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James Chisholm, class of '41,
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Jim is now in charge of quality control for open hearth furnaces at Fairless, the unloading of all ore ships and the operation of the plant's two big blast furnaces—each with a rated output of 1500 tons per day.

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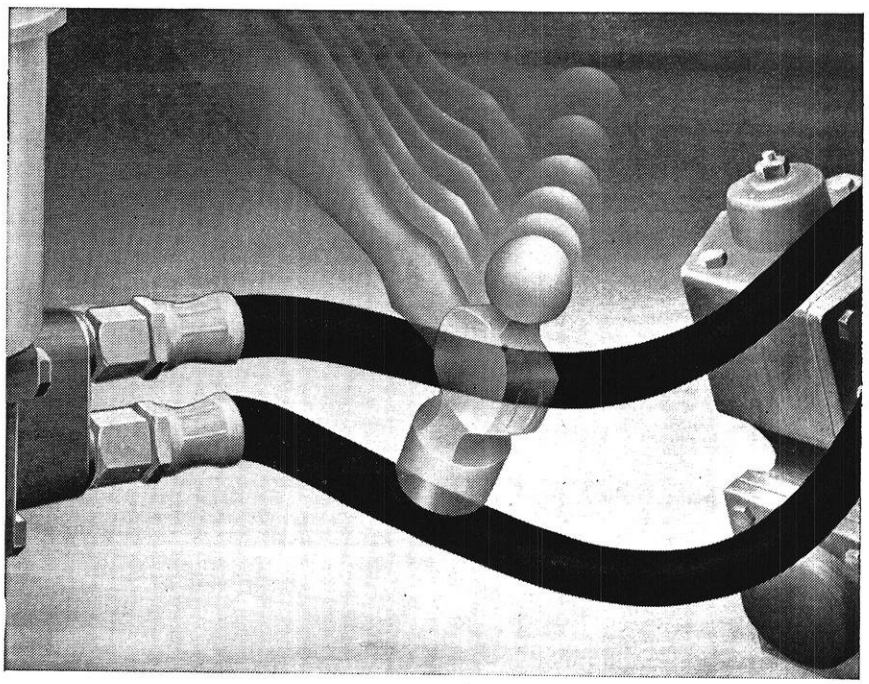

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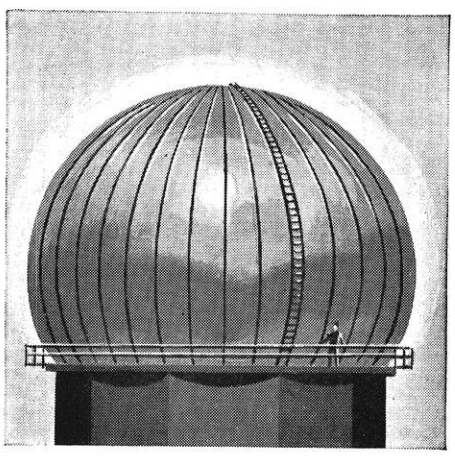

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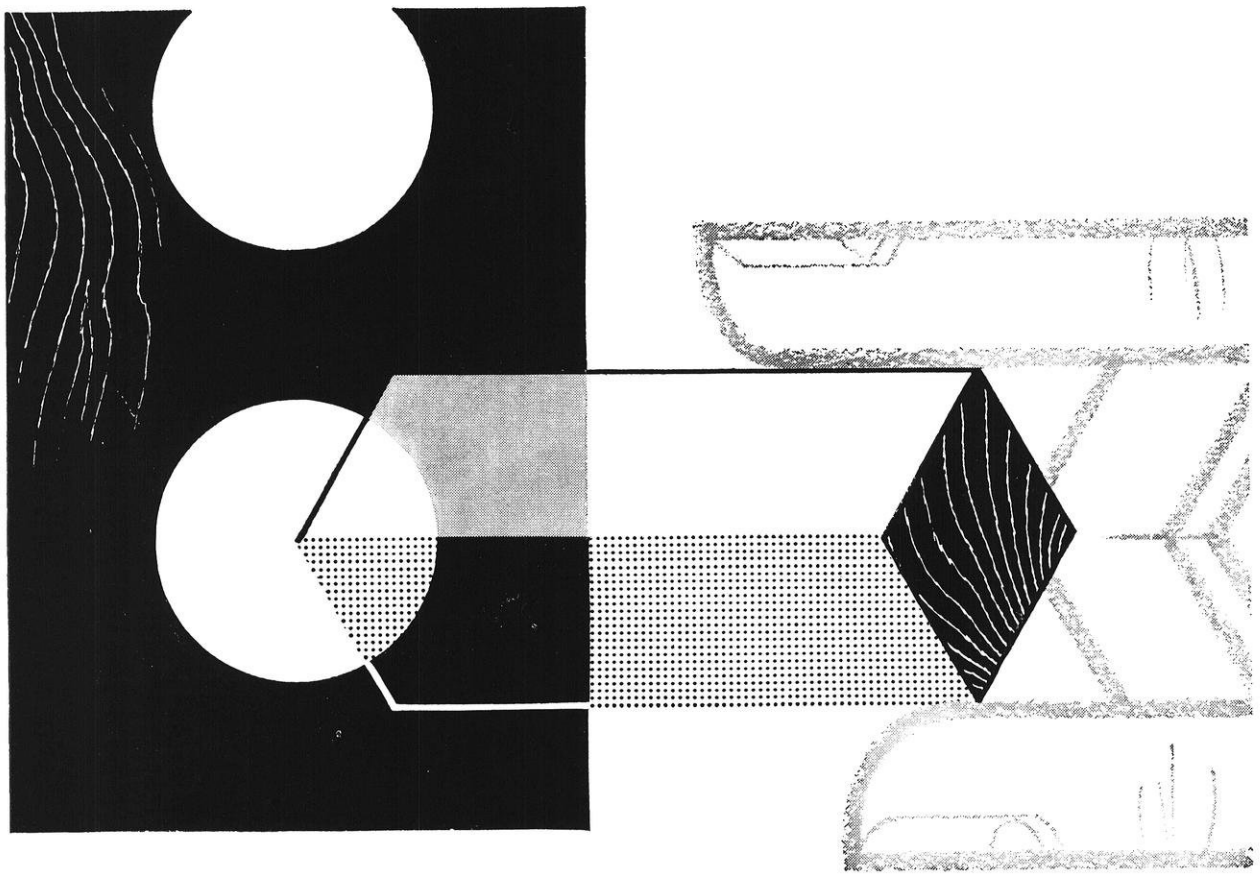

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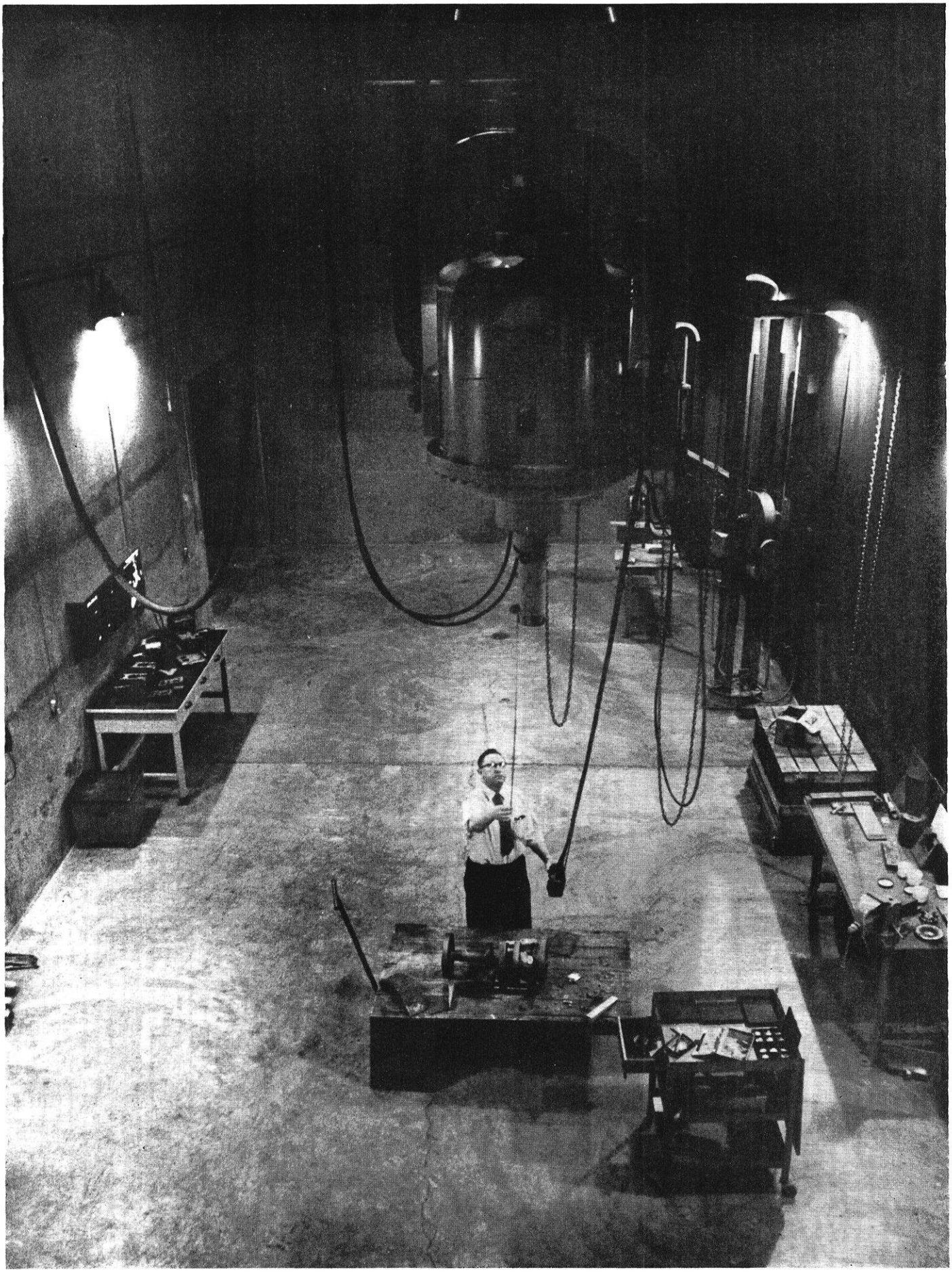

WISCONSIN ENGINEER

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FOUNDED 1896

Volume 60 **MARCH, 1956** **Number 6**

Articles

		Page
WHAT'S HAPPENING TO T. V.?	*Bob Strehlow*	10
SILICONES	*Mark Whelan*	12
MAN-MADE GEMSTONES	*Richard Kulakow*	18
THE FORWARD LOOK—SAFETY	*Russell Uttke*	21

Features

CAMPUS NEWS	*Larry Barr and Dick Peterson*	28
W.S.P.E.	*Bob Elton*	36
SCIENCE HIGHLIGHTS	*Ted Witzel*	46
SO YOU THINK YOU'RE SMART	*Sneedly*	62
STATIC	*I. R. Drops*	66

Cover

Prof. Doke calls it art!
We call it frustration . . .

Frontispiece

An International Harvester laboratory worker positions a hugh X-Ray unit above a work table in preparation for his project.—Courtesy International Harvester & General Electric

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A BOLD APPROACH TO MISSILE ELECTRONICS

a statement by DR. L. N. RIDENOUR, *Director of Research, Lockheed Missile Systems Division*

Electronics is central to the technology of guided missiles. Dramatic improvements in missile performance require faster, more accurate perceptions and reactions of electronic missile guidance and control systems.

Here at the Missile Systems Division of Lockheed, we are aware of this requirement. We also know that electronics is experiencing the greatest revolution in its history; the vacuum tube, hitherto the cornerstone of electronic design, is being replaced by new solid-state devices which have superior performance and reliability.

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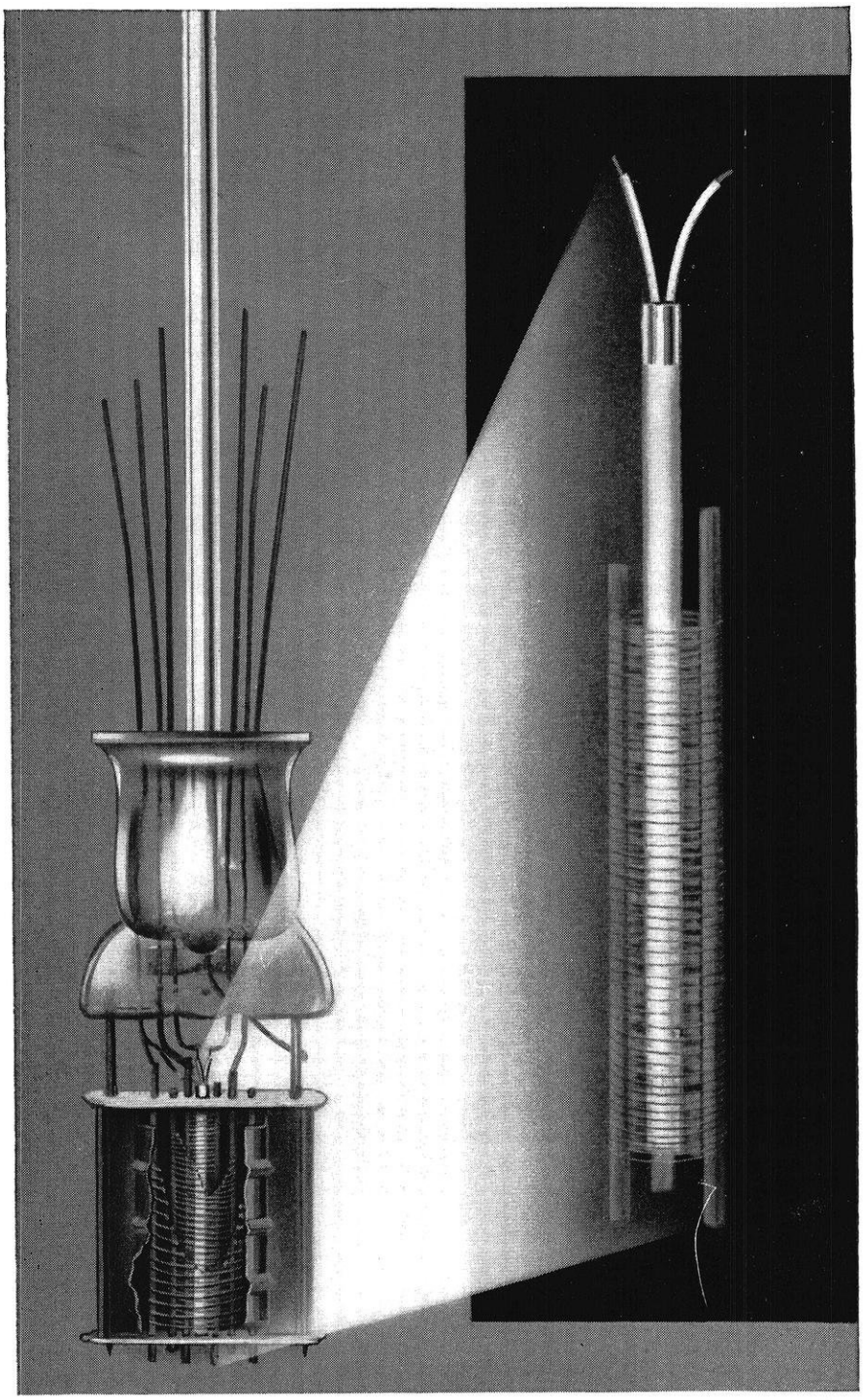
How alumina grain is part of your future



In electronic tubes Norton 38500 or 38900 ALUNDUM* fused alumina grain is used to coat heater filament tubes (shown greatly enlarged). The grain is put in suspension and the filament is drag coated, spray coated or electrically deposited (cataphoresis).

THE importance of electrochemically refined materials, such as the ALUNDUM fused alumina (aluminum oxide) grain referred to here, is part of yours and *everybody's* future.

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WHAT'S HAPPENING TO T.V.?

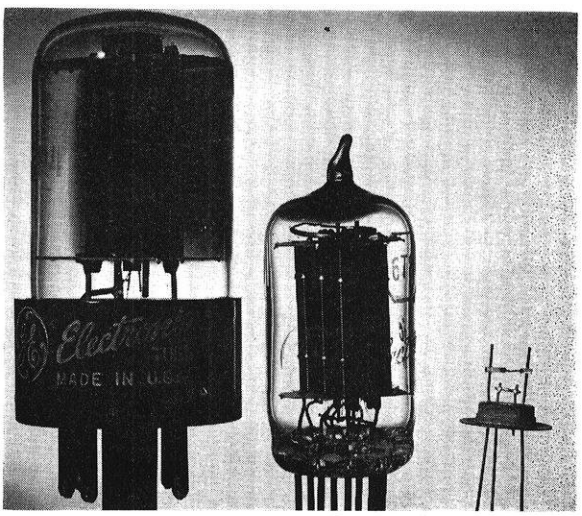
by Bob Strehlow, e'57

Television sets today are far different from the bulky monstrosities with seven inch screens which were common ten years ago. Circuits have been designed and revised and new components have been developed which make the modern television set bear as little resemblance to the old as the new Ford does to the model T. Developments are occurring so rapidly, in fact, that a 1956 model television set already has a half-dozen circuit changes which will improve the picture. The design of television receivers has been directed to these objectives: reduce cost, reduce set size while maintaining a large picture, reduce weight in order to achieve some degree of portability, and improve electrical circuits to obtain the best picture.

Another factor, which is stressed by some manufacturers and forgotten by others, is to make the set easier to service. In a television set there are at least a thousand points where trouble can occur, and since a set owner can expect to pay from one-fourth to one-half of the cost of the set for servicing it during its useful life the serviceability of a set should not be overlooked. If a manufacturer uses some weird circuit to enable use of fewer parts or odd, hard to replace parts which he has picked up cheaply, it's going to take time and therefore money to repair.

Many changes have been made in circuits which are too technical to go into here, but the improvements they have made in performance are obvious. Perhaps you recall the discouraging array of controls on the old sets which have since been eliminated or relegated to the back of the set because they are so little used. Sync circuits are now stable even in areas of heavy interference, and virtually no adjustment is necessary. Automatic gain control has eliminated the picture flutter that used to exist everytime an airplane flew overhead. Retrace line blanking has taken away those annoying white, slanting lines which appeared whenever a dark picture was shown on the screen. The list could go on and on, so this article will cover only the more basic changes.

Probably the most extensive change circuit-wise, in television receivers, has been in the power supply. Formerly, all sets had one type of power supply which consisted of the following: a transformer to provide the high voltage for the plates of the tubes, and low voltage for the filament; one or two tubes to rectify the high voltage a-c to d-c, and capacitors and inductors to convert the pulsating d-c output of the tubes to a constant value voltage. Electrically, this type of supply

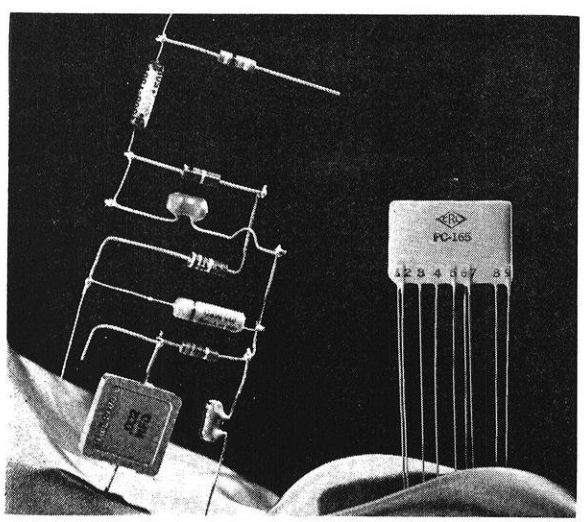


—Courtesy General Electric

Fig. 2.—The new GE transistor, with its metal top removed to show construction details, is shown here with a regular vacuum tube, left, and a miniature vacuum tube, middle. The transistor can perform many of the functions of the much larger tubes.

performed well, the objection to it being its weight, fifteen to twenty pounds, and its cost, approximately thirty dollars. The transformer and rectifier have been replaced by selenium rectifiers and series filament wiring.

The selenium rectifier is a device which rectifies the a-c by the chemical properties of selenium rather than through the thermionic process of a vacuum tube. The seleniums are operated directly from the line (110 volt a-c), and produce a pulsating d-c which is filtered as before. The output of a single selenium would be approximately 130 volts d-c, but since most circuits require a higher voltage, two seleniums are connected in



—Courtesy Centralab, Milwaukee

Fig. 1.—Here is a comparison of a vertical integrator with similar component parts wired together.

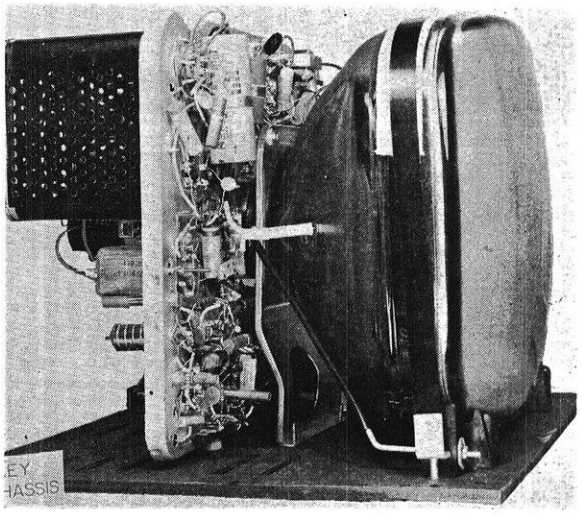
a voltage doubler circuit which produces an output of about 250 volts. The seleniums will be most efficient and last longest if they are run as cool as possible. Consequently, they are built with a large cooling surface and located in a well ventilated position in the set. The dimensions of a typical rectifier including cooling fins is 2 by 2 by 2 inches. A very recent development, which hasn't been used in commercial receivers yet, is silicon rectifiers. They offer better electrical characteristics than seleniums and are resistant to heat as well. Because of this, no cooling fins are required and they occupy about one-fifth the volume of seleniums.

As selenium rectifiers nullified the necessity of a high voltage a-c source and the rectifier tubes, the series arrangement of the tubes eliminated the low voltage supply. In this type of connection only a portion of the line voltage appears across each tube, and when one tube burns out they all go out, just as the old-fashioned series Christmas tree lights. The only requirements in a series connected circuit are that the voltages required by each tube add up to the line voltage and that the current requirement for each tube is identical. This may seem like a very satisfactory solution for the power supply problem, and to the manufacturer of the set it is, but the customer will find it will cost him more to keep this type of set in working condition.

When the seleniums go bad, which occurs frequently as the original equipment as used by the manufacturers has as low a rating as possible to minimize cost, the d-c voltage drops. This is first apparent to the viewer as a black border along the top or sides of the picture. In order to cure this trouble it would have been only a matter of a few minutes to replace the rectifier tubes, but in the case of seleniums the chassis has to be removed and the new components soldered in. This requires much more time and is therefore more expensive to service. Also, seleniums cost four times as much as comparable rectifier tubes.

Series wiring in the filament circuit has greatly increased the rate at which tubes fail. The short tube life is caused by the unequal heating rate of the tubes and the large initial current through the low, cold resistance of the tubes. These conditions produce a voltage peak 50 to 75 percent higher than the rated value of the tube. When the burned out tube is replaced, it is a matter of hunt and peck until the defective tube is located, which again adds to the service cost. Some manufacturers have added a resistor in series with the filament string which has a high resistance when cold, but decreases when hot. This cuts down on the overload on the tube filament but a time lag of one to two minutes between turning the set on and receiving the picture occurs.

The picture tube and associated circuits have received extensive improvement and today are much different from the seven and ten inch types first used. In the first small tubes the deflection was done electrostatically, that is the electron beam was maneuvered



—Courtesy Crosley Co.

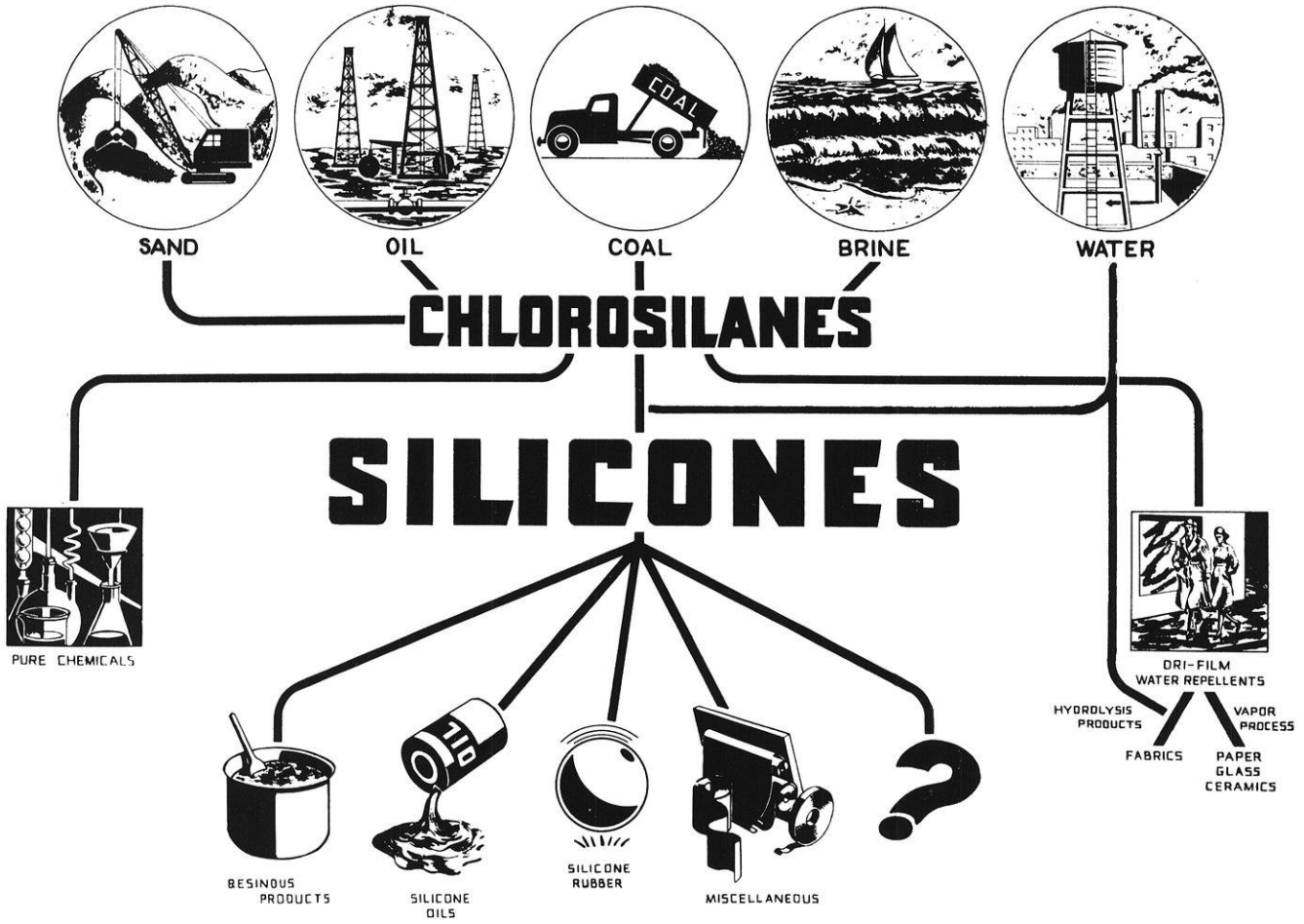
Fig. 3.—The new vertical chassis fitted around the neck of the picture tube.

over the face of the tube by means of four plates in the neck of the tube arranged in a square which were given positive or negative charges to repel or attract the electron beam. As picture sizes became larger the voltages to deflect the beam became excessive, so magnetic deflection came into use. This type of deflection was accomplished by having a number of coils around the neck of the tube which produced a magnetic field within the tube to deflect the beam. A serious defect of this deflection yoke was a distortion in the picture known as pincushioning, which caused the edges of the picture to distort. This was eliminated by winding the yoke in a special manner known as the cosine yoke. Cosine yoke winding has been universally used in the last two or three years.

A kinescope also needs a focusing device to form the electron beam in a fine line to enable satisfactory definition. In the older sets this was accomplished by an electro-magnet. Later, as better permanent-magnet materials were developed they were used instead. An ion trap on the picture tube, which removes the occasional ions from the electron beam which would damage the phosphor screen, was originally an electromagnet. As in the focus coil it was also replaced by a permanent magnet. The latest improvement, in this respect, is to incorporate within the tube itself the focusing and ion trap magnets. This makes for a very simple and straightforward assembly with only the deflection yoke and a centering device on the exterior of the tube. This reduces cost and possible breakdowns during use.

