Winter 12-1952

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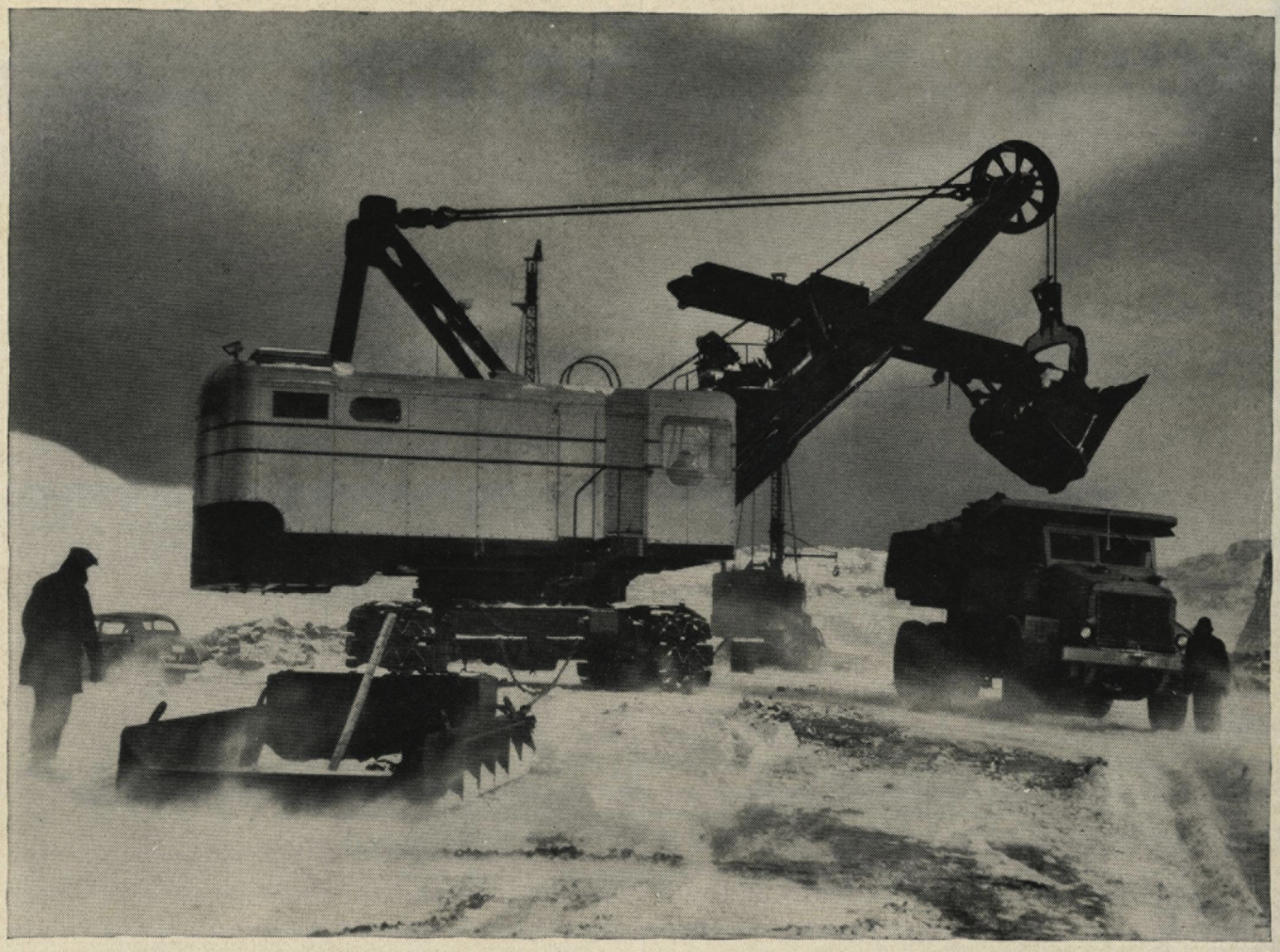
Rose Technic Staff
Rose-Hulman Institute of Technology

DECEMBER 1952

ROSE TECHNIC

PEG CRAWFORD

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED



There's been a cold war on in Minnesota lately

. . . And our metallurgists have won it.

Up in the iron ore range, where 40 below zero can be expected frequently, shovel operators usually plan their operations to remove a year's supply of ore during warm weather months when the ore is workable. But recently, with steel requirements ever increasing, shovel operators began working around-the-calendar.

And they ran into trouble.

During one cold spell when the temperature dropped to 40° below throughout the iron ore range, the ore froze solid. The extreme cold caused steel in the equipment to lose some of its toughness, and power shovel booms and dipper sticks broke all over the range as the huge steel dippers were rammed into the frozen ore with tremendous force.

But there was one significant exception. Operators using shovels with booms and dipper sticks made of one particular steel went right on gouging up frozen ore without any equipment trouble.

Those shovels stood up because the heavily stressed parts were made from U·S·S TRI-TEN—a remarkably strong steel that has a high degree of toughness, even at low temperatures.

Moreover, the users were able to cut the weight of their TRI-TEN parts by 25%, even though some working stresses were increased *50%*. "And," says one shovel manufacturer, "TRI-TEN steel has enabled our customers to operate this equipment successfully at temperatures as low as —45°F."

• • •

U·S·S TRI-TEN is only one of hundreds of steel compositions developed by United States Steel to meet special service conditions. Trained U. S. Steel metallurgists work with manufacturers all over the country to help solve problems involving the more efficient use of steel. United States Steel Company, 525 William Penn Place, Pittsburgh 30, Pa.

USS

2-1942

UNITED STATES STEEL

Rose Technic

VOLUME LXIV, NO. 3 DECEMBER, 1952

In This Issue

The Cover

Miss Peg Crawford is the designer of our Christmas cover. Peg, a senior Commercial Art student at Indiana University, was evidently inspired by the line, "Then he turned with a jerk," in "The Night Before Christmas." But even Peg can't explain how Santa changed hats between "strobe" shots.

The Frontispiece

Round and round he goes, and when he stops, this workman will have finished inspecting a series of large stator frames for electric motors. Stator frames constitute the stationary portion of electric motors, inside which rotors spin to produce mechanical power. Ranging from 100 to 500 horsepower, such motors drive pumps, hoists, conveyors, compressors, generators, rolling mills, crushing mills, and fans. Courtesy of GENERAL ELECTRIC.

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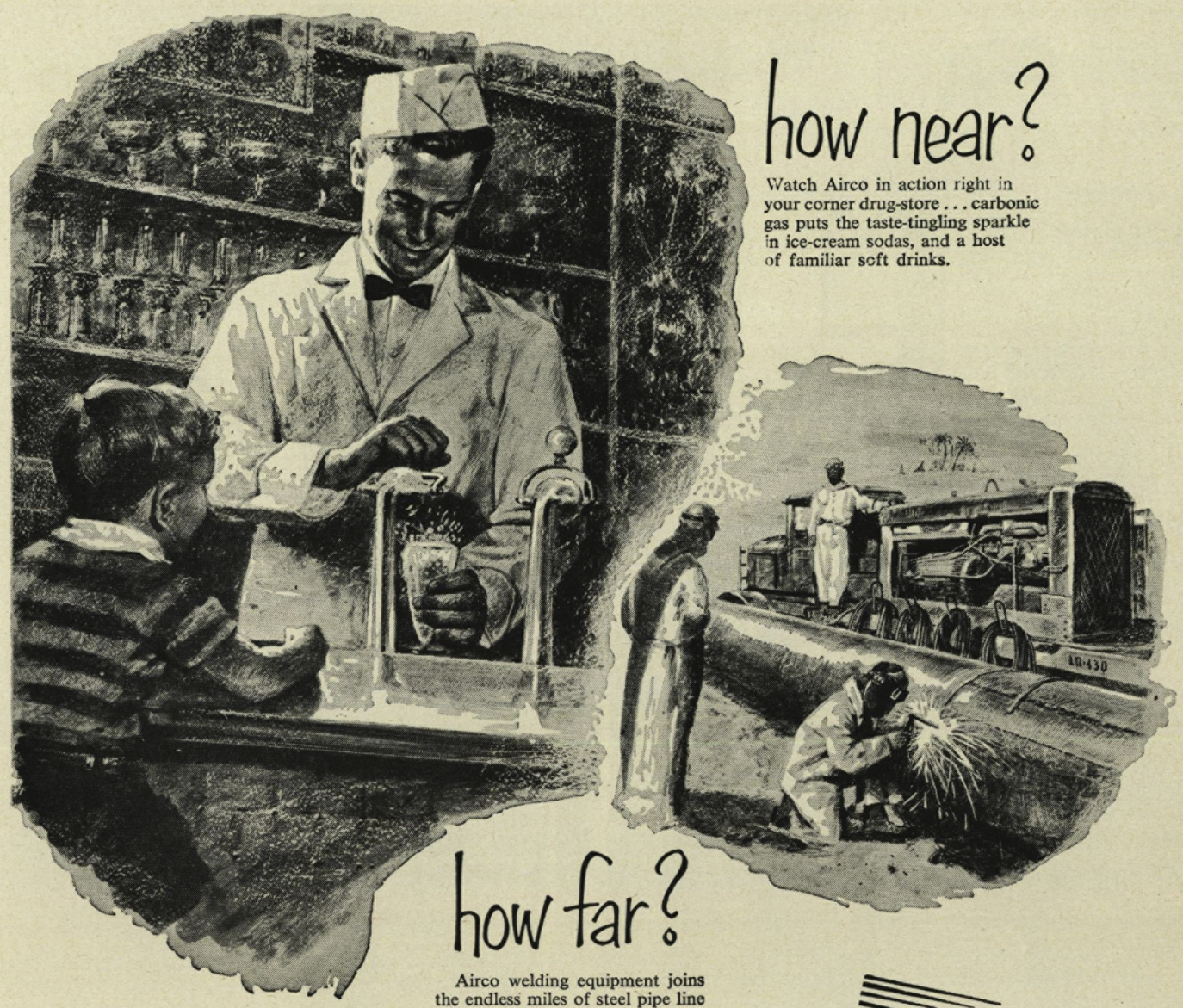

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HIGH SCHOOL GRADUATES OF 1953

You are cordially invited to visit Rose Polytechnic Institute during the present school year to learn more about your college entrance and the engineering courses available to you at Rose. The next freshman class will be admitted September 8, 1953.

NOBLE C. BLAIR

Admissions Counselor

ROSE POLYTECHNIC INSTITUTE

TERRE HAUTE, INDIANA

Note for a faculty member's briefcase!

Recently we had the pleasure at General Motors of welcoming 19 faculty members from leading engineering schools to Detroit.

This was part of our continuing effort to discover ways in which GM can be of help in furthering the growth of engineering education in America.

And their professors informed us that they would welcome information on General Motors employment opportunities which they could pass along to their students.

In the thought, therefore, that other faculty members may share their opinion, we are publishing this message.

So we would like you to know these few simple facts about GM job opportunities.

1. They are broadly assorted—fitting a wide range of talents—from the pure scientist to the young man who sees in his engineering training a fine background for production or management work.
2. They cover a wealth of subjects—from chemistry and chemical engineering to mechanical and electrical engineering, from metallurgical engineering to industrial engineering.
3. They offer reasonable advancement for the diligent and ingenious mind. For the industrial climate at GM is conditioned by a traditional respect for the engineering point of view. Witness the number of key GM executives in both divisions and top management who began their careers as engineering graduates on GM drafting boards.

And we would like you to feel free at any time to write us, or ask our College Representative, who periodically visits your campus, any detailed questions on the subject of GM jobs for your talented students.

GM POSITIONS NOW AVAILABLE IN THESE FIELDS:

Mechanical Engineering
Electrical Engineering
Metallurgical Engineering
Industrial Engineering
Chemical Engineering

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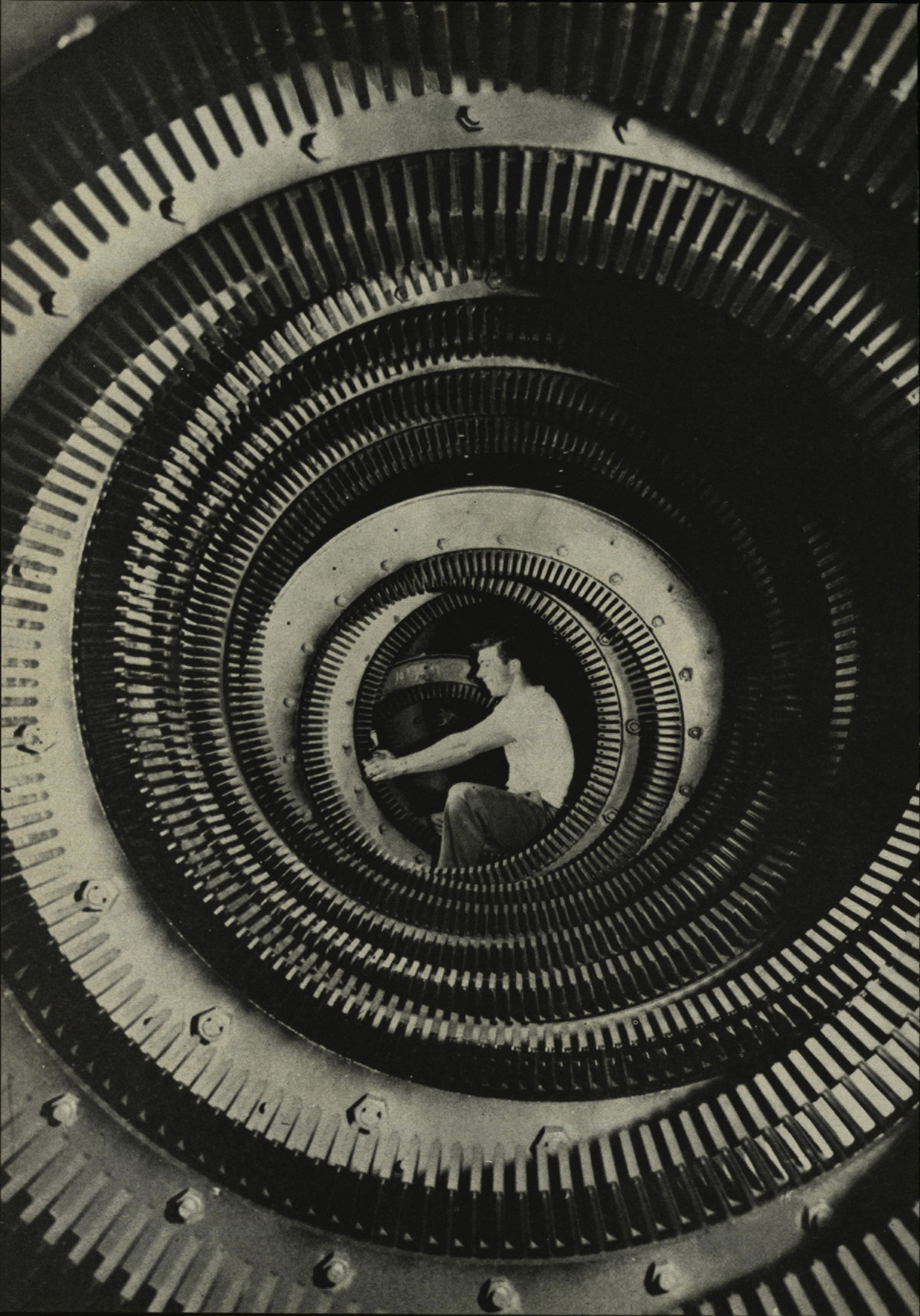


Are Students Discouraged?

Every year, at about this time, the battle cry of the freshman has been "The professors are out to get me." This year is no exception. There is one striking difference, however, that seems to be indicative of an avalanche of protests against some of the present-day teaching methods. Even seniors and juniors, hardened to the engineering-college grind, are letting their disgust be known. But when, and why, do students become discouraged?

