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MARCH

1960

The Wisconsin

engineer

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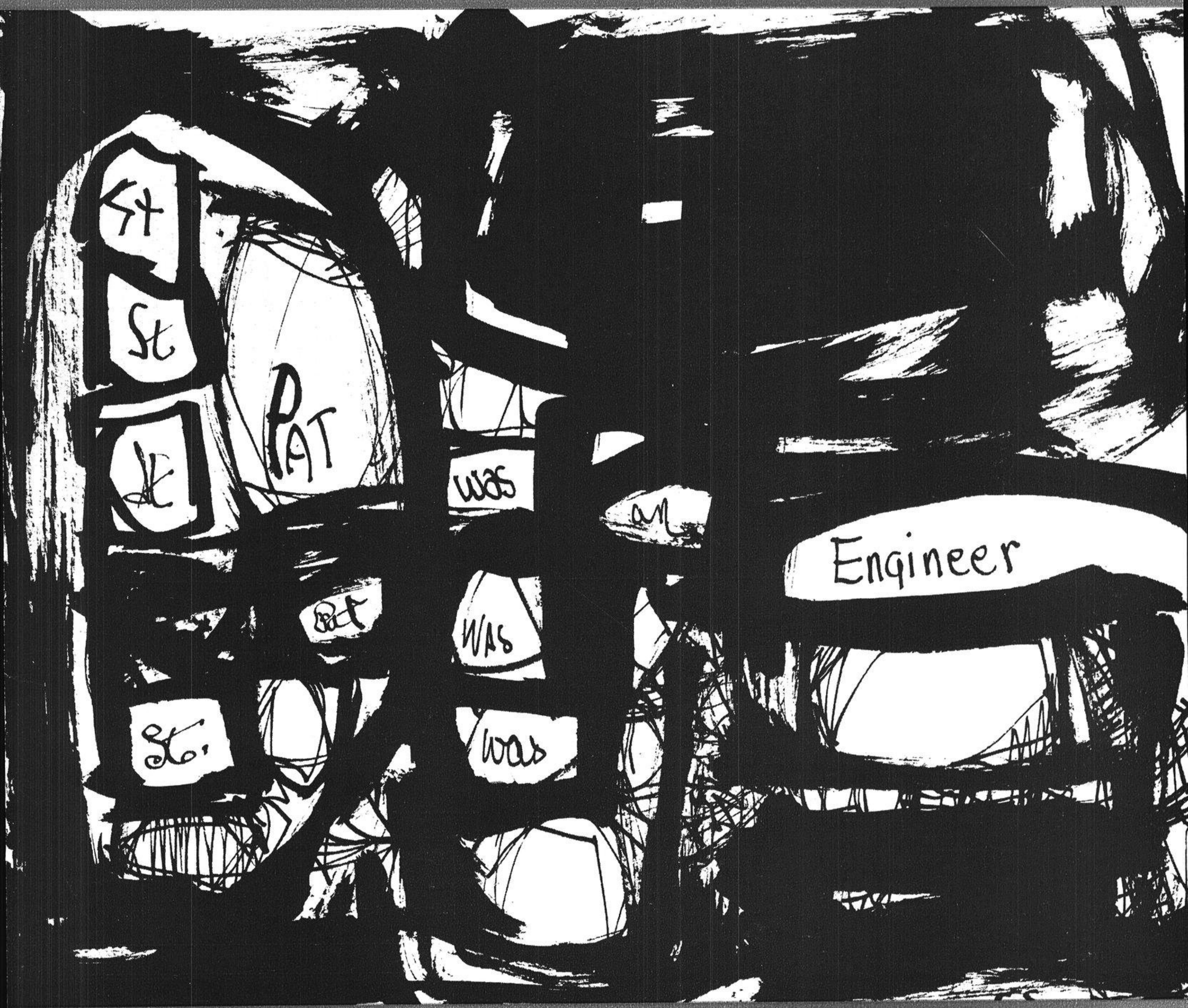

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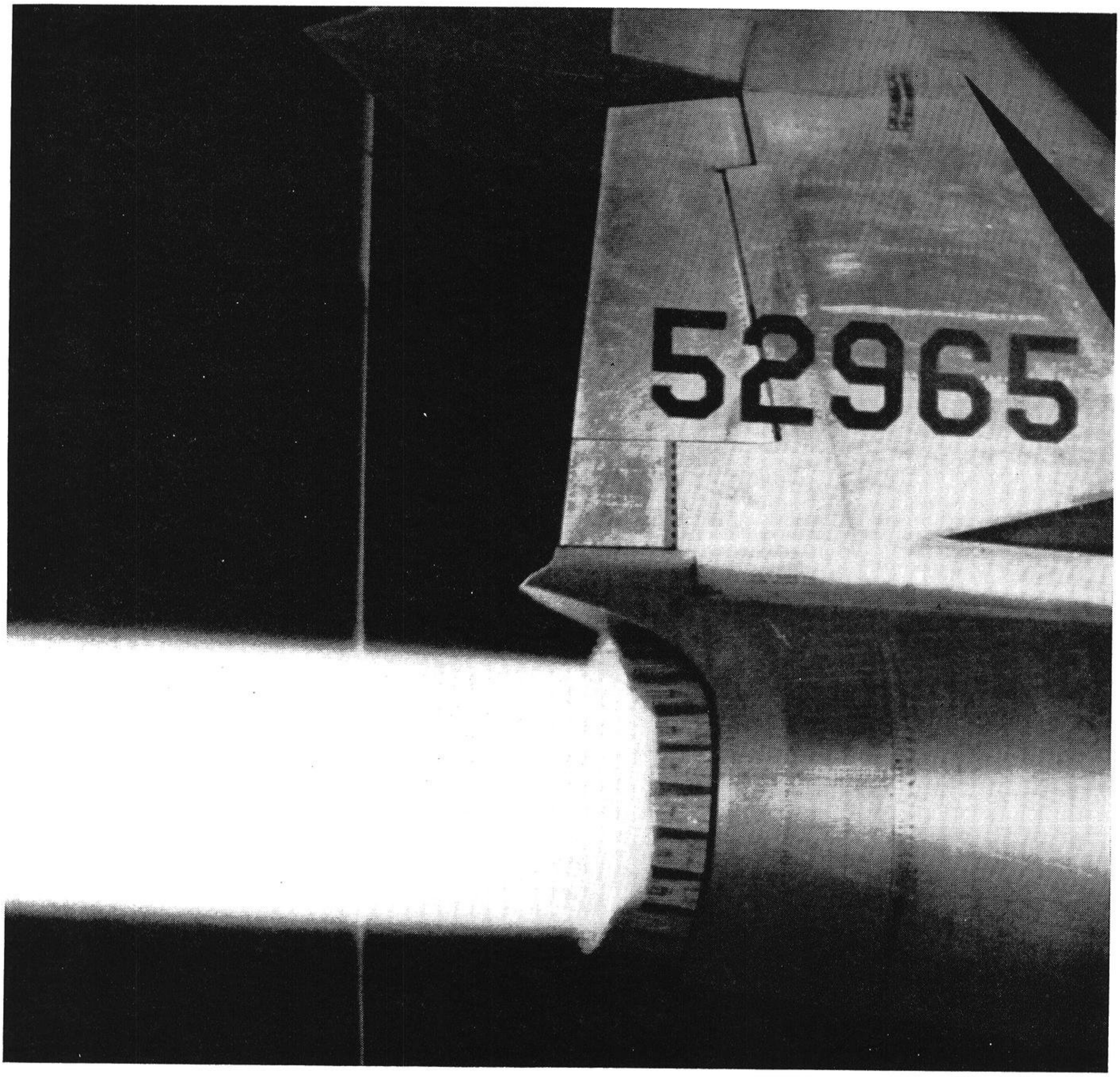

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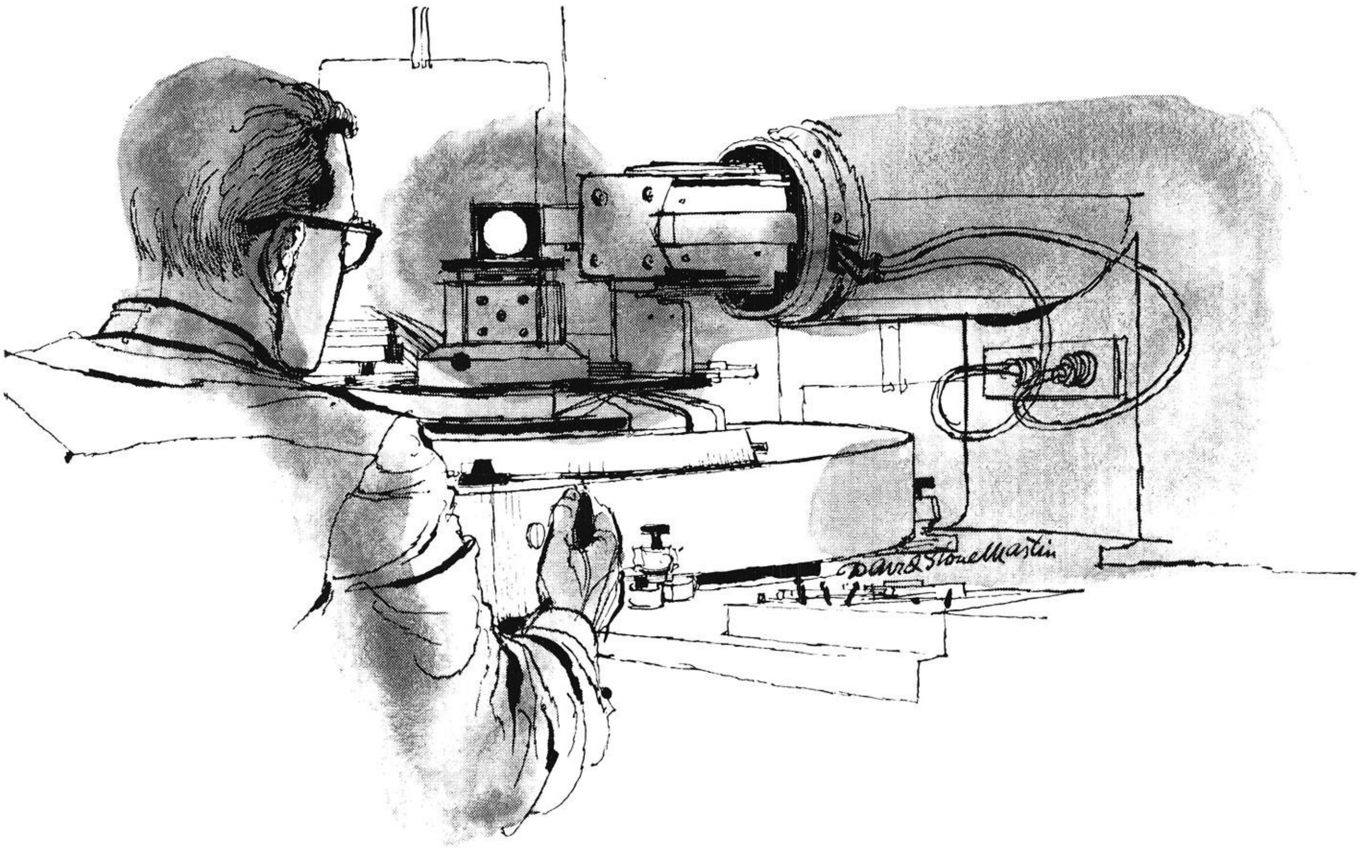
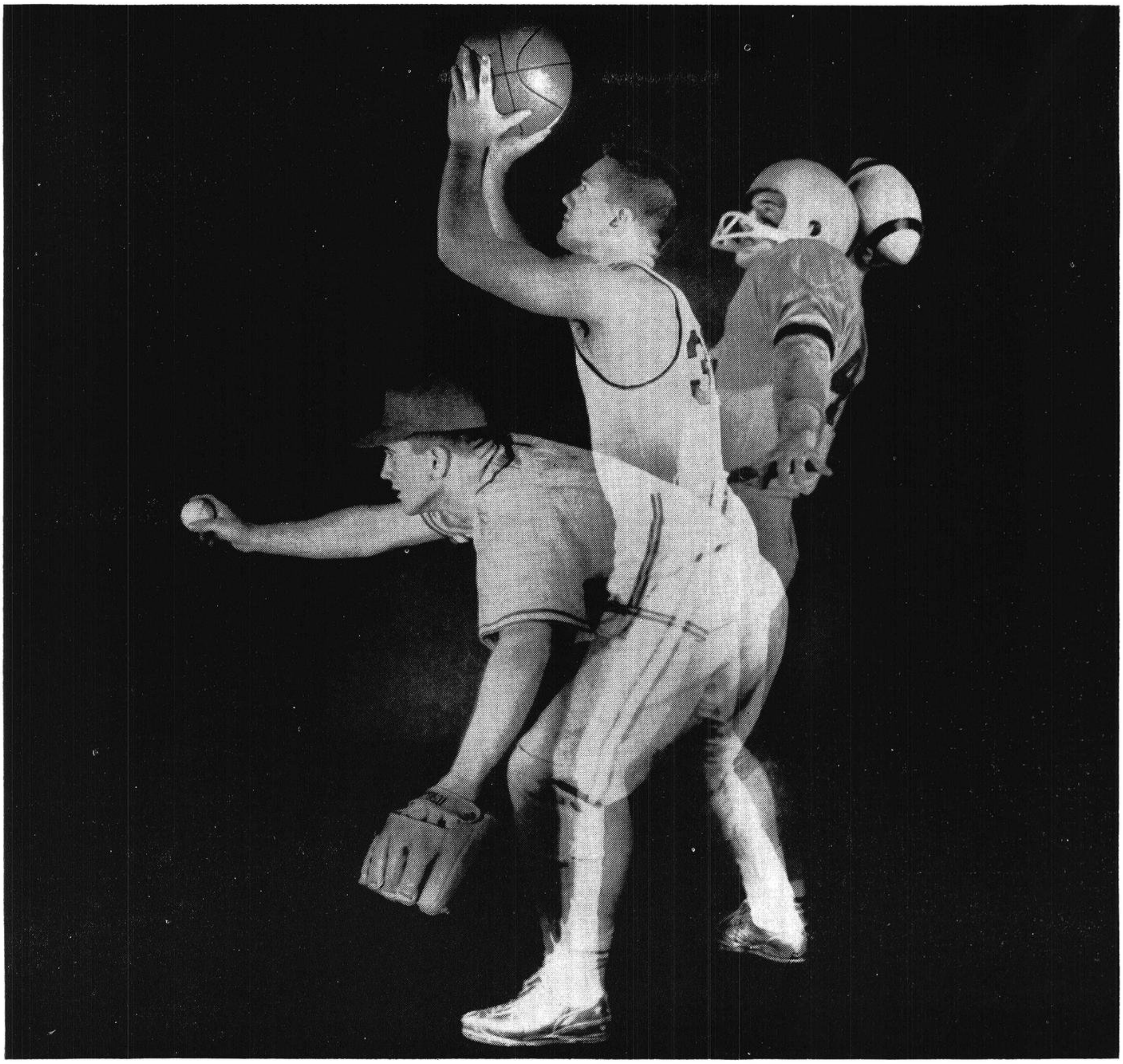


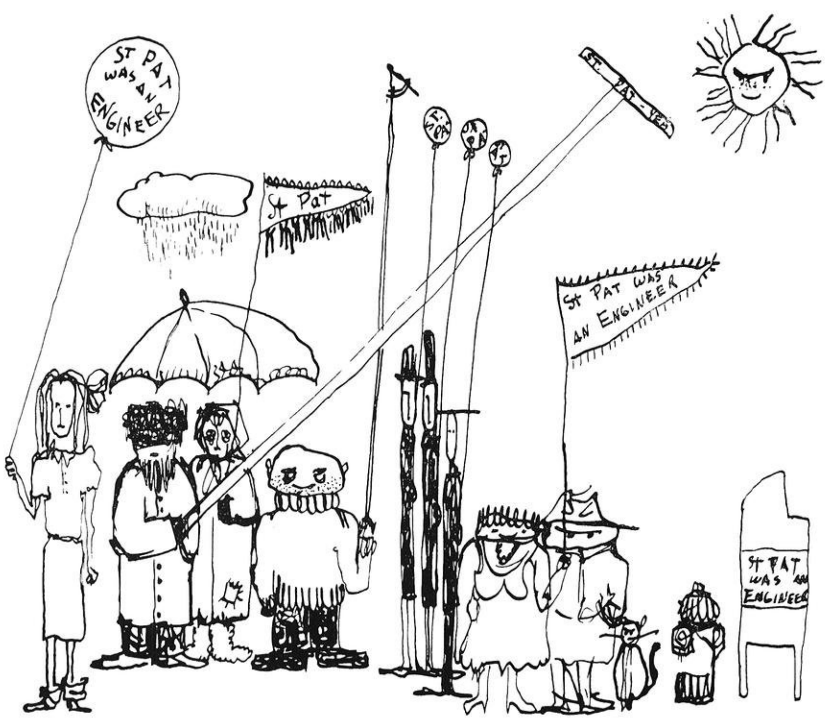


Forsooth! Verily! Hearken! Hear Ye! Zounds!

It is hereby proclaimed that the seventeenth day of the month of March in the year nineteen hundred and sixty Anno Domini shall be known as Saint Patrick's Day, in honor of our dear, departed fellow engineer; one by the name of Patrick and will be known to all as St. Pat.

In honor befitting this commemoration, green beer shall be the order of the day and all engineers without beards shall be known as "Neatniks." Our motto shall be: "With slide rule and T-square, we stand together—foul or fair." Our flower shall be the shamrock; our food shall be the potato; and our song shall be, "Swing and sway the suspension way."

Authorized and paid for by Polygon Board.



Cartoons and Proclamation by Carol Schiffleger.

Volume 64 MARCH, 1960 Number 6

WISCONSIN ENGINEER

The Student Engineer's Magazine

FOUNDED 1896

Features

Departments

Cover

The pen and ink of the draftsman allow one form of communication for the Engineer, the pen and ink of the artist are also used as a form of communication. The ideas are expressed with the feelings of the artist; to receive the idea, the viewer must be sensitive and understand the feelings of both the artist and himself.

In this issue's cover by artist Carol Schiffleger, the idea of design predominates. The areas of light and dark, line and form, oppose and complement each other to build a pleasing background which brings forth the idea, "St. Pat was an Engineer."

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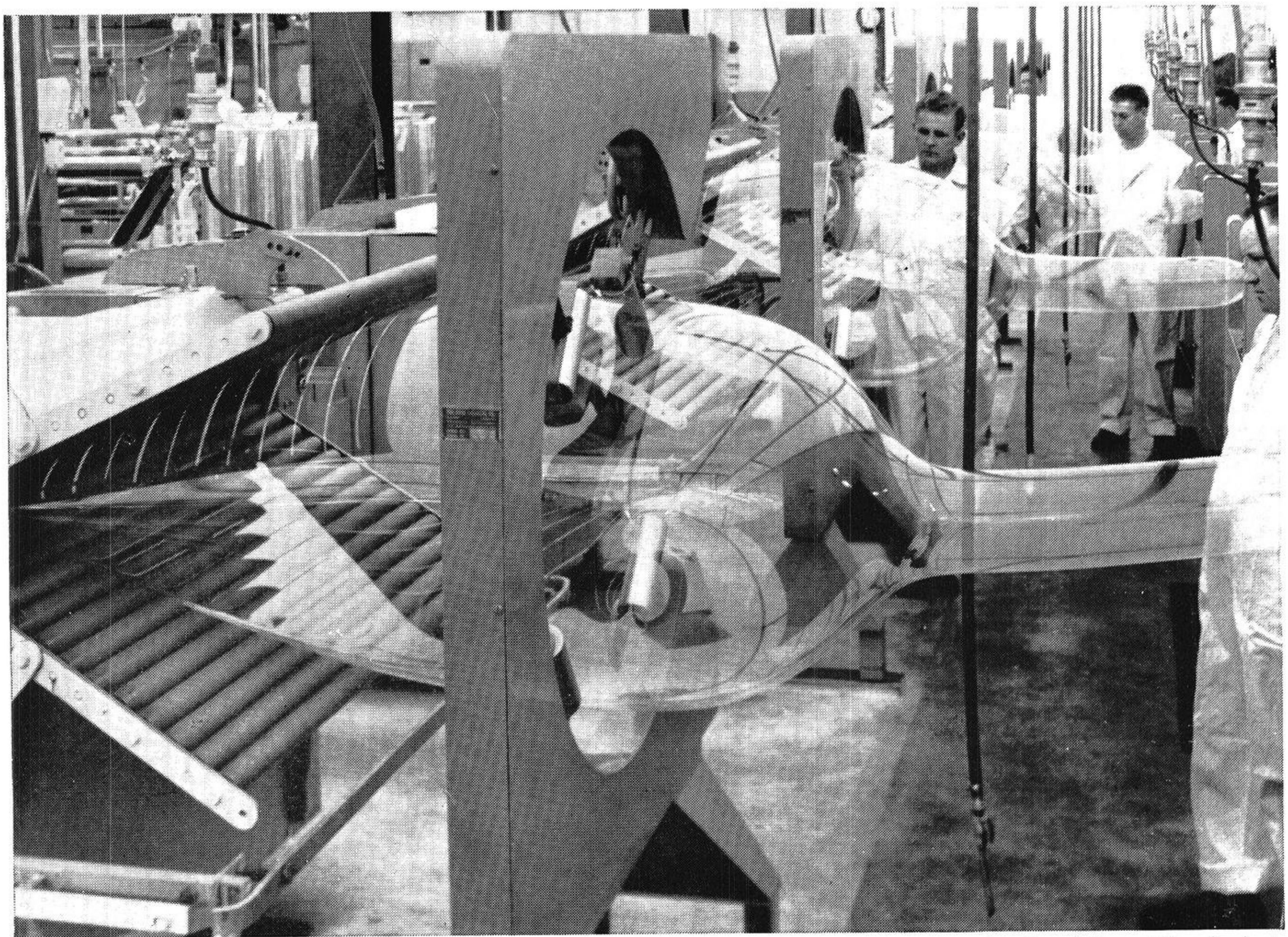

Interior of Saran Wrap* plant.

DOW is tomorrow-minded

product

Publishing a *complete* list of Dow products—all 700 odd of them—is an elusive project. By the time such a list was off the press, new names would have to be added to bring the list up to date. The reason: development of new products is the order of the day at Dow, every day of the working year.

These new products are developed to meet the needs of the many industries Dow serves. *Today's* problems in manufacturing and processing must be solved, and, as these industries advance, new chemicals and materials will be needed to implement tomorrow's technology. At Dow, research and development aim at anticipating these future needs . . . thus a "tomorrow-minded" attitude toward products is always evident.

The product group of Dow Agricultural Chemicals, for example, has expanded manyfold in recent years through a vigorous research and developmental program. In the early '50's it consisted of two or three products. Today it includes many varieties of weed killers, fertilizers, fumigants, insecticides, feed additives and animal health aids. A new crab grass killer has recently made its debut, first in a series of new "ag chem" products slated for the homeowner market.

Dow's work in automotive chemistry is typical of the "tomorrow-minded" attitude. Dow currently supplies a number of chemicals and plastics materials to auto makers—latex-based metal primers, antifreeze, upholstery materials and brake fluids, to name a few. But a quick tour through Dow's two Automotive Chemicals Laboratories would reveal that Dow will be ready with the right chemicals and plastics for the job, no matter which way future automotive design goes! One under development, for example, is a chemical that cools the engine by continuous boiling.

One of the most outstanding success stories at Dow is that of Separan®, a product developed to fit into industry's future. This chemical is a flocculant, or "settler" of solids in solution. Perhaps "super flocculant" would be a better description because Separan takes minutes to do jobs that formerly took days. Introduced in 1955, it has gained widespread recognition in mining, pulp and paper and other industries.

In such a climate of creativity and tomorrow-mindedness, new opportunities at Dow are constantly opening up for people who have their eyes—and their thoughts—on the future. If you'd like to know more about the Dow opportunity, please write: Director of College Relations, Department 2426FW, THE DOW CHEMICAL COMPANY, Midland, Michigan.