As picture tubes were developed with large screen area, they also become longer in order to keep the angle which the electron beam traveled to cover the face of the tube down to a value which the components then used could deliver. The length would have been excessive for tubes above sixteen inches so kinescopes and deflection yokes were designed for a greater deflection angle. As as example of the advantage gained a

(Continued on page 52)



—Courtesy General Electric

by Mark Whelan, ch'57

As a starting material for chemical synthesis on an industrial scale, silicon has some advantages which are unmatched. There is an inexhaustible supply constituting about 28 per cent of the earth as we know it, and the oxide of silicon is easily and inexpensively obtained from natural sources.

Why then, has the use of silicon compounds been limited to the metallurgical and ceramic arts? Perhaps this question may be answered best by Frederick Kipping who spent nearly a half century working on organo-silicon chemistry at the University College, Nottingham, England. In a lecture he gave at the conclusion of his work in 1937, he stated his opinion as to the future possibilities of the field to which he had devoted his life in these words:

> We have considered all the known types of organic derivatives of silicon and we see how few is their number in comparison with purely organic compounds. Since the few which are known are very limited in their reactions, the prospect of any immediate and important advance in this section of chemistry does not seem hopeful.

The potentialities of silicon which Kipping failed to recognize were seen by a group of American scientists in the late 1930's. Research carried out on silicon oxygen polymers was put to practical usage in 1942 as a lubricant which prevented arcing of aircraft spark plugs at high altitudes. This was the modest beginning of commercial silicones and was the only use made of them until the war ended. After the war, the military contracts were canceled and silicone producers found themselves with no industrial customers. However, all during the war, research had continued aiming at peace-time manufacture of silicone products. As a result, production of silicones has increased 40 per cent annually since the end of the war while the average growth of the chemical industry in the same period has only been 9 per cent.

Physically, silicones come in a variety of forms including fluids and oils, greases and compounds, resins, varnishes and elastomers. Chemically, they are analogous to organic compounds in that the basic element, silicon, is tetravalent and that it is possible to build an infinite number of compounds by substitution. Polymerized compounds based on the silicon oxygen linkage with organic radicals attached have the general formula

$$\begin{array}{c} R \\ | \\ R-Si- \\ | \\ R \end{array} \left[\begin{array}{c} R \\ | \\ O-Si- \\ | \\ R \end{array} \right]_n \begin{array}{c} R \\ | \\ O-Si-R \\ | \\ R \end{array}$$

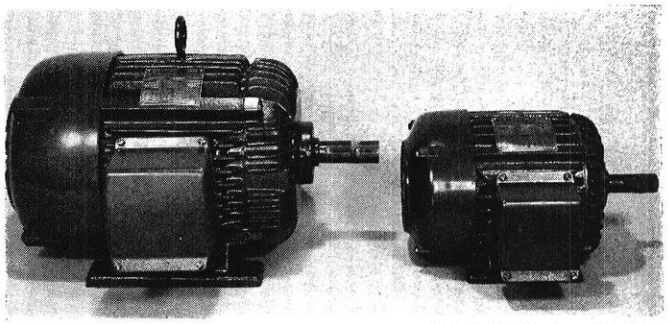
and are called silicones, where n can vary from zero to many thousands and R may represent anything from a

hydroxyl to another silicone chain. The radicals on one polymer need not be the same, and an almost infinite number of variations is possible. In practice, however, R is usually a simple alkyl or aryl radical and variation of radicals within the molecule is limited.

Silicones may be prepared by either the Grignard method or the direct method depending on economic considerations and chemical feasibility of the method. In the direct method silica and coke are mixed and placed in an electric furnace. The silica is reduced to silicon which is one of the starting materials. The other reactant is usually methyl chloride which is prepared by chlorinating methane gas. These two reactants are mixed in a reaction at a high temperature and moderate pressure using copper as a catalyst. The desired products are then hydrolyzed and condensed to form silicon polymers. When the Grignard method is used the process is similar except that the Grignard reagent replaces the catalytic chamber. Another type of silicones, phenyl silicones, is produced by these methods using chlorobenzene instead of methylchloride.

To the engineer silicones represent a new class of engineering material with a most unusual combination of properties. They are a chemical hybrid, a cross between organic and inorganic materials. Perhaps the best recognized property of silicones is that of heat resistance. They resist deterioration at elevated temperature, and many types can withstand 500° F. or higher for prolonged periods with little loss of important properties. It may not be surprising to think that a polymer having the same type of structure found in quartz should be stable at high temperatures; but what is to prevent the necessary organic component of silicones from being destroyed by heat? The answer to this may be found in the fact that silicon oxygen bonds tend to change the chemical character of substitute groups. Whatever the reason may be, the fact remains that the organic part of a silicone maintains its integrity at temperatures far above those at which fully organic materials remain stable. Not only do silicones resist high temperatures but they maintain their properties at low temperature too. Silicone resins and rubbers retain flexibility at temperatures which cause other resins and rubbers to become brittle and useless. Fluids show little change in viscosity in going from ordinary temperatures to high or low temperatures. The reason for this is again found in the structure of the polymer. At low temperatures the silicone molecule takes the form of a coil which permits great flexibility, but as the temperature is increased there is an uncoiling or straightening of the molecule. The straightened molecule has a higher viscosity than it has in the coiled form, and this increase in viscosity due to change in shape balances, to some degree, the decrease in viscosity due to thermal effects.

The long life of silicones is another property which adds to their merits. Silicones not only stand up better than organic materials at extreme temperatures but they last longer at intermediate temperatures. Silicones are also chemically inert to a large degree and are unaffected by most chemicals except concentrated bases and acids and aromatic hydrocarbons along with an excellent resistance to oxidation, sunlight and outdoor exposure. Silicones also have outstanding water repellency, a property which stems from the fact that siloxane, a part of the molecule, orients itself to the material which is the base—cloth, paint, metal or whatever it may be—and exposes the organic and water repellent part of the molecule to the moisture.

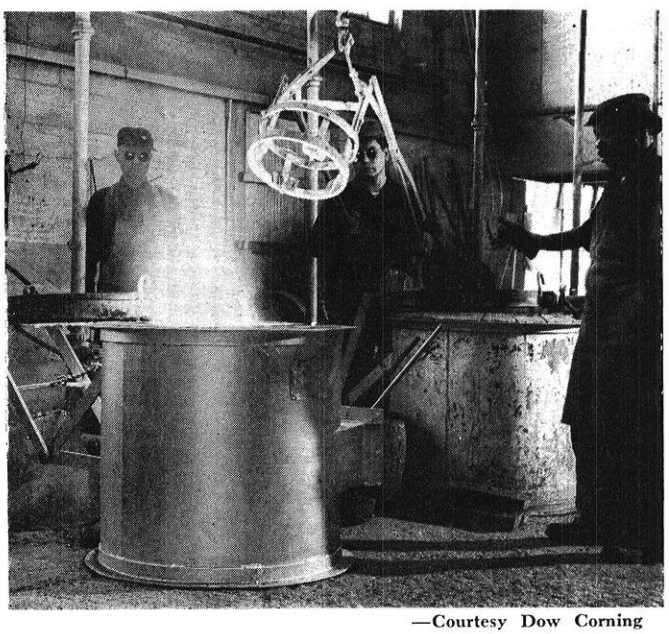


—Courtesy Dow Corning

The motor on the left is class A insulated and the one on the right is class H. The class A motor occupies a standard frame, while the silicone insulated motor, delivering the same 7½ hp, takes only a 2 hp frame.

The unique combination of silicone properties is of even greater importance than any one single property. No other fluids have the combination of good oxidation resistance, low vapor pressure, low freezing point, good heat stability and flat viscosity curve. No other resins or rubbers have the combination of good dielectric strength, good arc resistance to ozone and weathering and good low temperature properties that silicone resins and rubbers have.

With all these advantages it is evident that silicones must have some disadvantages too. Silicone resins and



—Courtesy Dow Corning

Silicone-aluminum paint withstands surface temperatures in the range of 500° F. on this floor furnace in a bronze foundry. Organic finishes blister and peel in a matter of weeks.

rubbers do not have the strength and toughness that some organic materials do have. Many aromatic hydrocarbons have adverse effects on silicones which does limit their usefulness in some fields. The greatest disadvantage that silicones have today, however, is that of high cost. At first silicones sold for $8.00 per pound which at present has been reduced to approximately $3.00 per pound. This problem will be solved as soon as the price volume cycle has been adjusted.

Silicones are classified according to their physical states into four groups: fluids, greases and other compounds, resins and rubbers. This classification provides a convenient basis for considering specific applications.

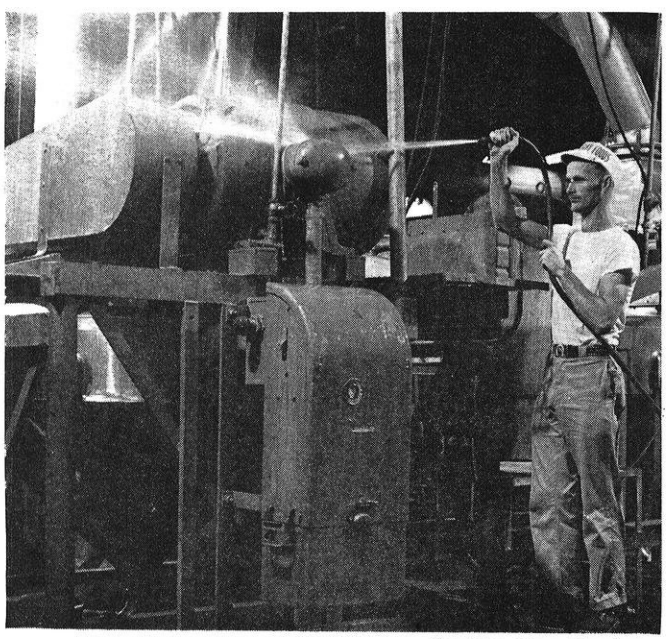
In the past ten years an amazing number of new applications have been found for silicone fluids. The product remained the same but the attitudes and viewpoints of scientists and engineers changed radically. Skepticism and indifference changed to creative thinking. Engineers and chemists of all kinds and doctors of medicine found significant uses for silicone fluids.

The simplest of the silicone fluids has a general formula:

$$\begin{array}{c} CH_3 \\ | \\ CH_3-Si-O \\ | \\ CH_3 \end{array} \left[\begin{array}{c} CH_3 \\ | \\ -Si-O \\ | \\ CH_3 \end{array} \right]_n \begin{array}{c} CH_3 \\ | \\ -Si-CH_3 \\ | \\ CH_3 \end{array}$$

n can vary from zero to over 2000. This degree of polymerization and type of organic radical attached to the silicon atom cause the fluid to have a variety of properties. In general, however, their properties may be summarized under two categories, dimethyl silicones and phenyl silicones.

The most useful property of dimethyl silicone fluids is their exceptional stability as compared with organic fluids. For example, a useful illustration is obtained by comparing the change in viscosity of high quality SAE–30 motor oil with a silicone fluid of comparable viscosity at room temperature. On cooling, the viscosity of the motor oil increases from 6.6 centistokes at 120° C. to 70,000 at –25° C. whereas, the silicone fluid increases from 70 to 1,300 over the same temperature range. This is an increase of 17 times compared with about 1,000 for the petroleum oil. Heat stability of these fluids is demonstrated by tests which showed no adverse effects on fluids when held at 250° C. for 1500 hours. The boiling point of fluids with the lowest viscosity range between 250 and 350° F., while most fluids are practically unboilable even at reduced pressures. The freezing point of dimethyl silicone fluids is –40° F. or lower. These thermal properties combined with good water, solvent and chemical resistances, inertness and good lubricating properties have made them adept for a multitude of uses.



—Courtesy Dow Corning

In an effort to reduce motor failure, this motor was rewound with silicon insulation in 1952. The motor is still in service and still immune to heat and moisture.

When methyl groups are replaced by the phenyl radical these fluids become extremely stable to heat, have better oxidation stability and better lubricating properties. Unfortunately, silicone fluids containing only phenyl radicals are solids, making it necessary to add some methyl groups to produce a liquid.

Recently, silicone fluids have appeared in various fields in which their properties have made them extremely adaptable. Their water repellent qualities have made them useful in a number of applications from masonry to shoe leather. Water repellent silicones used in masonry prevent moisture from entering the interior of the masonry and subsequently from bleaching out salts or in wintertime from freezing and causing spalling.

A good anti-foaming material, something that engineers have long searched for, has been found in a silicone-type anti-foamer. It has been put to use in such industries as paper, molasses, whiskey, caustic soda and food technology. In these anti-foam applications, silicones are able to hold their own competitively on an economic basis in spite of their high cost because of the very low concentrations required. Typical applications use 1 to 200 p.p.m. so that a little bit of silicone does a job equivalent to a relatively large amount of other known anti-foam agents.

For specialized applications, silicone fluids are ideal for heat transfer. They can withstand high temperatures for long periods of time without change in properties. They have reasonable heat transfer properties, very low vapor pressures, do not form sludges and present no fire hazard. For example, silicone fluids used in a hot immersion bath for accelerated aging tests on magnesium have been used continuously for three years while the old hydrocarbon oil bath had to be replaced monthly.

Silicones are commonly used in eyeglass cleansers in which paper tissue is impregnated with silicone fluid.

Textiles have also been rendered water repellent by treatment with silicone fluids. Treated fabrics are re-

(Continued on page 56)

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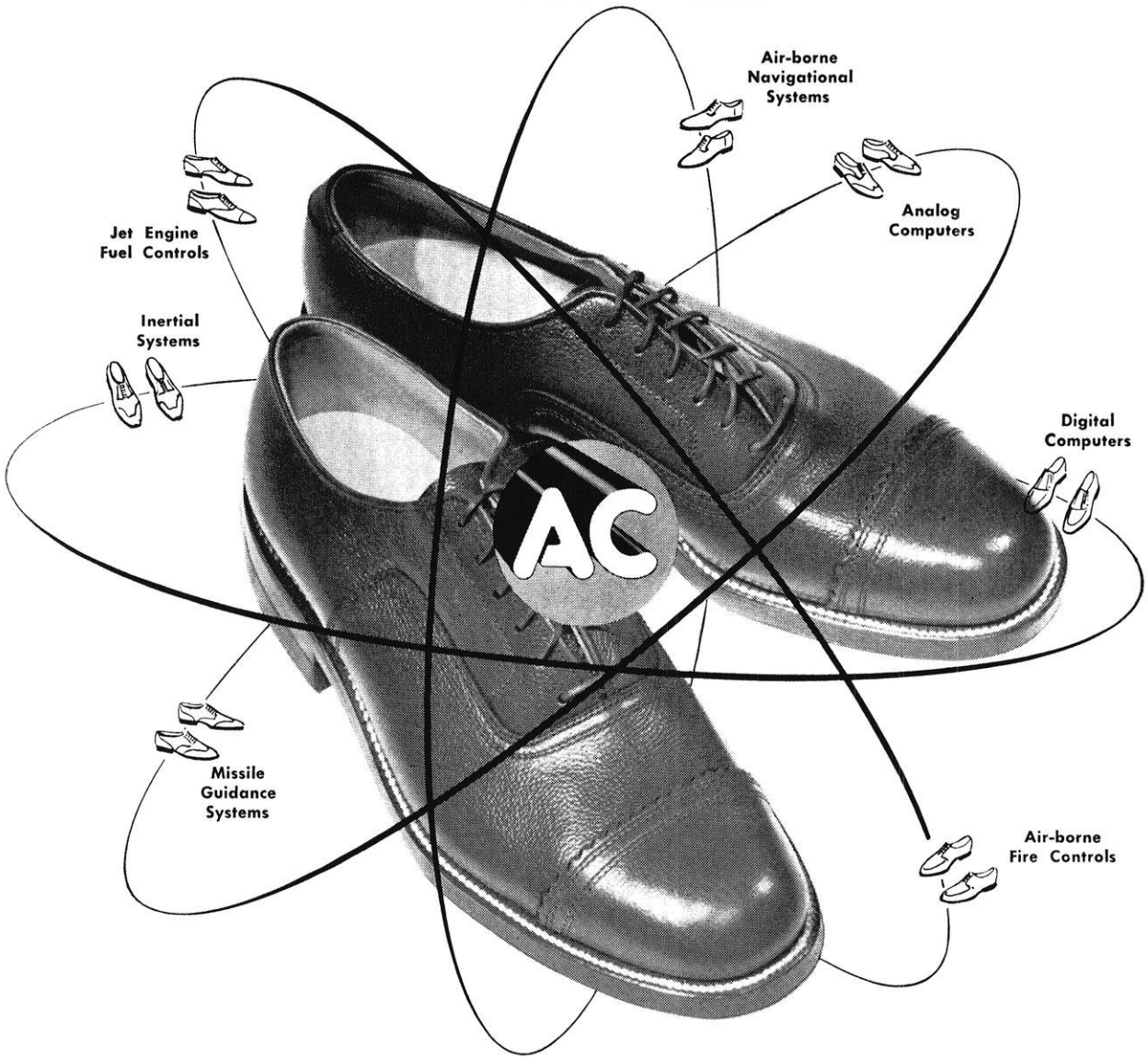

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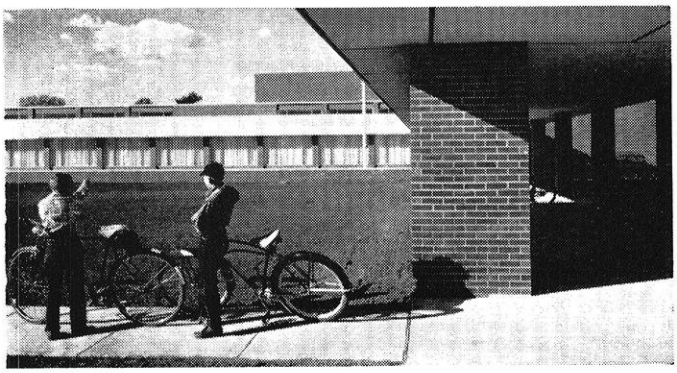
GM GENERAL MOTORS

DOW PROFILE NO. 1—RALPH PFISTER

RALPH PFISTER'S FAST RISE in only four years at Dow exemplifies the opportunities that exist with the "fastest-growing chemical company."

"Expansion is so rapid at Dow, you have to keep moving up, growing, learning, just to keep pace."



THIS COMMUNITY CENTER in a Dow city is typical of the excellent recreational facilities available to Ralph Pfister and other Dow employees.

Thus, this 27-year-old production engineer explains his new position as Superintendent of a multimillion dollar warehouse with a work force of 100 men.

In June, 1951, Ralph Pfister graduated from Northwestern University's Technological Institute. His studies, experience and natural inclination pointed to a future in production engineering. Pointed right to a position as process engineer in the Dow saran plant.

Within three years, Ralph moved to Ass't. Superintendent of a production train in a wing of the Styron® plant, to Ass't. Superintendent of the entire wing and two months ago to Superintendent of the 500,000 sq. ft. warehouse serving all wings of the plant.

"Always something new to learn . . . upper management not only allows but encourages our making the important decisions . . . the people are interesting, stimulating both at work and socially."

These excerpts from a conversation with Ralph Pfister give a quick profile of employment at Dow. Here is the fastest-growing company in the nation's fastest-growing industry. Dow communities provide some of America's most pleasant living surroundings and educational and recreational facilities.

Whether your interest be production, research or technical sales, for more information on a career at Dow write for the 16-page booklet "Opportunities with The Dow Chemical Company." Address your request to Technical Employment Department, THE DOW CHEMICAL COMPANY, *Midland, Michigan, or Freeport, Texas.*

you can depend on DOW

MAN-MADE GEMSTONES

by Richard Kulakow, bch'57

The search for synthetic gemstones has been stimulated by the increasing shortage of good, natural crystals, and by the realization that man-made crystals may be cheaper, better, and more versatile than any found in the earth. Nature was not fair when she did not produce diamonds, rubies, sapphires, and emeralds in sufficient quantity and quality for the industrial and personal uses of the world. She also took care to hide deposits of these jewels in so remote and undesirable places, that man now finds it useless to extract most of them. It is because of this, that crystal growing has become an important part of laboratory research in the last twenty-five years.

Synthetic gemstones are just one type of *manufactured gems*. Essentially, they are real stones, and they have the same composition as the natural. The elements constituting these artificial stones are combined by chemical processes. For example, both the real and the synthetic diamond are made from carbon, and the synthetic ruby consists of Al_2O_3 just as the natural. Besides having the same chemical composition, synthetics have the same physical properties as natural stones.

Diamonds, rubies, sapphires, and emeralds are the most important synthetic jewels produced in the laboratory, and they have reached the commercial stage of production.

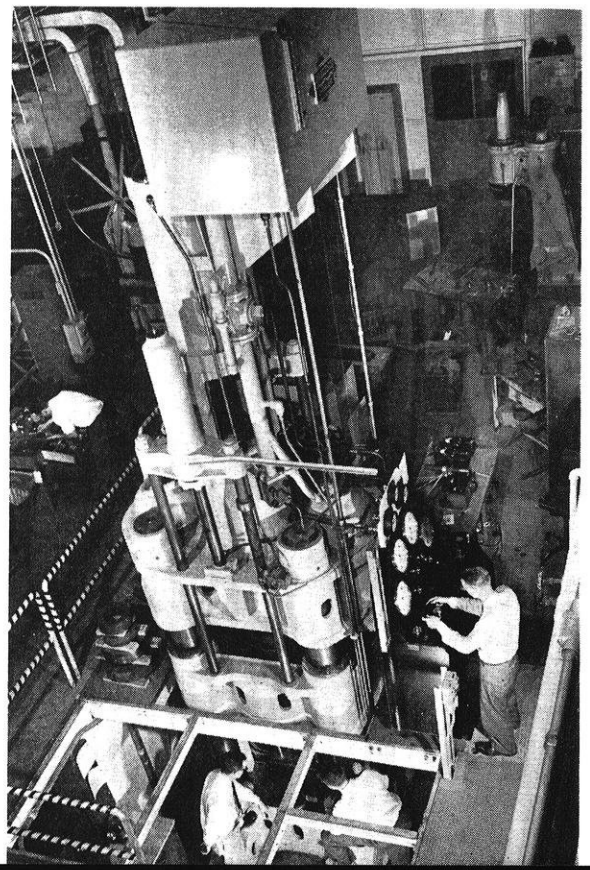
The story of man's attempts to make diamonds is, it must be confessed, very largely a record of failures, and yet it is rich in scientific and human interest. The first men who attempted its production had varied backgrounds. They ranged from first scientists to downright charlatons.

The search for a process for making synthetic diamonds had its origin in 1797 and has progressed until the present time. In that year, an Englishman, Smithson Tennant, showed that diamond is a form of carbon, by burning it with pure oxygen. It gave off pure carbon monoxide gas and left no residue. From then on a number of men tried their hands in making diamonds. The general process consisted of dissolving some form of carbon in a solvent and then allowing it to crystallize out. J. B. Hanney, in 1880, mixed hydrocarbons, "'bone oil", and lithium in an iron tube, welded it shut, and heated it to redness. In the residue, he claimed, there were diamonds of a density of 3.5 (the same as real diamonds), but repetition of this experiment always resulted in failure. In 1943, an exhibit marked "Hannay's Diamonds" was found in the British National Museum, and after x-ray analysis they were found to be diamonds of a rare type. There was then, and still is, quite a bit of doubt as to whether or not Hannay actually made these diamonds, but the consensus of opinion is that they were the first synthetic diamonds made.

As strange as it may seem, the man who is generally given credit for the first success in this field was actually the victim of a fraud. He was Henri Moissan. In 1890, while perfecting his electric furnace, he melted iron and graphite in his furnace and plunged the white-hot crucible into cold water. After dissolving the residue in acid and chemically treating it, Moissan reported small particles present, which he called diamonds. They actually were diamonds, but in 1924 Moissan's widow said that he had been the victim of fraud by one of his assistants, who had introduced real diamond fragments into the crucible to end the experiments with which he had become bored.

Even though success had been reported, experimentation was continued by other men. In 1906, Sir William Crookes and Sir Andrew Noble tried, but without results. In 1926, M. LaRosa at the University of Palermo in Sicily thought he had made synthetic diamonds in a "singing arc", but they proved to be the

Schenectady, N. Y.—General Electric Research Laboratory's 1000-ton press for achieving high pressures (100,000 atmospheres or 1.6 million psi). This is the apparatus in which GE man-made diamonds were first produced.



effect of impurities, and not diamonds after all. J. W. Hershey at McPherson College in Kansas repeated Moissan's method and reported success, but that is questioned.

It must be remembered, however, that at that time, X-ray was not being used for analysis, and that such small traces of the supposed diamonds were being found. And as a result, a statement that they were real synthetics was based on very little evidence.

But men kept on claiming success. A German, Hans Karabacek, obtained a patent for diamond making, but spectroscopic analysis at a later date showed that they had the same impurities as the Cape diamonds that were mined.

Finally, present day experimentation proved successful without a doubt. Basing their experimentation on the thermodynamic potential of diamonds proposed by Willard Gibbs, and the thermodynamic properties published by F. D. Rossini and R. S. Jessup, the General Electric Company developed synthetic diamonds. Four G. E. physicists: E. P. Bundy, H. T. Hall, H. M. Strong, and Robert Wentorf developed the diamonds. Although the exact method has not been announced, it is known that over 100,000 atmospheres pressure at 2500° C. for hours is required. The diamonds produced —the largest is one-sixteenth of an inch—pass all tests, including X-ray analysis.

So, after approximately one hundred and fifty years of work, man is finally able to make synthetic diamonds just like the ones that it took Nature thousands of years to form.

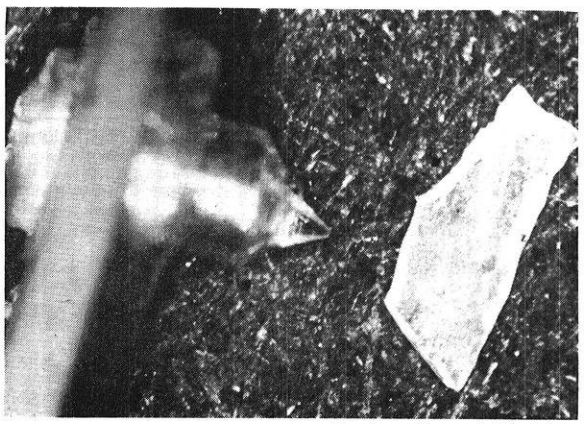
When we turn from diamond to consider corundum (of which ruby and sapphire are colored varieties) there is a very different story to tell. The men working had earlier and better success.

The earliest attempts at making corundums synthetically consisted of fusing small fragments of the natural stone together. These larger stones were called reconstructed gems, but they were of very poor quality. In 1895, Michaud improved this process, and his rubies (red corundum) found markets in France, Germany, America, and India. In India they were believed to have been sold as real rubies.

Then Gaudin made microscopic rubies by fusing alum at high temperatures with a little chromium as pigment. Later, Ebelman produced white sapphires by fusing alumina in boric acid. Many other men experimented with different processes, with some success. Their general plan was to form a molten mixture of salts in which alumina was soluble; saturate the solution with alumina; and volatilize the solvent, causing the almina to crystallize out.

Finally, in Paris, in 1902, a new process of making rubies on a commercial scale was developed, which can be used to make any variety of corundum. This process is called the "Verneuil process", after its inventor.

This method consists of dropping a small amount of purified and finely divided pure alumina into an oxy-



—Courtesy General Electric

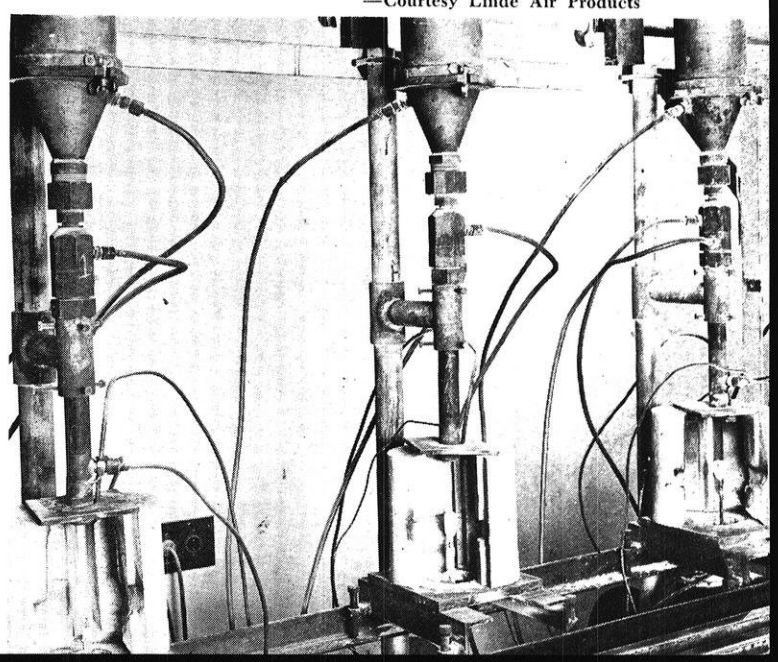
Shown above is the largest diamond yet made by General Electric. About 1/16th of an inch in its longest dimension, it has been photographed beside a standard, diamond, high-fidelity phonograph needle to indicate its relative size.