Perhaps the first signs of dejection appear when a student realizes that it would be more profitable for him to remain away from a class than to attend. Too many times lectures are filled with theoretical abstractions that prove worthless when it comes to solving a problem. In other words, everything that isn't covered in class is covered on the tests. Even when problems are discussed in class, the chances are that ninety percent of the students haven't worked them. For what instructor ever assigns a chapter to be read without simultaneously indicating that several problems should be handed in the next time? If the problems are to be graded, the student will probably try to solve them without reading the background material, because he usually hasn't time to do both. This may be the reason why students are forced to "cram" a chapter the night before an examination.

Then too, it can be rather disconcerting to realize that to prepare adequately the assignments for a week will require more time than you have available—that is, unless you need only four hours sleep a night! Of course, someone will answer that most college men seem to find plenty of time for recreation. It is true that many of them do, but the percentage who must be burdened with a guilty conscience concerning the laboratory reports or fifteen problems due the following week is probably high.

There are undoubtedly a number of instructors who seem to overlook the fact that students have obligations to fulfill in more than one course. It never seems to occur to them that a student must spend nearly an entire evening in review for an hour examination and thus may have had to postpone work in other courses. An instructor who requires that problems be handed in at a certain time for full credit fails to realize that the value of working such problems is not lessened by solving them one day later. How much more leeway it would give the student in planning his study time if problems were merely required but not graded nor demanded on a certain day. Some may even say that problems should not be required at all; if a student can pass a course without working any problems, "more power to him."

Furthermore, should there not be some consistency among instructors and courses concerning the portion of the final grade determined by tests, class recitation, and the like? An open discussion of the subject among faculty members might do much toward creating a more standardized system and avoiding the usual confusion in the minds of most students. An evaluation of testing methods and their relative accuracy would prove not only quite interesting, but it might help relieve a condition that allows nearly fifty percent of those entering engineering colleges to falter sometime before the four years are completed.

Any real solution to the problems prevailing could not be devised without considerable thought. It is a personal belief of this writer that the perplexities are not insurmountable. The difficulty lies in finding those who will accept the challenge these problems offer, for apathy in such a situation is disastrous.

R.A.K.

Catalysis: Key to

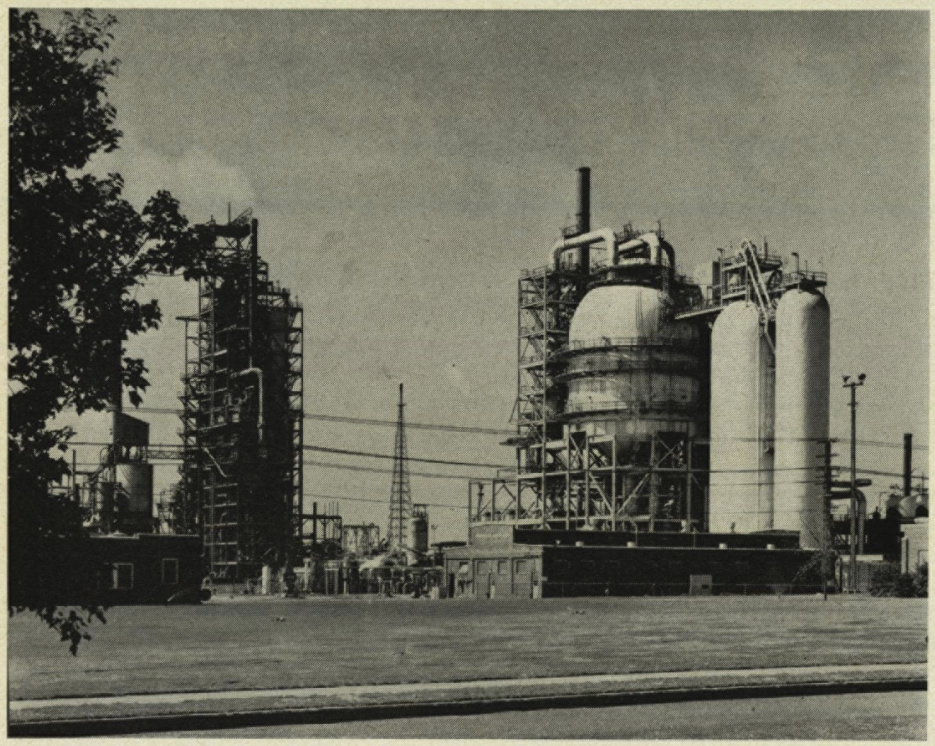
A Brief History of Catalysis

During the middle part of the 18th century many investigators began reporting strange occurrences in chemical reactions they were investigating. Roebuck and his colleagues developed the chamber process for the manufacture of sulfuric acid and discovered that sulfur dioxide could be oxidized readily if small amounts of the oxides of nitrogen were present. No explanation for this phenomenon was advanced. Also, Parmentier, in 1781, succeeded in producing sugar from starch in the presence of acids. As in the case above, the process was not completely understood.

Around the turn of the century, two of the great men of science announced theories which had a far-reaching effect on chemistry. Lavoisier, late in the 18th century, discovered the real nature of combustion and the true composition of water. Dalton, in 1806, announced his atomic theory. These discoveries, while of importance in all fields of chemistry, provided a means by which catalytic phenomena could be interpreted.

During the 19th century many independent investigators, notably Faraday and Kuhlman, reported cases where the presence of another substance affected a chemical reaction. In 1836 came the first generalization—Berzelius, famous already for his pioneer work in determining atomic weights, gathered together the several loose ends available and stated that the occurrence was quite common in chemical reactions. Berzelius named the phenomenon "catalysis".

Rapid strides followed this statement of Berzelius: Pasteur's work on microorganisms, the development of physical chemistry, and the application of the principles of catalysis to industry. In 1901 Ostwald gave us the modern definition of a catalyst—"A catalyst is a substance which alters the velocity of a chemical reaction without itself being changed or entering into the end product." Ostwald further predicted that catalysis would be universally recognized in theoretical chemistry and would have a widespread industrial application.



View of fractionating and cracking units at Bayway Refinery

The true history of modern catalysis must begin with the researches of Sabatier and Ipatieff. These two men opened up tremendous fields which have proved of utmost importance to the chemical and engineering industry. Sabatier, working in the field of organic catalysis, noted that a catalyst might also change the direction, or end product, of a chemical reaction in addition to affecting the rate of reaction. Ipatieff, studying reactions at high temperatures and pressures, noted that the very walls of the reaction vessel might affect the reaction rates to a considerable extent. Haber, Bosch, and Mittasch in Germany pioneered in the catalytic synthesis field, using air and other gases.

A vast amount of research has been done since the time of all these men and several facts have emerged. One is the realization that no completely adequate explanation can be advanced for the remarkable affects of catalysts in the light of present day knowledge. Another is that any substance whatever, when introduced into a chemical reaction, will have some effect on the reaction. This effect in most cases will be quite small but measurable. These facts will help explain the peculiar situation existing in the field, that *applied* catalytic chemistry has always been, and in the immediate

Chemical Progress

By Donald Wood, soph., ch.e.

future probably will continue to be, well ahead of *theoretical* chemistry.

It has been said that of all the chemical processes developed for industry each year in the United States three out of every four are processes involving catalysis at some stage in the process. Thus it can be seen what a tremendous field has opened for the chemical engineer.

Modern Catalytic Theory

While it has been stated above that no adequate explanation of catalysis has been advanced, there is enough information available to enable us to theorize about catalytic behavior.

Chemists have split the field into two parts, characterized by the physical condition of catalyst and reactants. The first of these is the homogeneous catalytic reaction, in which catalyst, reactant, and end product are all in the same phase, *i.e.*, gas, liquid, or solid. Of these phases the case where all participants in a reaction are solids is extremely rare. The second part, heterogeneous catalytic or phase-boundary reactions are by far the most numerous in the field. In fact some investigators have stated the belief that many of the reactions thought to be homogeneous are really heterogeneous, and are partly due to dust particles present in the reactants, and to wall catalysis rather than wholly due to the catalyst used.

Homogeneous reactions have not been studied to as great an extent as the heterogeneous ones and very little is known about the mechanism of the reaction. Most investigators are of the opinion that in the liquid or gaseous phases there occur numerous three-way collisions between molecules of the two reactants and a molecule of the catalyst. When such a collision occurs a molecule of the end product is formed.

Several theories of the manner in which a heterogeneous reaction takes place have been advanced. The one to which most investigators subscribe at this time is known as adsorption. This theory states that a catalyst, when introduced into a chemical reaction, has the property of attracting large quantities of one of the reactants to its surface, where they are held securely. Ideally the catalyst should attract and hold enough of the reactant to completely cover its surface with a film one molecule thick. This has the effect of raising the concentration of the reactant at the surface of the catalyst, or phase—boundary area. Thus the reaction proceeds with great speed on the catalytic surface. As the desired substance is formed it is desorbed from the catalyst surface and its place taken by more molecules of the absorbed material. Another type of adsorption known as activated adsorption is believed to actually disassociate the molecules attracted to the catalyst surface into atoms, which are far more reactive than the molecular layer.

Some catalysts also operate by formation of intermediate compounds. For example, the reaction:

$$A + B \rightarrow AB$$

may proceed very slowly. However A might react with C rapidly:

(*Continued on page* 22)

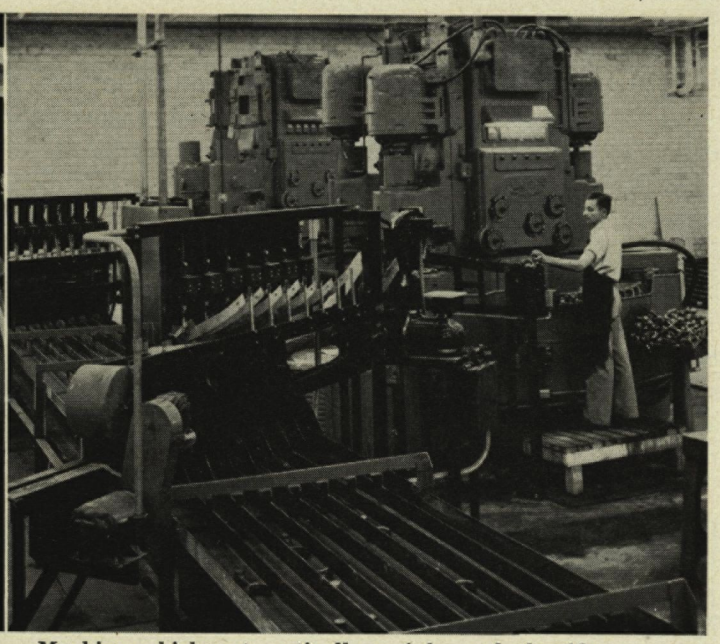
Close-up of "cat" cracker

Automation - - Electronic

By William

In 1947, Del S. Harder, Ford's vice-president of manufacturing, started to make general improvements in his machines to improve their output. Before he knew it he was up to his neck in "automation," which at that time was merely a gleam in a production expert's eye. Today the new Ford engine plant at Cleveland, Ohio, has a rated capacity double that of any other in the industry.

Tool control board which informs tool setters of need for changing tools before they wear out and cause a breakdown.



Machine which automatically weighs and classifies connecting rods in order that they may be matched with pistons and caps in perfect balance.

Imagine, if you can, a machine the length of five football fields. Actually this machine is a series of separate machines operated together by electric controls and automatically feeding each other by a complex system of shuttles, conveyors, and other devices. This completely "automated" plant has machinery varying in size from small turnover devices to an enormous broaching machine 98 feet in length. The complete machine has a length of 1,545 feet and consists of 42 machines used to machine 6-cylinder engine blocks from rough castings. This machine performs 530 drilling and cutting operations on each casting, with accuracy unknown to human hands.

"Automation," a word which immediately caught industrial engineers' fancy, means no more or less than the automatic handling of materials being processed in their journey between machining operations. No doubt it is what Henry Ford had in mind when he fastened a rope to an automobile body and pulled it along the floor of his plant in Highland Park, Michigan, thus creating the first assembly line more than fifty years ago.

Automation achieves its success by reducing two of the three time-consuming portions of a machining operation. That is to say it cuts the time required for loading and unloading; therefore the machine is allowed to operate more nearly at its maximum speed. Due to the fact that some machines are loaded differently than other machines, or because a different side or portion of the casting requires machining, it is quite often mandatory to turn the part 90° or 180° in either a horizontal or vertical plane. Thus, turnover devices or turntables are incorporated in the line to accomplish this feat completely without the aid, assistance, or control of a human.

Possibly the outstanding thing that would impress a visitor to the plant is the lack of operators to run the machines. All of the machines, turntables, and conveyor systems are controlled by "electronic brains" which route materials to the proper machines at the proper times. These "electronic brains" receive bits of information from various electric switches which act as lookouts along the route of the material. The "brain" will compile the data, make a decision as to what is the best course of action to follow and then activate the fingers of steel which, completely without human guidance, perform the required action, whether it be moving the part from one machine to another, turning it over, picking it up, or turning it around. While its human counterpart is able to direct

uilds Engines

s, jr., m.e.

only one operation at a time, these "electronic brains" are capable of simultaneously directing a multitude of shop operations.

Other phases of the "electronic brain" portion of automation are control panels which tell the tool setters when and which cutting tools must be changed. These tool-control boards, equipped with pre-set counting dials and automatically operated lights, avoid-costly and time-consuming long-period shut-downs, reduce tool breakage, and improve the quality of machine work. When a tool in operation reaches its life expectancy limits, the tool board flashes a signal which informs the toolsetters that the tool is ready for replacement. In this manner the tools are not overworked and all of them are changed before a mishap occurs.

Before the Ford engineers decide to put a part or unit on an automated line there are two primary questions which they must answer.

1) Is the part or unit adaptable to automation.
2) Will the savings of automation over normal manual operation be high enough to justify the added set-up expense.

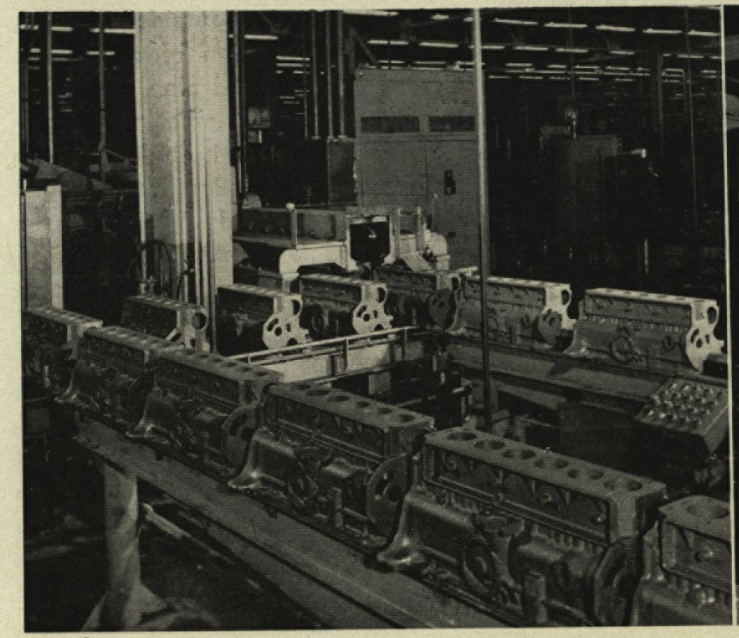
If the answer to both of these questions is "yes" the job may then be turned over to a tool contractor. The tool contractor will be responsible for the design and construction of the machine and its automatic loading and unloading devices. Generally the machine will be equipped with manual loading and unloading stations which must be removed; then new automatic loaders and unloaders are put in their place. The tool contractor will also be responsible for the proper setup and completion of a successful tryout of the machine and its allied loaders, unloaders, shuttles, and turnover devices.

The design of the automation equipment is quite intricate and more often than not, very difficult. The designer endowed with a Rube Goldberg instinct has a definite advantage at this type of work. Ford engineers have discovered that it is best to get the certified machine drawings before starting the design because often the shuttles, transfer methods, and conveyors grow in length before they are completed.

