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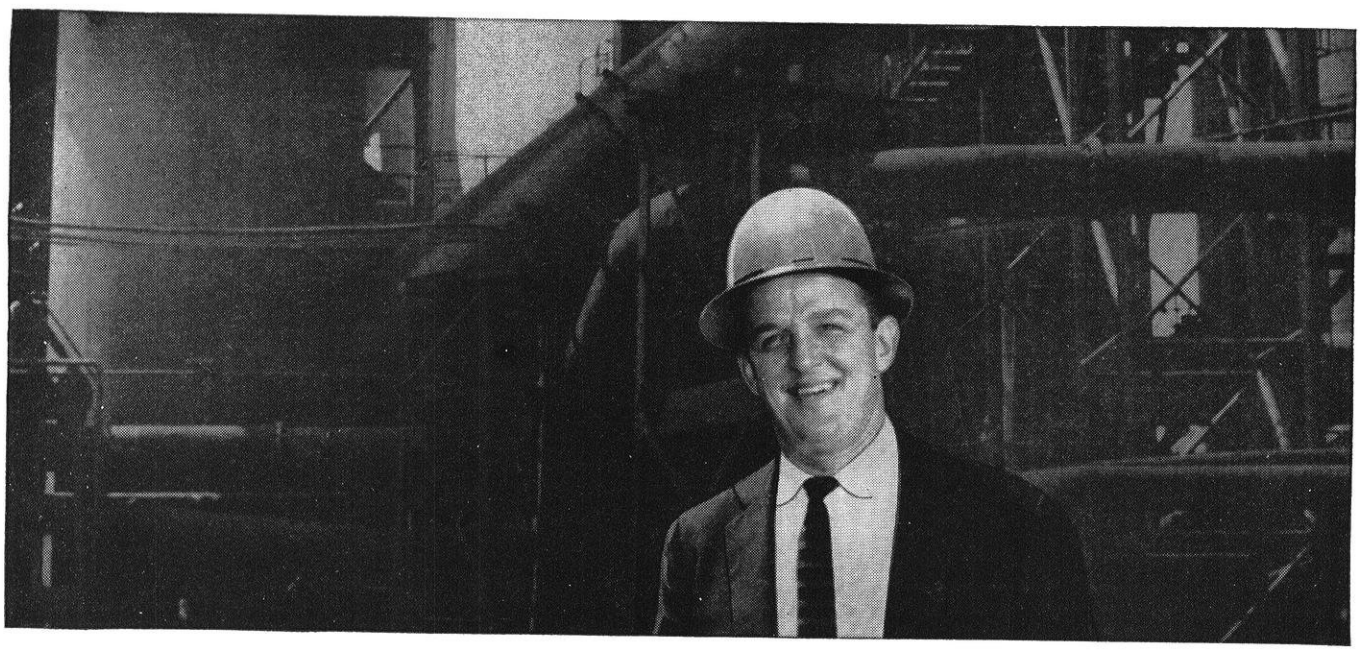
DECEMBER
1956
The Wisconsin
25¢

engineer

Thomas A. Beattie, class of '47,
speaks from experience when he says:

"At U. S. Steel one has a great amount of varied experiences. There is truly never a dull moment."



After receiving his B.S. in Mechanical Engineering in 1947, Mr. Beattie entered the employ of U. S. Steel as a student engineer. That was on September 22, 1947, and included service in the United States Navy from 1943 to 1946.

Mr. Beattie's progress from that date onward is typical of that of many engineering graduates who plan their future with U. S. Steel. For, within two years, we find Mr. Beattie advanced to the position of Process Engineer, Maintenance Department. Then on April 16, 1951, he was promoted to Relief Foreman, Shops, Maintenance Department. On March 1, 1952, he was made Turn Foreman, Blooming and Bar Mills, Mechanical Maintenance Department. And on January 1, 1955, he was promoted to his present post of Assistant Superintendent, Maintenance Department, of U. S. Steel's National Tube Division's National Works.

In this position, Mr. Beattie's responsibilities are numerous. They include the Service Power House and Skelp Mill area; maintenance of four blast furnaces and blast furnace auxiliaries, plus a sintering plant; maintenance of two blooming mills and soaking pits; maintenance of one bar mill; maintenance of three Bessemer converters, three open hearth furnaces, three open hearth auxiliaries, and seventy overhead cranes ranging from two to 200 tons. He supervises 680 men.

As Mr. Beattie remarks: "A steel plant includes all departments . . . every craft known to industry. In the space of three years, a U. S. Steel engineer can obtain experience that may take three times as long under different employment circumstances. One meets all types of problems and personnel. Each day is varied, certainly not dull, and yet no problem is insurmountable. Certainly, there is no possibility of getting 'into a rut' here."

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THE GOODYEAR WORLD

VOL. 2 NO. 3

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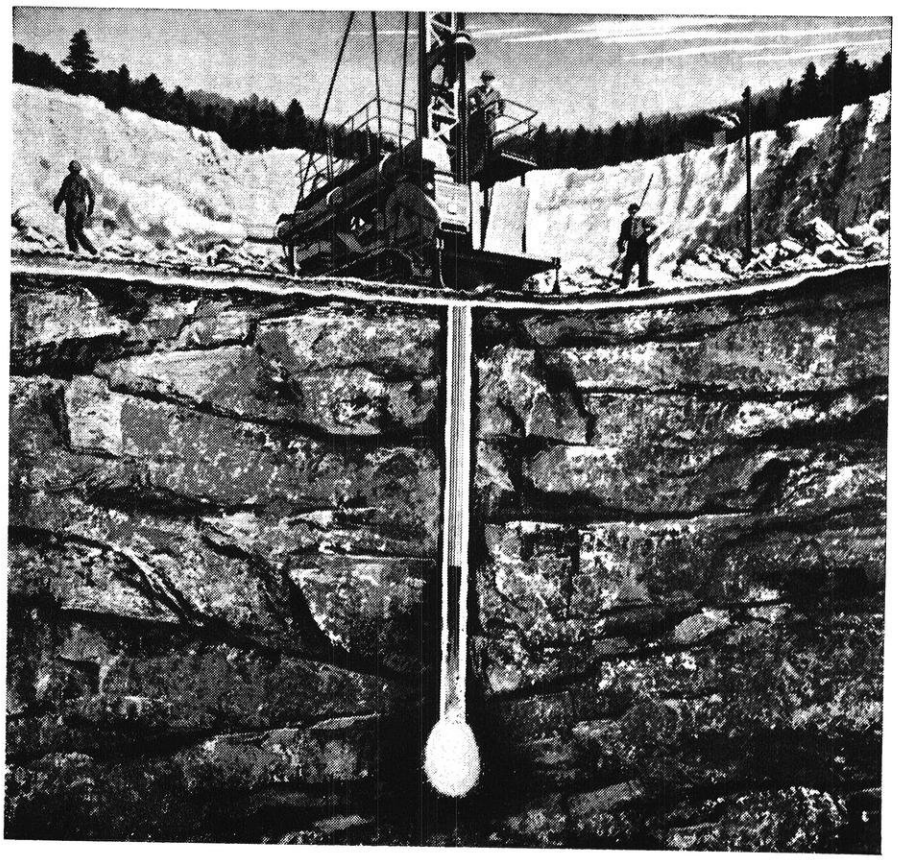

Akron, Ohio—White-hot answer to the queries of quarrymen for faster, cheaper blast-hole drilling is a new machine that literally burns its way through rock. Conventional machines drill at 1 to 1½ feet per hour. This jet piercing machine goes through the same rock at 20 to 30 feet per hour.

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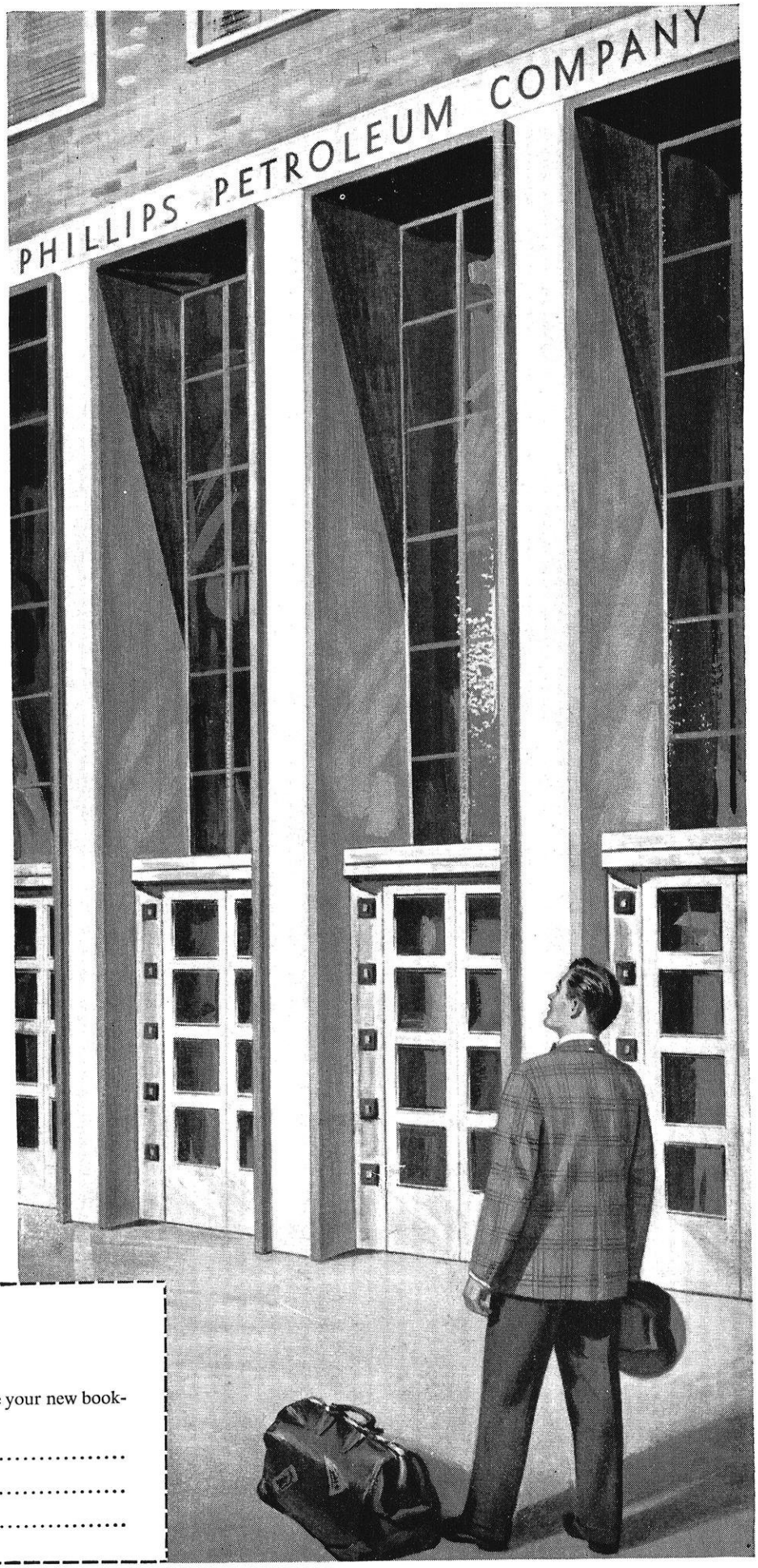

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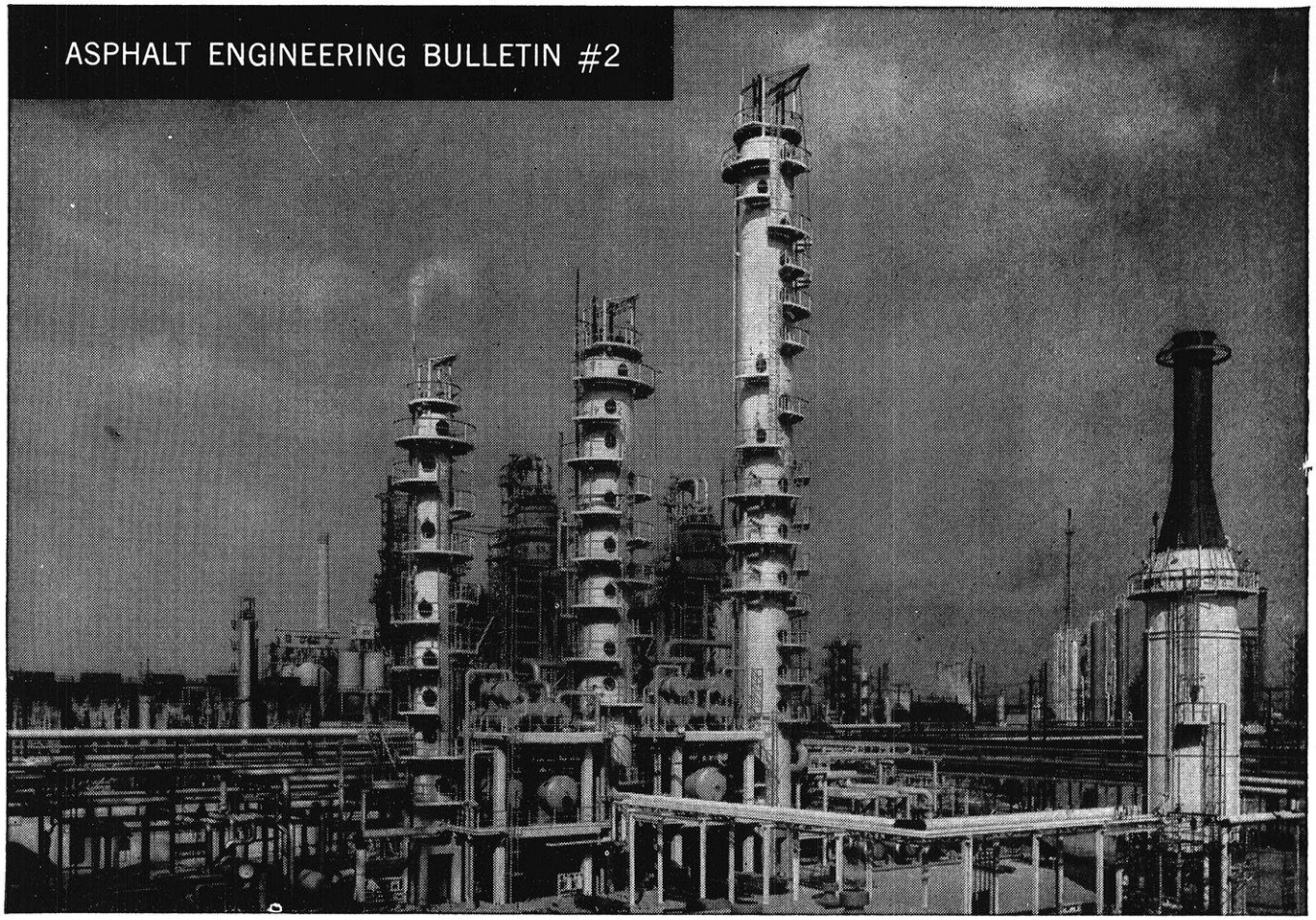


An array of standard types and grades of Asphalt comes from refineries in volume for a wide variety of engineering and industrial applications.

Asphalt is a versatile family of materials

"ASPHALT" denotes a class of material produced from crude petroleum . . . it is inherently durable, waterproof and adhesive.

Asphalt is produced in a variety of consistencies from hard solids to liquids. The harder types are called *Asphalt cements*. The more fluid types are called *liquid Asphaltic materials*.

ASPHALT CEMENTS

By far the largest proportion of the Asphalt family. Semi-solid to solid, Asphalt cements answer virtually any logical demand for the properties desired in hot-mix types of pavement, pipe-coating, water-proofing and similar engineering and industrial products.

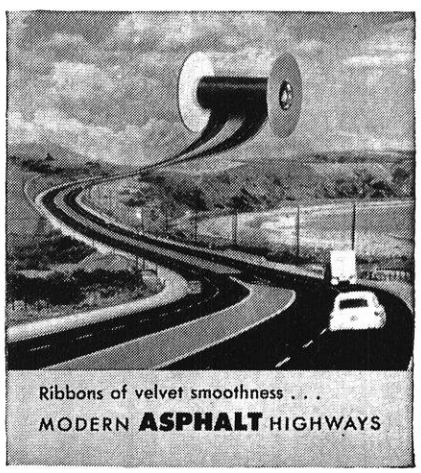
LIQUID ASPHALTIC MATERIALS

Fluid at normal temperatures, but developing high-binding ability shortly after application, liquid Asphaltic materials are comprised of: (1) Cut-back Asphalts and Road Oils, and (2) Emulsified Asphalts.

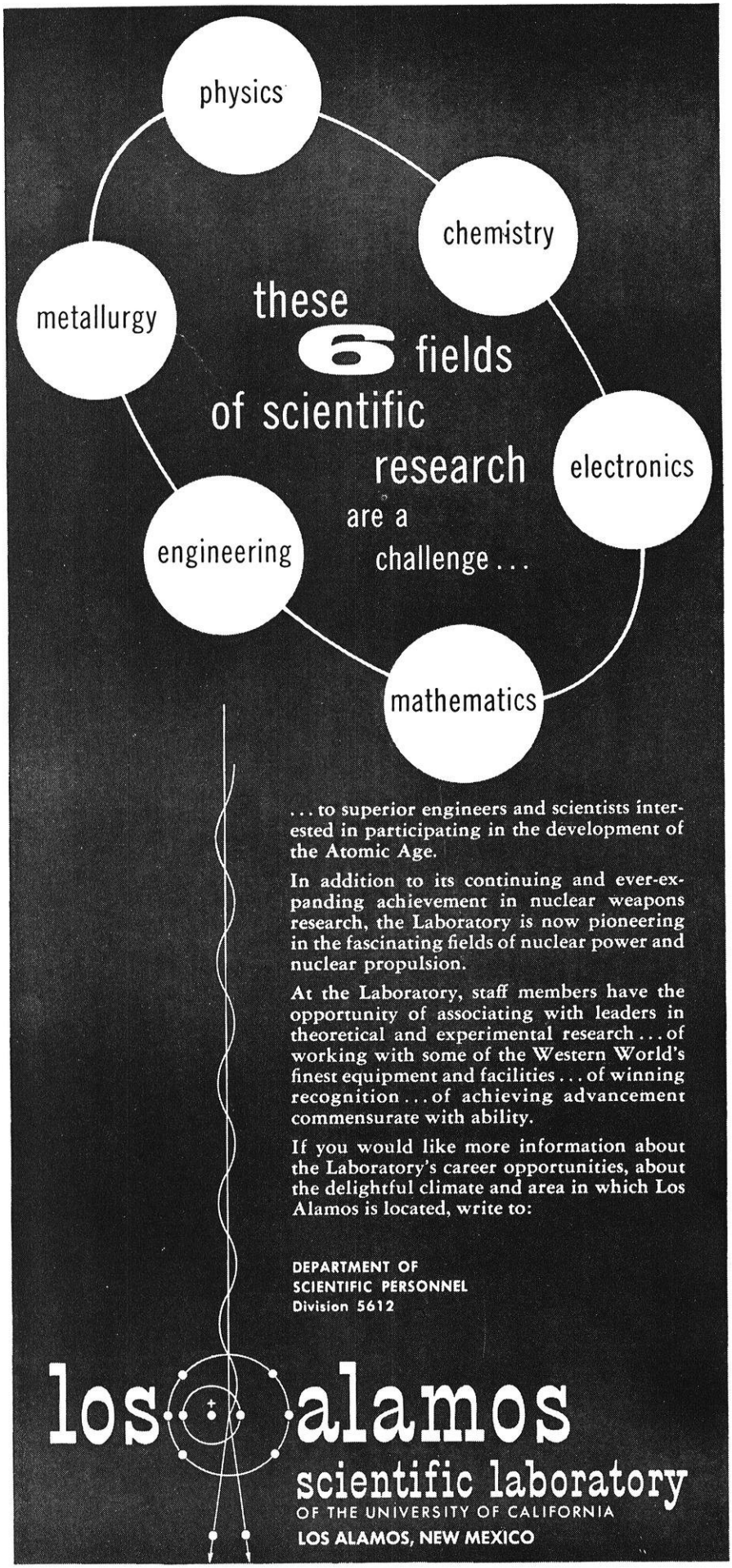
The first are blends of Asphalt cements and various amounts and types of petroleum diluents, in three standard types: Slow Curing, Medium Curing, Rapid Curing. The Rapid Curing type contains, relatively, the most volatile diluent. "Cutback" Asphalts are versatile paving materials. They also fulfill various industrial needs.

The emulsified Asphalts consist of minute Asphalt globules suspended in chemically-treated water. Also, in three standard types: Rapid Setting, Medium Setting, Slow Setting. When deposited upon stone or soil, as in road construction, the emulsions "break," allowing the water to escape and leaving an Asphalt film on the aggregate. Names of the types indicate relative rates at which their Asphalt globules coalesce.

Study the characteristics and applications of Asphalt. *Keep a complete file of these bulletins.*



THE ASPHALT INSTITUTE, Asphalt Institute Building, College Park, Maryland



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WISCONSIN ENGINEER

The Student Engineer's Magazine

FOUNDED 1896

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Frontispiece

Largest axial-flow compressor ever built is this three stage compressor, which provides the airflow for the transonic circuit of the Propulsion Wind Tunnel at the U. S. Air Force's Arnold Engineering Development Center, Tullahoma, Tennessee. This view from the downstream end of the huge Westinghouse-built compressor shows the 63-foot streamlined nacelle that encloses the end of the drive shaft. The transonic circuit of the Propulsion Wind Tunnel will test full-scale operating jet engines, or large-scale aircraft and missile models at testing velocities ranging from 500 to 1000 mph.

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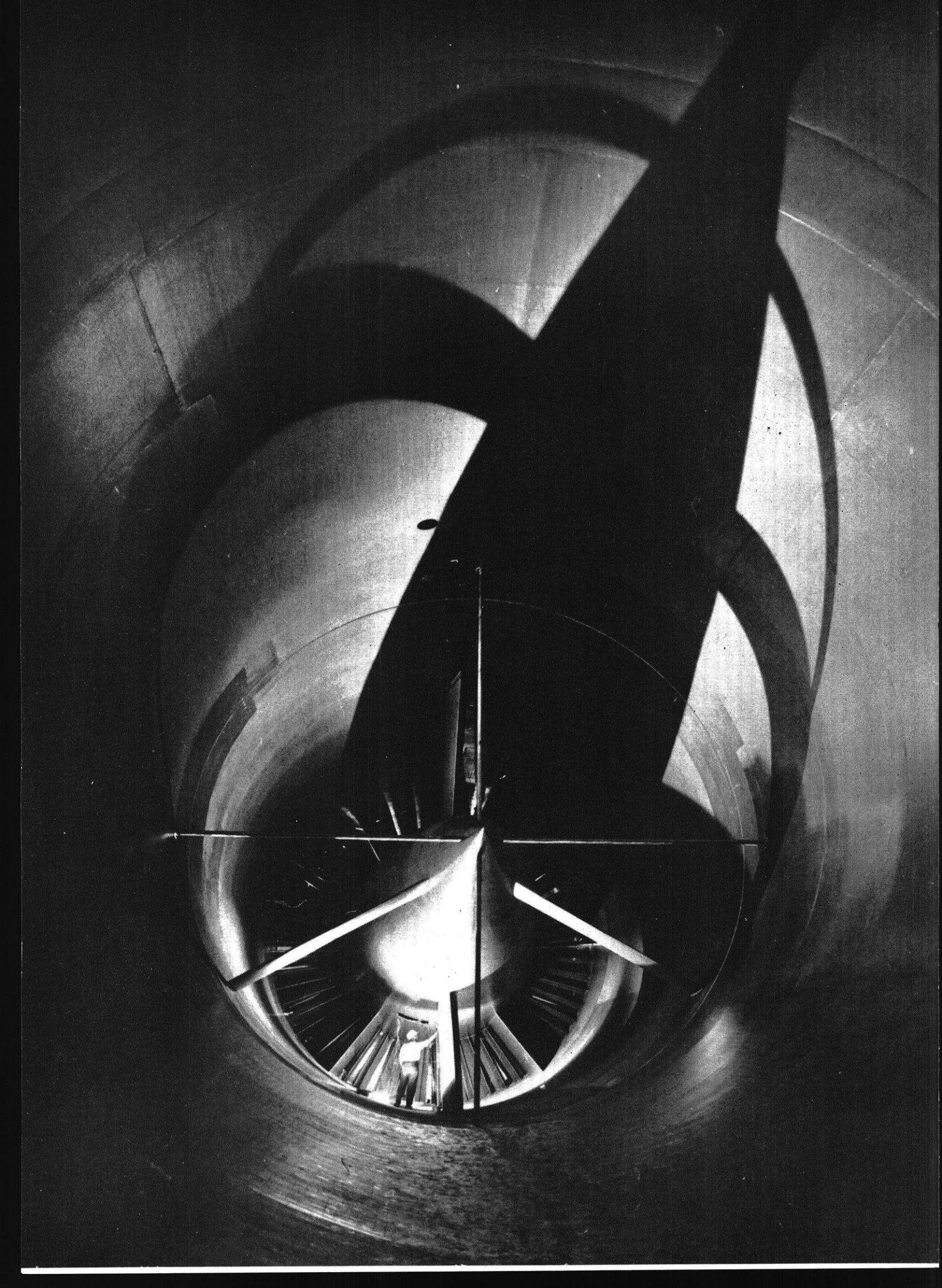

Rambling WITH THE EDITOR

Interviewee and the Interviewer

The young engineer is a strange being, possessed of many devils, occasionally he is found to speak in weird parables known as formulas, consult his trusted Bible, a handbook and unfortunately, at times, forget the obligations which lie before him in his fertile field of prosperity. Graduating engineers of Wisconsin, you have an obligation to yourself and your schol in your dealings with industry. Have you realized your position and lived up to your responsibilities?

The placement program carried on at this University is a vast one, and it functions for the benefit of every graduate. Throughout the year, several hundred companies send their representatives in search for talent—both in personal and technical ability. As beginning engineers, you are in demand by these representatives, your opportunities are unlimited and the bounty is high.

In return for the opportunities at your disposal you need only fulfill the few requirements of your placement program. The first step is to submit the required personal data and recommendations to the placement office. Fill out your employment forms with care and answer questions with sincere honesty and integrity. Secondly, in anticipation of an interview with a company, prepare yourself by becoming familiar with the characteristics of the industry and then present yourself at the interview in a business-like manner. Thirdly, and of paramount importance is to remember to present yourself. When prosperity reigns and there are times of plenty it is too easy to become slightly careless and forget what should be remembered. This one aspect of your relations with company representatives is by far the most important to you, your school and your profession.

As engineers, you must recognize and live up to the code of ethical relations formed and developed by your predecessors, which has placed you in the favorable position from which you view the world today. "Professional morals, like rules of health and grammar, are most effectively observed instinctively"—live up to your obligations faithfully.

J.G.B.

JENKINS VALVES

for another mid-town

Manhattan record-maker

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"vertical city" of 10,000

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Associated Architects: HARRISON & ABRAMOVITZ and JOHN B. PETERKIN
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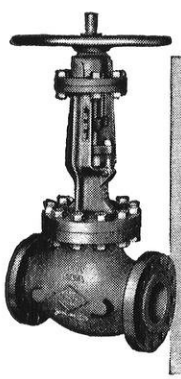
A DAILY "POPULATION" of 10,000 office-workers requires, for modern standards of comfort and convenience, piping comparable in volume and variety to that of some cities. The thousands of Jenkins Valves chosen for reliable, efficient, and safe control of major systems in this complex network include Iron Gates and Checks on the main city water supply; Cast Steel Gates with motor operation for remote control on fire lines; and Bronze Valves of all patterns on water, oil, air, and gas lines.



JENKINS
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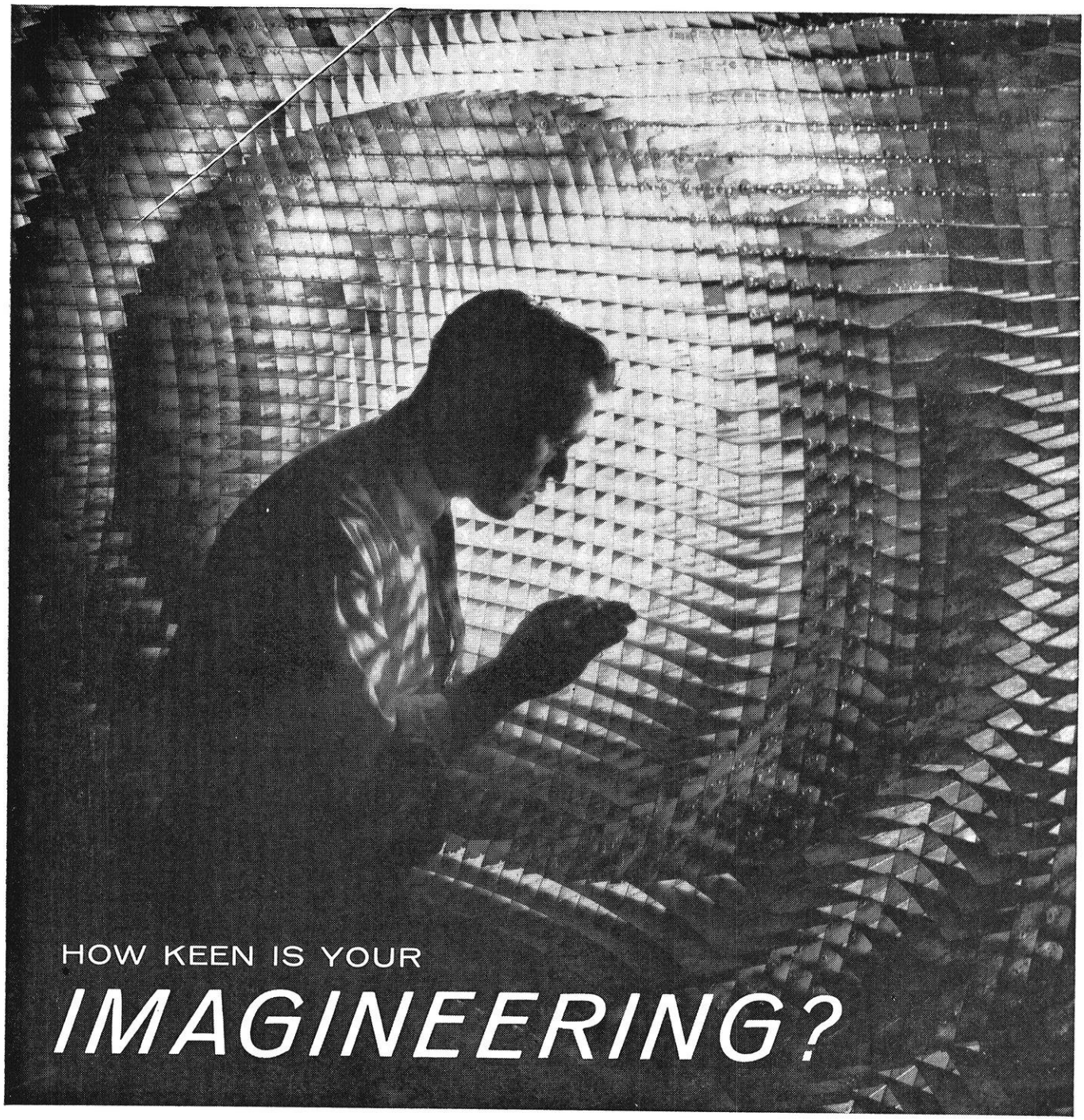

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■ Imagination is a valuable trait for the engineer making his career with Sperry. For here there are many challenging opportunities to be met in such fields as missiles, inertial guidance, radar, computers, microwaves and gunfire control. And while you work with the acknowledged leaders in these fields you can further your formal education—with Sperry paying your full tuition for advanced or continuing studies.

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P.S. In case you *didn't* identify the equipment shown above, it is part of an 8 ft. Sperry-designed radar antenna for long range missile guidance.

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First Reverie It's almost Christmas and no decision about a job after OPERATION GRADUATE—only five months away.

Second Reverie Why can't Mary and I settle this thing during Christmas vacation — the last Christmas vacation too — next year it's only a day off.

Third Reverie Wonder if she would buy New Jersey as a place to live. Working for Public Service has its appeal. Its service area has everything for a good life. Urban advantages in suburban communities — culture recreation, and all that make life pleasant.

HEAR! HEAR! And we say to you, Big Boy, that your dreams are not idle ones. Grasp them. Working for Public Service Electric and Gas Company is definitely good — and Mary will love New Jersey.

Sometime soon, a Public Service representative will be on your Campus. Look him up and get the low-down on the Company's job opportunities. In the meantime, write for literature to show Mary during the holidays — use the coupon.

Public Service Electric and Gas Company,
Room 2152A, 80 Park Place, Newark 1, N. J.

Please send me literature on New Jersey and job opportunities with Public Service.

