in the input circuit which so affects the conductivity to the output contact that a larger current change occurs in this output circuit. The largest current amplification ratio has been about four. A power gain of 20 db has been obtained with this arrangement up to about one mc. Above this frequency the performance falls rapidly and only an occasional crystal will amplify at four mc. The linearity of amplification was said to be rather good but no distortion data were available. Noise measurements have been made only at low frequency—about 10 kc—when the noise energy was found to be 70 db above the thermal noise of an equivalent resistor. As a power amplifier, they have operated with about 50 milliwatts output. BTL feel that they have only scratched the surface of this field and a tremendous amount of work needs to be done to explore fully the many possibilities. They consider the performance data quoted above as characteristic of this particular unit designed and not the limiting properties of the basic idea. It was quite evident that they expected rapid advances in the art but refused to speculate about what ultimate performance might be achieved."

Synthetic Wood

A new material, which can be substituted for wood panels, is now being produced by Curtis Co., Inc., Clinton, Iowa. This material, called "Prespine," looks like wood, can be handled like wood, and in some respects is superior to actual wood.

The basic raw material of "Prespine" is pine waste. In the manufacturing process the pine waste is ground into fine uniform sawdust, mixed with resin and other ingredients serving as a binder, and the mixture put through a pressing operation. "Prespine" has no grain like natural wood; however, this is due to having no directional alignment of fibre. The surfaces of this synthetic wood are ten times more resistant to denting and have less dimensional changes than real wood. In many other ways "Prespine" reacts approximately the same as natural wood.

The production of this new product should, in future years, help to conserve our diminishing lumber supply.

THE CIVIL ENGINEER

continued from page 5

bers listen attentively to what he has to say. He introduces himself, an attorney for the corporation. and outlines to the council the plans for the new factory and the benefits it will bring to Smallburg. He petitions the council for an extension of the city water lines and the paving of the street leading out to the plant, and side walks. Then he introduces his companion, the plant engineer, a "civil" who informs the council just exactly what is needed with dimensions, amounts and sizes and adds to the petition a request for waste disposal facilities which the attorney had overlooked.

The Council consults its City Engineer, a "civil," as to the feasibility of doing what the corporation asks and whether this may be done at a reasonable cost and whether or not the property that will be assessed will be benefited. The City Engineer, being a foresighted person and well attuned to local gossip and having made some approximate preliminary surveys, is able to assure the council of the desirability of making the improvement. Thereupon the Council approves the petition after a solemn debate and a dignified hesitation that fools nobody and directs the City Engineer to prepare detailed plans and an accurate estimate of the cost.

The scene changes, we are now in the office of Sam Turner, Division Engineer of the North Western Electric Power Corporation. Sam has just returned from a meeting in New York of the board of directors of the corporation and has called a meeting of his own department heads who now are sitting around the table waiting for Sam to talk. They know he has important news. They are all there—even Bill Goodman, the chief of surveys who was out in the hills with his surveyors and had to be reached by a man in a jeep bringing the message from the telegraph office. Bill started back with the messenger, stopping just long enough to put a tooth brush into his pocket and not even bothering to shave.

Sam knows his audience is anxious to hear what went on at the board meeting so he begins a long rambling story of his trip across the continent by plane. Sam is a master of the art of suspense and its a good idea occasionally to let it be known who's boss so he keeps them waiting. But finally he reaches the end of his travel talk and begins to tell what went on at the board meeting. The boys stop squirming and pay attention.

It seems that the directors have decided to develop the Hondo River, get all the power there is out of it by building a series of dams like a flight of steps all the way up the valley beginning at the mouth of the river, making the water turn an electric generator at every dam over which it flows. Sam and his staff

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WHAT'S YOUR BULL'S EYE?

WHATEVER your goal, there's a wealth of opportunity at Allis-Chalmers. For its breadth of operation is unmatched in industry.

Gas turbines, betatrons, induction heaters—more than 1600 ingenious products have made A-C an integral part of every basic industry.