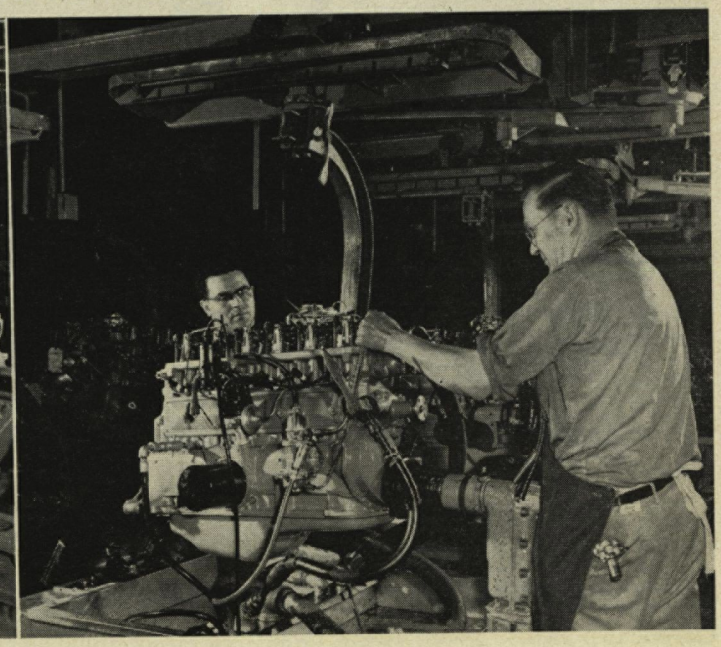
The tool industry will no doubt feel the impact of automation as soon as the method catches on in other companies and industries. This will be due to the fact that automation not only decreases the time required for unloading and loading, but, partially because of this, the machines are able to operate faster. The fact is that now, broaching speeds of the automated lines are double that which was previously possible. It is quite possible that as more developments are made on the automation system, the speeds of drilling, reaming, tapping, and other processes may be improved similarly.

Special mention should be made of the intricate chip removal system employed in the new Ford plant.

(*Continued on page* 26)



View of a mammoth 96-foot broaching machine with broadside and lengthwise shuttles.



"Hot test" sparks life into newly-born 6-cylinder engines.

Campu

By Jack Farell, jr., ch.e.; Jack Fr

The office crew, or . . . . Al's Diner at Noon.

Homecoming

This years homecoming was short one of its highlights. There was no bonfire. Due to extreme dryness and the fire hazard thus caused, the bonfire was left standing, unburnt.

The homecoming festivities were started, as usual with Rosie's trip to town under the guidance of the Greencaps. This year Rosie was fitted with a water spray in her trunk. The addition furthered the fun of the Frosh who showed their colors well by getting a goodly number of the usual signatures on Rosie.

A pep rally in the field house was held, upon Rosie's return from town. At this time Rose's first football queen was crowned. The added attraction was accomplished by the R-Men. The method of selection was as follows. Nominations were made by the student body, and these nominations were screened by an impartial committee who chose six to be voted on by the student body. The queen and two attendants were thus chosen. This year's queen was Miss Fonda Jo Stewart of Clay City, Indiana, and her two attendants, Miss Beverly Kerestury of South Bend, and Mrs. Lynn York of Terre Haute. The coronation was done by Phil Brown, who seemed pleased with the situation. After this, Phil gave a shortened introduction and the rally ended with a few yells.

On Saturday night, the annual Homecoming Dance was held at the Terre Haute House. At the dance the fraternity house decoration trophy was awarded to Lambda Chi Alpha. The dance, as well as all the other homecoming functions, was a huge success. The credit for this goes to the Blue Key members, who did their usual fine job.

The returning alumni had several other meetings during the weekend. On Saturday morning a business meeting was held in the auditorium. This was followed by a luncheon in the field house. A banquet was held preceeding the dance on Saturday night. At these meetings Paul Grafe, class of 1920, now chairman of the board of the Grafe-Callahan Construction Co., was elected president of the alumni association. Walter Osmer, class of 1920, was named vice-president, Darrell Criss of the faculty, class of 1943, was re-elected secretary-treasurer, and Dr. George Christopher, class of 1911, was named as the new alumni member on the board of managers of the institute.

Student Center

For four years, Rose has been trying to obtain "outside" support for the construction of a Student Center. The original plan of the administration was to erect a combination dormitory and student union building, but this plan was dropped due to lack of funds. Thanks to the alumni and friends of Rose, a Student Center will be constructed between the main building and Barrack A.

The building will consist of one ground floor containing approximately 3000 sq. ft. On this floor will be located a snack bar and soda fountain, television lounge, and a ping-pong room. It will be open in the evening and probably seven days a week. There is a possibility (in the future) of doubling the ground floor area and constructing a second floor over the second half of the ground floor. This space would be used for the school clubs, such as the Technic and Student Council. Although the building will be ready next September, it is hoped that it might be in operation at Commencement time, in June.

Basketball

The 1952-53 basketball season at Rose: thrill packed action and a winning team. A team of veterans returns, minus only two from last year's squad, Leo Little and Ralph Bennett. Seven lettermen are back and all are due for extensive action this season. Joe Buscher, 6' 4" junior will be battling the backboards with

urvey

.e.; and Herbert Smith, soph., e.e.

help from forwards Don Snape, Dick Green, and Bob Dedert. Harry Badger, versatile star of many games last year, will try a position entirely new to him, that of guard. Do not be surprised to see him at forward, however. Harry Zorman will be showing his usual speed at the other guard with help from Jim Matthews and Roy England. Dick Gordon, a member of last year's reserve squad will also help to provide plenty of depth at guard. Other members of the squad include: Rex Leonard, a junior out for the first time but giving the other guards lots of competition; Bob Steinhauser, Phil Kirk, and John Gregory, all upperclassmen on the squad. Freshmen include: Phil Boller, Walt Johanningsmeier, Art Sutton, Art Masters, Bill Kallal, and Bill Finnegan.

Coach Jim Carr is working the team hard on the fast break and defensive play. Plenty of time is also being spent on a good, set offense. Nineteen games are scheduled this year and the schedule may prove to be a tough one.

Rose Bows to Cedarville

Rose Poly's Engineers fell, by a score of 20-7, before a second-half Cedarville rally in the last road game of the football campaign.

Cedarville took a 7-0 lead in the first half, but Rose came back to knot up the game in the third quarter when Al Merrelli made a 34-yard payoff pass to Bob Mogle, and Jim Mook made the extra point. Rose made another touchdown threat in the third quarter, but was stopped on the Cedarville one-foot line.

Cedarville scored once in the third and again with four minutes left in the game to make the score 20-7.

Engineers Swamp Aurora

Rose outran the Spartans of Aurora for a 35-7 victory to make homecoming a complete success.

The Engineers got their first tally after Bill Scharpenberg intercepted an Aurora pass and brought it back to the 14-yard line. Ground gained by Larry Samuels and Harry Stutts brought a touchdown in three plays.

The second touchdown came in the second quarter when Larry Samuels hit pay dirt to cap off a 40-yard Engineer march.

Aurora got their lone marker in the third quarter when they gained possession of the ball on a Rose punt and moved it seventy yards for a touchdown.

Bob Young scored from the 4-yard line for the fourth Rose touchdown after Harry Stutts brought the ball to the twelve and an Aurora penalty moved the ball to the four.

Bob Mogle intercepted an Aurora pass and ran it back 39 yards for the final touchdown of the day.

Jim Mook had a perfect day by scoring all five conversions.

Rose Downs Principia

After a scoreless first half, Rose

(*Concluded on page* 32)

Floor space was scarce at the Homecoming Dance.

Research an

Edited by Fritz Wheeler, sr., e.e., John Ri

Strapping Machine

A new power-driven strapping machine is designed to speed high-volume, flat steel strapping operations and reduce operator fatigue, producing strap joints by spot welding.

Featuring a streamlined, color-coordinated housing for integration into standard-type conveyor lines, the strapping machine produces welded joints with strengths approaching the tensile strength of the size of strapping used. The machine can accommodate many different package sizes. Also, there is no limit to the amount of strap that can be fed or the amount of slack that can be taken up.

The machine's 31-inch table height permits it to be installed in standard-height conveyor systems. Considering overall dimensions, the machine is 43-1/8 inches wide by 45 inches deep by 47 inches high. It weighs 1350 pounds.

In operation packages approach the machine on a roller conveyor from the right. After strapping, they leave the machine from the left. Roller sections in the table top of the strapping machine facilitate location of packages over the tensioning and welding unit, eliminating the necessity for manual lifting. Fourteen ball-transfer rollers built into the table top around the strapping mechanism further eliminate handling operations by permitting packages to pass over this mechanism or to be turned for cross strapping with a minimum of effort.

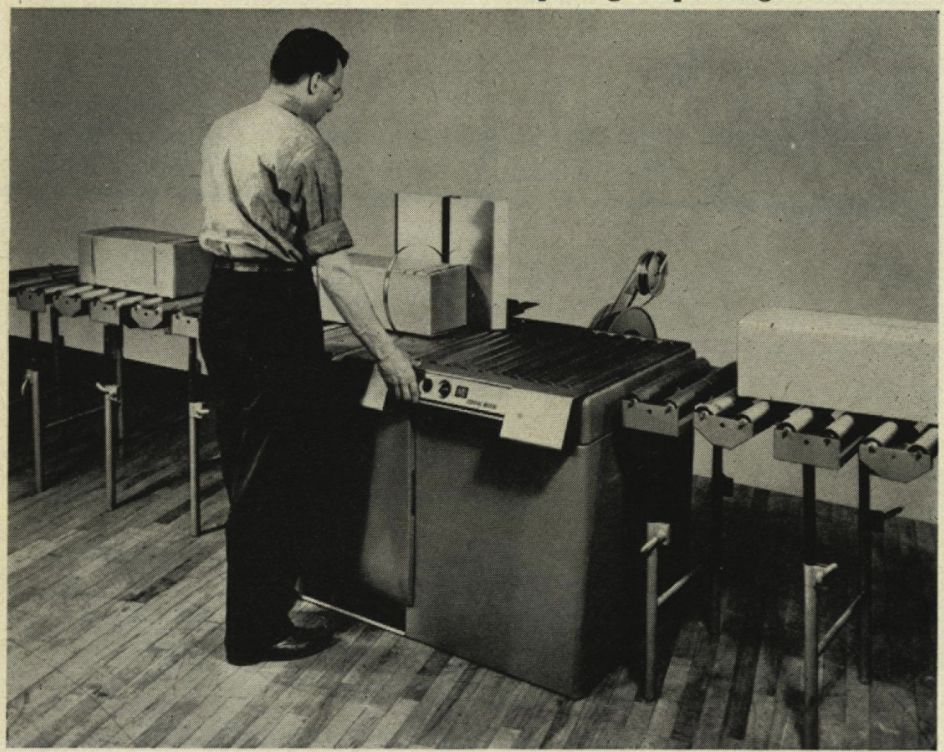
When a package is centered over the strapping mechanism, the operator simultaneously feeds out the required length of strap by deflecting the strap-feed pedal with his foot while guiding the strap around the package and into the V-shaped guide slot in the table top with his right hand. His left hand is used to hold the package in place against the back guide. The guide slot in the table top automatically centers and locates the entering strap.

When the strap is around the package, the operator actuates the cycle bar under the control panel with his right hand. This causes the strap to be tightened around the package to a predetermined tension, cut from the coil, and then joined by welding. The entire operation is completed in a matter of seconds.

The design of the machine assures full safety to the operator. Tensioning or welding is not possible while the operator is feeding the strap because he must first release his right hand from the strap before he can use it to actuate the cycle bar.

All operations formerly requiring physical effort are now done by the machine. Also, skilled labor is not necessary for operation. Women workers can easily strap packages at high volumes and to uniform strap tensions without fatigue.

The machine is electrically powered and electronically controlled. Its welding circuit uses 230-volt, 60-cycle, single-phase current. Its control circuit uses 115-volt, 60-cycle, single-phase current.



New strapping machine.

Jet Engines Produced Hours Apart At World's Largest Jet Plant

The turbojet plant at Kansas City, Mo., which is the largest and most complete jet engine production facility in the world, produces jet engines only hours apart.

The jets are built almost entirely of stainless steel, aluminum, and magnesium, in order to produce the combinations of strength, heat-resistance, and light weight which are so vital to high-performance aircraft engines. These materials enter the plant in the form of stainless steel

Development

h.e., and Jack Vrydagh, sr., m.e.

sheets; and stainless steel, aluminum, and magnesium castings and forgings. Although the bulk of the work is done in the main plant, a wide-spread group of subcontractors produces small, but vital parts.

Production in the huge plant is organized on the flow system, with raw materials entering by truck or freight car at one end, and flowing out the other as completed engines, ready either for immediate installation in fighting planes or for shipment and storage as "spares" at forward military areas or aboard carriers of the fleet.

A battery of huge concrete test cells provides the facilities for block-testing each engine as it comes off the assembly line. The first test is called the "green run" after which the engine is completely torn down, inspected, and re-assembled for a final check.

Plastic Kidney

A new-type "plastic kidney" has been developed by engineers who were guided in their efforts by members of the medical profession. The new "kidney"—one of the most compact and mobile units yet built—is now in successful operation at two of the nation's leading hospitals.

The improved kidney is enclosed in a metal cabinet. The complete unit and accessories can be transported quickly from hospital to hospital with the aid of one or two technicians.

Key feature of the unit is a 50-foot length of thin flexible cellophane tubing wound spirally around three concentric hollow-cylinders made of expanded metal screen. As blood is drawn from an artery in the patient's arm, it passes through the tubing and in so doing is purified, as impurities filter out through microscopically small holes in the tubing—holes that are too small for larger blood components, such as corpuscles, to leak out.

The metal screen cylinders and the encircling plastic tubing are immersed in a specially prepared bath called a "dialyzate," and as the impurities diffuse out of the tubing, they pass into the bath and are drained off. The purified blood continues through the tubing and returns to the patient by way of a venous opening in the other arm. An electric-eye safety device immediately shuts off the unit if a leak appears in the tubing or if a blood-clot occurs.

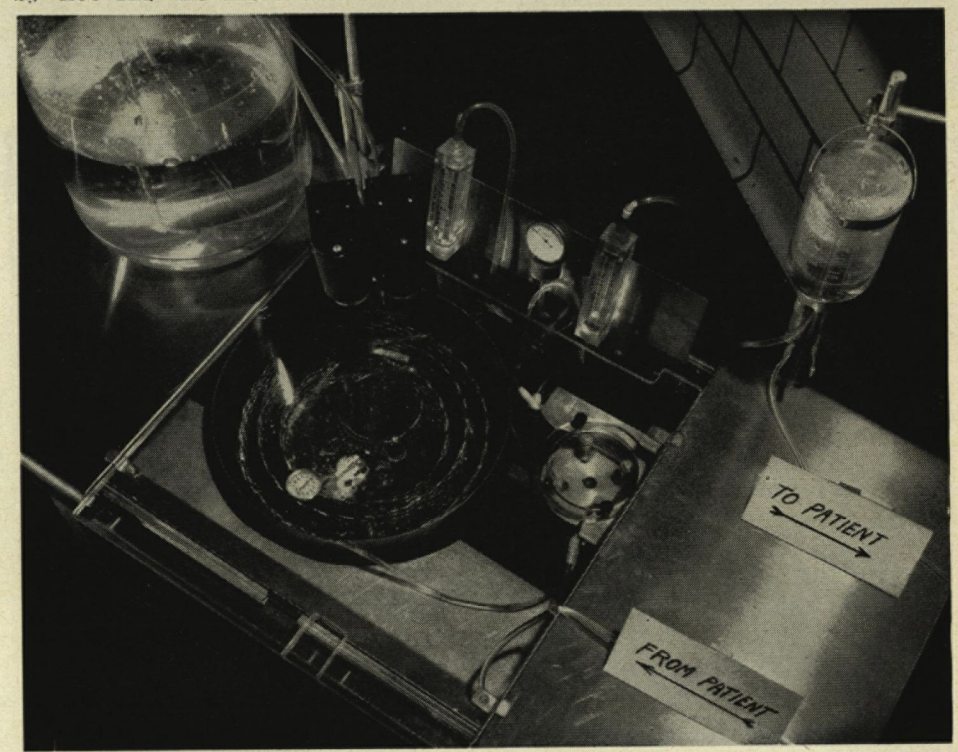
To make sure that the patient loses no vital blood components while impurities are being removed, the dialyzate bath is made up of compounds such as sodium, potassium, and carbonate in just the right proportions. By varying the pressure between the blood and the bath, and by keeping the right concentration of compounds, an equilibrium is set up and normal blood composition is maintained during the removal of impurities.