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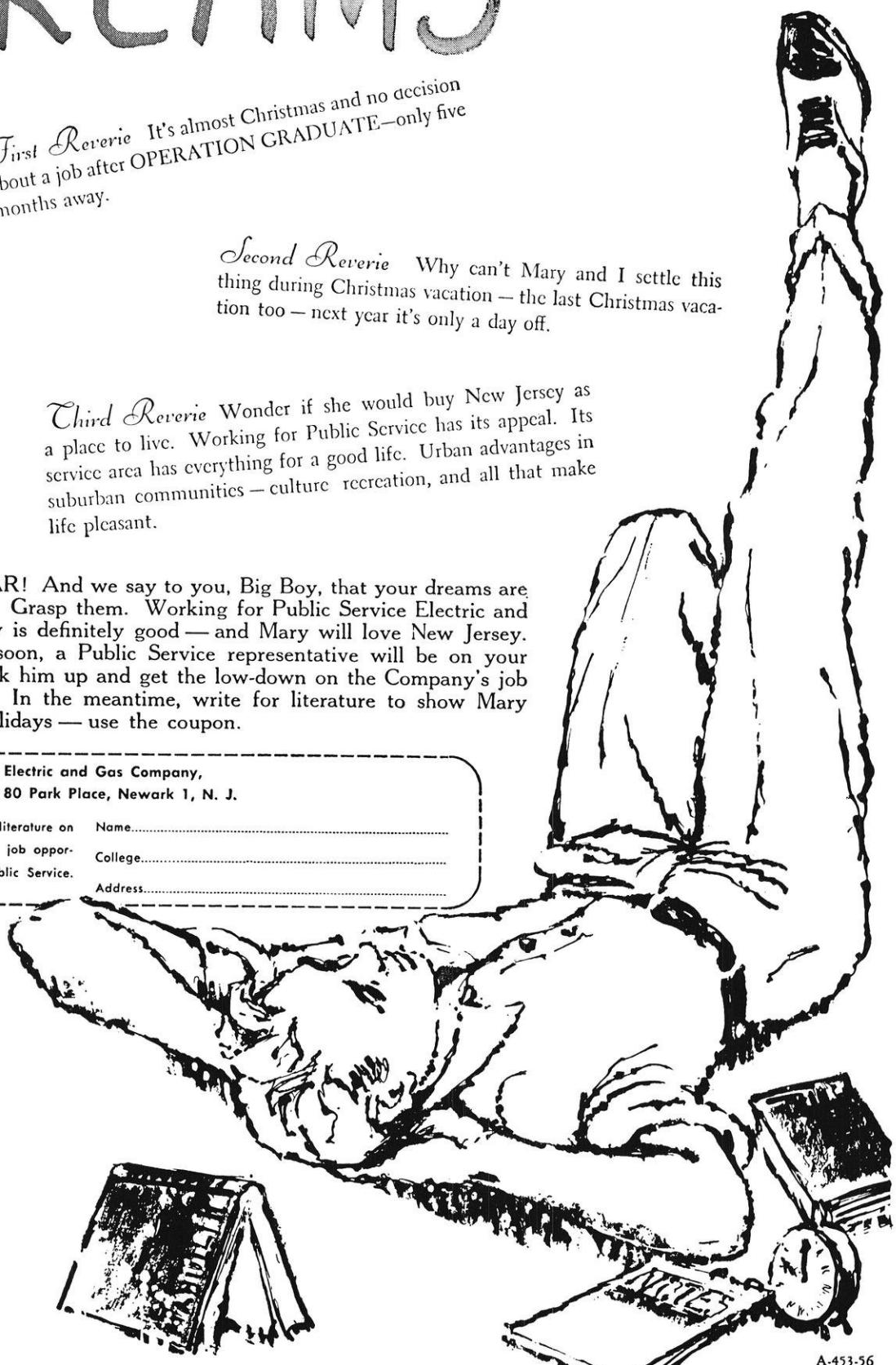

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LIQUID METAL HEAT TRANSFER IN NUCLEAR REACTORS

The field of nuclear power is not one that is easily delved into, but in this article one of its most important aspects, that of transferring the heat of the reactor from the reactor core to a steam generator, is clearly and concisely explained. This method of heat exchange by liquid metals promises to be the key to future reactor utilization

by Davis Hubbard che'57

The day is approaching when it will be economically feasible to produce electric power using nuclear reactions as a source of energy. Scientists and engineers are working day and night on the problems involved, and they are fast approaching the realization of their goal. As much energy as is now produced by hydroelectric and steam generating power stations will one day be produced by nuclear reactions.

The heart of any power producing installation is the source of energy. In the case of nuclear power, the energy is in the form of heat produced in the nuclear reactor. A great deal of heat can be produced continuously by a nuclear reactor; the problem is to transfer it outside the reactor where it can do useful work such as producing steam to operate a turbogenerator.

Scientists have designed nuclear reactors which operate well and even produce their own fuel. The only major problem is the design of a suitable heat transfer system.

Inside the nuclear reactor, the energy is produced by nuclear reactions involving the disintegration of heavy nuclei contained in the fuel and the subsequent release of energy and additional neutrons. This fuel consists of about five per cent fissionable material and ninety-five per cent source material from which fissionable material is made in the reactors.

These neutrons which are released in the fuel can take one of the following courses.

1. They can leak out of the reactor core and be lost.

2. They can be captured by the materials in the reactor other than the fuel. This type of reaction releases radiation, but serves no useful function. A typical reaction of this type follows.

$$_{7}N^{14} + {}_{0}n^{1} \longrightarrow {}_{6}C^{14} + {}_{1}H^{1} \text{ (proton)}$$

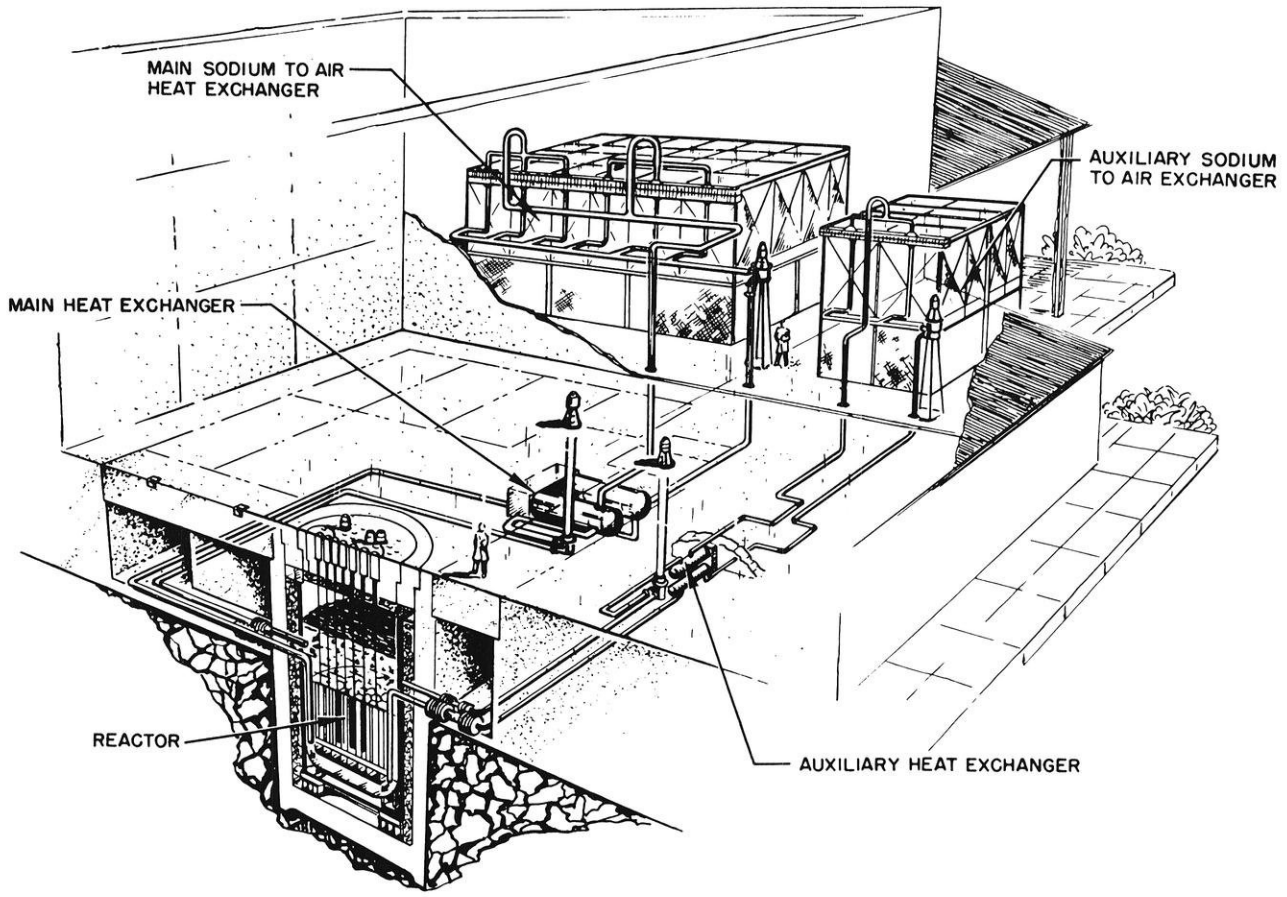
$$_{3}Li^{6} + {}_{0}n^{1} \longrightarrow {}_{1}H^{3} + {}_{2}He^{4} \text{ (alpha particle)}$$

3. They can be captured by fuel source material and produce more fissionable material, as in the following reaction.

$$_{92}U^{238} + {}_{0}n^{1} \longrightarrow {}_{92}U^{239} + Y \text{ (gamma radiation)}$$

$$_{92}U^{239} + {}_{0}n^{1} \longrightarrow {}_{93}Np^{239} + {}_{-1}B^{0} \text{ (beta particle)}$$

4. They can be captured by a fissionable nuclei and produce a fission reaction and produce more heat and



This is a typical proposed nuclear power plant reactor and heat exchanger system, using the liquid metal medium as a heat transferring device.

neutrons. The following is an example of this type of reaction.

$$_{92}U^{235} + {}_{0}n^{1} \longrightarrow {}_{57}La^{147} + {}_{35}Br^{87} + 2{}_{0}n^{1}$$

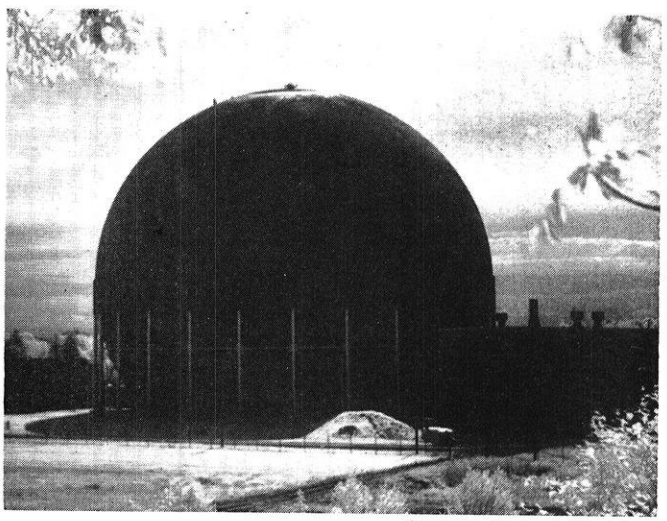
Only certain heavy nuclei undergo these reactions readily; these are the ones used for fuel in the reactor. The three major fissionable nuclei are uranium-235, uranium-233, and plutonium-239. Reactions occur when the heavy nuclei are bombarded with neutrons. However, all the fission reactions do not yield the same products.

The fission products fall into two general classes, those in the "light" group with mass numbers of 80–110 and those in the "heavy" group with mass numbers of 125–155. Because all the reactions are not the same, different numbers of neutrons are produced as the result of each separate fission. The average number neutrons emitted for each fission is 2.5 ± 0.1.

These neutrons are emitted at a high energy level, that is, a high velocity, but before they in turn can react with other nuclei, their velocity must be greatly reduced. Since neutrons are electrostatically neutral, they are able to penetrate the depths of the fuel atoms without a high velocity to overcome any electrostatic forces. Therefore, slow neutrons can penerate the nuclei just as easily as high velocity neutrons.

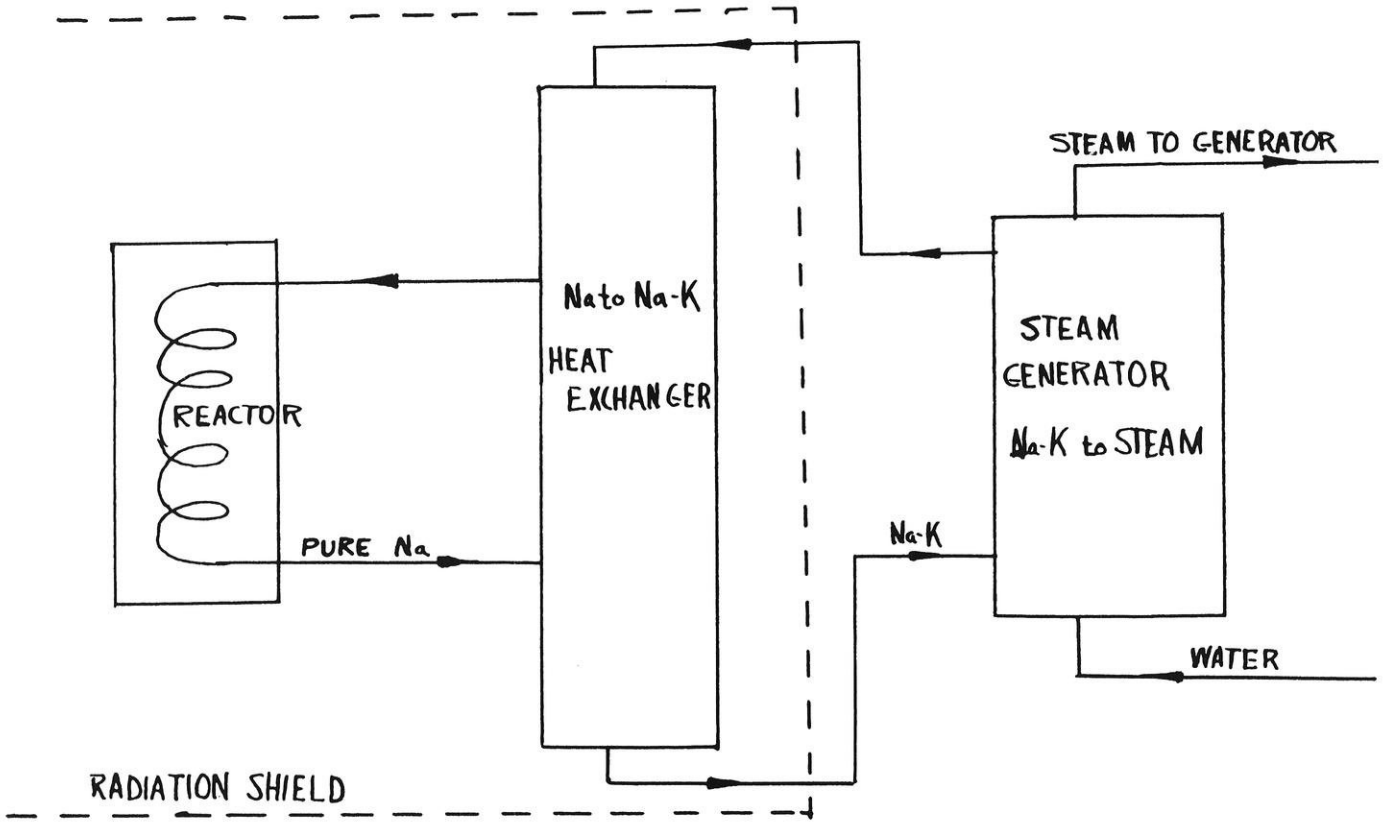
Because they require a greater length of time to traverse the distance through the body, slow neutrons have a better chance of hitting another nucleus before they can escape to the surroundings.

To reduce the velocity of the fast neutrons, a material known as a *moderator* is employed. The fast neu-



—Courtesy General Electric

This 225-foot sphere of the West Milton, New York atomic power plant houses a prototype submarine reactor that distributes commercial atomic-electric power to the surrounding communities.



A simplified diagram of liquid metal heat transfer using the sodium and sodium-potassium alloy heat transfer fluids. Such a system has been under test for the last four years at the Knolls Atomic Power Laboratory in Schenectady, New York, with favorable results.

trons collide with the moderator nuclei and transmit a part of their kinetic energy to the moderator nuclei.

A good moderator is one which can slow the neutrons down with a small number of collisions but doesn't absorb many of the neutrons. After a number of these velocity reducing collisions, the neutron has approximately the same kinetic energy as the molecules of the moderator. Since the kinetic energy of a molecule depends on the temperature, these neutrons are called *thermal* neutrons.

When the production of neutrons in the reactor exceeds the losses to absorbing media and to the atmosphere, the fission reactions in the reactor will continue at an increasing rate. If this process were allowed to continue, the reaction would get out of control and the reactor would destroy itself.

To control the reaction, rods of material having a large capacity for absorbing neutrons are inserted in the pile. These rods are operated automatically by servomechanisms and are pushed farther in or out as the rate of the reaction varies. With this arrangement for absorbing the excess neutrons, the number of neutrons present can be controlled quite closely.

As was mentioned earier, the major problem in the design of a power reactor is the problem of transferring the heat from the reactor to the steam generators where useful work can be done. One of the most common ways for cooling the reactor and transferring heat out of the system is by cooling with a circulating fluid.

Essentially, the fluid is first circulated through the core of the reactor where it is heated; then it is circulated through the steam generator where it in turn heats the water. These power reactors must operate at high temperatures; and therefore, the properties of the heat transfer fluid at high temperatures must be considered.

There are many desirable properties for this heat transfer fluid. Ones of major importance are high heat capacity, high heat transfer coefficient, low neutron absorption, stability at high temperatures, stability under radiation, and high boiling point.

Having a high heat capacity means that the mass flow rate can be kept as low as possible. This requires a pump of lower capacity. The fluid should not absorb neutrons to any great extent, because the greatest possible number of neutrons per unit of fuel is desired. This means that the losses of non-fissionable materials must be kept to a minimum. It is essential that the fluid be stable at high temperatures and under radiation effects.

A high boiling point means that the fluid will have a vapor pressure at the high temperatures. Thus, the

At the Geneva conference, where 70 nations gathered, commercial exhibits of industries from all over the world illustrated almost every aspect of the peaceful use of atomic energy.

system of piping, valves, and pumps can be designed to operate at a much lower pressure than if a fluid which vaporized at a low temperature were used. This reduces the cost of the system a great deal.

Some other desirable characteristics for the heat transfer fluid are a low melting point, non-corrosive with materials used in construction, easy to purify while the system is in operation, not harmful to personnel, modifier characteristics, low cost, and chemical inactivity.

If a fluid has a low melting point, it can be kept liquid at room temperature without any means of heating the piping. If the fluid corrodes the piping, impurities are formed. Many impurities are good neutron absorbers; therefore, they must be removed to obtain the greatest neutron economy. If the fluid has modifying characteristics, the amount of other modifying material in the reactor can be reduced, making the size and cost less.

Even though there is no known fluid with all these desirable properties, there are several fluids which have some of the desirable characteristics. Many of them have been tested in small scale heat transfer systems built by the United States Atomic Energy Commission. Some coolants which have been tried are air and other gases, ordinary water, heavy water, and liquid metals such as sodium, potassium, and bismuth.

Air has one big advantage—its availability, but this is offset by several disadvantages. Air has poor thermal properties for heat transfer. It is costly to pump. If discharged into the atmosphere, after use, it may contain radioactive wastes. Radioactive argon, which would

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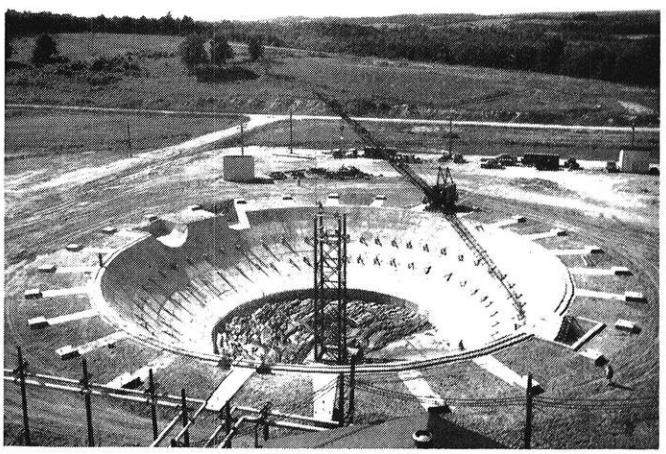
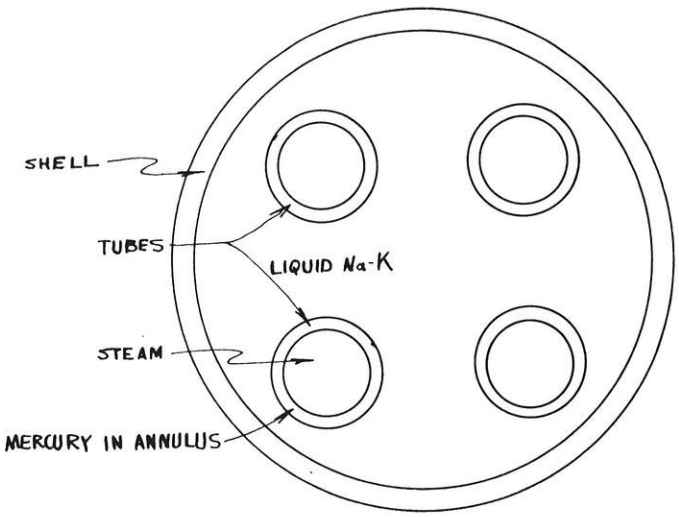


—Courtesy General Electric

In the future, this scene of a nuclear power plant beginning construction may be common in many parts of the world.



End section of the steam generator of the liquid metal heat transfer system.

have to be filtered out or removed in some other manner, is formed as it passes through the reactor.

Water has several advantages in addition to its low cost and high availability. It has good pumping characteristics and good heat transfer properties. However, there are several disadvantages that make its use difficult.

It has a very high vapor pressure at the high temperatures required in power reactors. This means that special high pressure piping and fittings would have to be built if water were used as the fluid for heat transfer. Water becomes radioactive upon bombardment with a neutron stream and remains radioactive for several hours, emitting large amounts of gamma radiation.

It also decomposes into hydrogen and oxygen under radiation. This is a disadvantage because hydrogen absorbs neutrons readily. The gas mixture is explosive, so that a fire hazard is present if the system is not completely leakproof.

Heavy water has the same thermal and chemical properties as regular water, but it is much more expensive. Because of this greater cost, the losses must be kept to a minimum, and the decomposition products must be recombined to form heavy water again. The deutrium which is a product of the decomposition due to radiation has a low neutron absorption tendency as opposed to the hydrogen formed by the decomposition of ordinary water.

Liquid metals, particularly sodium and sodium-potassium alloys, offer many desirable heat transfer characteristics. Sodium and sodium-potassium have good thermal properties, having heat capacities of about one-fourth that of water. They also have high thermal conductivities at the temperatures encountered. At these temperatures, the vapor pressures of sodium and sodium-potassium alloys are very low thus reducing the material costs in the piping system.

These liquid metals are stable at high temperatures and their physical properties are not affected by radioactivity. The sodium-potassium alloy is liquid at room temperature; the sodium metal melts at 208° F. Both liquid metals have nearly the same pumping characteristics as water. However, these liquid metals have some serious disadvantages.

The major disadvantage of the sodium and sodium-potassium systems is the high chemical reactivity of the materials when exposed to air and water. This means that the circulating system must be completely leakproof, and all piping must be jacketed with an inert gas to prevent fires. Since the metals are so reactive, impurities in the form of sodium oxide form readily. These impurities increase the tendency for the liquid metals to corrode the piping. Because of this, they must be removed frequently, and a system of purification while the system is operating is needed. All pipes carrying sodium must be heated in some way to keep the metal fluid at room temperature.

Other liquid metals and fused salts such as lithium, lead-bismuth alloy, and mercury have been tried. None of them seem to have the high heat transfer coefficient, low pumping requirement, and good melting and boiling point coupled with the low cost of the sodium-potassium systems.

Considering all advantages and disadvantages, the sodium and sodium-potassium alloy heat transfer fluids seem to offer the most efficient, economical method for producing power from a nuclear reactor.

Such a system of liquid metal heat transfer has been under test for the past four years at the Knolls Atomic Power Laboratory in Schenectady, New York. The system has given favorable results as far as the technical operation of the system goes. All the engineering problems have been met and their solutions found.

The test set up uses two liquid metal heat exchange circuits in series as in the simplified diagram.

The first circuit contains pure sodium which circulates through the reactor and cools it. This sodium circuit is coupled to the second circuit by means of a shell and tube heat exchanger.

The second circuit contains a sodium-potassium alloy and is coupled to the steam generator which is another shell and tube heat exchanger. The steam generated is used to operate turbogenerators producing electric power. Aside from the steam generator itself, the steam system is of standard construction. The heat exchangers used as steam generators are of special construction to eliminate any possible contact between the sodium-potassium alloy and the steam.

The tubes are of concentric construction with mercury filling the annulus.

The mercury provides an adequate heat transfer bond while separating the two highly reactive fluids. The mercury is not reactive with either water or liquid

sodium-potassium alloy. The liquid metal is circulated through the shell, and it vaporizes the water in the inner tubes.

The heat exchanger used to connect the pure sodium and Na-K systems is of the same general construction, but the annulus of the concentric tubes contains static sodium. The sodium which is circulated through the nuclear reactor becomes mildly radioactive, and this static layer of sodium eliminates any leakage of radioactive material to the external sodium-potassium system.

Sodium and sodium-potassium alloy burn spontaneously in air, making them hazardous to personnel. For this reason, the piping systems, storage tanks, pumps, and valves must be entirely leak-tight. A few problems arise in testing the piping systems for leaks, because the sodium and sodium alloys will leak through hydrostatically sound systems.

This means that the pipes cannot be connected by standard fittings or by flanges using metal gaskets. The pipes can, however, be connected by welded joints. These welds must be sound, though, because the liquid metal will attack any slag penerations or imperfections in the weld and will form leaks. The only way that a sound sytem of welds can be obtained is by using extreme care in the fabrication of the system.

As was mentioned earlier, the liquid sodium system cannot be tested hydrostatically. Nor can a high pressure fluid be used to locate leaks, because all the valves and pipes are designed for low pressure operation due to the low vapor pressure of the liquid metals.

The high pressure testing might injure some of the components of the system. The best method for detecting the leaks in the system is by the use of a high-vacuum helium mass spectrometer leak testing device. Each part of the system is tested as it is fabricated. The section is evacuated and enclosed in a helium jacket. If the section under test has even a small leak, the mass spectrometer will detect the presence of any helium that has leaked into the system. This method can be used for leaks as small as one cubic centimeter of gas per second.

Because of the high reactivity of the liquid metals used, the entire system must be jacketed with an inert atmosphere. This includes the atmosphere over all storage tanks and reservoirs.

This inert gas jacket has two functions. First, it is a safety measure against fires. Second, it minimizes the contamination of the liquid sodium through leakage of air into the pipes. In order to have this jacket of inert gas, all pipes carrying the liquid metals must be double welded.

The annular space is filled with argon which is used because it is heavier than air; it is cheap; and it is available in high purity. The pressure is kept near atmospheric pressure in the annulus.

This low pressure differential plus the fact that argon is heavier than air minimizes the leakage of the argon to the atmosphere. Instead of argon, helium or nitrogen could be used, but they are not readily available in the high purity required. The sodium combines with any impurities in the atmosphere over the storage reservoir, especially oxygen. The sodium oxide formed increases the tendency for the sodium to corrode the piping.

Since it is impossible to eliminate these impurities entirely, a method of purifying the liquid metals, for use while the system is in operation, was developed. Two general methods were found which could be used to purify the liquid sodium and sodium alloy.

Distillation yields liquid metal of high purity, but the process requires a long time. Another method, filtration through a sintered metal filter, does not give metal of as high purity as does distillation. However, this method is faster, and it was found that this treatment was satisfactory for purification. A method for purifying the liquid sodium while the system is in operation was devised.

Nearly all of liquid metal is kept at about 700° F. while a small fraction is fed into a cold reservoir where it is kept just above the freezing point (208° F.). At this temperature, the impurities, which are mostly sodium oxide, precipitate and they can be filtered out of the liquid. The purified metal is fed back into the system, and another fraction is taken to be purified. In this manner, the amount of corrosive impurities in the fluid is kept to a minimum without interrupting the operation of the system.

In the test system, stainless steel was used for all the piping, because techniques of its fabrication are familiar. The tubes in the heat exchangers carrying sodium and sodium potassium were made of L-nickel. After three years of continuous operation, the piping showed no appreciable corrosion when the cold trap purification method mentioned above was used.

Since sodium is solid at room temperature, some arrangement for heating the pipes above the melting point must be used. Electrical resistance heating is the best method. Non-reactive mineral wool was used to insulate the heating elements. In case of a leak in the system, the mineral wool would help smother any fire which might start.

For the sodium-potassium system, no heating elements are necessary, because the sodium-potassium alloy has a melting point of 675° F., and is liquid at room temperature.

The liquid metals must be circulated in the piping system by means of pumps. Either electromagnetic or mechanical pumps may be used for this purpose.

In electromagnetic pumps, a current is made to flow in the liquid metal, and a strong magnetic field around the pipe exerts a force on the current carrying fluid. This type of pump has several advantages. It is completely leak-proof; it has no moving parts; it can be easily controlled by varying the magnetic field strength around the pipe.

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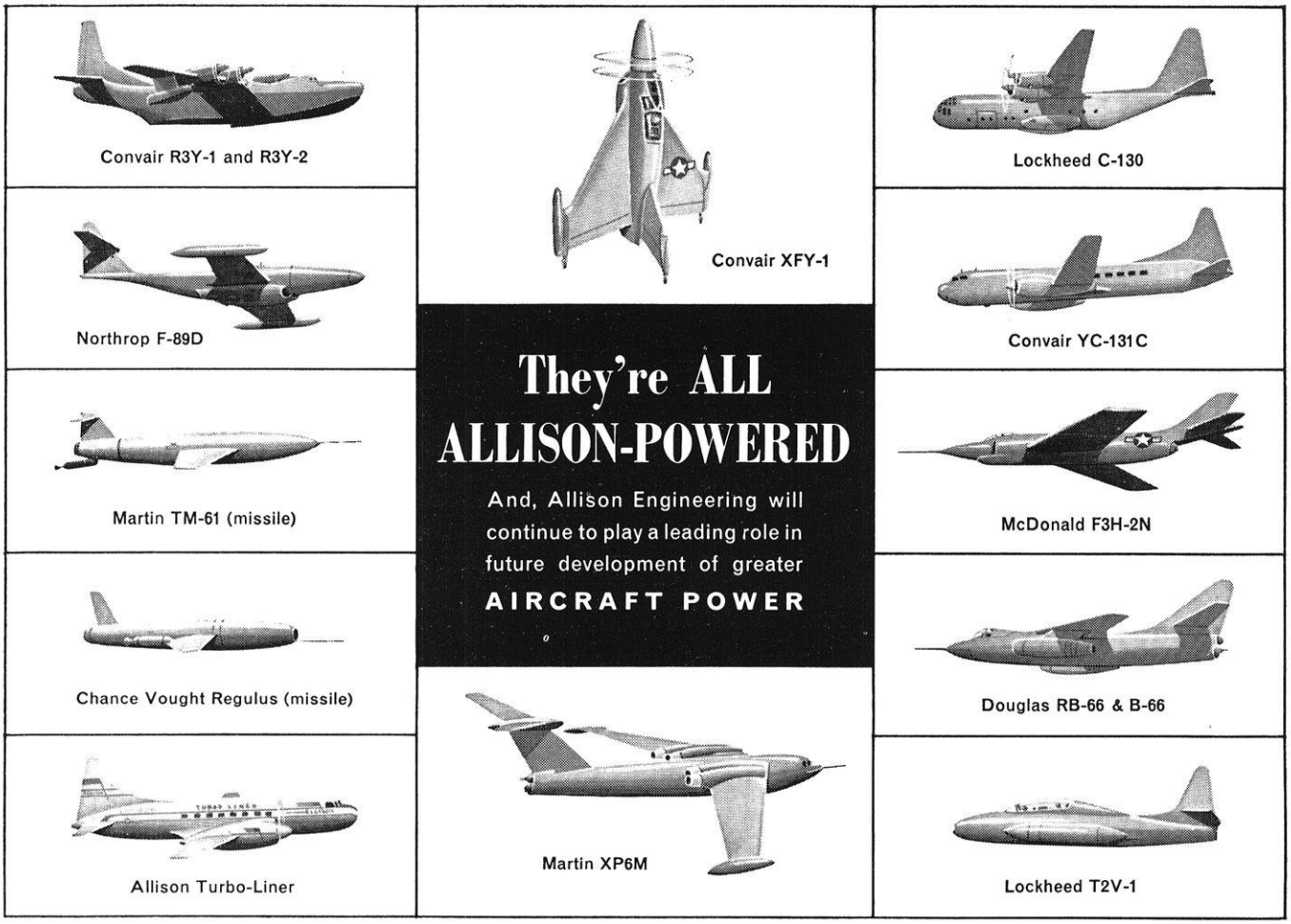

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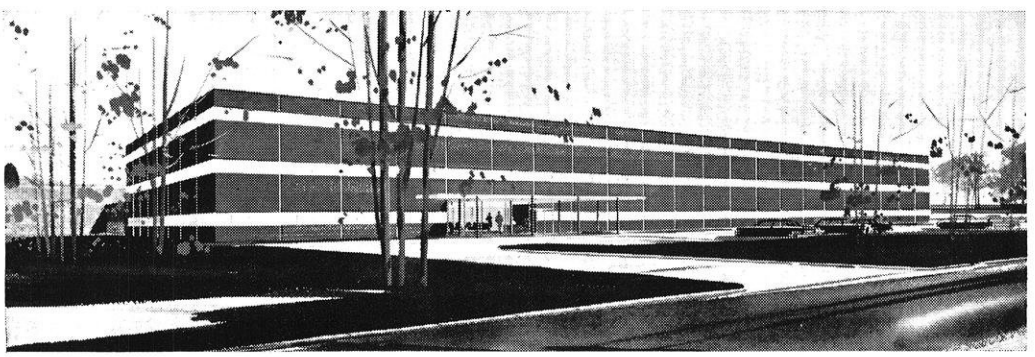

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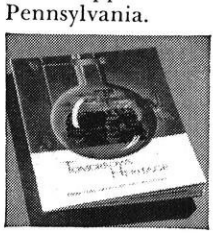

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THE BIG BLOW

The "jetstream": a wide river of air flowing at 20 to 40 thousand feet above sea level with highest speeds in excess of three hundred knots.

by Russell Porath m'57

Recently the air, weather, and forestry services have realized the presence of a weather phenomena which they named "the jetstream." The jetstream can best be described as a wide, flat river of air flowing on a meandering course, generally from west to east, with a central axis of peak velocity winds at 20 to 40 thousand feet above sea level.