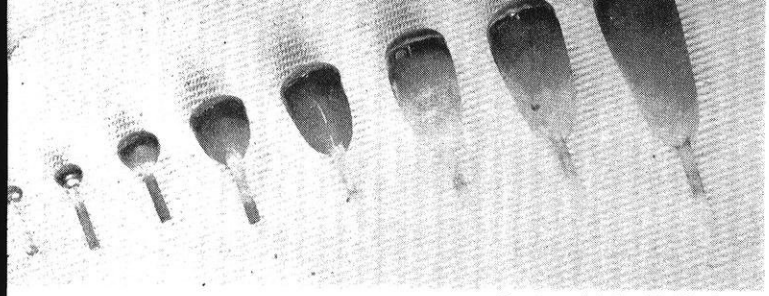
hydrogen flame. The alumina fuses at the high temperature and is collected as a drop. This is repeated to form a "pear- or carrot-shaped mass of alumina called a *boule* or *birne*. When the desired size is formed, the furnace is shut off and allowed to cool. Boules as large as 750 carats have been made. When no pigment is added to the alumina, a colorless, transparent product called a white sapphire is obtained.

By adding pigments, different colored boules can be obtained. With the addition of chromium oxide, up to seven per cent, to the alumina, boules of different shades of red are obtained—synthetic rubies. Adding two per cent iron and titanium oxides gives boules of a blue color called synthetic sapphire proper or synthetic sapphire. A green stone is obtained by adding a mixture of vanadium and cobalt oxides. The colors are evenly spread throughout the stone, and in some

Three burners and furnaces of the original Laboratory Pilot Boule Bank are shown. The bank was made up of six burners operated automatically from a central control panel. The photograph shows opened furnaces with finished boules in position.

—Courtesy Linde Air Products





—Courtesy Linde Air Products

Progressive stages in the growth of synthetic ruby crystal from "seed" to finished boule.

cases they are colored better than even the natural stone.

A third type of manufacturing process for synthetic gemstones is cloaked in great secrecy. This bright green stone is the emerald. Emeralds were first made in 1848 by Ebelman. He heated powdered boric acid and powdered emerald.

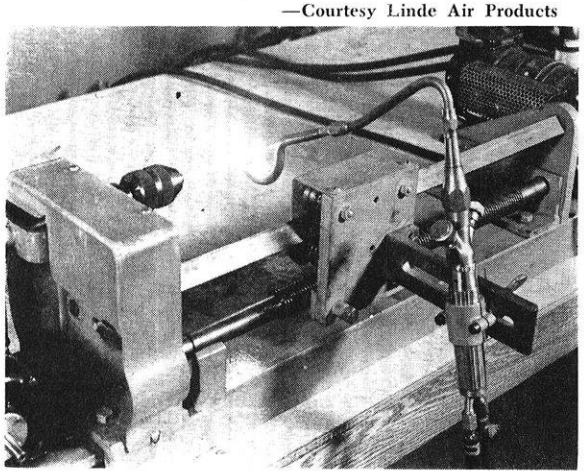
In 1930, Jaeger and Espig of the research staff of the I. G. Farbenindustrie, Bitterfield, Germany, made the first true synthetic crystals of emerald. They were up to two centimeters long. But during the War the work was discontinued, and since the plant is now in East Germany, nothing is known about its present production.

At the same time, Carroll F. Chatham of San Francisco made an emerald crystal of one carat. He does all his own work in a small two room laboratory; his production is two thousand carats per month! His process is a well guarded secret, and all he will tell us that it consists of forty-five separate steps, and it takes ten months for a batch to mature. Expertly calculated guesses as to his process range from a bomb type of reaction as Hannay used, to a slow crystallization process. Whatever his method, he is producing good synthetic emeralds.

Synthetic jewels are not only of the same color and appearance as the natural stones, but they have the same chemical and physical characteristics. The synthetic diamond is as close as possible to the real stone in its refractive index, specific gravity, and hardness. It shows just as much "fire" as a real one, and in some cases even more.

This machine is used for flame-polishing straight corundum rod. The rod is rotated as the oxy-fuel gas flame travels along its length. The polish obtained is more uniform than is possible by manual operation.

—Courtesy Linde Air Products



As far as emeralds are concerned, the synthetics have the same color and shape—the hexagonal form of crystal. The specific gravity and refractive indices are lower than those of the natural, but the differences are slight.

For a specific example let us take the corundum gems and compare them. The following table was made by A. J. Moses comparing the natural and synthetic sapphire.

	Synthetic			Natural		
	Verneuil			India	Ceylon	
Al_2O_3	99.84	99.85	99.83	97.51	99.33	99.26
Fe_2O_3	trace	trace	trace	1.95	0.92	0.97
TiO_2	0.11	0.12	0.13	.....	.....	.....
SiO_2	none	none	none	0.80	.....	.....
	99.95	99.97	99.96	100.26	100.25	100.23

This shows that the synthetic is chemically the same, and in some cases even purer. They also are alike in specific gravity, index of refraction, hardness, and party properties.

Although the synthetics are so close to the real gem, there are still ways to distinguish them for which jewelers are very thankful. From a technical standpoint, an experienced person would have no trouble telling a synthetic from a real stone.

The corundum stones have certain microscopic characteristics due to their method of manufacture that give them away. The boules have structure lines in them parallel to the surface. This is thought to be due to fluctuations in temperature during its formation or to an uneven distribution of the pigment. A cloudiness or presence of gas bubbles is observed in the synthetics, differing from those in the natural stones. Since the synthetics are cooled quickly, great strain develops in the boule, causing internal cracks that make the stones look like they have been chipped. Also, since production of synthetics did not start commercially until the opening of the present century, any sapphires or rubies with a history dating previous to 1900 were likely to be real. And prior to 1947 star sapphires were not made synthetically.

Man-made emeralds also have cracks and flaws in them which natural stones do not have. Switzer says that synthetic emeralds of this country and Europe fluores with a deep red color when exposed to ultraviolet rays, while the natural doesn't.

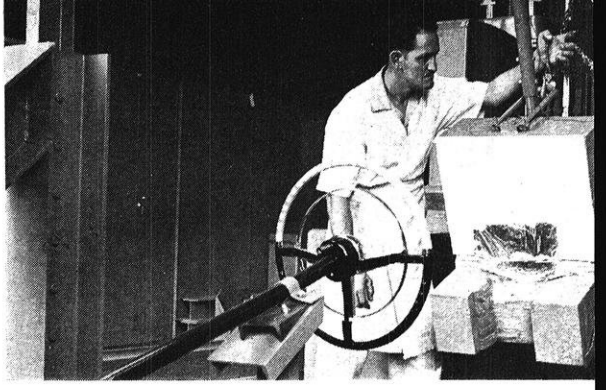
Although all of the above tests and examinations must be conducted by skilled men, there are a few tests that the average person can use to tell imitation gems from synthetic or real jewels. Jewels are good conductors of heat, thereby feeling cool to the touch, which is not true of most imitations. A drop of water will hold its shape on natural or synthetic stones, but not on others. In cases of doubt, a laboratory appraisal can usually be obtained for about two dollars.

The value of any precious stone is dependent on many factors. It is a basic fact that the value of the artificial gem is always much less than that of the nat-

(Continued on page 54)

The Forward Look
—SAFETY

by Russell Uttke, m'56



—Courtesy Ford Motor Company

A Ford safety engineer is about to release a 160-pound "body block" into a steering wheel in a test which will determine how much energy the wheel can withstand before failure.

"If this nation were confronted with an epidemic disease that took the lives of 38,000 persons in one year, and the medical profession did not take steps to control the situation, there would be a congressional investigation."

These words were written by Dr. Hunter Shelden of Pasadena, California, in a recent issue of the Journal of the American Medical Association. He was referring to the fact that more of our citizens have been killed on U. S. highways than have died in all the wars since 1776.

Actually, the number of traffic fatalities per mile travelled has decreased consistently in the last twenty years. Although there was reported a 100% increase in miles travelled, available highways were increased by only 1%. Despite this, there was a 55% decrease in traffic fatalities.

This was due to the improvements in vehicle control and performance. The most notable achievements were 4-wheel hydraulic brakes, blow out resistant tires, power steering, stronger headlights, better visibility, increased structural strength, and the various power assists.

In spite of all the precautions, accidents will continue to happen. Now the problem is how can injury be prevented when an accident occurs. While all the improvements in accident prevention devices were being made, injury prevention was all but completely ignored.

Twenty years ago J. C. Furnes composed a provocative complaint called "And Sudden Death". His statement is just as meaningful today.

> "Collision, turnover or sideswipe, each type of accident produces either a shattering dead stop or a crashing change of direction, and since the occupant—meaning you—continues in the old direction at the original speed, every surface and angle of the car's interior immediately becomes a battering, tearing projectile, aimed squarely at you—inescapable . . . It's like going over Niagara Falls in a barrel full of railroad spikes."

Not long after this was written, Chrysler started a safety campaign by recessing knobs, reversing window vent knobs to point away from the passengers and padding the rear of the front seat to protect the back seat passengers. "After three years" recalls Chrysler's John Gunther today, "the stylists came to the safety engineers and begged to be allowed to jazz up the dashboard. They said it was all well and good to be safe, but you had to sell the automobile."

Chrysler gave up on its safety interiors.

In 1950 Nash offered safety belts as optional equipment with very poor results. They dropped the idea.

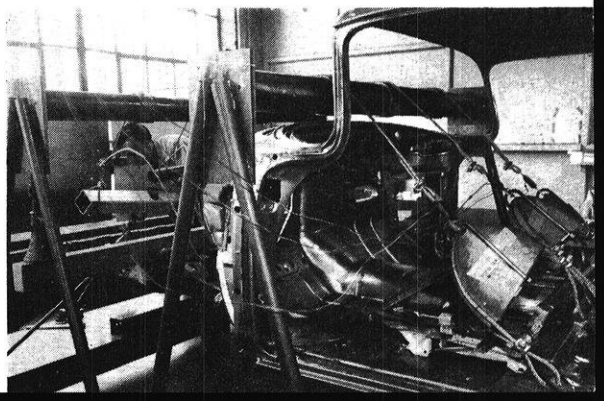
Some of the auto manufacturers are convinced that the public opinion about safer interiors is changing. They are now offering and in some cases emphasizing safety features.

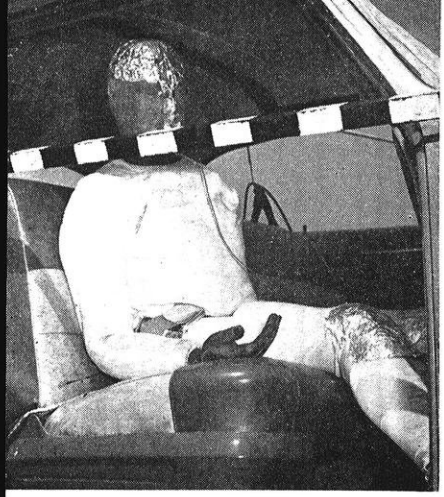
There are indications that the manufacturers are on safe ground in doing this. In a recent issue of Popular Science Monthly a ballot was printed containing twenty automobile accessories or extras and the readers were asked to vote for "the ten you would prefer to have on your next car". Ten of the items were luxury types and ten were safety features. The percentages that follow are the results of more than 5000 ballots.

Crash padding on dash	97%
Shock absorbing bumpers	91%
Safety belts	88%
Pop-out windshield	87%
Collapsible steering column	83%
Airplane type doors	81%
Recessed rear view mirror	78%
Airplane type frame	77%
Higher back on front seat	59%
Padded steering wheel	58%
Car radio	43%
Air conditioning	33%
Nylon upholstery	22%

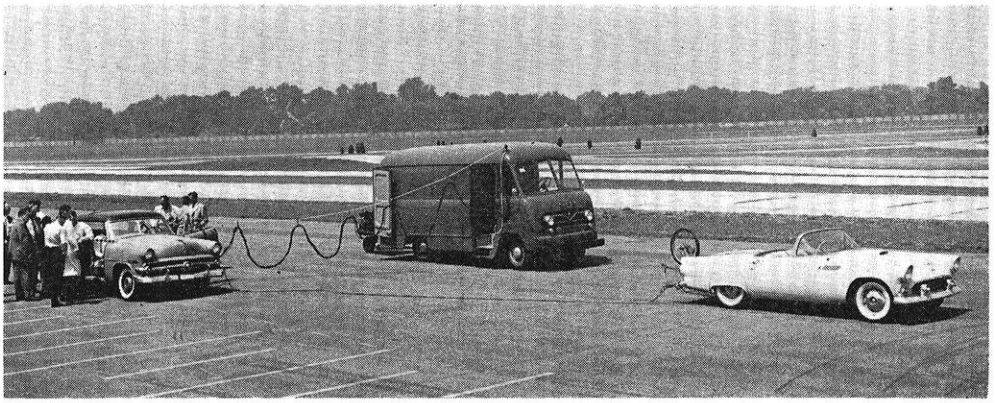
Safety belt anchors are tested for pull-out strength in this test conducted by a General Motors Engineer.

—Courtesy GM





1. This carefully engineered, life-like dummy is strapped into a test car with a seat belt. If he strikes the instrument panel, the foil on his head and knees will close an electric circuit, recording the speed of impact.



2. A survey of a crash car is made by a group of Ford Safety engineers before the start of a crash test. The Thunderbird at the right is used as a towing car with a very accurate fifth wheel speed recording device attached to the rear.

Two tone paint job	17%
Lighted glove compartment	15%
Built in ash tray	14%
Electric clock	13%
Electric window lifts	12%
Chromium trim	11%
Whitewall tires	10%

Ford Motor Company, the leading promotor of safety features, will feature safety door locks, a deep dish steering wheel, more firmly anchored seats, and shatter proof glass in the rear vision mirror as standard equipment on its 1956 models. As optional equipment, Ford offers padded inside visors, a padded dashboard, and safety belts. The price of the safety belt and padding is $25 while the padding alone costs $16. Ford claims to make no profit on these items.

Ford's safety devices, like most other company's, are designed to prevent accident injuries that occur at speeds below forty miles per hour. Many accidents are in this category as a driver often has a chance to decellerate before the impact occurs. It is a little known fact that about half of all highway fatalities are caused by vehicles moving slower than 40 mph.

The door latches are designed to keep the doors closed under crash-impact loads. The number one cause of injury and death on the highways is ejection from the car. In addition, when the doors remain closed in a crash, the body has more support, and the roof is less likely to buckle.

The safety belts are designed to keep the passenger from bouncing around inside the car and also keeps him from flying out of the car in case the door latches should fail. The number two cause of death is cracking heads on the windshield.

The reason for padding the dash board is obvious; to cushion the impact of skull upon metal. A raw egg dropped on Ford's new padding material from a height of about 10 feet will not smash or even crack. The dashboard is the number three killer.

The deep dish steering wheel is designed to absorb force under impact instead of skewering the driver on

3. Safety engineers adjust an aircraft type gun sight camera in the roof of the crash car. This camera, which is mounted in a cut-out section of the roof panel, will photograph the movements of the dummies inside the car at the time of impact.

the steering column. The steering post is the number four killer.

In developing these features Ford wrecked hundreds of steering wheels and crashed more than sixty cars.

Ford, however, is not alone in the safety equipment field. Chrysler corporation offered safety belts as optional equipment last year and all 1956 models will have safety door latches.

Studebaker–Packard will have safety door latches on all models and will offer safety belts as optional equipment. On the Packard and Clipper models there is an automatic door lock. A button on the dash board locks all four doors. They can be unlocked individually by raising the buttons on each door. In a recent public test, four 150 pound dummies, two wearing safety belts and two rigged to throw their entire weight against the door, rode in a 4-door Studebaker that

crashed at forty miles per hour into a concrete barrier. The front end of the car was badly demolished, but the dummies were still in the car and the door could still be easily opened and closed.

Fisher Body has been putting safety door locks on all General Motors products since May, 1955, but did not announce it till August. Chevrolet will offer a padded dashboard by the end of January. Chevrolet dealers in the Madison area offer safety belts which are dealer installed. These cost $9.95 for the front seat set.

Although the public seems convinced of the worth of safety features they seem hesitant to accept some of them. In the Madison area, Ford dealers say the padded dashboard sells very well but most buyers don't have seat belts installed in their new cars.

One of the reasons stated for not installing safety belts in a car is: "Hate to be strapped in the car in case of a fire caused by the crash." Actually fires break out in less than 1 per cent of today's injury producing accidents. The risk of getting burned is probably decreased by wearing a safety belt because it may keep you from being knocked unconscious.

There have been many accidents where people owe their complete recovery and even their lives to the fact that they were wearing safety belts.

A few years ago, the Ansul Chemical Company of Marinette, Wisconsin installed belts on all of its 57 company cars. In 1953, six of the drivers were involved in very bad accidents that almost demolished their cars. Five of these drivers came through without injury. The sixth who was seriously hurt in a head-on collision would have been killed, in the opinion of the Indiana State police, had he not been wearing the belt.

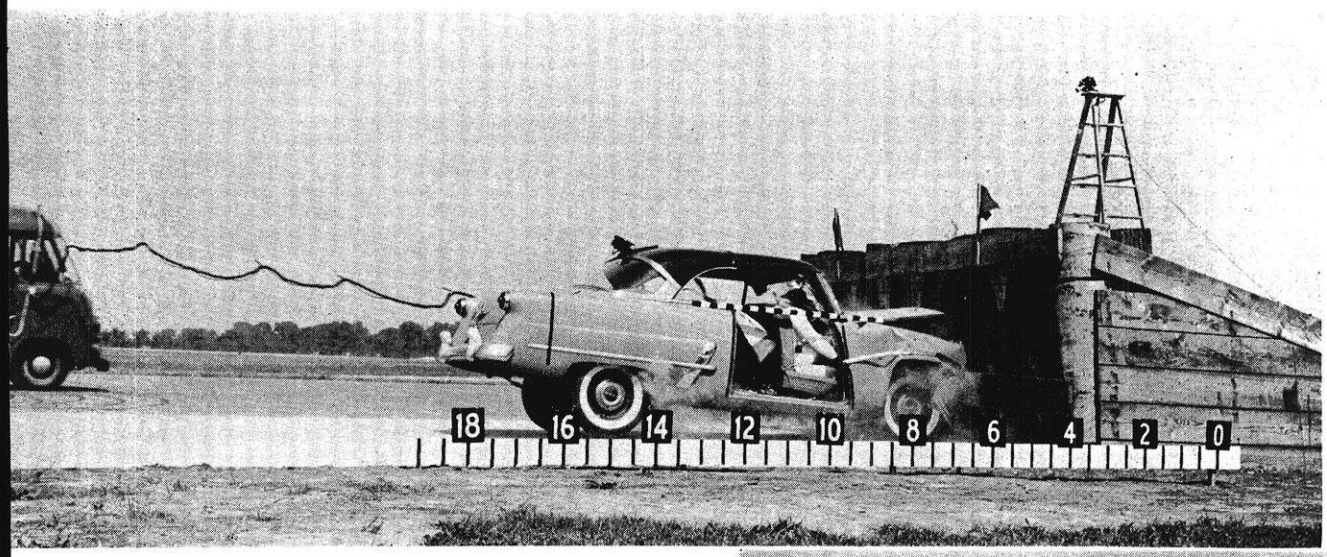
Francis Kocinski, an engineering student, fell asleep at the wheel of his car and hit a telephone pole at thirty miles per hour. He moved the 10″ pole and its concrete base four inches in the earth, and damages to the car amounted to $850. The driver's injury consisted of a chipped tooth and a cut tongue where he hit the steering wheel, and a long black and blue stripe, two inches wide across his hips caused by the safety belt he was wearing. Edward R. Dye, director of automobile safety research at the Cornell Aeronautical Laboratory estimated that Francis hit the belt with a force of 2400 pounds.

A thirty year old Colorado National Guardsman, driving a panel truck, came over a rise at 60 mph and saw a cow crossing the road. He applied the brakes, skidded, missed the cow, and went over the shoulder and down into a 15 foot deep pit. His truck rolled over 1½ times and came to rest upside down. He was wearing a safety belt and was not seriously hurt.

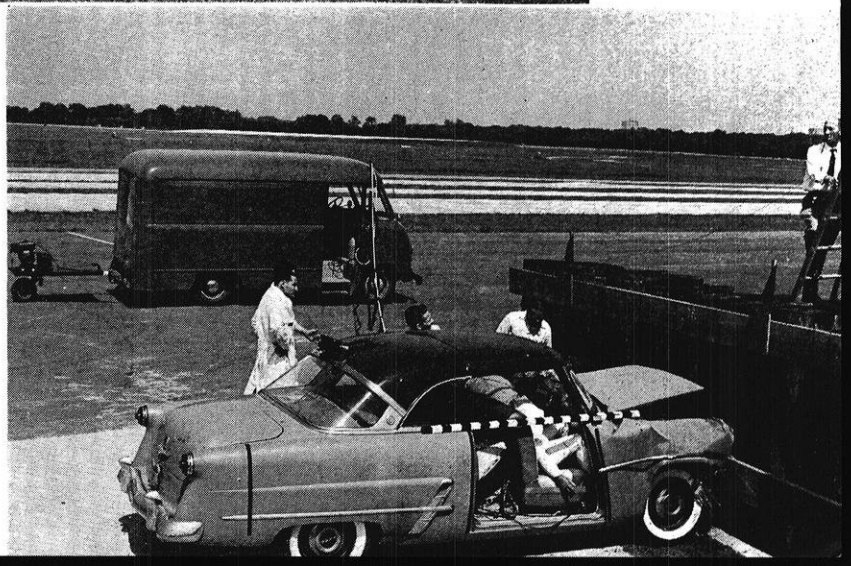
These incidents, and many more like them, are a good indication that highway travel would be safer if all vehicles were designed for safer operation.

Prevention of injury in automobiles, after being

(Continued on page 56)

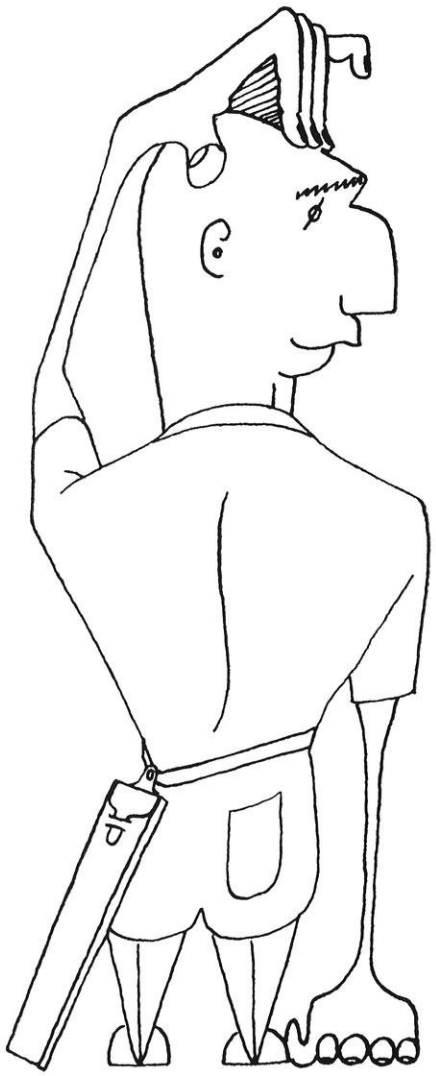


4. The moment of impact! In this photograph a high-speed camera snapped the crash car as it struck the barrier at 30 MPH. Data on the crash is recorded in the truck following the car. The cable connects recording devices in the truck with electrical instruments in the crash car.



5. After the test, Ford safety engineers carefully survey damage and tabulate all effects of experimental car crashes. The barrier shown above is made of timbers embedded in concrete and banked by several tons of earth.

—Photographs Courtesy Ford Motor Co.



"I'm Out For Blood... New Blood"

"D'ya know where I can find some?"

This is Sneedly looking for eager freshmen and sophomores who want to join our organization.

He's looking for engineers with the following talents:

- ★ WRITING ABILITY
- ★ ARTISTIC ABILITY
- ★ LAYOUT EXPERIENCE
- ★ PHOTOGRAPHY HOBBY
- ★ INTEREST AND DEPENDABILITY

The Wisconsin Engineer has this to offer:

- ★ VALUABLE TRAINING IN ENGINEERING WRITING
- ★ VALUABLE RELATIONSHIPS WITH STUDENTS AND FACULTY
- ★ BUSINESS EXPERIENCE FOR BUSINESS STAFF MEMBERS
- ★ EXCELLENT JOB AND SCHOLARSHIP REFERENCE
- ★ SHORT WORKING HOURS WITH MAXIMUM RETURNS
- ★ FOUR MONTHS VACATION EACH YEAR

Contact Ron Schroeder, U–3641, John Bollinger, 6–7915, or Bob Walter, 6–6694, and arrange for an interview. Don't delay: This offer may be withdrawn without notice!

John E. Young is working toward his B.S. in chemistry from California Institute of Technology this June. He has maintained honor standing in classwork while serving on the school newspaper, in the debating society, and as treasurer of the student body. John is interested in chemical research and development.

John Young asks:

How does research differ from development work at Du Pont?

John Aaron answers:

John B. Aaron worked for Du Pont as a summer laboratory assistant even before he graduated from Princeton with a B.S. in 1940. After military service he obtained an M.S.Ch.E. from M.I.T. and returned to Du Pont in 1947. Over the years he has had many opportunities to observe Du Pont research and development work. Today John is process and methods supervisor at the Philadelphia Plant of Du Pont's Fabrics and Finishes Department.

Well, John, it's hard to define the difference in a way that will satisfy everybody, because one always finds a lot of overlapping between research and development work. But most people agree that there are differences, especially in time sequence. Research work comes first, because one of its main objectives is to establish or discover new scientific facts that will supply the foundation for new industrial developments. In other words, research men seek new knowledge about matter, generally working with small quantities of it.

Development work comes later, and Du Pont has two main types. First, there is *new process* development. Here scientists and engineers modify, streamline, and augment the findings of research so that new chemical products can be profitably made on a large scale—or existing products can be made by newer and more efficient methods. Pilot-plant and semi-works operations are usually included under this heading.

Second, an important kind of development work is directed toward improvement of *existing processes and products*. Here the men study how to obtain yield increases, utilize by-products, increase outputs, and solve sales service problems as they arise. This may require considerable research, and that brings us back to the overlapping I previously mentioned.

There are genuine differences, John, but a good deal of similarity, too—especially in the constant need for imagination and creative effort. I think you'll find that research and development work are equally challenging and rewarding at Du Pont.

ARTHUR F. FALK

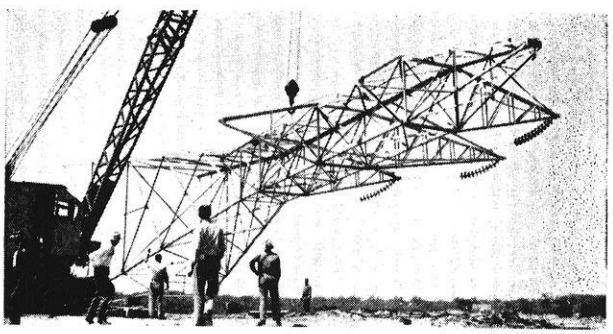
"I'm glad that I chose WISCONSIN ELECTRIC POWER COMPANY"

Upon receiving a BS degree in electrical engineering from the University of Wisconsin in 1948, Arthur F. Falk chose Wisconsin Electric Power Company as the best place to begin a career in the field of sales engineering. Beginning as a Cadet Engineer in July of 1948 he has made steady progress in the Power Sales Division. He now handles special industrial heating problems as an Industrial Heating Engineer. He says, "I'm glad I chose WEP Company. I like my work and look forward to the future."