The new "plastic kidney" offers several advantages over previous types of artificial kidneys.

The ease with which it can be moved from one hospital to another makes it highly useful in emergencies. In addition it is the first unit to be designed in which complete sterilization can be performed with the components in operating position, thus eliminating long delays in dismantling and reassembling.

The new "kidney" contains no rotating joints, valves, or excessive points of pressure. This reduces the danger of blood clotting or breaking of blood cells to virtually zero and makes for easier, longer operation of the device.

(Concluded on page 36)



The "innards" of the plastic kidney.

"Homecoming - - 1952"

1. Princess Mary Ellen York and hubby Lynn. 2. Rosie scored on a flying saucer in ATO's display. 3. The bonfire that didn't come off. 4. A Spartan rode a rocket at the TX house. 5. Princess Beverly Kerestury and brother Dick.

1. The Sigma Nu's hung out the wash. 2. Hydraulics system of the '53 Rosie. 3. The usual toll was exacted for autographing Rosie. 4. Queen Fonda Jo Stewart—Rose's first—and Gail Mathas. 5. Engineers 34 — Spartans 7. 6. Lambda Chi's prize-winning creation.

Fraternity Notes

By John Gregory, George Ross, Robert Dedert, and Richard Kerestury

Theta Xi

With the closing of football season, Kappa Chapter wishes to congratulate brothers Mook, Rader, Ulbrich, Sovereign, Verdeyen, Scharpenberg, Stoker, and Lai (Mgr.) for the fine record which they helped acquire for the "Fighting Engineers" during the 1952 season.

We would also like to congratulate Kappa's newly acquired brothers. These being Lincoln Lai, Ed Masuoka, and Gene Stoker who were recently initiated into the bonds of Theta Xi.

In conjunction with these good wishes, we would also like to extend our heartiest to Jim "Abe" Schwartz who recently pinned Miss Mary Jo Lundstrom of Terre Haute, and to Robert "Bud" Guiler who took the fatal step Thanksgiving day. "Bud" was united into the bonds of matrimony with the former Miss Carolyn Ann McGregor, also of Terre Haute.

The Theta Xi house has been humming with activity during the school year with several house parties, a field hockey game with Saint Mary-of-the-Woods girls, and the homecoming festivities. 1701 Chestnut was really jumping on the 7th and 8th with the open-house parties going full steam.

Sigma Nu

The house painting is finally drawing to a close; cold weather hampers the painters, but the paint is still flowing despite the unfavorable conditions. About all that remains is trim, especially sills and door frames.

Woe is me, another pin is out! Guess who has taken the fatal step? None other than William Stewart who pinned Miss Barbara Cozak of Norwich, Conn. Five brothers have claimed the title of "pinned" in the recent campaign; the crystal ball indicates some more pins may be out soon.

Miss Doe Baldridge and Robert Ray announce their engagement—this is a real flash, straight from the mouth of the Emminent Commander himself.

Homecoming festivities were very enlightening as Beta Upsilon welcomed back many illustrious alumni. The house fairly rocked as everyone entered into songs or enjoyed a pleasant conversation with friends from anywhere imaginable. The Homecoming week-end all summed up will go down in the annals as one worth remembering.

Alpha Tau Omega

Dust, dirt and paint were flying in the vicinity of Gilbert and Orchard as the clean-up and fix-up campaign proceeded at Gamma Gamma of Alpha Tau Omega. The basement was completely cleaned up and the accumulation of several years discarded, through the industry of brothers Al Furlan and John Gregory. The walls of the recreation room were given a fresh coat of whitewash by pledges Bill Johnson and Gail Mathas. The meeting rooms also are soon to be redecorated.

The "Get Acquainted" parties for freshmen which were held November 21, turned out very satisfactorily. Entertainment for the evening featured a special "Get Acquainted" game with a much-appreciated prize, brothers "Matty" Mathews and Bob Miller singing "Mountain Railroad" and "Brazil", and a ukulele trio consisting of brothers Kermit Morris, Bill Supp and John Gregory. It appeared that all had a good time.

The Province conclave for Province XVII of Alpha Tau Omega was held at Illinois Epsilon Xi chapter at Northwestern University on December 6,7. Gamma Gamma sent several delegates to this assembly to discuss and coordinate activities of ATO's throughout the states of Indiana and Illinois.

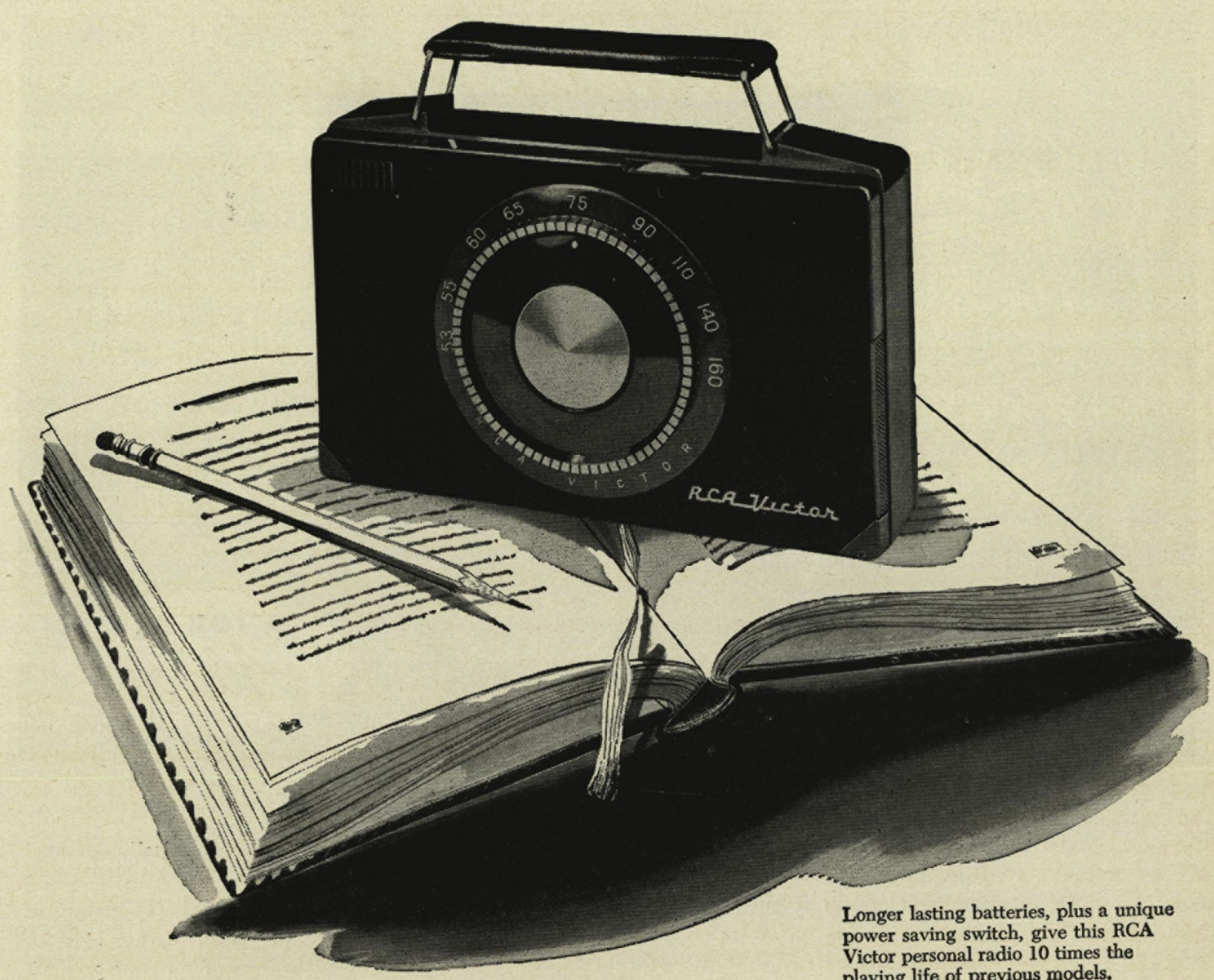
Lambda Chi Alpha

The month of November brought another homecoming to Rose and the Lambda Chi's.

The festivities at the Lambda Chi house consisted of a Buffet Dinner held at the house on Friday evening, followed by an "open house" after the pep rally. This started out as a card party and the old graduates meeting their classmates. As the party progressed, Glen Rout, the Maestro, played the piano and all the Lambda Chi's, old and new, began to harmonize. All in all, everyone attending had a great time.

Saturday night brought around the annual Homecoming Dance and the results of the best homecoming decoration. Lambda Chi Alpha won it this year for the second time in the past three years. The decoration was based on the theme, "From Sparts to Parts," and showed the Spartans of Aurora being ground up and going through several processes before coming out as finished nuts, bolts, screws, and gears.

The boys of Theta Kappa wish to take this time to congratulate Brothers Larry Samuels and Bud Teague on jobs well done during the past football season. Larry played great ball on both offense and defense and Bud held down the head manager's job in a fine fashion. We also wish good luck to all the basketball players and we're pulling for a great team this year. Let's all back them up!



Longer lasting batteries, plus a unique power saving switch, give this RCA Victor personal radio 10 times the playing life of previous models.

New Personal Radio...plays 10 times longer

About the size of the average book, this new Personal radio—developed through RCA research and engineering—offers new convenience and economy to those who want a light, beautifully streamlined, long-lasting instrument.

Secret of its long life is a new dry cell "B" battery—used in combination with redesigned "A" batteries to create a more lasting power source. Additional life is given by a unique switch, for use in areas where radio reception is strong, which reduces the drain on the batteries, and adds up to 30% to their lives. RCA Victor's new receiver plays *instantly*, without needing to warm up, has an automatic control to keep the sound volume even, and can be had in six rich colors.

Development of this compact radio is another example of RCA research and engineering at work for *you*. RCA research means better quality and performance from any product or service of RCA or RCA Victor.

* * *

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

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- Development and design of radio receivers (including broadcast, short-wave and FM circuits, television, and phonograph combinations).
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- Design of component parts such as coils, loudspeakers, capacitors.
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- Design of receiving, power, cathode ray, gas and photo tubes.

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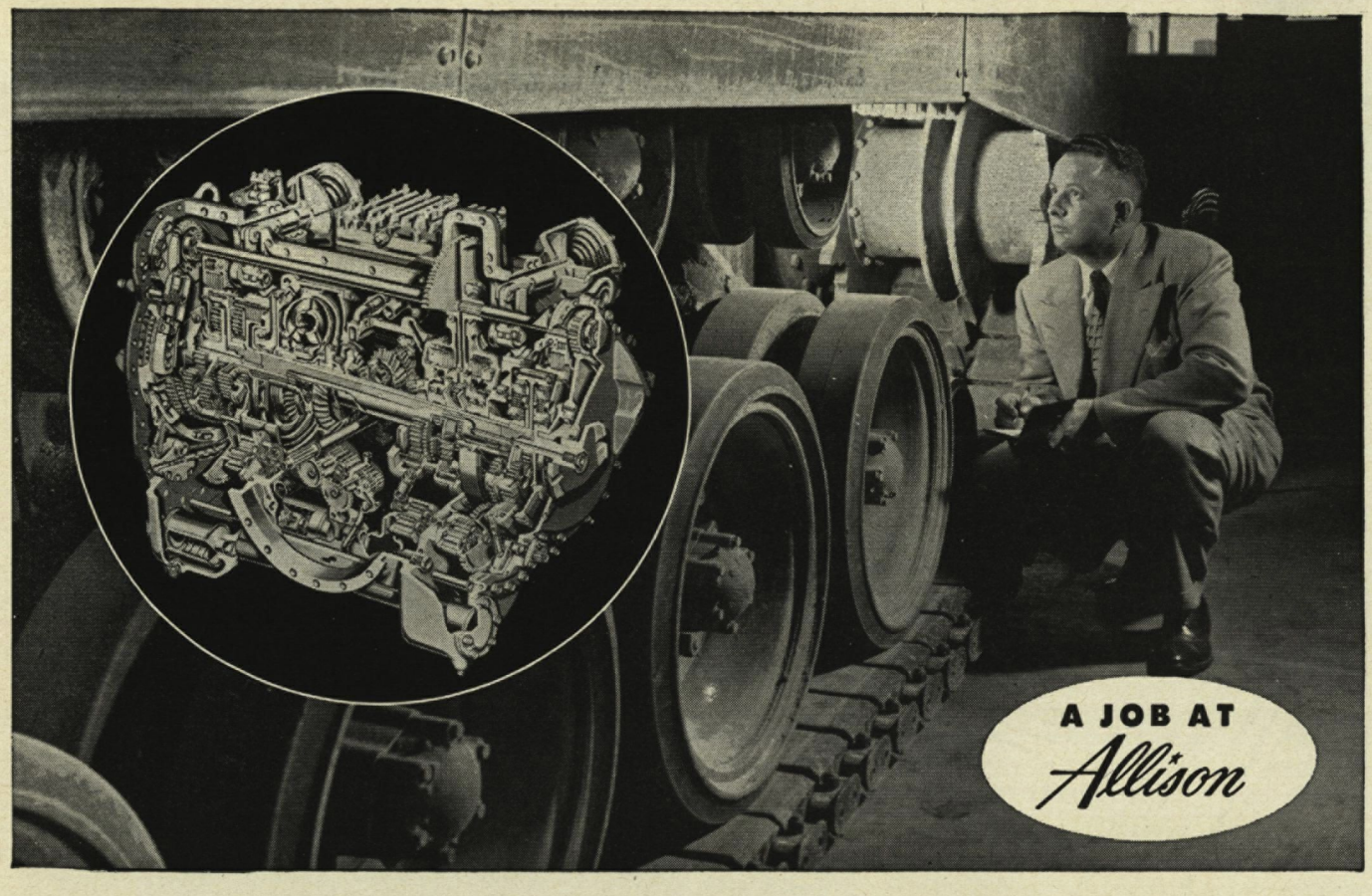


● **ALTON R. PATTERSON,** who received his M.E. from the University of Oklahoma in 1950, is another engineer at Allison who has a responsible position in an advanced field of science and mechanics. He is responsible for the application and best usage of hydraulic transmissions, like the CD-850 shown in the inset, to tanks and other heavy military vehicles.

These big and complex Allison Cross-Drive transmissions do more than their name implies. Along with the functions of a Torqmatic Transmission, they also brake and steer the vehicle. With a single lever, a tank driver is able to maintain finger-tip control. To accomplish this exacting assignment, some transmissions require as many as 5000 parts, including hydraulic drive, planetary gearing, steering and braking mechanism and hydraulically-operated clutches and bands.

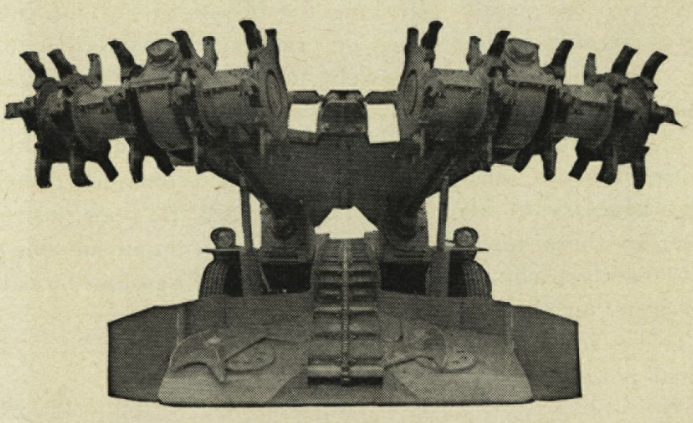
Pat's job is to insure the proper mating of transmission to vehicle, requiring him to work closely with manufacturers and proving grounds all over the country. One of the problems with which he is now working is a track vibration analysis and resolution of the effects of the vibration on the transmission. The result of his work will contribute toward better performance of a military vehicle, longer life for its parts and an improved product for our national defense. And, meanwhile, Pat is accumulating skill and experience in a field where the commercial possibilities have hardly been scratched. He is building his own future while working to insure the peaceful future of his country.