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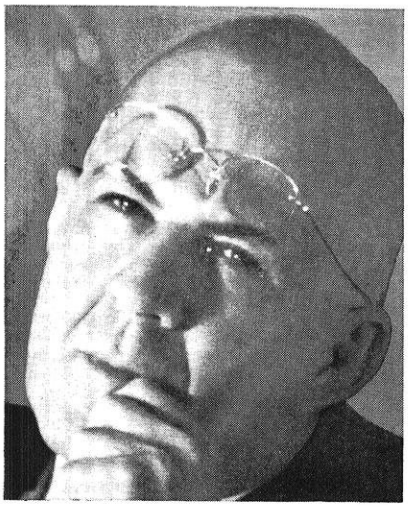

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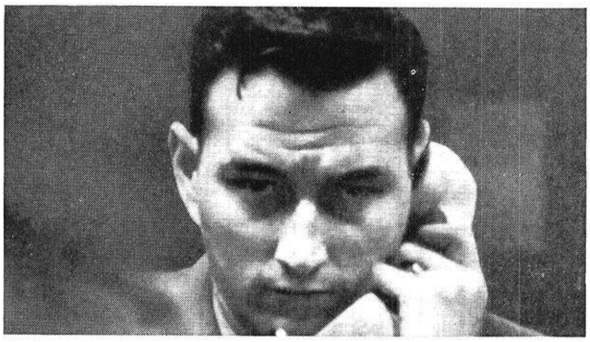

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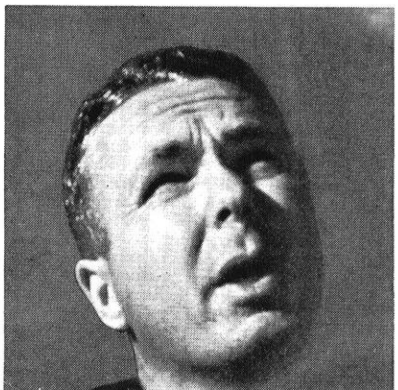

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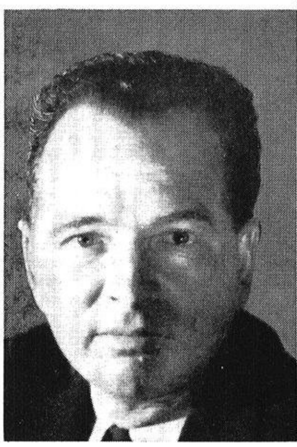

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GUSTAV O. HOGLUND, Division Chief of Alcoa Process Development Laboratories, B.S. in Aeronautical Engineering, University of Michigan

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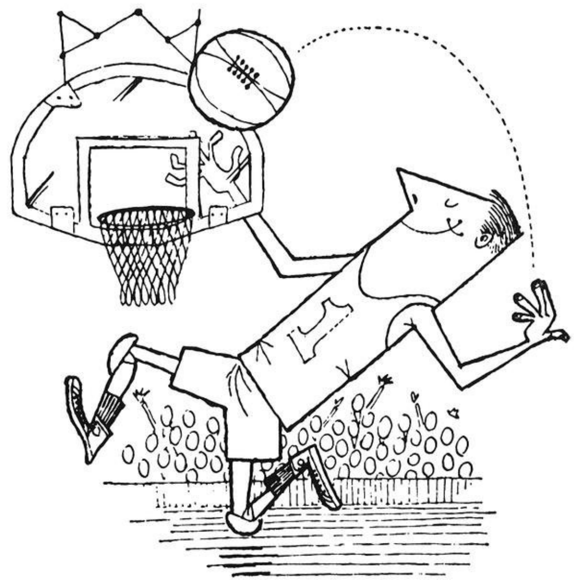

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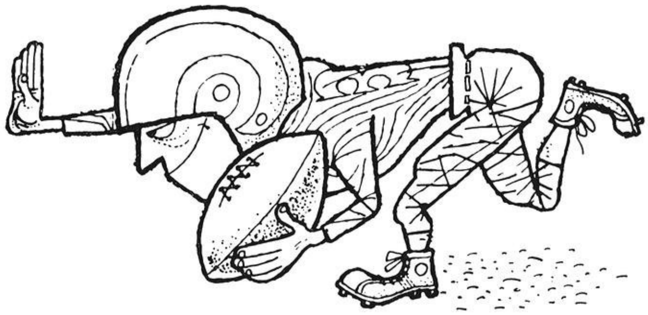

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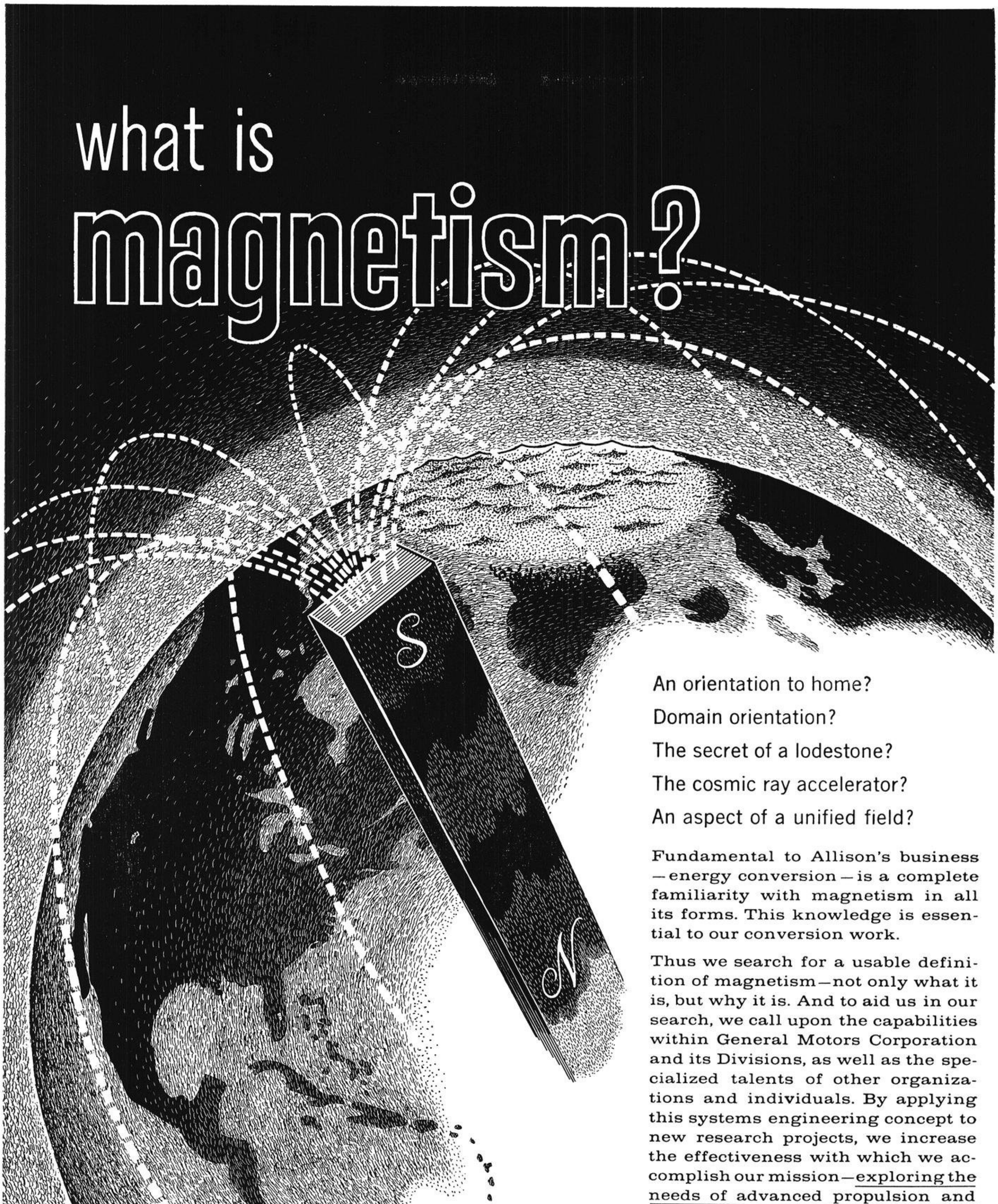

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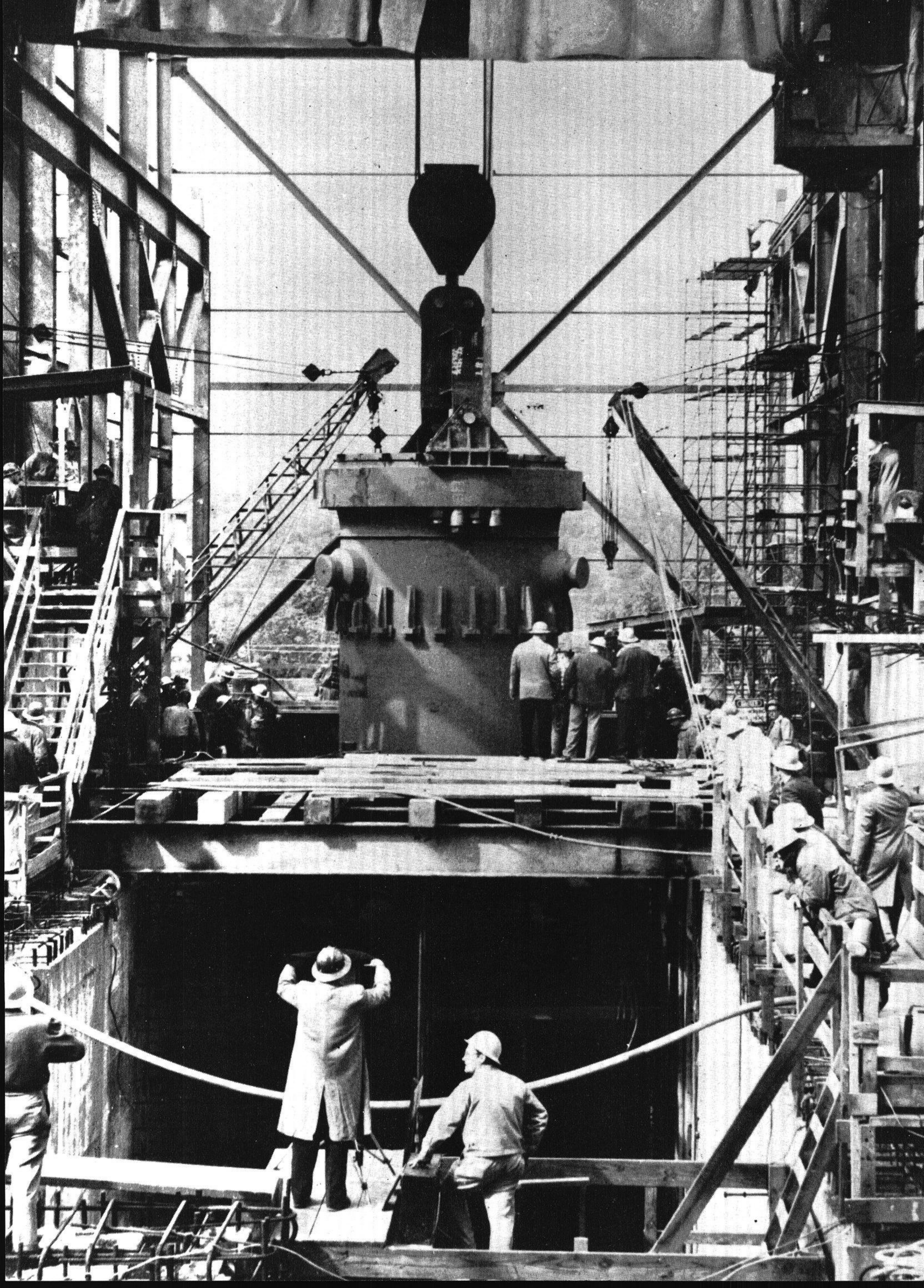


Rambling WITH THE EDITOR

A Stumbling Block to Understanding

The people of this country are awakening to the realization that there is a tremendous problem in communicating technical knowledge. Scientific knowledge which has been gained with the advent of the atomic age, cannot be fully utilized until the problem of communication can be solved. Two groups of people are making decisions which they are not capable of making.

Government officials, who are elected for their party line or pleasant personality are being forced to make judgments concerning technological advancements of which they know very little. The reason for their ignorance of the facts lies partly in the lack of an understandable system of communicating scientific knowledge.

Industrial leaders, many of whom have no scientific background, are forced to set company policies which should be based on a thorough knowledge of the technology of their industrial field. Here again the stumbling block is the absence of a way of transmitting ideas and facts to the people making decisions.

The idea has been advanced that the solution lies in leaders in government and business learning all there is to know about the problems they encounter. This is, with the tremendous advance in scientific discovery, nearly impossible. Certainly it will be a step in the right direction to have the businessman get a good basic understanding of science just as it is good for the engineer and scientist to get a knowledge of the humanities. The real solution seems to be in finding people who can convey knowledge through written and oral presentation. This job of necessity will need a knowledge somewhere between a thorough understanding of science and the decision-making abilities of our country's leaders. Thus arises a field which will be of tremendous importance in molding the future of the modern world, technical journalism, the ability to communicate knowledge between the two levels mentioned previously. If you like to write or speak, not in the flowery drawn out style of modern fiction writers, but with but one purpose in mind; that of giving an understanding to your readers, then the world of communications holds many opportunities for you.

DONALD D. ROEBER
Editor

"Down . . . to the right . . . down . . . all set." This is what the man in the center is telling the crane operator to do with the 235-ton reactor vessel as it is lowered into position at the Atomic Power plant, under construction at Shippingport, Pa.

—Photo courtesy Atomic Energy Commission, Pittsburgh Office.

SUCTION PRESS ROLLS

by Gerald A. Mathews, me'60

A major item in the production of that all important commodity, paper

PAPER PRODUCTION

Early Development

PAPER has been made in one form or another since 200 B.C. The first papermill in America was built in Germantown, Pennsylvania, in 1690. The production of paper at that time was essentially by hand and remained so until the early nineteenth century, when a Frenchman named Louis Fourdrinier invented an endless bronze screen device now called the Fourdrinier wire. This invention revolutionized the papermaking industry because it permitted paper to be produced continuously. Previously, paper was made in batches, much like mixing a batch of cement.

In the later nineteenth century, an Englishman, H. W. Millspaugh, invented the forerunner to today's suction press roll. The suction roll operating in a Fourdinier machine resulted in a papermachine which not only produced paper continuously, but rapidly as well. With this invention came the growth of the paper industry. In a highly developed state, but of these inventions are still being used and improved upon to produce better and cheaper paper.

How Paper Is Made

Paper can probably be made from any fiberous vegetable matter, but it is usually made from softwood fibers. This is primarily because no other source is available which is so plentiful and still produces such a uniform and high quality product.

The first step in the papermaking process is to debark the logs which have previously been cut into four foot lengths. This is done by tumbling and rubbing the logs in a huge drum. The debarked logs are then ground up along the grain by grooved, stone wheels. The pulp produced by the grinding operations is washed from the wheels and screened to remove any splinters.

After the pulp has been screened, small wooden chips are added along with chemicals (calcium sulfate or sodium hydroxide) and the whole batch is cooked under pressure. The purpose of cooking is to separate the cellulose fibers from the non-cellulose material. Cellulous is not attacked by chemicals, but lignin, which binds the fibers together, is easily dissolved. The mix, now called stock, is also bleached during the cooking process. When the batch has finished cooking, it is blown at a firm target to break up the remaining lumps and chips. After it has been screened once more, it is ready to be placed in the headbox on the papermachine.

The Papermachine

A papermachine is one of the largest and most delicate pieces of machinery found anywhere in industry. It ranges in size from approximately 50 to 250 feet long and is two stories high. Any papermachine can be divided into two main sections: the wet end and the dry end.

Wet End. The wet end consists of the headbox, Fourdrinier wire, and press section. In the headbox, the stock has been diluted until it is about 98 per cent water and 2 per cent fibers. The level of the liquid in the headbox is kept constant at all times to form a pressure head. The depth of this pressure head regulates the speed that the stock is used by the machine and thus helps determine the thickness of the paper sheet produced. At the bottom of the headbox is a long horizontal slit through which the stock squirts under pressure from the constantly level pressure head. The stream of stock emitting from the slit falls on the Fourdrinier wire that is continuously moving beneath the slit.

The Fourdrinier wire is a wide, bronze screen that travels over small table rolls which allow the water to drain out leaving the first mushy vestige of the paper sheet.

The sheet now proceeds to the press section which usually consists of three suction press rolls. Beginning with the press section and ending with the dryers, the paper sheet is always supported by a heavy felt sheet when it is pressed between two rolls. In the press section, the felt prevents the paper sheet from being pockmarked; throughout the rest of the machine, the felt is a blotter.

The press section removes more water from the paper, and when it leaves the press section, it is a finished product except for being wet and unpolished.

Dry End. The dry end consists of the dryers, calendars, and winders. Dryers are hollow rolls through which steam is passed. The steam heats the roll and, as the paper sheet passes between and over the rolls, it is dried. The calendar is located right behind the dryer section; it is a vertical stack of highly polished rolls whose purpose is to polish by applying high pressure to the sheet as it passes through. After the sheet leaves the calendars, it is cut into desired widths and wound on the winders for storage.

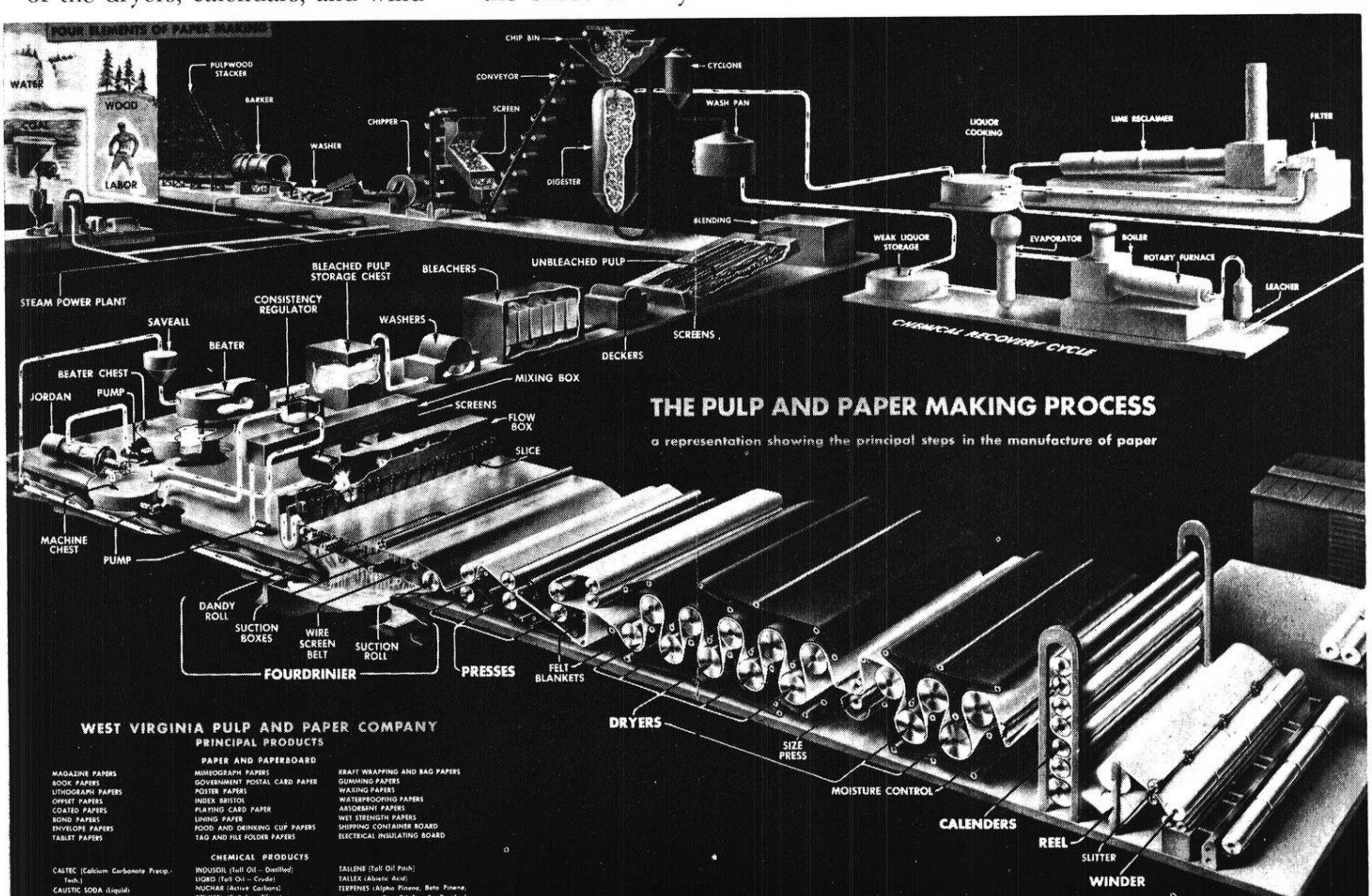
Papermachines are powered by large electric motors that are connected to differential drives which in turn are connected to the various rolls. The nature of the papermachine demands that roll speeds be constant and synchronized. Synchronization is accomplished by connecting each section to a positive speed controller. Care must be taken to allow for shrinkage of the sheet as it dries; the dryer rolls on the end will, therefore, turn slightly slower than those directly adjacent the press section.

OPERATION OF SUCTION PRESS ROLLS

The suction press roll receives the sheet directly from the Fourdrinier wire. The roll consists essentially of two parts, the shell and the suction box. The suction box is rectangular and has one open side, similar to a flowerbox. It is approximately 10 inches wide, 14 inches deep, and 200 inches long. When in operation, it fits inside the shell with its open side flush against the shell's inner surface. The contact between the box and shell is made airtight and slippery by means of a graphite-fiber seal which is held against the shell by a flexible air tube in the suction box.

The shell is a cylinder about 30 to 40 inches in diameter, 2 inches thick, and 216 inches long. Except for a narrow band on each end, its entire surface area is covered with small (5/32 inch diameter) holes.

The purpose of the suction roll is to remove as much water from the sheet as it possibly can. As the shell revolves around the suction box, which is always stationary, the water is drawn from the sheet, through the holes and into the suction box where it is pumped to the outside. If the felt, upon which the sheet rides, was not used, the vacuum in the suction box would



cause small depressions on the sheet. These depressions, or pockmarks, can never be completely removed and therefore cheapen the paper's quality.

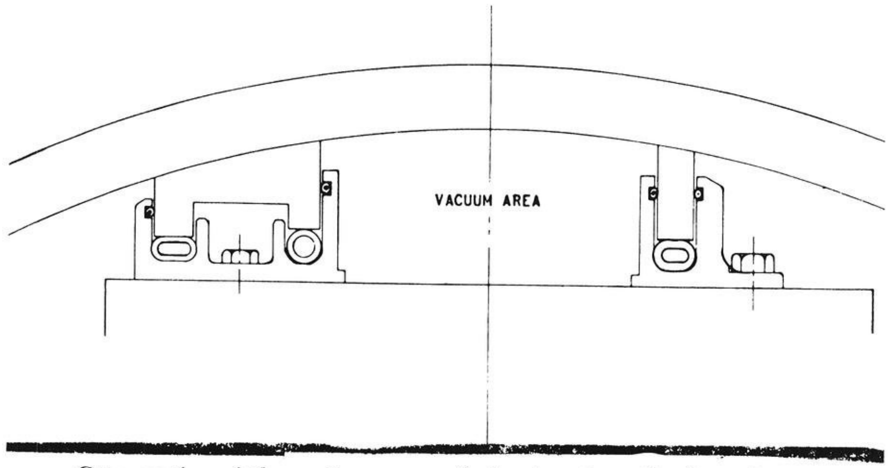
Installation

The roll is installed with the aid of an overhead crane using a wide sling or protective pads so as not to injure the shell. After being lifted from its packing crate, the roll is mounted into place on the bearing stands. It is then aligned and leveled, but no angular adjustment is made on the box until the assembly has been solidly mounted.

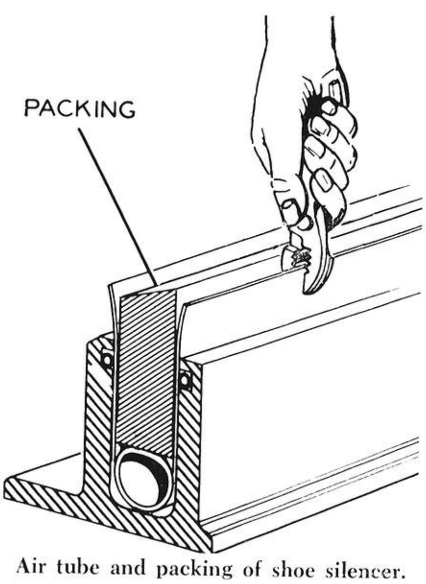
Servicing and Cleaning

Like any other piece of machinery, suction press rolls have to be cleaned and serviced. As the papermachine usually runs for long periods of time without stopping, the roll should be cleaned at every opportunity when the machine is shut down for more than a few minutes.

The end deckles, which control the width of the sheet being made, have adjustment screws that must be kept well lubricated for ease of operation. The end deckles themselves should be moved back and forth to clean their opearting surfaces. The holes in the shell are cleaned with a chemical solution, and care must be used when selecting the type of cleaner to use because of the effect it might have on the shell's rubber covering and on various seals and fittings. After the shell has been cleaned, the entire roll should be rinsed thoroughly. At least once a year, the suction box should be removed from the shell and given a complete cleaning to remove collections of old grease and foreign matter.



Cross section of the suction press roll showing the wide shoe silencer supported by flexible air tubes.



Air tube and packing of shoe silencer.

Primary Problem Encountered

One of the greatest problems to be solved when operating a papermachine is the reduction of the noise produced by the suction rolls. A large amount of noise is created when the felt and paper sheet are lifted from the suction area of the shell. This is a situation similar to pulling the cork from a bottle except that there are millions of these "explosions" occurring every second and their sum is an ear-splitting din.

The solution of this problem has been developed along two lines. The first concerns the arrangement of the holes in the shell; the second deals with the position and shape of one of the packing seals inside the shell.

On the early suction rolls, the holes in the shell were drilled in a straight line along a line parallel to the axis. This arrangement was perfecty suitable until the modern high-speed papermachines were developed. As the roll speed increased, the noise increased also, until it reached a point where it bordered upon becoming harmful to employees working near the roll. In the ensuing search for noise reduction, shells were developed with holes designed into various patterns. The principle underlying the rearrangement of the holes was that with the holes staggered, not as many would come off the suction area at the same time as they did on the older shells. With fewer holes popping at once, it was reasoned, there would be less noise.

The idea was carried a step farther when the holes were arranged at such a distance from each other that the sound from one hole was out of phase with the sound emitted from another hole a fraction of a second later. The result of this plan is that the sound from one hole cancels the sound from the other, and a more silent roll was developed.

The second method of silencing roll noise has manifested itself in the form of a remodeled packing strip. On the early suction rolls, the packing strips were the same shape on both sides of the suction area. In modern rolls, the packing strip under the place where the sheet is pulled off the shell has been enlarged and provided with narrow slits through which air can bleed to the surface of the roll. The theory behind this setup is to gradually relieve the vacuum in the holes under the sheet while it is passing over the packing strip. Ideally, when the sheet lifts off the hole on the other side of the modified packing strip, there is no vacuum and, therefore, no "pop." This idealized case has never been achieved, but the shoe silencer, as the ventilated packing strip is called, has contributed significantly to noise abatement. Most suction rolls operating today have both silencers and the noise-reducing hole patterns.

MANUFACTURE OF SUCTION PRESS ROLLS

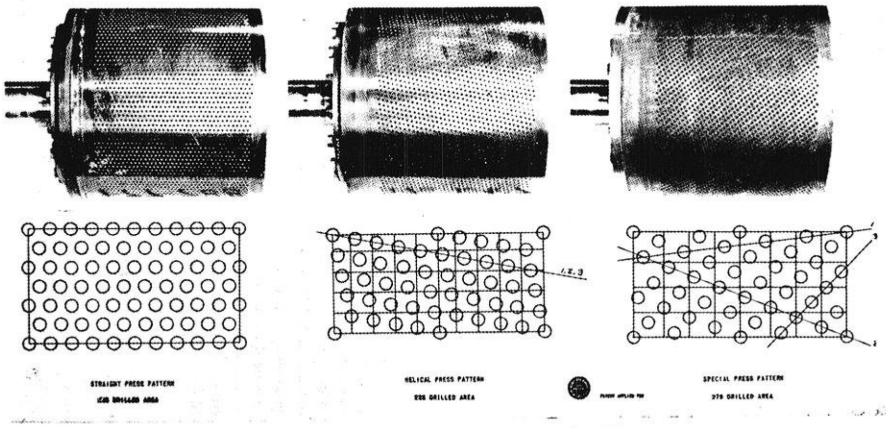
Method of Casting

The shell of the roll is always centrifugally cast. This adds to the cost of production since there are not many foundries in the country that are equipped to cast a roll of such large dimensions and the job of casting is, therefore, subcontracted out to a specialized foundry. The shell could be cast in the conventional method, but the advantages of the centrifugally cast roll far outweigh the additional cost incurred. Among the advantages of the centrifugally cast shell are: uniform soundness, minimum machining required to finish the roll, and greater strength.