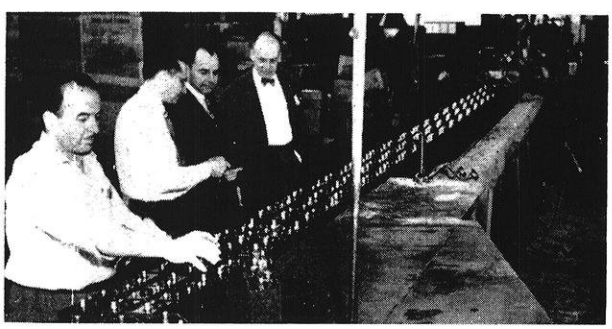
THERE'S A PLACE FOR YOU IN OUR FUTURE!

Many engineering graduates choose Wisconsin Electric Power Company because of its reputation for sound and steady progress . . . for its modern and pioneering policies. For example, our power plants have established world records for efficiency. They were the first to develop and use the process of burning pulverized fuel, the first to introduce radiant superheaters into their furnaces. Engineering talents are needed in the varied fields of our operations. Recognition of ability is assured through an unique "management inventory" system which has received industry-wide attention.

PLANNING — Engineers are needed to help plan and design the generating, transmission and distribution facilities which serve the needs of more than half a million electric customers in Wisconsin and upper Michigan.



CONSTRUCTION — Engineers are needed to supervise the details of a continuing construction program. The 1955 construction budget for the Wisconsin Electric Power Company system amounted to more than 41 million dollars.



SALES -— Engineers are needed for many phases of the Company's sales program. Openings are available in the field of industrial sales . . . in the activities of lighting, heating, air conditioning and commercial groups.

ADMINISTRATION — Engineers are needed for many activities which provide an excellent training for advancement into administrative fields. Many of our executive positions are now held by engineering graduates.

Write to our PERSONNEL SERVICES DEPT. for a copy of our Annual Report and other information

WISCONSIN ELECTRIC POWER COMPANY

231 West Michigan St., Milwaukee 1, Wisconsin

Boeing engineers find rewarding jobs in Wichita, Seattle

This model of a supersonic airplane design was dropped at extreme altitude from a B-47 Stratojet. Telemetered data revealed the characteristics of its supersonic flight to destruction at the earth's surface. This is just one example of Boeing-Wichita's continuing development of advanced aircraft and associated system components.

At Wichita research and development programs are expanding rapidly. Laboratory space has been quadrupled and many other new engineering facilities have been added to keep pace with increasing emphasis on technical development. At both of the company's plants, Seattle and Wichita, the increased scope and magnitude of this development effort is creating additional and excellent career opportunities for all types of engineers.

This means that if you are an electrical engineer, a mechanical engineer, a civil or an aeronautical engineer or a physicist or mathematician with an advanced degree, there is a real challenge for you in one of Boeing's design research or production engineering programs. You would work in a tight-knit team where there is plenty of room for self-expression and recognition.

Boeing engineers are working now on future airplanes and missiles that will maintain the standard of technical superiority established by the B-47 medium bomber, the B-52 intercontinental bomber, the BOMARC IM-99 pilotless interceptor, the 707 jet transport and the KC-135 jet tanker-transport.

Recognition of professional growth is coupled with career stability at Boeing — twice as many engineers are now employed by the company as at the peak of World War II. They enjoy a most liberal retirement plan. How would *you* like a satisfying, creative job with the pick of the engineering profession? There may be one waiting for you in the progressive communities of Wichita or Seattle.

For further Boeing career information consult your Placement Office or write to either:

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

RAYMOND J. B. HOFFMAN, Admin. Engineer
Boeing Airplane Company, Wichita, Kansas

BOEING

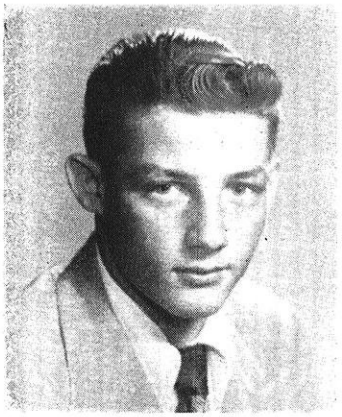
Aviation leadership since 1916

SEATTLE, WASHINGTON WICHITA, KANSAS

CAMPUS NEWS

compiled by Dick Peterson, m'57 and Larry Barr, m'57

Ron Schroeder



John Bollinger

NEW EDITORS, BUSINESS MANAGER ELECTED

The board of directors of The Wisconsin Engineering Journal Association elected the officers who will guide the *Wisconsin Engineer* through the next year.

As announced by board chairman Wayne K. Neill, Ron Schroeder, m'57, will succeed present editor Bob Hentges, and Bob Walter, met'57, will take over the post of Business Manager, now held by Barclay Gilpin. In addition, John Bollinger, m'57, will work with Schroeder as Associate Editor.

These new officers will officially assume their responsibilities for the May issue of the Engineer, although they will be broken in on next month's Engineer. These men will choose their respective staffs with the advice of the present editor and business manager.

Ronald Schroeder, Editor

Ron moves up to the post of Editor-in-Chief from the post of Assistant Editor, which he held during the past year. He started working on the Engineer staff as a freshman, and wrote Statics and Engine-Ears before this year.

Ron is at present a member of the Men's Halls Association Cabinet from Swenson House, and he served as Dorm Chairman for Campus Chest. He is a member of Beta Theta Pi fraternity.

Ron hails from Milwaukee and expects to graduate from mechanical engineering in February, 1958.

Robert Walter, Business Manager

Bob, a transfer student from Creighton College in Omaha, Nebraska, served as National Advertising Manager during the past year. He did not work on the staff prior to that.

Other interests in which Bob has been active are Hoofer's sailing club and this year's Engineering Exposition.

John Bollinger, Associate Editor

John rises to second in command of the editorial staff from Assistant Editor. He worked previously on the article staff as a sophomore.

John at present has the responsibilities of General Chairman of the 1956 Engineering Exposition. He also is a member of Polygon Board, ASME, Tau Beta Pi, and Pi Tau Sigma.

He is a mechanical engineer from Manhasset, New York.

1956 EXPOSITION NEWS

LARRY BARR, *Publicity Manager*

This will be the final report to you, the reader, before Exposition time (April 20–22). At this time there is much to be done, but the majority of planning is finished and here is how it shapes up.

The exposition will begin at 2:00 P.M. Friday, April 20th with a short opening ceremony. At this time, all exhibits will be ready for public display and will be the "backbone" of the exposition. The forty industrial exhibits will cover every type of manufacture from small transistor equipment to massive machines. Each exhibit will have a representative from the sponsoring company to answer questions and explain operations. This part of the exposition looks very good.

Student exhibits of many types will be shown. There will be stu-

(Continued on page 30)

The Importance of Cable Engineering and Design

Cable engineering is concerned with the design and use of wires and cables to direct the flow of electrical energy from its source to the point of utilization. It is generally more economical to generate electric power in relatively large blocks at strategically located power plants and to transmit it over relatively long distances than to generate in small quantities where it is used.

There are, therefore, two general types of wires and cables used in the electrical industry:

(a) those used for power transmission, usually at voltages above 22 kilovolts,

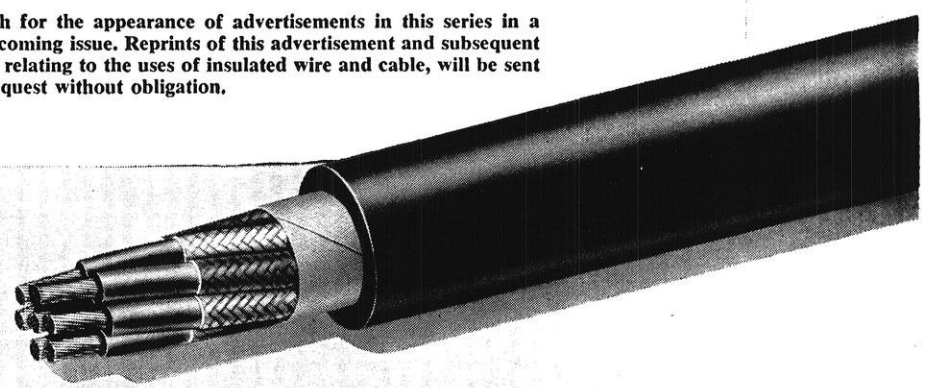
(b) those used for power distribution at lower voltages.

Cables used for power transmission are generally single conductors with no insulation. They are supported on insulators above ground at such separations or spacings that the air provides the required insulation. For power distribution, on the other hand, where the space occupied by the power line is important, insulated cables are used. This discussion deals with the design and use of insulated wires and cables for power distribution systems.

Insulated distribution cables carry power from the transformer stations along the transmission lines to its point of ultimate utilization. The voltages at which power is distributed vary from about 15 kilovolts to 115 volts used in individual homes. The higher voltages are used for the distribution of relatively large amounts of power from the transformer stations to substations nearer the points of utilization, such as industrial plants, where it is transformed to low or utilization voltages, either alternating or direct current. Large quantities of electric power are distributed in this way and the value of the distribution equipment required is great. The value of the insulated conductors, including those for both portable or stationary installations, probably exceeds that of any other single item used in power distribution. The design and operation of insulated conductors and distribution systems are of great public and commercial importance. The primary function of insulated cable engineering and design is to provide safe, adequate, reliable and pleasant appearing distribution systems. Electric power is so extensively used in modern life that interruptions to it are serious. The failure of electrical power in an industrial plant throws people out of work and reduces production.

The appearance or sightliness of cables installed overhead in a community is important and is attained chiefly by installing such cables with a small and uniform sag from pole to pole.

Watch for the appearance of advertisements in this series in a forthcoming issue. Reprints of this advertisement and subsequent ones, relating to the uses of insulated wire and cable, will be sent on request without obligation.



US RUBBER

Electrical Wire & Cable Department

United States Rubber

Campus News

(Continued from page 28)

dents operating much of the equipment in the engineering buildings, such as the turret lathe and plastic molding press. These exhibits will actually show more about the field of basic engineering than will the industrial exhibits.

The foundry, machine shop, and welding laboratory will be in operation, also by students. Other exhibits will include a solar energy display, a Ferrari racing car, and possibly the GM "dream-car". Sounds good doesn't it?

There will be a nominal 25¢ admission charge to help defray the cost of printing a 16-page booklet given to each spectator. This booklet will serve as a guide and explanation of where and what everything is.

Movies will be shown continuously and other entertainment and items of interest will be available to the spectator.

Further Exposition announcements will be made in the newspapers and on radio and television. Watch for them and don't forget, COME TO THE 1956 ENGINEERING EXPOSITION!!

STAFF POSITIONS

Engineering Students interested in editorial, art, photographic, or business staff positions can arrange an interview.

See page 24.

AIEE-IRE

Members of the AIEE-IRE at the Electrical Engineering College enjoyed beer and pizza pie Thursday evening, February 9, after their meeting in Tripp Commons at the Memorial Union. This was the first meeting of this type held on the University of Wisconsin Campus. Gordon Fortney was responsible for the arrangements, which included serving over sixty pizza pies, two quarters of beer and potato chips.

At the meeting 148 electrical engineers were present, representing undergraduate members of the AIEE-IRE and their guests, graduate students and members of the faculty.

The highlight of the meeting was a lecture of "Automatic Control Problems on Piloted Aircraft" given by Mr. Henry Rechtien of the McDonnell Aircraft Corp., St. Louis, Missouri.

Mr. Rechtien, apparently overwhelmed by the large group he was to address, remarked that had he known, he would have brought along the real airplane to illustrate the main controls and structures instead of the small model which he had brought.

A model airplane, connected to the output of an analog computer, was used to illustrate the tendency of an airplane to oscillate about its center of gravity along its longitudinal axis when the controls are used at speeds over 600 mph. To increase the stability of the plane at these speeds, a feedback system was introduced. Since the complex maneuvering of an airplane may be reduced to mathematical equations, the computor is an ideal method for studying the effects of feedback systems.

ENGINEERING INSTITUTES

ELECTRICAL ESTIMATING

April 9, 10

Two full days will be devoted to this subject. One day will consist of a workshop with the registrants working actual problems under the guidance of qualified instructors. The first day will give background information for use in the workshop.

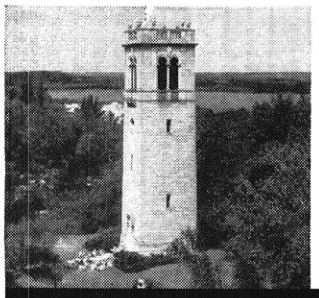
Fee $15. Ralph D. Smith, Institute Coordinator.

ENGINEERING ECONOMICS

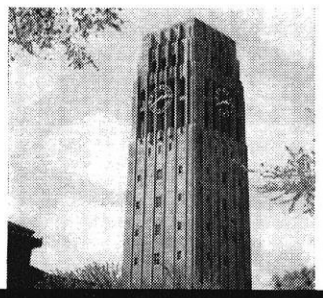
April 11, 12

Because many decisions in regard to the economic selection and evaluation of equipment, methods, and processes require technical knowledge, engineers are being called upon increasingly to either render such decisions or to furnish the necessary information. This institute will present methods and suggestions that will be valuable to technical personnel in calculat-

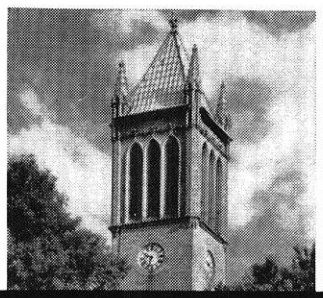
(Continued on page 60)



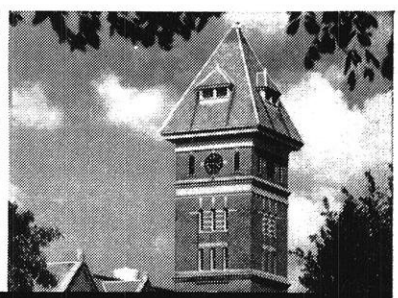
WISCONSIN



MICHIGAN



IOWA STATE



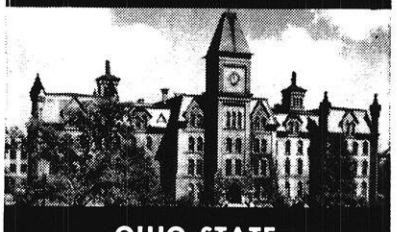
PURDUE

TEXAS A&M

ILLINOIS

PENN STATE

GEORGIA TECH



OHIO STATE

Where do you go from here?

Year after year, we draw on these nine schools for electrical, mechanical, industrial and general engineers.

If you are looking for a future with real opportunities for growth and advancement, Square D has a lot to offer. The potential growth and development of the electrical industry is tremendous—doubling every ten years, in fact. And Square D is a long established, top ranking name in that expanding industry. Equally important, Square D offers the kind of personalized training that equips you to go far . . . *fast!*

Why not let us tell you more about Square D and what we have to offer?

Mail the Coupon

We'd like to send you a brochure, "Your Engineering Career." It gives the simple rules to follow in selecting an engineering career.

SQUARE D COMPANY

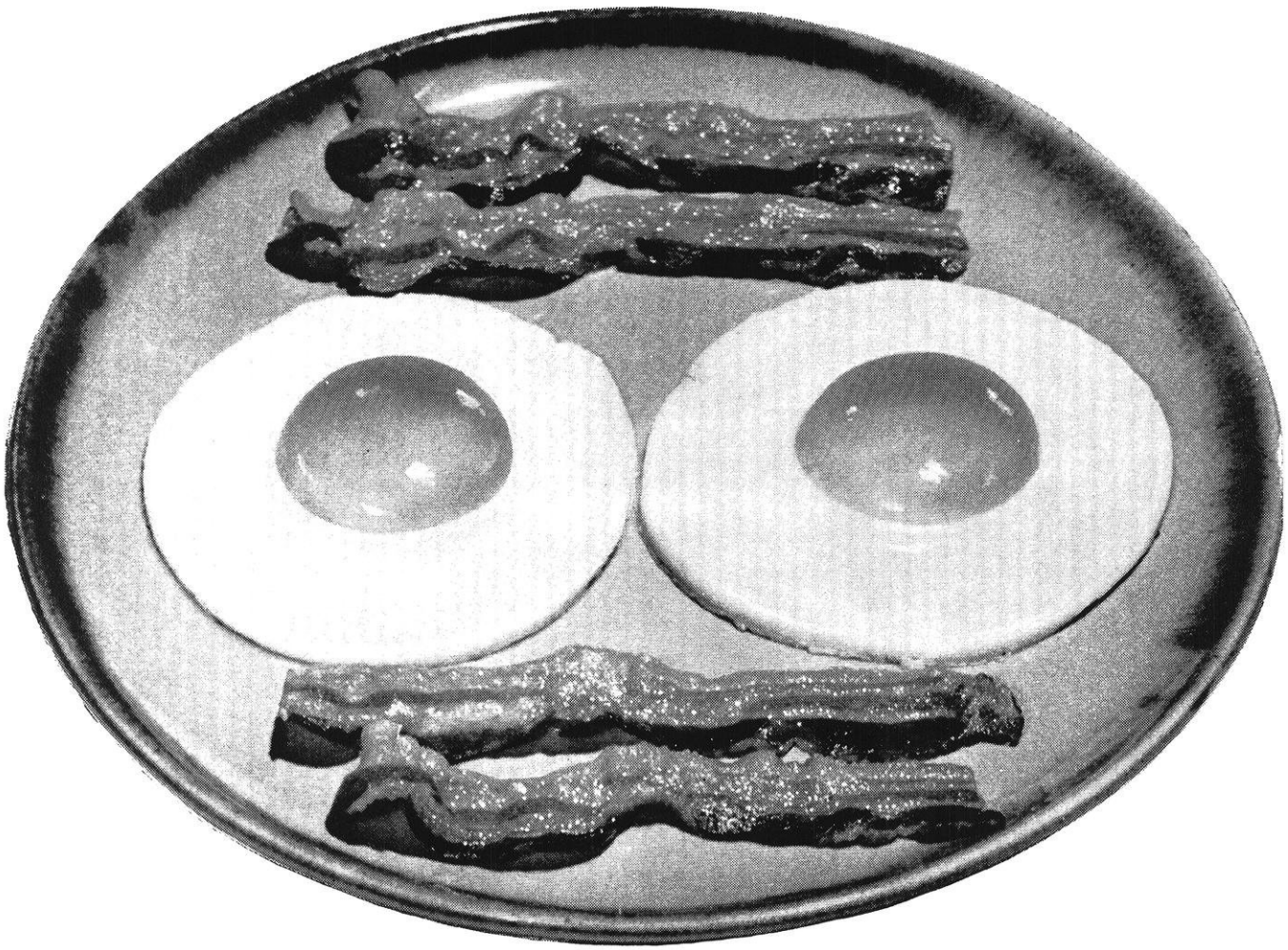
Square D Company, Dept. SA
6060 Rivard Street, Detroit 11, Michigan
I'd like a copy of Square D's brochure, "Your Engineering Career"

Name_____

School_____ Class_____

Address_____

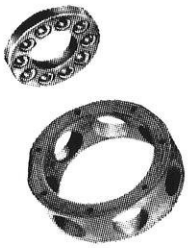
City_____ Zone____ State_____



. . . a combination that's hard to beat!

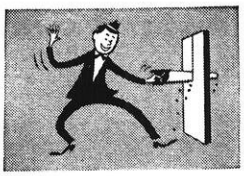
Laminated plastics . . . for a combination of properties that *can't* be beat

SYNTHANE is a favorite material among engineers, designers, and product-conscious executives because it possesses a combination of many properties. It is light in weight, strong; has high dimensional stability, excellent electrical properties and chemical resistance. It's also easy to fabricate.

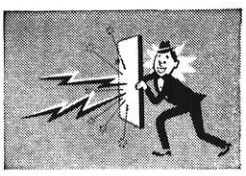


Synthane makes excellent ball bearing retainers. High dimensional stability, wear resistance and non-galling properties keep bearings humming smoothly at 100,000 rpm and up! Synthane's light weight minimizes the effect of any eccentricities, provides lower starting torques, less bearing weight. The Synthane plant has facilities for producing practically every type of laminated plastic retainer known.

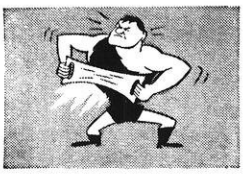
Property combinations! Synthane has them . . . in over 30 individual grades . . . sheets, rods, tubes, moldings and completely fabricated parts. Send for free illustrated catalog today.



EASILY MACHINED



DIELECTRIC STRENGTH



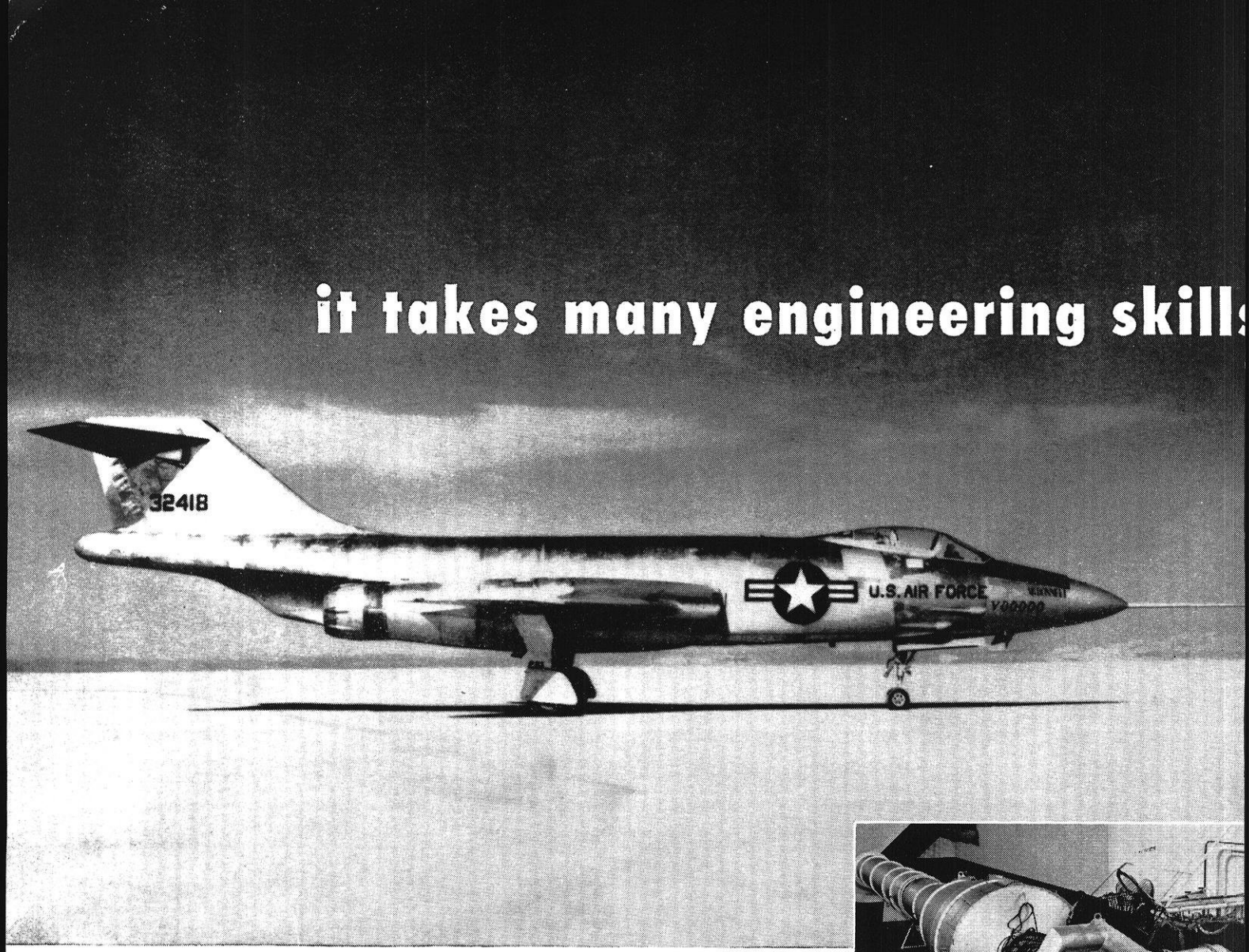
TENSILE STRENGTH

CHEMICAL RESISTANCE

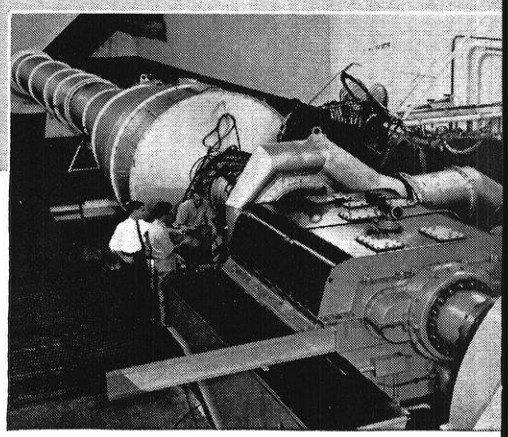
SYNTHANE

SYNTHANE CORPORATION, 13 RIVER ROAD, OAKS, PA.

it takes many engineering skills



McDonnell "Voodoo", *the most powerful jet fighter ever built in America.*



J-57 POWERED AIRCRAFT

MILITARY

F-100	F8U
F-101	A3D
F-102	B-52
F4D	KC-135

COMMERCIAL

Boeing 707

Douglas DC-8

MECHANICAL ENGINEERS are concerned with many phases including experimental testing and development, mechanical design, stress and vibration analysis, combustion research, heat transfer and nuclear reactor development.

AERONAUTICAL ENGINEERS work on innumerable internal and external airflow problems concerned with design, development and testing of aircraft powerplants. Some who specialize in analytical engineering forecast engine-airplane combinations a decade in advance of design.

ELECTRICAL ENGINEERS directly contribute their specialized skills to the analysis and development of controls, systems and special instrumentation. An example is the "Plottomat" which automatically integrates and plots pressures, temperatures and air angles in performance testing.

o create the top aircraft engines

An aircraft powerplant is such a complex machine
that its design and development
require the greatest variety of engineering skills.
Pratt & Whitney Aircraft's engineering team
has consistently produced
the world's best aircraft engines.

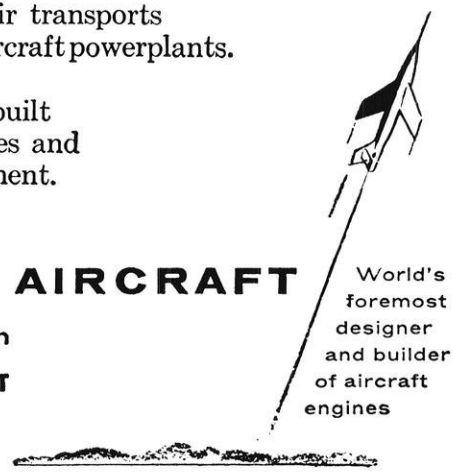
The best planes are always designed
around the best engines. Eight of the most
important new military planes are powered by
Pratt & Whitney Aircraft J-57 turbojets.
The first two jet transports in the United States
will use J-57s. Further, no less than
76 percent of the world's commercial air transports
are powered by other Pratt & Whitney Aircraft powerplants.

Such an enviable record can only be built
on a policy which encourages, recognizes and
rewards individual engineering achievement.

PRATT & WHITNEY AIRCRAFT

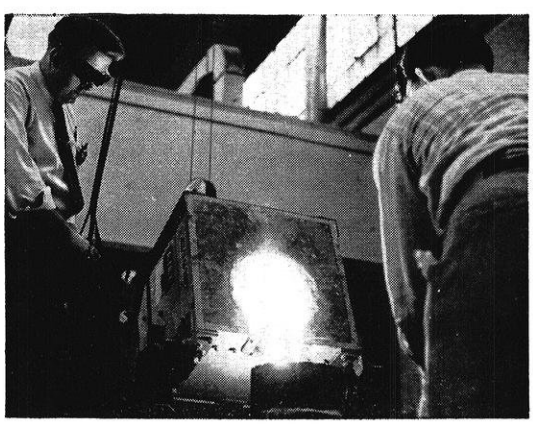
Division of United Aircraft Corporation

EAST HARTFORD 8, CONNECTICUT

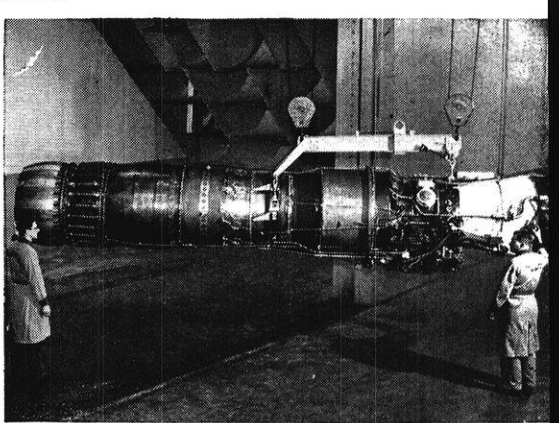


World's foremost designer and builder of aircraft engines

HEMICAL ENGINEERS, too, play an important
ble. They investigate the chemical aspects of
eat-producing and heat-transferring mate-
als. This includes the determination of
hase and equilibrium diagrams and exten-
ve analytical studies.