☆ ☆ ☆

Allison **DIVISION, GENERAL MOTORS CORPORATION • Indianapolis, Ind.**

Design, development and production—high power TURBINE ENGINES for modern aircraft . . . heavy duty TRANSMISSIONS for Ordnance and Commercial vehicles . . . DIESEL LOCOMOTIVE PARTS . . . PRECISION BEARINGS for aircraft, Diesel locomotives and special application.

Another page for **YOUR BEARING NOTEBOOK**

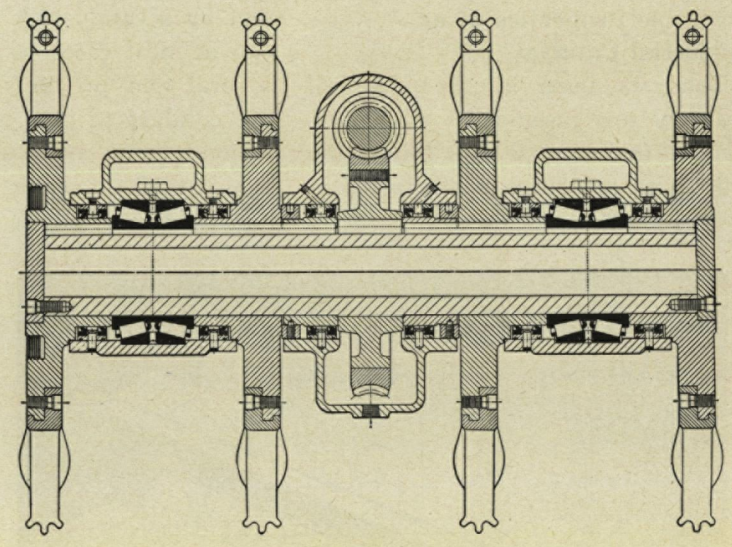


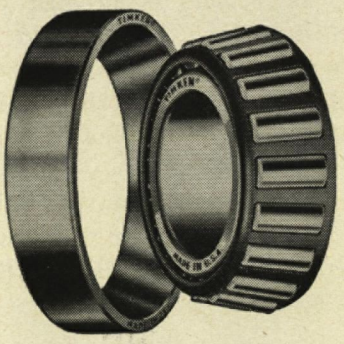
How to help a "miner" cut and load 2 tons a minute

This mechanical "Miner" cuts a coal seam and loads the coal, too—at the rate of 2 tons a minute! To insure this kind of performance, engineers used 86 Timken® tapered roller bearings on cutter heads and vital shafts. Due to line contact between rollers and races, Timken bearings have extra load-carrying capacity. Their tapered construction lets them carry radial and thrust loads in any combination. Shafts are held in positive alignment. Wear reduced. Trouble-free performance assured.

How to mount cutter heads on TIMKEN® bearings

Two-row Timken bearings, pre-adjusted at the time of manufacture, are used in all supporting positions of the cutting head assembly. The bearings are fixed in the housing at one end (left), and permitted to float in the other (right). Because of extreme dirt conditions encountered in the mining operation, a special type of two-element seal is used. Lubricant is forced between the two seals to give maximum protection to the bearings inside.





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TAPERED ROLLER BEARINGS

Want to learn more about bearings?

Some of the engineering problems you'll face after graduation will involve bearing application. If you'd like to learn more about this phase of engineering, we'll be glad to help. Clip this page for future reference and for a copy of the 270-page General Information Manual on Timken bearings, write today to The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ⧆ AND THRUST ⧆ LOADS OR ANY COMBINATION ✳

Catalysis: Key to . . . .

(*Continued from page 9*)

$$A+C \rightarrow AC$$

and compound AC might react rapidly with B:

$$AC+B \rightarrow AB+C.$$

These reactions proceeding rapidly might appear as though C were not entering the reaction at all, thus:

$$A+B \xrightarrow{C} AB$$

This reaction is particularly difficult to detect, however circumstantial evidence points to some such occurrence. MnO_2, for example, when used to prepare O_2 in the laboratory sometimes changes from a coarse black powder to a fine brown mass indicating that some change involving the MnO_2 has occurred.

Desirable Properties of an Industrial Catalyst

Catalysts used in the chemical industry are practically all of the contact (solid) type and this is the type with which we will be concerned.

Industrial requirements for a catalyst consist of (1) activity, (2) selectivity, (3) adequate lifetime and (4) mechanical strength.

Activity:

The catalyst for a process should be active, in so far as possible, under conditions where the equilibrium position is favorable. Some catalysts are active only at a temperature range where the equilibrium position would be unsatisfactory at atmospheric pressure. In these cases, if a more suitable catalyst cannot be found, the pressure on the reaction will have to be adjusted to the most economical point.

Selectivity:

This is probably the most important single requirement to be met by a catalyst. A given reaction can in most cases be made to yield several end products. By choosing the catalyst to give the desired reaction we can make many processes commercially feasible. For example, on studying catalytic cracking it is seen that several catalysts greatly accelerate the cracking of hydrocarbons. However the yield of different fractions varies greatly with the various catalysts. From a graph showing the effects of various catalysts on cracking *n*-hexadecane it is apparent that a silica-alumina-zirconia catalyst will give a remarkably large yield of C_3 and C_4 thus making the process very economical where these fractions are the ones desired. This reaction is an important one in the manufacture of gasoline by catalytic cracking.

Lifetime:

A catalyst may be extremely active and fulfill the requirement of selectivity and still not be suitable for an industrial catalyst due to its short useful life. One reason for the requirement that a catalyst have a long lifetime is obvious: Where the initial cost of the catalyst is high (as in the case of a material like platinum) the process would be very uneconomical if it were necessary to replace the catalyst after short periods of production. A second reason that is becoming increasingly important in the chemical industry arises from the fact that, in most cases, the most economical process for chemical manufacture is the continuous one. Any lengthy interruption of this process is extremely costly.

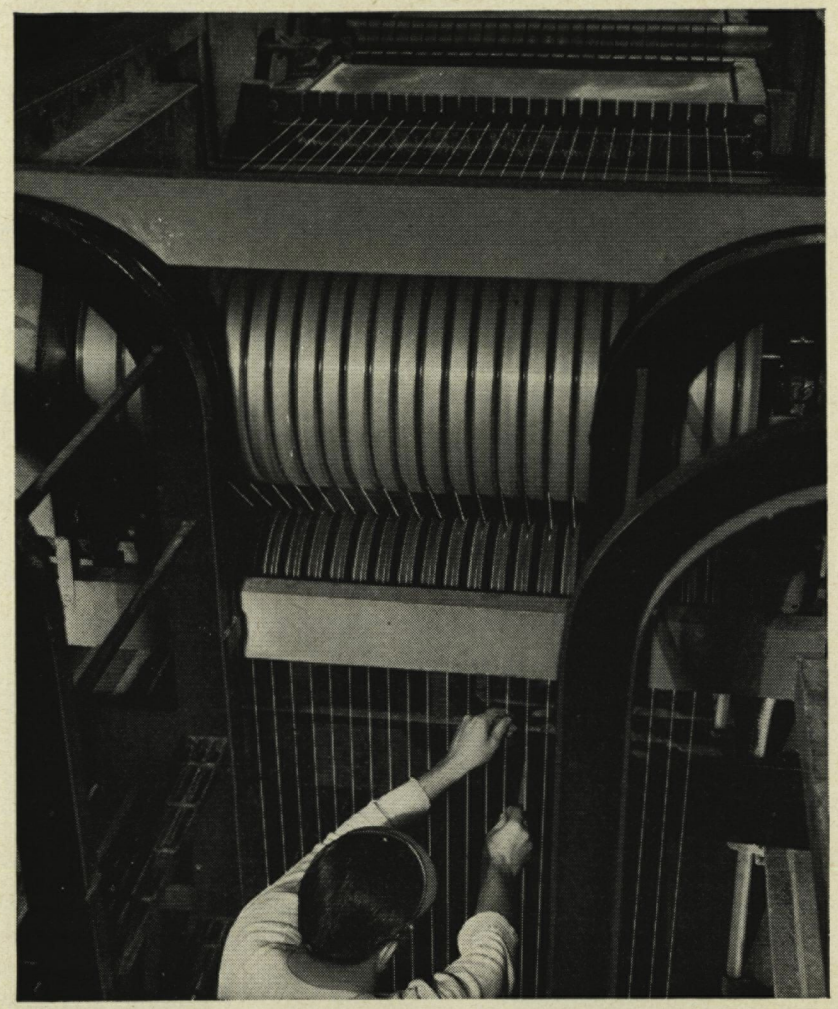
Accordingly, industrial catalysts should either have a long lifetime (several thousand hours or an extremely high yield of product per unit of catalyst), or it should be possible to regenerate them on the spot, cheaply, and in a short time, so that the *total* lifetime is very long.

Several different solutions of this problem have been found. They will be discussed in the last part of this study.

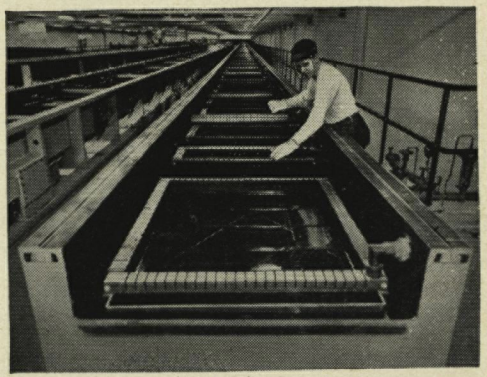
Mechanical Strength:

The importance of the fourth requirement, mechanical strength, depends upon the type of reaction which confronts us. Some reactions

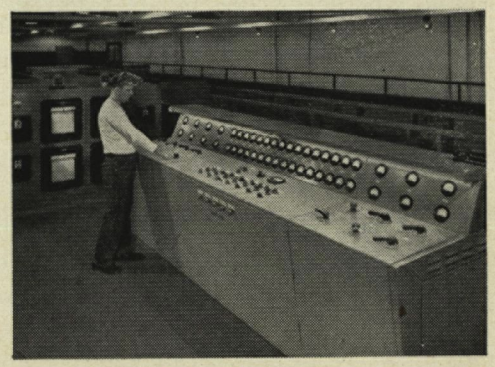
(*Concluded on page 24*)



25 strands of steel wire start on their way to be electrolytically coated with copper, lead and brass.



Part of the 600 foot long electroforming machines where wires go through successive baths of plating solutions.



Console of controls for entire process is readily operated when necessary, even though seldom used in the almost fully automatic operation.

ENGINEERING . . . with a pioneering twist

There's a real incentive in working out ways to do things that have never been done before. And problems in pioneering are constantly cropping up at Western Electric—manufacturing unit of the Bell Telephone System.

For example: the revolutionary electroforming process dreamed up and made a reality by Western Electric engineers for making copper coated steel wire.

The big idea was this: Could a process be developed in which successive coats of copper, lead and brass would be deposited on steel wire electrolytically in one continuous operation?

Engineers of varied skills—electrical, mechanical, chemical, metallurgical, civil—went to work as a team. After solving many problems, they came up with a process that makes better, stronger wire at lower cost—does it at the rate of 1¾ billion feet per year.

Recent developments such as microwave radio relay networks for telephone calls and television programs—operator and customer dialing of long distance calls—secret electronic equipment for the Armed Forces—promise an ever-widening field for young engineers of varied training at Western Electric.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

Catalysis: Key to . . . .

(*Concluded from page 22*)

can be catalyzed over thin layers of metal catalyst in granulated particles or gauze. Others must use beds of material where the pressure of the charge might crush the bottom layers. In other reactions, where the catalyst must be regenerated frequently, it might be necessary that the catalyst have a particular size and shape and be strong enough to undergo the regenerative process. Some of the latest techniques use catalysts in the form of spheres of microscopic size. The mechanical characteristics of the catalyst determine whether it can be used in all these methods.

Developing the Catalyst

A discussion of catalyst development makes necessary the introduction of two new terms. They are: 'Carrier'—A carrier is a substance (usually inert, catalytically speaking) mixed with a catalyst either to increase the surface area of the catalyst or to provide mechanical strength. 'Promoter'—a promoter is a substance mixed with a catalyst to increase its catalytic properties. Both the catalyst and the promoter may act as catalysts separately, but optimum reaction is obtained when they are mixed.

After the substances to be tested are selected, experimentation proceeds along two lines, variation of components, and variation of process conditions.

Variation of component:

Industrial catalysts almost without exception are composed of two or more elements or compounds. The proportion in which the various substances are mixed, the substances themselves, and the manner in which they are combined, all have widely varying effects on the reaction.

An example of correct catalyst composition shows that for the hydro-desulphurization of gasoline both CoO and MoO_3, plus a carrier, are active catalysts. A combination of the two, however, is more active, while a peak effect is obtained by using cobalt molybdate, $CoMoO_4$, without a carrier.

Variation of process conditions:

Experimentation at this level is usually the final step prior to installation of an actual pilot plant. At this stage the work done previously in the laboratory is adapted by the engineer to the commercial process. The catalyst is first tested under optimum conditions for the uncatalyzed reaction, then these conditions are varied in an attempt to find the optimum conditions with the catalyst present.

Under these actual working conditions many difficulties arise that were not encountered in the laboratory. For example, the laboratory investigator might have conducted his experiments using raw materials of a higher degree of purity than would be economical to use commercially. The impure raw materials used in the actual operation might poison the catalyst quickly and increase the cost prohibitively.

Catalyst Manufacture

After the best catalyst has been developed the process engineer must determine how the catalyst can be produced. Several methods are available to him. They are:

(1) Precipitated Catalyst: Hydroxides or carbonates are precipitated from acqueous solutions of the constituent and promoters. Any carrier may be added either before or after precipitation. The catalysts are then filtered and dried. They vary from soft powder to hard glassy gels.

(2) Decomposition Catalyst: Metal nitrates, oxalates, or other salts, are mixed with promoters and decomposed to metal oxides by heat. These occur as a fine powder and it is necessary to bond the catalyst in some manner.

(3) Impregnated Catalysts: Solutions of metal nitrates or other soluble salts plus promoters are used to impregnate porous granules of an inert carrier. The granules are then heated to oxidize the salt.

(4) Skeletal Catalysts: An alloy of the active metal catalyst plus aluminum or silicon is prepared by fusion. The aluminum or silicon is then leached out using NaOH or KOH, leaving a skeleton of the catalyst. This type has excellent mechanical strength and large surface area.

(5) Fused Catalysts: Mixtures of oxide, or active metal, catalysts are fused and then crushed to size. The catalyst has a low surface area but excellent mechanical strength.

(6) Cemented Catalysts: Oxides in the form of powders such as result from (1) and (2) and natural oxide ores are shaped into desired sizes by cement binders.

(7) Powdered Catalysts: These are used for liquid or gaseous systems.

Recent Developments in Industrial Catalysis

Most of the recent developments in the chemical industry have been aimed at cost reduction by increasing the catalyst lifetime and lowering the shutdown time for catalyst regeneration.

Two new processes illustrate this statement: The Thermofor process developed by the Socony-Vacuum Co. uses a moving catalyst bed in the reactor with a separate regenerator. The catalyst bed moves from the reactor to the regenerator and back in a continuous cycle. This results in no process shutdown for catalyst regeneration. The Fluid Hydroforming process of Standard Oil Co. of New Jersey and Standard Oil Co. of Indiana uses a finely powdered catalyst moving continuously through the system supported on oil vapors and air. Again shutdowns are eliminated. Also better catalyst-reactant contact is achieved.

With the concentration of many industrial laboratories upon catalytic reactions, within the next few years we should see an enormous amount of progress made toward a true understanding of catalytic chemistry.