In the early days of papermaking, when machine speeds were not very high, these features were not needed, but the speeds (above 2000 feet per minute) and pressures used on modern papermachines necessitate having rolls that can withstand high stress. Uniform soundness is particularly important because the shell must retain its strength while rotating at speeds of approximately 250 revolutions per minute with about ½ million holes drilled into it. Any void or inclusion could easily cause a dangerous stress concentration that would ultimately result in a fracture.

The ½ million or so holes in the average roll are drilled at the foundry on a multi-spindled drilling machine. This machine can drill up to 266 holes simultaneously, but it still takes several weeks to finish the job. The drilled shell is then sent to the rubber factory where its rubber covering is applied. The shell is then shipped back to the foundry, put on the same drill machine as before, properly indexed with the aid of a previously applied guide mark, and redrilled over the holes in the shell. This may seem like a large waste of time and money, but it must be done this way because drilling the shell through the rubber covering damages the rubber when the chips are withdrawn. The ¼ million dollar cost of the drilling machine dictates that all drilling be done at one company in order to make the investment worthwhile.

When the shell arrives at the rubber company, it is prepared by having its surface grit blasted to remove any oil, grease or paint and to give the rubber a better surface to bond with. The shell is given a coating of cement which is allowed to dry before the rubber base stock is laid on. Successive sheets of rubber about ⅛ inch thick are then built up in plies until there is a covering on the shell about 1-½ inch thick. Next, wet cotton duck strips are wrapped over the raw rubber to hold it firm. The roll is then placed in an oven and vulcanized at 260 degrees Fahrenheit for about 22 hours. When the curing process is finished, the roll is put on a lathe and has its rubber coating reduced to a thickness of 1-⅛ inch; the ⅛ inch is removed during the finishing grinding.



Suction Press Noise—Reducing Hole Patterns.

Metals Used in Manufacture

Suction press rolls are made almost exclusively out of either a bronze alloy or stainless steel. The trend in the papermaking industry today is toward stainless steel shells because of their high resistance to corrosion and greater strength. Years ago, when press speeds were around 1000 feet per minute, bronze rolls were sufficient for the job, but with the development of high-speed machinery, greater pressure was needed to obtain paper of the same quality. This pressure, exerted on the suction press roll by the top press roll, was too great for any bronze alloy so some other metal with equal corrosion resistance but with greater strength was needed. Stainless steel has these qualities.

Problems Encountered in Manufacture

Centrifugal Casting. The very size of the shell creates many problems in the centrifugal casting process. In order to cast the shell, a mold must be provided that will withstand the pressure of 75 times the force of gravity needed to hold the molten metal against the mold wall while it is freezing. Centering the mold prior to pouring is also of utmost importance. The least amount of unbalance will introduce undesirable vibrations when the mold is spinning at high speeds and cause an eccentric casting which must be scrapped.

Machining. Careful attention must be paid to machining and finishing to make sure no blemishes are left on the shell. A parabolic crown must be ground to just the right shape to compensate for deflection while in operation. At the speeds and pressures the rolls of a papermachine are subjected, not even stainless steel resists deflection. Deflection correction is of prime importance if paper of uniform thickness is to be obtained.

Miscellaneous. The rubber covering on the shell is a problem because, as of the present, no rubber product has been developed that can withstand the temperatures and pressures used in the day to day operation. The shells, therefore, have to be recovered periodically because of cracks and looseness in the rubber covering.

Before the complete roll is put into operation, it must be dynamically balanced. Any irregularities in its motion cause a corresponding irregularity in the quality of the paper produced.

THE FUTURE OF THE SUCTION PRESS ROLL

The suction press roll is not apt to be replaced as a component of the modern papermachine in the near future, not unless something completely revolutionary is invented to take its place. Manufac-

(Continued on page 51)

THE ELECTRIC POWER PLANT:

Turbine-auxiliary equipment

by John H. Nicolaus me'60

ELECTRIC power consumption in the United States has approximately doubled every ten years over the last half-century. Vast quantities of power are consumed every day in homes and industries. Through engineering and science, new uses for electricity are constantly being developed. The steam-generated electric power plant is the source for nearly all of the electricity produced today.

THE POWER PLANT IN GENERAL

The electric power plant has three major components; a steam generator, a prime mover, and an electrical generator. The fuel for the steam generator can be natural gas, fuel oil, or coal. The use of atomic energy is also becoming practical. The type of fuel depends on the location of the plant, but most often coal is used. The prime mover that is most used is the steam turbine. Turbines vary in size, construction, and requirements for operation, depending on the specific use for which they are intended. Electrical generators also vary, according to the output which is expected.

In order for these three components to operate effectively and efficiently, a good deal of additional equipment is necessary. This report is concerned with the equipment necessary for the operation of the steam turbine.

After steam passes through the turbine, it must be condensed and returned to the boiler. Cooling water must be provided for this purpose. Effective circulation of the cooling water must be maintained, as it is desirable to keep the water cold in order to condense the steam rapidly.

There is another circulation system involved in moving the condensed steam back to the boiler. This system is independent of the cooling water system, but it is also necessary for proper condensation to take place.

The shaft of the turbine must turn on bearings which need constant lubrication in order to prevent wear and heat on the bearing surfaces. The lubricating oil is circulated through filters, which remove any dirt or foreign matter, and through coolers, which serve to keep the oil, and hence the bearings, from overheating.

All three of these circulation systems are an integral part of the operation of the turbine. The equipment used in these systems are classed as turbine-auxiliaries. Together, the turbine and its auxiliaries are an essential aspect in the function of the electric power plant.

COOLING WATER CIRCULATION SYSTEM

Water Source

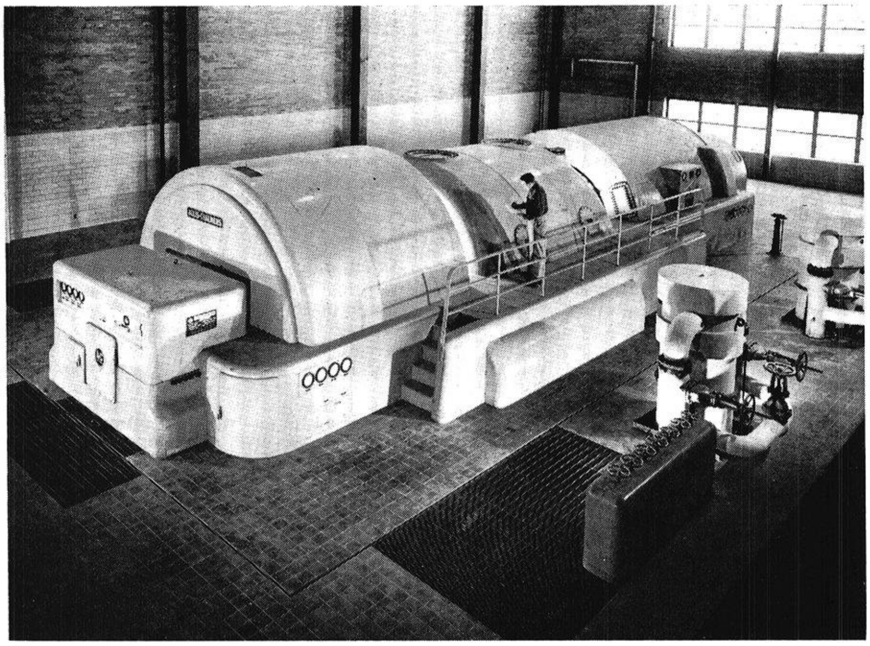
The power plant should ideally be located near a source of water that can provide an unlimited amount of cold, fresh water. Usually a lake or river serves as the source. In the case where the supply is limited, the same water must be used over, but it must first be cooled. Cooling can be accomplished by means of fountains or cooling towers.

Even when there is an adequate source of raw water, precautions must be taken to keep large amounts of foreign matter out of the water. The only reason for this is to prevent damage or clogging of the pumps and pipe lines that are used for circulation.

The first step in keeping the water clean is to have an isolated pool, protected from the rough waters of the lake or river. Water is taken directly from the pool and into the plant through some type of grating, which keeps out driftwood, seaweed, and other extraneous objects.

The water then flows through the circulation system within the plant.

Inside the plant, there is another means of removing the smaller de-



75,000-kw, 36,000-rpm, steam turbine-generator unit.

bris which may be present. This is the traveling screen. Every bit of water entering the plant is actually strained by the screens. The debris which is collected is dumped into a trough and is flushed back into the lake, away from the point cf intake.

Circulators

The next point in the circulation system is the circulator. The purpose of the circulator is to draw water from the reservoir, which is at lake level directly beneath the floor of the plant, and pump it through the condenser and back into the lake. A circulator is simply a large centrifugal pump driven by either an electric motor or a small steam turbine. Often there are two circulators for each condenser.

Water leakage around the end of the shaft is prevented by means of water seals. A water seal is a jacket of water around the shaft, through which water is constantly forced at a pressure higher than that of the water within the circulator.

In operating a circulator, the first step is to turn on the seal water. Then the pump must be primed. The method used for priming is to draw a vacuum on the pump cylinder. A vacuum can be obtained with the use of steam jets. The decrease in pressure causes the water to rise and fill the pump. When this has been done, the pump can be started and circulation will begin.

Condensers

The function of the condenser has already been introduced. It is a very large cylinder for the condensation of steam from the turbine and is kept cold by a constant circulation of water. The circulation has been discussed up to this point.

A condenser can have any number of water passes, but usually a one- or two-pass is used. Steam from the turbine enters the condenser, located directly beneath the turbine, by means of the exhaust hood and passes over the tubes which carry the cold water. The condensate is collected at the bottom of the condenser in a reservoir called the hotwell. The condensate and the hotwell will be considered later in connection with the boiler water circulation.

In operating the condenser, the inlet valve must first be opened. Assume that the circulator has already been started. Because the inlet pipe can be as large as two or three feet in diameter, the inlet valve is very large and must be operated hydraulically. Water is forced into a cylinder, moving a piston which opens or closes the valve.

Another preliminary operation that must be carried out before the turbine is started is to draw a vacuum in the condenser. With a low pressure, the steam passing through the turbine can expand more rapidly and more completely. This is desirable, for more work can be obtained from the steam in this manner. Vacuum is obtained by steam jets, and once the steam starts passing through the condenser, the vacuum is automatically maintained. A common condenser pressure is 28 inches of mercury vacuum.

Discharge

The last stage in the circulation system for the cooling water is the discharge. Water is discharged from the condenser with enough force to carry it out into the lake. The water can be discharged either

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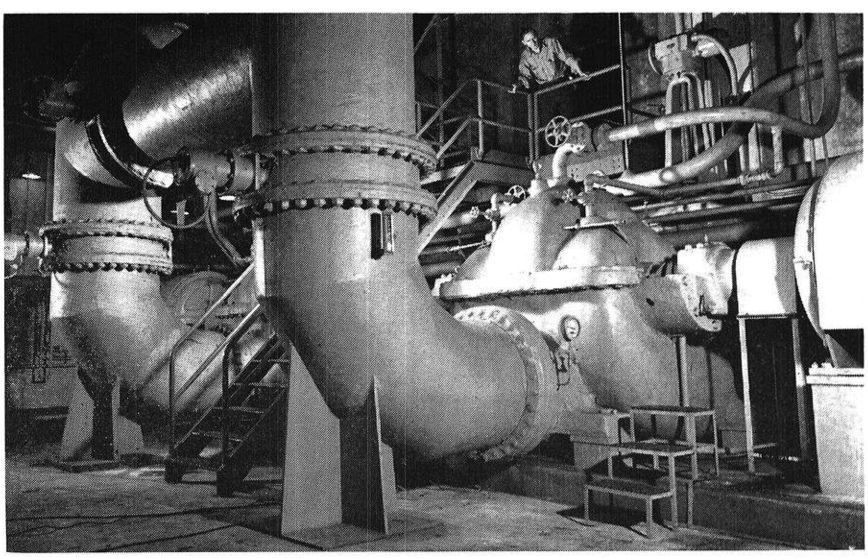


Two 42″ x 36″ circulating water pumps. Each rated at 35,000 g.p.m. 20 ft. head, 290 rpm and driven by a 250 hp A–C motor.

CARBURIZING OF STEEL

by Dennis P. Tronca me'60

A presentation of the methods used to increase the surface hardness of steels by carburizing

IN THIS age of momentous industrial advancement, one of the most important construction materials is steel. Steel's multitude of uses require that it have many and varied properties to allow its use in a wide range of applications. Among the many methods of preparing steel for these applications, carburizing ranks high in importance.

CARBURIZING MATERIALS

Carburizing materials may be solids, liquids, or gases, depending on the method of carburizing being used. The solid carburizers usually contain charcoal as a base and include wood charcoal, coke, bone, or leather charcoal, and charred peach pits. These materials must all be activated by an energizer which is primarily a carbonate of barium, calcium, or sodium. A typical solid carburizing compound contains 60 per cent coke, 14 per cent barium carbonate, and one per cent sodium carbonate. The gas carburizers include such gases as carbon monoxide, propane, methane, producer gas, or any gas rich in carbon.

The liquid carburizers contain sodium or potassium cyanide to which is added sodium chloride, sodium carbonate, or other mineral salts, of which there are many mixtures available.

CARBURIZING STEELS

The selection of steel to be carburized should be based on the requirements demanded by the service in which the finished steel is to be used. Generally, a good plain carbon steel, low in carbon content is satisfactory. A low carbon steel is necessary so that in later hardening operations, the core or center portion of the steel will remain tough. Many low alloy steels are also used for carburizing, because their better strength and wearing qualities make them very desirable. The alloying elements commonly used in steels subjected to carburizing include chromium, molybdenum, nickel, and vanadium.

Pack Carburizing

Pack carburizing of steel, which is the oldest method known, utilizes solid carburizing materials. The steel is packed into pots or boxes, made of high-alloy materials for heat resistance, along with the solid carburizing compound which is granular in form. The pots or boxes are placed in a furnace and heated to the temperature near 1700 degrees Fahrenheit. At this elevated temperature the activated carbonous materials give off carbon monoxide gas which will react chemically with the steel to form iron carbides. Typical reaction equations for the steel packed in a mixture of charcoal and an energizer such as $BaCO_3$ include:

1. $C + O_2$ (initial air in charcoal) $= CO_2$
2. $3Fe + 2CO = Fe_3C$ (iron carbide) $+ CO_2$; $CO_2 + C = 2CO$
3. $BaO_3 = BaO + CO_2$; $CO_2 + C = 2CO$

The amount of carbon absorbed by the steel during carburizing is depedent upon:

1. The initial composition of the steel.
2. The temperature at which the steel is heated.
3. The length of time the steel is held at the carburizing temperature.

4. The nature of the carburizing material.

Steels of low carbon content will absorb carbon more readily than steels of high carbon content; e.g., a case depth of 0.050 inch requires the work to be at 1500 degrees Fahrenheit for approximately twenty-eight hours, while the same case depth would be obtained in about three hours at 1750 degrees Fahrenheit. In general, a carbon pickup of 1.15 per cent carbon or below is considered good practice, although a carbon content of 0.90 per cent is the best for maximum hardness and toughness of the case.

Gas Carburizing

Gas carburizing is done at elevated temperatures in a gaseous medium. This type of carburizing must be done in gas-tight retorts or muffles which are capable of withstanding carburizing temperatures. The furnaces used are of the continuous flow and batch types. In the continuous flow process parts are placed on trays and pushed through a series of muffles at a rate which will give the desired thickness of case to be produced during the carburizing period. The muffles are closed at both ends by doors, one of which is always kept closed so the trays can pass through the muffles without allowing the carburizing gas to escape. In the batch process, parts to be carburized are rotated in a rotary retort or suspended in a gas-tight retort. The gases used in this process must be freely circulated around the parts to be carburized to insure a uniform depth of case.

The following equations are the fundamental gas reactions important in gaseous carburizing:

1. $2CO = CO_2 + C$
2. CH_4 (methane) $= 2H_2 + C$
3. $CO_2 + H_2 = CO + H_2O$
4. $CH_4 + CO_2 = 2H_2 + 2CO$
5. $CO + H_2 = C + H_2O$

The gas must flow over the work to remove the hydrogen, or the reaction in equation 2 would go to equilibrum (stop reacting). Too rapid a flow might result in the decomposition of the gas at the iron surface at a rate faster than the carbon is dissolved, in which case free carbon deposits as soot.

In gaseous carburizing, the time and temperature are closely controlled with the carburizing temperature running between 1600 and 1700 degrees Fahrenheit. After a predetermined time at the carburizing temperature, the gas is turned off, and the steel is allowed to cool in this neutral atmosphere. Cooling in a neutral atmosphere increases the case depth or penetration of the carbon. This in turn reduces the carbon concentration at the surface of the steel by diffusion of carbon from the surface toward the lower carbon case.

In gas carburizing, an average case depth of 0.045 inch is obtained in a total time of six hours.

Liquid Carburizing

Liquid carburizing has been done in salt baths for many years. It is an easily controlled method which will give good results and clean work. It can be done in externally heated salt pots or in pots heated by immersed electrodes. The pots used in this process are made of pressed steel, although special pots containing nickel and chromium are frequently used because of their longer life and lower overall cost.

Steels to be carburized are immersed in a molten bath containing more than 25 per cent of a cyanide compound held at a temperature between 1475 and 1550 degrees Fahrenheit. Between these temperatures the steel will pick up both carbon and nitrogen from the bath and a treatment of one hour results in a case depth of about 0.010 inch. The nitrogen in the cyanide-hardened cases is present as finely dispersed iron nitrides which result in high hardness and brittleness. Reaction equations of a sodium cyanide solution are:

1. $2NaCN + O_2$ (from air above bath) $= 2NaCNO$
2. $3NaCNO = NaCN + Na_2CO_3 + C$ (carbon to iron) $+ 2N$ (nitrogen to iron)

Thus cyaniding nitrides iron while it carburizes it, and the resulting surface layer is more brittle that a plain carburized surface zone.

To keep the liquid carburizer active as a carburizing agent, the concentration of the sodium cyanide must be kept above 25 per cent. This can be done by adding a new carburizer or by additions of a salt mixture rich in sodium cyanide.

Selective Carburizing

While selective carburizing is sometimes not considered an entirely different type of carburizing, it has a significant number of differences. These differences are present mainly in the processes used and not in the materials used, because either pack, gas, or liquid carburizing materials can be used. The major differences are explained below.

The carburized case, obtained from any of the above processes, is so hard that it is impractical to machine it. Consequently, any areas of the part that have to be drilled or machined after carburizing must be kept soft. Steel may be selectively carburized by one of three methods:

1. The work piece can be cooled from the carburizing box or vat and machined before it hardens, or inert materials can be packed around places to be kept soft, and holes can be filled with fire clay to keep them unaffected by carburizing compounds.
2. Stock may be left where it is desired to keep the part soft. Then the part may be carburized and slow cooled to leave the case soft. This case can then be readily machined off where the soft surface is required before hardening the part. This will result in a part which is hardened where desired, and soft where desired.
3. Parts may be copper plated to hold off carburizing. The copper prevents the contact of carburizing gases with the steel, thus preventing absorption of carbon. The whole piece can be plated with copper and the copper machined off the particular portions to be hardened, or selective plating of portions to be kept soft may be employed.

(Continued on page 53)

"THE GERMANIUM TRANSISTOR"

Its application and effect upon the electrical industry

by Ronald H. Smith, che'60

IN 1948, physicists at Bell Telephone Laboratories, conducting experiments with germanium, announced the development of today's transistor. Their transistor received a very moderate welcome. A New York newspaper carried the story on page 46. The importance of the announcement was not lost, however, by the commercial tube makers, who had already heard rumors of the work.

The man chiefly responsible for the transistor, which was basically a diode or a two wire device to which a third wire is attached, was William Schockley (Ph. D., Massachusetts Institute of Technology), a member of Bell Lab's physical research staff. Schockley had begun his work on semiconductors before World War II, when his object was to make a semiconductor amplify.

Fundamental Definitions and Concepts

Rectification, the ability to transform an alternating current into a direct one, is essential to radio reception. A piece of galena with a "catwhisker" probe became an essential part of early radio sets, since it acted as a rectifier through its semiconducting properties. In the 1920's, the electronics industry fastened on the vacuum tube, which could not only rectify but amplify or increase the voltage or current.

A vacuum tube is made by sealing a filament and a plate into an evacuated tube; a two-element electron tube or a diode is formed. When the filament is heated by an electric current, electrons are emitted. If the plate is made positive with respect to the filament, electrons are attracted to the plate and there will be a current in the tube. If, however, the plate is made negative with respect to the filament, the electrons will be repelled and there will be no current. The diode thus acts as a rectifier if it is connected in an a–c line. There is current during half the cycle when the plate is positive. If a third element, the grid, is inserted into the tube, it can be used as a control for the tube current. The tube is then known as a triode, and it can act as an amplifier as well as a rectifier.

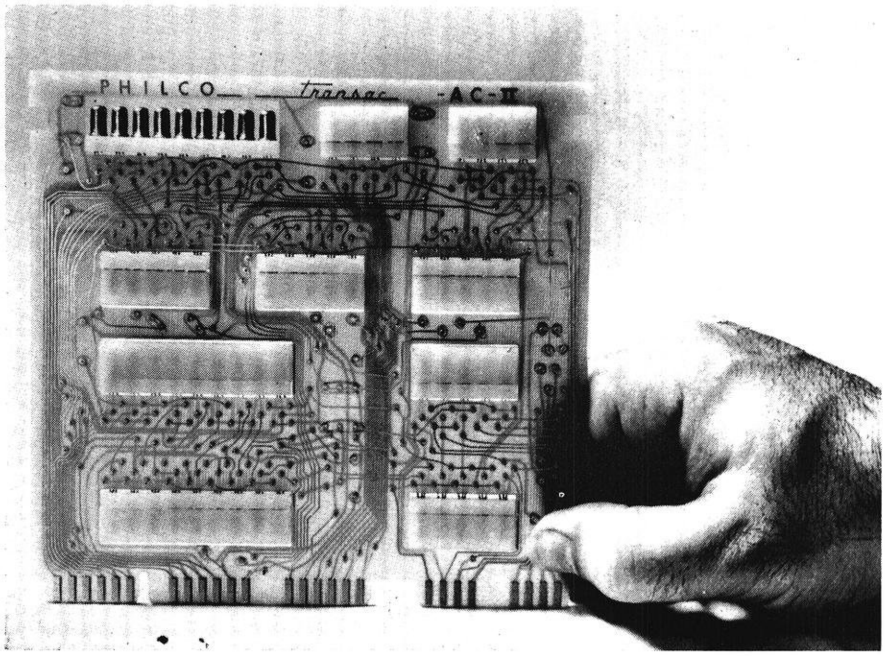
The concept of semiconductors is very important to the understanding of transistors. When energy in the form of heat or an applied emf enables electrons to readily leave their orbits, the element with this property is known as a conductor. If this release of electrons is not easily possible for a lack of current carriers, the element is known as an insulator. The electrons in the outer orbit form bonds with electrons of neighboring atoms and break-away is not easily possible. Some elements are called semiconductors because they conduct electricity only under certain circumstances.

Germanium, a semiconductor commonly used in the production of transistors, has a valence of four, or four electrons in its outer orbit. To make up its crystal structure, each germanium atom forms a covalent bond with a neighboring atom.

By the introduction of certain impurities into the crystal structure of germanium, current carriers can be produced, and the crystal will no longer act as as insulator. For example, if an atom with five electrons in its outer orbit replaces a germanium atom, four of the electrons will form bonds, and one will remain free to wander through the crystal structure. Germanium of this type contains negative current carriers and is called N-type germanium. If an atom having only three electrons in its outer orbit replaces a germanium atom, there is a vacancy or hole in the crystal. The net effect of adding this type of impurity is to produce a quantity of holes or positive current carriers. Germanium of this type is called P–type germanium.

CONDUCTION IN GERMANIUM

Conductivity	N-type	P-type
Conduction by	Excess electrons	Holes
Energy band in which carrier moves	Conduction band	Filled band
Charge of carrier	Negative	Positive
Valence of impurity atom	Five	Three
Nomenclaure for atom	Donor	Acceptor
Typical impurities	Arsenic Antimony	Boron Aluminum Gallium Indium



Transac printed circuit board incorporates 60 Philco transistors.

Construction of the Transistor

The original device announced by Bell Labs was the point contact transistor. In mid 1951, Bell Lab disclosed a second major development, the junction transistor, in some respects an improvement over the first device. The point contact transistor consists of a semiconductor, usually germanium metal; three electrodes, which are fine points; and the base, the external circuit. The emitter is positive, and the collector, which is connected to a higher voltage battery, is negative. A small change in the emitter current causes a large change in the collector current, and the transistor therefore amplifies an alternating current.

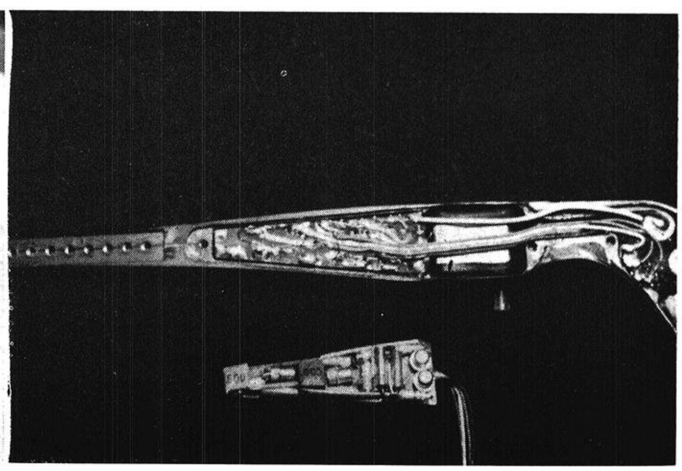
The junction transistor, is made of three sections pressed together. Usually, two of the small sections will be N–type germanium, and in between these there will be a section of P–type germanium. Since the action takes place at adjoining surfaces of N and P sections, the combination is called a junction transistor. It is possible to make P–N–P as well as N–P–N junction transistors.

Germanium, the main raw material used in the production of transistors, is obtained from certain ores found in the Belgian Congo and also from the flue dust in gas works in Great Britain, which use coal from Durham and Northumberland. Before it is suitable for the manufacture of transistors, lengthy refining processes are necessary, and it is finally delivered to the manufacturer in the form of a white powder, germanium dioxide. Then it is reduced to the metal and purified several times to obtain the required degree of purity. Minute, carefully controlled amounts of another element are added to produce the different properties of N and germanium.

Since merely bringing two pieces of appropriate germanium into contact with each other will have little effect, the fabrication of transistors has become as touchy as the purification of germanium. The junctions are produced by alloy or diffusion processes that are rigidly controlled. Because the methods of fabrication and design differ, a great variety of transistors are being produced.