METALLURGISTS investigate and develop high temperature materials to provide greater strength at elevated temperatures and higher strength-weight ratios. Development of superior materials with greater corrosion resistance is of major importance, especially in nuclear reactors.



WORLD'S MOST POWERFUL production aircraft engine. This J-57 turbojet is in the 10,000-pound thrust class with considerably more power with afterburner.

W. S. P. E.

WISCONSIN SOCIETY OF PROFESSIONAL ENGINEERS

ENGINEERS' CREED

As a professional engineer, I dedicate my professional knowledge and skill to the advancement and betterment of human welfare.

I PLEDGE

To give the utmost of performance, to participate in none but honest enterprise, to live and work according to the laws of and the highest standards of professional conduct. To place service before profit, the honor and standing of the profession before personal advantage, and the public welfare above all other considerations. In humility and with need for Divine Guidance, I make this pledge

—Photo by Clair J. Wilson

Newly elected officers are: seated, A. L. Genisot, 1st Vice Pres., A. G. Behling, President, Clifford Nelson, 2nd Vice Pres.; standing: H. N. Kingsbury, Secretary-Treasurer, Theron Brown, director, and W. G. Bryan, director.

ANNUAL MEETING

The Wisconsin Society of Professional Engineers at their 13th Annual Meeting at the Schroeder Hotel in Milwaukee Saturday, January 28th, elected the following new officers:

A. G. Behling, Milwaukee Consulting Engineer, president; A. L. Genisot, President, Genisot Engineering Company, Rhinelander, First vice president; Clifford Nelson, President, Nelson Construction Company, Black River Falls, second vice president; Harold N. Kingsbury, Madison, Committee on Water Pollution, State of Wisconsin, secretary-treasurer, and Theron Brown, Madison Gas & Electric Company, director, and Wayne G. Bryan, Director of Public Works, Neenah, director.

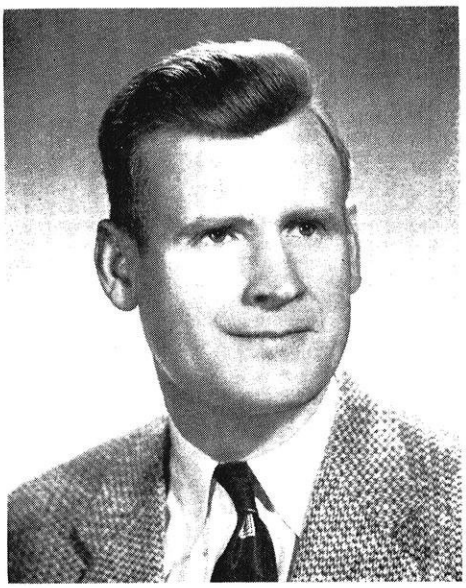
Speaking before the Wisconsin Society of Professional Engineers at their 13th Annual Meeting, Saturday Noon Luncheon, Mr. T. A. Abbott, Manager of Research Engineering at Standard Oil Company of Indiana cautioned that many pupils are lost to engineering and science because they are ill advised when entering high school. If the pupil does not take Algebra he closes the door to an engineering or science career. He encouraged engineers to use their experiences and take part in planning and running our schools. He said we probably need teachers more than engineers.

Mr. Abbott suggested engineers in industry could help by supporting science clubs, science fairs and field trips. He noted that summer study for advanced degrees often represented a hardship to teachers supporting a family and suggested industry provide scholarships for teachers as it does for undergraduate students.

Outstanding Engineer Award was given by Wisconsin Society of Professional Engineers to Edwin J. Kallevang, retired Vice President of Engineering, Wisconsin Power and Light Co. While Mr. Kallevang is retired he has been active in engineering circles and has served his profession untiringly. The award was presented at the Society's 13th Annual Meeting in Milwaukee.

(Continued on page 38)

Meet the President



WILLARD W. WARZYN
Southwest Chapter President

Always one for action at the exact time when the best will come of it, Willard W. Warzyn, President, Southwest Chapter Wisconsin Society of Professional Engineers, married Jeanne Carroll the day he graduated from the University of Wisconsin with a B.S. degree in Civil Engineering June 1, 1942.

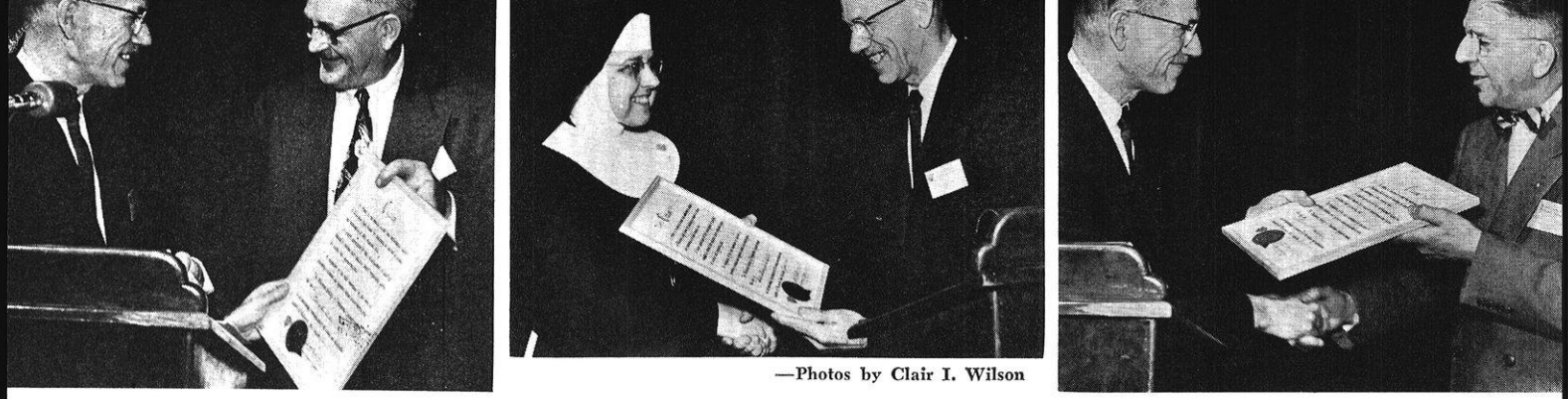
Foundations are Engineer Warzyn's specialty. Professionally he prevents cracks in structures, morally he's against a crack showing up anywhere. Family, church, community, professional society, or in his own consulting firm, you'll find Willard Warzyn, not at the top making bumptious noises, but down where the hip boots and the roots are, testing, trying, guiding, designing solidity, so that whoever or whatever follows may build upward in confidence.

From graduation to 1946, Warzyn was with the Dravo Corporation, Pittsburgh, Pennsylvania, in the Engineering Works & Contracting Divisions on crane and bridge design, and construction, then a year with Rust Engineering, also of Pittsburgh, on structural design of reinforced concrete and structural steel for industrial plant construction, and from 1947 to 1955 with Mead and Hunt of Madison, Wisconsin, as design engineer, later chief structural engineer, working largely on design of hydro electric plants. On June 1, 1955, Willard organized his own firm, the Warzyn Engineering and Service Company, Madison, in the field of foundation and structural engineering, and particularly prepared for soil boring and analysis.

Member of the American Concrete Institute, Madison Technical Club, American Society of Civil Engineers, as well as N.S.P.E. and W.S.P.E., Willard Warzyn is known as a quiet digger who can and will speak up when there's something to say, but only after thorough preparation and consideration of all the angles.

Best one-word description of Willard is dependability. That's why the boys in W.S.P.E. and A.S.C.E. put him on their legislative committees, a spot that turned out to be a seven-year job, culminating as State Legislative Committee Chairman for W.S.P.E., a chair on the Southwest Chapter's Board of Directors, and then Chapter President. That's what the Lake Edge Congregational Church at Madison was after when they made him Building Committee Chairman for the $100,000 addition to the church as an educational unit.

Father of 3 girls, (10 and twins of 8), President Warzyn likes to spend his hobby hours at music, both he and Mrs. Warzyn sing in the church choir, and Willard pulls a good bow on the violin. Come spring, summer and autumn, any free time left over from his busy schedule finds him gardening. END



—Photos by Clair I. Wilson

University of Wisconsin Dean of Engineering Kurt F. Wendt presents W.S.P.E. Citations to high school teachers Frederick W. Schuler, Sister Mary de LaSalle, and Henry P. Hertz (left to right).

HIGH SCHOOL SCIENCE TEACHERS HONORED

Three teachers were honored as outstanding science teachers by the Wisconsin Society of Professional Engineers, Saturday, January 28th at their 13th Annual Meeting. They were Frederick W. Schuler, West High School, Madison, Wisconsin, Sister Mary de LaSalle, Pius XI High School, Milwaukee, Wisconsin, and Harry R. Hertz, Brandon Public High School, Brandon, Wisconsin.

Taking part in this ceremony were John Gammell, Director of Graduate Training, Allis-Chalmers Manufacturing Company, Kurt F. Wendt, Dean, College of Engineering, University of Wisconsin, William D. Bliss, Dean, College of Engineering, Marquette University, and Fred J. Van Zeeland, Dean of Engineering, Milwaukee School of Engineering.

The citation read:

"In tribute to the physical science and mathematics teachers of Wisconsin High Schools for developing an interest in science and mathematics in their students, and

In sincere appreciation for their encouragement of qualified students to continue their education toward professional degrees in science and engineering, and

In recognition of the vital importance of this work in developing scientists and engineers needed to keep America great . . . .

The Wisconsin Society of Professional Engineers presents to the outstanding representative of the science and mathematics teachers of Wisconsin, this citation."

PRESIDENT'S REPORT TO THE WISCONSIN SOCIETY OF PROFESSIONAL ENGINEERS

January 26, 27 and 28, 1956

A. O. Ayres

Your President is pleased to make the following report covering the first six months of this administrative year.

All excepting standing committees, were appointed and were functioning late in August. The Chairman of each committee was requested to hold an early meeting and work out a program for the ensuing year. It was suggested that the preceding committee chairmen should be contacted and invited to these meetings. The committee chairmen were responsive to this suggestion and developed excellent agendas for the year 1955–56. The final results will not be evident until later in the year. A report of results to date of these committees will follow later in this program.

The agenda for an annual business meeting always includes the President's Report. What does the membership expect the President to report? The society is made up of its officers, Board of Directors, current and standing committees. A society's progress must take place through committees and therefore your President's Report must give some explanation of his activities from a purely administration standpoint. In this regard I hasten to make the statement that every committee has given the Board and the officers their 100% cooperation.

The Board of Directors has held many more meetings than is customary in our society. This was due largely to the urgency of legislative matters in reference to the passage of Bill 688, A. At each of these meetings the Board has been pressed for time to complete its agenda. One of the reasons for this has been the active interest of committee chairmen present at these meetings and the Board has many times taken time out of regular business to consider their problems.

The question has come up for years regarding the administration of the state secretary's office. This year is no exception and we are faced with the same problem now. It is of course recognized that a paid full time stenographer and office clerk, and later a full time executive secretary is most desirable. This matter together with a reconsideration of the location of the state secretary's office has been referred to a committee of the Board and will receive further study. This is mentioned to the Convention for the reason that I have received many inquiries—both verbal and written—from various parts of the state on the question of secretarial service. It has been definitely concluded that the administration of your WSPE budget does not make provision for expansion of secretary's office organization without considering a voluntary form of membership, viz., "sustaining".

I have given a lot of thought to our WSPE organization on the state level and have reviewed the policy followed in the present and past administrations. In comparing our organization with many others, with particular reference to the larger ones, it would seem advisable to have a clear and well or-

ganized record available at all times of the engineers who have served the WSPE in offices and on committees. Such a log of the records of these men would be of great value to incoming administrations when new committees are set up. This record would also have the effect of honoring the individuals for their sacrifice or time and effort made in the past. This in itself would be stimulating to the society in its effort to enlist in the active service intelligent and competent members. If such a record was established and made a permanent part of the secretary's records, available to a committee on committees the society should benefit by maximum results. The advantages of such a system are too numerous to mention in this report; however, a very important reason would be that when emergencies arise in legislative or other matters the right personnel can be selected quickly to represent our society.

Up to this time I have visited all of the Chapters in the state and most of them several times. I should like to make another recommendation in the interest of coordinating intra and inter chapter activities. The chapters will be administered within their organizations as such more successfully if their presidents meet several times annually at some central point, a state society officer to be present.

Many of the other state societies, including Michigan, Illinois and Ohio carry out this plan.

In conclusion I find myself in the same position as past presidents —in having reached just the half way point in the administration and would like to be able publicly to express appreciation to them for a completed job. I do want to thank each and every engineer who has participated in our committee programs and to further state that the Board of Directors have received every cooperation from these men. We extend our thanks now.

Since the society undertook a very serious problem during the latter part of the former administration, namely—the passage of Bill 688, A—I want to extend the congratulations and thanks of the Board and officers to Ed Kellevang, Charles Nagel and their committees for spearheading this important task. No engineering society in this country ever accomplished more in the same time. The individual members of WSPE throughout this state are to be congratulated for having gone to work in that emergency to protect the interest of the engineer and they were successful. We all should be proud of ourselves.

Your administration expects to have the same response in the months to come as it has had since the middle of last summer—in carrying out the objectives of this organization.

In recognition of the services and outstanding contributions by Edward J. Kallevang to the administration and development of Society affairs while serving as President, as Chairman of the Legislative Committee and as its representative to the National Society and for his continued interest in the advancement of the engineering profession, hereby awards him this testimonial.

Membership Report

January 28, 1956

During the course of this past year, January 28, 1955 to January 28, 1956 the Board of Directors held eight regular meetings and one special meeting to carry on the business and direct the activities of the society.

Meetings were held in Milwaukee, Madison and Lake Delton on the following dates—March 12, May 6, July 9, August 20, September 16, October 15, December 3, 1955, January 7 and January 26, 1956. A special meeting was held July 23, 1955.

Total members and affiliate members as of January 28, 1955:	
Members	1087
Affiliate Members	83
	1170
Losses since January 28, 1955:	
Deceased	9
Dropped (Non-payment of dues)	36
Resigned	20
Transfer to other state	2
	67
Change of Classification:	
Engineers-in-training to Professional Engineers	6
Additions:	
Members	118
Affiliate Members	42
Reinstatements	6
	166
Total Members and Affiliate Members as of January 28, 1956:	
Members	1150
Affiliate Members	119
Total	1269

ANNOUNCEMENT

It is appropriate at this time to announce that our Society has not been unmindful of the many outstanding contributions to engineering technology and to the engineering profession by the late Edwin W. Seeger.

I am sure you will be pleased to know that your President has asked

Friday noon Luncheon, Schroeder Hotel

the President of the Engineers' Society of Milwaukee to act as the chairman of a committee to develop the possibilities open to us to provide a suitable memorial to commemorate the memory of Mr. Seeger and his many accomplishments.

The committee will consist of three members: Mr. Edwin T. Sherwood, the chairman, who represents the Engineers' Society of Milwaukee, for which Mr. Seeger, at one time, served as President; Mr. Justin A. Duebel, who represents the Milwaukee Chapter of the American Institute of Electrical Engineers, for which Mr. Seeger was elected a Fellow; and Mr. Fred T. Agthe who represents the Wisconsin Society of Professional Engineers, for which Mr. Seeger served as President, Director, and National Representative, and as a Vice President of the National Society of Professional Engineers.

"Ed." as he was affectionately called, took an active interest in engineering society affairs and was a vital factor in many of the important society developments of this community.

Your President is confident that the committee will find a suitable means to perpetuate the name and memory of Edwin Seeger, who was beloved and respected by all of us.

ENGINEERS IN STATE EMPLOYMENT

Many department heads in state service in Wisconsin are wondering these days where to find competent trained engineers to fill the gaps in their engineering personnel. The dearth of engineers desiring state positions is well known and this, in spite of the rosy promises of paid vacations, sick leave, cost of living bonus and retirement benefits, offered the prospective client for a career position in state engineering work.

The two primary incentives, however, namely—promotion to the better positions and a pay scale commensurate with the responsibility of these positions are not so clearly defined.

A recent inquiry sent to ten states from California to New York showed appreciably higher salary schedules in effect in these states. More rigid entrance requirements are also specified. However, the graduate engineer registered in Wisconsin could meet these requirements were they enforced in Wisconsin, and no doubt would welcome the chance to do so particularly for positions in the higher classifications.

In Ohio, for example, Grades I to X, are used to classify the engineering positions. It is a definite requirement for each and every grade that the applicant possess at the time of employment a license as a professional engineer registered in Ohio. The other states contacted had similar requirements, or in lieu thereof, the requirement for graduation from an accredited college of engineering. In addition, in most states a comprehensive written examination is required.

Contrast this with the requirements in Wisconsin, where in the Grades I to VI only for the highest two grades, V and VI is registration mentioned at all and even then the wording "registration or eligibility therefor" is weak and not specific. Also in Wisconsin, for all grades, graduation from an accredited engineering college is listed only as a "desirable" qualification. Further, written examinations are not required for placement in the better paid engineering positions, but only an oral interview of ten to fifteen minutes duration, wherein nothing of technical nature is discussed. Under these conditions, a properly qualified engineering graduate who is considering a position in engineering in Wisconsin State Service must view possible promotion incentives with some scepticism, knowing that he may have to compete with a non-graduate, who likely is not registered and who, as a consequence, will no doubt be satisfied with generally lower salaries.

Viewing this picture objectively, the properly qualified engineer is likely to seek employment where the incentives of an adequate salary schedule and orderly promotional procedure are more clearly defined.

Some state department heads, when confronted with these views, state that they do not dare to raise the standards to the levels required by other states as they feel that the available supply of engineers will become even more limited. Evidently department heads in other states have no such fears.

Such a change in policy in Wisconsin would be more likely to result in salaries for engineers which are more in line with those paid by other states and the nation as a whole for similar classifications. With this incentive, engineers would once again be attracted to positions in state service. The result would not be a decrease, but rather an increase in the number of qualified engineers available for state work. The incentives of an adequate salary and an orderly promotional procedure would once again be present for those engineers interested in state employment.

P. H. Thern, P. E.

ENGINEERS ATTENDING FROM OTHER STATES

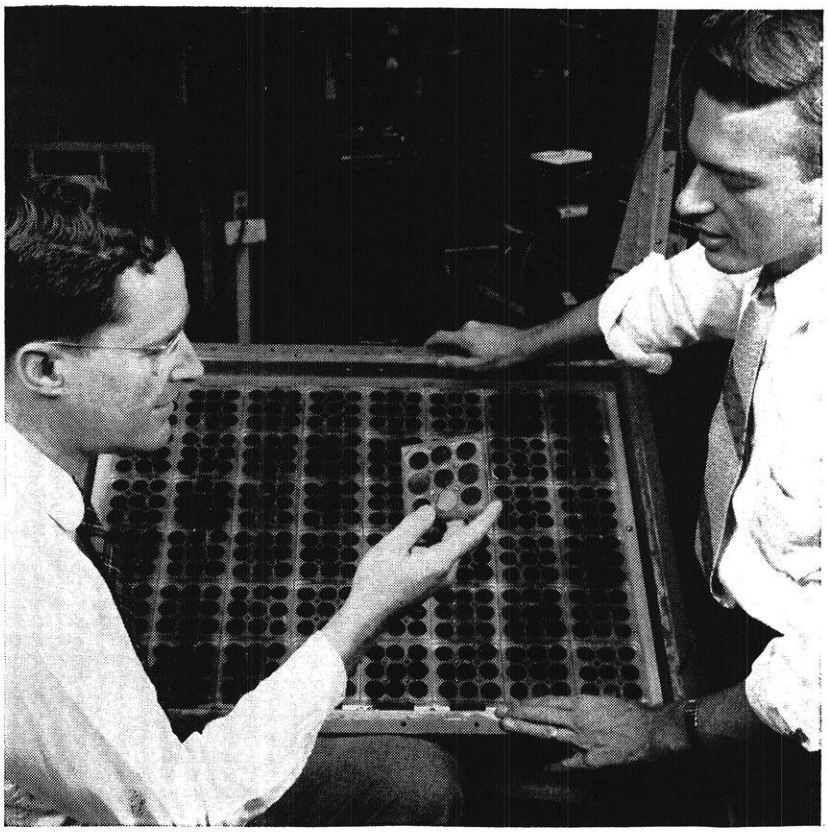
The Wisconsin Society of Professional Engineers was most happy to have the following out of state Professional Engineers present at our Annual Meeting:

Paul H. Robbins, Executive Director, N.S.P.E., Washington, D. C.
Arthur W. Tews, Pres. of M.S.P.E., St. Paul, Minn.
Hal E. McWethy, Executive Secretary, M.S.P.E., St. Paul, Minn.
James J. Ryan, Past President, M.S.P.E., St. Paul, Minn.
Norman Brewer, Kalamazoo, Mich.
W. L. Collins, Secretary of Am. Soc. of Engrg. Edu., Urbana, Ill.
Floyd J. Stanek, Univ. of Illinois, Urbana, Ill.
T. A. Abbott, Std. Oil Co., Whiting, Indiana
J. D. Coleman, Gen'l. Motors, Dayton, Ohio
Virgil E. Gunluck Chi. Transit Authority, Chicago, Ill.
C. Y. Thomas, Vice President Spencer Chemical Co., Kansas City, Mo.

(Continued on page 42)

How the Bell Solar Battery Converts Sunlight into Electricity

Another example of the pioneering opportunities for engineers at Bell Telephone Laboratories



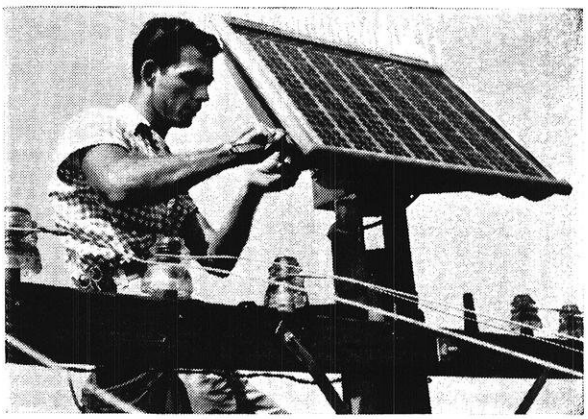
In a career with Bell Telephone Laboratories, young engineers and scientists can expect to take part in pioneering radically new developments in the field of communications. One such development is the Bell Solar Battery.

Like the transistor, the Bell Solar Battery was invented by Bell System scientists. Indeed, it was the study of semiconductors which revealed the fact that sunlight could induce the movement of electrons in silicon and thus create electric current.

The basic unit of the Bell Solar Battery is a thin disc compounded of two kinds of treated silicon. The body of the disc is silicon with a trace of arsenic to provide negative potential. Into this body boron is diffused, to a depth of less than 1/10,000 of an inch, providing positive potential. The junction of these layers of treated silicon is the "*p-n*" junction. Equilibrium between the *p* and *n* regions is upset when the disc is exposed to sunlight, which jolts electrons free, and causes them to move across the *p-n* junction. The charges pass through contacts, and current — though a small amount — flows.

In the past year, the efficiency of the Bell Solar Battery has been increased from 6 to 11%. Right now, in Americus, Georgia, the battery is being used experimentally to power a rural telephone system. And more widespread application is in the offing.

The Bell Solar Battery is one of many developments underway in the Bell System to improve America's telephone service. The special role of Bell Telephone Laboratories in forwarding the exciting search for tomorrow's better telephone service is creating many fine career opportunities for young scientists and engineers. Your placement officer can give you more information about careers with Bell Telephone Laboratories, and also with Bell Telephone Operating Companies, Western Electric and Sandia Corporation.



The Bell Solar Battery consists of 432 silicon discs wired together. It is mounted on telephone poles to catch prevailing sunlight, and on a sunny day can produce 10 watts. Excess energy is fed into storage batteries, to be used at night or in bad weather.

BELL TELEPHONE SYSTEM

W.S.P.E.

(Continued from page 40)

Chapter News

SOUTHWEST CHAPTER

CHAS. M. PERLMAN

30 Registered Engineers of the Rock County area were guests of the Southwest Chapter of W.S.P.E. at the Morse Hills Country Club on Tuesday evening, Jan. 31 to hear a talk on the scope and purpose of professionalism in engineering.

Professor Paul Grogan of the University of Wisconsin showed the need for engineers in the technical organizations to be part of a group which is devoted to professional, ethical, economic, and social life of the engineer. Professor Grogan presented a brief history of W.S.P.E. and its progress since it was founded in 1934.

Professor Ben Elliot, active in affairs of the National Society of Professional Engineers, briefed the group on how the Society promotes the economic and social welfare of the engineer. Professor Elliot pointed out that the professional status of the engineer has made great strides, and that N.S.P.E. is well recognized in legislative actions.

Mr. E. J. Kallevang, retired Chief Engineer of the Wisconsin Power and Light Company, gave a brief report on recent salary survey report conducted by the N.S.P.E. He also pointed out the active part taken by W.S.P.E. in state legislation affecting the health, welfare, and safety of the public.

President Ayres, Paul Grogan and Page Johnson were responsible for making the arrangements for the dinner meeting. Much credit is due Mr. Walther Fischer and Mr. Ervin Dahlund of Fairbanks–Morse Company for local arrangements. Approximately 15 officers and committee chairman from the Southwest chapter and the State Society were present.

The interest that the "get-together" has created is most gratifying, 38 engineers requested the University of Wisconsin Extension Division to start refresher courses in preparation for registration. Additional W.S.P.E. application blanks have been requested from registered engineers in the area. Needless to say, Page Johnson, Chairman of our Membership Committee, is keeping up with the demand.

* * *

Effective January 3rd of this year, John Glaettli, Jr. was appointed Assistant State Chief Engineer, in which position he will direct the activities of the five divisions of the Bureau of Engineering.

He was born in Milwaukee and received a BS degree in Civil Engineering from the University of Wisconsin in 1909. Since 1931 he has been with the State of Wisconsin as engineer for the Department of Public Welfare and for the State Bureau of Engineering.

Prior to 1931 he was associated with the University of Wisconsin as instructor in structural engineering, with the United States Shipping Board as a structural engineer, and for a period of eight years was a structural engineer and superintendent on numerous buildings in the city of Madison.

He is a member of the National Society of Professional Engineers, and S. W. Chapter of W. S. P. E. and is an Associate Member of ASCE.

WESTERN CHAPTER

M. L. HOGLUND

The new officers for this year are:

James W. Johnson, President
John R. Mangan, Vice-President
J. Robert Koenig, Secretary-Treasurer
Manford P. Hanson, Director

Directors James M. Allen of the State Highway Commission, and Norman Moser of Dairyland Power Cooperative continue their terms in office, and complete the roster of Chapter officers.

Following is a brief biographical sketch of each of the officers that were elected.

Johnson attended Eau Claire State College and the University of Wisconsin. He has been employed by the State of Wisconsin Highway Commission from 1926 to the present time. He has previously served as Director and Membership Chairman of the Western Chapter.

Mangan is a graduate of the Illinois Institute of Technology five-year cooperative course in Mechanical Engineering. He was employed by Goodyear Aircraft and was in charge of Refrigeration Research Division. Following this he spent a year in consulting work in Eastern United States. He was employed by The Trane Company in 1948, and is now Superintendent of the No. 2 plant of The Trane Company. He is currently completing his second term as Secretary-Treasurer.

Koenig was graduated from Marquette University in 1935 in electrical engineering. He was then employed by The Trane Company after which he was employed by the U. S. Navy Bureau of Ships, contract design division. He has been employed by Dairyland Power Cooperative from 1948 to the present time.

Hanson was graduated from the University of Minnesota in 1929 in mechanical engineering. He was employed by the Frigidaire Corporation from 1929 to 1930. He was employed by the Northern States Power Company in 1930 and worked in the results department at the Highbridge and Riverside Steam Generation Stations. He came to La Crosse in 1940 as Assistant Superintendent of the French Island Steam Generating Plant of Northern States Power Company. He is now Superintendent of that plant.