"I needed to 'Find' Myself—that's why I picked Allis-Chalmers,"

says A. J. MESTIER

Massachusetts Institute of Technology Sc. B.—1943
and now Manager, Syracuse District Office

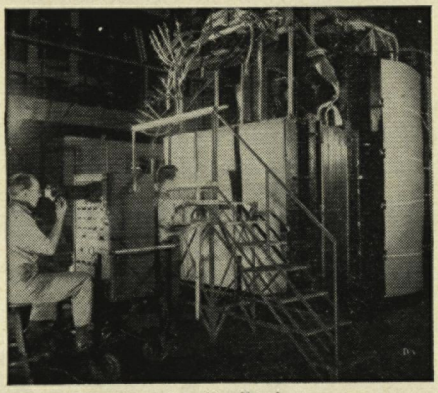
"I WAS LOOKING for an engineering job, but I wasn't very sure just what phase of this broad field would interest me most. I didn't know whether I wanted straight engineering, sales engineering, production or some other branch of industrial engineering.

"Allis-Chalmers Graduate Training Course gave me a means of working at various jobs—seeing what I liked best—and at the same time obtaining a tremendous amount of information about many industries in a very short time."

Experience Typical

"My experience is typical in many ways. I started the Graduate Training Course in 1946, after three years in the Army. My first request was to go to the *Texrope* V-belt drive department. From there I went to the Blower and Compressor department; then the Steam Turbine department. By the time the course was completed in 1948, my mind was made up and I knew I wanted sales work. I was then assigned to the New York District Office and in 1950 was made manager of the Syracuse District. The important thing to note is that all Allis-Chalmers GTC's follow this same program of picking the departments in which they want to work.

"Best of all, students have a wide choice, for A-C builds machines for every basic industry, such as: steam and hydraulic turbine generators, transformers, pumps, motors and other equipment for electric power; rotary kilns, crushers, grinders, coolers, screens and other machinery for mining, ore processing, cement and rock processing. Then there is flour milling machinery, electronic equipment and many others."

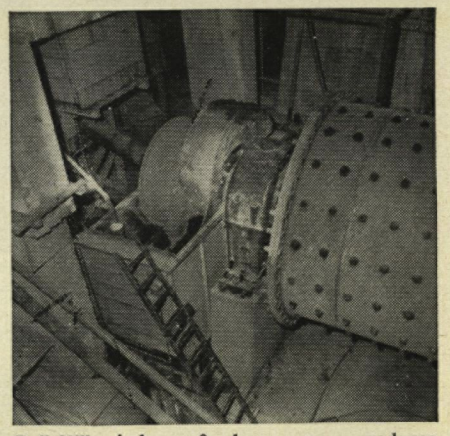


Taking surge voltage distribution tests on power transformer in A-C shops with miniature surge generator and cathode-ray oscilloscope.

A Growing Company

"In addition, new developments and the continuing growth of the company offer almost endless opportunities for young engineers.

"From my experience on the Graduate Training Course, I believe it is one of the best conducted in the industry and permits a young engineer to become familiar with a tremendous variety of equipment—both electrical and mechanical—which will serve him in good stead in his future profession."



Ball Mill grinds ore for large copper producer. Same type of equipment from Allis-Chalmers pulverizes much of nation's cement.

Texrope is an Allis-Chalmers trademark.

ALLIS-CHALMERS

For information call the Allis-Chalmers District Office in your locality or write to
Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin

Automation: Electronics builds. .

(*Continued from page* 11)

This phase, although sometimes considered lightly in the process of designing a plant, is very important in an automated system using all the intricate electric switches and controls that are utilized in a plant of this type. A good deal of the castings are "dry" machined. This process causes a fine, metallic dust which, if not properly taken care of, will get into even the best electrical contacts and cause disturbances. On most operations where dry machining is employed, the chips are arranged to fall into vibrating chutes which direct them into hoppers. As the hoppers become full they are emptied into a "chip buggy" which delivers them to the salvage department, where they are formed into briquets and then sent to the foundry to be used again. Where wet machining is employed, the cutting fluid and chips are arranged to flow into troughs under the floor and then into settling tanks, where the fluid is stored and filtered for reuse, with the chips being carried by conveyors to the salvage department.

The process of inspecting the parts is also done automatically by machines. Electronically a Tinius-Olsen dynamic balancing machine automatically balance drills and balances the 6-cylinder crankshafts. The final inspecting is done on a Sheffield Precisionaire gauge which inspects 27 points of the crankshaft simultaneously. Connecting rods are automatically weighed and sorted in order that they may later be matched with pistons and caps in perfect balance.

Automation has caused an appreciable reduction in scrap in the new Ford plant. It is practically impossible for a part to fall or to be dropped from the tracks on which they travel. Also the parts are not jostled together in such a manner that the machined surfaces become scratched.

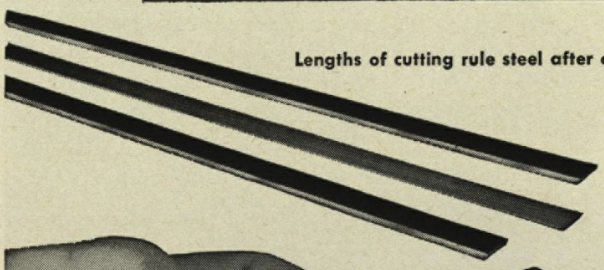
As the finished blocks leave the final machining operation they are picked up by arms of steel which are suspended from an overhead conveyor. These arms carry the blocks to assemblers throughout the plant where the engines are completely assembled. The engines are taken off of this arm only after they have passed a 20 minute "hot test" in which the completed engines are run and completely checked and adjusted. From here they go to an assembly plant where they may become part of your next car.

Undeniably the automation system requires fewer men to operate it. However the saving in manpower may not be quite as great as it appears. It has been estimated that the number of men required to operate the machinery may be cut by 90%. This does not take into consideration the fact that many more maintenance men and tool setters are required. This will cut the

(*Concluded on page* 30)

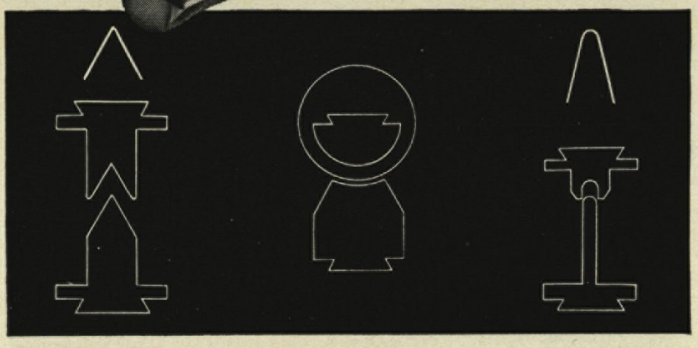
What's Happening at CRUCIBLE

about scoring and cutting rule steel



Lengths of cutting rule steel after edging

Shaped to cut wallet section (note bends, and form-holding method)



Some examples of the many shapes of bends needed

Scoring and cutting rule steel is a cold-rolled specialty steel for use in preparing dies for cutting paper, leather, rubber and other materials.

It is a pre-tempered product manufactured by skilled workmen, using precision rolling and hardening equipment, to close limits for chemistry, grain size and hardness. This product must also be capable of meeting intricate bend requirements in the hardened and tempered condition.

This specialty is furnished with round edges and in coil form to the rule manufacturer who grinds the edges — the one edge square and the other to a knife edge as well as cutting the material into desired lengths. This is sold to a die-maker who bends the rule to the required shape. This is then the nucleus of a pre-hardened die, which when properly brazed and supported is used to cut out material for display cards — aircraft parts — pocketbooks — wallets — gloves — gaskets — washers.

engineering service available

Since there is a great diversity of cold-rolled products, our staff of field metallurgists can help you apply what you require. Take full advantage of Crucible's more than 50 years experience as the first name in special purpose steels. Crucible Steel Company of America, General Sales and Operating Offices, Oliver Building, Pittsburgh, Pa.

CRUCIBLE first name in special purpose steels

52 years of Fine steelmaking

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

Takes a lot to lay a carpet in the jungle

The scene is "darkest Africa".

But Africa is lightening. Man's quest for minerals, for new areas for agriculture and trade, is slashing ultra-modern, glaring-white air strips in once impenetrable jungle.

Those pavers, portable air compressors, pumps and air tools—such as you might see working a city street—are Worthington Blue Brutes going to "lay a carpet" in that hole in the jungle.

Thus, Worthington, a major producer of equipment for public works, industry and farm, brings the fruits of American technical genius to the strange places of the world.

And illustrates, too, how the unique American talent of *diversification* helps public, employees and stockholders. For Worthington makes many things—not just construction equipment and pumps, but also engines, water works machinery, power transmission, petroleum equipment, air conditioning and refrigeration, many others.

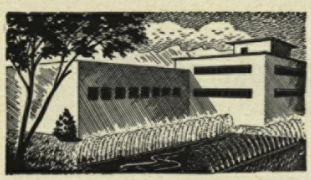
Such diversification builds *stability* . . . makes Worthington, 112 years old, a strong link in the chain of American business.

Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Harrison, New Jersey.

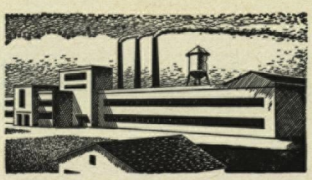
WORTHINGTON

The Sign of Value
Around the World

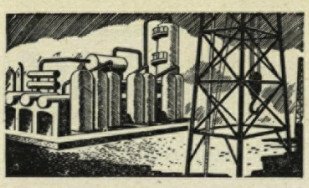
1.14



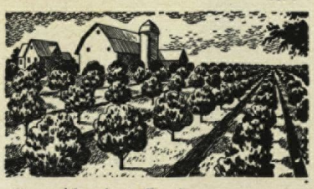
Good Water and Sanitation—engines pumps • water treatment • comminutors air compressors • air tools



Lower-Cost Manufacturing—pumps compressors • steam turbines • motors power transmission • air conditioning



Petroleum Products—compressors engines • pumps • chilling equipment refrigeration • decoking systems



More Abundant Food—compressors fertilizer mixers • air conditioning refrigeration • pumps

How high taxes destroy jobs

JOHN SMITH is a good mechanic who saves his money and starts a little alley shop making widgets. He works hard, hires two good fellow-workers, his wife keeps the books, and he prospers. He keeps costs low, sells widgets at $2 each, and has a good year—he makes $1000 profit.

He's delighted. Now he'll buy modern machinery that will cut costs so he can sell widgets for $1.50. He knows he'll sell so many he can hire 3 more men and raise everybody's wage. Progress!

But no! The government steps in and takes a big part of his $1000 for taxes. So John Smith cannot buy the new machinery, 3 new jobs are not created, wages cannot be raised.

In other words, the expansion which would have increased widget supply and cut their cost from $2 to $1.50 does not take place—exorbitant taxes have throttled progress, kept supply restricted, and have kept prices high; taxes have held down the standard of living. In other words, taxes have reduced jobs and wages, and injured progress. *Just as high taxes always do.*

Automation: Electronics builds. .

(*Concluded from page 26*)

saving down to about 50% over that of the manually operated line. These men are generally paid at a higher rate also. Worker fatigue is cut to a minimum on the automated lines and with the elimination of chain hoists and other lifting devices the worker is able to concentrate on the problem of assembling the engine. The result is a better product.

Automation is not restricted to engines alone. Ford's new stamping unit at Buffalo, New York has made automation an integral part of its layout and design. Here the sheets of steel are automatically handled between the presses which form the many panels used in an automobile. At the Dearborn, Michigan plant Ford has even gone so far as to automate the manufacturing of curved windshields.

PARTS MADE ON AUTOMATED PRODUCTION LINES

Dearborn	Cleveland
Cylinder blocks	Cylinder blocks
Cylinder heads	Cylinder heads
Tappets	Connecting-rod caps
Rocker-arm shafts	Camshaft
Exhaust valves	Bearing-caps, main
Curved windshield	Rocker-arm shaft
Ring gears	Oil pan
Gas tanks	Piston
Push rods	Flywheel housing
Flywheel housing	

Admittedly the best and most efficient method of production is to pour the raw materials in one end of the plant and to get the finished product out of the other end. This, however, is very difficult to do with all the intricate assembly operations required on most products. Ford has stepped in this direction, in addition to the automated lines of the engine plant, by building a new and equally modern foundry next door to the plant. This foundry will feed the rough castings to the hungry paws of the broaching machines, and to the various drilling, reaming, countersinking, tapping, and other operations necessary to complete an engine.

"On Target" Today demands electronic computations

This booklet — "Engineering at Arma" — emphasizes the importance of engineers, physicists and mathematicians at Arma. You may find it the prologue to your career. Write for your copy to Engineering Division, Arma Corporation, 254 36th Street, Brooklyn 32, N. Y.

Today's gunnery is a far cry from the days of slugging it out at close range — it demands split-second solutions to constantly varying, increasingly complex mathematical problems. Only continuous engineering advances in electronic instrumentation can accomplish this feat.

Thirty-four years of outstanding engineering design and precision manufacture have gone into Arma's leadership in this vital supply link to our nation's Armed Forces. Through specialized knowledge in electronic instrumentation, in the years to come Arma will contribute even more significantly to our *industrial and military might.*

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QUALITY ARMA INSTRUMENT PRECISION

PIONEERING IN INSTRUMENTATION FOR 34 YEARS

Campus Survey

(*Concluded from page* 13)

Poly's Engineers came through for a 13-7 victory over Principia in the season's final game.

The first Rose touchdown came in the third quarter after Harry Stutts and Larry Samuels made ground gains which set the stage for a 30-yard pass from Young to Rader, who ran the ball 27 more yards to the end zone. Jim Mook booted the extra point.

Bill Scharpenberg intercepted a Principia pass and brought it back to the 21-yard line to start the second touchdown drive. Stutts gained seven yards on the ground and a pass from Young to Mogle put the ball on the ten. Stutts got four more yards. A pass from Stoker to Mogle hit pay dirt for the score.

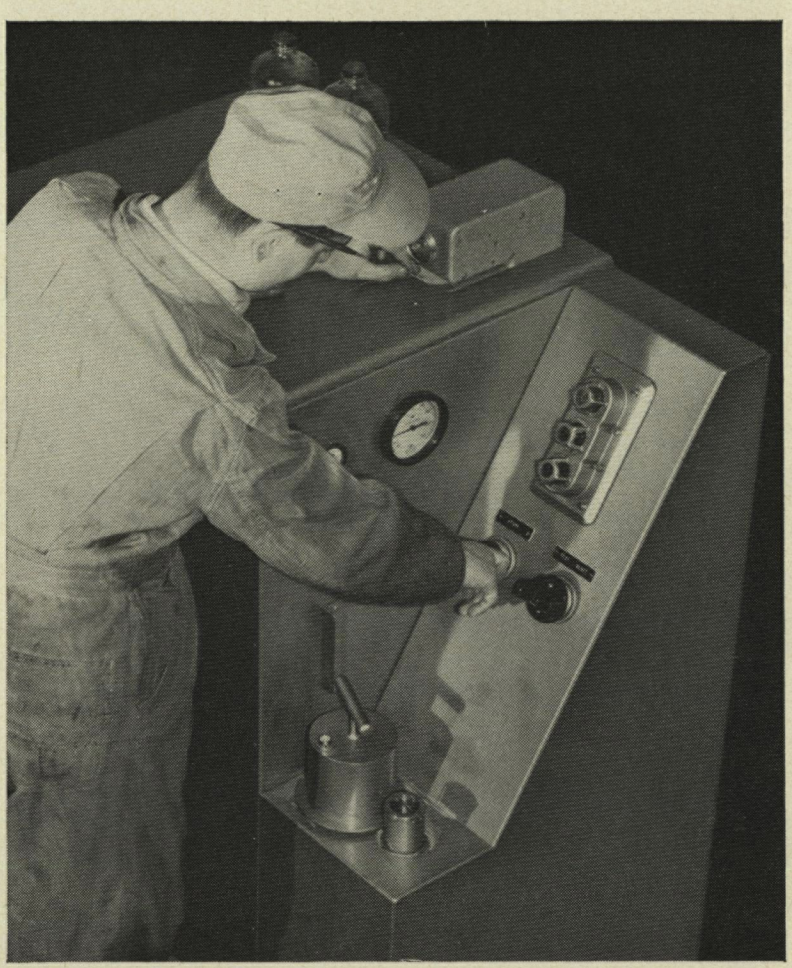
Principia got their lone touchdown in the fourth quarter after a 40-yard pass put them on the Rose four and a short pass put them across the goal line.