Pick any field—electrical, hydraulic, mining, mechanical. *Pick any type of work*—research, design, production, sales. You'll find them all at A-C... offering a real proving-ground for your talents and training—a real chance for success.

INVESTIGATE

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ONE OF THE BIG 3 IN ELECTRIC POWER EQUIPMENT—
BIGGEST OF ALL IN RANGE OF INDUSTRIAL PRODUCTS!

Write for Book No. 6085, outlining A-C's Graduate Training Course.

Allis-Chalmers Mfg. Co., Milwaukee 1, Wisconsin

have orders to start the surveys and studies for the first of the dams and to have the designs ready by spring so that construction may be started early in the summer.

Sam and his staff start work by separating the project into its parts and assigning each to the proper department. Bill Goodman will have to take the maps made from aerial surveys and get the information more accurately, cover the whole watershed with levels. The hydraulic engineer will have to begin studies to know just how much water is available in the river, day by day, month by month, and year after year. He will also have to determine the proper height to build each dam to generate the required amount of power. Then the designers will start work on the plans and specifications for the dam, the spillway, and the power house. While the office hums with activity, the real estate buyers will be out in the field cautiously dickering for the purchase of the land that will be flooded when the dams are built and the water backs up to form lakes. So Sam and his "civils" have a busy fall and winter ahead of them with lots of construction work to follow. Probably enough to keep them busy for years before the water of Hondo River is harnessed and supplying current for light and power to all that part of the state.

Six months have elapsed since the previous paragraph ended, and we are now in the Chicago office of James Patterson and Son, Incorporated, General Contractors.

Old man Jim Patterson bursts into his private office and dumps a roll of blue prints and a book of specifications onto the table. Then before he takes off his hat and coat presses each one of half a dozen call buttons to summon his department heads. This battery of call buttons is the pride of old Jim's life, for although you couldn't get him to admit it, in the secret recesses of his mind these buttons are the symbol of his success. Quite a long road and a hard one from brick masons helper to president of a construction corporation doing upwards of seven million dollars of work a year.

By the time he hangs up his hat and coat the department heads begin to come in, first of all young Jimmy, he's the "Son," four years out of State where he took the construction option of civil engineering. Then come the other department heads, gray haired and hard boiled veterans of the contracting industry.

"There," says the old man, "are the plans and specifications for the first of the dams that Western Power is going to build on the Hondo River. I had to lay down twenty-five dollars to get them and Western Power is going to pay me back that twenty-five dollars but they'll never know it. Pull up your chairs and let's get busy; we're going to have plenty of competition to meet."

Then brazenly and unashamed without a glance at young Jimmy, he cuts a slice off his plug of chewing tobacco, puts it in his mouth and a minute later makes a bulls-eye on the cuspidor placed out of sight around the corner of his desk.

Then follows two weeks of feverish activity in the offices of the construction corporation. All the numerous questions that must be decided in making up a proposal are brought up for discussion at meeting of the department heads; price of materials, their transportation to the site, what equipment to use, establishing a camp for the men, the labor cost for every operation, bonds, insurance, financing, overhead, contingencies and profit. Every question is argued at length, old Jim and young Jimmy settling their differences and the rest of the department heads mostly holding back except now and then. Young Jimmy is smooth and plausible, full of new ideas; old Jim, red in the face most of the time pounding his fist on the table to emphasize a point, glaring across the table at Jimmy with his "new fangled" notions yet secretly pleased at the way the youngster is taking hold.

When it comes to the last item, the profit, old Jim doesn't ask for advice, just writes a figure at the bottom of the proposal blank and adds it to the total of all the other items and lets the rest of them, including Jimmy, guess at how much he added. He's still the president of the corporation, isn't he? Then with the proposal in his pocket, he puts on his hat and coat, puts his head around the corner of the desk for one last shot that makes the target ring, and starts for the offices of Western Power to turn in the bid.