Uses of the Transistor

In 1952, the transistor was first used commercially in hearing aids. By the end of 1953, the transistor was shown to be useful for many communication functions in radio and television receivers, sound and



The qualitone Hearing Aid Amplifier is completely enclosed in the eyeglass frame.

Transac Circuit Panels are assembled into C–1100 series airborne computer system.

high frequency amplifiers, electronic computers, control systems, and similar equipment. Today, the transistor is put to work wherever it is advantageous to amplify a control signal. It is comparable in flexibility with the thermionic electron tube or vacuum tube. In fact, its range of application supplements that of tubes by making feasible operation of electronic equipment in smaller sizes, consuming less power, and with improved reliability, especially under conditions of high vibration or shock.

A good example of the usefulness of the transistor occurs in telephone switchboards. An automatic-dial office of average size contains about 65,000 mechanical relays that connect one phone with another in response to the number dialed by a customer. The relays, which can perform slightly less than one thousand switching operations per second, limit the number of calls that can be handled at any one time. Vacuum tubes can perform a million switchings per second, but because of their excessive power demand, size, and overall cost their use is uneconomical. Transistors, which can switch as fast as vacuum tubes, do not have the drawbacks of the tubes. Moreover, they can be built to last for the telephone office's engineered life, about forty years.

Since the ordinary vacuum tubes have an airborne life expectancy of only 100 to 500 hours, the Air Force has also been replacing tubes with transistors. The transistor is even being utilized in home instruments because it simplifies circuits and leads to manufacturing economies. Transistor radios have already become a common appliance. The transistor is now competing with the vacuum tube in nearly every one of its applications.

Comparison of the Transistor and Vacuum Tube

The advantages of the transistor have already been mentioned. It is much smaller than the tube, and thus the circuit can be more compact. No energy is necessary to heat a filament, thus there is a saving in space and weight by elimination of the heater source. The elimination of the heater source also tends to increase stability in the circuit and to permit longer life. The transistor requires less than 0.0010 per cent of the power required by a vacuum tube, hence we can afford to use it in places and in quantities we could never use vacuum tubes. In other words, the transistor will, to a large degree, free electronics from the vacuum tube's limitations: relatively short life, high power consumption, bulkiness, and fragility.

The development of transistors has been retarded by four main difficulties. The first of these is operation at high frequencies.

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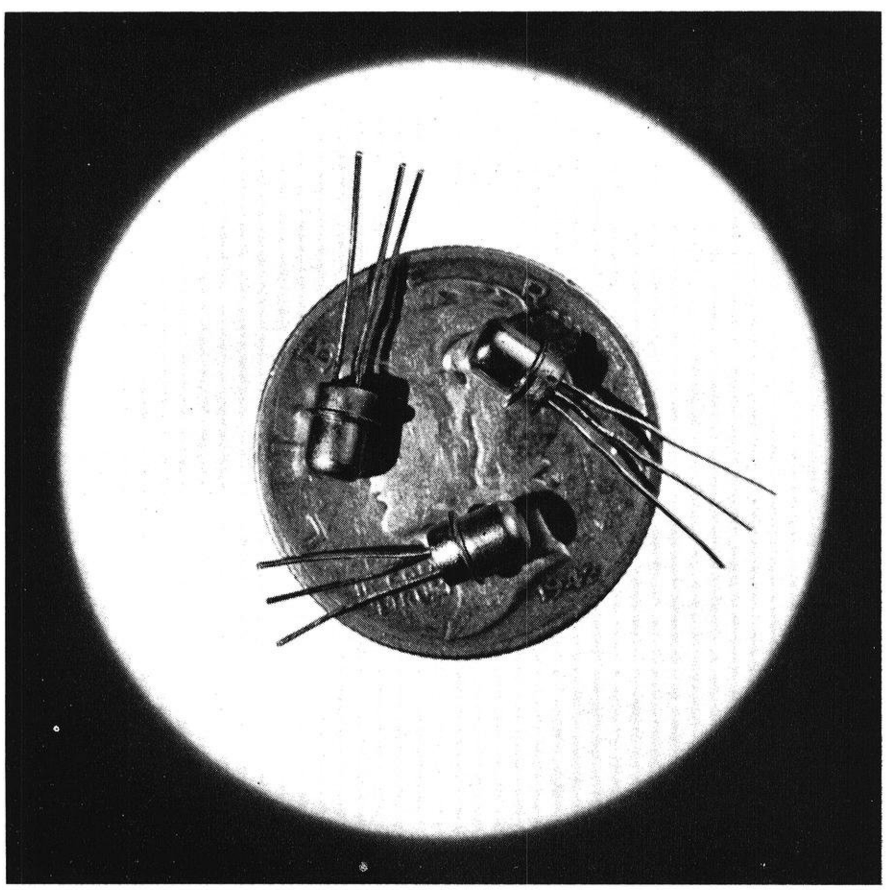
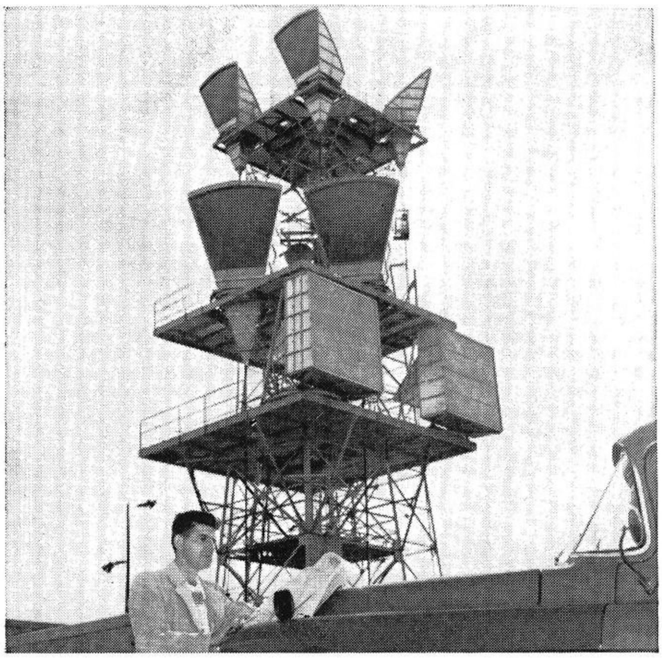
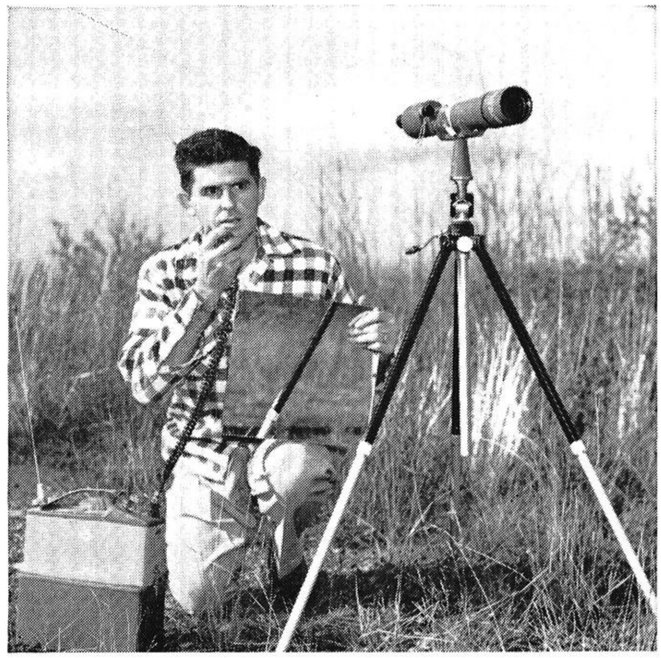




Dick Ernsdorff studies a microwave site-layout chart atop a mountain near Orting, in western Washington state. On assignments like this, he often carries $25,000 worth of equipment with him.



Here, Dick checks line-of-sight with a distant repeater station by mirror-flashing and confirms reception by portable radio. Using this technique, reflections of the sun's rays can be seen as far as 50 miles.

He wears two kinds of work togs

For engineer Richard A. Ernsdorff, the "uniform of the day" changes frequently. A Monday might find him in a checkered wool shirt on a Washington or Idaho mountain top. Wednesday could be a collar-and-tie day.

Dick is a transmission engineer with the Pacific Telephone and Telegraph Company in Seattle, Washington. He joined the company in June, 1956, after getting his B.S.E.E. degree from Washington State University. "I wanted to work in Washington," he says, "with an established, growing company where I could find a variety of engineering opportunities and could use some imagination in my work."

Dick spent 2½ years in rotational, on-the-job training, doing power and equipment engineering and "learning the business." Since April, 1959, he has worked with microwave radio relay systems in the Washington-Idaho area.

When Dick breaks out his checkered shirt, he's headed for the mountains. He makes field studies involving microwave systems and SAGE radars and trouble-shoots any problem that arises. He also engineers "radar remoting" facilities which provide a vital communications link between radar sites and Air Force Operations.

A current assignment is a new 11,000 mc radio route from central Washington into Canada, utilizing reflectors on mountains and repeaters (amplifiers) in valleys. It's a million-dollar-plus project.

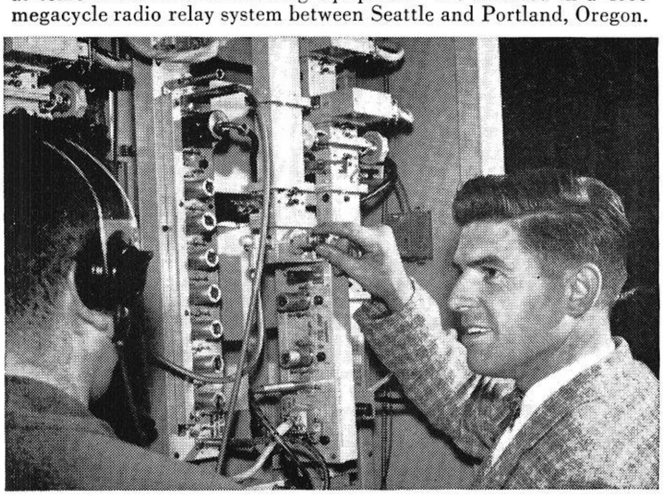
"I don't know where an engineer could find more interesting work," says Dick.

* * *

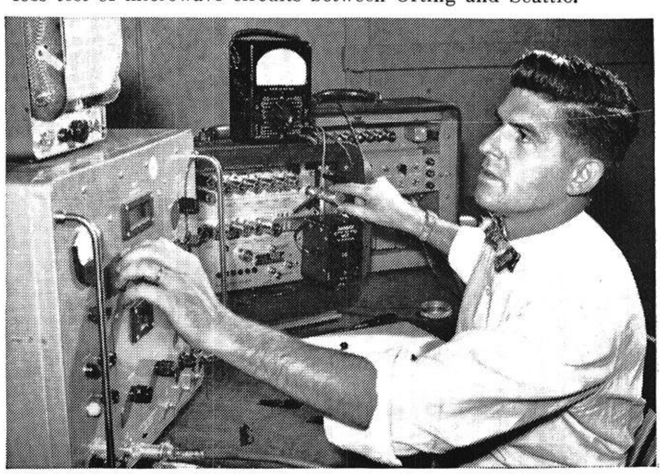
You might also find an interesting, rewarding career with the Bell Telephone Companies. See the Bell interviewer when he visits your campus.

BELL TELEPHONE COMPANIES

Dick stops by the East Central Office building in Seattle to look at some microwave terminating equipment. It's involved in a 4000 megacycle radio relay system between Seattle and Portland, Oregon.



In the Engineering Lab in downtown Seattle, Dick calibrates and aligns transmitting and receiving equipment prior to making a path-loss test of microwave circuits between Orting and Seattle.



SCIENCE HIGHLIGHTS

Donald Norris ee'60

THIS month's column features an article on the Niagara Falls project. Other items of interest are the completion of a supersonic wind tunnel, the design of a million pound dead-weight machine and the production of subminiature electrical filters.

REVERSIBLE PUMP TURBINES USED AT NIAGARA PROJECT

Details of a project to pump the water of Niagara uphill were disclosed recently at an engineering meeting in Atlantic City, New Jersey. Work has already begun on the project, designed to increase the supply of water available to electric generating stations at Niagara Falls.

In explaining the purpose of the project, it was pointed out that a treaty agreement with Canada limits the amount of water that may be diverted from the Niagara Falls and used to turn electric generators. Because of this restriction, and varying demands for power, water available during the evening hours that now goes to waste could be used to meet daytime demands for industrial power.

Engineers, trying to devise a plan to put this water to use, decided to pump it out of the river and into a reservior eighty-five feet above river level. To do this, they devised reversible pump turbines, that is turbine generator sets that could be run backwards.

Normally, the turbine wheel is spun by water flowing past it, and in turn spins a generator connected to it by a shaft. In the new units now being built, the process can be reversed by feeding spare electric power into the generator and using it as a motor. This in turn spins the turbine backward and causes the turbine to act as a pump, raising water to the reservoir. As needed, this extra water can be allowed to run back downhill and generate power.

Two new power plants that will benefit by the process are located some five miles from Niagara Falls at Lewiston, New York. The reversible turbine-pump units will be housed in Tuscarora plant. From here the water will flow to the Lewiston Plant at a lower level. A similar installation will be used by Canadian authorities on the other side of the Niagara River.

It is estimated that without the pumping operation over two billion cubic feet of water would go to waste during a twelve hour period. This is equivalent to over one million kilowatts of additional power. The reservoir to be filled by the pumping operation will have a capacity of 25,000 acre feet. It is about a mile square in area and about eighty feet deep.

The intake of the Lewiston and Tuscarora Plants is in the city of Niagara Falls, New York, about 2½ miles above the falls. The water will flow under the city through two tunnels about 46 feet wide by 66 feet high. These are cut-and-cover tunnels about 22,000 feet long made of reinforced concrete.

The tuscarora reversible pump-turbines will rank among the largest units of this type ever built. Each pump-turbine is rated to pump 3400 cubic feet per second of water against a dynamic head (water pressure) of 85 feet. The dynamic pumping head will vary between 57 and 99 feet. The pump turbines will run at 112.5 revolutions per minute in a clockwise direction as turbines and counterclockwise for pumping.

Since there are only a few reversible pump-turbines in operation, the model tests in the laboratory had to be quite complete in determining not only the performance for pumping and turbining, but such other factors as cavitation, wicket-gate moments, and transient behavior in case of power failure.

Each new installation will add to the general knowledge leading to further improvement of this comparatively new type of prime mover.

SUPERSONIC CIRCUIT AT TULLAHOMA NEARS COMPLETION

Largest of the 22 wind tunnels and test cells at the U.S. Air Force's Arnold Engineering Development Center in Tullahoma, Tennessee, is the propulsion wind tunnel comprised of a transonic unit now in operation and a supersonic circuit nearing completion.

The propulsion wind tunnel, one of the three major laboratories at the Center, is powered by the world's largest rotating machine. The machine is over 480 feet long and develops 216,000 horsepower. It includes the world's two most powerful synchronous motors, each rated 83,000 horsepower, and two smaller "starting" motors of 25,000 horsepower each. The four motors are connected in tandem to drive two huge compressors: one a three-stage unit for the transonic circuit; the other an 18-stage unit for the supersonic circuit.

The transonic circuit at the Center has been conducting aerodynamic and propulsion tests for nearly three years, and it soon will be joined by its associated supersonic tunnel. Tests have been conducted on more than 30 of the major weapon-system projects of the United States government, including the USAF Titan, Snark, GAM–72 and Bomarc missiles, nose cones for all intercontinental ballistic missiles, the Navy's Polaris, the Army's Juniper and the National Aeronautics and Space Administration Mercury "man-in-space" project.

—Photo Courtesy Westinghouse

These giant rotary converters located at Aluminum Company of America's Badin, N. C. smelting works were installed around 1918, and are rated 6,825 kilowatts at 525 volts. The pile of 312 silicon rectifier cells in the foreground will be used to build as static converter rated 6,000 kilowatts at 600 volts. The silicon rectifying equipment, although nearly equal in rating to the "rotaries", will be only one-third the cubic size of the old machines. In addition, the new converter—a joint development by Westinghouse and Alcoa—will be practically maintenance free.

MILLION-POUND DEAD-WEIGHT MACHINE DESIGNED FOR NEW NATIONAL BUREAU OF STANDARDS

Final designs are nearly completed for dead-weight machines of 300,000 and 1,000,000 pound capacity which will be installed at the new Gaithersburg, Maryland, location of the National Bureau of Standards. These machines will be used to calibrate force-measuring devices that are used, in turn, to calibrate other devices and machines for measuring and applying large forces. Force measurements are widely used in industrial fields such as weighing, materials testing, automatic control of machinery, and rocket development, and there is a consequent need for precisely measuring forces larger than ever before.

By use of dead weights totalling 111,000 pounds, the Bureau now calibrates force-measuring devices to an accuracy of 0.02 percent. The Bureau's largest dead-weight machine had a capacity of 102,000 pounds when installed in 1927. Nine 1,000 pound weights were added to this machine in 1931, thereby increasing its capacity to its present limit of 111,000 pounds.

When this machine was installed, there were few devices capable of measuring 100,000 pounds. Since that time, there has been an increasing number of large force-measuring devices, some as large as 3,000,000 pound capacity. From only a few in 1927, the number of force-measuring devices submitted to the Bureau for calibration has grown to more than 900 in 1959. Devices measuring forces over 111,000 pounds are calibrated by the Bureau by means of equipment that have been calibrated previously in the deadweight machine.

To calibrate devices that measure forces greater than the capacity of the dead-weight machine, several steps are required, and errors are introduced, thereby lowering calibration accuracy. Load cells of 3,000,000 pounds capacity are now calibrated to an accuracy of 0.4 percent in the Bureau's 10,000,000 pound compression machine. This accuracy, however, is not sufficient for the needs of modern industry.

Industrial weighings require accuracies of 0.05 to 0.2 percent; and accuracies of 0.1 percent or better are now needed for measuring thrusts of large rocket engines. Calibration accuracies with the new machines should be well within these requirements. Weights for the machines are expected to be accurate within 0.005 percent. Temperature, too, will be controlled carefully. Because the indication of a force-measuring device depends on the temperature, pro-

(Continued on page 50)

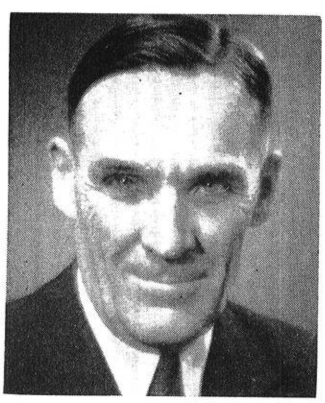
ENGINE EARS

by Bob Helm, ce'61

M. E. PROFESSOR RETIRES

The man who once wrote a pioneering volume on the gasoline automobile has retired from the University of Wisconsin faculty.

He is Ben Elliott, professor of mechanical engineering and head of that department at the University, who is almost as spry today as he was when he and a colleague compiled the pioneering textbook on the automobile more than four decades ago.



Dean Emeritus Ben G. Elliott.

At that time, automobiles were in the covered-wagon stage, as were books on them.

As a learned technical volume, the book was a big success. It was a standard text for many years in trade and vocational schools and in many institutions of higher learning throughout the United States. It went into five editions and sold several hundred thousand copies. Through the textbook, Ben Elliott helped thousands of engineering students to understand the fundamentals of an automobile engine, and also helped just plain car owners who wanted to learn something about the cars they were driving.

After the writing of "The Gasoline Automobile," Professor Elliott turned out three companion volumes: "Automobile Power Plants," "The Automobile Chassis," and "Automobile Repairing," as well as an operating engineer's handbook and numerous articles in technical publications. He also served for awhile on the editorial staff of "Power" magazine in New York.

During his many years of teaching and research in mechanical engineering, Elliott's special fields have been internal combustion engines, automobiles, and steam power. Just as he has successfully promoted understanding in these areas, he has successfully promoted understanding in many other aspects of engineering, and in his nearly half a century of service to Wisconsin education and research has engendered a confidence in Ben Elliott, not only as an engineer, but as a man of absolute integrity and goodwill.

STUDENT WINS AWARD

David C. Hoffman of rural Madison, mechanical engineering student at the University of Wisconsin, Madison, is among ten engineering and commerce students at eight midwest universities who have been awarded special scholarships by the Maytag Company Foundation, Inc.

This is the sixth year that special scholarships, each amounting to $200, have been awarded to engineering and commerce students by the foundation. Those receiving the grants are selected by college faculties.

ATOMIC REACTOR

The University of Wisconsin recently awarded a contract to the General Electric Company for construction of a ten-thermal-kilowatt pool training reactor expected to be in operation on the campus next fall.

Wisconsin is purchasing the General Electric reactor with the assistance of a $150,000 grant from the Atomic Energy Commission under the AEC's educational assistance program.

The reactor, Wisconsin's first of this physical size, is designed expressly for education and research. It will be used to train students in reactor operation and nuclear research procedures, and for advanced research in engineering, chemistry, and other fields.

The reactor, to be housed in the Mechanical Engineering building, will permit nuclear engineering students to become familiar with a wide variety of problems such as core loading, reactor control, and fuel handling and storage.

The reactor will be constructed of standard open pool reactor components and will use standard reactor control and instrumentation systems.

TRIANGLE NEWS

Triangle activities have continued at their usual rapid pace with parties held on February 6 and February 20. Highlight of the social schedule was a faculty tea and a buffet luncheon held prior to the St. Pat's dance on March 12.

As basketball season draws to a close Triangle is practicing for the annual National Triangle basketball tournament at Northwestern. In addition to the basketball tournament, there will be a dance, chug-a-lug contest and the annual Triangle Sweetheart Contest.

Triangles' reference library received a tremendous boost with the donation of approximately 200 volumes of engineering texts from Triangle Honorary, Dean Emeritus B. G. Elliott.

AIEE–IRE

BOB BALTES

The American Institute of Electrical Engineers and Institute of Radio Engineers had its first meeting of the new year Wednesday, February 10, 1960 at 7:00 p.m. in 2033 Engineering Building. President Bill Dashelet brought the meeting to order. After minor business was taken care of, the main speaker of the evening was introduced—Mr. John E. Dolan from the American Electric Power Service Corp. Mr. Dolan gave a very interesting talk on Nuclear Power Reactors. The members enjoyed the talk, refreshments, and AIEE-IRE book covers.

KHK

KHK started off the new semester with these new officers to lead them to higher achievement: President—Carl Much; Vice-President—Lee Eichenseer; Recording Secretary—Karel Olson; Treasurer—Chuck Holderness; Alumni Secretary—Howard Luedtke; Corresponding Secretary—Ron Hintz; Assistant Treasurer—Don Panzenhagen; Social Chairman—Bob Baltes; Assistant Social Chairman—Jim Ably; Rushing Co-Chairmen—Mike Stanke and Jim Westoby. Elected to the Fraternity Executive Board for the spring semester were: Bob Baltes, Mike Stanke and Lee Eichenseer. The new slate of officers assumed their duties January 11, 1960.

The graduating Seniors celebrated their accomplishments at a farewell party at the chapter house on January 23rd. A Founders Day Banquet, held in Milwaukee February 27th, was sponsored jointly by Theta Chapter of Milwaukee School of Engineering and Delta Chapter of Madison. The banquet was attended by alums from the Milwaukee, Chicago and Madison areas.

ASCE

At a recent ASCE meeting, new officers were elected. They are:

Don Graff—President
John Crane—Vice President
Fay Kell—Secretary
Gary Neilsen—Treasurer
Peter Van Horn—Polygon Board Representative

Oscar Dittrich was selected to represent ASCE in the St. Pat's day competition.

The February meeting featured an address by a member of the Bureau of Reclamation.

MINING AND METALLURGY CLUB

At a recent meeting of the Mining and Metallurgy Club the following new officers were elected:

James Huff—President
Mel Andrasco—Vice-President
Raymond Mosser—Secretary
Howard Schloeman—Treasurer

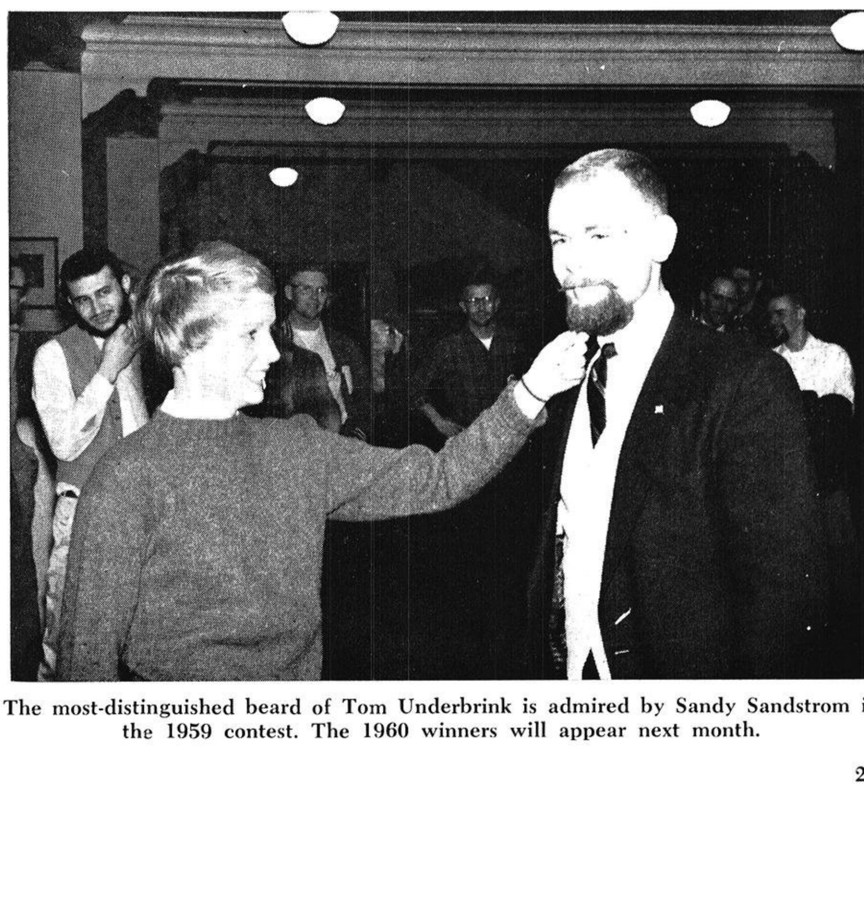
Mr. Thomas Carlson of Kennecott Copper Company gave an interesting talk on the mining and refining of copper.

Representatives of United States Steel's South Works will speak on new steel making processes at the next meeting of the club.