Library Notes

Rachel Carson is currently bombarding the Best Seller Lists with two entries. Her famous *Sea Around Us* is still riding high after 64 weeks, and her second title, *Under the Sea-Wind* is doing itself right proud too. Both books are oceanic in flavor but even landlubbers from Death Valley are enthusiastic over the vivid yet simple descriptions of marine life.

Vestal, Stanley, *Joe Meek, The Merry Mountain Man.*

He was the Davy Crockett of our Great Northwest, bold, adventurous, humorous, a first class trapper, Indian fighter, pioneer, peace officer, and frontier politician. He was the wittiest, saltiest, most shameless wag and jester that ever wore moccasins in the Rockies. Could one find a more delightful fellow to spend a few pleasant evenings with, through this excellent portrait by Stanley Vestal?



THIS NEW FLASH POINT TESTING MACHINE is so accurate that a sample with as little as 1/10 of 1% unsafe material in it will cause a rejection. Recently developed by Standard Oil's Engineering Research Department, this revolutionary device reduces the average time from 20 minutes for a flash test to two and a half minutes, avoids human errors in testing flash point, can be used right at the loading rack.

Adventures in Research

The flash point testing problem that was solved with the machine shown above is only one of the many problems presented to Standard Oil's new and growing Engineering Research Department.

In the last few years, it has developed and put into operation instruments to measure vapor pressure, 158° point, acidity and viscosity. Ultrasonic generators have been built for general use in providing energy for experimental purposes. The department is studying application of radioactive isotopes to instrumentation and control problems related to refinery operation.

One of our research divisions is carrying out an extensive theoretical study of stresses in pressure vessels having flat, conical, hemispherical, toriconical or torispherical heads.

In our work on product evaluation, we have developed a new test for quenching oils based on the fundamental heat transfer relationships involved.

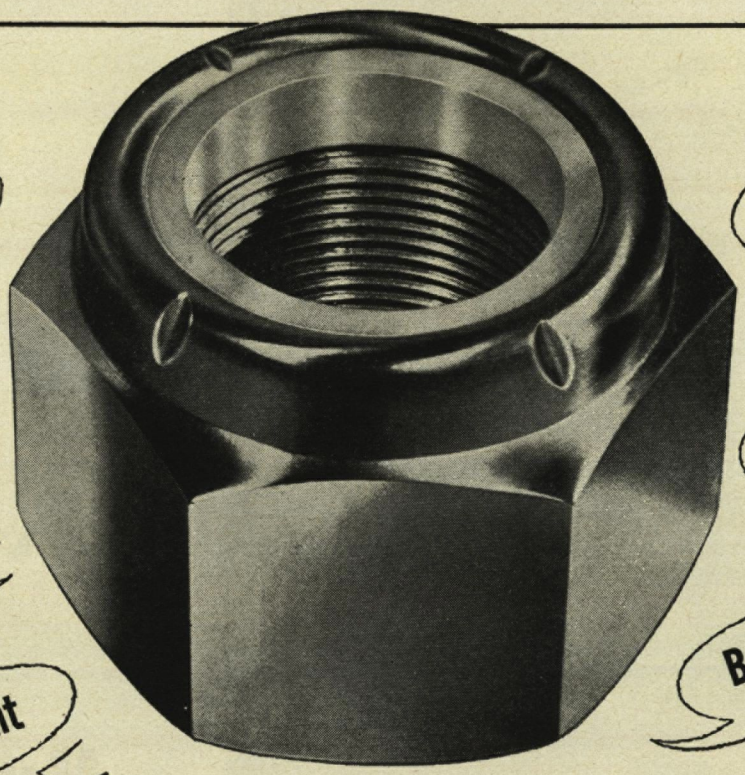
Problems such as these are the daily fare of Standard Oil's Engineering Research Department. Here is a challenging opportunity for young men with advanced training in chemistry and engineering. Many and varied problems continually arise in the design, construction and operation of petroleum industry equipment.

Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois

STANDARD

Whenever fastening problems arise...



Vibration

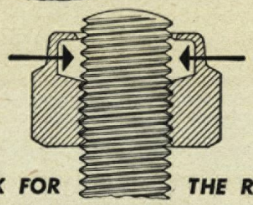
Maintenance

Reusability

Oil Seepage

Bolt Loading

Adjustment



Consider ELASTIC STOP NUTS

LOOK FOR THE RED LOCKING COLLAR

It is threadless and resilient. Every bolt impresses (but does not cut) its full thread contact in the Red Elastic Collar to fully grip the bolt threads. In addition, this threading action properly seats the metal threads—and eliminates axial play between bolt and nut threads. All Elastic Stop Nuts—regardless of type or size—lock in position anywhere on a bolt or stud, maintain accurate adjustments and seal against liquid seepage. Vibration, impact or stress reversal does not disturb prestressed or positioned settings.

Whenever fastening presents a problem—ESNA is ready with a quick answer. More than 3000 types and sizes of self-locking vibration-proof fasteners—plus the "know-how" of ESNA engineers—are available here at ESNA.

ESNA has long been known as "design headquarters" for self-locking fasteners. Accepted by Army, Navy and Air Force, virtually every aircraft built in the past decade has been Elastic Stop Nut-equipped. On the railroads, in the oil fields, on automobiles and construction equipment, Elastic Stop Nuts manufactured to exacting quality control standards, are doing specialized jobs every day.

Be familiar with the design help ESNA offers. Write us for details on Elastic Stop Nuts. Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, N. J.

ELASTIC STOP NUT CORPORATION OF AMERICA

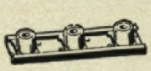

HIGH TENSILE


ANCHOR


HIGH TEMPERATURE


SPLINE


CLINCH


GANG CHANNEL


NYLON CAP

DESIGN HEADQUARTERS FOR SELF-LOCKING FASTENERS

This is the Boeing team's jet heavyweight

Here is a flight shot of the giant Boeing B-52 Stratofortress. An eight-jet heavy bomber, the Stratofort is a fast, husky teammate to the B-47 Stratojet medium bomber. It's 153 feet long, measures 185 feet from wing-tip to wing-tip, and is powered by eight Pratt & Whitney J-57 engines. Speed and other performance details are carefully guarded secrets.

This Boeing jet-bomber team is another example of the trail-blazing that, for 35 years, has kept Boeing engineers at the head of the design parade.

If you measure up to Boeing standards, you can share this Boeing prestige. You'll work with men renowned in their fields on such challenging projects as guided missiles, nuclear-powered aircraft, and the exploration of supersonic flight.

You can work in Seattle in the Pacific Northwest, or, if you prefer, at Wichita in the Midwest. Boeing provides a generous moving and travel allowance, offers you special training, a salary that grows with you — and a future of almost limitless range.

Plan *now* to build your career as a member of Boeing's distinguished Engineering personnel after graduation. Boeing has present and future openings for experienced and junior engineers in all fields, for aircraft

- **DESIGN**
- **RESEARCH**
- **DEVELOPMENT**
- **PRODUCTION**
- **TOOLING**

also for servo-mechanism and electronics designers and analysts, and for physicists and mathematicians with advanced degrees.

For further information, consult your Placement Office, or write:

JOHN C. SANDERS, Staff Engineer — Personnel
Boeing Airplane Company, Seattle 14, Washington

BOEING

Research and Development

(*Concluded from page* 15)

The "kidney" has been successfully used for combatting chronic and acute uremic poisoning that takes place when kidney functioning breaks down. In cases of poisoning caused by sulfa drugs, barbiturates, or carbon tetrachloride, it is believed the "kidney" can take over the job of the overworked human organ. It may also prove useful after certain abdominal operations, when kidney blockage results, or to reduce excessive amounts of such substances as potassium in the blood. In research the unit is a valuable tool in the study of body functions.

New Radiation Effect Microscope

Deadly radioactive materials, hidden behind a thick concrete wall, can now be safely studied and photographed under a microscope by atomic scientists, using a new instrument jointly announced recently by American Optical Company's Instrument Division, at Buffalo, N. Y., who built the device, and the General Electric Company, Schenectady, N.Y.

First of its kind, the instrument is being installed in the Knolls Atomic Power Laboratory, operated by General Electric for the Atomic Energy Commission. According to Dr. Kenneth H. Kingdon, technical manager of the laboratory's technical department, the instrument is expected to make possible investigations on the effects of radiation damage to materials that have never before been accomplished.

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

Operated by remote control, the instrument permits atomic researchers to work in complete safety. Some sort of remotely controlled "mechanical hands," similar to those developed by KAPL engineers and first announced in 1948, could be used to place the specimens in position, and to remove them after examination.

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

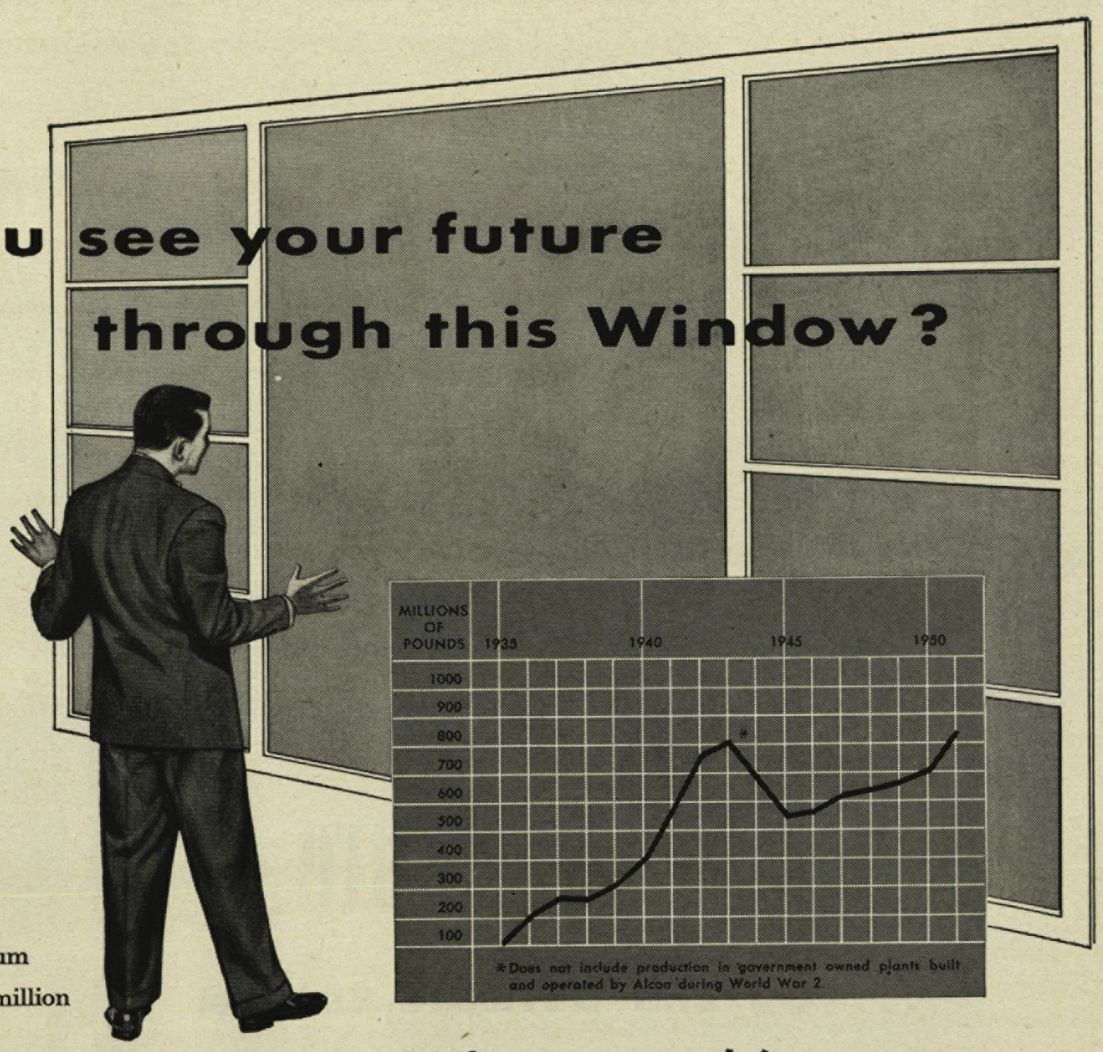
Both lens systems are offset by means of mirrors, which change the light path from horizontal to vertical, and then back to horizontal again. Radioactive radiations from inside the test cells are not reflected and cannot get around the offset. If the tube were straight, however, they might be able to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

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

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

Polarized light, consisting of vibrations in a single plane, as opposed to ordinary light in which the vibrations are in many different directions, is invaluable in the study of metals, and may also be used.

Can you see your future through this Window?



This is an aluminum window, one of four million that will go into buildings in 1953. Twenty years ago, it was just an idea in the mind of an Alcoa development engineer. Ten years ago, only a few thousand were made annually. Now, production *is increasing* at the rate of over half a million a year. This is just one of a torrent of new uses for aluminum which means that Alcoa must continue to expand. Consider the opportunities for you if you choose to grow with us.

What can this mean as a career for you?

This is a production chart . . . shows the millions of pounds of aluminum produced by Alcoa each year between 1935 and 1951. Good men did good work to create this record. You can work with these same men, learn from them and qualify yourself for continually developing opportunities. And that production curve—is still rising, we're still expanding, and opportunities for young men joining us now are almost limitless.

Ever-expanding Alcoa needs engineers, metallurgists, and technically minded "laymen" for production, research and sales positions. If you graduate soon, if you want to be with a dynamic company that's "going places", get in touch with us. Benefits are many, stability is a matter of proud record, *opportunities are unlimited.*

For more facts, consult your Placement Director.

The best things in aluminum come first in

ALCOA ALUMINUM

By ALUMINUM COMPANY OF AMERICA • Pittsburgh, Pennsylvania

a look to the future

...YOU and DETROIT EDISON

BEFORE YOU CHOOSE the place where you'd like to work, look ahead. Carefully consider the character of the company you'd like to join.

Ask yourself if it is a progressive concern, led by men of energy and vision. Does it provide a wide variety of jobs that lead to positions of higher trust? Is it a *company with a future*—one that will reward your loyalty, ability and accomplishments with well-defined *opportunities for advancement?*

Detroit Edison is widely recognized as such a company.

It is an independent electric utility—one of the largest in the United States. Detroit Edison is owned by 60,000 investors and operated by 11,000 employes, who serve 3,500,000 people living throughout the key industrial and agricultural section of southeastern Michigan.

The Detroit Edison Company is a forward looking enterprise with a half century of progress to mark its present growth. As an example of its foresightedness, Detroit Edison engineers are working with Dow Chemical Company as one of our country's four atomic research teams. They are investigating the use of nuclear heat in thermal electric generating plants . . . an investigation pointing toward better ways to provide electric power for the nation.

It is an aggressive company keeping constant pace with the productive area it serves—a utility which during the last six years has increased its electric generating capability by 50 per cent—and by 1954 will have doubled its facilities of a decade ago.

This steady march of progress calls for a continued program of expansion . . . it demands able men of many skills to assume new positions of responsibility in scores of different jobs.

There is no limit on your initiative at Detroit Edison. You may select your starting job through an orientation program which also allows you to observe many of the Company's operations as a background to your successful future. And, once started, you are encouraged to advance as far as your ability and energy will carry you.