The three foregoing sketches might have been taken from the life story of civil engineers. They are fictitious and the usual statement that "any reference to any person, living or dead, is purely coincidental" is in order. It would be easy to make up more stories but three are enough to illustrate occurrances common in the career of a civil engineer.

To a young man preparing for a career in civil engineering, I would like to say you are making a wise choice. Civil Engineering is an honorable and useful profession and so is any kind of engineering, but I prefer "civil." It is just as if you should ask me which kind of pie is the best pie—lemon, pumpkin, mince, or apple. I would answer that they are all good, but I prefer "apple."

EDITOR'S NOTE: *This is the first of a series of articles which will be written by the different department heads. Their purpose will be to inform prospective engineers of the duties and opportunities connected with the different branches of engineering, and help clear up some of the questions that the student engineers ask most often.*

THEN AND NOW

continued from page 14

You have been exposed to some mighty good courses here at M.S.C. How much has been absorbed lies with the individual.

The work here has, to a great extent, been from a theoretical angle with some practice thrown in to help out. Therefore, your first few years in the field will be spent in securing the practice and tieing it in with the theory previously obtained.

That means that you are by no means a 10,000 dollar a year man and will not be one for several years. However, with your formal schooling behind you, the realization that your education is not complete and with the ability to keep your nose to the grandstone, there is no question but what you will reach the top of your profession.

Hence, it is advisable to look over the available jobs very carefully. It is a mistake to choose the one offering an exceptionally high starting salary as it is very often simply a blind alley with no future. Take the position which pays a reasonable salary and has the greatest prospects for the future along the lines in which you are particularly interested.

MUCH ADO ABOUT RUBBER

continued from page 11

elements of beauty and accessibility to suitable residential districts. Housing conditions and a community offering the various cultural advantages was of paramount importance in acquiring and keeping a permanent body of personnel. (Being mindful of all the research centers located around New York City for this one reason.)

After these general and countless technical considerations had been deliberated for sometime and a hoard of blue prints had been revoked or altered there evolved the master plan of construction. The site chosen consisted of 314 acres on top of a high plateau half way between Cleveland and Akron. The entire area, beyond that reserved for building expansion, is to be landscaped and there will soon be lots available on which research employees may build. Athletic fields and baseball diamonds will be built in the spring of '49 and generous acreage will eventually be developed for agricultural experimentation plots. Add to this two 4200 foot landing strips and one can envision the scope of this development.

Ready accessibility to public utilities is a must, and in this respect the B. F. Goodrich Research Center is well serviced. Two high pressure gas lines pass through the premises, and 33,000 volts are wired in from Cleveland so that a special regulator station and a sub-station are required, respectively. To insure sufficient water, two reservoirs of 800,000 gallons total capacity lie underground and adjacent to the main buildings. Emergency operation has been contemplated with the installation and supply of oil and oil heat equipment, while emergency lighting in those windowless buildings is always available from evercharged storage batteries.

To date the research center consists of six buildings, all constructed of a light colored brick. Three of these are practically windowless and three stories high. These three larger buildings are built to appear as one structure. However, there is but one corridor connecting them and each has a function distinct and separate from the others.

One unique feature of the construction is the emphasis put on flexibility of floor space. With few exceptions the interior walls are made of painted "optimistic" green sheeting so that overnight a laboratory or office may be remodeled and/or enlarged to suit the occupant simply by removing a few bolts, shifting and resetting the wall.

Starting from the front, buildings A and B house offices, dispensary, assembly room, a 10,000 volume library, conference rooms, cafeteria, dining rooms and most important, a great many of the principal

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chemistry and physics laboratories, where most of the problems get their start. Ph.D.'s are the rule up here, not the exception, and common use is made of such tools as X-ray, ionization chambers, geiger counters and electron microscopy, and the other modern tools so necessary in solving today's fundamental research problems.