AMERICAN FOUNDRYMAN'S SOCIETY

The newly-elected officers presided at the first meeting of the American Foundrymen's Society. The new officers are Dick Stueber, President; John Tralmer, Vice-President; and Adrian Beltran, Secretary-Treasurer.

(Continued on page 34)



The most-distinguished beard of Tom Underbrink is admired by Sandy Sandstrom in the 1959 contest. The 1960 winners will appear next month.

SHE SKIS

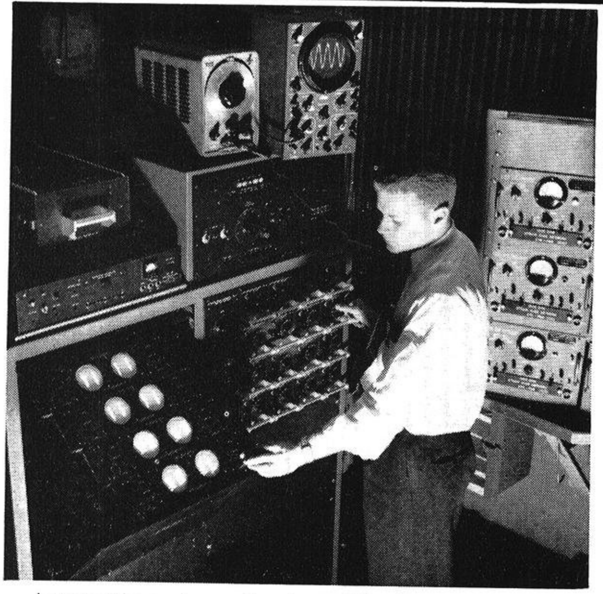
Kay Lokken skis to satisfy her winter wanderlust. We were forced to have her ski for us during the week, because most week ends she's out of town on the slopes.

After our romp in the snow, we suggested a talk over a cup of coffee, (which was a welcome warming idea) and we learned that she is also interested in other outdoor sports, especially swimming. Kay holds a Water Safety Instructor certificate, so if you meet her at the beach, you need have no fear of drowning.

The afternoon was pleasantly spent in floundering in snow (up to our knees). All in all, a rewarding experience as can be seen from the photos of our March Girl of the Month.

—Photos by Peter N. Gold

engineers



Automatic systems developed by instrumentation engineers allow rapid simultaneous recording of data from many information points.

Frequent informal discussions among analytical engineers assure continuous exchange of ideas on related research projects.

Under the close supervision of an engineer, final adjustments are made on a rig for testing an advanced liquid metal system.

and what they d

The field has never been broader
The challenge has never been greater

Engineers at Pratt & Whitney Aircraft today are concerned with the development of all forms of flight propulsion systems—air breathing, rocket, nuclear and other advanced types for propulsion in space. Many of these systems are so entirely new in concept that their design and development, and allied research programs, require technical personnel not previously associated with the development of aircraft engines. Where the company was once primarily interested in graduates with degrees in mechanical and aeronautical engineering, it now also requires men with degrees in electrical, chemical, and nuclear engineering, and in physics, chemistry, and metallurgy.

Included in a wide range of engineering activities open to technically trained graduates at all levels are these four basic fields:

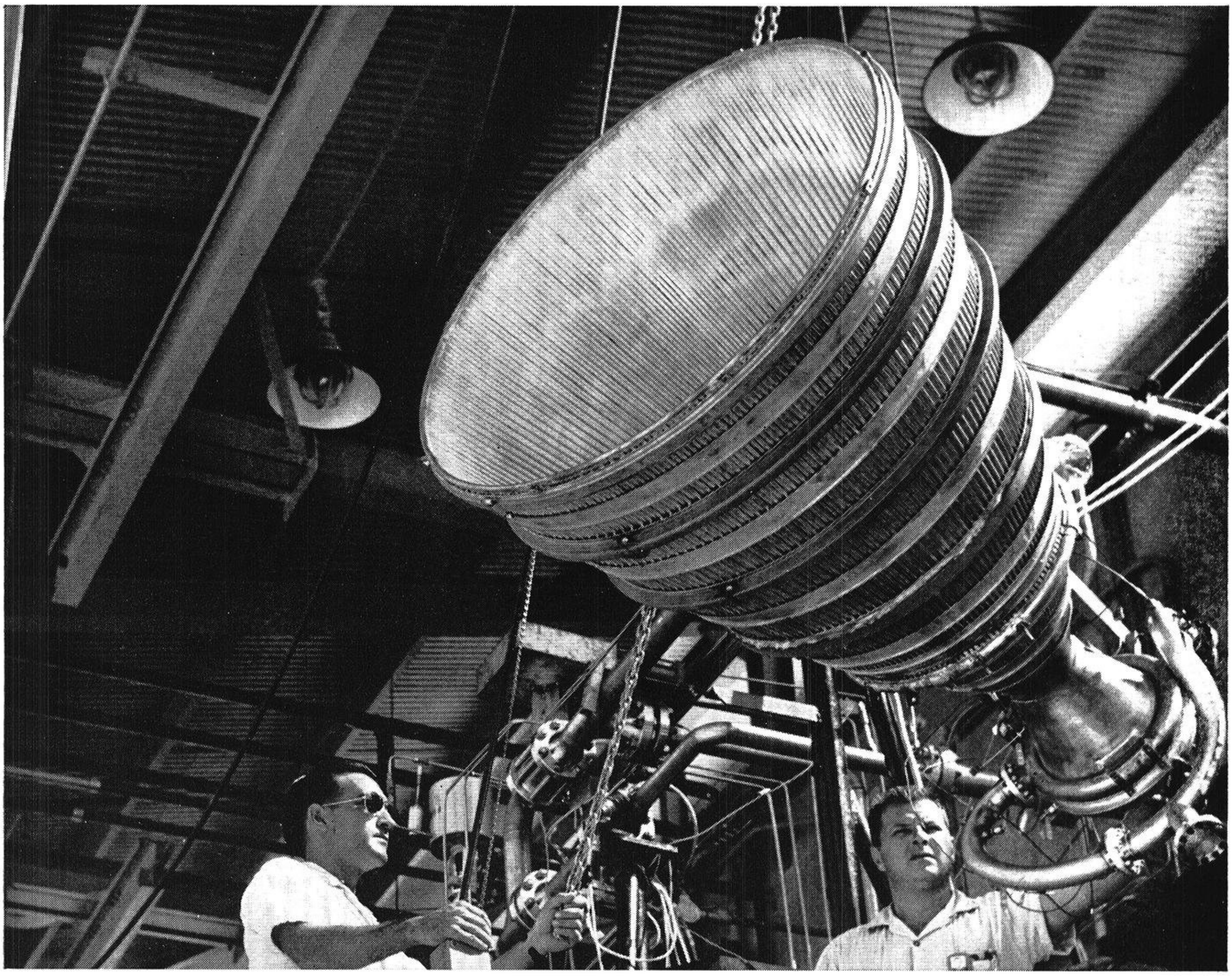
ANALYTICAL ENGINEERING Men engaged in this activity are concerned with fundamental investigations in the fields of science or engineering related to the conception of new products. They carry out detailed analyses of advanced flight and space systems and interpret results in terms of practical design applications. They provide basic information which is essential in determining the types of systems that have development potential.

DESIGN ENGINEERING The prime requisite here is an active interest in the application of aerodynamics, thermodynamics, stress analysis, and principles of machine design to the creation of new flight propulsion systems. Men engaged in this activity at P&WA establish the specific performance and structural requirements of the new product and design it as a complete working mechanism.

EXPERIMENTAL ENGINEERING Here men supervise and coordinate fabrication, assembly and laboratory testing of experimental apparatus, system components, and development engines. They devise test rigs and laboratory setups, specify instrumentation and direct execution of the actual test programs. Responsibility in this phase of the development program also includes analysis of test data, reporting of results and recommendations for future effort.

MATERIALS ENGINEERING Men active in this field at P&WA investigate metals, alloys and other materials under various environmental conditions to determine their usefulness as applied to advanced flight propulsion systems. They devise material testing methods and design special test equipment. They are also responsible for the determination of new fabrication techniques and causes of failures or manufacturing difficulties.

...at Pratt & Whitney Aircraft...



Exhaustive testing of full-scale rocket engine thrust chambers is carried on at the Florida Research and Development Center.

For further information regarding an engineering career at Pratt & Whitney Aircraft, consult your college placement officer or write to Mr. R. P. Azinger, Engineering Department, Pratt & Whitney Aircraft, East Hartford 8, Connecticut.

PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

CONNECTICUT OPERATIONS — East Hartford

FLORIDA RESEARCH AND DEVELOPMENT CENTER — Palm Beach County, Florida

Engine Ears

(*Continued from page 29*)

President Dick Stueber opened the meeting and welcomed all of the new members. Mr. Harold Mokwa of Howard Foundry was the guest speaker for the evening.

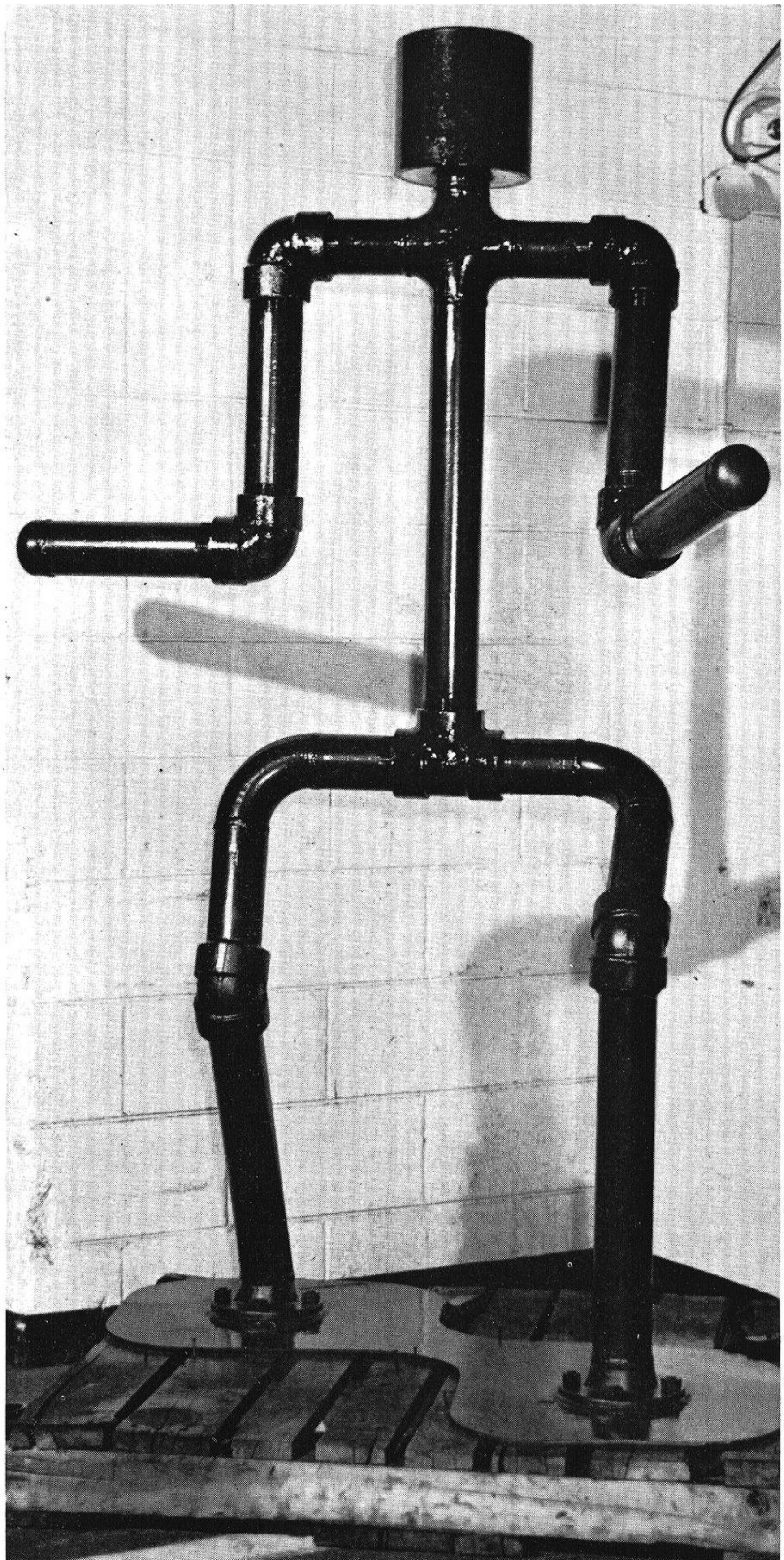
Mr. Mokwa gave a very interesting talk on the uses and some of the history of the investment casting process. His discussion was accompanied by slides showing the operations involved and some of the castings produced. Refreshments were served following the meeting.

The next meeting will feature Mr. Don Spence of Pelton Steel Castings Company.

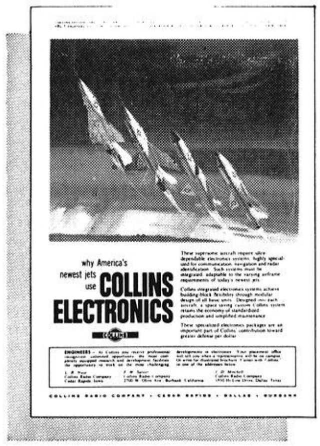
Oscar The Ironman

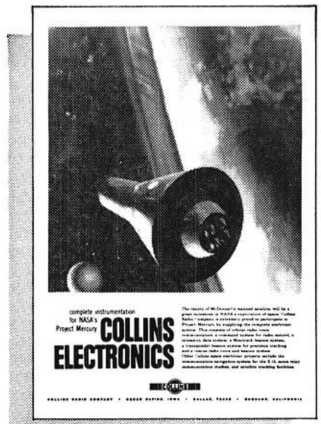
The history of Oscar, Triangle Fraternity's mascot, dates back to when the Engineering Building was what is presently known as the Education Building located across the hill from the Law Building. Oscar, a seven foot pipe man, was originally constructed by engineering students who placed Oscar outside the steam lab in the basement of the old engineering building, blowing steam across the hill at the lawyers. When the engineering department moved to its present location, Oscar was given to Triangle for safekeeping, a monument to the engineer's supremacy over the lawyers.

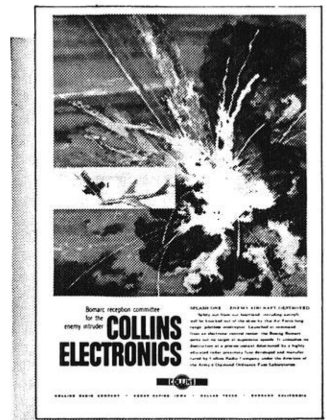
Each year Oscar is carried forth to the St. Pat's Dance, where as a guest of honor, he proclaims that St. Pat was an Engineer. Numerous attempts by lawyers to steal Oscar have usually met with failure. Four hundred pounds of stainless steel pipe has been too much of an obstacle for the limited muscular power of law students. The lawyers, however, did manage to dispose of Oscar the 1st via the depths of Lake Mendota. Oscar the 2nd, mysteriously disappeared in the busy city of Chicago at Triangle's National Basketball Tournament in 1954. Oscar the 3rd is carrying on the tradition in fine style as he sparkles in his blarney green attire. A visit to the University of Illinois for an Xmas formal highlighted Oscar's 1959 travels. Twenty Triangle men from the U. of I. whisked him away in the early hours of the morning after the usual spirited Triangle homecoming party. Upon his return, he was given a new coat of paint and is ready again to take his stand at this year's St. Pat's Dance.

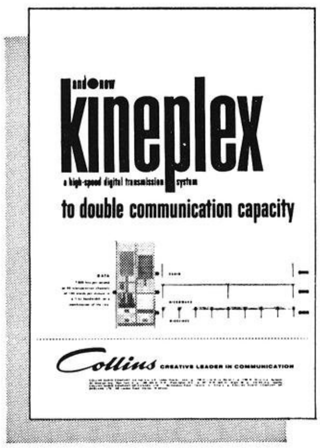


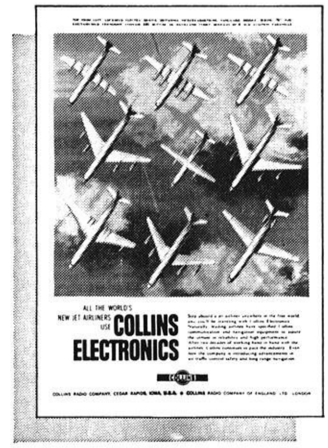
Oscar the Ironman, mascot of Triangle fraternity.











COLLINS ELECTRONICS– diversification

These specialized electronics systems are an important part of Collins' contribution to advancements in military and commercial communication.

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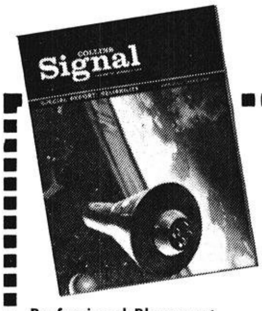
Collins needs engineers and physicists to keep pace with the growing demand for its products. Positions are challenging. Assignments are varied. Projects currently underway in the Cedar Rapids Division include research and development in Airborne communication, navigation and identification systems, Missile and satellite tracking and communication, Antenna design, Amateur radio and Broadcast.

Collins manufacturing and R & D installations are also located in Burbank and Dallas. Modern laboratories and research facilities at all locations ensure the finest working conditions.

Your placement office will tell you when a Collins representative will be on campus.

For all the interesting facts and figures of recent Collins developments send for your free copies of *Signal*, published quarterly by the Collins Radio Company. Fill out and mail the attached coupon today. You'll receive every issue published during this school year without obligation.



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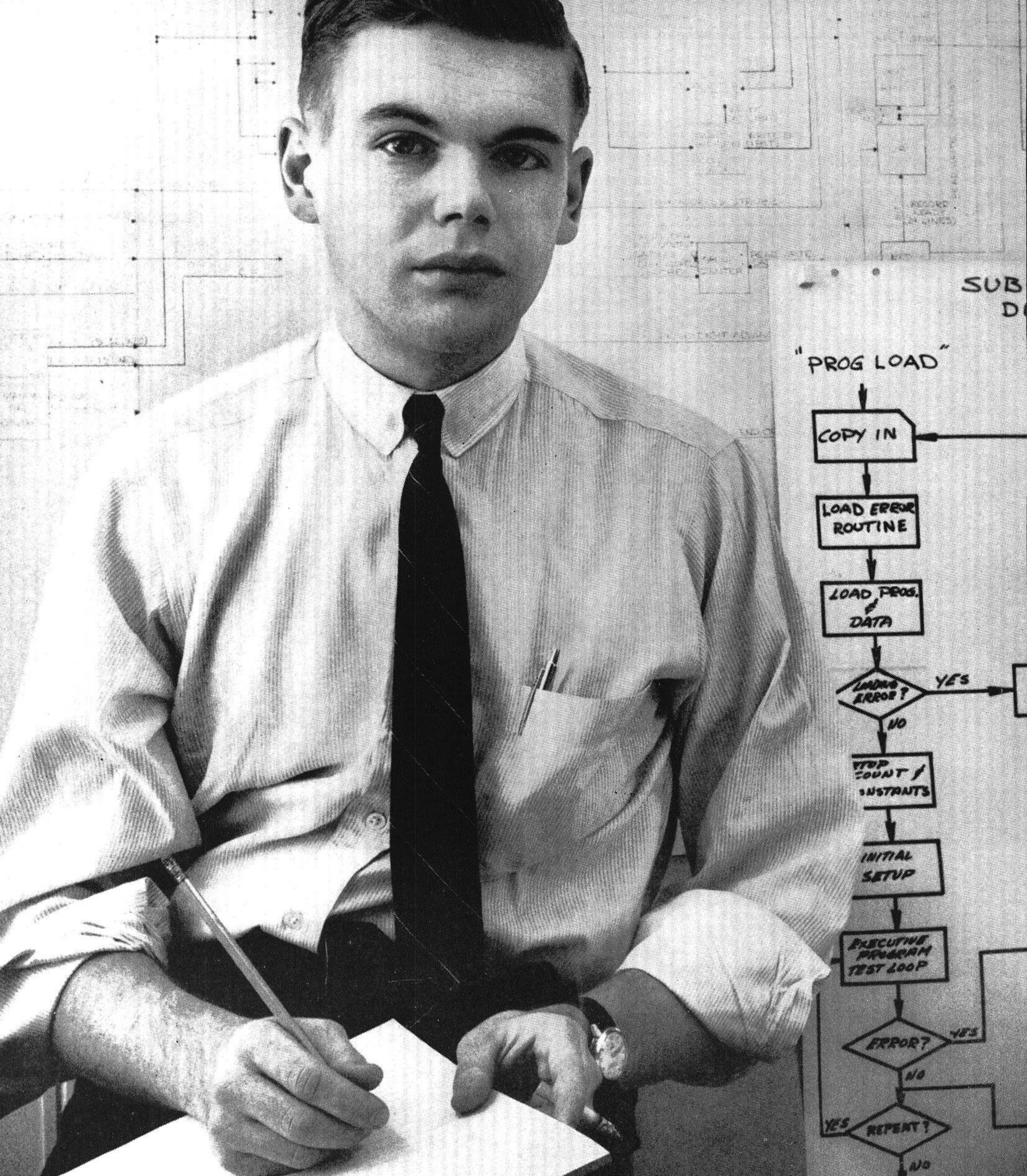
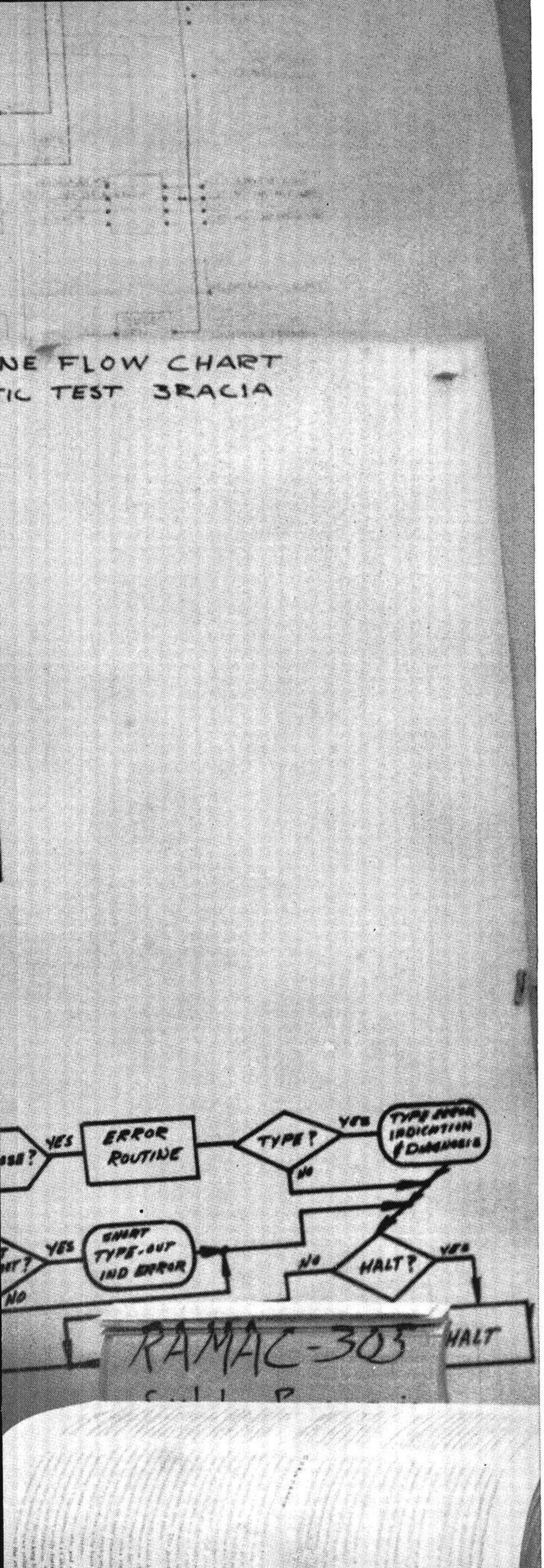


Robert M. King (B.S.E., Princeton '57, M.S., Carnegie Tech) is investigating applications of the electronic computer in advanced computer design. A skilled computer programmer, he has done original work in organizing programs that make possible computer self-diagnosis.



HE GETS COMPUTERS TO DIAGNOSE THEIR OWN FAULTS

With the increasing size and complexity of modern computers, one of the most interesting problems that engineers face is the rapid and efficient location of failures within the system.

The method which they have found most practical is to use the speed and logical abilities of the computer itself to make the diagnosis. Programming computers to perform this function is the job of Robert M. King.

The Diagnostic Technique

He prepares programs for the computer which actually simulate the deductive processes of a man investigating the faults of the machine. Each program instructs the computer to exercise various segments of its circuitry in a logical order.

The result of each test is checked against the correct result, stored in the computer memory, of previous tests of the same circuitry when in proper working order. If the results do not agree, a message is automatically typed which indicates the failure and which component caused it.

A computer is particularly adept at this job. It can take into consideration simultaneously a large number of factors. It can also work at very high speeds. Once a program is properly written, the computer makes no errors. Appropriately enough, diagnostic programming often aids in designing better computers.

A Programmer's Background

Computer programs are the result of ingenious applications of many intellectual qualities. Computer design and language are based on sound laws of logic. Therefore an important prerequisite is the ability to analyze complex problems and to deduce from them useful methods of solution consistent with machine requirements.

If you think you might be interested in working in one of the many fascinating areas of computer programming, you are invited to talk it over with an IBM representative. The future can be as unlimited as the future of the computer itself.