At this meeting special tribute was paid to Thomas Reynolds, retired chief division engineer of the State Highway Commission and founder and first president of the Western Chapter, for his serv-

(Continued on page 44)

At David Sarnoff Research Center, Princeton, N. J., RCA tests one of loudspeakers used in new high fidelity "Victrola" phonographs.

RCA creates a new kind of high fidelity in the silence of this room

In this room you *can* hear a pin drop. The jagged walls absorb alien noise so that delicate instruments can make sure reproduced sound matches the original as closely as possible.

Thus a new kind of high fidelity is born—and brought to you for the first time in new RCA Victor Orthophonic "Victrola" phonographs. *Listen!* Here is distortion-free performance through the range of audible sound. Here is *more* music than you've ever heard before. Here is the ultimate in high fidelity.

The skill behind new Orthophonic "Victrolas" is inherent in all RCA products and services. And continually, RCA scientists strive to open new frontiers of "Electronics for Living"—electronics that make life happier, easier, safer.

WHERE TO, MR. ENGINEER?

RCA offers careers in research, development, design, and manufacturing for engineers with Bachelor or advanced degrees in E. E., M. E. or Physics. For full information, write to: Mr. Robert Haklisch, Manager, College Relations, Radio Corporation of America, Camden 2, N. J.

RCA®

RADIO CORPORATION OF AMERICA

Electronics for Living

W.S.P.E.

(Continued from page 42)

ices to the engineering profession. President Brindley did this on behalf of all of the members of the Western Chapter.

MILWAUKEE CHAPTER

R. M. LYALL

Announcement of new officers of the Milwaukee Chapter for the coming year was made by President Wes Lallier during the annual meeting held Jan. 28. The new administration is headed by Karl Werwath, president of the Milwaukee School of Engineering. Other officers elected include E. C. Koerper, vice president, A. R. Striegl, director, and J. Randall Myer, sec.–treas. The new officers will assume their posts July 1, 1956.

Thursday Luncheons

The Thursday luncheons continue to highlight good food and good fellowship sprinkled with an occasional special event of current interest. During the past month we heard the story of colored Television from Herb Zwarra of the Telephone Company and had an opportunity to preview General Electric's new film "This is Automation."

The Opinion-Meter demonstration has been rescheduled to March 15 to permit us to see the Automation film.

An especially attractive luncheon meeting was scheduled for Feb. 16 when W. A. Pollack of the Electric Co. discussed Peacetime uses of Atomic Energy. Pollack has been a student of this subject since it first came on the horizon and we are expecting a message of special significance.

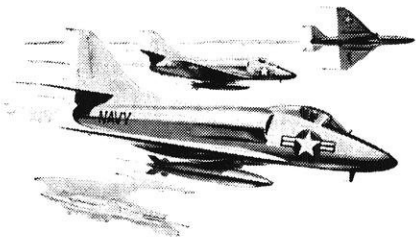
National Engineers Week activities were under the direction of Carl Mathies. A number of events and devices are implemented to acquaint the general public with the contributions of the Engineering profession toward our present day standard of living and to a brighter future.

Arrangements were made to have the electric sign on the City Hall proclaim Engineers Week and Mayor Zeidler issued a special letter designating Feb. 19 to Feb. 25 as Engineers Week in Milwaukee. A similar proclamation was issued by Governor Kohler in Madison.

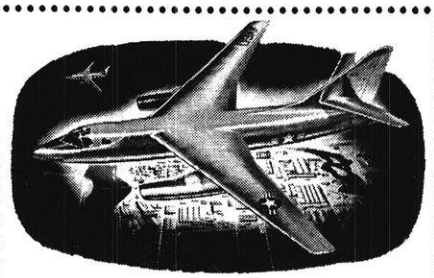
Television and radio told the Engineers Week story with spot announcements and special programs on achievements of the profession. Newspaper coverage will be given to significant events.

Special window displays were made in several downtown stores as well as the Telephone Building, the Milwaukee Gas Light Bldg. These displays included machinery manufactured in Milwaukee, and highlighted Engineering achievements of Wisconsin companies. Engineers Week posters appeared in many store windows and in all High Schools. Vocational guidance speakers are being made available to the local High Schools and Colleges. END

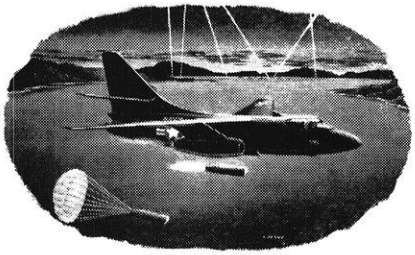
F4D, "SKYRAY"— only carrier plane to hold official world's speed record



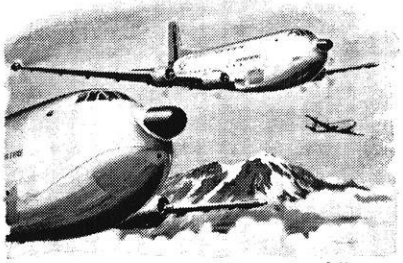
A4D, "SKYHAWK"— smallest, lightest atom-bomb carrier



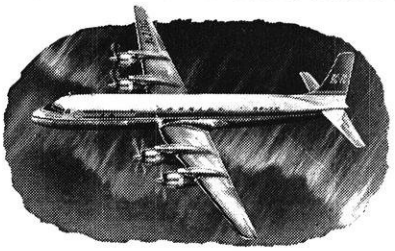
RB-66 — speedy, versatile jet bomber



A3D, "SKYWARRIOR"— largest carrier-based bomber

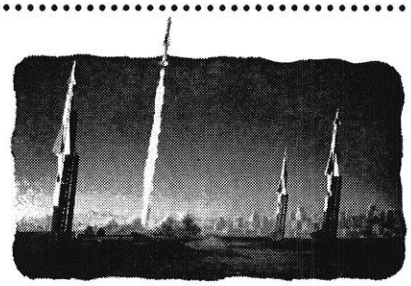


C-124, "GLOBEMASTER"— world's largest production transport

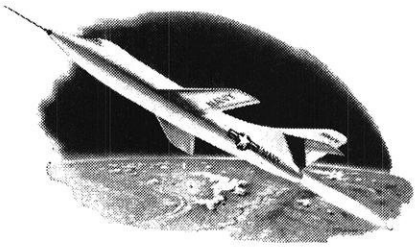


DC-7 "SEVEN SEAS"— America's finest, fastest airliner

Engineers: join this winning team!



"NIKE"— supersonic missile selected to protect our cities



D558-2, "SKYROCKET"— first airplane to fly twice the speed of sound

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Challenging opportunities now exist in the following fields:

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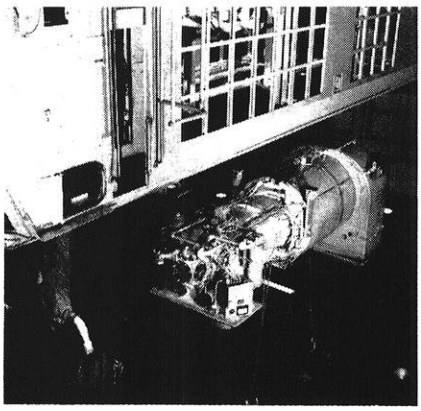
C. C. LaVene, Employment Manager... Engineering General Office
3000 Ocean Park Blvd.... Santa Monica, California

SCIENCE HIGHLIGHTS

edited by Ted Witzel, EE'57



RAILROAD POWER CHAMP

The Union Pacific Railroad has ordered fifteen 8500 h-p gas turbine-electric locomotives from the General Electric Company and has expressed intent of ordering two additional blocks of fifteen locomotives each. It is believed these units will be the most powerful internally-powered locomotives ever built.

Total cost of the 45 locomotives would be in excess of $38,000,000.

Currently Union Pacific has a fleet of twenty-five 4,500 h-p gas turbine-electric locomotives in service.

The new locomotives will be built in two sections (permanently coupled together) with an enginemen's cab at one end. A fuel tender will be coupled behind the locomotive. Geared for freight service, they will have a top speed of 65 miles per hour and will weigh 408 tons on 12 axles. Over-all length with the fuel tender will be 165 feet 8½ inches and height will be 16 feet 2 inches.

Gas turbine-electric locomotives pack a large amount of power into a comparatively small space, require no water, have fewer moving parts than other types of similar horsepower and use a low cost bunker C oil as fuel.

The fuel tenders for the locomotives are being built by Union Pacific. They are used in order to keep the weight of the locomotive on the driving wheel constant instead of losing weight and traction as the fuel is burned.

The fuel tenders will be 46 feet 5½ inches long and will have a capacity of 24,000 gallons. They will be insulated with four inches of glass wool in order to retain the heat of the fuel which is heated as it is placed aboard.

EARTH SATELLITE

General Electric will build the first stage rocket propulsion system for the earth satellite which will be launched in 1957 in connection with the International Geophysical Year. The program, "Project Vanguard", was recently announced by the Department of Defense. The satellite's power plant will be the fifth major engine to be designed and produced by the company.

GE's first major engine, which had a thrust rating of 16,000 pounds, was produced in 1950 for the company-designed Hermes A-1 missile. Prior to 1950 reconstructed and launched were many German V-2 missiles in addition to research done on new rocket engine designs.

The company's two-stage Bumper program was a significant preliminary step in the development of a satellite. It helped solve the problem of starting rocket engines at high altitudes.

Started in 1946, the Bumpers were composed of a WAC Corporal missile mounted on a V-2. After the V-2 burned out in flight, the second stage fired and ascended under its own power.

The fifth of these two-stage rockets, fired in 1949, exceeded the minimum orbital altitude required for satellite operation, gaining an altitude of 244 miles. The velocity, however, – 5150 mph – was only about one third that needed to establish orbital flight. Engineers believe that, had the Bumper rocket been multi-staged, the added thrust and velocity of the added stages could have resulted in an artificial satellite.

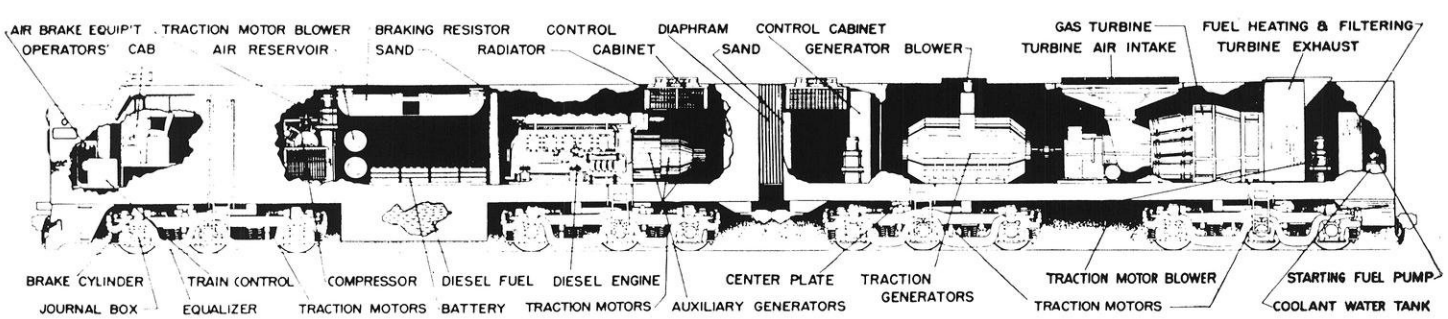
'CAT EYE' ELECTRONICS SYSTEM PERMITS AIRMEN TO SEE IN DARK

An optical amplifier enabling airmen to see in the dark with daylight clarity is being perfected by the Air Research and Development Command.

Known popularly as "Cat Eye," the electronic system is intended for use by a human or in conjunction with instruments.

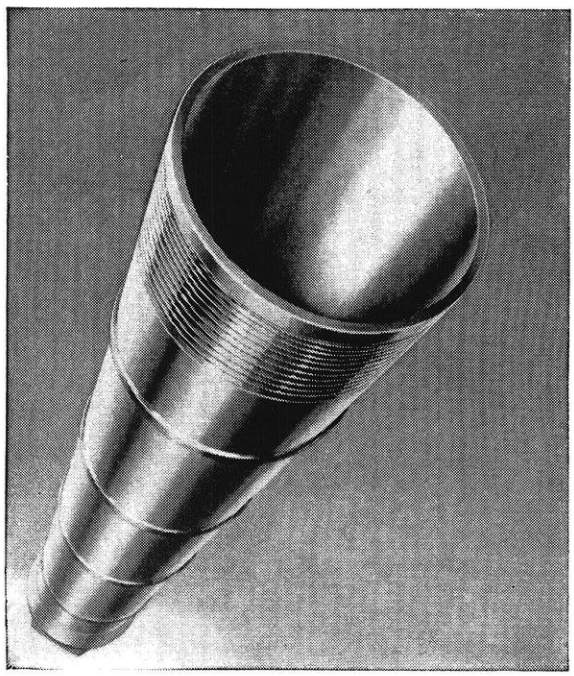
Working on principles similar to TV, the optical amplified is approximately 1,000 times more sensitive than a standard television camera. In use, it presents a cath-

(Continued on page 48)



Another page for **YOUR STEEL NOTEBOOK**

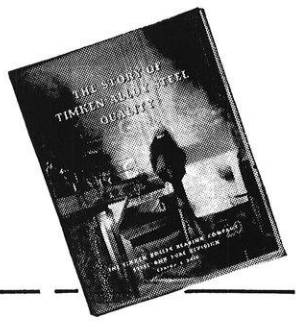
The bomb that's built not to explode



This cylinder is called an accumulator. It's used in aircraft to store hydraulic pressure, principally for raising and lowering landing gear and wing flaps. Its working pressure amounts to 3,000 pounds per square inch—so great that faulty material or construction would cause the accumulator to burst with the deadly power of a bomb. The manufacturer was having trouble with variations in the strength and quality of the steel being used. Defects showed up after machining. Rejects were running at a high rate.

The manufacturer called in metallurgists of the Timken Company for help in solving the problem. They recommended a certain analysis of Timken fine alloy seamless steel tubing, specially heat-treated for this application. Result: since switching to Timken fine alloy steel, the Company reports each accumulator can be tested safely at 6,000 pounds per square inch—twice its working capacity—and that rejects are now a rarity.

Want to learn more about steel or job opportunities?



Some of the engineering problems you'll face after graduation will involve steel applications. For help in learning more about steel, write for your free copy of "The Story of Timken Alloy Steel Quality." And for more information about the excellent job opportunities at the Timken Company, send for a copy of "This is Timken." Address: The Timken Roller Bearing Company, Canton 6, Ohio.

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

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Fine Alloy
STEEL

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING

Science Highlights

(Continued from page 46)

ode ray tube image not unlike a television picture. Even when used under the poorest lighting conditions at night, it presents a clear, sharp picture.

The optical amplified is expected to become an invaluable aid to the Air Force as a reconnaissance tool. In a flight test airborne observers were able to see the ground clearly on a moonless, winter night.

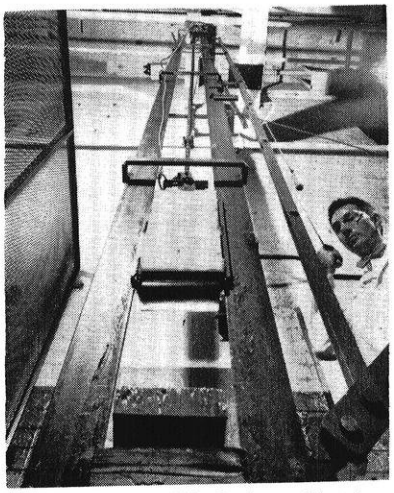
"Cat Eye" senses and amplifies the always present light unseen by the human eye. Photons, the electromagnetic waves which appear as light to the eye over certain frequencies, are sensed and imaged on a photosensitive surface. There they are transformed from photons to electrons, accelerated and produce electrostatic images. These are further amplified and are sensed by an electron beam. The resultant signal again is amplified onto the cathode ray tube.

"Cat Eye" is able to "see" where the human eye or other electronic instruments cannot because of its ability to increase the contrast between light and dark. This might be likened to a television viewer changing the contrast control on his television set. The result is a more clearly defined black and white picture.

By increasing this contrast, or ratio, between black and white, "Cat Eye" improves the quality of even the poorest nighttime view. Although development work has been aimed primarily at a black-and-white picture presentation, Air Research & Development Command scientists say the optical amplifier also can be used for color.

IMPACT GUILLOTINE FOR TESTING SHOCK RESISTANCE

To a metallurgist, the Charpy Notch Impact test is as familiar as the chemical symbols Fe, C, and O. Although long used as a method for determining the transition point between ductile and brittle zones of metals, the method has some major disadvantages. For example, sample preparation takes considerable time and a V-shaped notch must be accurately machined 79 mils deep into one side of the small sample. A pendulum-type apparatus breaks the sample by swinging a weight against it. Final data is in the form of a graph with impact energy for rupture plotted against the temperature of the sample. Even after elaborate preparations and careful technique, the exact temperature of the transition is not clearly defined.



—Cut courtesy Westinghouse Electric

A new method now being used by materials engineers at the Westinghouse Electric Corporation uses an impact guillotine and a much larger sample, 14 inches long by 3½ inches wide, by 1 inch thick. Instead of the notch, a weld bead is put on the bottom side of the sample and an artificial crack put into this weld by means of an abrasive cutting wheel. A standard weight is dropped on samples at various temperatures and the transition temperature readily bracketed within a narrow range. For example, if trials at minus 20 degrees F show breakage each time, and trials at plus 20 degrees F produce no breakage, the transition point is clearly defined within useful limits.

Results are reproducible by the guillotine method and sample preparation has been cut to one third that of the Charpy method. Another laboratory step that's making the metallurgist's job a little easier.

END

A FEW YEARS AGO, HE WAS ON CAMPUS AT PURDUE UNIVERSITY, AND NOW...

FLOYD D. (Doug) WALLACE, JR., above, is a senior project engineer at Allison.

He left Purdue in 1947 with his AE degree and came to Allison the same year. Presently, he is in charge of instrumentation and automatic process controls at Allison's new Research & Development test center.

With Allison now in the midst of a $75 million engineering expansion and building program, much of his time is spent in vendor contact work, studying and selecting equipment most adequate to do the job; observing, and helping with installation. He is shown above checking a control valve positioning amplifier on the instrument panel for controlling air pressures and temperatures of four electric motor-driven, axial flow compressors. This new facility is part of the new Research and Development test center, which—when completed—will enable testing of individual combustion components for turbo-prop and turbo-jet engines, compressor and turbine components.

Doug's work is "cut out" for him for some time to come, for only recently, Allison broke ground for the engineering building which is to be the center of expanded Research and Development facilities for advanced types of aircraft engines for commercial and military use.

With this long-range expansion program, Allison needs more engineering personnel, and opportunity for young graduate engineers is unlimited. Arrange now for an early interview with our representative on your campus, or write for information about the possibilities of YOUR engineering career at Allison: Personnel Dept., Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

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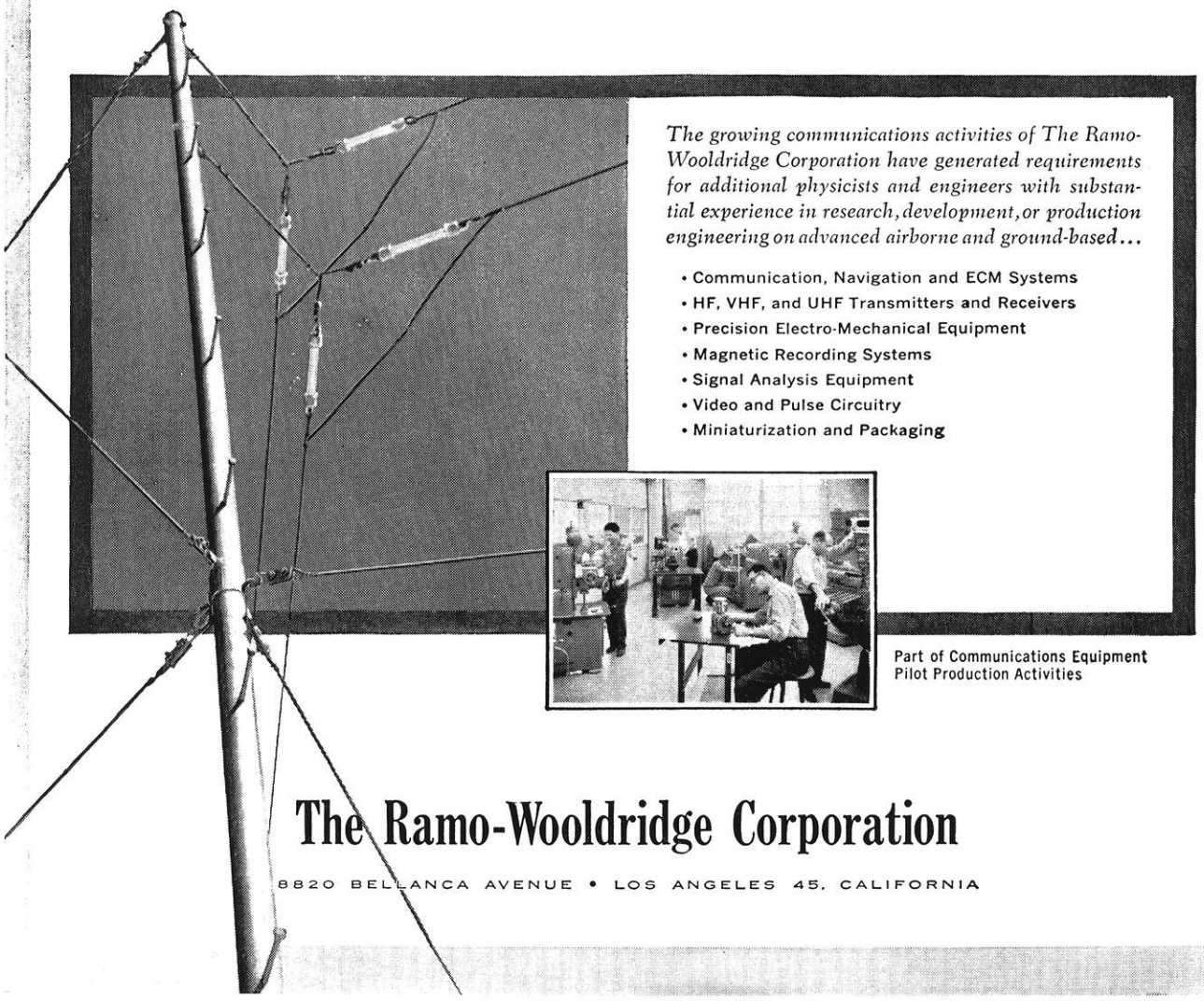
ADVANCED Communications

The design of modern communications equipment involves much more than electronic circuit techniques. Keyboards and coders are often required to translate the intelligence to be transmitted into "machine language." Recording and reproducing devices store intelligence until the equipment is ready to transmit it, or hold received intelligence until it can be translated back into human language by a printer or other output display device.

The combination of such mechanical and electromechanical techniques with the better known but still developing techniques of electronic circuit design makes of modern communications a much broader field than is commonly recognized. When such technical tools are used to provide equipment tailored to our rapidly improving understanding of propagation phenomena and information theory, the resulting practical improvements in communication are sometimes little short of spectacular.



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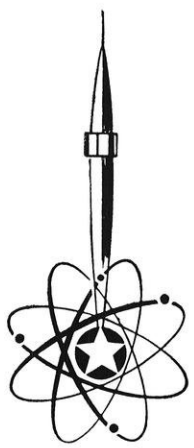

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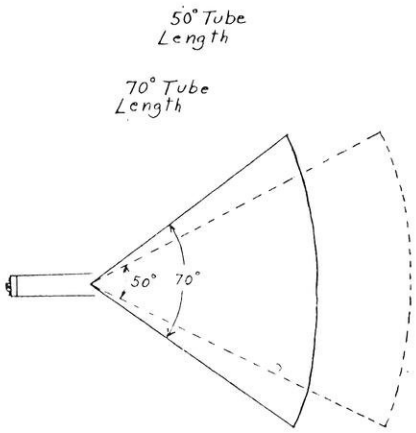
An enlarged reprint of the above cut-out silhouette, suitable for framing or pinning up, will be sent free to any engineering student on request.



Television

(Continued from page 11)

presently used twenty-seven inch tube has a length of approximately twenty-two inches, while an old style narrow deflection twelve inch tube has a length of twenty-five inches.

The other end of the tube has been improved also. Phosphor coatings have been developed to give a greater output of light but the most publicized change has been the aluminized tubes.

In a non-metallized screen only fifty percent of the light generated by the phosphor is transmitted towards the front of the tube, and of this fifty percent about twenty percent is lost in internal reflections in the tube face. By applying a thin coating of aluminum to the face of the tube over the phosphor the light output is almost doubled. The coating increased contrast by keeping the inside of the tube dark, thus preventing the lighting of dark portions of the picture. The resolution or sharpness is also improved because the brightness control will not have to be turned up as high to obtain the desired brightness. This in turn will lower the anode current in the tube which decreases the size of the electron beam. Considering all this, an aluminized tube at an extra charge of five to ten dollars is well worth the cost.

To further aid the trend toward compactness many methods of producing circuits are being used and developed. One of the earliest is the use of printed circuits to take the place of half a dozen resistors and condensors. These units are extensively used in audio coupling and vertical integrator circuits. They are highly reliable and much cheaper than the cost of separate units as well as reducing installation time.

The increase in use of printed circuits has paved the way for automation in the manufacture of television sets which would mean lower cost and a better product for the consumer. General Electric has used a process known as dip soldering since 1949 which is a combination of printed and standard components adaptable to automatic assembly. Formerly, each component was separately placed and soldered in its position. In the General Electric method the component leads are all inserted in rivets and eyes on a specially prepared chassis. The whole assembly is then dip soldered which completes every soldering operation at once. This method reduces the chances for error in construction and lowers the cost of the sets as well.

Another terrific improvement, as far as saving space is concerned, is the use of a vertical chassis instead of the horizontal. In this type, all the tubes and components are mounted on a vertical sheet of metal which has a hole in it through which the neck of the picture tube protrudes. Since the neck of the tube is about a third of the length of the tube, this design makes use of the dead space which was previously required to house the picture tube. When the back of the set is removed all the tubes are easily accessible, a fact which is appreciated by servicemen who have to operate in the blind on some of the old sets to perform even the simplest repairs. If more extensive service on these sets is necessary the whole cabinet lifts off of the chassis with the removal of only four bolts. This type of set is easily recognized as the controls are usually on the side of the cabinet in order to keep the shaft length as short as possible.

The audio portion of the set is in just as sad a shape in the new sets as in the old. Television sound, as it is frequency modulated, has wonderful possibilities, but in most sets it goes through a triode first audio stage, a single beam or pentode final stage, and into a four or five inch speaker which puts it on par with the ten or fifteen dollar table radio. In the table models it is really pathetic with a four inch speaker in a baffle of about one-half cubic foot size. The consoles are a little better with an eight or twelve inch speaker, but no effort at all is made in the circuitry to produce decent fidelity. Some set manufacturers blatantly advertise their sets as hi-fi, but on examining the set you find they added a dollar and a half three inch speaker with a condensor type crossover to their twelve inch speaker. The improvement is practically nil. High quality sound is available on special models put out by some manufacturers. Motorola is one of these with a good ten watt push-pull amplifier and a coaxial speaker in a modified bass-reflex baffle. Fidelity costs money though, and as long as people show a preference for cheap sets and pay no attention to sound quality, the set designers will ignore it also.

All the changes and improvements haven't been covered by any means, and new designs and circuits are appearing everyday. Transitors and ceramic stacked tubes promise further lowering in size and cost but have only been used in experimental models as yet. Color, which is still in its infancy in terms of production, will become common in the next few years when changes are made which will reduce its complexity and cost. Black and white television will still continue to be the main product of receiver manufacturers for the next three to five years, and improvements will continue to be made to give us that sharp, scintillating picture the advertisements tell us about. **END**

Four top scientists discuss creative thinking before fellow research men and engineers at a Joint Technical Conference held in French Lick, Indiana, by Standard Oil and its affiliates. Panel members were, left to right above, E. L. d'Ouville, G. W. Ritter, P. C. White, and T. A. Abbott. Moderator was Joseph K. Roberts, left inset, general manager of research and development for the parent company.

The Very Idea!

PETROLEUM scientists and engineers have a habit of coming up with the *very* idea to solve a problem at the very moment it is needed. They have created hundreds of new products and have improved others, putting the petroleum industry in the van of American industrial progress.

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In such an atmosphere of progress, young scientists and engineers find great opportunities to make positive contributions and build interesting careers.