Engineers run building C, half of which is devoted to mechanical engineering with physical testing and evaluation laboratories, while the other half is given over to the chemical engineers' pilot plant and laboratories. Both groups have at their service supply rooms and a complete machine shop, well staffed with a variety of skilled machinists and technicians.

The assignment of a problem to the chemical engineering department is a result of test tube and glassware quantity research in building A and B, and appears as a request for a few pounds or a few tons of a new product, or of an old product as born of a new technique. These larger quantity preparations made in the simplest assembly of equipment make it possible to determine more fully the products' usefulness. They serve to acquaint the engineers with the problems involved and permits production cost estimates. If testing, evaluation and cost estimate indicate a basis for continued interest a small pilot plant is constructed for more complete study of the conditions of unit operation.

Various GR-S rubbers are still offering lots of room for investigation, but to mention one of these recipes might suffice. Butadiene, which has been liquified by cmpression and cooling is mixed with styrene, soapy water and several "salt and pepper" ingredients. The mixture is heated and stirred under pressure whereupon the butadiene and styrene molecules link together forming a synthetic rubber emulsion quite similar to latex obtained from a rubber tree. The emulsion is then stabilized by the addition of anti-oxidants, heated and coagulated with acid producing curds. When sheeted out, washed and dried this rubber is ready for manufacturing into finished products.

Many other problems of production not directly related to rubber arise, such as the production of the monomers themselves, or the conversion of by-products to commodities suitable for sale. Often the economic importance of the by-product eclipses that of the product originally sought, but whatever the case a great variety of equipment is essential.

With the need apparent an extensive stock pile of equipment was accumulated over a period of years. Many of the pieces such as pumps, agitators, crushers, heat exchangers, driers, flow meters and temperature recorders are pretty much standard pilot plant equipment. There remained, however, a large number of items such as reactors and stills which had to be especially designed to serve a wide variety of purposes. The use of stainless steel and glass lined steel is general practice, not the exception. Such equipment is purposely designed in somewhat "erector-set" fashion so as to permit accessability for cleaning, and readily facilitate the addition of auxiliary equipment. Figure one illustrates two small pressure reactors especially designed for investigating the emulsion polymerization of such monomers as butadiene and styrene. These reactors have proven their value in obtaining information as evidenced by the development of problems to larger scale equipment, and also permitting the evolution from bath-wise production to continuous flow operation. They are constructed of glass lined steel capable of withstanding 200 psi pressure and equipped with variable speed agitation and delicate temperature controls.

High vacuum equipment is of paramount importance in distilling such materials as would be pyrolized by excessive heat. Several vacuum stills have been built to satisfy the need. Figure two shows a still with a packed and insulated column (at left) capable of being heated by temperature controlled Dowtherm or water. On the right is seen a mechanical vacuum pump capable of reducing the pressure to .05 mm. Hg. and a cylindrical oil booster pump which operates between 200 and 500° C. and lowers the pressure to about .01 mm. Hg. Provision was made for large scale vacuum and fractional distilling towers by having a four-story clearance in a portion of the pilot plant.

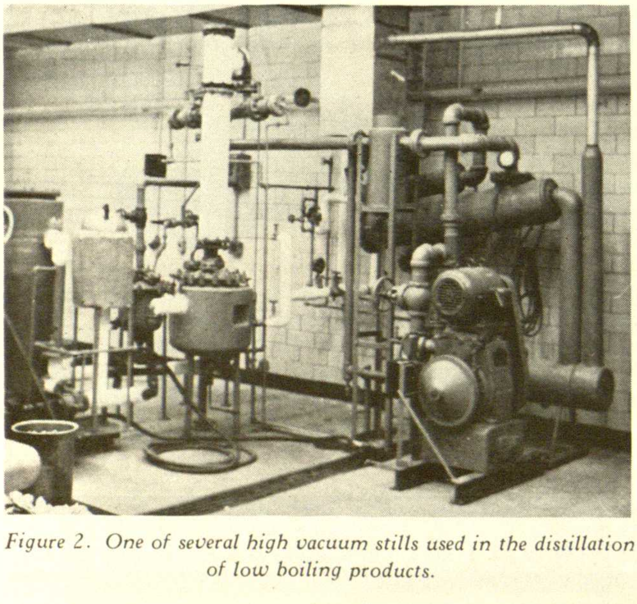

Figure 2. One of several high vacuum stills used in the distillation of low boiling products.