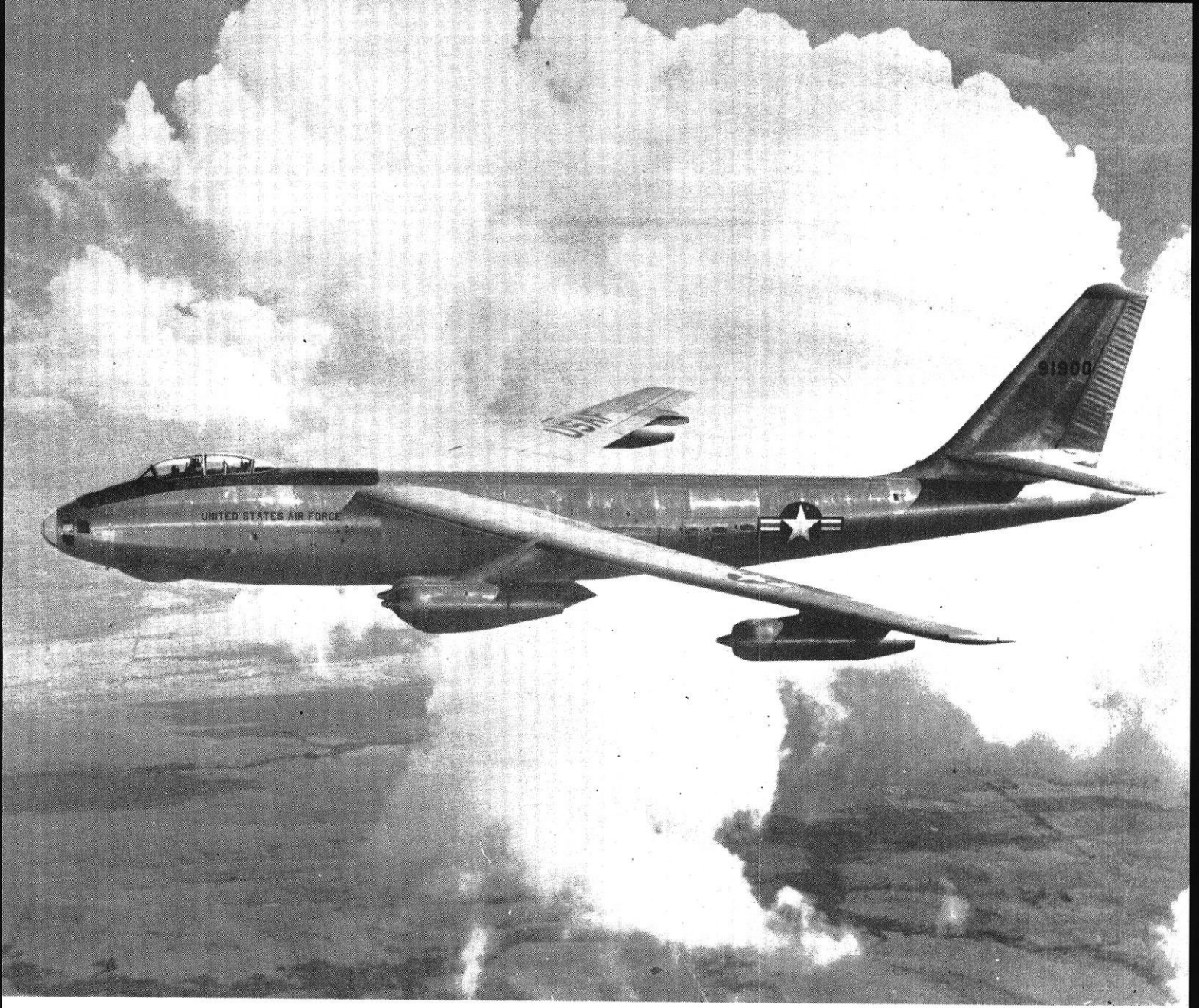
Various experiences of the United States Air Force and the Department of Forestry indicate that the jetstream has pertaining effects on navigation and fire control. This information was brought to light within the past five years largely through the advent of high altitude aircraft.

High velocity winds present over the United States throughout the year have proved to be either invaluable or seriously detrimental to the fuel consumption problems of our latest high-altitude aircraft. That this is true will be cited in later examples of documental and personal experience.

Although many extensive programs to investigate the jetstream have been completed, the sum total information still remains quite generalized; however, increasing interest of the United States Weather Bureau has enabled that organization to pinpoint the jetstream at any given time with a certain amount of accuracy. On the other hand, it remains to be seen how accurate their forecasting will prove, since little has been attempted thus far except on a very loose and long range basis.

The jetstream is a concentrated core of high velocity winds imbedded in the general flow. Its width may vary from ten miles to several hundred, although it is generally observed to be approximately three hundred miles wide. The depth remains fairly constant at about three or four thousand feet. The strongest winds are located in the center, or core, of this cross-section; their velocity will decrease as much as fifty knots in a thousand feet either above or below the center maximum.

Speeds up to three hundred knots have been recorded as a maximum performance of the jetstream, although two hundred knots is a more regular occurrence. Studies made by Japanese scientists using delicate equipment noted the highest speed winds recorded anywhere, in excess of three hundred knots. At the



outer limits of the core, where the velocity is lowest, a violent turbulence has been recorded. This tubulence was attributed to the shear forces of the jetstream through a normal flow of calmer air, a common occurence that accompanies any abrupt change.

The jetstream is located at different altitudes at different times; the range includes anywhere from twenty thousand feet to eight miles, although it has been observed occasionally at much lower altitudes. It is usually located about ten thousand feet higher in the summer season than in the winter, with an average of fifty knots per hour faster flow in the latter season. Like so many other aspects of the jetstream, both these observations remain unexplained.

The relative global positions of the jetstream vary continually. Data gathered by one group showed five different jetstreams, or fingers, over the North American continent at that particular time; another observation made by the same group one week later revealed only one huge jetstream present, located over the United States.

In February of 1920 Major Bob W. Schroeder, United States Army pilot and holder of altitude records, climbed westward from Dayton up to nearly seven miles. Although Major Schroeder's course was always westward, he landed east of where he started. A powerful jetstream had shoved him backwards; undoubtedly he considered such a strong headwind only one of nature's rare freaks, for no further investigation was made at the time.

In World War II, however, "the Siberian pet," strongest of all, once held General LeMay's bombers motionless over the Pacific as they struggled on a westerly course toward Japan. On the other side of the world the jetstream was a navigational aid, pushing English-based bombers over European targets with such rapidity that an element of surprise was affected.

The realization began to dawn; as the operational level of aviation increased to higher altitudes, the existence of these tubular bands of high speed winds became more and more apparent.

Typical global positions.

Lieutenant Colonel Napolean Shaka, present head of the observer section of the 306th Bomb Wing at MacDill Air Force Base, may be rightfully credited for naming these winds "the jetstream." His experience came in the fall of 1951 on a SAC training mission out of Mildenhall, England. Colonel Shaka was several hundred miles southwest of Cornwall when he turned his mission straight east to complete the second leg of the flight. A "return" showed up on the radar scope's one hundred mile range that shouldn't have been there, unless it was a fastgrowing weather echo.

But the weatherman hadn't mentioned it in his briefing. The situation was worrying in that the flight was approaching the rough weather so fast, so he switched his radar to the fifty mile range. Much to his surprise the "build-up" turned out to be nothing more than a coastal break-up, and the "fast approach" was not the front's speed at all, but his own.

His mission of B-29's had been caught up in the lower reaches of the jetstream and was being literally blown across the English Channel at a ground speed of five hundred knots per hour.

Today Colonel Shaka's job of observer at MacDill carries him into the jetstream frequently for tracking, plotting, and investigative purposes. With the fuel reservations inherit in modern aircraft, especially of the jet-powered type, it has become an essential problem to plot reliable data concerning the jetstream. It's either that or "take your chances," for the jetstream can be quite dangerous to aircraft that need large and well constructed runways to land on, should their fuel run out bucking the jet.

The Strategic Air Command has recently finished an extensive program called "Project Black Sheep" for that purpose. SAC aircraft have found wind shears up to thirty knots increase per one thousand feet altitude near the heart of the jet. The largest single value reported in Project Black Sheep was a fifty-two knot decrease over fifteen hundred feet. This value was observed near Tulsa, Oklahoma in March of 1954 by five pairs of B-47s in that area.

Since these values all formed a smooth pattern of the jetstream, it is believed this maximum value for vertical shear is quite reliable. Another complicated investigation of the project was concerned with measuring the small-scale structures of the jetstream's upper field. It was done by photographing the individual distinguishing characteristics of the jet aircraft's exhaust trail. Wind shears thus measured were up to and including three and one half knots per one hundred feet over intervals ranging from one hundred fifty to three hundred feet.

"If you can't beat it, then join it," is the latest theory of aircraft versus weather. This is, in effect, what SAC had done. They found that horizontal windspeed variations are much more important for jet flight planning and fuel management than vertical wind shears. Variations of forty knots over ten nautical miles at B-47 cruising level have been observed in the jetstream by Project Black Sheep.

These things are important to the jet aircraft that cruises normally at the general levels of the tropopause and jetstream. The jet can be diverted vertically above or below its level of optimum cruise, so that flight is

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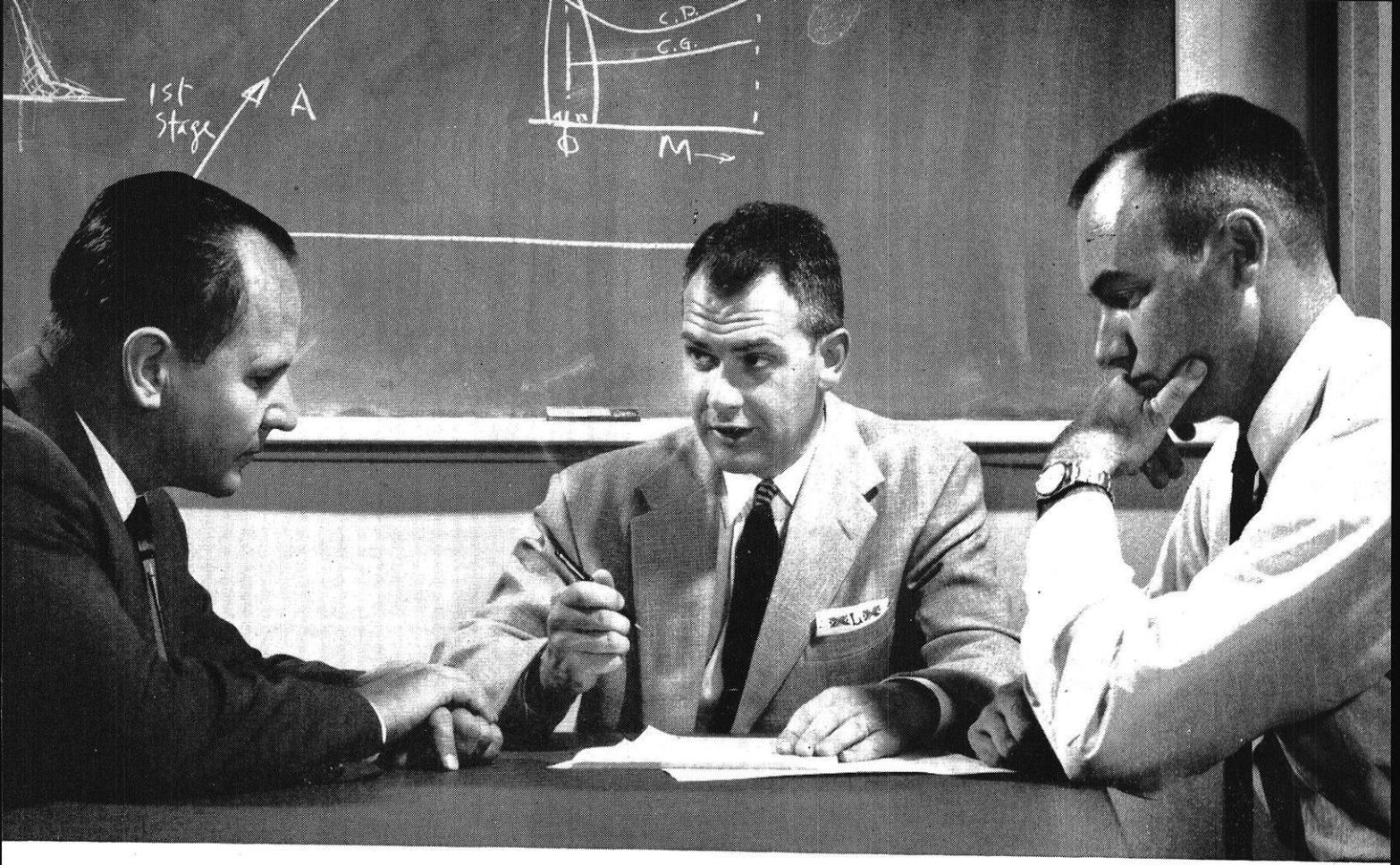

L. K. Edwards (center), advanced design and systems analysis department head, discusses launching of a ballistic missile with W. P. Gruner (left), head of weapons systems integration, and Systems Analyst G. W. Flynn.

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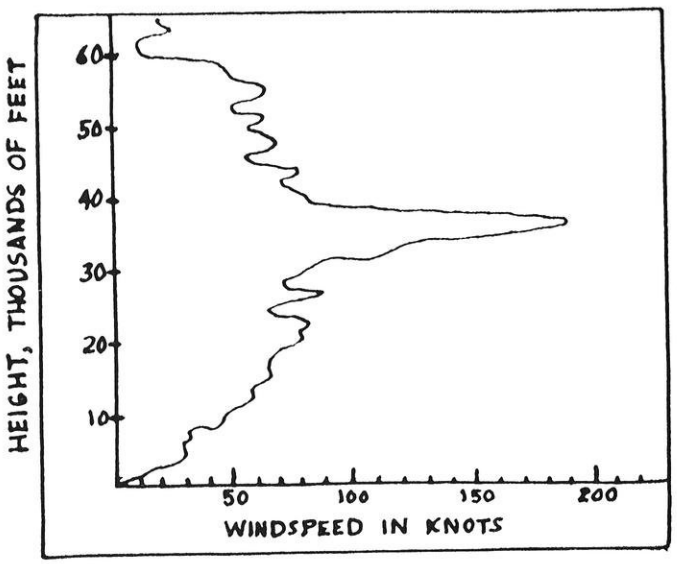
The Big Blow

(Continued from page 22)



Altitude location of jetstream. Graph based on actual wind observation showing jetstream with speed approaching 200 knots at altitudes between 30,000 and 40,000 feet.

made at levels of more helpful winds. As the flight progresses the altitude of the aircraft is continually adjusted to stay in the core velocity of the jetstream. If this isn't done, the time and fuel schedule of the aircraft may become endangered.

For instance, a change from one hundred twenty knots to sixty knots and back to one hundred twenty knots within four hours was experienced at thirty four thousand feet over Columbus, Ohio by a flight of B-47s on March 5, 1954. Some weeks later, another flight of B-47s observed a wind change from two hundred knots to seventy-two knots at forty thousand feet over Muscle Shoals, Alabama during a three hour period of local flying.

The smart aircraft commander knows that his track for the shortest travel time between air points is not a straight line. One February, 1954 mission of B-47s out of MacDill Air Force Base carefully routed around the jetstream on the westbound leg of the flight, and into it while eastbound, bringing them to their destination nineteen minutes ahead of their great circle time. By flying farther they got there faster.

Generally speaking, B-47 experience during maximum endurance cruise has actually shown that the average amount of time saved by flying a minimal time path over that of a great circle path is about five per cent of the total flight time. Putting his savings in dollars and cents, a single eight to nine-hour mission of thirty-five B-47s would save fifty-six hundred dollars by flying the minimal time path instead of the great circle track.

To the Forest Service the jetstream means "a strong, vertical wind shear." They have studied its relativity to the lightning problem and found that it sometimes appears to make storms worse, while in other situations it tends to blow the tops off towering cumulus clouds, thus hindering them from reaching lightning-storm proportions. This alone is their sole reason for jetstream study.

Their observations show that certain types of clouds are often associated with the jetstream. This association between cloud formations and high-altitude winds points to the possibility of observing and mapping the jetsream by visual methods.

In turn, foresters may find that the jetstream clouds serve as indicators of fire weather and lightning conditions and signal some of the probable patterns of fire behavior.

Cloud forms of the jetstream appear to be of four types. Two high cloud types are 1) long streamers of cirrus moving at high velocity, and 2) great patches of cirrocumulus showing small waves and ripples. The other two types are middle cloud formations; 3) the altocumulus lenticular, resembling a stack of leaning flapjacks, and 4) the altocumulus billows, parallel bands of clouds showing waves or billows at right angles to their motion.

As an additional phase of their cloud survey, twenty-five fire lookouts recorded daily observations of jetstream clouds during the summer season. The surveys are still in progress. This information will provide the basis for making generalized jetstream maps, which in turn will be compared with the daily high-altitude maps furnished by the Weather Bureau.

With the small amount of data available, it is difficult to generalize on the relationship between surface winds and the jetstream. The mountain winds due to convective heating, downdrafts, and frontal winds all exceed twenty-five knots. On the other hand, surface winds below the jetstream may be very light. However, surface winds greater than thirty-five knots seem due solely to a jetstream effect. These winds are dangerous from the fire-danger standpoint because they may occur in dry weather.

With the fire lookout stations reporting regularly the wind velocities present at their stations, it was found that winds over twenty-five knots were almost invariably associated with a jetstream condition.

Where the jetstream fails to reduce the severity of a lightning-storm build-up, or where it tends to increase its severity, the Forest Service hopes to offset the effect by cloud seeding. Laboratory experiments conducted by them have proved that the introduction of such nuclei as dry ice or silver iodide will modify cumulus cloud structures favorably. The exact course of events of the Forest Service's experiments remain for the future to decide, however, as more information is obtained.

THE END

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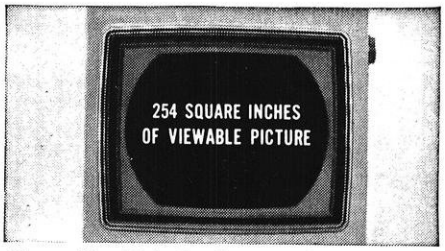

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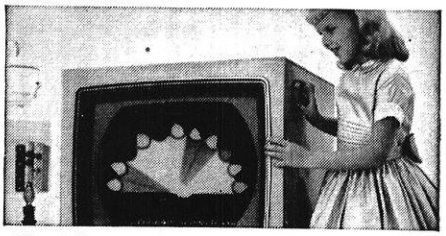

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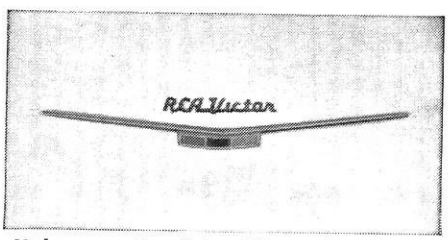
Color TV is a common-sense investment—costs only a few cents a day. It's sure to become the standard in home entertainment for years to come—yet you can enjoy Color every night *right now!* And you can buy on easy budget terms.

Now starts at $495 — no more than once paid for black-and-white. This is the lowest price for Big Color TV in RCA Victor history! There are 10 stunning Big Color sets to choose from—table, consolette, lowboys, and consoles, too.

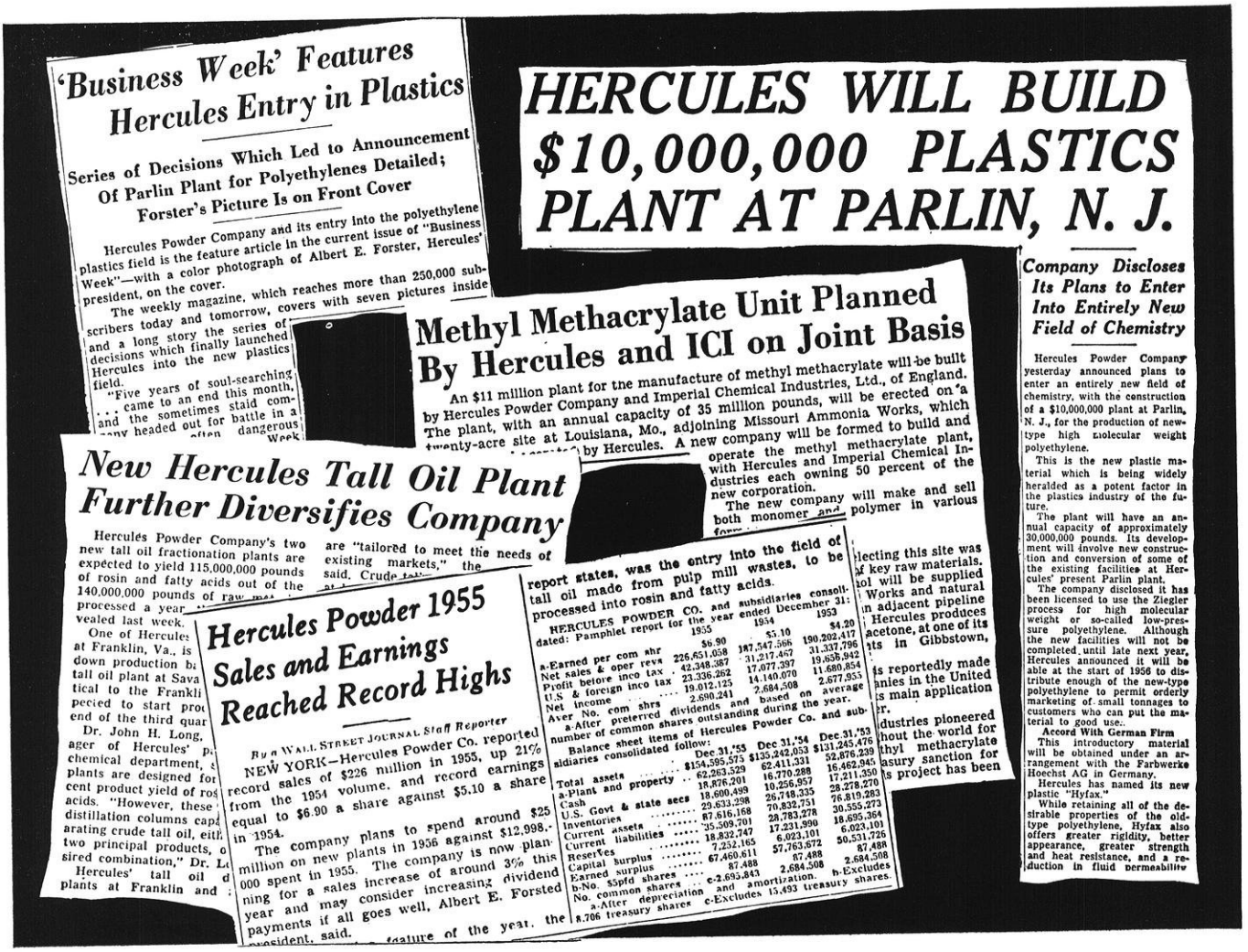


Make sure the Color TV you buy carries this symbol of quality. Because RCA pioneered and developed Compatible Color television, RCA Victor Big Color TV—like RCA Victor black-and-white—is First Choice in TV.

RCA®

RADIO CORPORATION OF AMERICA

ELECTRONICS FOR LIVING



'Business Week' Features Hercules Entry in Plastics

Series of Decisions Which Led to Announcement Of Parlin Plant for Polyethylenes Detailed; Forster's Picture Is on Front Cover

Hercules Powder Company and its entry into the polyethylene plastics field is the feature article in the current issue of "Business Week"—with a color photograph of Albert E. Forster, Hercules' president, on the cover.

The weekly magazine, which reaches more than 250,000 subscribers today and tomorrow, covers with seven pictures inside and a long story the series of decisions which finally launched Hercules into the new plastics field.

"Five years of soul-searching . . . came to an end this month, and the sometimes staid company headed out for battle in a [illegible] dangerous [illegible]

HERCULES WILL BUILD $10,000,000 PLASTICS PLANT AT PARLIN, N. J.

Company Discloses Its Plans to Enter Into Entirely New Field of Chemistry

Hercules Powder Company yesterday announced plans to enter an entirely new field of chemistry, with the construction of a $10,000,000 plant at Parlin, N. J., for the production of new-type high molecular weight polyethylene.

This is the new plastic material which is being widely heralded as a potent factor in the plastics industry of the future.

The plant will have an annual capacity of approximately 30,000,000 pounds. Its development will involve new construction and conversion of some of the existing facilities at Hercules' present Parlin plant.

The company disclosed it has been licensed to use the Ziegler process for high molecular weight or so-called low-pressure polyethylene. Although the new facilities will not be completed until late next year, Hercules announced it will be able at the start of 1956 to distribute enough of the new-type polyethylene to permit orderly marketing of small tonnages to customers who can put the material to good use.

Accord With German Firm

This introductory material will be obtained under an arrangement with the Farbwerke Hoechst AG in Germany.

Hercules has named its new plastic "Hyfax."

While retaining all of the desirable properties of the old-type polyethylene, Hyfax also offers greater rigidity, better appearance, greater strength and heat resistance, and a reduction in fluid permeability

Methyl Methacrylate Unit Planned By Hercules and ICI on Joint Basis

An $11 million plant for the manufacture of methyl methacrylate will be built by Hercules Powder Company and Imperial Chemical Industries, Ltd., of England. The plant, with an annual capacity of 35 million pounds, will be erected on a twenty-acre site at Louisiana, Mo., adjoining Missouri Ammonia Works, which is owned by Hercules. A new company will be formed to build and operate the methyl methacrylate plant, with Hercules and Imperial Chemical Industries each owning 50 percent of the new corporation.

The new company will make and sell both monomer and polymer in various

New Hercules Tall Oil Plant Further Diversifies Company

Hercules Powder Company's two new tall oil fractionation plants are expected to yield 115,000,000 pounds of rosin and fatty acids out of the 140,000,000 pounds of raw [illegible] processed a year [illegible] vealed last week.

One of Hercules at Franklin, Va., is down production b tall oil plant at Sava tical to the Frankli pected to start pro end of the third quar

Dr. John H. Long, ager of Hercules' p chemical department, plants are designed for cent product yield of ros acids. "However, these distillation columns cap arating crude tall oil, eith two principal products, o sired combination," Dr. L

Hercules' tall oil d plants at Franklin and

are "tailored to meet the needs of existing markets," the said. Crude tall-

report states, was the entry into the field of tall oil made from pulp mill wastes, to be processed into rosin and fatty acids.

Hercules Powder 1955 Sales and Earnings Reached Record Highs

By a Wall Street Journal Staff Reporter

NEW YORK—Hercules Powder Co. reported record sales of $226 million in 1955, up 21% from the 1954 volume, and record earnings equal to $6.90 a share against $5.10 a share in 1954.

The company plans to spend around $25 million on new plants in 1956 against $12,998,000 spent in 1955. The company is now planning for a sales increase of around 3% this year and may consider increasing dividend payments if all goes well, Albert E. Forsted president, said.

[illegible] feature of the year, the

lecting this site was f key raw materials. ol will be supplied Works and natural n adjacent pipeline Hercules produces acetone, at one of its ts in Gibbstown,

s reportedly made anies in the United s main application r.

dustries pioneered hout the world for hyl methacrylate asury sanction for s project has been

HERCULES POWDER CO. and subsidiaries consolidated: Pamphlet report for the year ended December 31:

	1955	1954	1953
a-Earned per com shr	$6.90	$5.10	$4.20
Net sales & oper revs	226,651,058	187,547,566	190,202,417
Profit before inco tax	42,348,387	31,217,467	31,337,796
U.S. & foreign inco tax	23,336,262	17,077,397	19,658,942
Net income	19,012,125	14,140,070	11,680,854
Aver No. com shrs	2,690,241	2,684,508	2,677,953

a-After preferred dividends and based on average number of common shares outstanding during the year.

Balance sheet items of Hercules Powder Co. and subsidiaries consolidated follow:

	Dec 31,'55	Dec 31,'54	Dec 31,'53
Total assets	$154,595,575	$135,242,053	$131,245,476
a-Plant and property	62,263,529	62,411,331	52,876,239
Cash	18,876,201	16,770,288	16,462,945
U.S. Govt & state secs	18,600,499	10,256,957	17,211,350
Inventories	29,633,298	26,748,335	28,278,270
Current assets	87,616,168	70,832,751	76,819,283
Current liabilities	35,509,701	28,783,278	30,555,273
Reserves	18,832,747	17,231,990	18,695,364
Capital surplus	7,252,165	6,023,101	6,023,101
Earned surplus	67,460,611	57,763,672	50,531,726
b-No. $5pfd shares	87,488	87,488	87,488
No. common shares	c-2,695,843	2,684,508	2,684,508

a-After depreciation and amortization. b-Excludes 8,706 treasury shares. c-Excludes 15,493 treasury shares.

A CHEMICAL HEADLINE MAKER OFFERS CAREERS WITH A FUTURE

When the editors of the nation's business press devote cover stories to a company, it's a good sign that the company is setting a fast pace in today's competitive world. By branching off into new fields of creative chemistry, by building its sales from $7,000,000 in 1913 to more than $226,000,000 in 1955, Hercules Powder Company was one of the big stories of 1955. With an investment of more than $28,000,000 going into new plant facilities this year alone Hercules will continue to be a growth leader in the years ahead. This is the type of company in which ability finds its opportunity for advancement; where a young man can grow into the type of job he will find most rewarding. Why not find out more about careers with Hercules from your placement officer? Or write direct to Hercules for additional information.

HERCULES

Personnel Department

HERCULES POWDER COMPANY

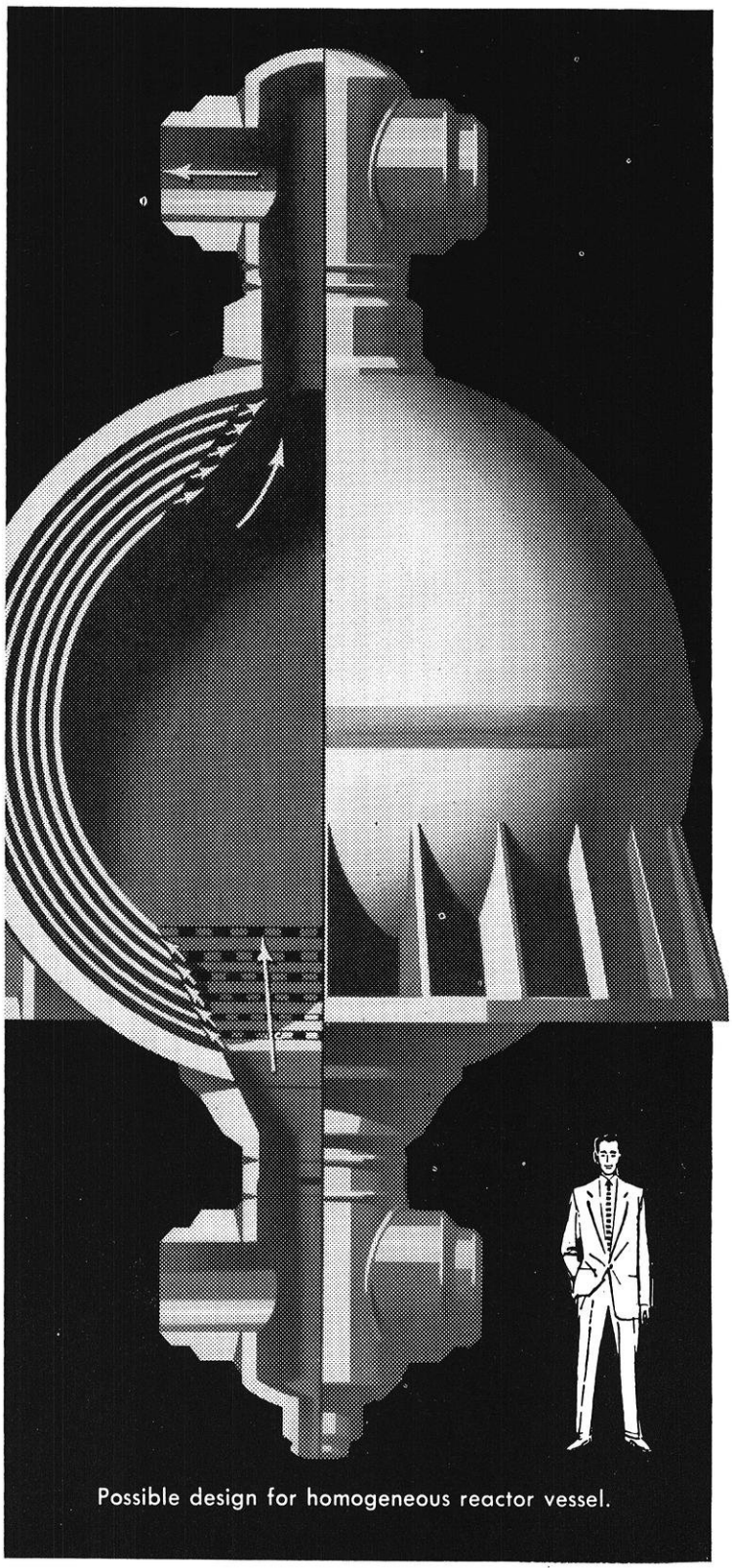
INCORPORATED

968 Market Street, Wilmington 99, Del.

GR56-2

Building the first large liquid-fuel reactor for a utility power plant.

. . . A PROBLEM IN ATOMIC POWER



Possible design for homogeneous reactor vessel.

The first large homogeneous reactor for a utility power plant is now being designed by Westinghouse engineers and scientists, in partnership with the Pennsylvania Power and Light Company, for whom the plant will be built. The plant will have a capacity of 150,000 kw.

Liquid fuel will be circulated throughout the nuclear power plant and carry heat to steam generators.

This is only one of many daring research and engineering projects young engineers can work on at Westinghouse.

Here you can work in your chosen field . . . electrical, mechanical, chemical and industrial engineering; physics; mathematics; metallurgy and many others. And, you can pick the type of work you prefer.

Rapid expansion of manufacturing capacity and entry into new fields like radar, automation and semiconductors, enable capable young men to advance rapidly.