Standard Oil Company

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STANDARD

Safety

(Continued from page 23)

seemingly ignored for so long, has suddenly become a heated subject. The various companies have differing opinions as to the actual worth of the safety devices and whether to emphasize safety in their sales techniques. Ford, the most active both in research and in applying their findings to their cars, seems to be forcing the rest of the industry to follow their lead. They are stressing their safety features as a selling point.

Benson Ford, vice president of Ford Motor Co., made a formal statement on September 8, 1955 that Ford's five part package of safety devices was not a "competitive sales secret" and all specifications and designs would be made available to other car manufacturers. "I hope they will use it", he said, "and work to improve the devices".

The effectiveness of these safety devices must be determined from accidents that occur on the roads all over the country. By studying these accidents, defects in design will probably be discovered and improvements will be made.

The industry has taken a big step in injury prevention equipment this year. Whether their motive was a genuine interest in the welfare of the motoring public or just a gimmick to sell more cars is irrelevant if the devices really perform their objectives, which are preventing or lessening injury, and saving lives. END

Gemstones

(Continued from page 20)

ural stone, even though it may surpass nature's best by a wide margin in all standards. For jewelers, the value depends first on beauty, then on durability, hardness, rarity and fashion in that order.

The synthetics are more expensive than imitations, but for a fraction of the price of a natural stone, they will give the same satisfaction as a natural stone would give for jewelry or for industrial uses. Originally American-made synthetics cost thirty to forty cents per carat during the War, but mass production and time have lowered the price to five cents per carat for rubies and two and one-half cents per carat for white sapphires. This allowed the United States to enter into competition with the imported Swiss gems selling for five cents per carat. In comparison, rough synthetic diamonds are worth as much as three dollars per carat to industry, while natural rubies and perfect diamonds cost up to three thousand dollars per carat.[11] Linde Air Products Company produces slender ruby rods up to thirty inches long at a cost of fifteen hundred dollars for a whole handful.

Since synthetics are so cheap as compared to the real stone, they have found hundreds of uses other than ornamentation. Since they are so hard, they are very important as abrasives in machine shops. Synthetic rubies and sapphires are cut and used for bearing in watches, and in physical and scientific apparatus. Examples of a few of these apparatus are: balances, chronometers, meters of all kinds, and precision gauges. They are also used in instruments for automobiles and aircraft. Since the coroundum can be melted and bent like glass, they have found uses as phonograph needles and as thread guides in the textile industry. They are also used as extrusion dies, pressure vessel windows, in oil burner orifices, as lenses, stiff compression springs, milk sprayer jets, small ball bearings, and even as the ball in ball point pens. And many more uses are being found every day.

Synthetics have had a great effect on the industry and the public. Since the United States can produce its own synthetic jewels, there will be no shortage of them in case of another war, as happened during World War II. Synthetics have given the public a chance to get finer instruments and watches at a lower cost, not to mention cheaper jewelry which is just as good as the natural. Although jewelers call them outright fakes, they are beginning to accept them along with the natural gemstone.

Besides the effect that synethics themselves have had on the world, they have opened new fields. Since they have caused the development of equipment capable of producing high temperatures and high pressures, industry will use this equipment for making new compounds or new alloys in forms never before thought of. We may even be able to make diamonds harder than the real ones! END

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Silicones

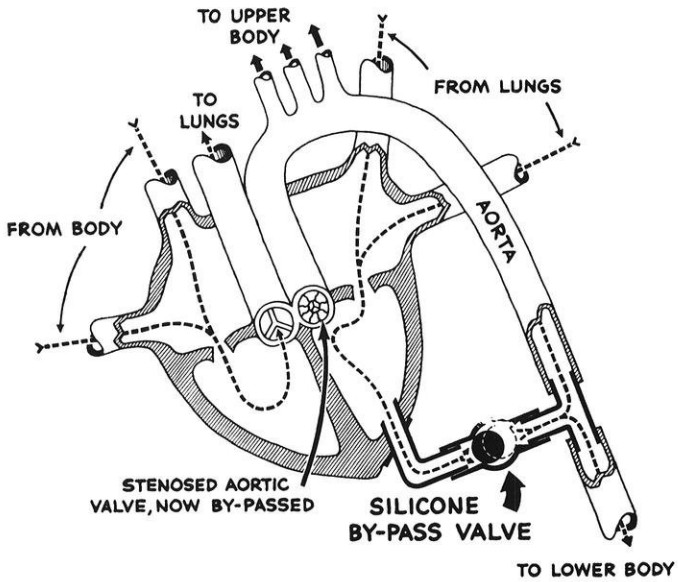
(Continued from page 14)

sistant to aqueous born stains including milk, grape juice and ink and have improved abrasion resistance, tear strength, wrinkle recovery and sewability. In the shoe industry, use has been made of the water repellant and low viscosity curve characteristics. Treated leather is also relatively unaffected by jet aircraft fumes and remains flexible at –75° C. (How about that?)

Silicone lubricants are most suitable for use in ball and roller bearings or lightly loaded metal to metal bearings. Most silicone lubricants are actually greases which have been prepared by adding fillers such as carbon black, lithium soap or silica to silicone fluids. Typical applications for silicone lubricants are in stoving and drying-oven conveyors, class H insulated electric motors, textile equipment operating under hot and humid conditions and also aircraft instruments. One of the latest lubricants developed is a phenyl silicone and promises to be an excellent lubricant for jet aircraft. It has passed viscometric tests ranging from –65° F. to 500° F. and has been tested for lubrication of steel on steel up to a pressure of 107,000 psi.

High viscosity silicone fluids are used as damping agents to absorb vibration in diesel and automotive engines.

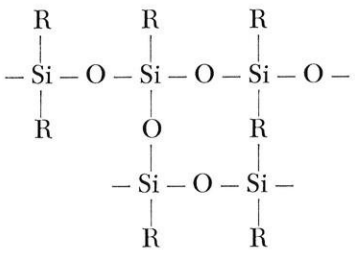
Some of the latest uses developed for silicone fluids show the ingenuity and imagination of scientists and engineers today. Liquid springs utilizing the compressibility of silicones are now available. Movie film edges are being treated with silicone also. Their lubricating ability for plastics and high light transmission account for their success as a protective lubricant of movie films. Dermatological applications have been discovered. The effectiveness of these fluids as constituents of ointments and skin protectants can be traced to their anti-social attitudes. Silicone base protectants have been proved effective in preventing skin ailments ranging from baby rash to occupational dermatoses. There have been no medicated salves discovered based on silicone fluid, but it has been used as an anti-biotic carrier, that is, anti-biotics suspended in silicone fluids. Silicones have even entered the cosmetic field. At least one cosmetic manufacturer is now producing a lotion containing this type of fluid.



—Courtesy Dow Corning

Blood flow is normally through the aortic valve, but when this valve narrows and tightens, blood backwashes into the ventricle, forcing the heart to work harder to remove it. The Silastic valve relieves this condition by by-passing the damaged valve entirely.

Silicone resins make the unique combination of properties characteristic of the silicone family available to the broad field known as "plastics". The most important of these properties are good heat stability between –50° C. and 200° C., good dielectric properties, good water repellancy, chemical inertness and good resistance to weathering. As would be expected silicone resins have a high degree of cross linking. The general formula of these resins may be represented by:



Silicone resins are usually classified according to their applications as folows: coating resins; laminating resins; moulding resins and foaming resins.

Silicone resins have found specialized uses in the protective coating field because of their good thermal stability and oxidation resistance. Silicone resin base varnishes are useful as protective coatings on electric motors. Aluminum pigmented modified silicone paints are especially suitable for use in the 300–500° F. range and for brief exposures to temperatures as high as 1500° F. Examples of these coatings in practical uses are on stacks, stoves and furnaces, steam pipes, exhaust lines and automobile manifolds.

There are indications that these applications are only the beginning of the usefulness of silicone based coatings. In years to come they may aid materially in the development of: (1) Outside paints that will last for ten years longer, (2) Outdoor varnishes that will have service lives of five years or more when used on metal or wood, (3) Container linings that will have resistance to a wide variety of foods and chemicals, excellent adhesion and good flexibility and fabrication properties, (4) Heat and corrosion resistant coatings that will reduce the staggering annual upkeep costs in the chemical and process industries, (5) Heat and weathering coatings that will find increasingly prominent places in the automotive, aircraft, appliance, heating and electrical industries.

Silicone laminating resins, although more expensive and weaker than organic laminates, are superior in quality at temperatures above 300° F. They are widely used for electrical insulation when reinforced with

(Continued on page 58)

To the man who intends to do creative engineering...

AiResearch is looking for your kind of engineer.

We have always been a pioneering company, constantly developing new products and searching out new and better ways of meeting the demands of modern civilization.

A sample of this ingenuity is our development of transducer-computer systems which simplify the job of flying. AiResearch also leads in the aircraft air-conditioning and pressurization fields. We are blazing the trail in overcoming the heat problem in jet flight. In the new, rapidly growing field of small turbomachinery we have more experience than all other companies combined. We produce more than 1000 different products, from unique air-valves that can operate under unprecedented temperature conditions to the most complicated complete systems. We work on the very frontier of present scientific knowledge.

That's why we need creative engineers . . . and appreciate them. You who qualify for an AiResearch position will receive stimulating assignments, utilize some of the finest research facilities in the country and be well rewarded financially.

AIRESEARCH AIR DATA COMPUTER SYSTEM *integrates electronic, pneumatic and electrical components to automatically sense, measure and correct for all air conditions affecting flight.*

Premium positions are now open for mechanical engineers ...electrical engineers...physicists...specialists in engineering mechanics...specialists in aerodynamics...electronics engineers ...aeronautical engineers.

Write to Mr. Wayne Clifford, AiResearch Manufacturing Company, 9851 S. Sepulveda Blvd., Los Angeles 45, California. Indicate your preference as to location either in Los Angeles or Phoenix.

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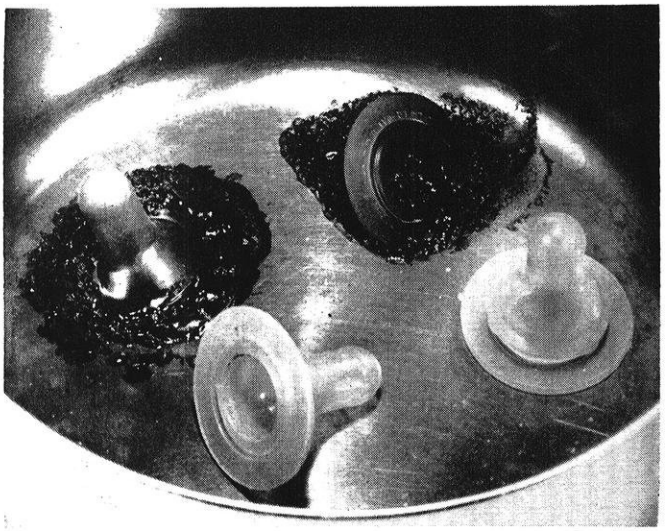
AiResearch Manufacturing Divisions

Los Angeles 45, California • Phoenix, Arizona

Designers and manufacturers of aircraft components: REFRIGERATION SYSTEMS • PNEUMATIC VALVES AND CONTROLS • TEMPERATURE CONTROLS
CABIN AIR COMPRESSORS • TURBINE MOTORS • GAS TURBINE ENGINES • CABIN PRESSURE CONTROLS • HEAT TRANSFER EQUIPMENT • ELECTRO-MECHANICAL EQUIPMENT • ELECTRONIC COMPUTERS AND CONTROLS



—Courtesy Dow Corning

Silastic baby bottle nipples do not swell, soften, or char at sterilization temperatures. The illustration shows nipples after being heated above sterilization temperatures. The silastic nipples did not char, but remained soft and pliable.

either glass cloth, asbestos or mica. This insulation is referred to as class H and is extensively used in electric motors and transformers. Motors used in heavy duty work can continue operation for periods up to ten times as long as the conventionally insulated motors. This is very important in generating plants and motors used on diesel electric engines in that a minimum amount of time is necessary for overhauling. Silicone laminated insulations also increase permissible operating temperatures and thereby make possible smaller and lighter transformers and motors for a given output.

One particular advantage of silicone laminates as electrical insulation is that the electrical insulating ash remains even when the insulation has been completely burned. For example, the Navy found that an armored cable might continue to function after a severe local fire, thus alowing a ship to return to base for repairs under its own power.

Silicone molding resins are now replacing many of the organic thermoset moldings such as Bakelite, melamine formaldehyde resins and even neoprene rubber. Ever since electricity has been used commercially the problem of providing a completely satisfactory molded electric insulating material has been a recurrent one. Today, with the strenuous operating requirements of modern aircraft, the limitations of organic insulators has been emphasized. In supersonic aircraft temperatures far above the maximum allowable for organic materials are found. At high altitudes, the extremely low temperatures for parts not exposed to the heat of combustion cause condensation of moisture from the air within the various parts of the plane. Thus, the ideal electrical insulator would have adequate mechanical properties combined with resistance to all temperatures and at the same time withstand high humidity. This is where silicones enter the picture. Silicone molding compounds have good arc resistance, maintain their molded dimensional tolerances, have adequate chemical and physical strength and most important, they show outstanding electrical resistance, even after prolonged exposure to both high temperatures and extremely high humidity.

Foamable silicone resins have all the properties inherent to other silicones but have very low densities. Some of the silicone resins can be foamed in place and therefore, can be used to form low density cores in relatively inaccessible cavities.

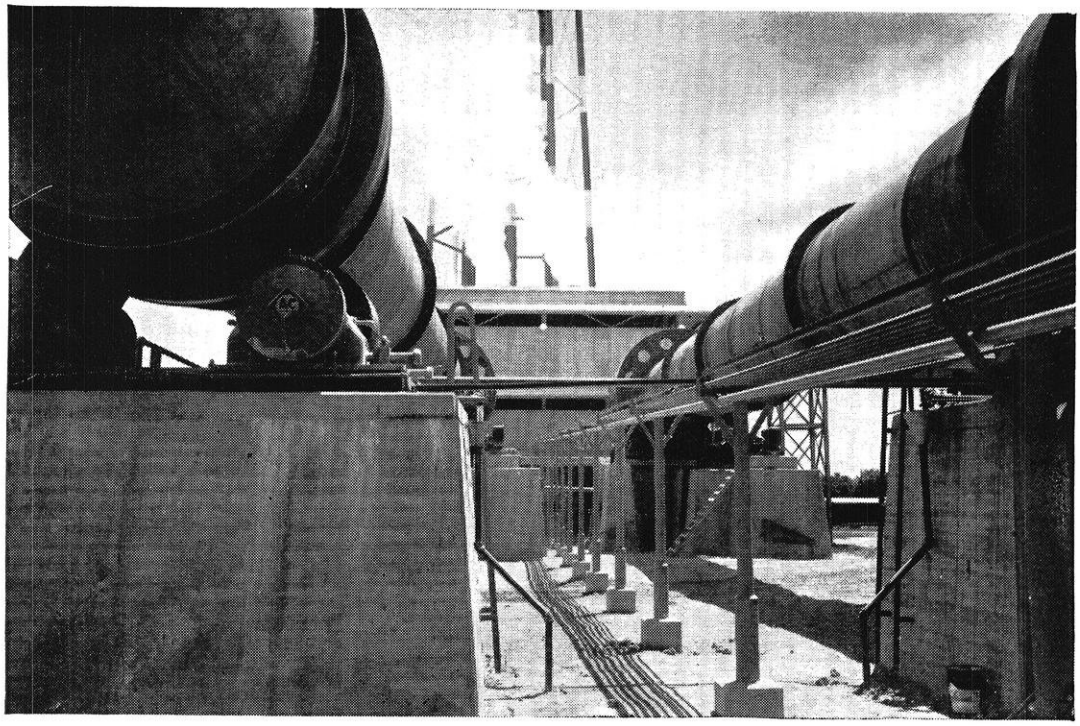
The importance of the engineering possibilities of silicone rubber was recognized as early as 1942 when production started on silicone rubber parts for military applications. These were gaskets for turbosuperchargers.

Silicone rubber has some unique basic properties which are responsible for its place in the industrial picture today. Rubbers can be made to withstand temperatures as high as 600° F. without serious deterioration; rubbers can also be made that are flexible at −130° F. The oxygen, ozone and weathering resistances are very good. Inertness, a basic property, is useful in many room temperature applications such as pharmaceutical closures. However, two or more of the basic properties are generally utilized; an aircraft ignition cable, for example, may require good insulation properties, low temperature flexibility, ozone resistance, heat resistance and oil resistance.

To prepare silicone rubbers, silicone fluids having a molecular weight of approximately 50,000 and viscosities between 10 and 12 million centistokes are employed. When these molecules are cross-linked, an elastic material is obtained. This gum is weak and it is necessary to compound it with fillers such as silica, titania or alumina. These ingredients are mixed and either molded, extruded or calendered and then vulcanized in an oven for 24 hours at high temperatures to obtain optimum properties.

Silicone rubbers are taking over where the properties of organic rubbers are not adequate to meet necessary qualifications. One of the latest uses for silicone rubbers is the gasket for emergency hatches on Douglas C-124 Globemasters which will remain flexible down to −120° F. and does not stick to metal after long inactivity. In medicine, the tubes which carry blood plasma to the veins in intravenous injections are composed of silicone rubbers. The property of thermal stability enables silicone rubber tubes to be sterilized time and time again, while organic rubbers deteriorate rapidly upon sterilization.

Today silicone chemicals and products are solving many industrial problems. Their unique properties—stability, chemical inertness, water repellency, high dielectric properties, lubricity over a wide range of temperatures—make possible better products and processes. They are being used in new applications and replacing old materials, so that many designs, up to now considered impossible or impractical with conventional methods, are being devised with silicones. **END**



CONSTRUCTION— Tremendous rotary kilns, like these, typify Allis-Chalmers role in the cement industry.

Join the company that serves 3 GROWTH INDUSTRIES

Match your engineering talents to the future needs of the construction, power and manufacturing industries. These are growing needs—for the population is climbing at the amazing rate of 50,000 people every *week!*

Many billions of dollars for highway *construction* alone are called for by the President in the next ten years. Allis-Chalmers builds equipment used in making cement, aggregate and steel as well as earth movers and graders.

Electric *power generation* will double in ten years. A-C builds the machines that make electricity.

Manufacturing output must increase $3.5 billion by this time next year. Allis-Chalmers builds motors, control, drives and many other types of equipment for this industry.

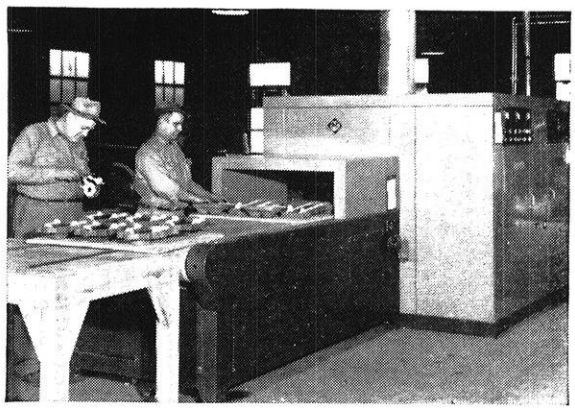
Here's what Allis-Chalmers offers to Young Engineers:

A graduate training course that has been a model for industry since 1904. You have access to many fields of engineering: electric power, hydraulics, atomic energy, ore processing.

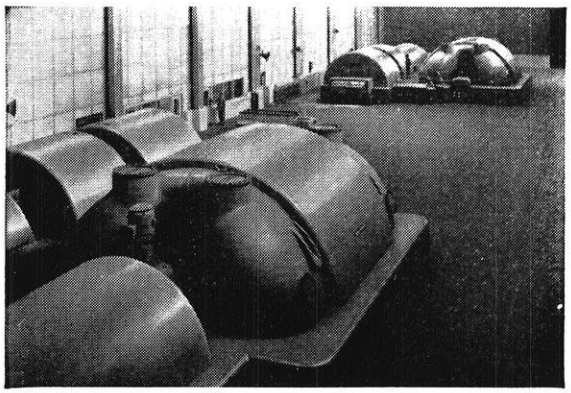
There are many *kinds* of work to try: Design engineering, application, research, manufacturing, sales. Over 90 training stations are available, with expert guidance when you want it. Your future is as big as your ability can make it.

Or, if you have decided your field of interest and are well qualified, opportunities exist for direct assignments on our engineering staff.

In any case—learn more about Allis-Chalmers. Ask the A-C manager in your territory, or write direct to Allis-Chalmers, Graduate Training Section, Milwaukee 1, Wisconsin.



MANUFACTURING—A-C aids high speed production and helps improve quality with dielectric sand core dryers like the one above.



POWER GENERATION—Growing use for power means growing demand for A-C steam turbines, transformers, and other equipment.

ALLIS-CHALMERS

A-4685

Campus News

(Continued from page 30)

ing engineering economic analyses and in establishing programs for planned equipment replacement.

Fee $20. Robert A. Ratner, Institute Coordinator.

INDUSTRIAL INSTRUMENTATION
April 19, 20

Control of manufacturing processes will be the field of study in this institute. Application of specific controls to certain processes will be discussed along with a general discussion of processes that lend themselves to control and possible means of controlling them. The institute will be of interest to manufacturing engineers, process engineers, design engineers, plant engineers, and electrical engineers.

Fee: $20. Ralph D. Smith, Institute Coordinator.

WORK MEASUREMENT
April 26, 27

Of continuing concern to the industrial engineer is the maintenance of established standards, the extension of standards to new operations or to other types of work, i.e. indirect workers, and the use of new techniques in establishing standards. This institute will present much valuable information on work measurement that will be of interest to those engaged in the performance of this activity and to works managers and other line personnel concerned with the proper evaluation of work. Those attending the institute are invited to present problems at the meeting for discussion by the group.

Fee: $20. Robert A. Ratner, Institute Coordinator.

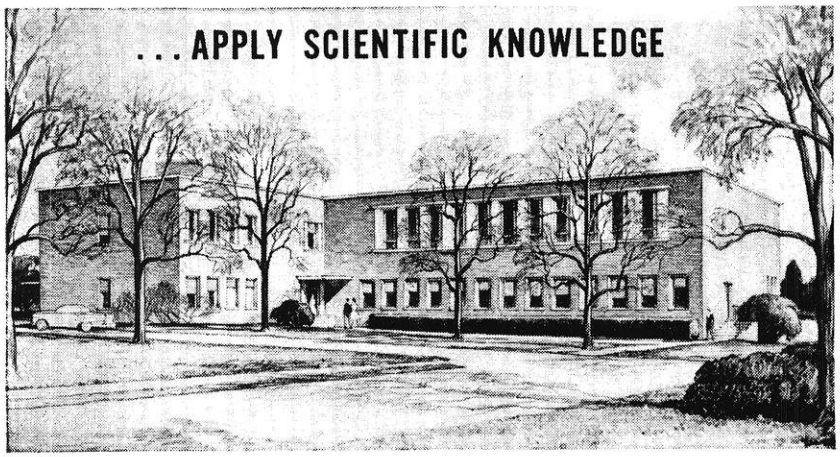
INDUSTRIAL POWER SYSTEMS
May 1, 2, 3

This institute will be of interest to industrial and utility personnel responsible for the design, installation, operation, and maintenance of industrial power systems. Subjects to be discussed will include load centers, circuit arrangement, voltages, grounded vs. ungrounded systems, relaying, etc.

Fee: $25. Ralph D. Smith, Institute Coordinator. END

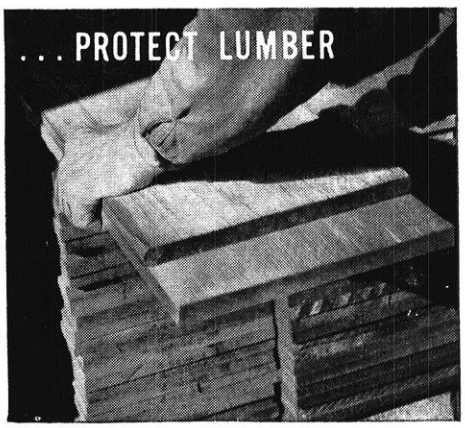
HOW *HERCULES* HELPS...

IN HEAVY TRAFFIC AREAS like this, floor tiles must be built to take a beating. Whether the tiles are of the rigid, mastic type or flexible flooring based on rubber or vinyl, Hercules Neolyn®, Mastolyn® or Staybelite® resin can contribute to lower processing costs and better wearing qualities. The wide variety of properties offered by these resins assures that there is one best suited for every floor tile formulation.



MORE THAN 17,000 VOLUMES of scientific literature and tens of thousands of company research reports will be housed in this new $1,000,000 Technical Information Center at the Hercules Experiment Station near Wilmington. In addition, the structure will provide quarters for the many technical specialists who serve the scientific information needs of the Hercules research staff—making the Center one of the nation's most complete information services to an industrial research organization.

WHICH HAD THE TREATMENT? The clean, unsplintered piece has been treated with Hercules Paracol® wax emulsion, making it possible to use every inch of lumber that has been pre-cut at the mill. The untreated piece (top) is badly "checked" and a portion of the end must be discarded before it will be suitable for use.



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HERCULES POWDER COMPANY
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968 Market St., Wilmington 99, Del. Sales Offices in Principal Cities

SYNTHETIC RESINS, CELLULOSE PRODUCTS, CHEMICAL COTTON, TERPENE CHEMICALS, ROSIN AND ROSIN DERIVATIVES, CHLORINATED PRODUCTS, OXYCHEMICALS, EXPLOSIVES, AND OTHER CHEMICAL PROCESSING MATERIALS.

HERCULES

CHEMICAL MATERIALS FOR INDUSTRY

So You Think You're SMART!

by Sneedly, bs'60

Due to circumstances beyond his control (and beyond him), Sneedly is not able to present the solutions to last month's problems. They will be ready next month (he hopes).

The first problem this month in a way dedicated to St. Pat. Where does green beer come from? Sneedly, in his short but pleasant stay here at the University of Wisconsin has not been able to figure it out. You probably can.

Sneedly has been offered a job on a farm next summer and has been given these problems to test his ingenuity:

* * *

Twelve of his oxen are going to be turned into a pasture of 3-1/3 acres and will eat all the grass in 4 weeks so that the pasture is bare. Twenty-one oxen are put on a pasture of 10 acres and eat all the grass in 9 weeks. How many oxen would it take to eat all the grass on 24 acres in 18 weeks? It can be assumed that the grass in all the pastures is at the same height when the oxen are turned into them and that the grass is growing at a uniform rate.

In his timber farming, Sneedly may run across a problem like this. In case he does he is going to do the practical thing and be prepared. See if you can help prepare him for this potential disaster.

* * *

A cross eyed woodpecker with bow legs and a synthetically shaped rubber bill requires 1 hour to peck ¼ of the distance through one of Sneedly's cyprus logs which is 29 years old. Shingles cost $.38 a hundred and weigh 8 pounds a piece. The log being pecked upon is 20 feet long and 40 pounds a foot. Assuming the coefficient of friction between the woodpecker's bill and the cyprus log is 0.232, and that there is a negligible resistance to diffusion, how many units of radioactive Vitamin B, will be required by the woodpecker if he is going to peck out enough shingles to roof a $3000 barn with a detachable chicken house? The woodpecker has an efficiency of 27% and gets double time for overtime. Got it?

Two lights, one 9 times as strong as the other are 64 feet apart. At what point between them will an object receive the same light from each of them?

* * *

The logarithms of two numbers differ by 1.4238 and the numbers themselves differ by 3,856. Find the numbers.

* * *

The other day in *Contemporary Trends* three girls asked Sneedly this: How much of the diameter of a ball of yarn would each girl wind off a 6″ ball if they each are to receive equal shares?

* * *

The antecedent of a ratio is 10. By what must the consequent be multiplied that the direct ratio may be nine times the inverse ratio.