Out of it all evolves three major functions of the research engineer. First, the basic research in design and efficiencies for various processes; second, the evaluation of the products and, thirdly, determining the design and materials for large scale construction. These studies and determinations constitute daily routine throughout the industry as a whole, and the vast expenditure necessary can be easily estimated.

Today, however, we can feel somewhat more secure than we did in 1940 and 1941 as America now possesses the technilogical and productive "know-how" of synthetic rubber production. Although several of the wartime government-owned plants have been sold to various rubber and plastic manufacturing concerns, the industry has been growing steadily behind the research activities, so necessary in a highly competitive field.

UNIT OPERATIONS LAB

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sample containing a known amount of water. The data gathered is used to correlate several empirical and theoretical formulae, as well as to ascertain the efficiency of the dryer.

Crushing and Grinding

The last operation to be discussed is crushing and grinding, or size reduction.

In the production of copper this process plays a major role just as in the manufacture of chalk, cement, and many others. Difficulties are often encountered in the form of damp or sticky materials, or, as in the case of copper ore, of malleable material in the feed. Hardness is also a factor since the same type of crusher would obviously not be used to pulverize chalk as is used to crush something as hard as road gravel.

The corner of the laboratory containing equipment for this operation consists of the following: an Allis-Chalmers gyratory crusher, a Denver crushing roll, a Denver jaw crusher, a Selectro vibratory screen, a ro-tap sieve and a rod mill.

Into these grinders several types of feed are introduced by the student, each feed with a specific troublesome property. The student is asked, on the basis of his data and experience in the lab, to recommend the proper machine for each type of feed. Size separation and machine power consumption are also taken into account.

Chemical engineering, one of the youngest fields of engineering, is also one of the fastest growing fields. Its graduates have an education that includes many fields of engineering and many phases of chemical engineering.

In industry chemical engineering is becoming more and more important every year, and the department at Michigan State College is doing an excellent job of keeping up with this advance.

DETROIT TELEVISION

continued from page 9

Upstairs, in the network's newsroom, an announcer was poised to tell both radio and TV audiences that Fraser was ready to go ahead with his lobby interviews.

At the proper cue, the announcer said his piece: "ABC now takes you to the hotel lobby, where you will hear the voice of Gordon Fraser."

Instead, the TV viewers saw a picture of a donkey with electric eyes, exhaling smoke at regular intervals.

The announcer, doing the unfamiliar radio and TV job, had forgotten that the television show was to open with a shot of the Democratic Party's papier mache donkey on top of the marquee of the Bellevue Stratford Hotel. (*Detroit Free Press,* October 8, 1948.)

Welcome Competition

As long as WWJ-TV was the only station operating in its area, Detroiters were normally curious about TV, but generally not curious enough to buy it. In February, 1948, after WWJ-TV had been on a regular commercial schedule for nine months, there were only 6,200 sets in use in Detroit, over 1500 of them in public places. As late as August, 1948, the number of sets in use had grown to an unimpressive 9050.

The October debute of WXYZ-TV and WJBK-TV appear to have greatly stimulated receiver sales, so that 30,000 is now being quoted as a conservative figure. The effect has been to make TV a much more attractive advertising medium to businessmen, and a more balanced source of entertainment to listeners. When regular program service is available from the East, giving Detroit the benefit of expensive network shows . . . well, what do you think?

F.O.B. — U.S.A.