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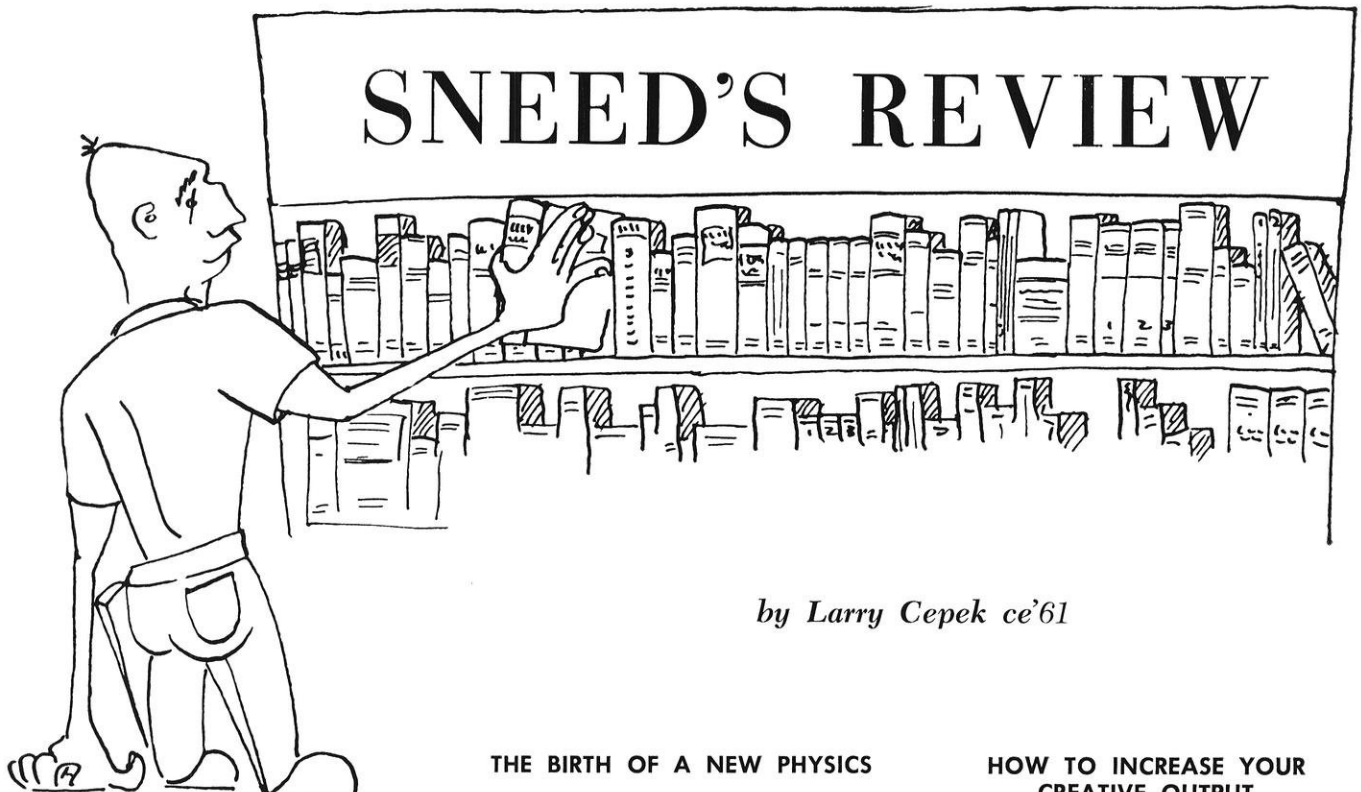


by Larry Cepek ce'61

THE PHYSICS OF TELEVISION

By Fink and Lutyens
Price: 95¢

One of the true technological triumphs of this century, television is the most advanced, to date, of human communication over appreciable distances. *The Physics of Television* is a clear and fresh account of how men have learned to control electrons, photons, and electro-magnetic waves to produce instantaneous moving pictures at great distances. The authors illuminate the many principles of physics that are applied in television systems, and they explain how the recent solution of problems in developing color television has thrown new light on the processes of the human eye.

Donald G. Fink, Director of Research of the Philco Corporation since 1952, was born in Englewood, N.J., in 1911. He graduated from M.I.T. in 1933 and became an editor of *Electronics* Magazine. Following World War II service as an expert consultant, Office of the Secretary of War, he became editor-in-chief of *Electronics.* Mr. Fink was president of the Institute of Radio Engineers in 1958.

David M. Lutyens received his B.A. degree in science from Magdalene College, Cambridge University, in 1947. After serving as a major in the British Army, he taught physics in England.

THE BIRTH OF A NEW PHYSICS

By I. Bernard Cohen
Price: 95¢

In this fresh account of the scientific ferment following the Renaissance, Dr. Cohen tells, through the lives of Copernicus, Galileo, Kepler, and Newton, the story of the search for a new physics—a physics to describe the dynamics of a moving universe. In dynamics with Aristotelian physics, Copernicus's concept of an earth in motion necessitated bold new explanations of natural phenomena, from the mechanics of rolling balls to the motions of stars and planets. This search culminated in Newton's master stroke, the formulation of the law of universal gravitation and his related laws, which are the foundation of modern science and technology and which represent "the creative accomplishment of the human spirit at its pinnacle."

Dr. I. Bernard Cohen, one of America's outstanding science historians, has edited the scientific papers of Issac Newton and Benjamin Franklin and has written many books, including *Science, Servant of Man.* Until recently, Dr. Cohen was editor of *Isis,* the official journal of the History of Science Society and is now Professor of the History of Science at Harvard.

° These books may be purchased by writing to Anchor Books, Doubleday & Company, Inc., Garden City, New York.

HOW TO INCREASE YOUR CREATIVE OUTPUT

Price: $1.50

"How To Increase Your Creative Output," is a new booklet developed specifically to help companies raise the level of creativity among their technical personnel. It is designed to be supplied by management to each member of the technical staff and provides practical guideposts for understanding the creative process and for increasing quantity and quality of creative work.

A special feature of the booklet is a double-spread "Flow Chart of the Creative Process," giving the twelve steps and sub-steps in creativity in order in which they most frequently occur. Included also is information on the "do's" and "don't's" of defining a problem, how to get underway in solving a creative problem, and practical suggestions on stimulating the creative process.

"How To Increase Your Creative Output," was prepared by Deutsch and Shea, Inc., technical man power consultants and is one of a series of publications on creativity.

CRYSTALS AND CRYSTAL GROWING

By Holden and Singer
Price: $1.45

This exploration into the beautiful world of crystals is the first book for the amateur scientist to explain fully the theory and prac-

Sneed's Review

(Continued from page 40)

tice of the modern crystallographer's remarkable art. Not only does the reader acquire a deep feeling for the eternal conflict between order and disorder in nature, but he learns the simple methods whereby he can grow and experiment with a dozen basic crystal types. Today, the comprehension of the nature and behavior of crystals is essential to most branches of science, paritcularly mineralogy, chemistry, solid-state physics, metallurgy, and electronics.

Alan Holden, a physical chemist on the research staff of Bell Telephone Laboratories, co-authors the book with Phylis Singer who teaches mathematics and art at the Far Brook School, Short Hills, N. J.

WAVES AND THE EAR

By Van Bergeijk, Pierce, and David
Price: 95¢

Man has always been concerned about sound, but in recent years more attention has been devoted to its understanding and control. This has resulted in fascinating discoveries—that fish "talk" in pleasurable inventions—stereophonic sound; and in fundamental knowledge—the transmission of nerve impulses to the brain. *Waves and the Ear* discusses with clarity the physical nature of sound waves and the physiology of the ear itself. Blending together the latest findings of acoustics, anatomy, electron psychology, hydro-mechanics, zoology, phonetics, and hi-fi engineering, this book is basic to an understanding of all sounds, including those we cannot hear.

The authors say this about sound: "When I think about hearing, I sometimes try to imagine what I would feel, what sort of person I would be, had I been born totally deaf. I would not be able to enjoy music or speech. Only with much and arduous training would I learn to speak coherently or, for that matter, to speak at all, unless someone somehow could convey to me by other means that there is such a thing as sound. It would be dangerous for me to venture out in the street, because I could not hear an approaching car nor the warning cry of a bystander. At least half of life would not exist for me, and the other half would be enormously complicated, even perilous."

Dr. William A. Van Bergeijk, a native of Holland, came to this country on a Fulbright Scholarship in 1953. He received his Ph.D. at Iowa State University and has won fellowships at Woods Hole Marine Biological Laboratories. Since 1956, he has been on the research staff at Bell Telephone Laboratories.

Edward E. David, Jr., is Assistant Director of Visual and Acoustics Research at Bell Telephone Laboratories, where he works with physical and biological scientists in fundamental studies of how man can most effectively operate the machines he is creating.

NEW BOOKS ON NUCLEAR REACTORS

A comprehensive collection of current information on nuclear reactors, their design, construction, and operation, and operation of "hot" laboratories, for handling of radioactive materials, has now been made available for distribution to all interested persons.

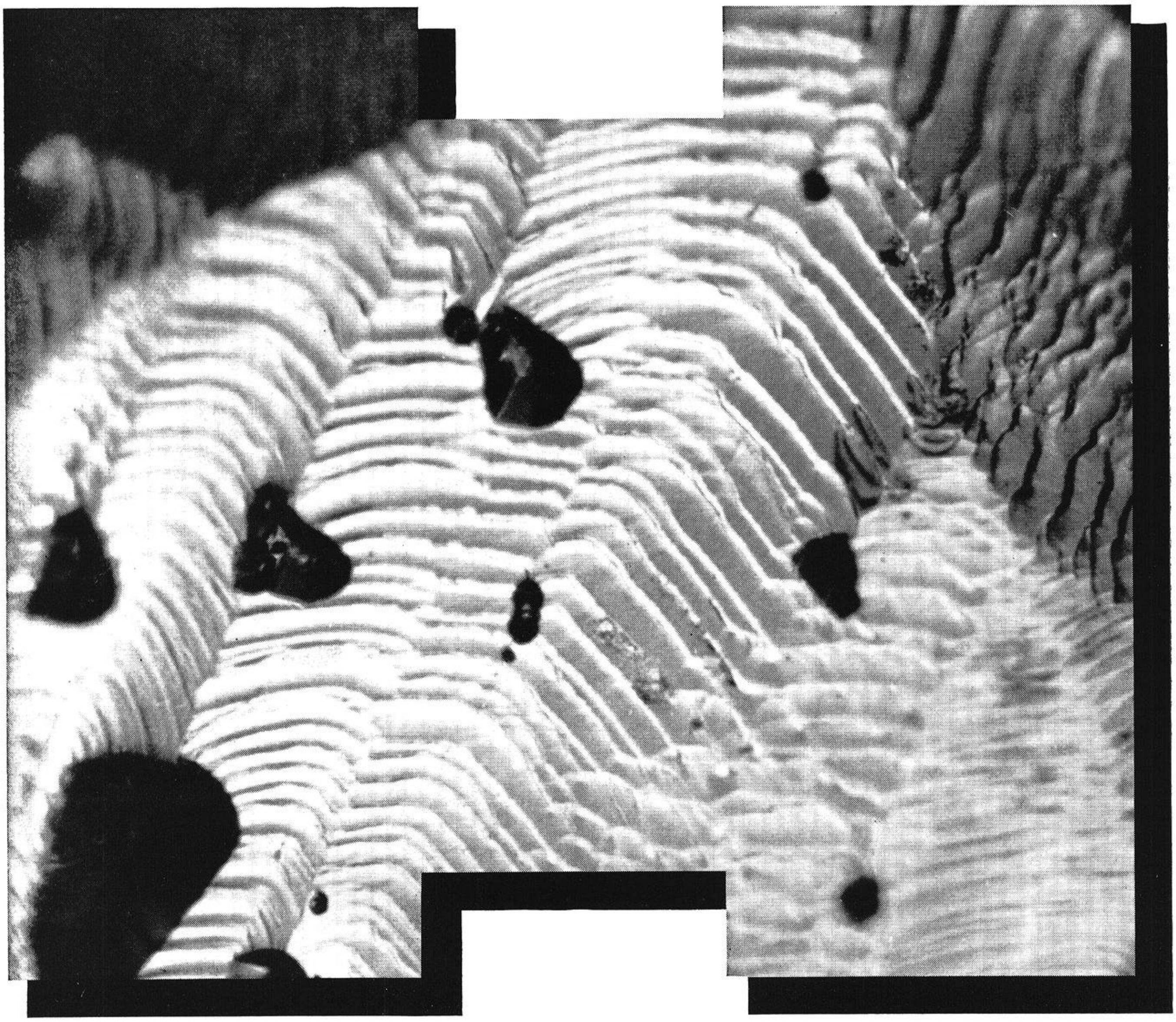
The books are based on papers presented at the 1957 Nuclear Congress, a joint meeting held in Philadelphia under the auspices of twenty-five major scientific and technical groups.

Volumes I and II, titled *Advances in Nuclear Engineering*, were edited by John R. Dunning of Columbia University and Bruce R. Prentice of General Electric Company and Chairman of the Nuclear Congress Program Committee. They deal with the design of nuclear reactors and their cores, educational use of reactors, metallurgy, instrumentation, heat transfer, problems of corrosion and materials, and related topics. The two volumes, containing over 1100 pages and more than 900 illustrations, are sold as a set for $35. Most of the 138 articles in volumes I and II are also available in single-copy format at 30 cents each.

The third volume, *Hot Laboratory Operation and Equipment*, edited by Frank Ring, Jr., of Oak Ridge National Laboratory, contains the most complete information currently available on devices and techniques for handling radioactive materials.

(Continued on page 58)

The industry that



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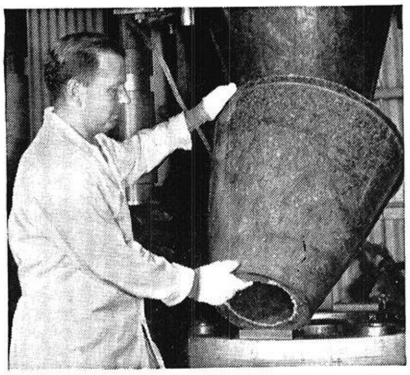

Exit cones *capable of withstanding temperatures of 6000° F, represent one example of advanced engineering being performed by the Hughes Plastics Laboratory.*

This photomicrograph (at left) of an etched silicon crystal is used in the study of semiconductor materials. Impurities introduced into crystals such as this form junctions for semiconductor devices.

In the fast-growing semiconductor industry, Hughes Products, the commercial activity of Hughes, is leading the field. Its programs include basic research on semiconductor surfaces; alloying and diffusion techniques; and materials characterization studies to determine the electrical effects of imperfections and impurities.

In addition, Hughes Products is developing new semiconductor devices such as parametric amplifiers, high frequency performance diodes, and improved types of silicon transistors. New techniques are being devised for casting silicon into various configurations. Also underway is the development of new intermetallic compounds for use in semiconductor devices.

Other activities of Hughes provide similarly stimulating outlets for creative engineering. The Hughes Research & Development Laboratories are conducting studies in Advanced Airborne Electronics Systems, Space Vehicles, Plastics, Nuclear Electronics, Global and Spatial Communications Systems, Ballistic Missiles... and many more. Hughes in Fullerton is developing radar antennas which position beams in space by electronic rather than mechanical means.

The diversity and advanced nature of Hughes projects provides an ideal environment for the graduating or experienced engineer interested in building rewarding, long-range professional stature.

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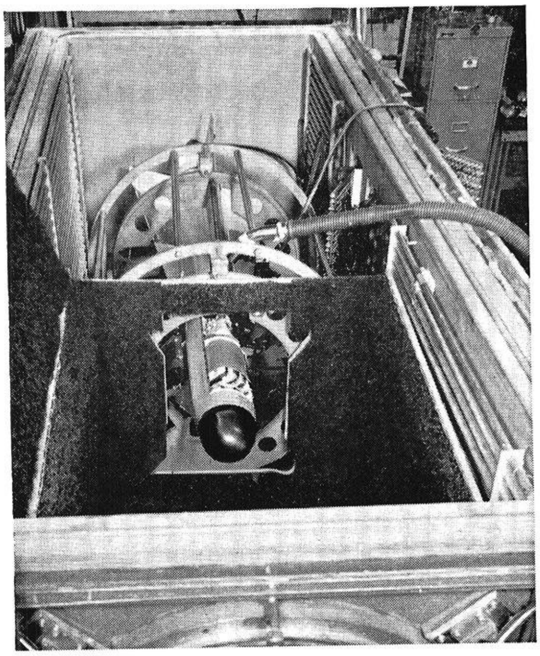
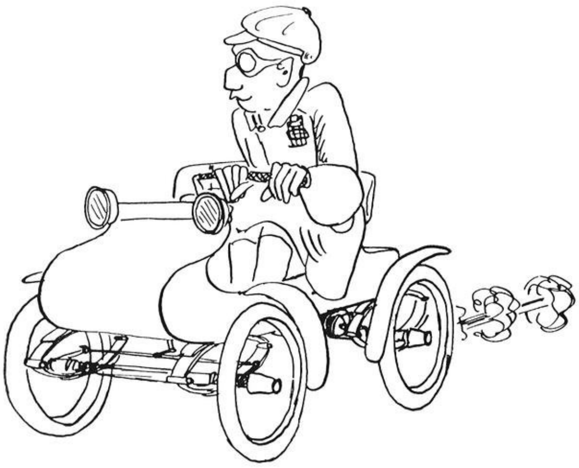
Newport Beach, Malibu and Los Angeles, California
Tucson, Arizona



Falcon air-to-air guided missiles, *shown in an environmental strato chamber are being developed and manufactured by Hughes engineers in Tucson, Arizona.*



THE ENGINEER OF YESTERYEAR

by Floyd Gelhaus, ee'61

THE SILVER LINING

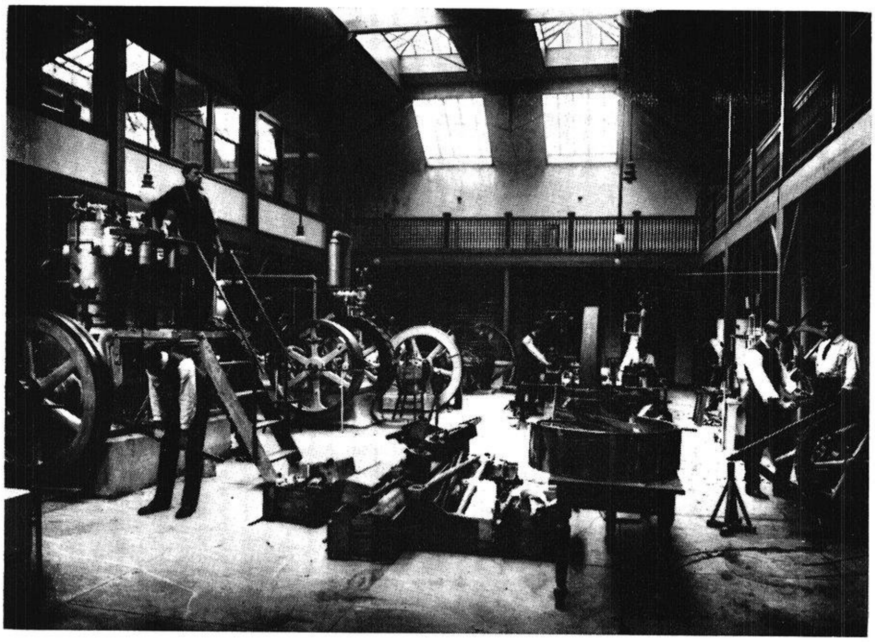
November, 1920

HARD coal is twenty dollars a ton in Madison this fall. Every time a professor throws a shovelful of coal into the furnace he says goodbye to ten cents, which will account in part for the wild and haggard air the faculty will wear during the winter.. It is going to be hard work to keep the houses warm enough for B. V. D.'s and georgette waists. Such are the economic effects of peace. And yet, to the optimist, there is a silver lining to the cloud of high priced coal dust. If we may judge by the quantity of slate we now receive with our ton of coal, the miners are now taking it out pretty close to the rind. We have been told in the past that American miners took only the easy pickings and left large amounts of coal behind them in such shape that it could never be taken out. It would seem that they can now take out anything that is black and get a good price for it. Apparently they are leaving nothing behind. If this is so, we must credit the war with a noteworthy bit of conservation. We are told that the coal supply in sight is sufficient to meet demands for 4000 years. So forty centuries from now, about the time when the coal would otherwise have played out, we may expect future generations to arise and give thanks for the tribulations heaped upon us in this year 1920.

CONCRETE BOATS

December, 1920

The first concrete boat on record was a rowboat built in 1849, at Carces, France, by M. Lambot. It is interesting to note that this boat not only marks the starting of the history of concrete ship construction, but it was also the first example of what, today, would be called reinforced concrete. This boat of M. Lambot's was patented and exhibited at the World's Fair in Paris, in 1855. It is said to be still in service. It was not until thirty-eight years later that any further attempts were made to construct concrete boats. A small boat was then built, in Holland, by the Fabriek van Cement-Ijzer Werken. It was called the "Zeeneuve," or "Seagull," and was at first used for duck shooters. It was still in use in 1918 by a cement products company in Amsterdam. The Fabriek van Cement-Ijzer Werken first built barges up to eleven tons capacity. These proved so successful that the plans were elaborated and resulted in the building of barges sixty-four feet long, fourteen foot beam, and of fifty-five tons capacity. The system of construction consisted briefly, of building longitudinal and transverse bulkheads space, approximately six feet apart, thus providing a cellular construction which made the craft practically unsinkable. In 1897, Carlo Gabellini, of Rome, Italy, began the construction of concrete scows, barges, row-boats, and bridge pontoons. One of his barges, which was built in 1906 for the military harbor at Spezzia, for the use of the Italian Navy, was subjected to the very severe test of being driven against some piling and subsequently rammed by a steel towboat, and yet showed results so satisfactory that the construction of similar barges followed. The first concrete boats built in the United States were a five-hundred twenty-five ton concrete scow, built for the San Francisco harbor traffic, and some barges built for use at Balboa, Panama Canal, in 1910. In 1917, at Redwood City, California, the San Francisco Shipbuilding Company undertook the construction of an ocean-going cargo vessel of nearly five-thousand tons, three-hundred thirty feet long, and forty-six foot beam. This boat, christened the "Faith," was launched March 14, 1918, and made her trial trip May 5 in San Francisco bay. The trial trip was entirely successful. The "Faith" has since traveled over thirty-five thousand miles. Her first trip was to Seattle and back. She then went to Peru with lumber, then to Iquiqui, Chili, for a cargo of nitrate, to New Orleans, via the Panama Canal, thence to a northern port in Cuba for a cargo of sugar for New York. The history of the service given by concrete craft is varied. After reducing the available information to a reliable basis, it appears that, in general, the con-



October, 1903—Mechanical engineers are experimenting in the steam laboratory to determine efficiencies of steam engines.

crete barge or ship is a success from the standpoint of design and construction. From the standpoint of operation, some difficulty has been experienced with barges operating in restricted channels unless these barges are properly fendered. The sides of a concrete vessel are apparently more tender than the sides of a steel ship and require, therefore, greater care in handling where obstacles are likely to be encountered, and where possible, a greater amount of fendering than is usually applied to a smaller steel vessel. This tenderness is not so important in the case of a ship as it is in the case of inland water craft. Whether a ship is of steel or concrete, makes relatively little difference when one takes into account the impact of so large a moving mass.

WAVE TRANSMISSION OF POWER

1921

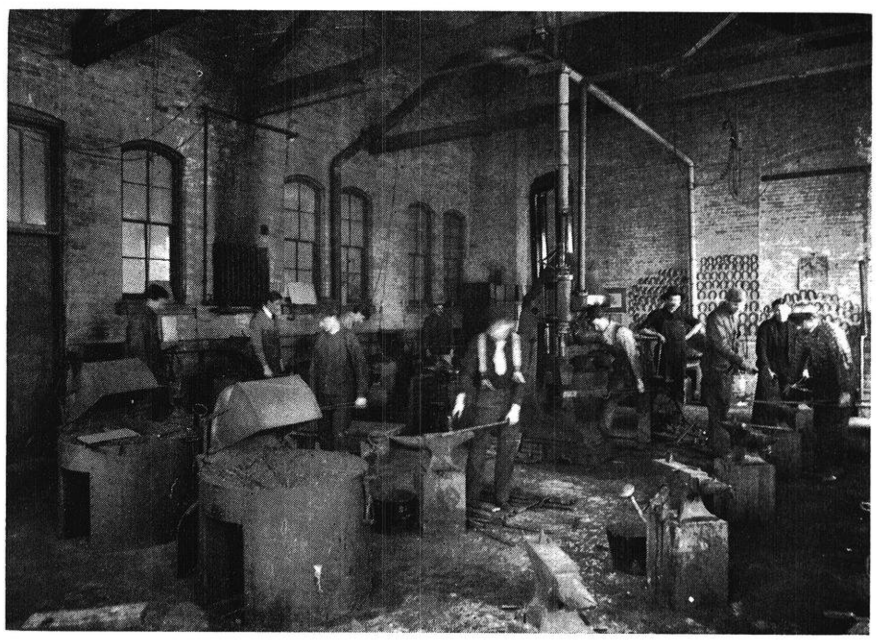
There are at present five methods in commercial use for the transmission of power; namely, steam, direct mechanical, electric, compressed air, and hydraulic. Wave transmission, or "sonic" transmission, is the name used to describe a sixth method in which waves or pulsations are set up in an enclosed column of liquid. The liquid, usually water, is contained in a flexible pipe connecting the apparatus generating the wave motions to the machinery which applies them to useful work. The principle of the method is absolutely distinct from that of hydraulic transmission. In this new form of transmission, there is no continuous flow; the particles of liquid merely pulsate backward and forward about a mean position. The pressure impulses set up by the wave-power generator travel through the liquid with the speed of sound waves, and deliver their energy to the wave power motor. Electricity offers an excellent analogy to explain both hydraulic and wave transmission. Direct current may explain the ordinary hydraulic transmission; alternating current, the wave transmission. The wave generator consists of one or more metal cylinders, each fitted with a piston connected by a crank-shaft to any type of high speed prime mover such as steam, internal combustion engine, or an electric motor. The wave motor is composed of one or more metal cylinders, each fitted with a piston designed to receive the power wave at the intake end. The other end of the piston is suitably connected to the tool or machine desired to be operated. The simplest application is found in such appliances as rock drills and riveting hammers. The possibilities for this new kind of transmission of power are wide, almost unlimited.

MOVING PLATFORMS PROPOSED TO DISPLACE SUBWAY CARS

1921

A series of traveling platforms, each moving three miles an hour faster than the preceding one, has been proposd by a firm of consulting engineers for cross-town use in

(Continued on page 47)



1893—metallurgical engineers learning the fundamentals of the drop forge and hand forging in the early forge shop.

Saint Pat's Dream

The good saint dreamed,
In fancy dim saw scenes drift by,
Saw lawyers pass until it seemed,
The whole of life had gone awry!

He dreamed--in dreaming planned,
A day of days, a joy indeed,
For all true sons within the land,
Who duty-bound upheld his creed.

Saw the gathering of his forces,
Hurling war cries to the breeze,
Lords of Nature's vast resources,
Masters of the land and seas.

Saw lawyers bowing, lawyers scraping,
Filling all the air with wails,
Heard them pleading and beseeching,
Saw them ride along on rails!

And the P. A. D.'s did grumble,
And the Fiddledephees did groan,
Egg-filled pockets made them tremble,
As they stood before the throne.

"Hail the King!" the plumbers shouted,
And the shysters bowed in fear,
Their downfall plainly flouted,
By old Saint Pat the Engineer!