Your opportunity to build a career at Westinghouse is not left to chance. A well-planned program of training . . . continued education at graduate school level (at company cost), and advanced management and professional development courses . . . all create a favorable and exciting climate in which to grow.

For further information, talk to your placement officer or ask him to make a date with the Westinghouse interviewer. Meanwhile, write for *Finding Your Place in Industry* and *Continued Education at Westinghouse.*

Write: Mr. C. W. Mills, Regional Educational Co-ordinator, Westinghouse Electric Corporation, Merchandise Mart Plaza, Chicago 90, Ill.

G-10301

Westinghouse

THE FINE ART OF HANDLOADING

The author presents a complete and eye-opening account of the advantages of handloading your own ammunition. Not only economy, but also increased accuracy and performance are gained by the sportsman who decides to make a hobby of the fine art of handloading.

Alfred E. Wiegand m'58

The purpose of this article is to acquaint the average sportsman with handloading procedure, costs and accuracy. Shooters have turned to handloading because of the economies afforded, and because of the outstanding performance they can obtain with their rifle by handloading. It is possible to save more than two-thirds of the cost of ammunition, develop ammunition having superior accuracy and performance and enjoy a very interesting hobby at the same time.

Reloading ammunition will pay dividends to the hunter who uses his rifle during the hunting season only. Why should a man leave his gun in the rack for all but two weeks out of the year when, if by handloading, he can make superior ammunition at low cost and have the fun of shooting the year round.

The economy of handloading will give him the opportunity to spend many more hours shooting his rifle. This will enable him to become more familiar with the performance of his gun and improve his shooting eye.

As a result of handloading he would have far less doubt about getting his game next fall, at least from the standpoint of being able to place his shot where it counts. In a great many instances, the shooters who make one shot kills are handloaders.

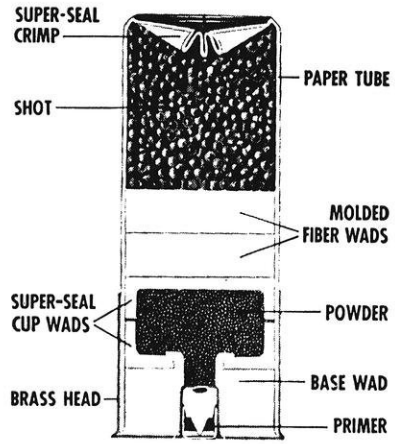
In order to simplify this discussion of handloading, it is first necessary to give descriptions of the cartridge components that the handloader must work with.

The cartridge case may be generally described as a container for the primer, the propellent charge of powder, and the projectile or bullet. It is the main body into which the components are placed resulting in a unit of ammunition which can be loaded, fired, and ejected from the breech of the rifle. When a cartridge is fired in a rifle, the case acts as a seal to prevent the escape of gases from the breach.

Center fire rifle cartridge cases are made from brass, 70 per cent copper and 30 per cent zinc, called cartridge brass. Cartridge brass differs from other brasses in that it has physical properties which make it well adapted to deep drawing, essential in the manufacture of cartridge cases. The cases are heat tempered leaving the mouth and sidewalls fairly soft and the head quite tough and hard.

The Boxer primer is used almost exclusively for center fire cartridges in America. It consists of a cup containing the pellet or charge covered by a paper disc which is backed by a small metal anvil. The anvil backs up the priming charge when the firing pin of the rifle strikes the primer.

The Boxer primer is also much easier to remove from the fired case and is therefore preferred by the handloader.



—Courtesy Winchester-Western

Here a cross-sectional view shows the main parts of the commonly used shot-shell.

Gun powder to the average shooter is probably the most foreign of the cartridge components unless he happens to be an experienced handloader. The numbers designating the various powders used in handloading are completely without meaning to the average shooter.

These numbers however, being the method used to identify the various types of powder, make it essential that the handloader know them. A list and description of the rifle powders used in handloading will be found in any handloading manual.

In order to obtain the performance expected of present day sporting rifle cartridges, it is essential that handloaders use jacketed bullets. Present day jacketed bullets consist of drawn gilding metal jackets in which a lead core is inserted and is swaged to shape in a steel die. Jacket metal hardness and lead hardness are varied depending upon the type of bullet being made.

Bullets to be used in low velocity cartridges are constructed differently than those to be used in high velocity cartridges. Like cartridge cases, bullets are carefully-designed precision-made products.

To begin handloading, the following equipment is essential:

Loading Press
Set of Dies for Press, 1 calibre only
Powder Scale
Powder Funnel
Case Lubricant
Case Mouth Chamfering Reamer
Bullets
Primers
Smokeless Powder

With these the handloader may begin his work.

Select a place for handloading with good light and adequate storage room for tools and supplies. A small drawer cabinet will be very handy for cases, dies, primers, bullets, etc. A solid heavy table or work bench is a necessity for the handloader to form a stable base for the loading press.

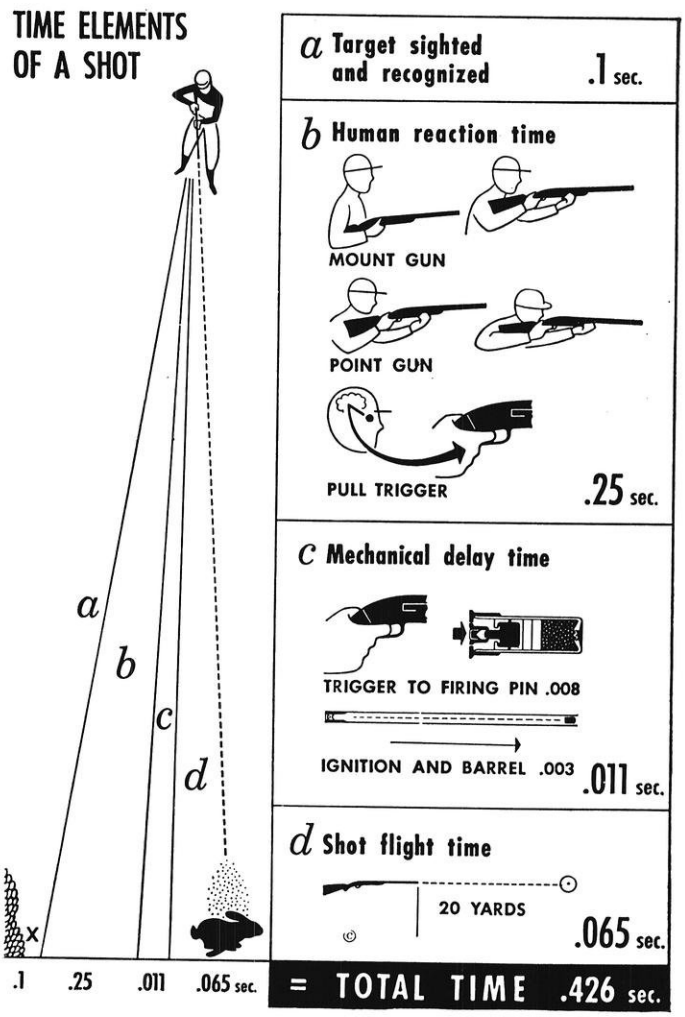
The first step in handloading is to give the cartridge case a close inspection.

Generally speaking, there are five things to look for in case inspection. They are: Neck Split; Body Split; Body-Head Separation; Swelled Head and Primer Pocket; and Excessive bulge.

If any of these conditions exist, the cases in question should be discarded. The only possible exception might be the case with excessive bulge. Oversize rifle chambers will cause the fired case to show excessive bulge.

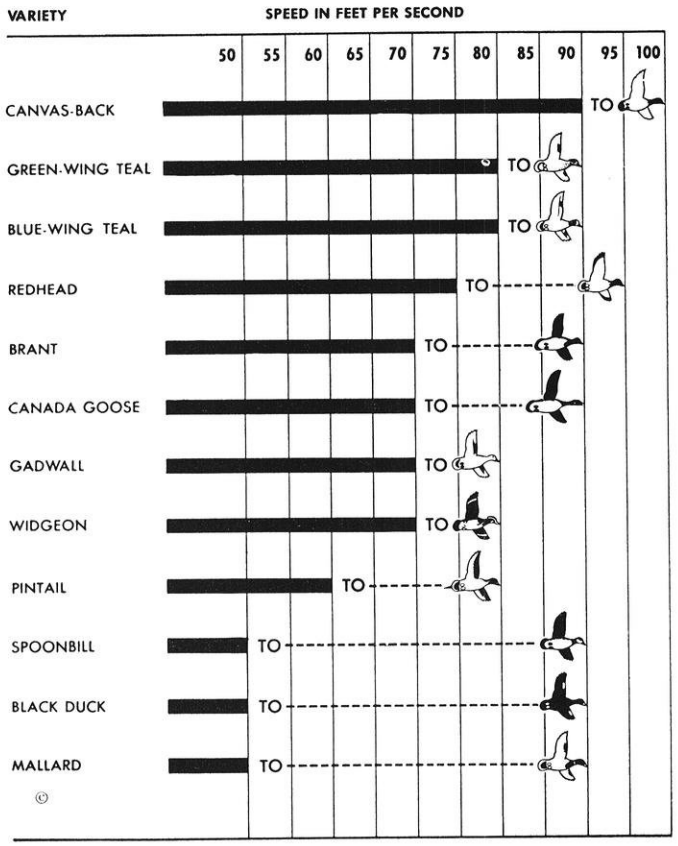
As long as the shooter is well aware of the condition, these cases may be reloaded with moderate charges. Full loads at maximum pressure levels should never be used in bulged cases because the extreme pressures might rupture them, with possible injury to the shooter. When bulged cases are reloaded, they should be neck resized only, and not full length resized which will work harden the brass in the area of the bulge.

Cases to be reloaded must be relatively clean and lightly lubricated in order to resize them easily. This is accomplished by wiping them with a cloth containing a small amount of case lubricant. By cleaning and lubricating the cases while inspecting them, all three jobs can be done at once.



The Speed of Wild fowl

Ducks and geese are known to be capable of fast flight, but just how fast can they fly? And what are the speeds of various species? A recognized authority gives the following estimates, helpful in determining the correct lead when shooting:



One precaution to observe is the over-lubrication of cases. If too much lubricant is used, it will build up in the die and cause oil dents, generally in the shoulder of the case.

Cases which are exceptionally dirty can be cleaned if they are immersed in 10% glacial acetic acid, washed thoroughly and dried.

Cases to be reloaded must be resized or reduced to such dimensions that the neck will grip a new bullet and fit properly in the chamber of the rifle. If the fired cases are to be used in the same rifle again, it is recommended that they be neck sized only. This means the body of the case is left as it was and only the neck resized to proper dimensions.

Cases should not be full length resized unless the cartridges are to be used in another rifle or the fired cases have expanded too much to go back in the rifle chamber easily. Consecutive full length resizing hardens brasss and shortens case life greatly.

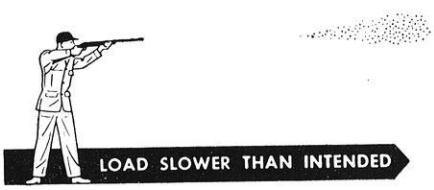
Before beginning the resizing operation, be sure to check the decapping pin for centering. It is not uncommon for the decapping stem in the sizing die to become slightly bent so that the decapping pin is not centered in the die. When this occurs the decapping pin does not hit the flash hole in the primer and is frequently broken. It may also pierce the web of the cartridge case and ruin several cases before discovery. It is best to check the pin for being on center before screwing the die into the press frame. The stem is easily straightened if found bent.

To begin the resizing operation, place the die in the press so that when the shell holder is moved to the top of the stroke, it nearly touches the bottom of the die. Then adjust the decapping rod so the decapping pin hangs below the bottom of the die about $\frac{3}{8}$ of an inch. The expanding plug should always lie about 1/16 inch above the bottom of the die, otherwise it will hit the web of the case before it has entered the die completely. Whether the die is made for neck sizing or full length sizing, it can be adjusted the same way.

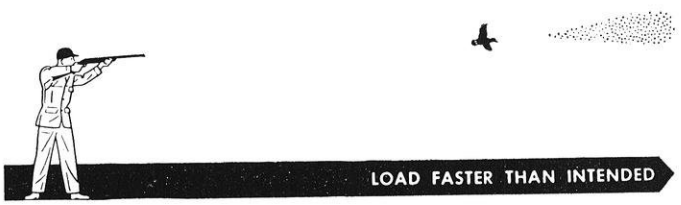
To perform the resizing operation, place a case in the shell holder and move the operating lever the full length of the stroke. This will move the case all the way into the die if the die has been set properly.

The case has been made to conform to the contour of the die and the decapping pin has pushed the fired primer out. Moving the operating lever in the opposite direction from before will remove the case from the die. As the case is going out of the die, the expander plug is automatically pulled through the neck of the case, resizing it to proper dimensions.

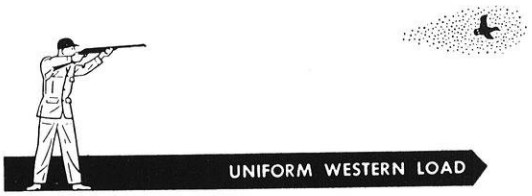
It is at this point that primer pocket cleaning takes place. It is not necessary to clean primer pockets after every firing but they should be inspected after every four or five reloadings to be sure no large deposits of residue have built up impairing proper primer seat-



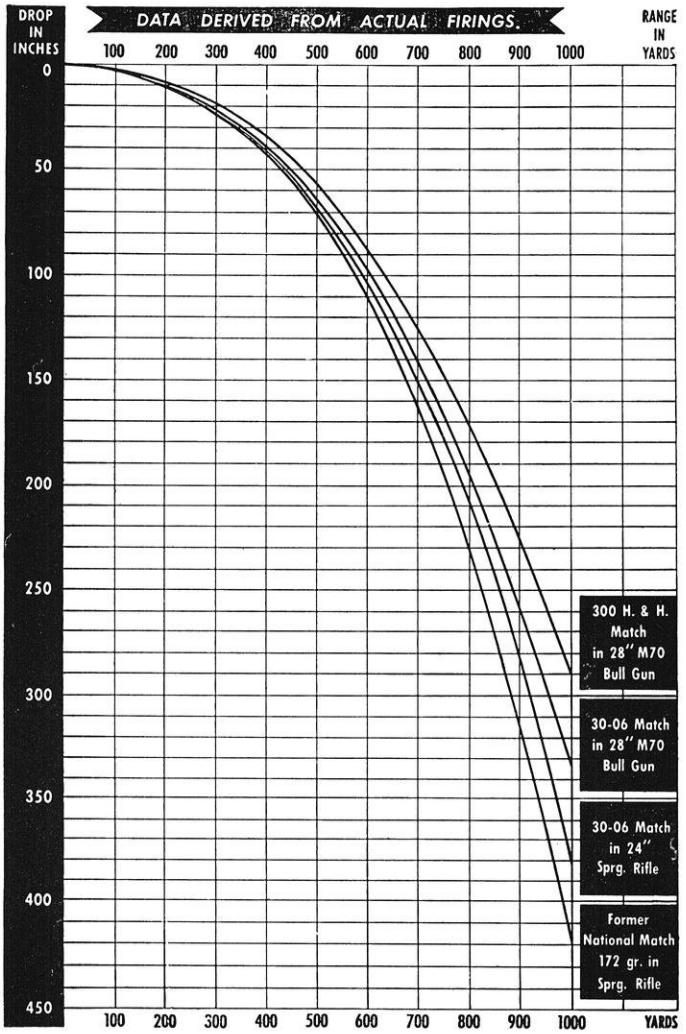
Never reaches fast moving bird.

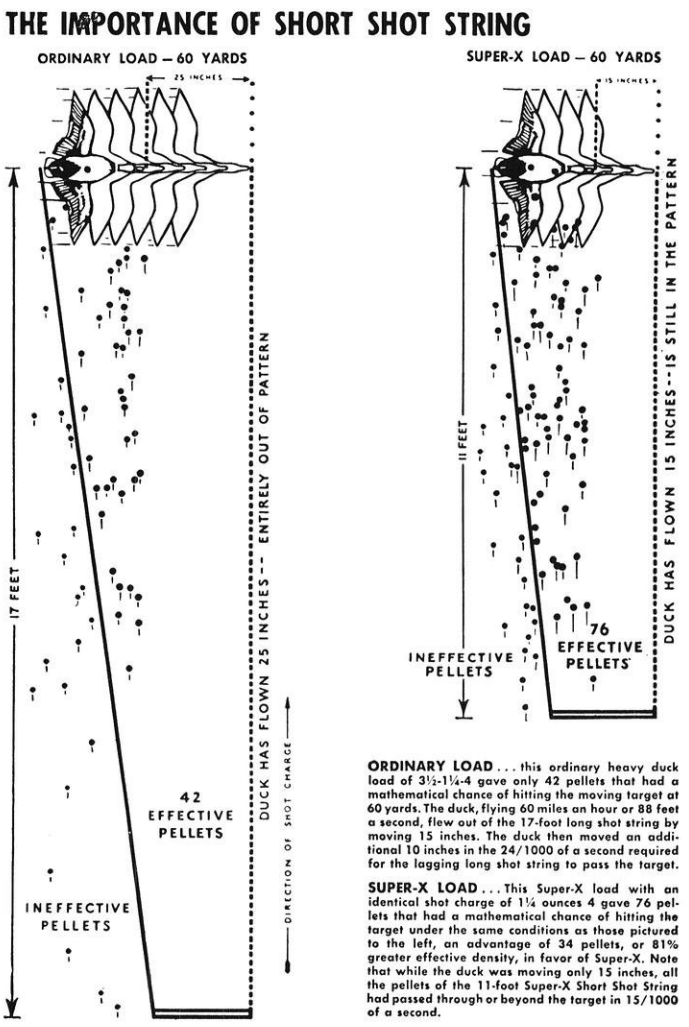


Gets too far in front of target.



Is on target and enables shooter to perfect his swing.





ORDINARY LOAD . . . this ordinary heavy duck load of 3½-1¼-4 gave only 42 pellets that had a mathematical chance of hitting the moving target at 60 yards. The duck, flying 60 miles an hour or 88 feet a second, flew out of the 17-foot long shot string by moving 15 inches. The duck then moved an additional 10 inches in the 24/1000 of a second required for the lagging long shot string to pass the target.

SUPER-X LOAD . . . This Super-X load with an identical shot charge of 1¼ ounces 4 gave 76 pellets that had a mathematical chance of hitting the target under the same conditions as those pictured to the left, an advantage of 34 pellets, or 81% greater effective density, in favor of Super-X. Note that while the duck was moving only 15 inches, all the pellets of the 11-foot Super-X Short Shot String had passed through or beyond the target in 15/1000 of a second.

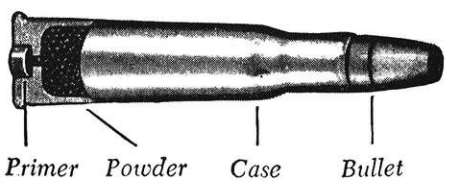
ing. The residue can be removed with a small end mill and a piece of flannel cloth or a wire brush.

Before the case reaches the bottom of the stroke, a new primer is placed in the primer inserting punch located below the shell holder in line with the die. The case in the shell holder is then moved down over the priming punch, forcing the new primer into the case.

After the cases have been resized and primed, they should be checked for size to be sure they will fit the rifle they are to be used in. Try one of the cases in the rifle. If it does not go in the chamber easily, one or two conditions might exist.

Either the case neck has lengthened sufficiently to make the case mouth tight against the forward end of the chamber; or the body of the case has expanded and also lengthened too much and must be pressed into the chamber. A slight crimping or marks on the mouth of the case indicate that the case neck has

(Continued on page 70)



—Courtesy Winchester-Western

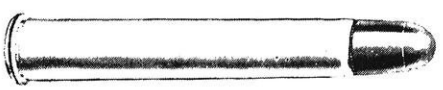
A cut-a-way view showing the main parts of the rifle cartridge.

Cartridge Types

Rimless

Rimmed

Bottleneck



Straight

ENGINE EARS

by Dave Rex m'57

SCHOLARSHIPS

$5,000 FOR ENGINEERING UNDERGRADUATE DESIGNS

The James F. Lincoln Arc Welding Foundation of Cleveland, Ohio, has announced the 10th in its series of design competitions for college engineering undergraduates. The Foundation is offering $5,000 in cash awards to students and scholarship funds to schools for undergraduate mechanical or structural designs in which arc welding is used. Actually two separate competitions are offered, one in mechanical and one in structural designs. A total of 46 awards will be made, the highest being $1,250. Winners and their schools also receive national professional recognition.

Any resident college engineering undergraduate may compete by entering a design for a machine, machine part, structural or structural part which makes a significant use of arc welding. Rules booklets are available free from The James F. Lincoln Arc Welding Foundation, Cleveland 17, Ohio.

FILMS

A new movie, "Heat Transfer 400° to 750° F." has just been placed in circulation by the Dow Chemical Company. It is an entertaining technical movie and discusses the story of modern process heating where precise temperature controls are required. Included are the advantages of vapor phase heating using Dowtherm, which does not have excessive pressures. The film was well received by more than 200 industrial and educational members of the American Institute of Chemical Engineers at the national meeting recently in Pittsburgh.

The film is readily obtainable from the Modern Talking Picture Service nearest you at no cost other than return postage. Further information is available in our office.

Union Carbide and Carbon Corporation, 30 East Forty-Second Street, New York, New York, has available for student groups the motion picture "The Petrified River." If your group would like to show this picture a print can be borrowed with no charge except postage from: Graphic Services Division, Bureau of Mines Central Experiment Station, 4800 Forbes Street, Pittsburgh 13, Pennsylvania.

ALUMNI

Jack C. Horth was the recipient of a James F. Lincoln Arc Welding Foundation award totaling $250 it was announced this last month.

The award was one of 20, totaling $20,000 made to men in 16 different states based upon projects or ideas that accelerate the progress of arc welding in industry.

FELLOWSHIPS

Two graduate fellowships and several assistantships in meteorology and oceanography for the 1957–58 academic year are available at the New York University College of Engineering. One fellowship carries full tuition plus $2,500. The other covers full tuition and fees.

Candidates must have had mathematics courses through differential equations and at least 12 hours of physics. They need not have taken undergraduate courses in meteorology or oceanography.

Applications can be obtained from: Assistant Dean in Charge of the Graduate Division, New York University College of Engineering, New York 53, N. Y. The forms must be returned to the College before April 1, 1957.

SOCIETIES

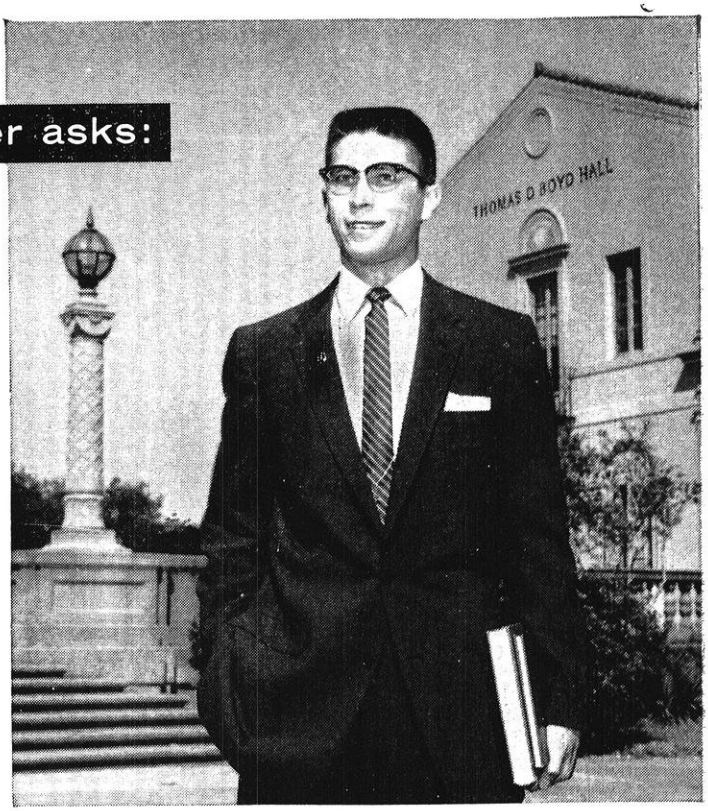
ASME IN NEW YORK

The Annual Meeting of the American Society of Mechanical Engineers held in New York this year was attended by some seven thousand engineers, among which was the three strong delegation

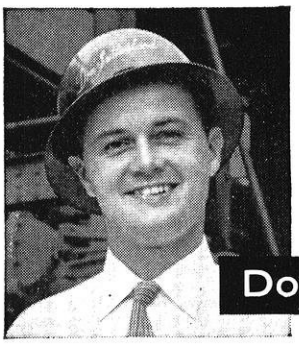
(Continued on page 72)

Oran Ritter asks:

Does Du Pont hire men who have definite military commitments?



Oran A. Ritter, Jr., expects to receive his B.S. in chemical engineering from Louisiana State University in June 1957. He's now editor-in-chief of the "L.S.U. Engineer," local president of Tau Beta Pi, and senior member of the Honor Council of his university. Oran's question is on the minds of many men planning a technical career.



Don Sutherland answers:

Donald G. Sutherland graduated from Virginia Polytechnic Institute in 1953 with an M.S. degree in chemical engineering and an R.O.T.C. commission. He was hired by Du Pont's plant at Victoria, Texas. After two years in the service, Don returned to his career in engineering, and is now doing plant-assistance work in the technical section at Victoria.

YES, Oran, we certainly do! We've employed quite a number of college graduates with definite military commitments, even when we knew they could work no more than a few weeks before reporting for duty. Take my own case. I was hired in November of 1953 and worked for only four weeks before leaving for the Army. Two years later I returned to Du Pont.

You see, we're primarily interested in men on a long-range basis. The fact that they're temporarily unavailable, for a good reason like military service, isn't any bar to their being considered for employment. After working only one day, an employee is guaranteed full re-employment rights—that's the law. And if a man works for Du Pont a full year before entering the service for two or more years, he receives an extra two months' salary. If he goes into the service for six months, he's paid a half month's salary. When he's entitled to a vacation but doesn't have time to take it before leaving, Du Pont gives him equivalent pay instead.

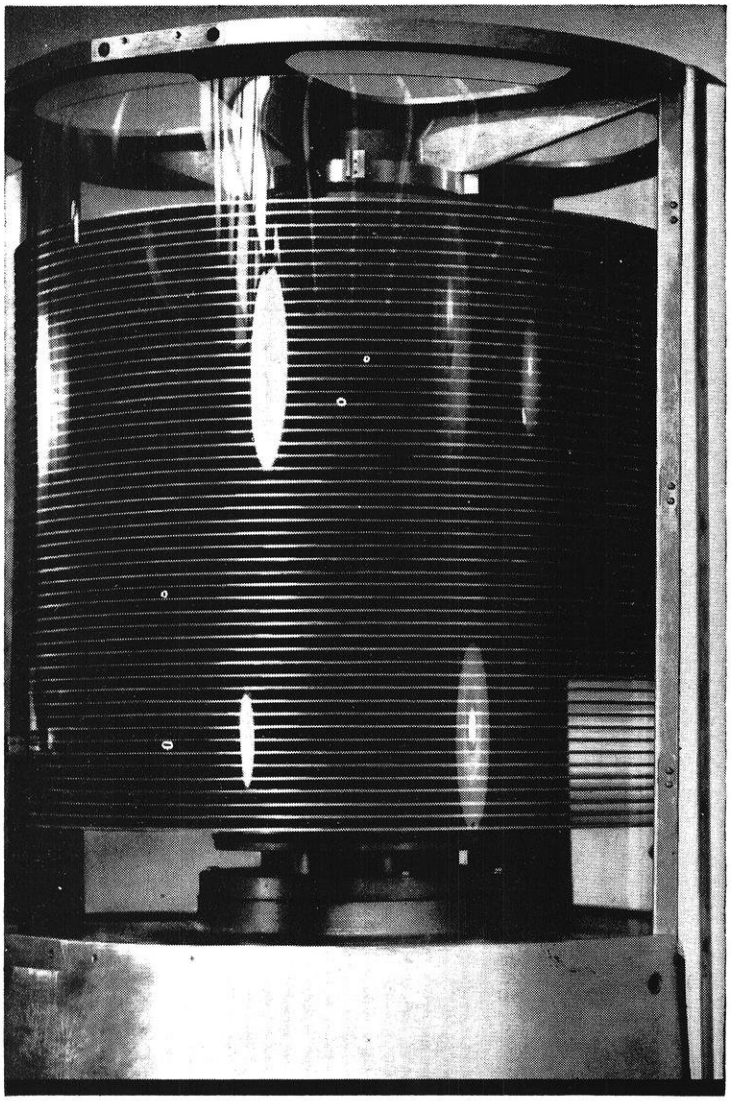
Even if present employment is impossible, Oran, we definitely recommend your talking with Du Pont's representatives as well as those of other companies. The very least you'll gain will be valuable background and some contacts of real benefit to you when you leave military service.

WANT TO KNOW MORE about working with Du Pont? Send for a free copy of "The Du Pont Company and the College Graduate," a booklet that tells you about opportunities for work in all departments of the Company. Write to the Du Pont Company, 2521 Nemours Building, Wilmington, Delaware.

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

Watch "Du Pont Theater" on television



Machine with "millions" on its "mind"

These whirling disks are the heart of RAMAC®—IBM's revolutionary new random access memory data accounting system. Capable of storing from *6 to 24 million* digits in its metal mind, RAMAC offers an entirely new approach to the problems of data maintenance and storage.

RAMAC is a storage instrument permitting management to reach facts almost instantly, without searching or sorting. It supplies immediate, automatically typed answers to queries put to it. For the first time, it makes possible "single step" data processing—the simultaneous processing of transactions *as they occur*. This new wonder tool for American business means record keeping with greater speed, range flexibility and economy than was ever before possible.

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RAMAC typifies the electronic wonders being brought to reality at IBM. If you are preparing yourself for an electronics career, you'll find IBM offers excellent opportunities for rapid advancement in the virtually "unlimited" field of electronic computers. A growing company in a growing field, IBM means a chance for you to develop quickly to the fullest extent of your capabilities.

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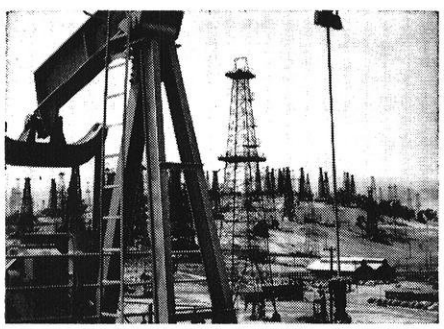
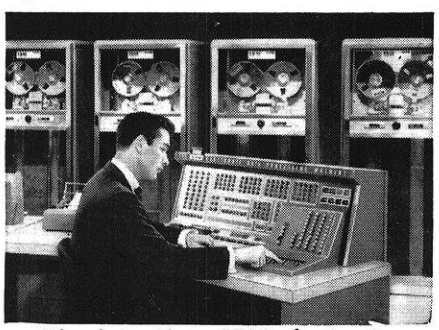


Oil spotter: IBM computers sift thousands of oil samples, enable geophysicists to strike gushers sooner.



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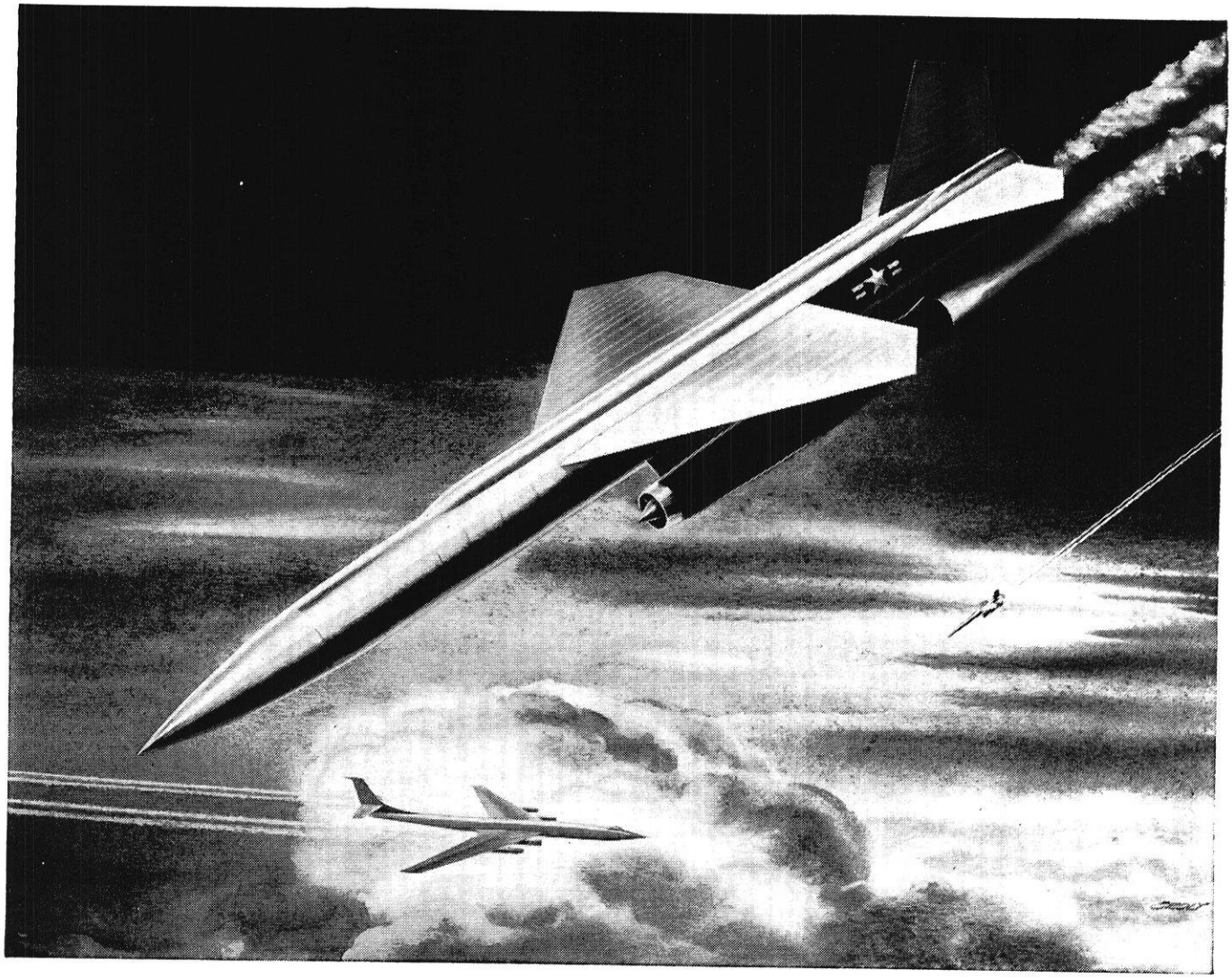

Boeing research produces a new defense weapons system

Boeing's BOMARC IM-99 is a long-range guided missile designed to strike enemy bombers while still over areas away from vital targets. It's a supersonic spearhead of an entire defense weapons system that includes communications, bases, logistics.