A network is already in operation in the midwest, connecting Buffalo, Cleveland, Toledo, Chicago, and St. Louis by coaxial cable. Detroit and Milwaukee are connected to the network by microwave relay. The Detroit link consists of a two-stage microwave relay from Toledo to LaSalle, Michigan, to Waltz, Michigan, to the Michigan Bell Building in Detroit. From the Bell Building, coaxial cables fan out to the three stations now in operation, WWJ-TV, WXYZ-TV, and WJBK-TV. Briggs' Stadium, and the RKO Theater Building are also coaxed to the Bell Building. The existing network is owned by the American Telephone and Telegraph Company, manned by its operating subsidiaries; A. T. & T. in turn leases the facilities of the hook-up to the various competing networks. A. T. & T.'s ownership of the network makes it possible for NBC, CBS, and ABC stations in Detroit to carry network shows, without having to build triplicate intercity facilities. Eventually, of course, the major networks will have their own private hook-ups, but their present needs are being satisfied by the common facilities.

An extensive network is also in operation in the East, linking the coast from Boston to Richmond. NBC and CBS plans for the next few years involve 90- and 80-station chains, respectively. As we go to press, a link is being completed between the Eastern and the Midwestern networks. Regular Eastern Network shows will make their Detroit debute on or about January 12. As proof of its importance, the Eastern annex will increase WWJ-TV's weekly program time by about 25 hours.

Incidentally, Notre Dame football is fed to the Midwestern network by a microwave relay system from South Bend to Chicago, owned and operated by Paramount Pictures, Inc.

About Color

"Color Television constitutes a definite further step in the solution of the many problems presented in the electrical communication of images." (Herbert E. Ives, then of the Bell Telephone Laboratories, quoted in the October, 1929, issue of *"Radio Broadcast."*) Color television, then, has been hanging around for about 20 years. It has failed to make the grade for the same reasons that held up black-and-white until the late thirties. The systems of color TV which have been demonstrated to date have had one or more of the following disadvantages: too expensive, too bulky, too unstable, or contain moving parts. Some of the technical problems encountered in B & W are even more severe in color. CBS has recently demonstrated a system which is electro-mechanical, that is, it contains moving parts, which are subject to more unpredictable wear than are the all-electronic systems. RCA has demonstrated an all-electronic system, but it has not been widely publicized as being a satisfactory solution to the problem of bringing color television to a quantity market. It seems safe to predict that financially successful color TV cannot cost very much more than black and white; all-electronic systems are in vogue, and color TV will most likely have to comply; and, aside from any technical arguments, it seems sensible that color TV will have to wait until black-and-white gets "out of the red." The people who are paying the bills in television don't mind telling you that they are losing money. They are working through an expensive medium, to a small market, a combination that doesn't usually appeal to a business-minded advertising agency; however, they feel that they have a sure thing; that if they are given a few years without the confusion of color competition, they can make television a large source of pleasure, and revenue, to a large number of Americans.

Orchids

Before you finish reading this article, and most of you won't care to read beyond this sentence, we want to thank the people who have generously supplied us with material: Dick Spencer, WWJ-TV Public Relations; E. J. Love, WWJ-TV Engineering; Don Zuehlsdorff, WXYZ-TV Publicity; and Floyd Roush, WXYZ-TV Engineering have all been hospitable, helpful, and generally indispensable.

For the benefit of the electron-chasers, a short technical summary of DET-TV follows:

WWJ-TV transmits on channel #4, 66-72 megacycles. The video transmitter is a 5 kilowatt Dumont, Heising plate modulated in a low level stage, the FPA being operated as a class B linear amplifier. The sound transmitter is a 2.5 kilowatt Dumont, phase-modulated. Peak effective radiated power is about 17 kilowatts for both transmitters. A temporary antenna system is now being used; a new dual antenna is now on order. The remote truck uses two RCA orthicon field cameras, linked to the Penobscot tower by a three-degree microwave beam, operating in the 7000 megacycle band. The studio cameras are also of the orthicon type, with the exception of film, slide, and test pattern pick-ups, which are iconoscopes. Orthicons are preferred in the studios because their higher sensitivity permits a more comfortable level of illumination than the iconoscope.