BY R. DEWITT JORDAN

Engineer of Yesteryear

(Continued from page 45)

New York City. This novel idea is not a new one, for such a system was actually operated at the World's Fair at Chicago in 1892. In 1902, Gustave Lindenthal, the noted bridge builder, wished to install moving platforms over the Brooklyn bridge. Present conditions afford an opportunity for a serious consideration of the method by the Public Service Commission of New York.

The scheme proposed is to use three sets of platforms with a combined width of about 12 feet, the fastest one to carry covered seats of two passenger capacity. Each platform unit is to be supported on motor driven trucks, the electrical elements of which are of identical construction but are to be driven at the required speed by currents of varying frequency. Whether or not the system will be installed in New York is unknown, but its successful operation may be of great importance to the street transportation industry.

NOISE REDUCTION BY FREQUENCY MODULATION

1939

Since the beginning of radio broadcasting for entertainment, and for the thousands of other uses to which this convenient method of communication has been adapted during the last generation, noise interference from natural or man-made sources has limited the range and reliability of reception in all services. In the past, some of the methods used for improving the signal to noise ratio have been (1) increased power at the broadcasting station, (2) application of special noise silencing circuits for receivers to reduce the effect of the noise upon the received signal, (3) isolation of the receiving station or receiving antenna from the noise region. The first method has been widely used by broadcasting stations. Power increases from 10 kilowatts to 25 kilowatts, and from 25 to 50 kilowatts have been common during the past ten years. One has but to note the number of 50 kilowatt stations operating in the country. An example of super-power has been the operation of the Cincinnati station WLW, which formerly broadcast with a power of 500 watts. The second method has recently found some application in amateur radio communication receivers, and is helpful in reducing the interference of certain types of noise. The third method is useful in reducing man-made noises present in many kinds of electrical equipment. By locating the receiving antenna as far as possible from the noise sources, and connecting to the receiver with a line which will not pick up the noise, much improvement is possible. It is also common practice in services such as police radio communication, to isolate the entire receiving station and make connections with the dispatching office by land wire.

In November, 1935, there was announced and demonstrated before a meeting of the IRE a new method of radio signalling, which showed remarkable increase in signal to noise ratios. It was the frequency modulation system of Major E. H. Armstrong of Columbia University. After four more years of development work, it has recently been announced that a station in the New York metropolitan area will begin operation this spring, utilizing this system. Production of receiving sets for this type of transmission has been started by one company. To get a picture of just what frequency modulation is, and to get some idea as to its advantages and disadvantages, let us compare it with amplitude modulation, used by all broadcasting stations. Modulation is the process used to alter some quantity of the radio frequency wave to permit it to carry the desired signal or intelligence. It might be noted, then, that amplitude modulation alters the amplitude of the radio wave; frequency modulation, the frequency. Let us see what frequency modulation does. The amount of frequency deviation is made proportional to the strength of the audio signal; the number of times this deviation occurs per second depends upon the frequency of the modulating signal. Here is a signal with unique properties. The band width is independent of the frequency of the modulating signal, and can be made as wide as desired, keeping in mind, of course, the limitations imposed by the frequencies available and location of other stations. Does it work? Yes! Early tests showed that signal-noise voltage ratio improvement of 50 to 1 could be obtained by this system. Broadcasting on a frequency of 41 megacycles from the top of the Empire State Building in 1935, receiving tests were made at two different locations, 65 miles and 85 miles from the transmitter. Both of these were below a line of sight distance from the transmitter, an important factor at ultra-high frequency. During a thunder storm when signals from New York's 50 kilowatt station WEAF were practically unintelligible, frequency modulation signals from the 2 kilowatt transmitter came through with scarcely a trace of static. Interference from automobile ignition systems and similar spark discharges which are severe at these frequencies have little effect of reception. Because of the limited signal range, frequency modulated stations like television stations will probably be confined to metropolitan areas during the immediate future. But in regions where reception is reliable, they will be able to offer the best in fidelity and freedom from interference, and will open up a new band of frequencies for broadcast use.

STEAM-TURBINE LOCOMOTIVE

1921

According to the Railway Gazette of London, a turbine driven locomotive is now being tried on the Swiss Federal Railways. The engine is designed for a turbine speed of 8000 rpm giving a running speed of 49 miles per hour. The boiler is equipped with a super-heater and condenser, fitted

(Continued on page 58)

The poem St. Pat's dream which was printed in the Wisconsin Engineer in 1926 makes reference to the P.A.D. fraternity of lawyers, who were the usual brunt of the engineer's pranks.

Science Highlights

(Continued from page 27)

visions will be made for determining their temperature coefficients by calibrating them at temperatures from 50 to 100° Fahrenheit.

Although the Bureau now calibrates tension-measuring devices only to 111,000 pounds, it will be able to calibrate devices in both tension and compression to 1,000,000 pounds in the new machines. These additional capabilities should greatly accelerate the extension of modern force measuring methods.

FREQUENCY SELECTION FOR AIR-LANE "ROAD MARKERS"

The National Bureau of Standards, at the request of the Federal Aviation Agency, is studying automatic computation methods for determining the best possible operating frequencies for radio transmitters used as "road markers" on air lanes.

A network of such transmitters marks routes between cities in the United States by sending out signals which assist pilots in flying a straight-line course. The rapid expansion of commercial and military air operations makes it necessary to add a substantial number of new transmitters to this network each year. The locations of these transmitters are determined by technical and economic considerations. However, the choice of carrier frequencies constitutes a surprisingly difficult combinatorial problem. Efforts to solve this problem are being carried out by the Bureau's Applied Mathematics Division.

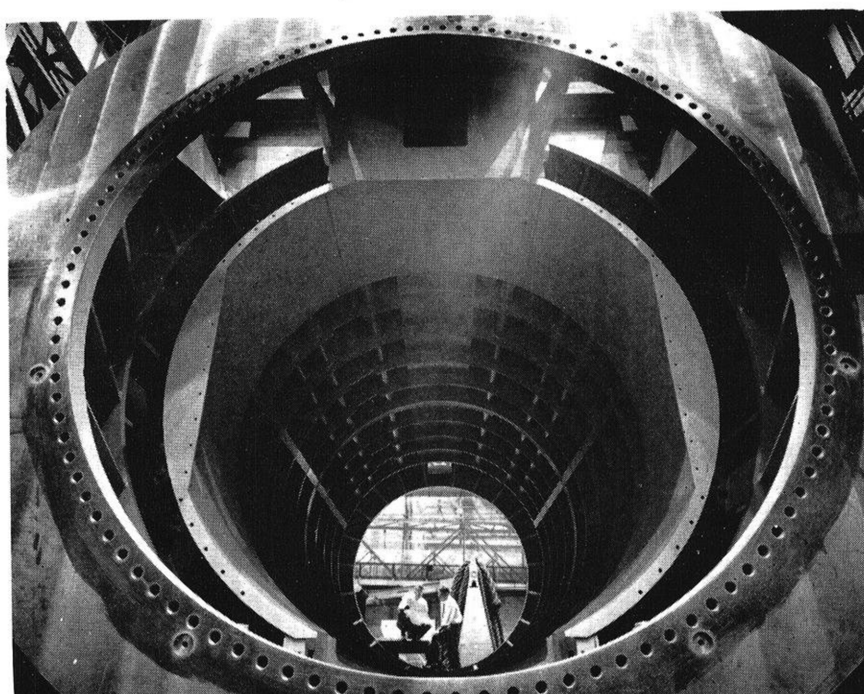
The difficulties of frequency selection stem from the fact that transmitters with identical or neighboring carrier frequencies must be spaced widely enough to prevent signal interference. Furthermore, this must be accomplished within the range of 100 discrete frequencies assigned to FAA. However, not only is the "interference radius" of a transmitter large (approximately three times the radius its signal "serves") but the number of transmitters in existence is already considerable and is increasing rapidly. For these reasons, assigning a frequency to a new transmitter without introducing any interference requires a laborious examination of many "old" transmitters.

Such an assignment may in fact be impossible without changing the frequency of one or more old transmitters. This, in turn, may create new interferences in the system and require alteration of the frequencies of still more transmitters. The insertion of a new transmitter into the network has sometimes required frequency changes at as many as eleven old transmitters. Such changes are expensive and disturb the smooth operation of the system, since pilots must be informed of and become accustomed to the alterations. An additional requirement introduced into frequency assignment is therefore the limitation of the number of changes.

As the frequencies and transmitters (old and new) are finite in number, ther are only a finite number of ways in which frequencies can be assigned throughout the network. This means that in principle the problem could be solved by examining all such network-wide assignments, rejecting those which lead to interference, and then selecting from the remainder, one which assigns the original frequencies to the largest number of old transmitters. This procedure is impractical because the number of cases to be examined, though finite, is so enormous (exceeding 10^{2000}) that the investigation could not be carried out in a reasonable time even on the most rapid electronic computer. What is needed is a **systemic,** rather than an **exhaustive** procedure.

The Bureau's efforts toward such a procedure can be roughly divided into two categories, which may be called **ad hoc methods** and **model construction.** The preliminary direction of the ad hoc activities was suggested by the fact that many new transmitters require changing at most one old transmitter. As a temporary aid to the FAA and an introduction to the general problem, a routine has been written to make such "easy" frequency assignments when possible.

The major activity in the model construction area has been the examination of a formulation which reduces the frequency assignment problem to the maximization of a sum. Computational



—Photo Courtesy Westinghouse

More than 14 feet in diameter and 30 feet long, this steel frame will house the world's largest 3600-rpm turbine-generator. The unit is now under construction at the Westinghouse Electric Corporation's East Pittsburgh, Pa., plant.

Rated at 384,000 kilovolt amperes, the completed unit is scheduled to be delivered to the Arkansas Power and Light Company's new station near Helena during the summer of 1960.

The 325,000-kilowatt steam turbine to drive the generator is being built at the Westinghouse plant in Lester, Pa.

methods and computer codes, although not immediately applicable in this instance, are available for this general type of problem, and efforts are being made to adapt them for frequency selection.

SUBMINIATURE FILTERS IN PRODUCTION

Acting like tiny telephone operators in space, sub-miniature and micro-miniature filters, which are used to transmit and receive information from missiles, satellites, and other less exotic uses, are growing smaller and smaller, but better and better. The special core units in the filters have been reduced from 4-1/4 pounds to 1/3 of an ounce. Since there are 23 filters in a complete set or "package," the weight saving alone is tremendous.

The powder core, the working member of the filter unit is made of molybdenum permalloy powder compressed under high pressures, annealed, and then finished. The filter can transmit and receive information on certain frequencies and filters out other frequencies. By using certain type filters, a missile or satellite can transmit such information as altitude, pressures, radiation, direction, various gases in the stratosphere or ionosphere, and other valuable information. Also, with the filter, changes in direction are made possible. With such filters, it is possible to receive several messages over the same wire.

In 1947, the telemetering system, which uses 23 filters, and auxiliary equipment weighed a total of 207 pounds. This same type equipment with the sub-miniature and micro-miniature units would weigh 11.1 ounces.

THE END

Suction Press Rolls

(Continued from page 17)

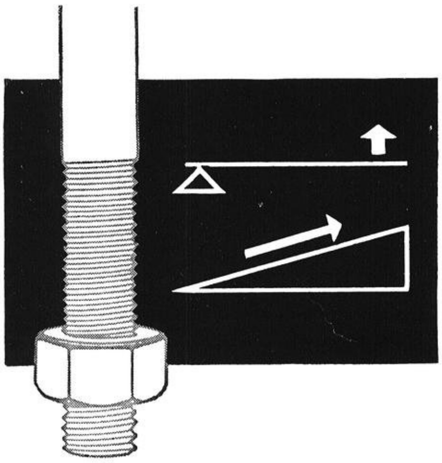
turers, therefore, are concentrating on developing the present roll.

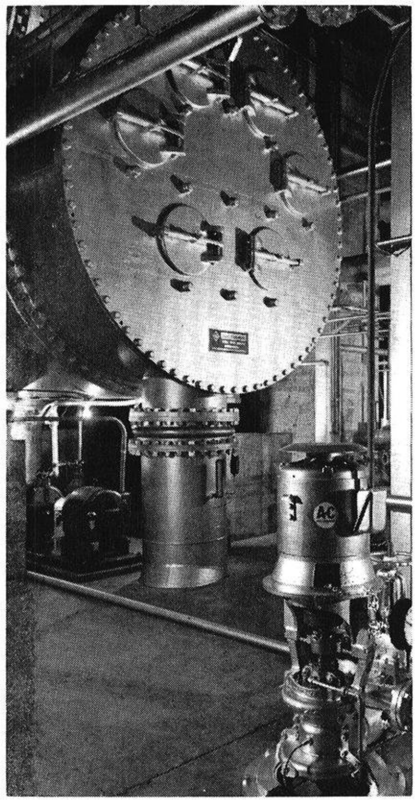
Rolls are being planned that have greater suction areas. This is so that the roll can absorb more water from the felt and sheet before and after they are pressed between the suction roll and the top press roll. In addition, thanks to high-strength alloys, rolls are being increased in length up to 300 inches. The high-strength alloys also allow the rolls to be used with increased pressures.

Another change involves the position of the roll in the paper-machine. By placing a hot dryer roll between successive suction rolls, the temperature of the water on the sheet is increased. This arrangement is known as a "hot press." As the water temperature is increased, its viscosity (resistance to flow) is decreased, and the suction roll can remove more water than it could with the conventional arrangement.

All of the above ideas are designed to accomplish one purpose, to increase production speed. Production speeds and profits can be increased only as fast as water can be removed from the sheet. As the suction press roll plays an important part in the removal of water from the sheet, it is under constant development, and the men who can improve on its performance are sure to be rewarded for their work.

THE END





Front, 10 hp drive, 50 gpm condensate transfer pump.

Back: Surface steam condenser.

Power Plant

(Continued from page 19)

into the protected pond or directly into the lake. In winter, it is discharged into the pond in order to prevent freezing.

BOILER WATER CIRCULATION

The water that is used for the purpose of generating steam is controlled in the turbine-auxiliary room, and hence it is considered in this report. Condensate from the hotwell of the condenser and raw make-up water are the two types of water that constitute the boiler feed-water.

Condensate

Condensate is removed from the hot-well by means of the hotwell pumps. The flow of water must be carefully watched so that the level in the hotwell does not become too high or too low. If the level becomes too high, water will rise into the condenser and cause an inefficiency in condensation; if the level falls, the hotwell pumps will run dry and lose their prime.

From the hotwell, the condensate is pumped to the feedwater pumps. These pumps are usually of the reciprocating type and can build up very high pressures. They pump the water at high pressure into the boiler room where it is again used to generate steam.

Make-Up Water

Although most of the water used for making steam is condensate, there is bound to be loss somewhere in the system. Therefore it is necessary to add raw water. This water must be as pure as possible to prevent slag and mineral deposits from building up in the boiler tubes.

Raw make-up water is first filtered before being admitted to the boiler water system. The filters work much like a water softener, removing minerals and other impurities. Filtered water is then pumped to the feedwater pumps, along with the condensate, and from there to the boilers.

BEARING OIL CIRCULATION

As was previously pointed out, a continuous circulation of the bearing oil for the turbine is necessary.

The bearing oil from the turbine flows directly into a filter tank, which is located in the auxiliary room, directly beneath the turbine room. In order to reach the outlet of the tank, the oil must flow through some filtering device, such as cloth bags mounted on a wire frame. These filters must be cleaned regularly to remove sludge and dirt particles. From the filter tank, the oil passes through the cooler and returns to the turbine.

CONCLUSION

The electric power industry will continue to be important to us as long as our need for electricity exists. And this need will not only continue to exist, but it will continue to increase with our progress in modern living.

Although the use of atomic energy is beginning to appear more widely and will take over as the heat source for generating steam, the use of steam turbines, including auxiliaries, and electrical generators cannot be eliminated.

THE END

Carburizing Steel

(Continued from page 21)

ECONOMIC ADVANTAGES OF CARBURIZING METHODS

Pack or gas carburizing is used when heavy cases are required. Of these two methods, gas carburizing is the more advantageous because it eliminates the time lost in bringing the packing boxes up to temperature. The labor of packing and unpacking carburizing boxes is also eliminated and there is no need to unload cars of carburizing compounds. Finally, the costs of gas are very low compared to the cost of the solid materials used in pack carburizing.

Liquid carburizing is the most desirable method of carburizing when relatively thin cases are required. This method has distinct advantages over pack and gas carburizing. It allows for fast heat transfer to the parts, and since the parts are covered with the salt solution, oxidation is eliminated during heating. Upon removal from the salt bath, a film of the salt compound adheres to the surfaces and prevents oxidation during transfer to the quench tanks. The quenching medium removes this film leaving the surface cleaner than before hardening. For these reasons many parts can be finish machined and ground prior to hardening, and full advantage taken of the extreme skin hardness. However, the primary fact which makes this process more adaptable and less expensive than gas or pack carburizing is the speed in which parts can be hardened.

TREATMENT AFTER CARBURIZING

After the carburizing treatment is completed, the composite steel, having a low-carbon core and a high-carbon case, is heat treated in different ways, depending on the results wanted. The three principal heat treatments for carburized parts are:

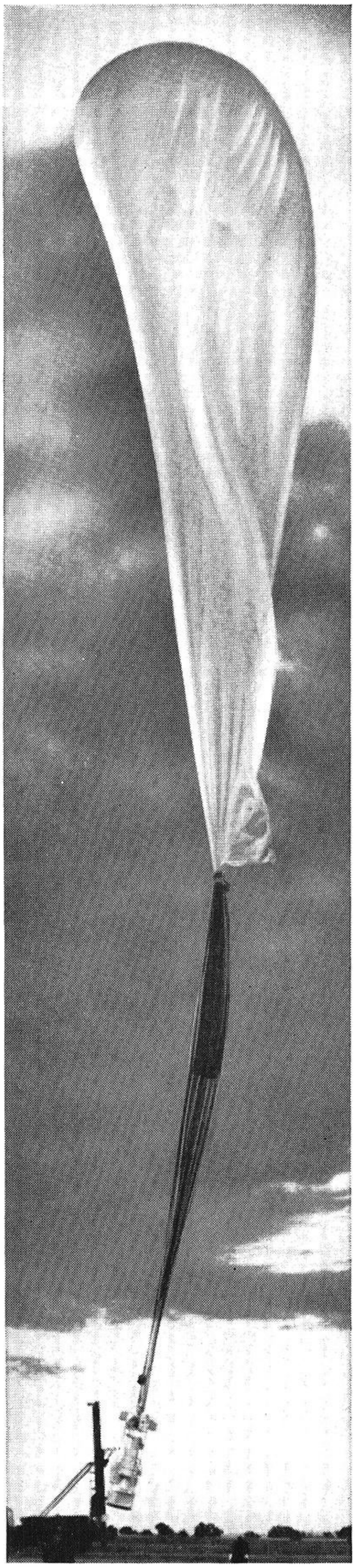
1. quenching directly from the carburizing box at the carburizing temperature and tempering;
2. cooling in the box, reheating once to the desired temperature, quenching and tempering;
3. cooling in the box, reheating twice to the desired temperature, each reheat followed by quenching and finally tempering.

When quenching directly from the box, water is used as a quenching media for plain carbon steels and oil is used for alloy carburizing steels. With this type of treatment the carburizing temperature seldom exceeds 1650 degrees Fahrenheit. To relieve the stresses caused by quenching, the parts are usually tempered at low temperatures after the quenching operation. The disadvantages of this treatment are the amount of warpage and distortion because of the high quenching temperatures and a brittle condition of the steel due to the grain growth at high temperatures.

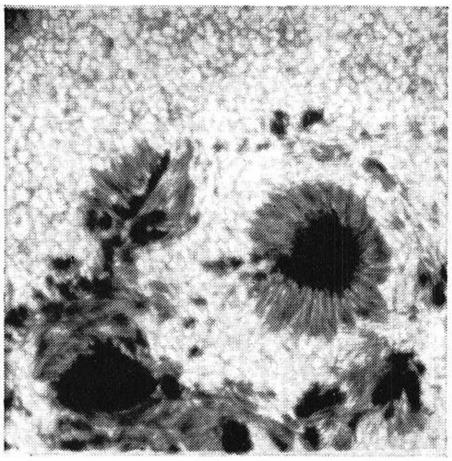
Carburized parts made of steels which coarsen at the carburizing temperature are usually cooled in the box and heat treated at a later time to develop desired properties. Parts that need great wear-resistance are heated within the hardening range of the steel in the case and then quenched in water or oil. This treatment will give a hard, fine-grained case but the core will remain tough. If parts are heated within the hardening range of the steel in the core before quenching, both the core and the case will be hardened. The core will have a fine grain structure, and the case will be coarse. After quenching, the parts are tempered at low temperatures to relieve stresses.

If a fine grain structure is desired throughout the case and core of parts cooled in boxes from the carburizing temperature, the double quench method is used. The parts are heated to the hardening range of the steel in the core, and then quenched in oil. Next, they are heated to the hardening range of the steel in the case and are quenched in water or oil. The parts are then tempered to remove quenching stresses. The first reheat and quench produces fine grain size and high physical properties in the core, and the second reheat and quench produces small grain size and high hardness in the case.

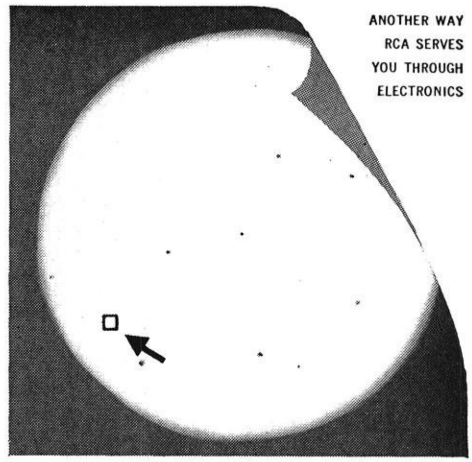
THE END



Going up for "good seeing." Unmanned balloon-observatory starts its ascent to take sunspot photos. "Project Stratoscope" is a continuing program of the Office of Naval Research and the National Science Foundation.



One of the sharpest photos ever taken of sun's surface. It, and hundreds of others taken by stratoscope, may answer mystery of violent magnetic disturbances on earth.



Exact position of photograph in relation to the total sun surface is shown here. Plotting and photography of precise areas was made possible by airborne RCA television.

RCA REPORTS TO THE NATION:

REMARKABLE NEW PHOTOS UNLOCK MYSTERIES OF SUN'S SURFACE

Special RCA Television, operating from stratosphere, helps get sharpest photos of sun's surface ever taken

Scientists recently took the first, sharp, searching look into the center of our solar system. It was achieved not by a missile, but by a balloon posted in quiet reaches of the stratosphere.

The idea was conceived by astronomers at the Princeton University Observatory. They decided that a floating observatory—equipped with a telescope-camera—would offer a stable "work platform" from which sunspots could be photographed free of the distortion caused by the earth's atmosphere.

But "Project Stratoscope" encountered an unforeseen and major obstacle on its initial flight. A foolproof method was needed for aiming and focusing the telescope of the unmanned observatory. Princeton asked RCA to help.

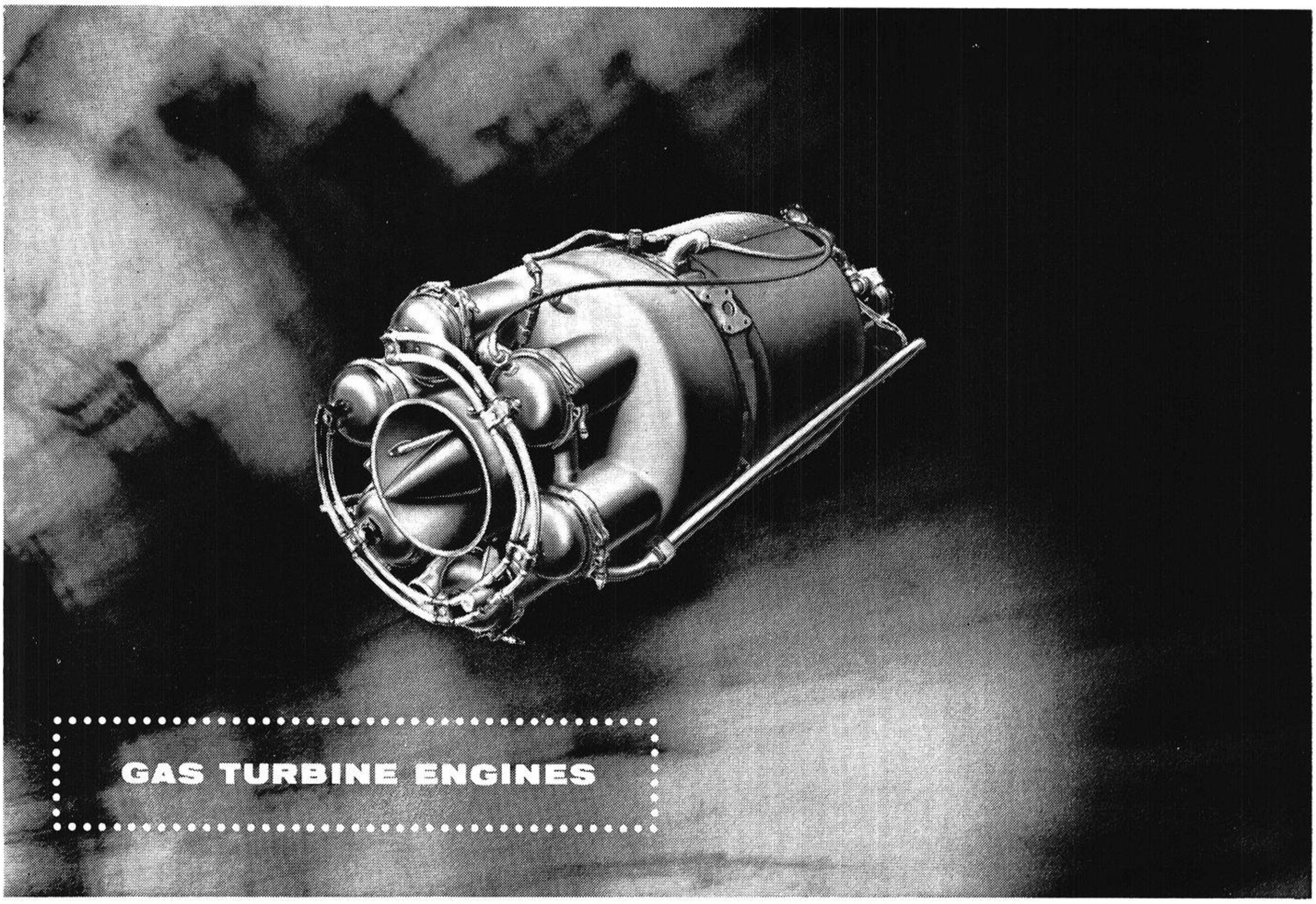
A special RCA television system was devised which enabled observers on the ground to view exactly what the telescope was seeing aloft. This accomplished, it was a simple matter to achieve precise photography—directed from the ground by means of a separate RCA radio control system.