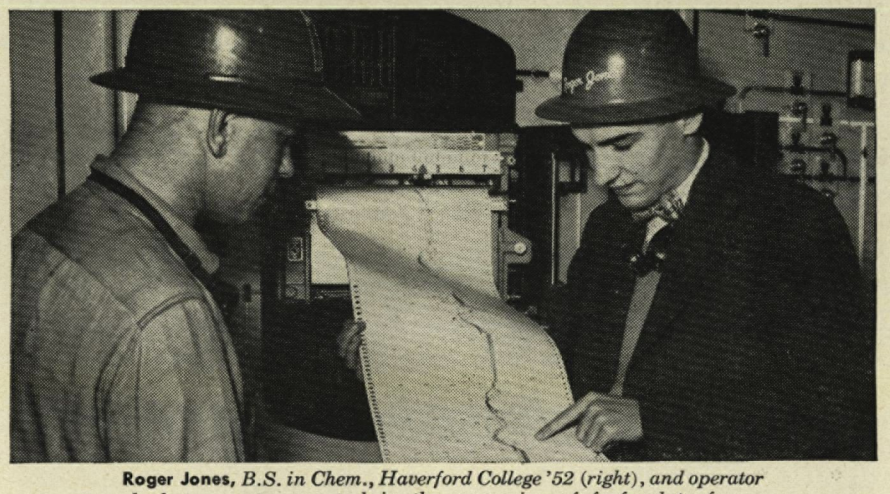
Here indeed is a firm and satisfying foundation on which to build your own career—Detroit Edison, a company that looks ahead for its employes as well as for the customers it serves.

The Detroit Edison Company

THE DU PONT DIGEST

Plant and Equipment Design and the Engineer

At Du Pont, men with many types of training translate laboratory developments into full-scale production



Roger Jones, *B.S. in Chem., Haverford College '52 (right), and operator check temperature control in the conversion of furfural to furan.*

Among the most interesting fields for engineers at Du Pont is the design of plants and equipment.

It takes ingenuity of a high order to translate a small-scale laboratory operation into all-out commerical production. Design engineers cannot always use purchasable equipment to scale up research findings, even with considerable adaption. About half of the time at Du Pont, entirely new equipment must be designed because of the novelty of the process developed by research.

For example, a number of unusual problems were involved in designing the equipment and plant for a process in which hexamethylenediamine, one of the intermediates for nylon, is made from furfural, derived from such agricultural by-products as corncobs and hulls of cottonseed, oats and rice.

In this conversion, these steps are involved:

$$C_4H_3OCHO \text{ (furfural)} \xrightarrow[\text{catalyst}]{\text{Heat}} C_4H_4O \text{ (furan)}$$

$$2H_2 \longrightarrow C_4H_8O \text{ (tetrahydrofuran)}$$

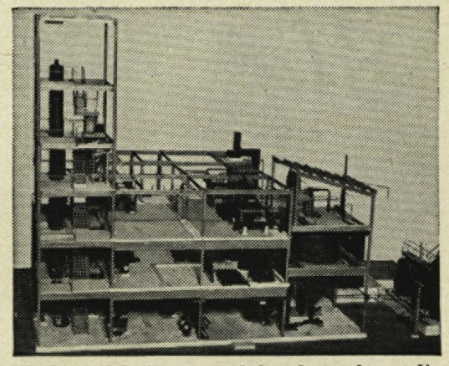
$$2HCl \longrightarrow Cl(CH_2)_4Cl \text{ (dichlorobutane)}$$

$$2NaCN \longrightarrow NC(CH_2)_4CN \text{ (adiponitrile)}$$

$$4H_2 \longrightarrow H_2N(CH_2)_6NH_2 \text{ (hexamethylenediamine)}$$

Here are some of the special problems that were encountered:

1. Design of equipment with close temperature control for converting furfural to furan. The design finally settled on employs a large number of tubes containing a catalyst, with a coolant circulated around them. Special sequence timers were devised for operation of the valves controlling production and regeneration cycles.



Scale model *of a part of the plant where adiponitrile is made from furfural.*

2. Design of high-pressure agitated autoclaves for the hydrogenation of furan to tetrahydrofuran.

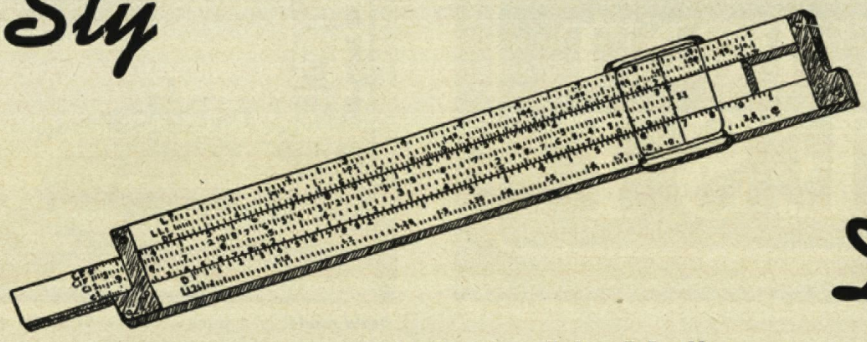
3. Selection of corrosion-resistant equipment for the hydrochlorination of tetrahydrofuran to dichlorobutane at high temperatures.

4. Design of a unique five-step distillation train to obtain high-grade adiponitrile without trace impurities.

Although most of these problems involve a great deal of chemical engineering, also needed on the designing team were mechanical, electrical, civil, metallurgical and industrial engineers. Thus design work at Du Pont is open to men with many types of training, and there is abundant opportunity for all.

E. W. Griffin, *B.S. in M.E., Duke; M.S. in Ind. Mgt., Georgia Tech '52 (right), instructs operator in handling of vapor-tight horizontal vacuum filter used in separating adiponitrile from sodium chloride.*

Sly Droolings



Stolen by John Voelker, sr., m.e.
John Simpson, sr. c.e., and Dick Bosshardt, soph. m.e.

The brain is a wonderful organ. It starts working the minute you get up and doesn't stop working till you get to class.

* * * * *

How to give a girl a surprise:

Place arms around waist. Draw her strongly toward you, and hold her tight. When she says "STOP!" release her. Note amazement on face.

* * * * *

Gunpowder—An agency employed by civilized nations for the settlement of disputes which might become troublesome if left unadjusted.

* * * * *

If the Russians were really proud of their Communist experiment, instead of an iron curtain they would have a plate glass window.

* * * * *

I have a sneaking suspicion that what's wrong with this old world is that there is too much sneaking suspicion.

* * * * *

Her dress was tight—she scarce could breathe.

She sneezed aloud and there stood Eve.

* * * * *

"Hell, yes," said the devil, picking up the phone.

* * * * *

Some guys are so lucky that they can take a penny to class and still make 97 on a true and false exam.

Harvey: "Look, is that lady's dress torn or am I seeing things."

George: "Both."

* * * * *

A New England epitaph reads:

"Here lies an athiest—all dressed up and no place to go."

* * * * *

Market report: Dressed poultry is up to 2¢ a pound, but live pigeons continue to drop a little.

* * * * *

Sunsuit—What a woman wears to lower her temperature and raise yours.

View—What keeps a guy in a manhole looking up.

* * * * *

A kiss is a mouthful of nothing that tastes like chlorophyll and sounds like a cow pulling her foot out of the mud.

* * * * *

Adolescence: The age when a girl's voice changes from "no" to "yes."

* * * * *

"I'll show him a thing or two," said the coed, getting into her new formal.

* * * * *

Mother: "Is that young man there yet?"

Daughter: "No, but he's getting there."

* * * * *

He: "When I squeeze you in my arms like this, honey, something seems to snap."

She: "Yes, pardon me a moment while I fasten it.

She: "How about a date, big boy?"

State man: "Can't. Gotta go to bed and get some sleep."

She: "Why?"

State man: "Tomorrow's my tough day. Gotta shave."

* * * * *

Bachelors know more about women than married men. That's why they're bachelors.

* * * * *

"Whose head feels the pillow
Of yon, white bed
Flunks like a dog.
Read on!" he said.

* * * * *

Adam and Eve were the first bookkeepers; they invented the loose leaf system.

* * * * *

Don't censure a man for flirting with the waitress. He may be playing for big steaks.

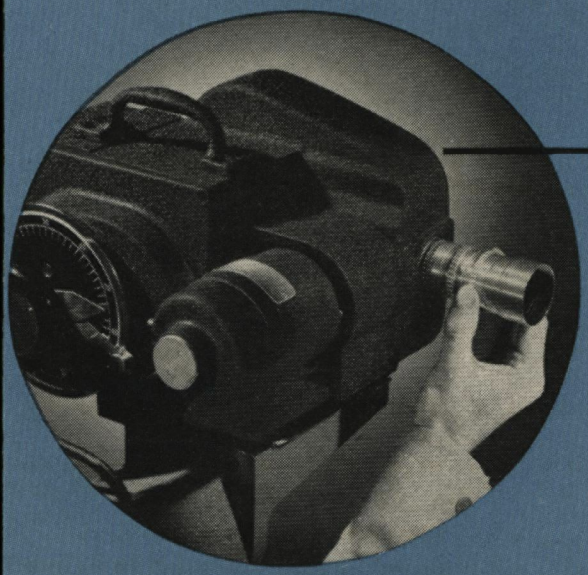
* * * * *

The excited voice of a young Smith girl came over the phone: "Two boys are trying to break into my room through the window."

"Listen, lady, this isn't police headquarters; this is the fire department."

"I know," she answered, "but my room is on the second floor, and they need a ladder."

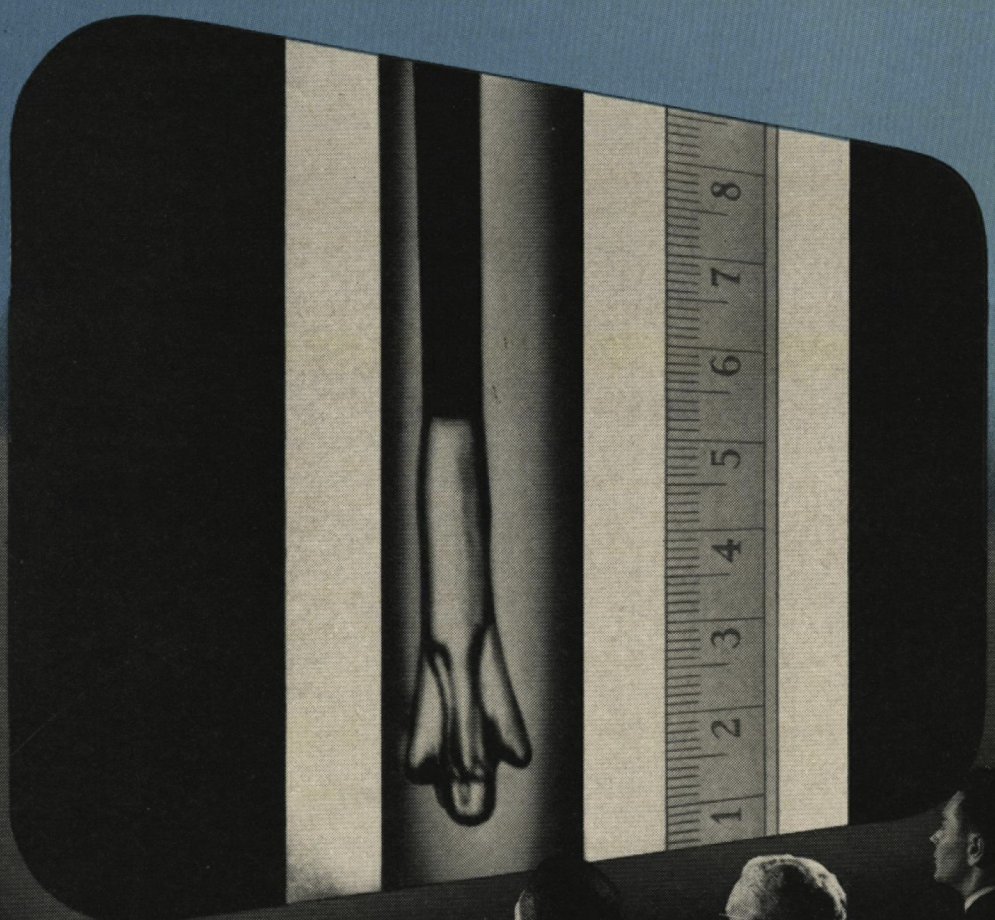
Engineering has a precision tool in photography



WHATEVER YOUR BRANCH of engineering, you'll find photography an increasingly valuable aid. With it you can picture lightning-fast operations—or extremely slow processes—at speeds suitable for study. You can capture fleeting instrument traces, study internal stresses in machine parts, examine metal structure and do countless other things.

The application of photography to engineering problems has become a specialty in itself. This has led graduates in the physical sciences and in engineering to find positions with the Eastman Kodak Company. If you are interested, write to Business and Technical Personnel Department, Eastman Kodak Company, Rochester 4, N. Y.

Here high speed motion-picture photography shows a cavity in a column of water produced when a 5-mm rod was shot through it at 12.2 meters per second. By taking the pictures at 3200 per second and projecting them at the standard 16 per second, time is "magnified" 200 times.



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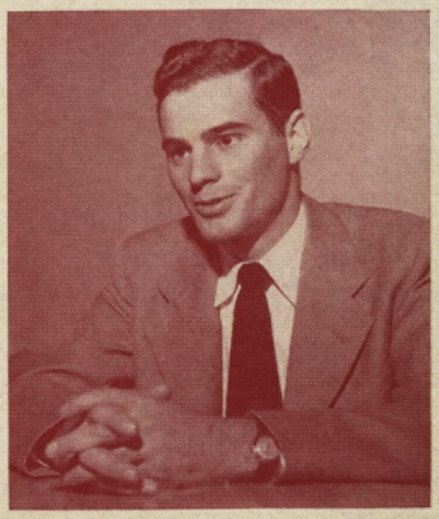
MY QUESTION TO THE G-E STUDENT INFORMATION PANEL:

"Are my opportunities for advancement as good in a large company, like G.E., as they are in a small firm?"

. . . Allen E. Galson, Cornell University, 1953



Two answers to this question, presented at a student information meeting held in July, 1952, between G-E personnel and representative college students, are printed below. If you have a question you would like answered, or seek further information about General Electric, mail your request to College Editor, Dept. 221-6, General Electric Co., Schenectady, N. Y.

M. M. BORING, *Engineering Services Division* . . . I think your opportunities for advancement are as good, if not better, in a large company. There is one point which is often overlooked in making such a comparison. That is, that any large company, and especially one as diversified as General Electric, is really made up of a number of small companies, but with more opportunities than you find in a small firm. We are an organization of many businesses.

With many diverse fields there is greater opportunity for college men and women to find the work most suited to their desires, talents, and abilities. With a wider choice of jobs there is more opportunity to get into work you really enjoy.

The college graduate, working for G.E., will discover new fields opening up to him. He will probably discover that there is some activity in which he is particularly interested. There are no fixed paths for college graduates at G.E. The college man or woman who enters our Company does not commit himself irrevocably to one type of work. It's our tradition to encourage the newcomer to look around, try several different assignments, and find the work most satisfying to him and to which he can make the greatest contribution. In G.E. the college graduate can investigate many types of work before choosing his field. And, he can change jobs without having to leave the Company, or lose the advantages connected with length of service—an impossibility in many small firms.

F. K. McCUNE, *Engineering Services Division* . . . There is one Company function which, I believe, provides great opportunities for advancement in General Electric. That is our system of training programs, designed to provide a continuous succession of young people to assume responsibilities for the Company's operation and management in the future. The principle of this training has been to develop men and women by providing them with productive employment, by giving them the opportunity to reveal their abilities, and by providing them with practical classroom study designed to broaden their understanding of the electrical industry and of business in general.

The most important contribution of the training programs has been in developing leaders for our Company. Many of the officers and executives in responsible key positions today are graduates of one or another of these programs.

Many small firms cannot afford to spend, either in time or money, the amount we do in preparing young people for better future positions. We believe, however, that these training programs are one of the best assurances that we will have men and women with qualities of ability, character, and leadership in our Company, prepared to cope with the problems and responsibilities of our complex society.