Engineers and scientists of *all* types contributed to the research that produced this vital weapons system. And they are continuing their contributions, not only to BOMARC, but to other significant advanced projects. Boeing engineers are coming up with solutions that will give direction to developments of the future. If this kind of pioneering appeals to you, and if you enjoy working with engineers of outstanding professional stature, you'll like Boeing.

And you'll find plenty of room for advancement. Boeing's growth — a 400% jump in the number of Boeing engineers in the last 10 years — assures openings ahead, and job stability. Boeing promotes from within, and every six months a merit review gives each engineer a *personal* opportunity for recognition, advancement, increased income.

Starting salaries at Boeing are high. If you are interested in continuing graduate studies, Boeing will arrange a special work schedule for you and pay all tuition and fees.

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SCIENCE HIGH-

by Ted Witzel e'57

FULL-SCALE PRESENTATION OF 'ELECTRONIC LIGHT'

The first full-scale presentation of man's newest light source—electronic light—was made recently when Westinghouse unveiled a room lighted by electroluminescence.

Panels no thicker than window glass line the ceiling and three walls, giving off light (approximately 50 foot-candles) equivalent to that in a modern, well-lighted office or class room.

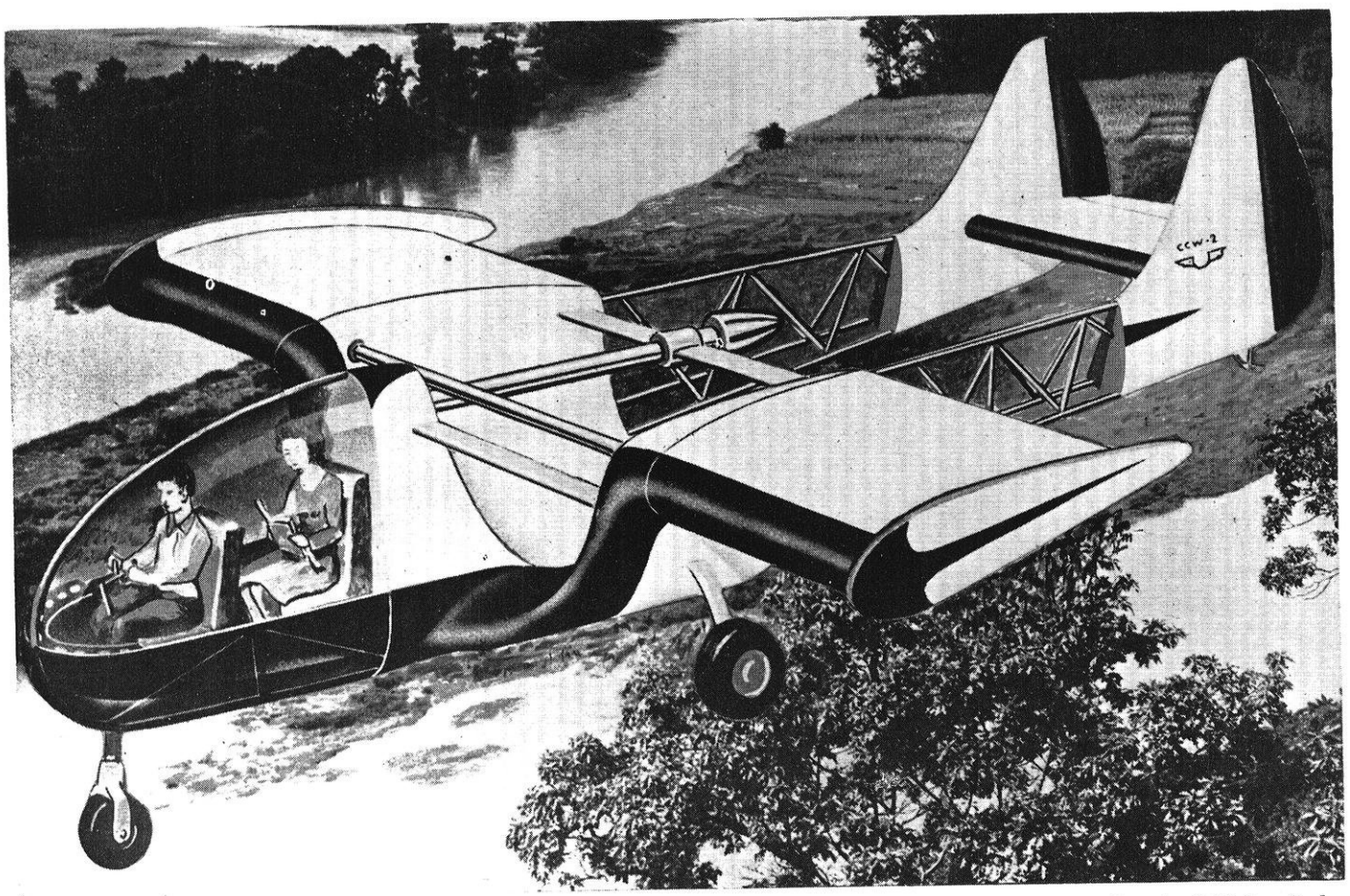
One hundred and twelve glass panels, each one foot square in size and giving off a soft green light, are used to illuminate the room with shadowless light. Walls and ceiling of the room are not lighted, but *are* light, creating an atmosphere of light without light fixtures.

Also shown was how the housewife of the future may have complete mastery over the lighting in her house—through electroluminescence. Two control knobs will be in every room, one for brightness and the other for color. Like the volume knob on a radio, these will adjust for any level of brightness, and, even more important, will create any color atmosphere, from varying shades of white, to blue or red.

First discovered in 1936 by Georges Destriau, French scientist, electroluminiscence is the giving off of light by phosphors coated on a glass panel that is treated to conduct electricity. When electricity is applied, the panel lights up.

"In its early days, electroluminescence was a laboratory curiosity," Mr. Arnott recalled. "You had to turn out all the lights and adapt your eyes to the darkness before you could see its faint light. Now we have panels that are brighter than fluorescent lamps."

Because the efficiency of electroluminescence is not yet up to present-day light sources, widespread use is not yet economically feasible. "However," Mr. Arnott declared, "if progress continues at the rate it has during the past two years, practical everyday electrolumines-

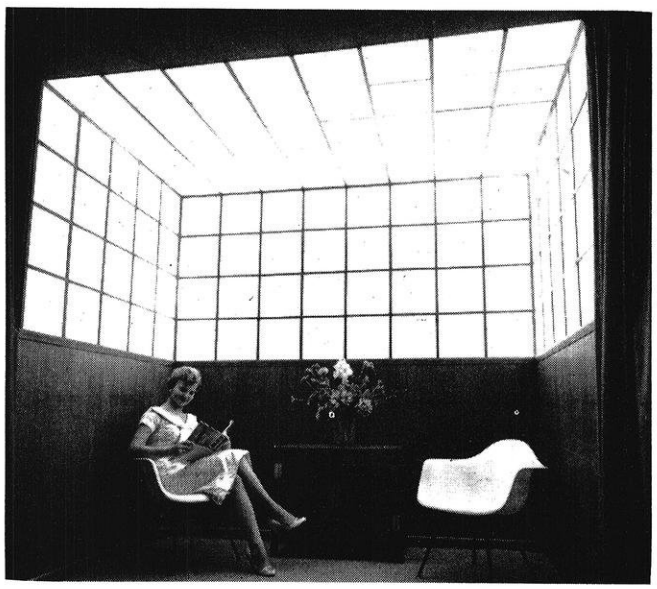


The two-passenger single-engine aircraft is expected to take off at about 5 mph in less space than its own length of 18 ft., climb at 4,000 ft. per minute, and achieve flying speed in the 200 mph class. A tornado of air, pulled sharply through the half barrel wing configuration, provides the basis for both lift and thrust.

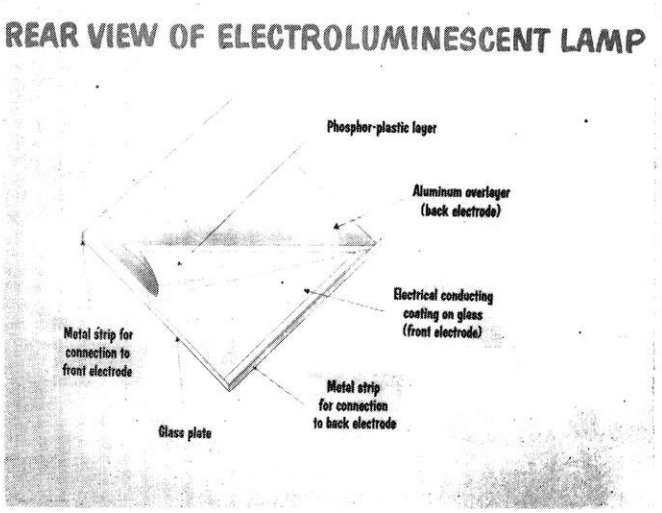
LIGHTS

cence should not be very far off. It may not be just around the corner; but it is certainly just over the next hill."

Freeing light from the confines of point or line sources such as incandescent or fluorescent lamps, electroluminescence promises to spark totally new concepts of lighting. Light in the future will be part of the construction of walls, ceilings, and possibly even floors. And, because electroluminescence is not restricted to flat planes, light may go into the construction of domes, balustrades, and other architectural designs.



First room with walls and ceiling made of light—Lillian Raspolic, a pretty secretary at Westinghouse's new Research Laboratories, is shown in the world's first room with walls and ceiling made of light. Panels no thicker than window glass line this room, providing light from man's newest and most promising light source—electroluminescence.



Electroluminescent panels are sandwich-like in construction—Sandwich-like construction of electroluminescent panels is shown in this drawing. A thin glass plate is coated with a transparent, but electrically conducting film. Over this is spread a layer of phosphor-embedded plastic; topping it off is an aluminum overlay. When electricity is applied to the two conducting layers, the phosphor in between lights up.

NEW HEAT-RESISTANT INSULATING MATERIAL

A new, high-temperature, high-voltage insulating material may prove to be worth more than its weight in gold in tomorrow's aircraft.

Dr. Daniel W. Lewis, research scientist at the Westinghouse Laboratories who developed the material in cooperation with Dow Corning scientists, said it can be formed into thick sections of solid, heat-resistant insulation for use in complex electrical equipment.

"By eliminating the solvent formerly necessary in other heat-resistant resins," said Dr. Lewis, "it is possible to produce an insulation which is entirely free of air spaces, or 'bubbles'."

The scientist explained that with previously available high-temperature silicone resins, a solvent was necessary to make the resin fluid enough for application. "However," he said, "the solvent often caused bubbles to form as the insulation hardened into solid form. By developing a solventless material we have eliminated this problem and produced an insulation entirely free of bubbles."

Dr. Lewis said that air spaces in insulating materials are weak spots which will break down at high voltage, thus causing serious deterioration of the insulation.

The scientist demonstrated how insulation deteriorates by connecting high voltage to a small transformer impregnated with a solvent containing varnish, then connecting an equal voltage to a like transformer impregnated with a solventless silicone resin. As the voltage was applied to the first transformer, electrical discharges occurred when voltage was applied to the void-free solventless silicone transformer.

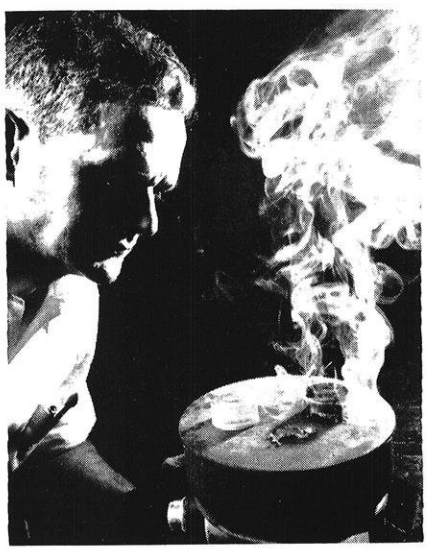
The newly developed silicone insulation provides greater heat resistance than that obtainable in

any other insulating resins, with similar filling characteristics, and is another step toward operating electrical equipment at higher output capacity or in higher ambient temperatures, Dr. Lewis said.

Because of its outstanding heat resistance, solventless silicone insulation can be used to protect electronic components in aircraft, missiles, and shows great promise for use in generators and motors.

He speculated that the new insulation might find its widest application in the aircraft field. "Because of its ability to operate continuously at 250 degrees Centigrade for thousands of hours and because it is void-free, solventless silicone insulation extends the horizon of the applications in higher ambient temperatures, at higher voltages, and in size reduction. This makes it a natural for use in aircraft," he said.

Dr. Lewis cited one instance in which a class "A" conventionally insulated transformer weighing nearly nine pounds could, by using the new insulation, be reduced in size to only four and one-half pounds, a weight savings of about 50 percent.



Insulation resists high heat—Lead on the hot plate is molten, and a conventional insulating resin (right) smoulders, but a few solventless silicone resin (left) remains intact. Dr. D. W. Lewis, demonstrates the heat resistant properties of the Westinghouse-developed resin which makes it ideal for use as high-temperature electrical insulation.

"This is possible," he said, "because wire of smaller diameter—which normally gives off more heat with the same current flow than larger diameter wire—can be used in the transformer. Also, smaller iron cores can be used, thus achieving further weight reductions. The excess heat generated by the use of smaller parts can readily be tolerated by the new insulation.

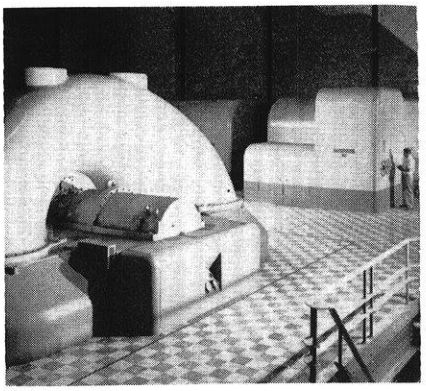
TURBINE GENERATORS IN NATION'S MOST EFFICIENT STATION

Each of the four turbine-generators installed at Kyger Creek station is a high-pressure, cross-compound, hydrogen-cooled, reheat unit. The high-pressure turbine element consists of a high-pressure and intermediate elements connected in tandem that drive a 130,000-kilowatt, 3600-rpm, 85 percent power factor hydrogen-cooled generator. The low-pressure turbine element is of the double flow type and drives a 87,260-kilowatt, 1800-rpm, 85 percent power factor, hydrogen-cooled generator.

The turbines are designed for normal steam inlet conditions of 2,000 pounds per square inch gauge, 1050 degrees F total initial temperature, 1050 degrees F total reheat temperature, and an absolute exhaust pressure of 1.5 inches of mercury and use a seven stage regenerative feed-water heating system.

The high-pressure turbine is a combination impulse and reaction type and expands the steam to the reheat point of about 500 psia. From the reheater, the steam returns to the intermediate-pressure turbine at 1050 F and is expanded to about 80 psia through additional impulse and reaction stages.

The 1800-rpm low-pressure turbine is a straight reaction double-flow unit. Steam enters at the center of the blade path and flows toward an exhaust opening at each end, then downward into the condenser. To reduce leaving losses, 40-inch long exhaust-end blades were used that provide an exhaust annulus of 205.9 square feet in each of the two ends.



One of the large turbine generators used at the Kyger Creek station.

"The exhaust-flow area of a condensing turbine is a measure of its economic kilowatt rating," Mr. Rowland pointed out. Continuing, he said, "The economic kilowatt rating can be raised by using higher steam pressures and temperatures and by increased extraction for feed-water heating all of which reduce the exhaust steam flow. Hence engineers are continually striving to build turbines for more advanced steam conditions and to develop longer exhaust and blades that provide greater exhaust annulus. Both are being explored in a continuing program of research and development. What the future holds is uncertain. But of this we can be sure: efficiency improvements will be made and as a result the heat rate of stations will inch lower and lower."

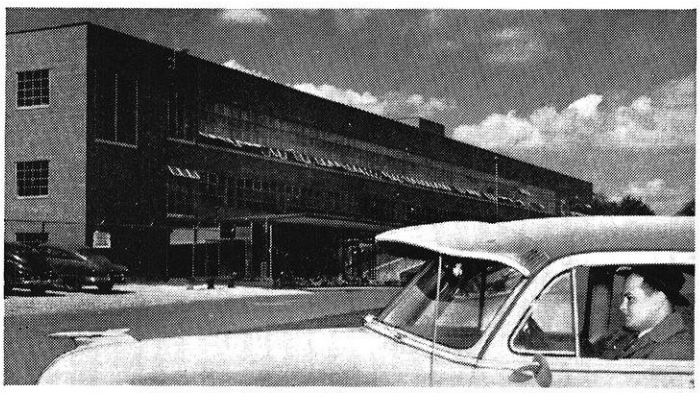
NEW REVERSING ROUGHING MILL TO USE CARD PROGRAMMING AND TRANSISTORIZED MEMORY STORAGE FOR AUTOMATIC OPERATION

A new reversing roughing mill now being completed, is expected to be the steel industry's first completely automatic card-programmed rolling mill. Its control system will permit an operator to initiate a detailed rolling schedule simply by pressing a push button. By selecting the proper card from several pre-punched for each schedule, it will be possible to attain a definite set of reductions while allowing for variations in

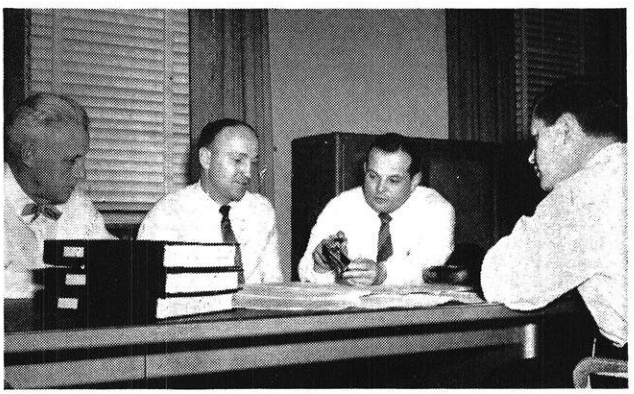
(Continued on page 54)

Meet Dick Foster

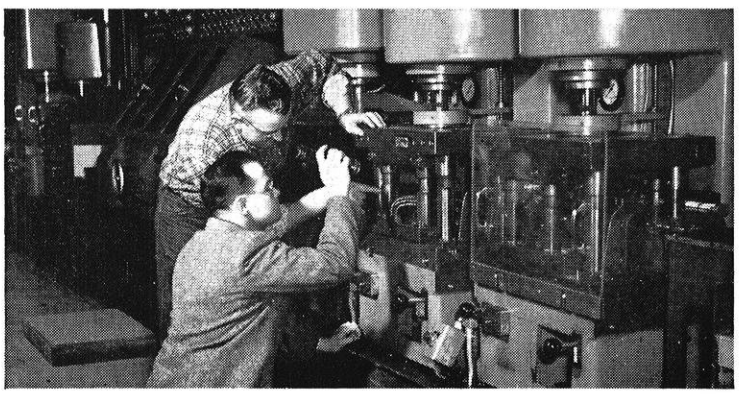
Western Electric development engineer



Dick Foster joined Western Electric, *the manufacturing and supply unit of the Bell System, in February 1952, shortly after earning his B. S. in mechanical engineering at the University of Illinois. As a development engineer on a new automation process Dick first worked at the Hawthorne Works in Chicago. Later, he moved to the Montgomery plant at Aurora, Illinois where he is pictured above driving into the parking area.*

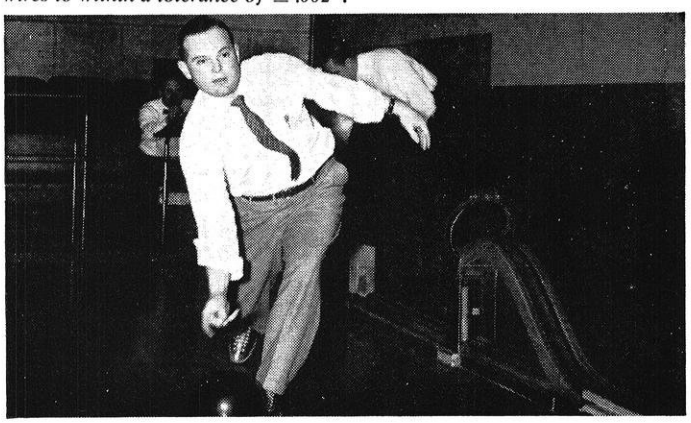


Dick's day may begin *in one of several ways; an informal office chat with his boss, a department "brain session" to tackle a particularly tough engineering problem (above); working with skilled machine builders in the mechanical development laboratory; or "on the line" (below) where he checks performance and quality and looks for new ways to do things.*



Here Dick and a set-up man check over *the automatic production line used to manufacture a wire spring relay part for complex telephone switching equipment. This automatic line carries a component of the relay on a reciprocating conveyor through as many as nine different and very precise operations—such as percussive welding in which small block contacts of palladium are attached to the tips of wires to within a tolerance of ± .002".*

Examining the plastic molded "comb" *components of the wire spring relay Dick recalls his early work when he was involved in working-up forming and coining tools for the pilot model of the automation line for fabrication of wire spring sub-assemblies for relays. At present he is associated with the expansion of these automation lines at the Montgomery Plant.*



Dick finds time *for many Western Electric employee activities. Here he is scoring up a spare while tuning up for the engineers' bowling league. He is active also in the golf club, camera club, and a professional engineering society. Dick, an Army veteran, keeps bachelor quarters in suburban Chicago where he is able to enjoy the outdoor life as well as the advantages of the city.*

Western Electric offers a variety of interesting and important career opportunities for engineers in all fields of specialization in both our day-to-day job as the manufacturing and supply unit of the Bell System and in our Armed Forces job.

If you'd like to know more about us, we'll be glad to send you a copy of "Your Opportunity at Western Electric" which outlines the Company operations and specific job opportunities in detail. Write: College Relations Department, Room 1030, Western Electric Co., 195 Broadway, New York 7, N. Y.

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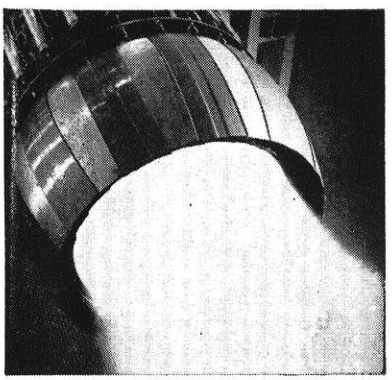
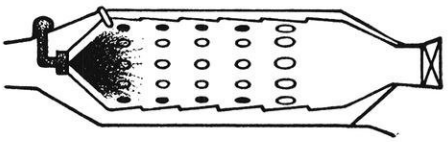
What's doing...



One indication of accomplishment in the combustion field: the J-57 engine, augmented by afterburner, provided the thrust which made supersonic flight practical for the first time.

This special periscope gives Pratt & Whitney Aircraft engineer a close-up view of combustion process actually taking place within the afterburner of an advanced jet engine on test. What the engineer observes is simultaneously recorded by a high-speed motion picture camera.

at Pratt & Whitney Aircraft in the field of Combustion*



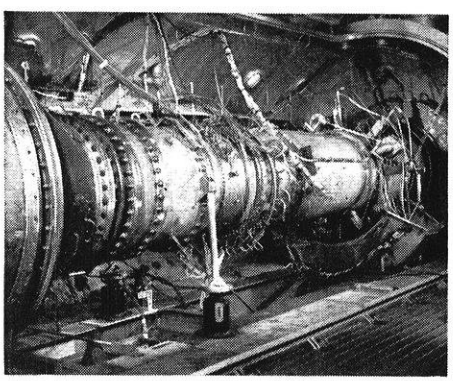
Historically, the process of combustion has excited man's insatiable hunger for knowledge. Since his most primitive attempts to make use of this phenomenon, he has found tremendous fascination in its potentials.

Perhaps at no time in history has that fascination been greater than it is today with respect to the use of combustion principles in the modern aircraft engine.

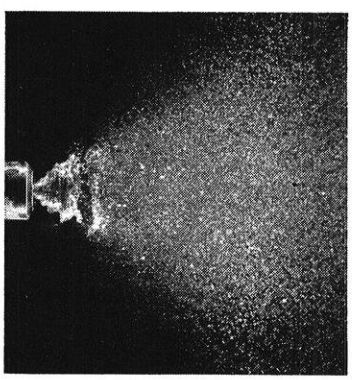
At Pratt & Whitney Aircraft, theorems of many sciences are being applied to the design and development of high heat release rate devices. In spite of the apparent simplicity of a combustion system, the bringing together of fuel and air in proper proportions, the ignition of the mixture, and the rapid mixing of burned and unburned gases involves a most complex series of interrelated events — events ocurring simultaneously in time and space.

Although the combustion engineer draws on many fields of science (including thermodynamics, aerodynamics, fluid mechanics, heat transfer, applied mechanics, metallurgy and chemistry), the design of combustion systems has not yet been reduced to really scientific principles. Therefore, the highly successful performance of engines like the J-57, J-75 and others stands as a tribute to the vision, imagination and pioneering efforts of those at Pratt & Whitney Aircraft engaged in combustion work.

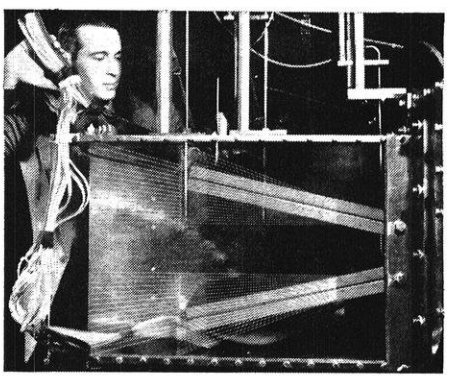
While combustion assignments, themselves, involve a diversity of engineering talent, the field is only one of a broadly diversified engineering program at Pratt & Whitney Aircraft. That program—with other far-reaching activities in the fields of instrumentation, materials problems, mechanical design and aerodynamics — spells out a gratifying future for many of today's engineering students.



Mounting an afterburner in a special high-altitude test chamber in P&WA's Willgoos Turbine Laboratory permits study of a variety of combustion problems which may be encountered during later development stages.



Microflash photo illustrates one continuing problem: design and development of fuel injection systems which properly atomize and distribute under all flight conditions.



Pratt & Whitney Aircraft engineer manipulates probe in exit of two-dimensional research diffuser. Diffuser design for advanced power plants is one of many air flow problems that exist in combustion work.

Watch for campus availability of P & W A color strip film on combustion.

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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.

In the matter of Mark T. Purcell, architect, vs Kenneth F. Lemke, prof. engineer; The Wisconsin Registration Board of Architects and Professional Engineers; and Warren R. Smith, State Treasurer, the attorneys have concluded their arguments and submitted their briefs in the Circuit Court of Dane County. We now are waiting for the Court's decision.

* * *

The NSPE kits for "Engineers Week" in February are now available and all Chapter public relations or engineers week chairmen should start making definite plans for this event. Gordon Mercer of Algoma is public relations chairman for WSPE and can tell you where and how to get the necessary material for any kind of program your Chapter wants to follow.

* * *

Reorganization of the Southeast Chapter has resulted in the formation of two Chapters; "Southeast", comprising Kenosha, Racine, and Walworth Counties. "Waukesha", comprising Waukesha, Dodge, Washington and Ozaukee Counties. Engineers who are now members of the Southeast Chapter will be transferred to the new Waukesha Chapter, automatically, if their mailing address indicates that they reside or work in any Counties that make up the Waukesha Chapter.

* * *

Any Chapter that wishes to bring some desired action before the Society at its annual meeting in January should submit its proposal in the form of a written Resolution, duly authorized by the Chapter officers, to the chairman of the Resolutions Committee not later than Jan. 10, 1957. The chairman of the Resolutions Committee is P. G. Ellis, 1029 N. Marshall St., Milwaukee 2, Wis.

NSPE NEWS

Education preparatory to the collegiate level is strictly a matter for the local government, the National Society of Professional Engineers agreed at their fall meeting in October at White Sulphur Springs, W. Va., but the Society did endorse steps to encourage students in the upper twenty-five per cent of their high school class to attend college.

The National Society, in extending its national policy on engineering education, also supported moves to provide better instruction, particularly in the fields of mathematics and science, as well as the development and expansion of the educational programs of technical institutes where the courses are at the post high school level.

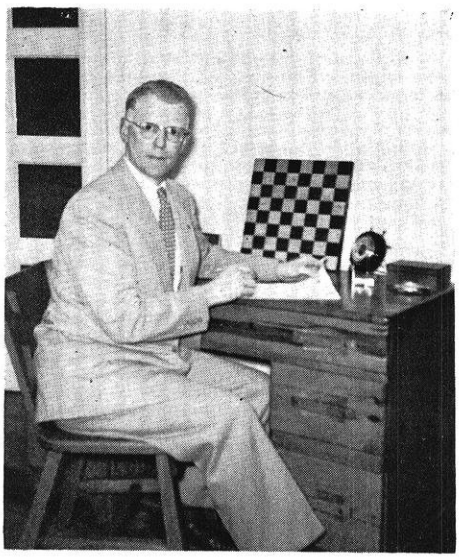
Financial support through federal funds for students not having received their bachelor's degree was opposed by the NSPE.

In other developments, the Task Forces of the newly formed Functional Sections for Consulting Engineers in Private Practice gave an extensive report at the meeting which brought together the directors of the National Society representing the forty-one state societies. The Task Forces—organized in May—were formed to investigate problems in such areas as fees, professional liability insurance, and ethical practices.

The Board of Directors received a report on two court cases involving interpretations of the professional provisions of the Taft–Hartley Act, in which NSPE has intervened as a "friend of the court." The first case involves a group of engineers at the Jersey City plant of Westinghouse who are seeking an election for decertification from the electrical workers' union. NSPE is supporting the con-

(Continued on page 44)

Meet the President



JOHN K. PRIMM
President, Fox River Valley Chapter

John K. Primm, President of the Fox River Valley Chapter is featured in this month's Meet the President Series. Mr. Primm resides in Manitowoc where he is a consulting engineer in the field of electrical wiring and illumination. A graduate of the 1941 class of Georgia school of Technology, Mr. Primm was employed by the Conduit and Grounding section, Electrical Engineering Dept., Design Division, TVA, in Knoxville, Tennessee. In 1942, he joined Robert and Co. Associates, in Marietta, Georgia where he designed low-voltage distribution systems and auxiliary systems. From 1943 to 1946, Mr. Primm was a radar maintenance officer in the U. S. Army Signal Corps. After leaving the Army in 1946, he worked as an applications engineer and in engineering sales promotion. Mr. Primm became a registered professional engineer in Georgia in 1947. The fair state of Wisconsin beckoned and in 1949 Mr. Primm established an electrical engineering consulting practice here in Wisconsin. He became a registered P.E. in Wisconsin in 1949. He also is a registered P.E. in Michigan and New York.

In addition to his membership in W.S.P.E. to which he transferred from the Georgia Society of Professional Engineers in 1949, Mr. Primm is a member of the Milwaukee Chapter of Illuminating Engineering Society.

Mr. Primm was born on February 16, 1913 in New York, New York. While in college he played football and was a member of the concert band. He married Carol M. Feiler of Elmwood, Wisconsin on June 23, 1956.

The Masquers (Little Theater Group in Manitowoc) where he serves as stage electrician occupy some of Mr. Primm's spare time. He also enjoys sport car and stock car racing. Mr. Primm owns a 1919 Mitchell touring car which he hopes to recondition.

W.S.P.E.

(Continued from page 42)

tention that professional employees are entitled under the law to a separate decertification election as a professional group.

The other case, at the Buffalo plant of Westinghouse, tests the doctrine of the National Labor Relations Board that it may include some nonprofessional employees with professionals in voting units on collective bargaining representation decisions. The NSPE brief declares that this is a clear violation of the law and constitutes a threat to the entire engineering profession in that such a rule may give the power of actual decision to the nonprofessionals.

The Board was advised that both cases are pending in the U. S. District Court for the District of Columbia and may be decided in the next month.

In regard to professional concepts in engineering, the National Society encouraged:

- Chapters to sponsor high school engineer clubs.
- Colleges to place more emphasis on professionalism—either through courses or lectures.
- State societies to work more actively with college engineering students who are forming student chapters of the state societies.
- More extensive work with young engineers following graduation.

A 29-minute color film, "American Engineer," was shown to the Directors. The film—designed as a tribute to the accomplishments of American engineers—is being used as a part of the Society sponsored National Engineers' Week, February 17–23, 1957, and is available to all NSPE chapters without charge.

Hosts for the meeting were the West Virginia Society of Professional Engineers, an affiliate of the National Society. The Honorable William C. Marland, governor of West Virginia, gave an address of welcome.

By action of the Board of Directors on October 27, 1956, the following engineers became members and affiliate members of W.S.P.E. We welcome you into our society.