* * *

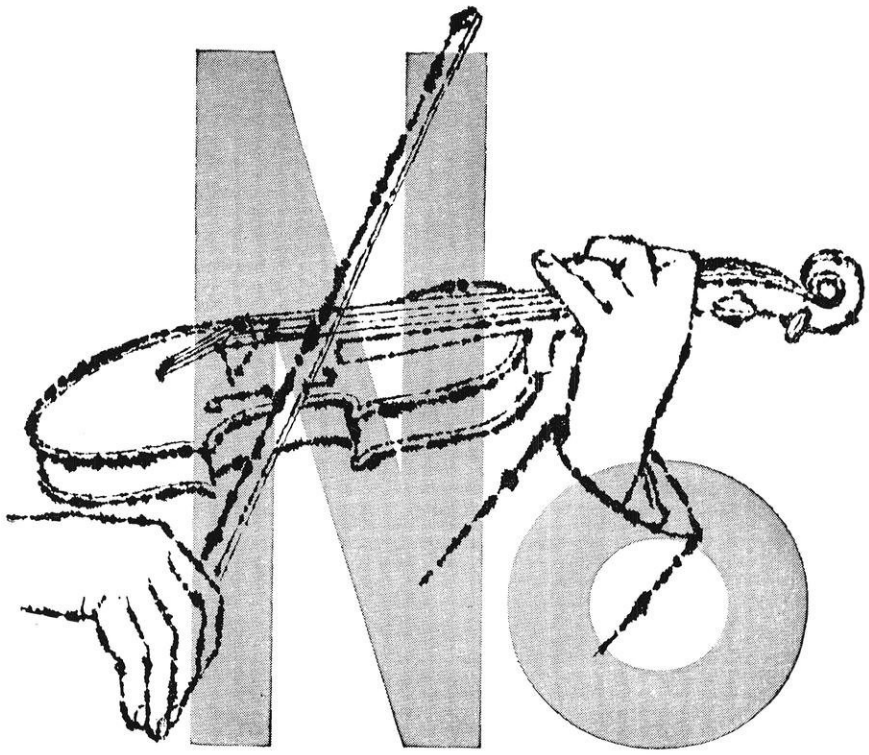
With this poem Sneedly leaves you until April:

A wealthy man two daughters had,
  And both were very fair;
To each he gave a tract of land,
  One round, the other square.

At twenty shilling an acre just
  Each price its value had;
The shillings that did encompass each
  For it exactly paid.

If cross a shilling be an inch,
  Which had the greater fortune,
She that had the round or the square?

END



violin music

The demand exceeds the supply. It's that simple!

With 3 engineering jobs available for every 2 engineers, some 5,000 companies are bidding for you with offers, inducements and background music. But don't be mistaken! Most of today's "opportunities" are *jobs*, not futures.

We, too, want engineers. But we're offering no violin music—only the opportunity for intelligent and careful evaluation—you of us and we of you—with the possibility of your joining one of the finest team operations in the whole new world of flight systems development.

Most of the people on that team are young, and moving ahead fast. They weren't lured here. They found out—and figured out—for themselves. We hope you'll do that too.

Contact your placement officer or J. M. Hollyday, The Martin Company, Baltimore 3, Maryland.

MARTIN
BALTIMORE

SLIDING DOWN THE WAYS at Groton, Conn., goes the USS Nautilus, newest and fastest member of our underseas fleet. During welding, Worthington heavy-duty turning rolls rotated the hull sections.

How the world's first atomic sub was welded

Welding the hull of the USS Nautilus, world's first atomic submarine, presented a tough problem.

Submerged-arc automatic welding seemed to be ideal for the job. Question was—could you rotate the hull sections of the Nautilus to take advantage of this fast, high-quality welding method?

Worthington's answer to General Dynamics Corporation's Electric Boat Division, builder of the Nautilus, was the largest turning roll ever built.

The result? Welding of the Nautilus hull was accomplished in record-breaking time — and cost less than originally estimated. Unchanged, the Worthington roll set-up is also being used in the construction of the nation's second atomic sub, the USS Sea Wolf.

Turning rolls for submarines aren't all that Worthington makes. The long list of Worthington-designed, Worthington-built equipment includes air conditioning units, construction machinery, compressors, Diesel engines, steam power equipment and, of course, pumps of all kinds. For the complete story of how you can fit into the Worthington picture, write F. F. Thompson, Manager, Personnel and Training, Worthington Corporation, Harrison, New Jersey. You may be glad you did.

4.25 B

See the Worthington representative when he visits your campus

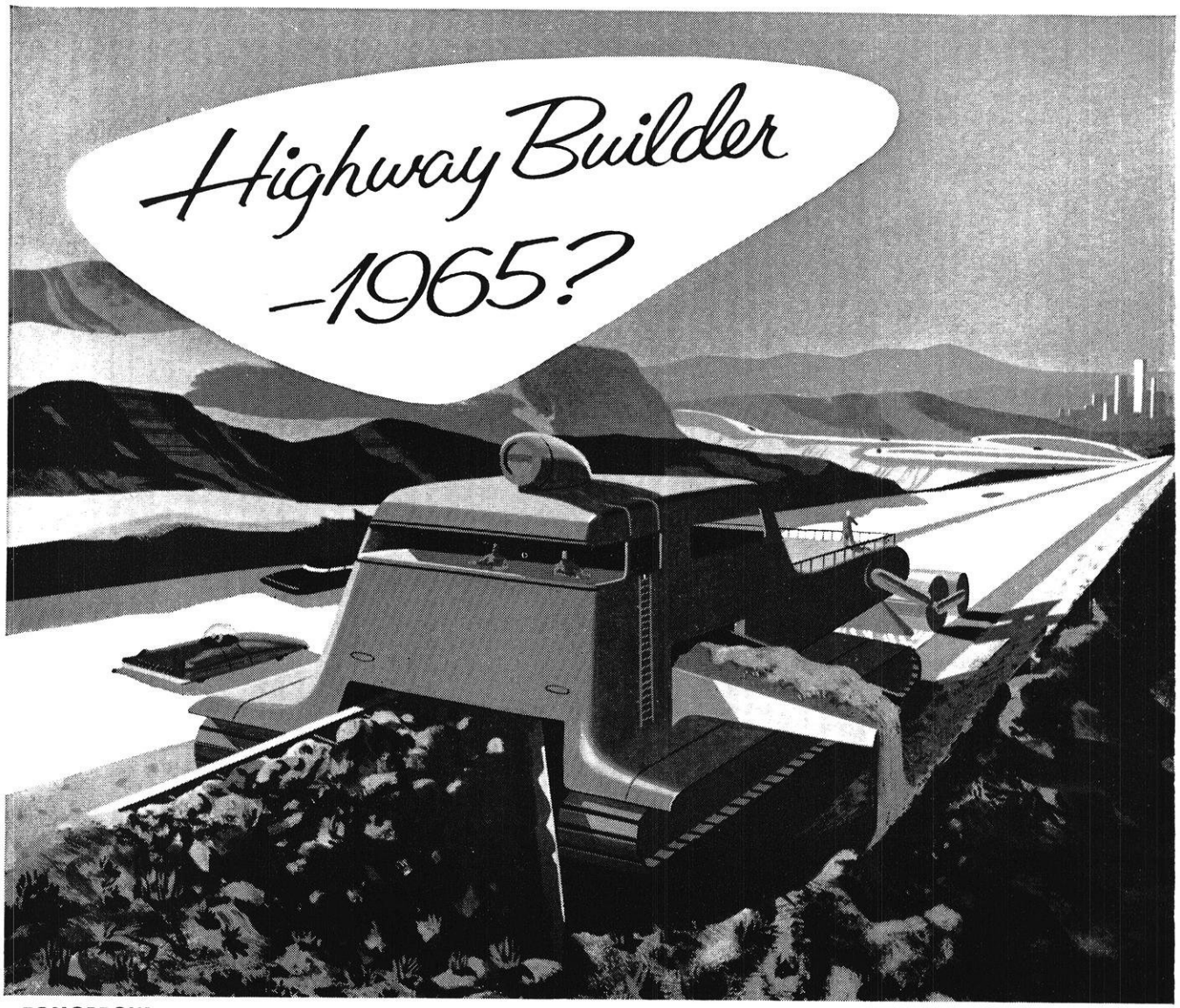
See the Worthington Corporation exhibit in New York City. A lively, informative display of product developments for industry, business and the home. Park Avenue and 40th Street.

WORTHINGTON

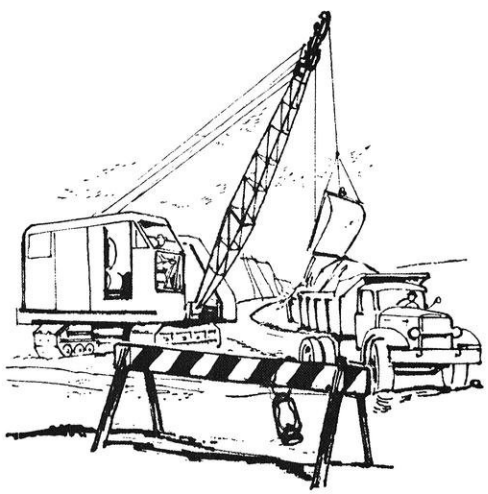
When you're thinking of a good job—think high—think Worthington

AIR CONDITIONING AND REFRIGERATION • COMPRESSORS • CONSTRUCTION EQUIPMENT • ENGINES • DEAERATORS • INDUSTRIAL MIXERS
LIQUID METERS • MECHANICAL POWER TRANSMISSION • PUMPS • STEAM CONDENSERS • STEAM-JET EJECTORS • STEAM TURBINES • WELDING POSITIONERS

NEW **DEPARTURES OF TOMORROW**



TOMORROW: A ribbon of paving unreels as this road-builder of the future turns open country into superhighway.



TODAY: New Departure ball bearings are used in power shovels, trucks and similar heavy-duty equipment, because they require no special attention and virtually no maintenance. Frequently they outlast the machine itself.

What a simple matter road building would be if it were reduced to a single machine that **levels, grades and paves** . . . all in continuous operations.

Such future prospects are often made practical through New Departure ball bearings. With New Departures, moving parts are held in close alignment while handling loads from any angle. Delays for adjustment and maintenance are eliminated. That's because these ball bearings are designed for high capacity and manufactured to close precision tolerances . . . by the company that has originated many of the greatest advances in ball bearings.

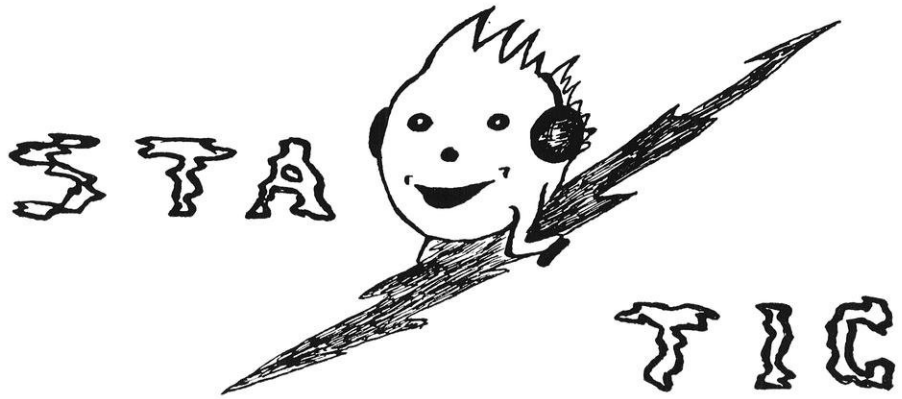
NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

GM GENERAL MOTORS

NEW DEPARTURE

BALL BEARINGS

NOTHING ROLLS LIKE A BALL



I. R. Drops, II

My Sliderule

My sliderule is my shepherd, I shall not want.
He maketh me to set down to the third place; and leadeth me to interpolate to the fourth.
He restoreth my average; and leadeth me along the paths of correct answers for his name's sake.
Yea, though I walk through the valley of the shadow of pop quizzers, I will fear no professor; for my sliderule is with me.
His log scales and trig scales they comfort me.
Thou preparest an answer for me in the presence of my professors, thou anointest my paper with right answers and my brain relaxes—
Surely Quality and Accuracy shall follow me all the days of my life and I shall dwell in the house of K & E forever.

* * *

For years the bum slept under bridges and in ditches. Then one day he switched to culverts and became a man of distinction.

* * *

Date: "Do you know what good clean fun is?"
E. E.: "No what good is it?"

* * *

Probably the reason that God made woman last was that he didn't want any advice while creating man.

* * *

Conversation heard on Ag Campus
"I gotta girl"
"Gurl? What's that?"
"You know"
"Show me a pitcher"
"Here"
"Oh, like a boy . . . what'r those"
"Those?"
"Yeah, those"
"Well, they all have em"
"Same number?"
"Yep"
"What'r they for?"
"Girls"
"I like horses"

During maneuvers an army commander ordered a notice to be displayed on a bridge stating: "This bridge has been destroyed by air attack." But to his chagrin, he noticed through his field glasses that a foot regiment was crossing the bridge despite his order. He sent his adjutant to the officer in charge post-haste to find out how he dared to defy his orders. An hour later the adjutant was back. "It's all right, sir, " he reported. "The troops are wearing signs saying, 'We are swimming.' "

* * *

And as they say in mechanics—
"Every couple has its moment"

* * *

Newton's tenth law—the dimmer the porch light the greater the scandle power.

* * *

Dinner guest at engineering banquet: "Will you pass the nuts, professor?"
Preoccupied Prof.: "I suppose so, but I really should flunk more of them."

* * *

Sally: "I'll never marry a man who snores."
Mother: "Yes, but be careful how you find out."

* * *

1st Con: "What are you in for?"
2nd Con: "Rockin' my wife to sleep."
1st Con: "But they can't put you in here for that."
2nd Con: "You ain't seen the size of the rock."

* * *

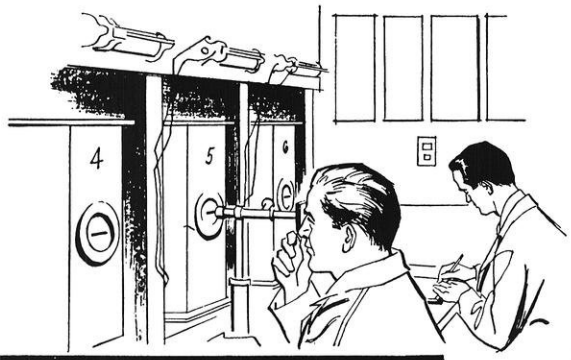
There was the engineer who was so stingy that when he took his girl to the beach on a hot, sunny day, he didn't buy her a parasol. He just told shady stories.

* * *

An old gent was passing a busy intersection when a large St. Bernard ran by, knocking him down.
A moment later, a Crosley car skidded around the corner and inflicted further damage. A bystander helped him to his feet, and someone asked if the dog had hurt him.
"Well," he answered, "the dog didn't hurt so much, but that tin can tied to his tail nearly killed me."

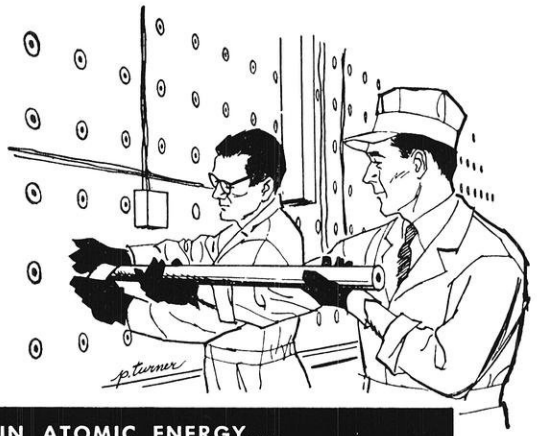
College graduates develop their skills...

growing with UNION CARBIDE



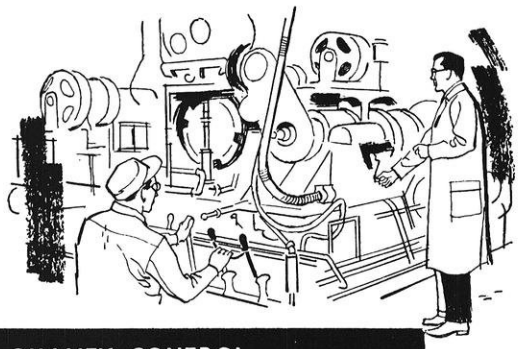
IN TITANIUM RESEARCH...

"After graduating in 1951 with an M.S. in metallurgical engineering, I joined the Metals Research Laboratories of Electro Metallurgical Company. Some of my research in corrosion behavior and notch sensitivity resulted in a patent for a stainless steel. In 1954 I was promoted to Section Leader, supervising research projects in titanium and other reactive metals."



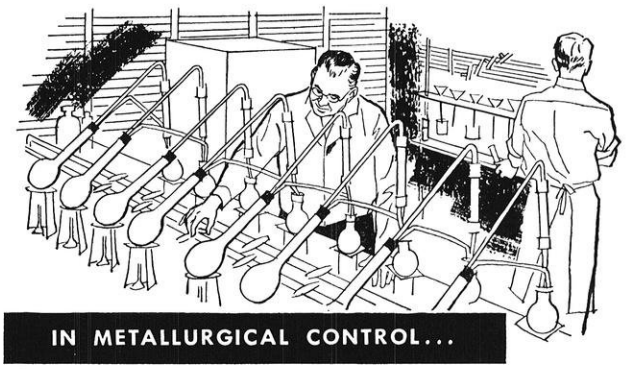
IN ATOMIC ENERGY...

"I graduated in '51 with a B.S. in physics and mathematics. Because of my interest in atomic energy I joined Union Carbide Nuclear Company at Oak Ridge in April, 1954. By November of that year I was classified as a Junior Physicist. I now supervise the operation of mass spectrometers used to analyze radioisotopes produced in atomic reactors here at Oak Ridge."



IN QUALITY CONTROL...

"I'm an electrical engineer, Class of '51. I started in Works Engineering at a National Carbon Company plant. A year later I transferred to a location where Works Engineering covered three plants, and soon became Engineer on important development projects. I was recently promoted to Assistant Head of the Product and Process Control Laboratory at one of the plants."



IN METALLURGICAL CONTROL...

"I'm a metallurgical engineer, Class of '49. I started at Haynes Stellite Company as a Development Engineer in high-temperature alloys, and in 1953 became Shift Foreman in the Metallurgical Control Department. Recently I was promoted to General Foreman, responsible for the Chemical, Spectographic, Material Release, and X-Ray Departments and the Test Laboratory."

THEY ARE KEY MEN WITH A FUTURE...

If you are interested in a future in production, development, research, engineering, or technical sales, check the opportunities with any Division of Union Carbide. Get in touch with your college placement officer, or write directly to:

UCC DIVISIONS INCLUDE...

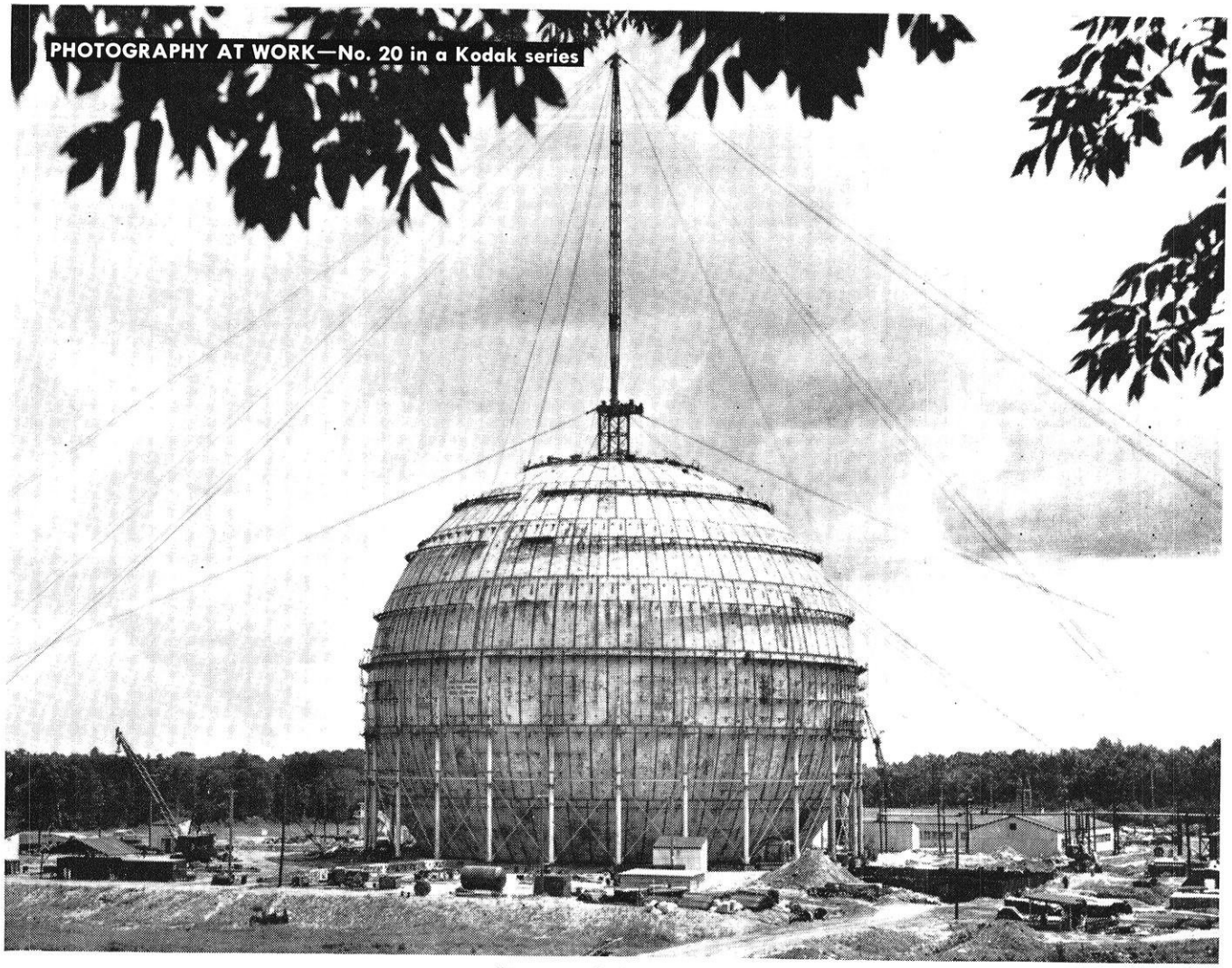
- Bakelite Company • Carbide and Carbon Chemicals Company
- Electro Metallurgical Company • Haynes Stellite Company
- Linde Air Products Company • National Carbon Company
- Silicones Division • Union Carbide Nuclear Company

UNION CARBIDE

AND CARBON CORPORATION

UCC

Industrial Relations Department, Room 406
30 East 42nd Street, New York 17, N. Y.



"Atom Apple," a 225-foot sphere of steel plates welded into virtually one piece.

An egg built to hatch miracles

–and x-ray photography searched every seam in its shell

To test America's nuclear wonders, the Knolls Atomic Power Laboratory uses history's largest steel sphere—with each weld proved sound by x-rays and photography.

This huge steel sphere, ten times larger than man has ever built before, houses the prototype power plant of America's nuclear submarine, Sea Wolf, designed and constructed by the General Electric Co. for the Atomic Energy Commission.

As a safety measure, every seam was welded, making the sphere virtually one piece. And to be positive every weld was sound, it was x-rayed—with proof of its internal bonds recorded on film.

Radiography like this is working today for welders large and small—and for foundries interested in providing flawless castings. And photography in other forms is working for all kinds of business and industry. It is helping solve design problems, increase production, train salespeople, speed up office routine.

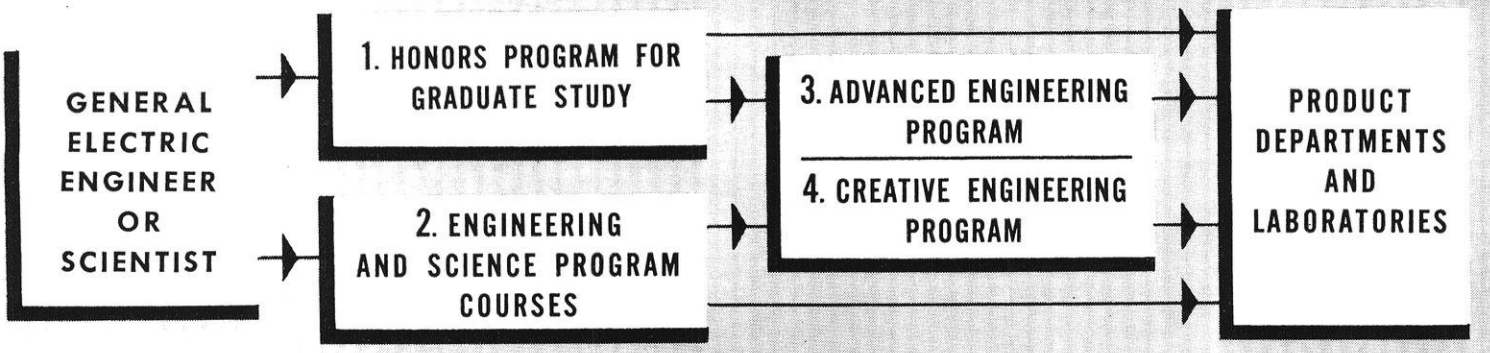
Behind the many photographic products becoming increasingly valuable today and those being planned for tomorrow lie intriguing and challenging opportunities at Kodak in research, design and production.

If you are interested in these opportunities in science and engineering—whether you are a recent graduate or a qualified returning serviceman, write to the Business and Technical Personnel Department.

Eastman Kodak Company, Rochester 4, N. Y.

Kodak
TRADE MARK

G.E. announces new Honors Program: latest addition to advanced-study opportunities



Further formal education as you learn and earn at General Electric

(1) Honors Program

G.E. selects qualified employees and reimburses them for tuition, fees, and books in connection with graduate study at universities located near G-E operations. You may participate in the tuition refund plan in one of two ways in selected G-E plant locations; by taking individual graduate courses while working a normal 40 hour week, or by carrying approximately one-half an academic load while working a reduced 20-hour week. You work full time and receive full pay during the summer months, unless time for thesis work is required.

(2) Engineering and Science Program Courses

Covering a variety of subjects—from engineering and production problems to product design and advanced physics—these G-E courses are the stepping stones to either the Advanced, or Creative Engineering Programs.

ADVANCED TECHNICAL COURSE consists of actual engineering problems in areas such as dynamics, electromagnetic fields, fluid flow, heat transfer, servomechanisms.

ENGINEERING DESIGN COURSE provides a background in materials, methods, and manufacturing processes, with instruction tailored to improve the engineer's design ability.

You may also take any of the numerous Specialized Technical and Departmental Courses that are continually offered.

(3) Advanced Engineering Program

To select and train technical leaders, this program combines extensive class and home assignments, with a 36-hour work week in association with Company technical leaders. The program is rigorous but the hard work pays off, for since its founding in 1923, 75% of its graduates have become engineering specialists and managers. Selection for the program requires either a Masters Degree or graduation from the Advanced Technical Course.

(4) Creative Engineering Program

This course is designed to help you make maximum use of your imagination and resourcefulness in solving problems and contributing new ideas. The number of patents registered by graduates of this program is almost double that of other engineers in General Electric. The one-year graduate-level Company course presents the latest techniques in creative engineering. Problems are worked on an individual basis or team basis. Complete facilities are available for construction of models and prototypes needed to demonstrate and develop any ideas.

For complete information write Mr. W. S. Hill, Engineering Services, Bldg. 36, General Electric Company, Schenectady 5, New York.

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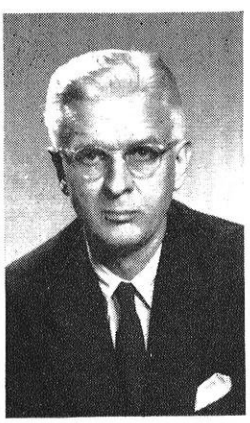
Progress Is Our Most Important Product

GENERAL ELECTRIC



G.E.'s CLARENCE H. LINDER, Vice President—Engineering, defines the challenge of technology.

ENGINEERS IN INDUSTRY

Industrial progress hinges on the engineers' ability to apply amazingly complex technology to the problem of creating new goods and services. It is vital that the engineer at G.E. be given every opportunity for self-development in his chosen field, and so the far-reaching educational programs described on this page are designed to satisfy three specific needs.

The Team Approach

The team approach to complex technical projects is extremely important in industry today. It brings together competent men with a wide variety of training and experience to blend their abilities in the solution of problems. To be prepared to work as a member of a team, the engineer must develop appreciation and understanding of the work and contribution of the other members. Recognition of this need is the basis of teaching philosophy all through the programs.

Importance of Supporting Sciences

Many of the problems facing engineers in modern industry are not found in the principal engineering sciences, but have shifted into areas which have been thought of as supporting sciences. An engineer working principally in aerodynamics, for example, may find the main roadblocks in his work are the limitations of the materials which are available. By working closely with experts in the field, the engineer must in fact influence the development of new and better materials.

Broad Technical Backgrounds

The solid core of industry's engineering effort is a body of men thoroughly grounded in the fundamentals of basic science. With the explosive increase in technology, the engineer and scientist need to keep abreast of all allied areas. G-E advanced-study programs give this opportunity.