WXYZ-TV transmits on channel #7, 174-180 megacycles. The video and sound transmitters are 5 kilowatt and 2.5 kilowatt RCA's, respectively. The antenna is located on a 287-foot tower erected on top of the Maccabees Building, giving a total height of 485 feet. The antenna design is such that the peak effective radiated power for both sound and video is about 6 times as great as the figures quoted above. The video transmitter is grid-modulated in the final amplifier; the sound transmitter is reactance-tube FM modulated. WXYZ-TV uses an RCA truck for remote operation; three orthicons are micro-waved to the Maccabees by a 7000 megacycle band relay. Studio cameras are also orthicons, except for film, slide, and test pattern pick-ups, which are iconoscopes.

Station WJBK-TV transmits on channel #2, 54-60 megacycles. The antenna height is 485 feet, peak effective radiated power is about 16 and 8 kilowatts of video and sound, respectively. The station is owned and operated by the Fort Industries, Inc. WJBK-TV was not interviewed, owing to a shortage of time.

I was struck by the beauty of her hand.

I tried to kiss her.

As I say, I was struck by the beauty of her hand.

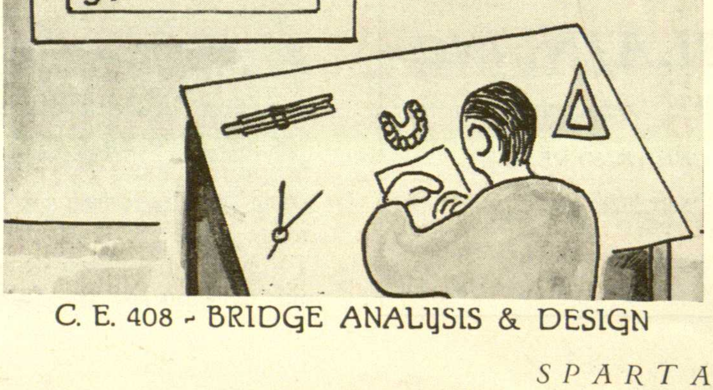
★ ★ ★

Dean (questioning a student injured in crowded elevator)—And were you kicked in the ensuing rumpus?

Student—No, it was in the stomach.

★ ★ ★

Ram—Come here, I can ewes ewe.



C. E. 408 - BRIDGE ANALYSIS & DESIGN

A man in an insane asylum was fishing over a flower bed. A visitor walked up and asked, "How many have you caught today?"

"You're the ninth," was the reply.

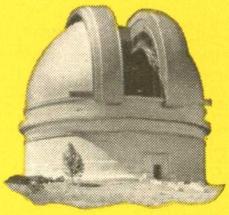
★ ★ ★

And then there were the three Chinese girls who never got married: Tu Yung Tu, Tu Dumb Tu, and No Yen Tu.

★ ★ ★

"Wuz dat yo bes' girl fren'?

"No, jus' necks bes'."



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.

Kodak

CAREERS AT GENERAL ELECTRIC

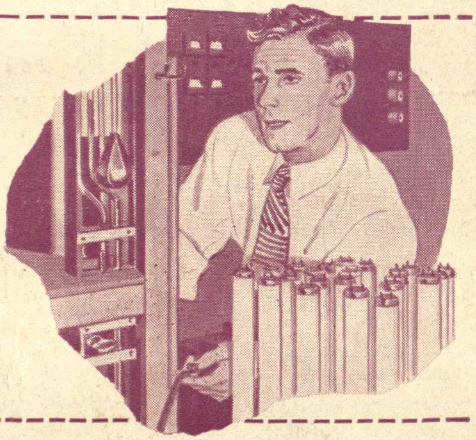
General Electric is not one business, but an organization of many businesses, offering opportunities in virtually all the professions. Here three G-E men brief the career-possibilities which the company offers to the student of advertising, the physicist, and the accountant.

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