(Continued on page 46)

Name and Position	Address	Reg. No.	Sponsor
SOUTHWEST			
John Delward Hendrickson Engineer Mead & Hunt, Inc.	120 W. Division Ave. Barron, Wis.	ET-1408	H. H. Buer
Vernon Daniel Coffey Civil Engineer Mead & Hunt, Inc.	8 Sherman Terr. Apt. 3 Madison 4, Wis.	ET-1397	H. H. Buer
Albert G. Law Civil Engineer Warzyn Engineering & Service Co.	2702 Monroe St. Madison, Wis.	ET-1386	W. W. Warzyn
Earl Hugo Reichel Civil Engineer Warzyn Engineering & Service Co.	651 Knickerbocker St. Madison 5, Wis.	ET-1331	W. W. Warzyn
Kenneth Roger Welton Civil Engineer Mead & Hunt, Inc.	2320 University Ave. Madison, Wis.	ET-1446	H. H. Buer
Dan L. Burnham Self-employed	PO Box 42 Platteville, Wis.	ET-1216	P. A. Johnson
James Fults Hall Engineer Trainee I Wisconsin Highway Commission	4310 Mohawk Dr. Madison 5, Wis.	ET-1356	C. M. Perlman
Robert H. Paddock District Engineer U. S. Bureau of Public Roads	1030 Waban Hill Madison 5, Wis.	E-5277	H. L. Lautz
Max F Koletzke Civil Engineer Lakeland Engineers, Inc.	545 Hilltop Dr. Madison, Wis.	E-5641	H. L. Lautz
Reinstatement L. Keith Astell Gen. Manager Lakeland Engineers, Inc.	2027 Rutledge St. Madison 4, Wis.	E-589	H. L. Lautz
WAUKESHA David Francis Hanley Senior Engineer City of Waukesha	210 W. Roberta Ave. Waukesha, Wis.	E-6138	W. E. Dick
NORTHWEST Wendell W. Wilson Design Engineer United States Rubber Co.	1127 Daniels Ave. Altoona, Wis.	E-2741	N. W. Gehlhar
August Sanford Ries, Jr. Staff Engineer National Presto Ind.	1901 Roy St. Eau Claire, Wis.	E-6053	V. M. Dufick
FOX RIVER VALLEY James Edward Madigan President Fertilizer Const. Co., Inc., Fertilizer Engr. & Equipt. Co. Inc.	Memorial Drive Green Bay, Wis.	E-5525	Geo. Martin
Peter Walter Kersztyn Gear Engineer Wis. Axle Div., Rockwell Spg. & Axle	R.R. 1, Box 211 Oshkosh, Wis.	E-6071	L. H. Kingston
William Ray Ottensmann Civil Engineer City of Oshkosh	City Eng. Office City Hall Oshkosh, Wis.	ET-1384	I. Van Akkeren
MILWAUKEE **Reinstatement** Carl Benjamin Babcock Arch. Eng. Miller Brewing Co.	4000 W. State St. Milwaukee, Wis.	E-1767	Phil Thern
Arthur William Kumm, Jr. Chief Engineer Wehr Steel Co.	8419 W. Hawthorne Ave. Milwaukee 13, Wis.	E-2240	J. R. Meyer
Emil Frank Vranich Vice-Pres. Robert J. Strass, Inc.	6730 W. Vienna Ave. Milwaukee, Wis.	E-4461	R. J. Strass
Members 9 Reinstated 2 Affiliates 8 Total 19			

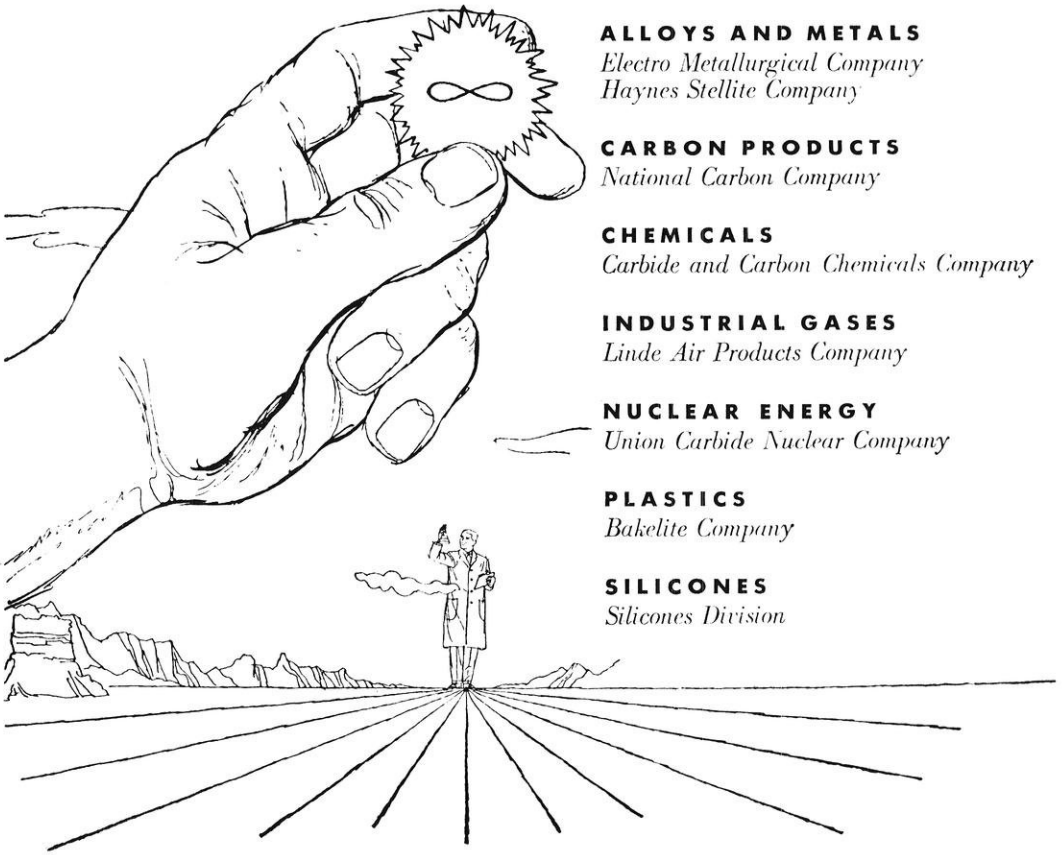
MEMBERSHIP REPORT

October 27, 1956

Total members and affiliate members as of September 14, 1956	
Members	1192
Affiliate members	125
	1317
Losses	
Resigned: H. J. Brenneke—Grafton, SE; George R. Aschauer—Racine, SE; R. C. Tegtmeyer—Madison, SW; Roy L Spaulding—Neenah, FRV.	4
Changes in classification: EIT to PE	
Robert F. Legore—Eau Claire, NW; Robert A. Meyer—West Bend, M.	[2
Additions	
Members	9
Member reinstatements	2
Affiliate members	8
	19
Total members and affiliate members as of October 27, 1956	
Members	1201
Affiliate members	131
Total	1332

THE HORIZONS ARE UNLIMITED

for college graduates at UNION CARBIDE



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Linde Air Products Company

NUCLEAR ENERGY
Union Carbide Nuclear Company

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Bakelite Company

SILICONES
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Union Carbide offers to college graduates opportunities in some of the most rapidly expanding fields in industry. In all these fields the Divisions of Union Carbide need engineers, chemists, physicists, and business and liberal arts graduates.
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Co-ordinator of College Recruiting.

UNION CARBIDE
AND CARBON CORPORATION
30 East 42nd St. UCC New York 17, N. Y.

W.S.P.E.

(Continued from page 44)

Chapter News

SOUTHWEST CHAPTER

All of us suffer a little from the wanderlust—but a lot of us have to sample the "grass on the other side of the fence" by proxy. The Program Committee informs us that, on December 6th, at the Cuba Club, we will have a chance for a little more sampling when Professor Gerald Pickett, Department of Mechanics at the University of Wisconsin, tells us about his trip to India. (Of course, you all realize that, being an engineer, Professor Pickett had eyes and ears only for items of engineering interest. It is these things of which he will talk.)

WISCONSIN VALLEY CHAPTER

The Wisconsin Valley Chapter met at Wausau for the first of a series of stag meetings which are to be worked in between the regular mixed meetings of the Chapter. Forty-six engineers attended this meeting presented by Mr. Martin Wendt of the Battle Creek, Michigan District Office of Civil Defense.

Mr. Wendt showed moving pictures of some of the Atom bomb tests which were set up to determine the affect of A-Bombing on engineering facilities and structures. He spoke on the part an engineering advisory committee could play in a community civil defense program. As a result of the meeting the Wisconsin Valley Chapter has set up a Civil Defense Engineering Advisory Council. Mr. L. W. Lembcke, chapter president, has appointed the following members to this group:

Chief of Staff—L. W. Lembcke

Traffic Engineering Section—Carl J. Dvorak

Community Protection Section—Henry J. Olk

Emergency Restoration Section—D. E. Thomsen

Water Supply Section—L. A. Manteufel

Sanitation Section—William H. Doyle

Public Works Resources Section—Gordon J. Morrison

Each member of this committee for the time being is to notify his local civil defense center of his appointment and be ready to later on work in the state organization set up.

The regular fall meeting of the Chapter was held at Wisconsin Rapids in September. This meeting was designed to handle much of the Chapter's miscellaneous business which sometimes cannot be taken care of at the program meetings.

A report was given by Mr. Al Genisot on the State Planning Meeting which he and Mr. Henry Olk attended. He stressed the need for close coordination between our chapter committee men and their respective state committees.

Action was started to amend our chapter constitution to put us on a June to June organizational year. This change if approved will make our participation in state committee functions more workable.

FOX RIVER VALLEY CHAPTER

The Fox River Valley Chapter of Wisconsin Society of Professional Engineers is scheduled to hold its first meeting of the fall season at 6:30 p.m. this Thursday, October 25, at the Valley Inn, Neenah. Following the roast beef dinner the members will activate the Chapter's program for the coming year.

"The scope of professional life", stated Chapter President John K. Primm of Manitowoc, "is far wider than mere technical interests. The professional engineer is a person of civic responsibilities, fully equal to the technical responsibilities of his chosen field. Our society is interested in such apparently diverse fields as pre-engineering curricula in high schools, rivers and harbors improvement, and the review of building codes and other regulations concerning public health and public safety."

The Fox River Valley Chapter includes in its membership about 200 registered professional engineers in 13 counties, and is the oldest chapter of the Wisconsin Society of Professional Engineers. All registered professional engineers and certified engineers-in-training are eligible for membership. Membership chairman is past president Robert W. Stieg of Clintonville. The other Chapter officers for 1956–57 are Vice President John R. Egan of Oshkosh, Secretary–Treasurer James A. Zimmerman, Appleton, and Directors Robert W. Frazier, Oshkosh, George H. Hall, Marinette, and William E. Raffin, Appleton. Robert Schindhelm, Appleton, is Public Relations chairman.

TENTATIVE OFFICIAL PROGRAM

FOURTEENTH ANNUAL MEETING, WISCONSIN SOCIETY OF PROFESSIONAL ENGINEERS, SCHROEDER HOTEL, MILWAUKEE, WISCONSIN, JANUARY 24, 25, 26, 1957

Thursday, January 24, 1957

P.M.

2:00 Registration
2:00 Board of Directors Meeting
7:45 Buses leave for Fred Miller Theater
8:30 Fred Miller Theater
2842 North Oakland Avenue
11:10 Buses leave Fred Miller Theater for Schroeder Hotel
11:30 After Theater Party—Schroeder Hotel—Milwaukee Chapter—Hosts

Friday, January 25, 1957

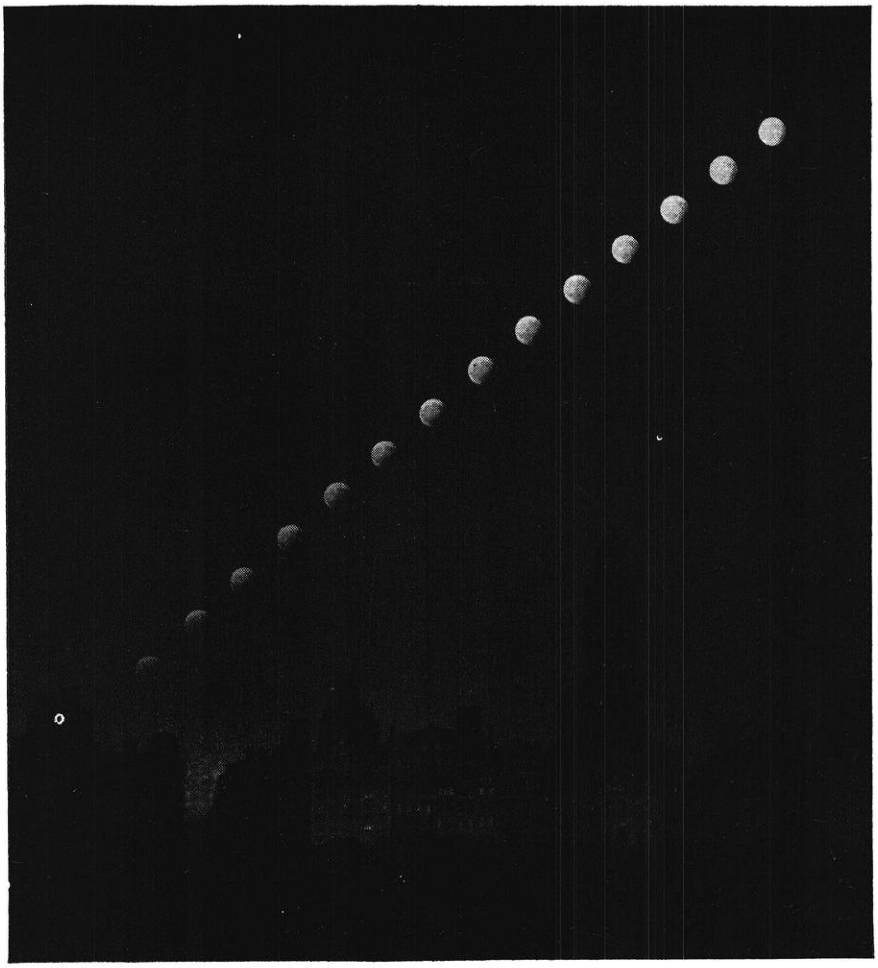
A.M.

9:00 Registration
9:30 Committee Meetings

A. Program
Karl O. Werwath, Chairman
Committee Members: Waldemar Neilson, John E. Hoeft, P. L. Schroeder, Carl J. Dvorak, J. L. Sullivan, Jr., A. R. Dent, Harold Ericson, Gordon Morrison, Frank Vilen, E. W. Deterling, Ellis P. Chellman, Fay Morgan, Richard R. Brindley, Fred Loebel

B. Membership
Foster Koehn, Chairman
Committee Members: L. W. Carlson, Rudolph R. Gocht, C. V. Anderson, Lynn C. Wilson, Page A. Johnson, Frank Carlson, Roy G. Boland

(Continued on page 66)



many moons

Less than 5,000 working hours from now, Martin will launch the world's first earth satellite. As with the famed Martin Viking Rocket program, this is to be No. 1 of a continuing series of astronautical research vehicles—man-made moons which will chart the way toward the conquest of the final frontier, space itself.

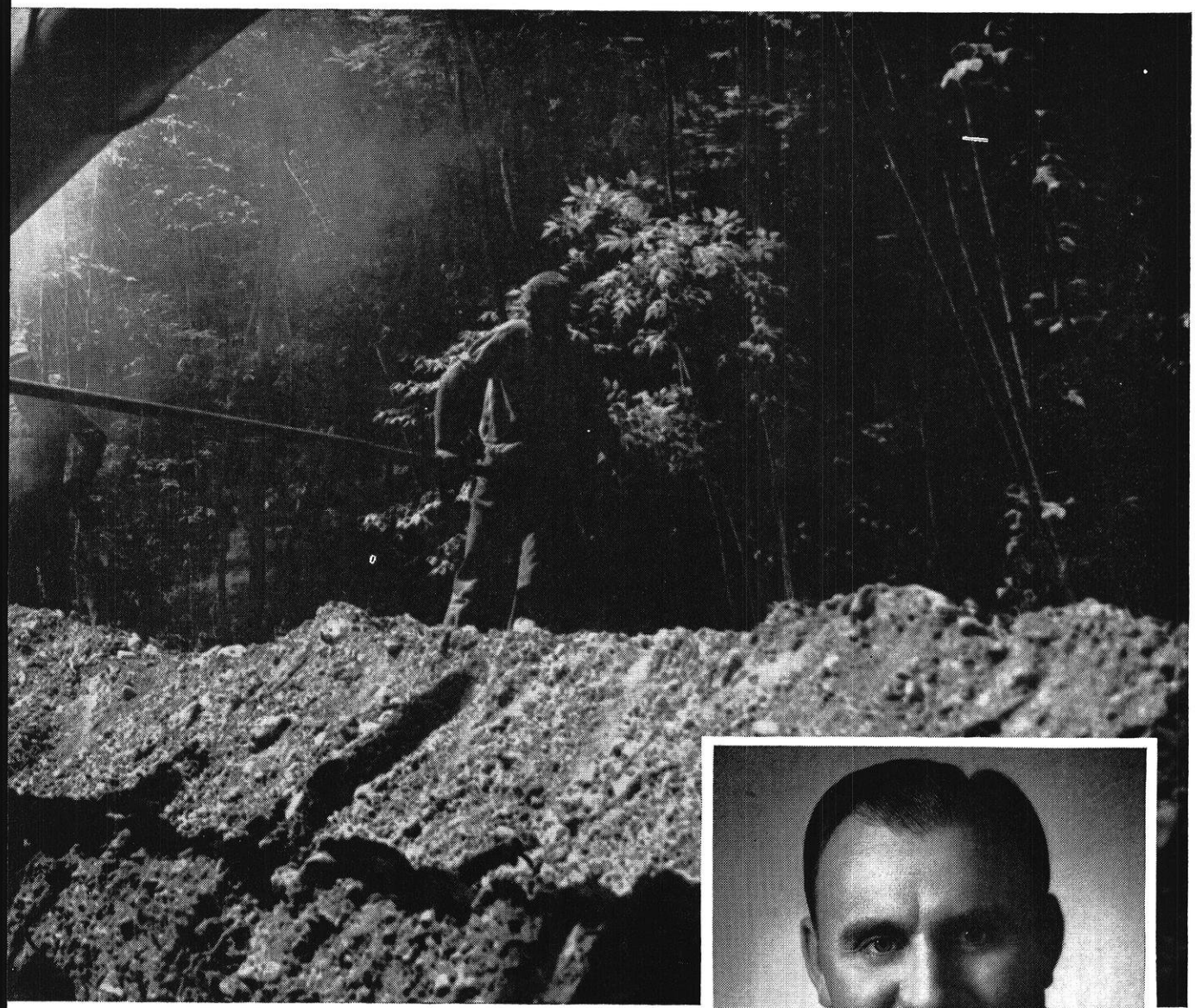
If you are interested in the greatest engineering adventure of our time, contact J. M. Hollyday, The Martin Company, Baltimore 3, Maryland.

MARTIN
BALTIMORE

Here's how graduate engineers move up in the *GAS* industry ... the nation's sixth largest

The Gas industry—the sixth largest in the nation—has a total investment of over $15 billion. Last year the industry set a new all-time record in number of customers, volume of gas sold, and dollar revenue. In fact, Gas contributed 25% of the total energy needs of the nation as compared with 11.3% in 1940. The Gas industry is a major force in the growth development and economic health of this country.

There are many opportunities for you in the Gas industry. The industry needs engineers, and does not overhire. You won't be regimented. There's always room for advancement. With utility companies and with manufacturers of Gas equipment, there's a future for you as an engineer. Call your nearest Gas Utility. They'll be glad to talk with you about your opportunity in the Gas industry. *American Gas Association.*



Charles C. Ingram, Jr. became Vice President of Oklahoma Natural Gas Company in less than 15 years

CHARLES C. INGRAM, JR.
B.S. in Petroleum Engineering, 1940
University of Oklahoma

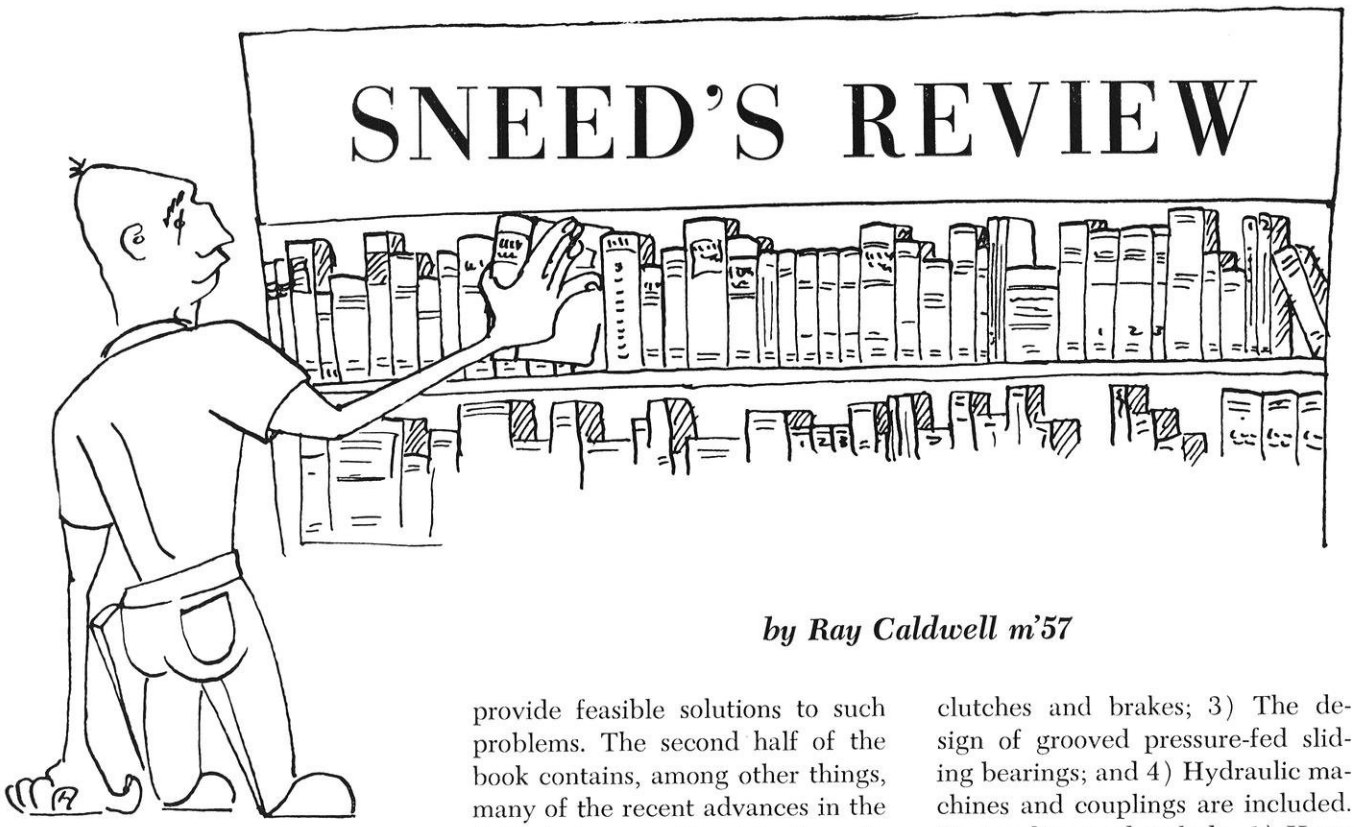
Charles Ingram has been Vice President of the Land and Geological Department of Oklahoma Natural Gas Company since June of 1955. Mr. Ingram joined the company immediately after his graduation from Oklahoma, and was soon called into service. Following his discharge, 5 years later, he rejoined the Engineering Department in Tulsa. He was quickly promoted to Assistant Chief Engineer and then took over the position of Superintendent of Gas Purchase and Reserves, and by 1954 was District Superintendent of the Oklahoma City district.

After 6 years with Lone Star Gas, Bill Collins took over a new job in a new field for the company

WILLIAM A. COLLINS, JR
B.S. in Mechanical Engineering, 1947
A & M College of Texas

Bill Collins is employed by the Lone Star Gas Company in Dallas as Coordinator of Air Conditioning and Utilization. Bill operates over 400 square miles in North Texas and Southern Oklahoma. Since joining Lone Star, Bill has worked primarily in the design, sales and installation of air conditioning equipment, with some time devoted to industrial gas applications. When it was found that a large scale air conditioning program requires close attention to design and installation as well as sales and service policies, a special department was organized in 1955. Bill was put in charge.

SNEED'S REVIEW



by Ray Caldwell m'57

RANDOM PROCESSES IN AUTOMATIC CONTROL

By J. Halcombe Laning, Jr. and Richard H. Battin

A high level, specialized work of unique importance for the physical scientist—a wealth of material previously unavailable in book form.

J. Halcombe Laning, Jr., Deputy Associate Director, and Richard H. Battin, Assistant Director of the Instrument Laboratory, Massachusetts Institute of Technology have written a book which provides the practical engineer and the theoretical research scientist with a basic background in the theory of random signals and noise, together with practical techniques to be used in the analysis and synthesis of linear control systems which are subjected to random inputs.

The first half of the book treats the basic concepts of probability and random time functions. These fundamental ideas are then used to develop analysis and design techniques for linear control systems containing both constant and time-varying components. Special emphasis is given to the non-stationary problem and the use of modern automatic computing equipment to provide feasible solutions to such problems. The second half of the book contains, among other things, many of the recent advances in the field that are pertinent to the subject, along with a wide variety of examples worked out in detail to illustrate each new idea presented.

MACHINE DESIGN

By Joseph Edward Shigley

This is a scientific, inclusive, realistic book on machine design.

Joseph Edward Shigley, Professor of Machine Design, and Head of the Department of Drawing and Design, Clemson College, South Carolina has written a book that not only presents an unusually scientific treatment of the subject but also broadens the scope of machine design, as usually presented, by developing the relations between the design specifications and the method of analysis or synthesis used in the solution.

Part one of the book constitutes a study of the design of fundamental machine members, while part two applies the principles developed in part one to the study of various design approaches to a group of common machine elements. Recent advances such as 1) The employment of methods of designing against fatigue; 2) New material on the design of bolted joints and of frictional contact rim clutches and brakes; 3) The design of grooved pressure-fed sliding bearings; and 4) Hydraulic machines and couplings are included. Topics discussed include: 1) Hertz contact stresses; 2) Castigliono's theory applied to the design of machine members; 3) Cost reduction in design; 4) Design of pressure-fed journal bearings; 5) Development and use of the fundamental Buckingham equation for dynamic loads on gear teeth in addition to the approximate method.

THE McGRAW–HILL ENCYCLOPEDIA OF SCIENCE AND TECHNOLOGY

Edited by William H. Crouse

Curtis G. Benjamin, President of the McGraw–Hill Book Company, has announced that the company will publish a multi-volume compendium of today's scientific and technological knowledge called "The McGraw–Hill Encyclopedia of Science and Technology." "This will be the most complete and unified compendium of science and technology ever assembled," he states, "and in our opinion it will fill an urgent need."

The encyclopedia will be made up of several thousand alphabetically arranged and cross-indexed articles, written by acknowledged authorities in science and engineering. Readability and comprehen-

(Continued on page 54)

FARMING FORESTS and FASHIONING FIBERS

A low-flying plane spreads ARCADIAN fertilizer on forest land and — for the first time — a new technique is available for making a vital crop grow faster.

That smart coat — fashioned of exciting CAPROLAN *deep-dye* nylon — seems remote indeed from growing trees. But both these new concepts in fibers and forestry depend upon Allied's creative use of nitrogen. Together they spell chemical diversity.

Some of Allied Chemical's 3000 products for farm, home and factory are described in a new booklet, "Introducing Allied Chemical." Write for a copy.

HERE'S HOW THEY'RE ALLIED

TRADEMARK PRODUCTS INCLUDE:

Arcadian fertilizers • Caprolan nylon • Plaskon resins • Mutual chromic acid
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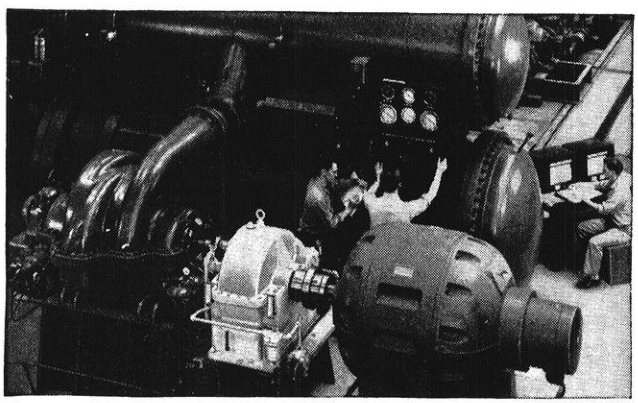
"POWER OFF!" Test operations are directed from this central control room, where special measuring instruments greatly speed up the collection of pump performance data. That's one way Worthington products are made more reliable by using . . .

. . . the world's most versatile hydraulic proving ground



COMPREHENSIVE TESTS are run on a Worthington centrifugal refrigeration unit (lower left) now in service as one of the Arabian American Oil Company's central air conditioning units in Dhahran, Saudi Arabia.

When you make pumping equipment that has to stand up and deliver year after year anywhere in the world, you've got to be sure it will perform as specified.

That's why we built one of the world's largest hydraulic test stands at our plant in Harrison, New Jersey. Here, over a half-acre "lake," we can check the performance of anything from a fractional horsepower unit to pumps handling over 100,000 gallons a minute. When you realize there are thousands of sizes and types of centrifugal pumps alone, you get an idea of the versatility we had to build into our proving-ground.

Naturally, our new test equipment is a big help to our research engineers, as well as our customers. Now they get performance data on products quickly and accurately. Using it, we can save months, even years, in developing new Worthington fluid and air-handling devices — equipment for which this company has been famous for over a century. For the complete story of how you can fit into the Worthington picture, write F. F. Thompson, Mgr., Personnel & Training, Worthington Corporation, Harrison, N. J.

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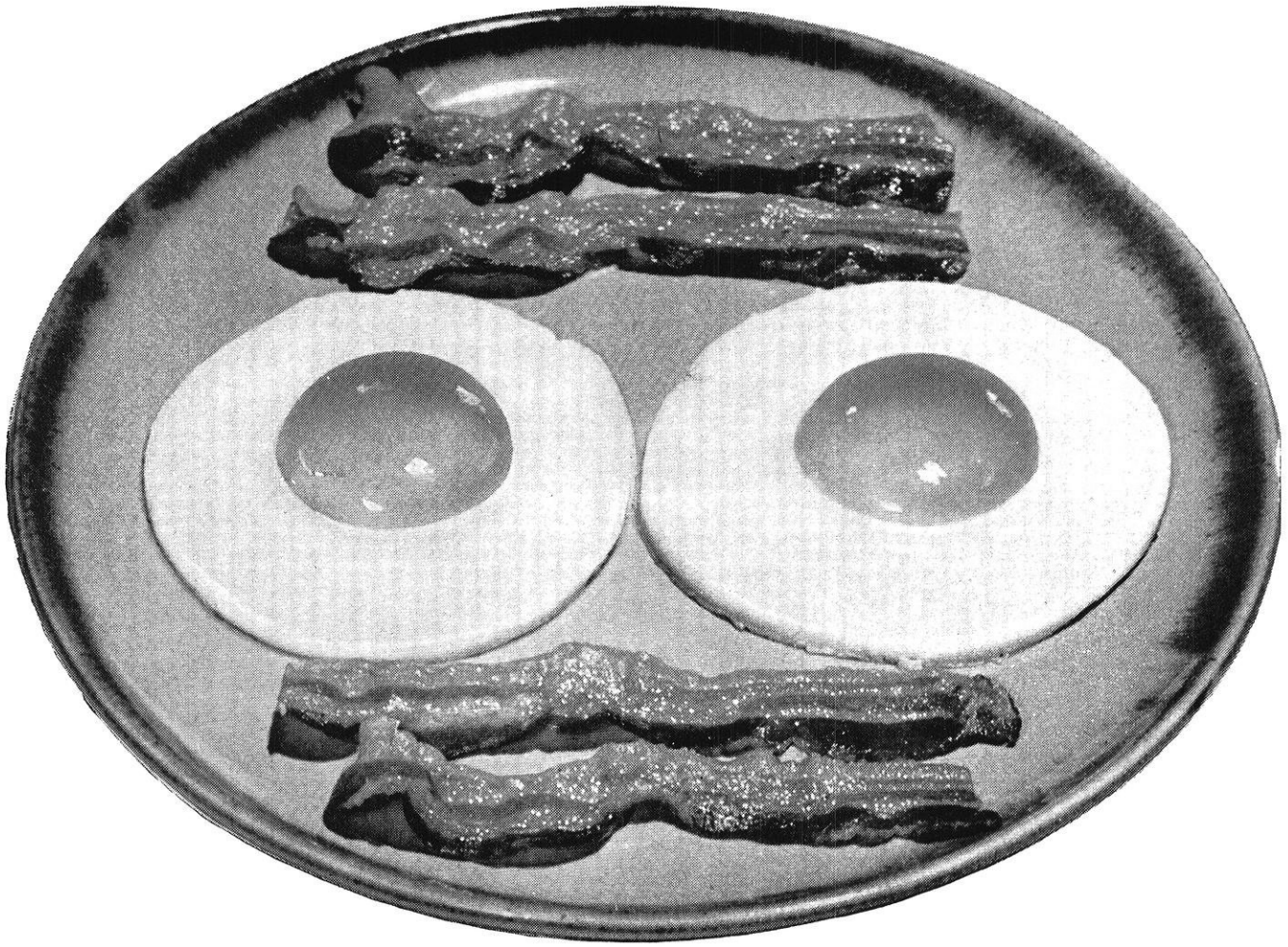
LIQUID METERS • MECHANICAL POWER TRANSMISSION • PUMPS • STEAM CONDENSERS • STEAM-JET EJECTORS • STEAM TURBINES • WELDING POSITIONERS



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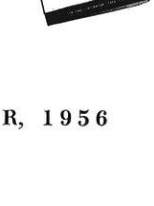
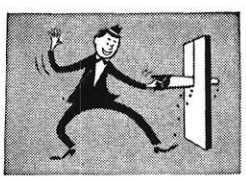
SYNTHANE is a favorite material among engineers, designers, and product-conscious executives because it possesses a combination of many properties. It is light in weight, strong; has high dimensional stability, excellent electrical properties and chemical resistance. It's also easy to fabricate.