The resulting pictures reveal sunspot activities in unprecedented detail. They provide the world with important information regarding the magnetic disturbances which affect navigation and long-range communications.

The success of "Project Stratoscope" is another example of RCA leadership in advanced electronics. This leadership, achieved through quality and dependability in performance, has already made RCA Victor the most trusted name in television. Today, RCA Victor television sets are in far more homes than any other make.

RADIO CORPORATION OF AMERICA

THE MOST TRUSTED NAME IN ELECTRONICS


GAS TURBINE ENGINES

Engineer of Yesteryear

(Continued from page 47)

below it, which utilizes water from the tender. Cooling is effected by allowing the returning water to fall in narrow streams from the roof, extending over the tender, designed for the purpose. As there is no blast nozzle, an air draft through ventilators is used in conjunction with a blower for maintaining the required action on the fire. The engine has shown a fuel economy which betters that of the compound locomotives in service by 25 per cent, while it runs very smoothly at high speed, this being accounted for by the reduction in the number of reciprocating parts.

MAN-MADE WIND OUTDOES NATURE

1939

Winds, dwarfing by their velocities the destructive rampages of typhoons in China seas, will soon be blowing in Boston, but they will be safely confined within the steel plates of the new wind tunnel at Massachusetts Institute of Technology.

In this 75 foot oval shaped chamber, scientists have combined for the first time means for simulating stratospheric flying conditions at high speeds and studying skin friction, turbulence, and flow separation which are important in designing any kind of machinery that handles fluids, such as fans, windmills, turbines, and pumps.

Thus, man-made gales and storms will enable science to study on the ground man's newest domain of the air. Thirty-five years ago, at Kitty Hawk, N. C., the Wright brothers achieved their first actual flight. On September 12, Orville Wright will dedicate this newest research arm of the air. In his honor it will be known as the Wright Wind Tunnel.

Once they "take off" inside the giant testing chamber, model airplanes will confront all the natural flying hazards of their flying brothers, and then some.

Wind speeds twice as great as the 200 mile an hour "blows" of a West Indies' hurricane will be manufactured by a huge propeller whirled by a 2,000 horsepower four-speed motor. This motor is the largest of its type ever built. Presenting advances in aeronautical research and affording visual lessons for future aeronautical engineers in the mysteries of aerodynamics, the tunnel will reproduce in proper ratio variations in barometric pressure up to theoretical altitudes of 35,000 feet. It may be operated under pressures from one-fourth of an atmosphere to four times the atmosphere near the earth's surface.

Cross-section dimensions of the testing section of the tunnel are six feet by ten feet, but it is slightly larger at the turns in order to decrease the air turbulence. It is enveloped in steel plates varying from three-eighths to five-eighths of an inch in thickness.

THE END

Transistors

(Continued from page 24)

When it is realized that holes and electrons have a finite mobility and there is a definite time required for a hole to cross the base and to be taken up by the collector, the problem can be easily seen. It has been largely overcome by producing transistors with narrower and narrower bases. The second difficulty is the capacity of the base-collector junction, which causes feed back at high frequencies. This problem has also been minimized. The biggest fundamental difficulty is the operation at high temperatures. Operation of germanium transistors above 45 to 55 degrees Centigrade requires careful attention to circuit stabilization, and even temperature variations at lower levels can cause difficulty. The use of silicon has been found to solve the temperature problem, and silicon transistors are now available for use under poor temperature conditions. The only remaining problem is the higher cost of transistors. Today, transistor cost is at least four times greater than that of a vacuum tube, but more sales and better manufacturing techniques will probably reduce the cost of transistors. The higher cost of transistors is usually counteracted by a lower operating cost.

Conclusion

The production of transistors has increased rapidly since 1953, when fifty thousand units per month were produced as opposed to thirty five million vacuum tubes per month. Although recent production figures are not available, it seems certain that the production of transistors now equals, if not exceeds, the production of vacuum tubes. Furthermore, all evidence seems to indicate that transistors will completely replace vacuum tubes in the near future.

THE END

Sneed's Review

(Continued from page 41)

ENGINEERING ELECTROMAGNETICS

By William H. Hayt, Jr. 328 pages. $8.50.

The McGraw-Hill Book Company announces the publication of a distinguished addition to the McGraw-Hill Electrical and Electronic Engineering Series, *Engineering Electromagnetics*, by William H. Hayt, Jr., Associate Professor of Electrical Engineering, Purdue University.

The new text introduces the reader to electromagnetic theory and enables him to readily understand more advanced works.

It includes electrostatics, the steady magnetic field, time-varying fields and Maxwell's equations, and applications of Maxwell's equations.

Vector analysis is used throughout.

Development follows that of several more advanced books, but, treatment is simplified, expanded, and well illustrated with problems to help familiarize the reader with this theoretical subject.

Such techniques as vector anaylsis, relativity, and solid-state physics are combined into a logically developed, clear, unadorned presentation of electromagnetics.

To illustrate and clarify the use of Maxwell's equations, the final two chapters provide an introduction to skin effect, wave motion, circuit concepts, radiation, and relativistic effects.

A unique feature of the book are the sections on relaxation and iteration methods of experimental mapping.

A useful innovation is an appendix on dimensions and dimensional analysis.

THE END

Why Frank G. selected HAMILTON STANDARD

FRANK G. has now chosen a company to launch his engineering career. Previously we have shown you how he gave Hamilton Standard a thorough looking-over. He was impressed by the spectrum of skills built into Hamilton Standard's products and the advanced planning program that predicts future technical and economic trends. Also he learned that participation in small project, design or analysis groups permitted unusual latitude to express his ideas and to get a job done.

CONCLUSION—Hamilton Standard offered career satisfaction and management potential.

Frank noted that Hamilton Standard, and United Aircraft Corporation, offer the country's finest privately owned research laboratories. Hamilton Standard is well diversified. Products range from tiny thermoelectric generators for satellites to the complex environmental conditioning system for the Convair 880. And, of course, the picturesque Connecticut countryside promises leisuretime living at its best . . . with New York and Boston just a few hours away.

CONCLUSION—Hamilton Standard's facilities, products and locale are superior.

GRADUATE STUDY COMPLETES THE PICTURE

Frank G. considers Hamilton Standard's graduate study program the finest in the industry . . . and this sealed the verdict. Knowing that the continuation of his studies will enhance his opportunities for advancement, Frank plans to take advantage of the company's tuition-paid study program at a choice of universities such as Rensselaer, Yale, Trinity, Columbia. Yes, Hamilton Standard scored high on Frank G.'s "career exam."

CONCLUSION—Whether you are an EE, ME, AE or MET why not take a good look *now?*

Write to Mr. R. J. Harding for

"ENGINEERING FOR YOU AND YOUR FUTURE"

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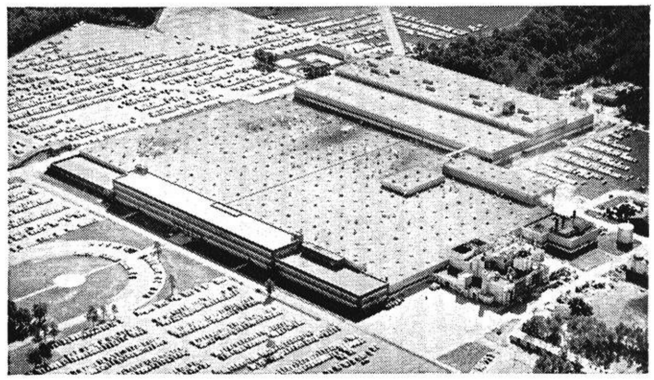
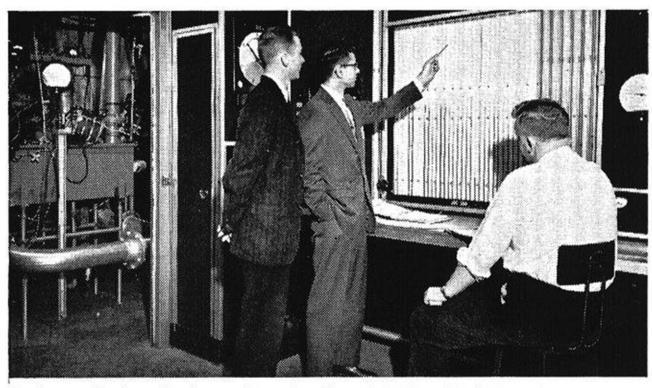
DIVISION OF

UNITED AIRCRAFT CORPORATION

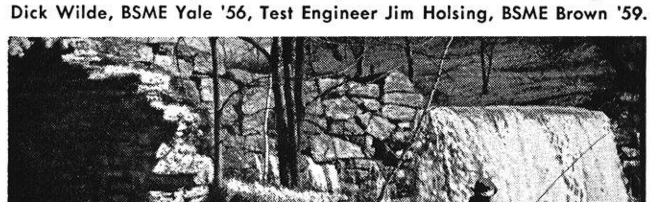
BRADLEY FIELD ROAD, WINDSOR LOCKS, CONNECTICUT



Every type of technical talent has helped create the Engineering Excellence of Hamilton Standard's products including aerodynamics, thermodynamics, vibration, servomechanisms, electronics, structures, reliability.



Assistant Project Engineer Don Coakley, BSME M.I.T. '52, points out performance test reading of a turbo compressor unit to Senior Test Engineer Dick Wilde, BSME Yale '56, Test Engineer Jim Holsing, BSME Brown '59.



Connecticut offers one of the country's most desirable living areas. Choose from city, suburban or urban homesites . . . unlimited recreational and cultural facilities.

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The word *space* commonly represents the outer, airless regions of the universe. But there is quite another kind of "space" close at hand, a kind that will always challenge the genius of man.

This space can easily be measured. It is the space-dimension of cities and the distance between them . . . the kind of space found between mainland and off-shore oil rig, between a tiny, otherwise inaccessible clearing and its supply base, between the site of a mountain crash and a waiting ambulance—above all, Sikorsky is concerned with the precious "spaceway" that currently exists between all earthbound places.

Our engineering efforts are directed toward a variety of VTOL and STOL aircraft configurations. Among earlier Sikorsky designs are some of the most versatile airborne vehicles now in existence; on our boards today are the vehicles that can prove to be tomorrow's most versatile means of transportation.

Here, then, is a space age challenge to be met with the finest and most practical engineering talent. Here, perhaps, is the kind of challenge *you* can meet.

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One of the Divisions of United Aircraft Corporation

STRATFORD, CONNECTICUT

For information about careers with us, please address Mr. Richard L. Auten, Personnel Department.

STRIPPED GEARS

by Todd S. Deutsch

"A sense of humor is the oil of life's engine. Without it the machinery creaks, squeaks, and groans. No lot is so hard, no aspect of things so grim, but that it relaxes before a hearty laugh."—TSD

Betcha Didn't Know . . .

. . . transportation costs would have been less if gold was discovered near Fort Knox instead of the Klondike.

. . . the outstanding contributions of the Romans was that they fully understood Latin.

. . . it shouldn't take many words to write an advertisement for condensed milk.

. . . a traffic light is a trick to get people half-way across the street safely.

. . . if you want to have fireworks on the Fourth of July in your home, tell your wife you want to do some fishing with the boys.

° ° °

The gentleman was gazing rapturously at "Spring," a large oil painting of a shapely and voluptuous girl clad only with a few strategically arranged leaves. Suddenly, the voice of his wife snapped,

"Well, what are you waiting for —Autumn?"

° ° °

Captain: "Why didn't you salute me this morning?"

Recruit: "I didnt see you, sir."

Captain: "Well, that's okeh then I was afraid you were mad at me."

Thought of the Month . . .

"A bathing beauty is a girl worth wading for."

° ° °

"Are you the young man who jumped in the river and saved my son from drowning when he fell through the ice?"

"Yes, ma'am."

"Where's his mittens?"

° ° °

Advice from one Professor to Another—"Just vary the Monotony."

° ° °

"What a day! I lost my job. I lost my billfold, my wife ran away with the water meter man, and the Dodgers lost to the Braves. Its unbelievable—leading by three in the eighth and they lost to L.A.

° ° °

A bored cat and an interested cat were watching a game of tennis.

"You seem very interested in tennis," said the bored cat.

"It's not that," said the interested cat, "but my old man's in the racket."

° ° °

1st girl: "I caught my boyfriend necking."

2nd girl: "I caught mine that way too."

He: "You remind me of an ocean."

She: "You mean I'm wild, romantic, and restless?"

He: "No, you just make me sick."

° ° °

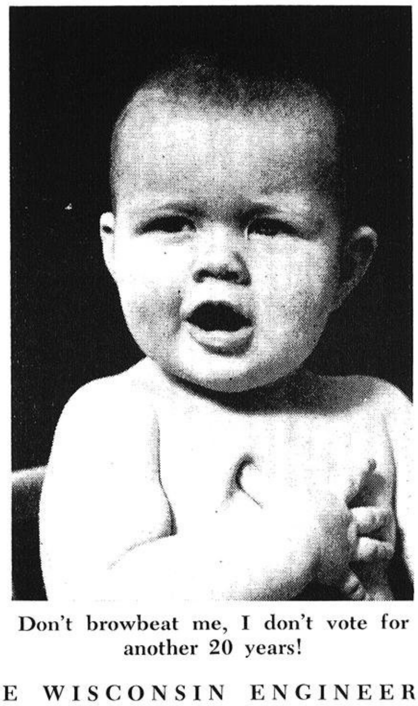
Senior: "Gee, I'm thirsty."

Frosh: "Wait a minute. I'll get you some water."

Senior: "I said I'm thirsty, not dirty."

° ° °

Sneedly Jr.



Don't browbeat me, I don't vote for another 20 years!

Things men like to hear a girl say:

—"No, I've never seen the golf course at night."

—"Why bother, there's no one home here."

—"You don't think this bathing suit is too tight, do you?"

—"Let's go Dutch."

—"Chaperone? What chaperone?"

—"My, but I'm cold."

—"YES!"

* * *

Irritated Prof: "If there are any morons in the room, please stand up."

After a long silence, a lone freshman stood up.

Professor: "What! Do you consider yourself a moron?"

Frosh: "Well, not exactly sir; but I do hate to see you standing all alone."

* * *

A sort of "old fashioned" student took his girl for a ride in his car near Picnic Point. After finding a nice place to park he kissed her softly and said,

"This is called spooning."

"Okay," she said, "but I'd much rather shovel."

An engineer and a liberal arts student were sharing a seat on a train. He was getting lonesome so the engineer started a conversation. They soon became a friendly pair.

"Let's have a game of riddles to pass the time," said the liberal arts student. "If I have a riddle that you can't guess, then you give me one dollar and vice versa."

"All right," replied the engineer, "but since you are supposed to be highly educated in Liberal Arts and worldly affairs, do you mind, therefore, if I only give you fifty cents; sort of like odds?"

"OK," said the liberal arts student, "You go first."

"Well," said the engineer. "What has three legs walking and only two legs flying?"

"I don't know," the L.A. student replied, "and here's your dollar. What's the answer?"

"I don't know either. Here's your fifty cents," replied the engineer.

* * *

She: "Aren't the stars pretty tonight?"

He: "I'm in really no position to say."

"Do you smoke?"

"No."

"Do you drink?"

"No."

"Do you neck?"

"No."

"Well, what do you do for fun?"

"I tell lies."

* * *

He had his hours, a few to spare
His grade point was a pip.
To graduate was soon his fare,
If he didn't make a slip.
He ceased to drink and didn't smoke,
His mind was in a trance.
Said please and thank you when he spoke
He didn't take one chance.
Then comes the day; he's almost free
His heart is full of cheer.
But they wouldn't give him his degree,
'Cause he didn't read the *Engineer*.

THIS ISN'T FUNNY!

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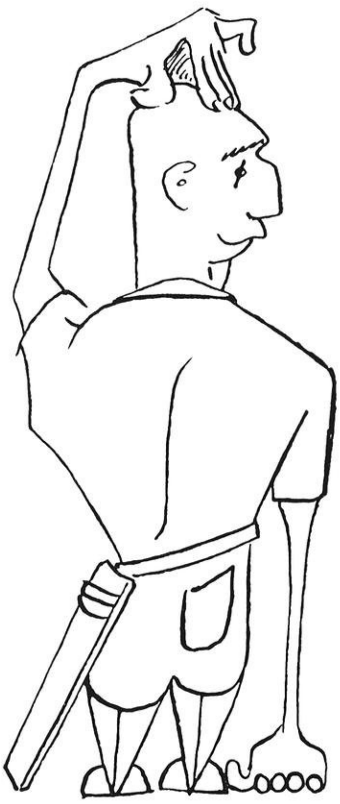


So You Think You're SMART!

by Sneedly, PhD '84

CAN March 17 and the St. Patrick's Day Dance be far off when there are so many grubby, mangy looking beards on the engineering campus? The campus resembles a province of northern Cuba inhabited by real live facsimiles of Castro, though I have not seen any beards to match the full, bushy elegance of Fidel's. This beard growing season presents great opportunities for the engineer; he can show his independence and non-conformity, his manliness and virility. Some coeds say the beards just show an engineer's close relation to the apes, but these remarks can be attributed mainly to a small group of cynical, panic button pushing seniors. As someone once said, a girl has not really been kissed until she has been kissed by a man with a beard. And may I humbly add, especially an engineer with a beard!

Just one word of warning to those planning to attend the dance. No one, I repeat, No One, will be allowed to enter the Union without a sliderule clamped on belt!

Now for this month's three problems, which are still worth 10^{-5} megabucks to the person sending in the first set of correct answers.

1. Bill and Mary left their house by the river and paddled upstream in their canoe. As they passed under the old stone bridge, Mary discovered a discarded glove floating in the river. Bill continued to paddle at a constant rate and after a fifteen minute ride from the bridge, he turned the canoe around and headed for home.

As they arrived home, Mary noticed the same glove floating in the water in front of the house. The bridge was one mile from their house.

What was the speed of the current?

2. Suppose you are a bartender and some customer poses this problem:

You have two identical glasses filled to the same level, one with straight gin and one with pure water. Now you pour a jiggerful of gin from the first glass into the second glass, mix well, bring a jiggerful of the mixture and put it into the first glass.

Will there be more gin in the water glass or more water in the gin glass?

3. You are told to go into Milwaukee and pick up some liquid refreshments for a party. You will have to average sixty miles per hour in order to return in time. If the trip there is made at a speed of thirty miles per hour, at what speed must the return trip be made in order to average sixty miles per hour?

The answers to February's problems:

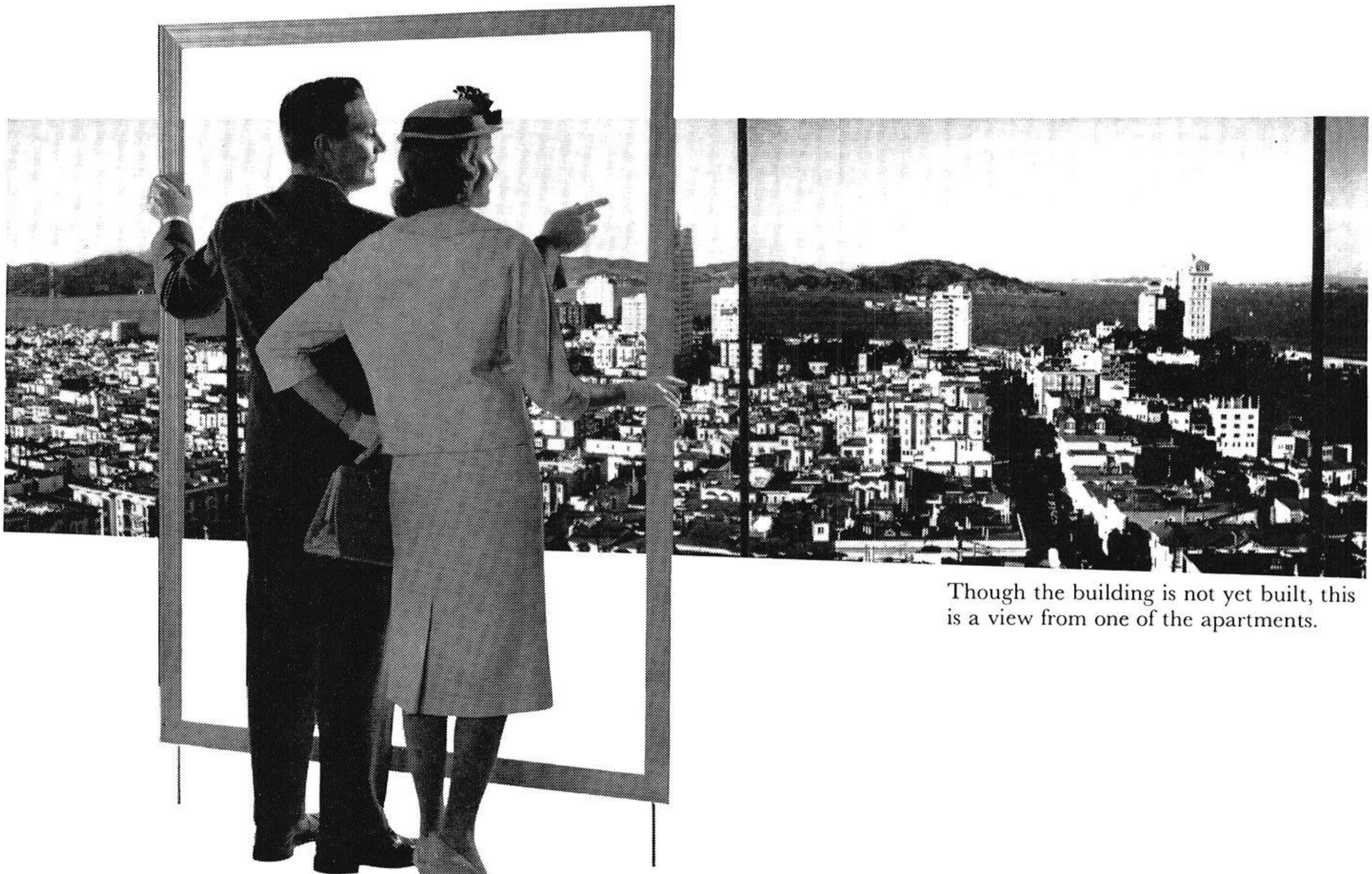
1. Set up the proportion $\frac{5}{2}$: 3, $\frac{10}{3}$: x and solve for x. The argument is whatever factor causes $\frac{1}{2}$ x 5 to give the result 3 must also be introduced into the product $\frac{1}{3}$ x 10. This factor is expressed by the ratio.

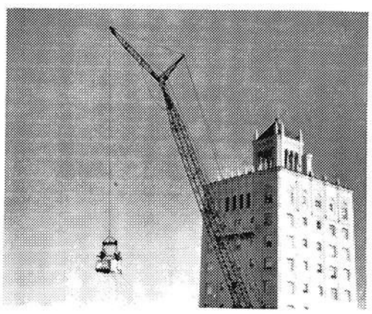
2. Twenty-five per cent of the total number of animals are horses.

3. The minimum total length of pipe required to connect the two wells to separate inlets on the watering tank is five miles. This is just an old max-min problem from first year calculus. Set up the expression for the total length, take the derivative, set it equal to zero, and solve for the unknown.

Send your answers to:

SNEEDLY
c/o The Wisconsin Engineer
Mechanical Engineering Bldg.
Madison, Wisconsin





One of a series

Interview with
General Electric's Earl G. Abbott,
Manager—Sales Training

Technical Training Programs at General Electric

Q. Why does your company have training programs, Mr. Abbott?

A. Tomorrow's many positions of major responsibility will necessarily be filled by young men who have developed their potentials early in their careers. General Electric training programs simply help speed up this development process.

In addition, training programs provide graduates with the blocks of broad experience on which later success in a specialization can be built.

Furthermore, career opportunities and interests are brought into sharp focus after intensive working exposures to several fields. General Electric then gains the valuable contributions of men who have made early, well-considered decisions on career goals and who are confidently working toward those objectives.

Q. What kinds of technical training programs does your company conduct?

A. General Electric conducts a number of training programs. The G-E programs which attract the great majority of engineering graduates are Engineering and Science, Manufacturing, and Technical Marketing.

Q. How long does the Engineering and Science Program last?

A. That depends on which of several avenues you decide to take. Many graduates complete the training program during their first year with General Electric. Each Program member has three or four responsible work assignments at one or more of 61 different plant locations.

Some graduates elect to take the Advanced Engineering Program, supplementing their work assignments with challenging Company-conducted study courses which cover the application of engineering, science, and mathematics to industrial problems. If the Program member has an analytical bent coupled with a deep interest in mathematics and physics, he may continue through a second and third year of the Advanced Engineering Program.

Then there is the two-year Creative Engineering Program for those graduates who have completed their first-year assignments and who are interested in learning creative techniques for solving engineering problems.

Another avenue of training for the qualified graduate is the Honors Program, which enables a man to earn his Master's degree within three or four semesters at selected colleges and universities. The Company pays for his tuition and books, and his work schedule allows him to earn 75 percent of full salary while he is going to school. This program is similar to a research assistantship at a college or university.

Q. Just how will the Manufacturing Training Program help prepare me for a career in manufacturing?

A. The three-year Manufacturing Program consists of three orientation assignments and three development assignments in the areas of manufacturing engineering, quality control, materials management, plant engineering, and manufacturing operations. These assignments provide you with broad, fundamental manufacturing knowledge and with specialized knowledge in your particular field of interest.

The practical, on-the-job experience offered by this rotational program is supplemented by participation in a manufacturing studies curriculum covering all phases of manufacturing.

Q. What kind of training would I get on your Technical Marketing Program?

A. The one-year Technical Marketing Program is conducted for those graduates who want to use their engineering knowledge in dealing with customers. After completing orientation assignments in engineering, manufacturing, and marketing, the Program member may specialize in one of the four marketing areas: application engineering, headquarters marketing, sales engineering, or installation and service engineering.

In addition to on-the-job assignments, related courses of study help the Program member prepare for early assumption of major responsibility.

Q. How can I decide which training program I would like best, Mr. Abbott?

A. Well, selecting a training program is a decision which you alone can make. You made a similar decision when you selected your college major, and now you are focusing your interests only a little more sharply. The beauty of training programs is that they enable you to keep your career selection relatively broad until you have examined at first hand a number of specializations.

Furthermore, transfers from one General Electric training program to another are possible for the Program member whose interests clearly develop in one of the other fields.

Personalized Career Planning is General Electric's term for the selection, placement, and professional development of engineers and scientists. If you would like a Personalized Career Planning folder which describes in more detail the Company's training programs for technical graduates, write to Mr. Abbott at Section 959-13, General Electric Company, Schenectady 5, N. Y.

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