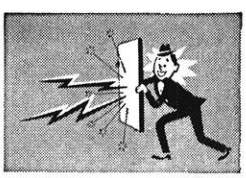
Synthane makes excellent ball bearing retainers. High dimensional stability, wear resistance and non-galling properties keep bearings humming smoothly at 100,000 rpm and up! Synthane's light weight minimizes the effect of any eccentricities, provides lower starting torques, less bearing weight. The Synthane 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

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Sneed's Review

(Continued from page 50)

sion, in general, will be at the college underclassman level. Designed to serve as a complete reference work for the student, engineer, scientist, and others seeking information on scientific or engineering subjects, it will total some 7,000 oversize pages, probably bound in ten volumes, and will be well illustrated. It will be completed in about three years.

William H. Crouse, author of 15 technical books, wil act as over-all editor of this vast publication. Thirty consulting editors, each an authority in his field, will select some 2,000 top specialists to write the articles, and each editor will review all articles in his field. A McGraw–Hill editorial staff of twenty will then assemble and copy-edit all contributions, prepare the index, arrange cross references, and generally do everything necessary to convert the contributions into bound volumes. THE END

Science Highlights

(Continued from page 38)

temperature and composition among individual slabs.

In addition to this control system —identified by the name "Prodac" to indicate its general applicability as programmed digital automatic control for system drives—the contractor is to supply all main drive and auxiliary electrical equipment, including two 3000-hp motors for the main horizontal rolls, a 375-hp mill motor for the attached edger, two 75-hp mill motors for horizontal mill screw down, and two 50-hp mill motors for adjustment of edger rolls.

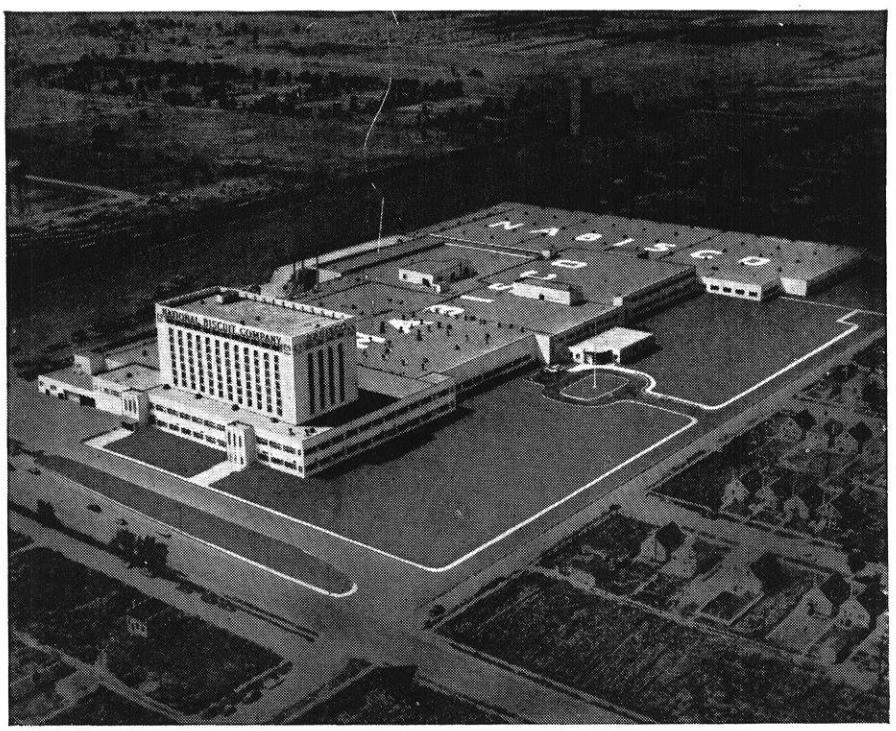
When in operation in late 1956, the card programming control system will be given the schedule for any set of rolling operations in the form of pre-punched IBM cards. These cards can be prepared for practically every slab and strip size and grade of steel so that proper drafts and speeds will produce a product of high uniformity at a high production rate. Each card will include all the requirements of a given schedule: mill screw-down opening, edger adjustment opening mill speed, and edger speed. Also included will be a notation to indicate when the last pass has been completed.

After a stack of punched cards is placed in the IBM card reader, the card applying to the first schedule is read and all information is transferred to a transistorized memory storage element. The mill is then ready to roll the entering slab. Automatic operation takes place when the first pass is initiated by the operator's pressing the pass-advance push button.

As the slab approaches, the control equipment acts through magnetic amplifier output units to preset roll openings and speeds. After one pass, reversing is brought about by sensing devices that read the position of the slab and reverse the rolls after a brief period of

(Continued on page 58)

STEAM AND THE WORLD'S LARGEST BAKERY



This new boiler plant at Nabisco's huge Chicago bakery was planned to provide, efficiently and economically, the steam that the bakery must have on tap at all times for heat, hot water and various processing operations.

Because the reliability, efficiency and economy of its steam source are so vital to this world-famous company, they selected B&W boilers.

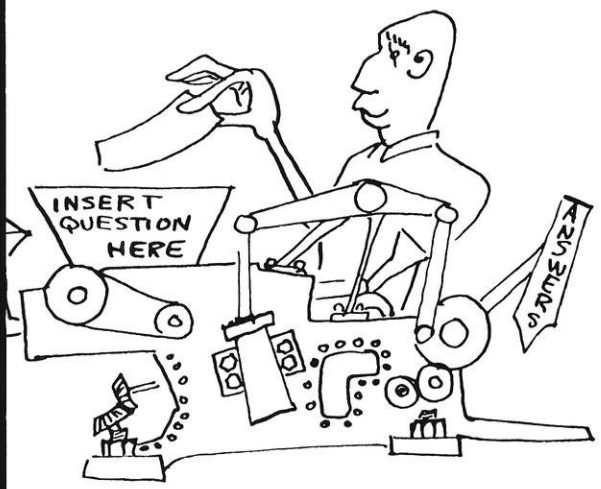
Think a moment of most companies' use of steam—and its cost. Take a fast turn around a boiler plant. Spend a little time chatting—perhaps quite profitably—with engineers. Get the facts on a company's invested steam dollars in relation to the return they're getting. If the facts add up to problems, B&W engineers can and will help industrial companies and their consulting engineers solve these problems.

When a B&W boiler is chosen, long-range performance is assured. And isn't that what the buyer really wants? Not the boiler but its end product, the steam, and the assurance of an efficient, dependable, economical steam source. The service records of thousands of B&W boilers, in thousands of large, small and medium sized industrial and utility plants, supply that assurance.

The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

BABCOCK & WILCOX
BOILER DIVISION

N-213



FINAGLE FACTORS

Ed. Note: This feature will be carried each month. You may find this page helpful in the future so why not save the whole series.

Multiply	*By*	*To Get*
Inches	2.540	centimeters
Inches	10^3	mils
Inches	.03	varas
Inches of mercury	0.03342	atmospheres
Inches of mercury	1.133	feet of water
Inches of mercury	345.3	kg per square meter
Inches of mercury	70.73	pounds per square ft
Inches of mercury	0.4912	pounds per square in.
Inches of water	0.002458	atmospheres
Inches of water	0.07355	inches of mercury
Inches of water	25.40	kg per square meter
Inches of water	0.5781	ounces per square in.
Inches of water	5.204	pounds per square ft
Inches of water	0.03613	pounds per square in.
Joules	9.486×10^{-4}	British thermal units
Joules	10^7	ergs
Joules	0.7376	foot-pounds
Joules	2.390×10^{-4}	kilogram-meters
Joules	0.1020	kilogram-calories
Joules	2.778×10^{-4}	watt-hours
Kilograms	980,665	dynes
Kilograms	10^3	grams
Kilograms	70.93	poundals
Kilograms	2.2046	pounds
Kilograms	1.102×10^{-3}	tons (short)
kilogram-calories	3.968	British thermal units
kilogram-calories	3086	foot-pounds
kilogram-calories	1.558×10^{-3}	horsepower-hours
kilogram-calories	4183	joules
kilogram-calories	426.6	kilogram-meters
kilogram-calories	1.162×10^{-3}	kilowatt-hours
kg-calories per min	51.43	foot-pounds per sec
kg-calories per min	0.09351	horsepower
kg-calories per min	0.06972	kilowatts
kg-cm squared	2.373×10^{-3}	pounds-feet squared
kg-cm squared	0.3417	pounds-inches squared
kilogram-meters	9.302×10^{-3}	British thermal units
kilogram-meters	9.807×10^7	ergs
kilogram-meters	7.233	foot-pounds
kilogram-meters	9.807	joules
kilogram-meters	2.344×10^{-3}	kilogram-calories
kilogram-meters	2.724×10^{-6}	kilowatt-hours
kg per cubic meter	10^{-3}	grams per cubic cm
kg per cubic meter	0.06243	pounds per cubic foot
kg per cubic meter	3.613×10^{-5}	pounds per cubic inch
kg per cubic meter	3.405×10^{-10}	pounds per mil-foot
kg per meter	0.6720	pounds per foot
kg per square meter	9.678×10^{-5}	atmospheres
kg per square meter	98.07	bars
kg per square meter	3.281×10^{-3}	feet of water
kg per square meter	2.896×10^{-3}	inches of mercury
kg per square meter	0.2048	pounds per square ft
kg per square meter	1.422×10^{-3}	pounds per square in.
kg per sq millimeter	10^6	kg per square meter
kilolines	10^3	maxwells
kiloliters	10^3	liters
kilometers	10^5	centimeters
kilometers	3281	feet
kilometers	10^3	meters
kilometers	0.6214	miles
kilometers	1093.6	yards
kilometers per hour	27.78	centimeters per sec
kilometers per hour	54.68	feet per minute
kilometers per hour	0.9113	feet per second
kilometers per hour	0.5396	knots
kilometers per hour	16.67	meters per minute
kilometers per hour	0.6214	miles per hour
km per hour per sec	27.78	cm per sec per sec
km per hour per sec	0.9113	ft per sec per sec
km per hour per sec	0.2778	meters per sec per sec
km per hour per sec	0.6214	miles per hr per sec
kilometers per min	60	kilometers per hour
kilowatts	56.92	Btu per min
kilowatts	4.425×10^4	foot-pounds per min
kilowatts	737.6	foot-pounds per sec
kilowatts	1.341	horsepower
kilowatts	14.34	kg-calories per min
kilowatts	10^3	watts
kilowatt-hours	3415	British thermal units
kilowatt-hours	2.655×10^6	foot-pounds
kilowatt-hours	1.341	horsepower-hours
kilowatt-hours	3.6×10^6	joules

Multiply	*By*	*To Get*
kilowatt-hours	860.5	kilogram-calories
kilowatt-hours	3.67×10^5	kilogram-meters
knots	6080	feet per hr
knots	1.853	kilometers per hr
knots	1.152	miles per hr
knots	2027	yards per hr
Lines per square cm	1	gaus
lines per square inch	0.1550	gaus
links (engineer's)	12	inches
links (surveyor's)	7.92	inches
liters	10^3	cubic centimeters
liters	0.03531	cubic feet
liters	61.02	cubic inches
liters	10^{-3}	cubic meters
liters	1.308×10^{-3}	cubic yards
liters	0.2642	gallons
liters	2.113	pints (liq)
liters	1.057	quarts (liq)
liters per minute	5.855×10^{-4}	cubic feet per second
liters per minute	4.403×10^{-3}	gallons per second
$\log_{10} N$	2.303	$\log_{10} N$
$\log_e N$ or $\ln N$	0.4343	$\log_{10} N$ or $\ln N$
lumens per sq ft	1	foot-candles
maxwells	10^{-3}	kilolines
megalines	10^6	maxwells
megmhos per cm cube	10^{-3}	abmhos per cm cube
megmhos per cm cube	2.540	megmhos per in. cube
megmhos per cm cube	0.1662	mhos per mil foot
megmhos per inch cube	0.3937	megmhos per cm cube
megohms	10^6	ohms
meters	100	centimeters
meters	3.2808	feet
meters	39.37	inches
meters	10^{-3}	kilometers
meters	10^3	millimeters
meters	1.0936	yards
meter-kilograms	9.807×10^7	centimeter-dynes
meter-kilograms	10^5	centimeter-grams
meter-kilograms	7.233	pound feet
meters per minute	1.667	centimeters per sec
meters per minute	3.281	feet per minute
meters per minute	0.05468	feet per second
meters per minute	0.06	kilometers per hour
meters per minute	0.03728	miles per hour
meters per second	1968	feet per minute
meters per second	3.284	feet per second
meters per second	6.0	kilometers per hour
meters per second	0.06	kilometers per min
meters per second	2.237	miles per hour
meters per second	0.03728	miles per min
meters per sec per sec	3.281	feet per sec per sec
meters per sec per sec	3.6	km per hour per sec
meters per sec per sec	2.237	miles per hr per sec
mhos per mil foot	6.015×10^{-3}	abmhos per cm cube
mhos per mil foot	6.015	megmhos per cm cube
mhos per mil foot	15.28	megmhos per in. cube
microfarads	10^{15}	abfarads
microfarads	10^{-6}	farads
microfarads	9×10^5	statfarads
micrograms	10^{-6}	grams
microliters	10^{-9}	liters
microhms	10^3	abohms
microhms	10^{-12}	megohms
microhms	10^{-6}	ohms
microhms	$1/9\times10^{-17}$	statohms
microhms per cm cube	10^3	abohms per cm cube
microhms per cm cube	0.3937	microhms per in. cube
microhms per cm cube	6.015	ohms per mil foot
microhms per inch cube	2.540	microhms per cm cube
microns	10^{-6}	meters
miles	1.609×10^5	centimeters
miles	5280	feet
miles	1.6093	kilometers
miles	1760	yards
miles	1900.8	varas
miles per hour	44.70	feet per minute
miles per hour	88	centimeters per sec
miles per hour	1.467	feet per second
miles per hour	1.6093	kilometers per hour
miles per hour	0.8684	knots
miles per hour	26.82	meters per minute
miles per hour per sec	44.70	cm per sec per sec

"A new era is beginning...

"As I review the progress in aeronautics within so short a span, and marvel at the complex aircraft of today, I call it an achievement little short of miraculous.

"Today, electronically-guided planes take off and land without human touch. Lethal sky missiles seek and destroy invisible targets with uncanny precision. And still other fantastic achievements in both man-controlled and pilotless flight are now in the offing.

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LEE De FOREST

Appropriately qualified to speak for aeronautics and other fields in which his own scientific achievements play an important part, Dr. Lee de Forest gives helpful counsel to young graduates headed for successful, rewarding careers.

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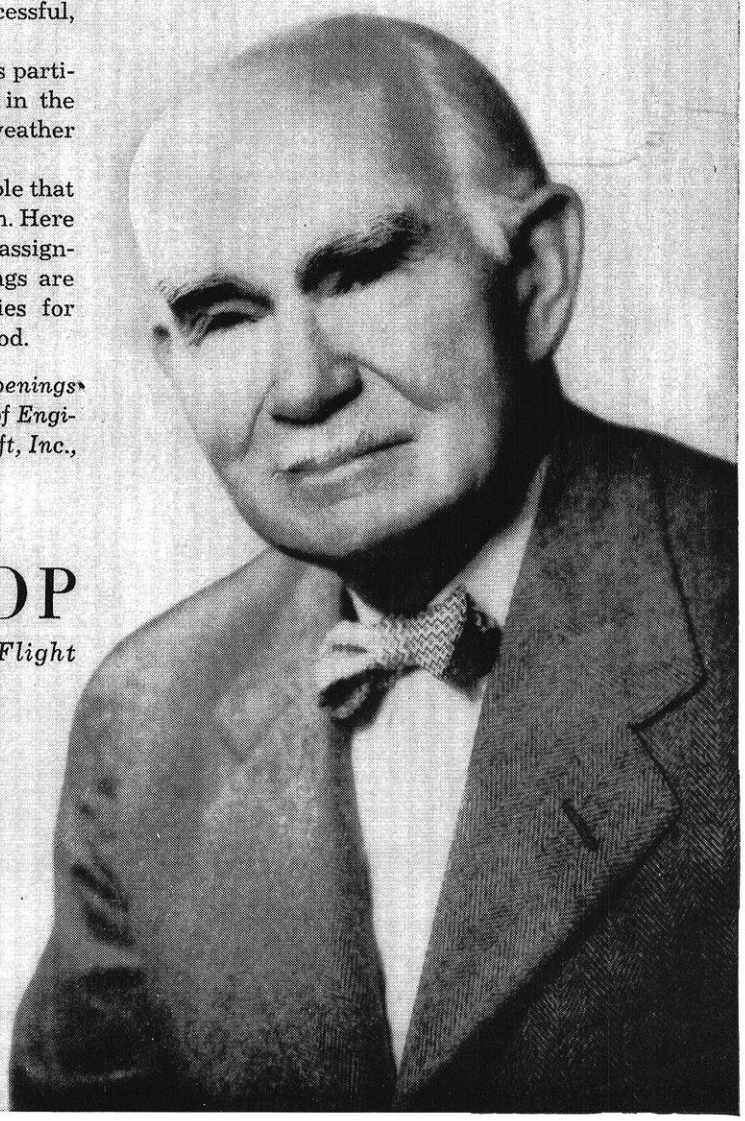
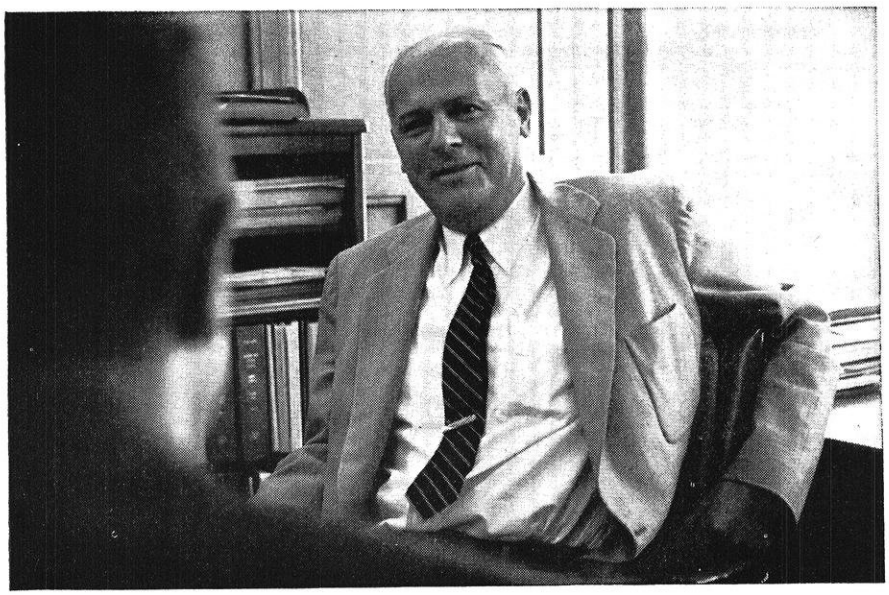


*A statement by Dr. Lee de Forest, pioneer in radio.

CAREERS WITH BECHTEL



JAMES F. DEL CURO, *Mechanical Engineer, Power Division*

MECHANICAL ENGINEERING

One of a series of interviews in which Bechtel Corporation executives discuss career opportunities for college men.

QUESTION: *As I understand it, Mr. Del Curo, the Power Division is concerned with the engineering phases of steam-electric generating plants?*

DEL CURO: That's true. Our own department is specifically concerned with the mechanical engineering phases of such plants.

QUESTION: *When the engineering graduate joins your department are his starting duties standard?*

DEL CURO: Yes. The routines are pretty well defined. We know a man learns best by actual doing, so he is put to work immediately on heat balances, line size calculations, specifications, miscellaneous and minor auxiliary equipment, instrument data sheets and information for plant data books.

QUESTION: *In other words, you sort of throw the man in and he has to learn to swim by himself?*

DEL CURO: No. He has plenty of help. He works under the direct supervision of a job engineer or the mechanical group supervisor.

QUESTION: *How long does this training phase last?*

DEL CURO: That will vary with the man, since aptitudes and desires to learn are different. The average is somewhere between a year and eighteen months.

QUESTION: *During this period he will gradually advance to more complicated equipment?*

DEL CURO: Yes. For example, after a while he will be doing original work on heat balances and system studies. He will be able to take an entire "piece" of a project and handle it on his own responsibility. He will become involved with bigger equipment and with the overall aspects of the power plant. Somewhere along the line he will likely be assigned to try his hand at piping materials, piping specifications and combined control specifications.

QUESTION: *What about the man who wants to specialize?*

DEL CURO: If, for example, a man shows a particular interest in steam turbines, instrumentation or control, and demonstrates a special aptitude for one of them, he will often be called on to work on that specialty, without being confined to it exclusively. Thus we encourage specialization, even during the training period, but also make sure that the young man gets overall experience through work in all phases of mechanical engineering.

QUESTION: *What about field experience?*

DEL CURO: That is, of course, highly desirable from his standpoint and ours. We make every effort to assign the young engineer to field work as soon as possible.

QUESTION: *What will he do in the field?*

DEL CURO: When we are building a power plant we try to get the young engineer on the job five or six months before the scheduled start up of the plant. He will actually help the chief start up engineer by writing up procedures, planning the hydraulic washing to steam lines, working on the start up of each piece of the equipment, checking out controls, etc.

He will also handle paper work such as filling out the data sheets that are later turned over to the plant operators to aid them in running the plant. By the time the turbine is rolled and the job ends, the young engineer has been able to see the end result of all the engineering work he and others have done back in the office.

QUESTION: *Are there any other types of field assignments?*

DEL CURO: If the young engineer desires such experience, he is sometimes used in the construction department if that group is shorthanded.

Bechtel Corporation (and its Bechtel foreign subsidiaries) designs, engineers and constructs petroleum refineries, petrochemical and chemical plants; thermal, hydro and nuclear electric generating plants; pipelines for oil and natural gas transmission. Its large and diversified engineering organization offers opportunities for careers in many branches and specialties of engineering—Mechanical . . . Electrical . . . Structural . . . Chemical . . . Hydraulic.

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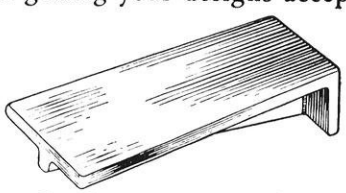
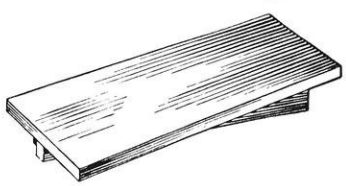
SUCCESSFUL designers state that costs are the most important factor in the success of any product development today. Manufacturers recognize this and, as a result, seek out the engineers who are cost minded.

Industry's stress on lower costs comes from the increasing competition for buyers. Rising costs of materials and labor must be offset by good designs to keep selling prices down to realize a profit from sales.

Ingenious use of materials is the best way you can eliminate needless expense in manufacture. By using steel as the basic material and welding for fabrication, you have a decided advantage in saving money for a manufacturing company . . . and getting your designs accepted.



Cast Construction — Costs $28.13



Welded Steel Construction — Costs $6.49

Results from using welded steel instead of gray iron are shown in the above design comparison of a typical bracket used on modern machinery. The cast bracket costs $28.13. The welded steel bracket costs $6.49, weighs 65% less, yet is stronger and more rigid than the cast design.

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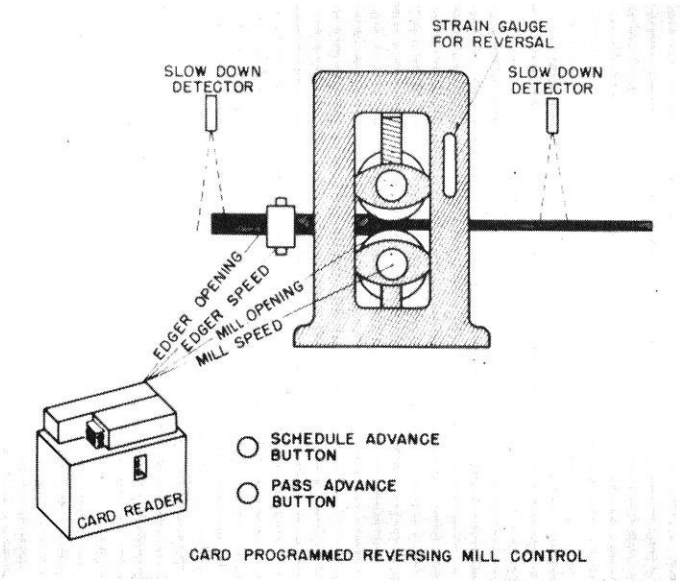

CARD PROGRAMMED REVERSING MILL CONTROL

Science Highlights

(Continued from page 54)

slowdown. After all but the final pass, roll openings and mill speeds are readjusted in accordance with the schedule filed in the memory storage element. When the final pass is completed, an indicator light automatically signals the operator at the crop shear that the strip is ready to enter the finishing mill.

The mill will then be preset for the next schedule by pressing the schedule advance push button. Again, a punched card is read by the card reader, its information is transferred to the memory storage element, and the mill is made ready for the schedule required for the next slab.

When completed, the new roughing mill will feed a six-stand continuous hot strip mill. Main horizontal rolls of the roughing mill are 42 inches in diameter and 44 inches wide. Each edger roll is 24 inches in diameter.

ALLOY DEVELOPMENT TO BOOST JET ENGINE EFFICIENCY

Scientists soon will begin full-scale tests on a new combination of high-temperature alloys that may increase the efficiency of jet engines more than 15 percent.

Described as the possible key to a major advance in the field of jet engines and gas turbines, the development involves the "sandwiching" of one high-temperature alloy around another to take advantage of the heat resisting qualities of each.

Research metallurgists, who were pioneers in the field of high-temperature alloys, worked more than five years on the new development that clads molybdenum with Inconel, a nickel-based high-temperature alloy.

Current high-temperature alloys restrict maximum turbine inlet temperatures to about 1600 degrees Fahrenheit. While these alloys are somewhat better than those of 10 years ago, they are still essentially of the same composition of a decade or more ago.

However, with the use of Inconel-clad molybdenum, inlet temperatures of between 1800 and 1900 degrees will be possible. At the present stage of progress on jet engines and gas turbines, an increase in temperature boosts efficiency on an almost directly proportional basis.

Mr. Bechtold demonstrated the qualities of the alloys by subjecting three specimens to stresses at high temperatures. Inconel alone broke when the temperature hit

(Continued on page 62)

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Ask him what he thinks about a writing career for engineers and he'll tell you this: "All through college, I was a staff member of *The Michigan Technic*, and editor as a senior. And I've never stopped being grateful for the decision I made to be an engineer-writer. I've learned more about what's going on . . . kept in touch with key developments in engineering throughout industry . . . thanks to that decision."

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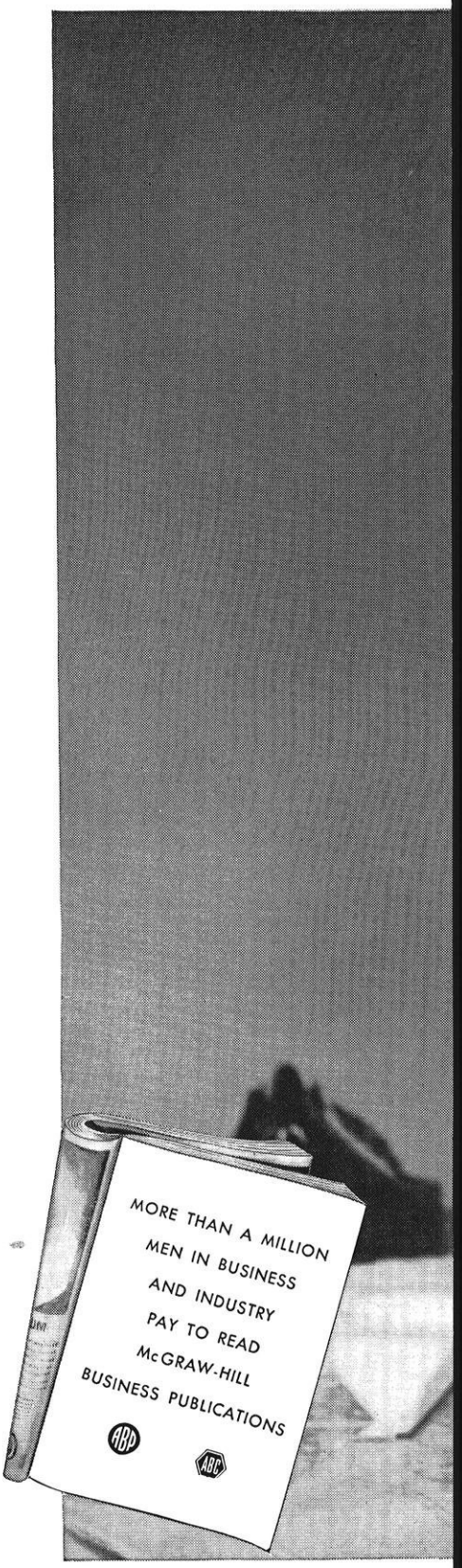

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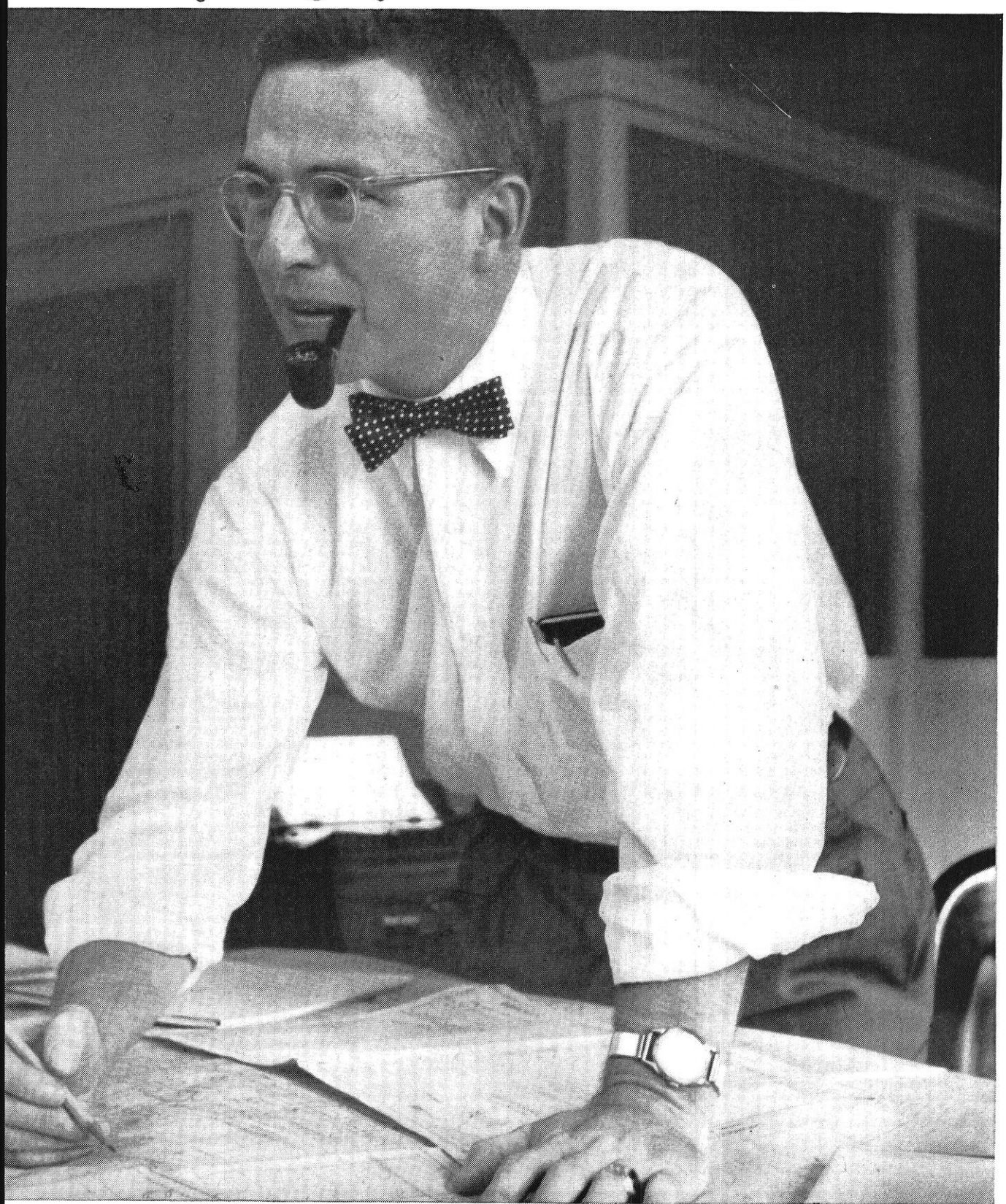


Science Highlights

(Continued from page 58)

between 1350 and 1450 degrees. Molybdenum did not break even at 1850 degrees, but did begin smoking at about 1300. This is due to oxidation which would rapidly burn up the metal if this were allowed to continue, he explained.

Mr. Bechtold demonstrates alloy qualities.

However, when heat was applied to "clad moly," the specimen neither burned nor broke even at 1850 to 1950 degrees, due to the oxidation resistance of the outer layer of Inconel and the strength of the molybdenum. The latter alloy was described as "by far the strongest material so far developed at temperatures above 1600 degrees."

Development of "clad moly" did not immediately answer the problem for a higher-temperature alloy, it was disclosed. Metallurgists found that when Inconel was rolled on molybdenum at high temperature, a layer of hard, brittle material formed between the two alloys which made the cladding alloy tear away easily. The metallurgists discovered that this intermetallic compound could be eliminated by placing a barrier material such as palladium between the two alloys.

FIRST ENGINE X-RAY

A General Electric engineering team has achieved the feat of making motion pictures of the innards of an engine while it is running.

The job involves taking X-ray pictures of the spinning, throbbing internal movements of the engine through its steel housing, and visually "stopping" with a camera their high-speed motion.

The new technique, called stroboradiography, could have a significant effect on engineering design. Slow-motion X-ray movies and still pictures of pistons, cams and other moving parts have enabled engineers to scrutinize, for the first time, complete cycles of engine operation for faulty performance or wear.

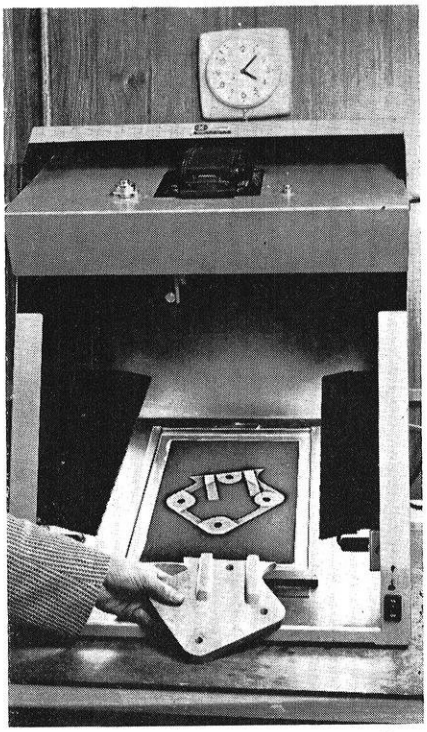
The revolutionary process gives designers their first glimpse inside a completed machine operating at normal speed under load conditions. Improved, lightweight designs, and perhaps important basic design changes could result from the X-ray motion studies.

The special stroboradiographic equipment was developed for use with its high-energy industrial X-ray betatron, operating at 5 million to 15 million volts.

Unlike conventional X-ray equipment, the betatron furnishes the surging radiation pulses—416 per second—that have given engineers this unprecedented "inside" view of any deflections, vibrations or bouncings inside a running machine.

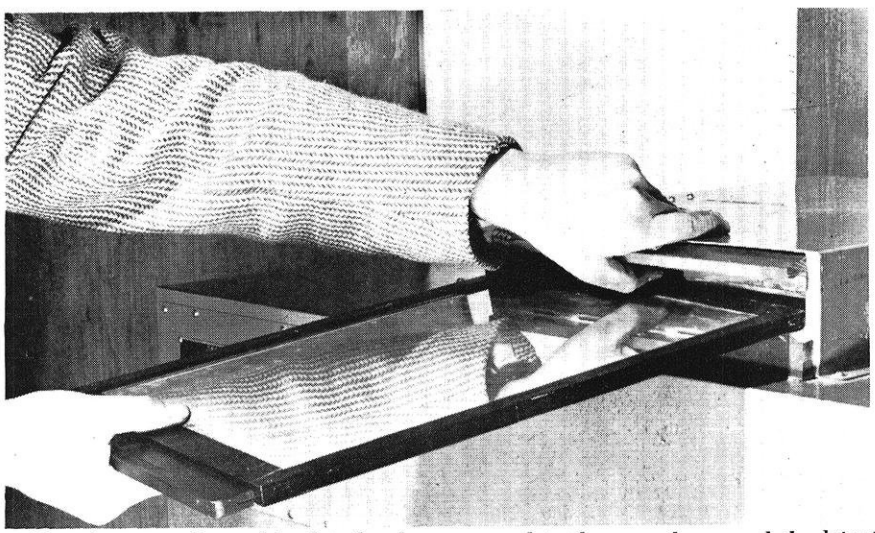
Previously, single-shot exposures of moving objects had been made with low-energy equipment, but the quality of the radiographs suffered when the object was composed of heavy parts of varying thickness.

The new process involves taking thousands of short exposures accurately synchronized with the moving part. With an exposure time of 10 to 15 millionths of a second, it is possible to radiograph an engine turning at several thousand revolutions a minute.



The xeroradiographic plate is best viewed with the aid of low-angle illumination.

A synchronizing disc attached to the specimen engine signals the betatron and releases the surge of electrons that make the split-second X-ray exposure. Several thousand repetitions result in a strong image clear enough to be analyzed for operational data. **THE END**



After the xeroradiographic plate has been exposed to the x-ray beam and the latent image formed on its electrically-charged coating, it is inserted into a dust-chamber, where a chalky dust carrying the opposite charge is sprayed against the plate, thus developing an image.

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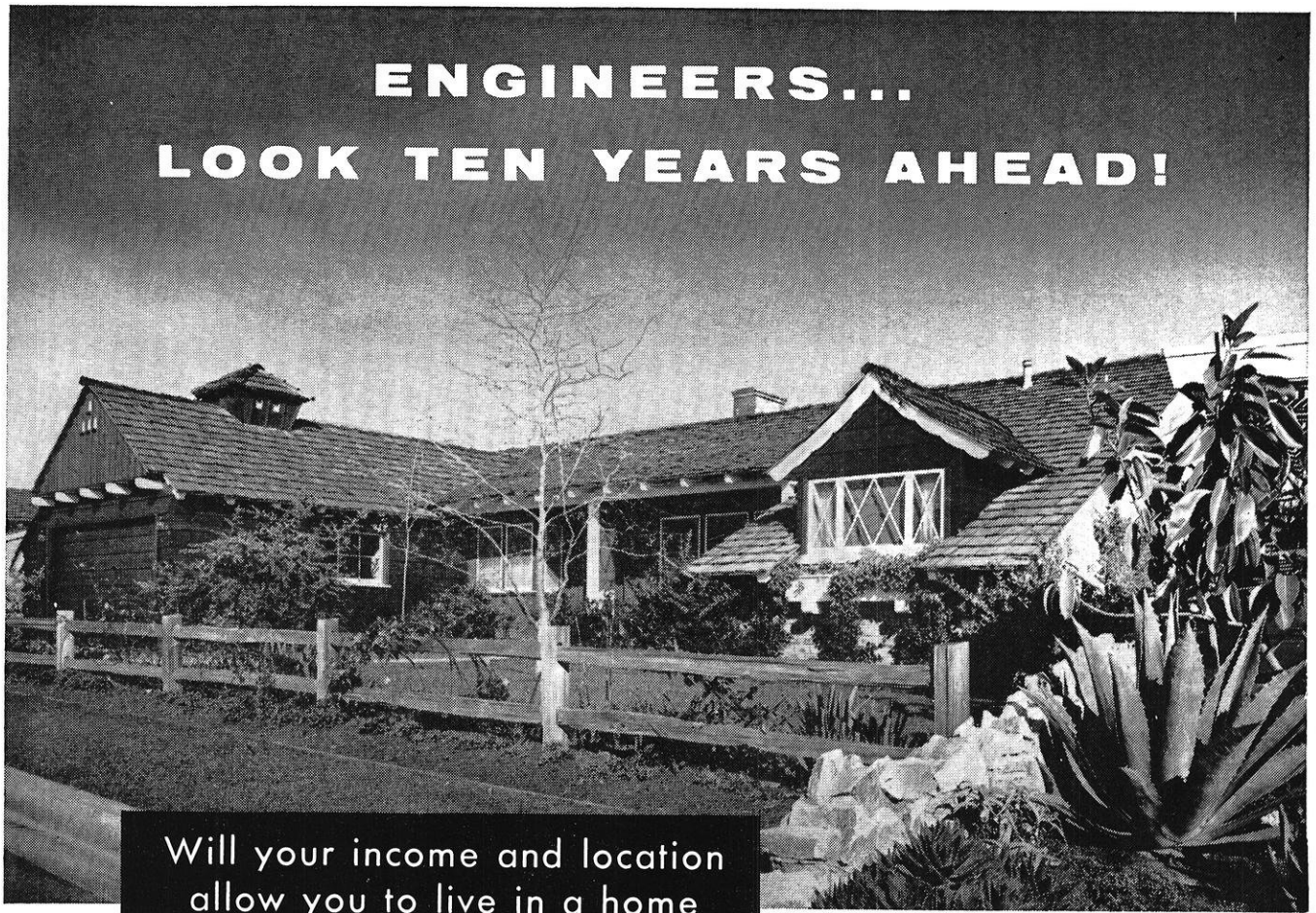

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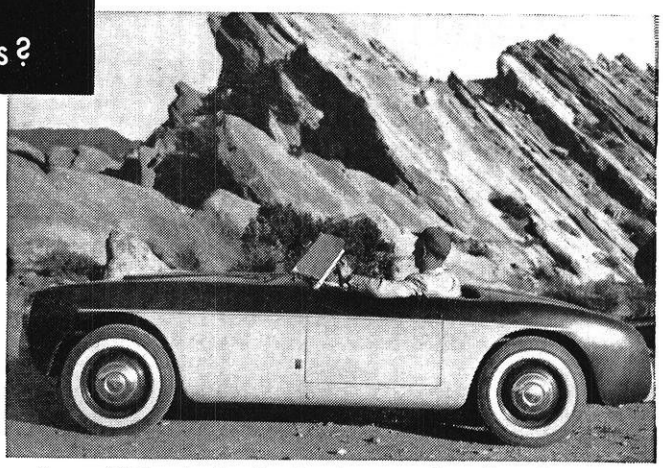

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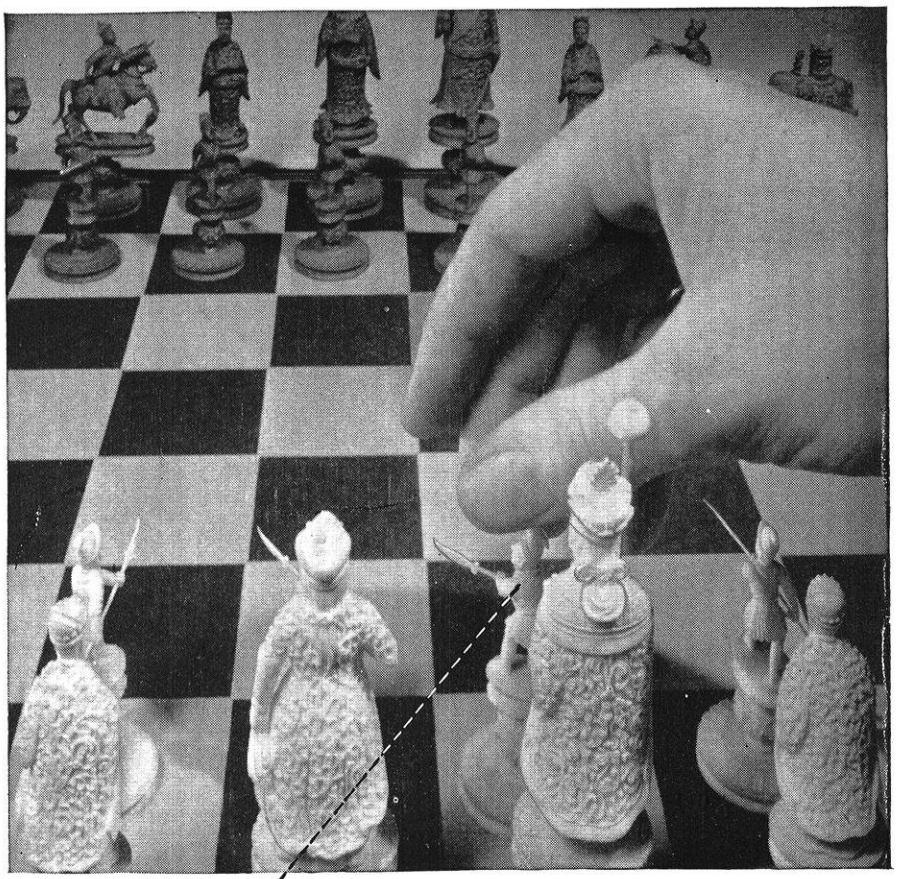

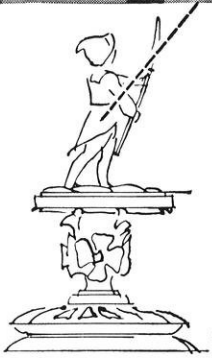

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MOTOROLA

Reactors

(Continued from page 17)

There are several types of mechanical pumps designed to handle liquid metals, but on all of them, leakage of liquid metal and contamination are the major problems. All of these pumps are centrifugal ones. The pump bearings are designed to operate using the fluid being pumped as a lubricant. These bearings are pressure-positioned, and there is never any metal to metal contact.

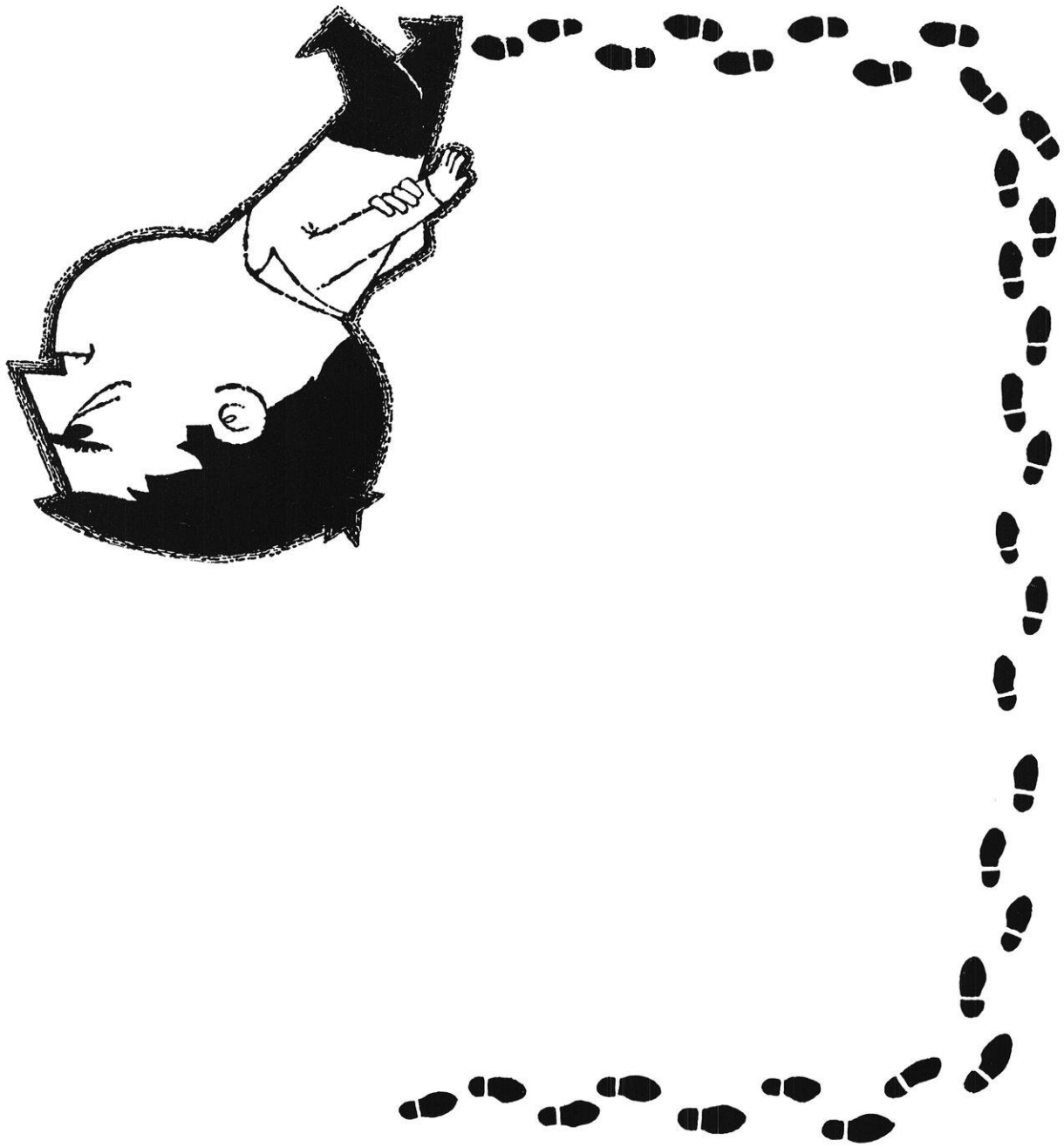
If the motor for the pump is mounted outside the inert atmosphere surrounding the pump itself, rotating shaft seal must be provided. This rotating seal will leak somewhat and a little of the inert gas will be lost. The motor can also be mounted inside the inert atmosphere. This is the so called "canned motor" installation.

The motor is not as readily accessible for maintenance, but the rotating seal is eliminated. By using a direct-current motor, the slow rate can easily be varied.

The instrumentation of a liquid metal system presents some problems. In many cases, standard measuring devices can be used if they are isolated from the hot liquid metal by some inert substance. The fluid lines connecting the instruments must be heated to the same temperature as the metal to prevent solidification and clogging of the lines. Electrical resistance measurements can also be used to good advantage because of the good conductivity of the liquid metals.

Now that the technical problems of this type of heat transfer system have been met, the economic aspects of the problem must be conquered. The theoretical costs for a nuclear power plant have been calculated, and they have been found to be comparable to the cost of producing power by water, diesel, or coal fired steam generating plants. When these ideas are put into practice, the nearly unlimited supply of power from nuclear reactions will become available.

THE END



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W.S.P.E.

(Continued from page 46)

C. Ethics and Practice
Kurt Roth, Chairman; Berry E. Brevik, Co-Chairman
Committee Members: P. L. Schroeder, E. M. Griffith, W. T. Kohn, L. H. Shaffer, L. F. Motl, William J. Cherones

D. Education
(Joint with Functional Group)
John Gammell, Chairman
Committee Members: Carl W. Geisler, J. L. Trebilcock, R. P. Boyd, K. L. Jensen, Harold A. Peterson, A. Bernard Drought

E. Legislative
Herman T. Hagestad, Chairman
Committee Members: Carl Cajanus, L. Jensen, F. J. Hoeppner, R. C. Buck, Leonard J. Hillis, William D. O'Connor

F. Public Relations
Gordon R. Merce, Chairman
Committee Members: Carl W. Geisler, R. L. Hungerford, E. J. Polasek, E. C. Kesting, Howard H. Buer, E. A. Ritchie, James Zimmerman

G. Interprofessional
Charles A. Nagel, Chairman
Committee Members: John A. Lofte, Harold Trester, Herman T. Hagestad

P.M.

12:15 Speakers' Table Assembly

12:30 Luncheon—Crystal Ball Room—
A. L. Genisot, Vice President, W.S.P.E., Presiding
Recognition of New Members July to December 31

1:30 Feature Address

2:30 Functional Groups
A. Education
(Joint with Education Committee)
John Gammell, Chairman
B. Industrial
V. Robins Tate, Chairman
C. Public Employment
E. J. Duszynski, Chairman
D. Consulting
Robert J. Strass, Chairman

6:00 Reception
Dutch Treat

6:45 Speakers' Table Assembly

7:00 Annual Banquet
A. G. Behling, President, WSPE, Presiding
A. Greetings
B. Introduction of Old and New Officers
C. Presentation of Outstanding Engineer Award
D. Feature Address

Saturday, January 26, 1957

A.M.

9:30 Business Meeting
President A. G. Behling, Presiding
A. President's Report
B. Secretary's Report
C. Treasurer's Report
D. National Representative's Report
E. Committee Reports:
(1) Education
(2) Ethics and Practice
(3) Membership
(4) Program
(5) Public Relations
(6) Legislative
(7) Interprofessional
F. Functional Group Reports:
(1) Consulting Engineers
(2) Education
(3) Industrial Employment
(4) Special Employment
G. New Business

P.M.

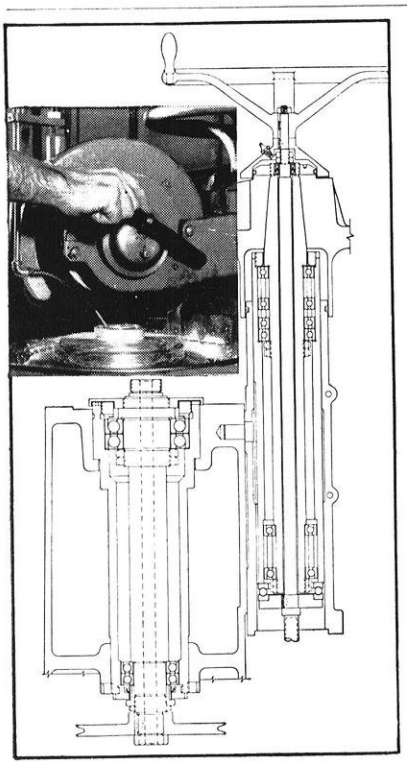
12:15 Speakers' Table Assembly

12:30 Luncheon—Empire Room
Clifford J. Nelson, Vice President, W.S.P.E., Presiding
A. Recognition of Official Delegates
B. Presentation of Awards
Outstanding High School Teachers
John Gammell, Chairman Education Committee, Introducing
1. A. Bernard Drought, Dean College of Engineering, Marquette University
2. Kurt F. Wendt, Dean College of Engineering, University of Wisconsin
3. Fred J. Van Zeeland, Dean, Milwaukee School of Engineering
C. Outstanding Science Teachers
D. Feature Address

2:00 Adjournment

2:30 Annual Business Meeting
Milwaukee Section, W. S. P. E.
Karl O. Werwath, Presiding

THE END



How a precision grinder holds its precision—for years

In pre-loading super-precision ball bearings, a precision surface grinder is used for close-tolerance grinding of bearing ring faces (see photo). In the grinder diagrammed here, moving parts are mounted on Fafnir ball bearings to assure the absolute rigidity essential for this exacting work.

All bearings indicated, except the thrust bearings at the bottom of the column supporting the wheelhead arm, are Fafnir pre-loaded, super-precision types. The oscillating wheelhead is similarly mounted. Original bearings in column and workhead have been in operation and have maintained their precision for over 15 years.

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An interesting aspect of an engineering career with Fafnir is the opportunity for first-hand observation of Fafnir products actually on-the-job in Fafnir plants. Fafnir bearings are widely used in equipment necessary for bearing manufacture, including machines such as the precision surface grinder above.

The opportunity for on-the-job evaluation of bearing performance is invaluable as a source of information — and, often, inspiration — in the vital, diversified work of designing, developing, and assisting in the application of bearings for all of industry. Perhaps Fafnir offers you the challenges and satisfactions you want in engineering, or sales engineering. We'd be glad to hear from you.

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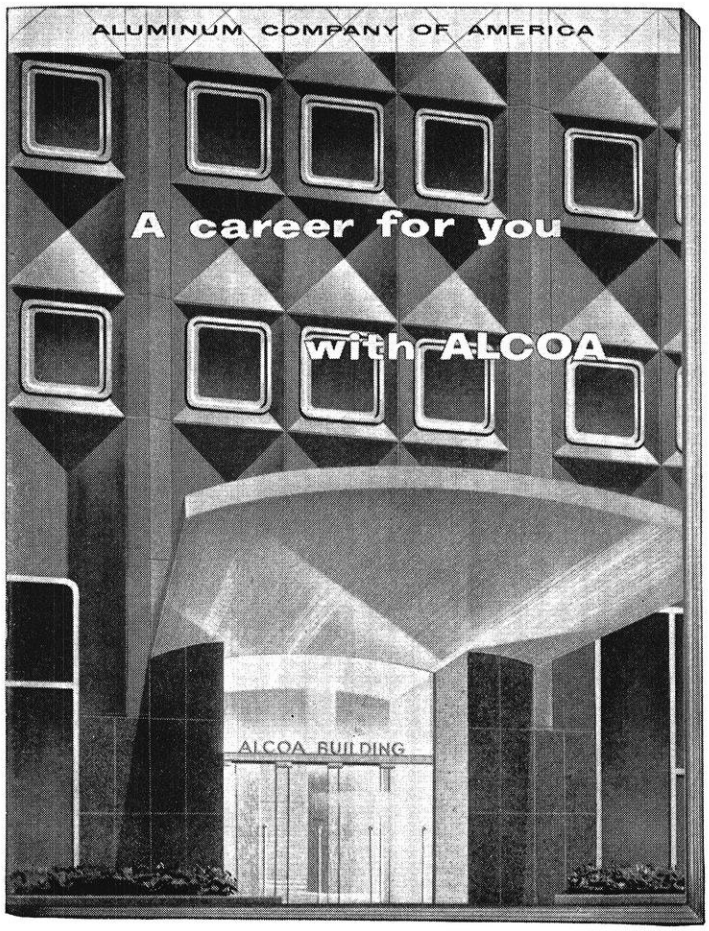

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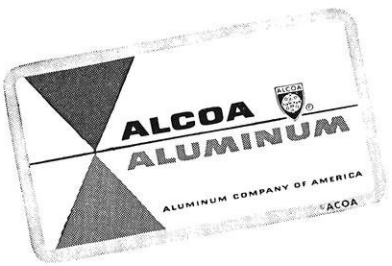

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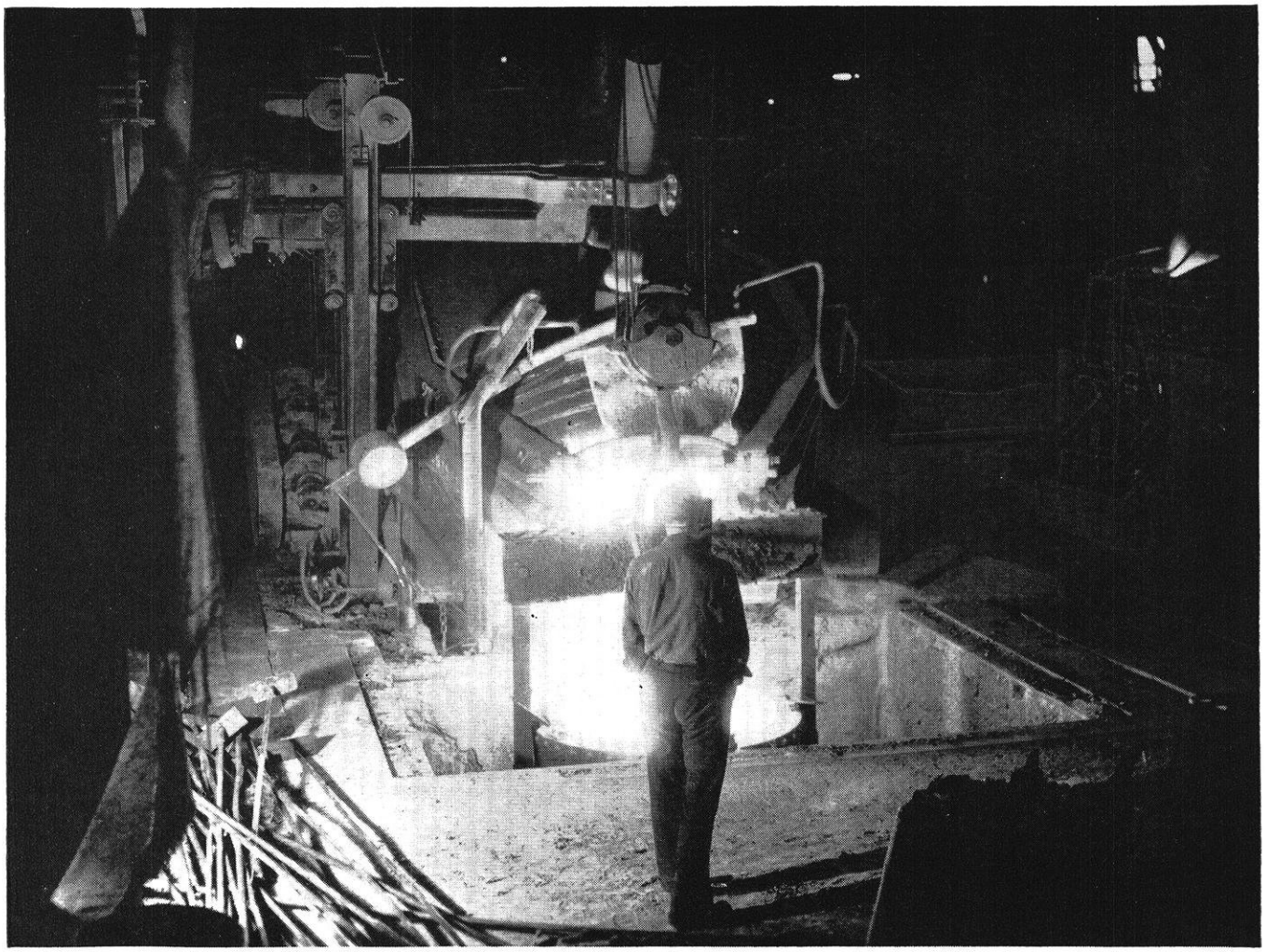

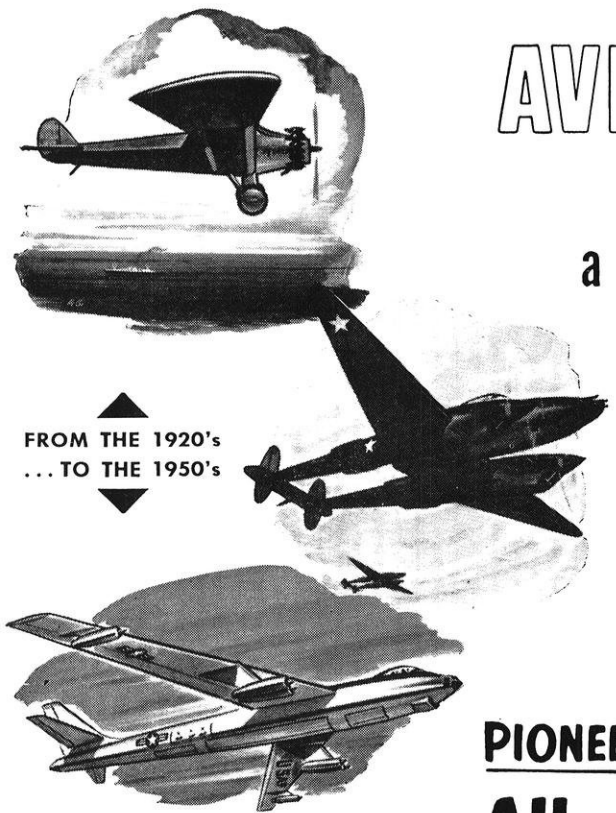

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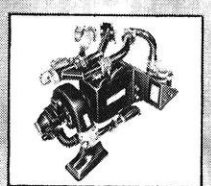
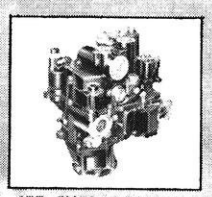
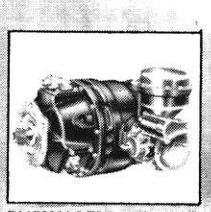


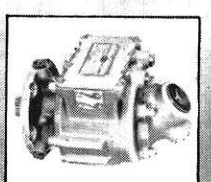
REFRIGERATION UNIT



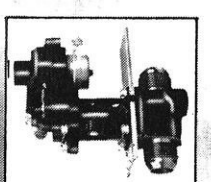
JET FUEL CONTROL



PNEUMATIC STARTER



HYDRAULIC PUMP



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UNITED AIRCRAFT CORPORATION

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Handloading

(Continued from page 31)

lengthened and must be trimmed to standard length. Oversize cases must be full length resized in order to again fit the chamber properly.

The cases that fit satisfactorily must be chamfered on the inside of the neck to allow free entrance of the bullet. A 60 degree countersink or case mouth chamfering reamer will work well.

Placing the correct powder charge in the case requires the use of either a powder scale or a powder measure or both. It is possible to set some powder measures without the use of a powder scale. However, due to the possibility of error, it is recommended that the measure be checked with an accurate scale. After the powder measure has been set it will "throw" charges quite uniformly and more rapidly than using the scale alone. (Figure 14)

For the beginner, the scale is the most economical and the most accurate device for the measuring of powder charges. First, set the scale to weigh the desired charge through the use of loading data tables in a manual. Then, in order to facilitate powder handling, pour a small amount of powder from the cannister into a small box or can. Weigh the charge by shaking the powder into the scale pan with a teaspoon.

Place the powder funnel in the mouth of an empty case and pour the powder from the scale pan into the case. Proceed until the desired number of cases have been charged. When this has been completed, look into all of the charged cases to see if the powder level appears to be consistent. There is seldom any variation in the charges if a scale has been used to measure the powder.

Next in the hand loading procedure is the seating of the bullet in the case. To begin this operation place the bullet seating die in the press so that when the shell holder is raised it nearly touches the bottom of the die. With the die in this position, an empty case should go into the die freely. Slide a charged case into the shell holder and place the bullet on the case mouth between thumb and forefinger. Still holding the bullet in place, move the case up into the die as far as it will go.

The depth the bullet is seated in the cartridge does not materially effect the ballistics of the cartridge. This does not mean seating depth will not affect accuracy. It means that seating depth may be varied considerably without creating any hazards in firing the cartridges. Experienced shooters recommend seating the bullet out far enough to barely clear the lands of the rifling for best accuracy.

This might increase the overall length of the cartridge so it would not function through the magazine of the rifle, in which case the bullets would have to be seated to standard overall cartridge length. Generally speaking, bullets should be seated so the overall length of the cartridges is the same as that of a commercially loaded cartridge.

The finished reload looks just like commercially loaded ammunition. It should perform equally as well or better if care was used in the reloading operations.

In commercial rounds, each one must consistently meet a standard. This standard requires that the round will perform safely in every action made for that caliber, whether the action is fifty years old and weakly constructed or not. This means that the shooter who owns a late model bolt action sporter rifle is not obtaining the performance from factory ammunition that he could from reloading to higher pressures.

Superior accuracy results from handloaded ammunition because the shooter can vary powder, powder charges, primers and bullets. By experimenting with various combinations of these, he can develop that particular load which fits his rifle best.

For instance, a given bullet might give excellent accuracy in one rifle and very poor accuracy in another. In many instances, a change in powder charge of only one half grain will reduce the group size from two inches to one inch at one hundred yards.

Match accuracy not only requires a keen eye and a steady hand but also takes ammunition which will perform perfectly in the particular rifle used. It takes only a small amount of testing to find loads which will increase the accuracy of any rifle. Over eighty five per cent of the participants in National Big Bore Rifle matches load their own ammunition. **THE END**

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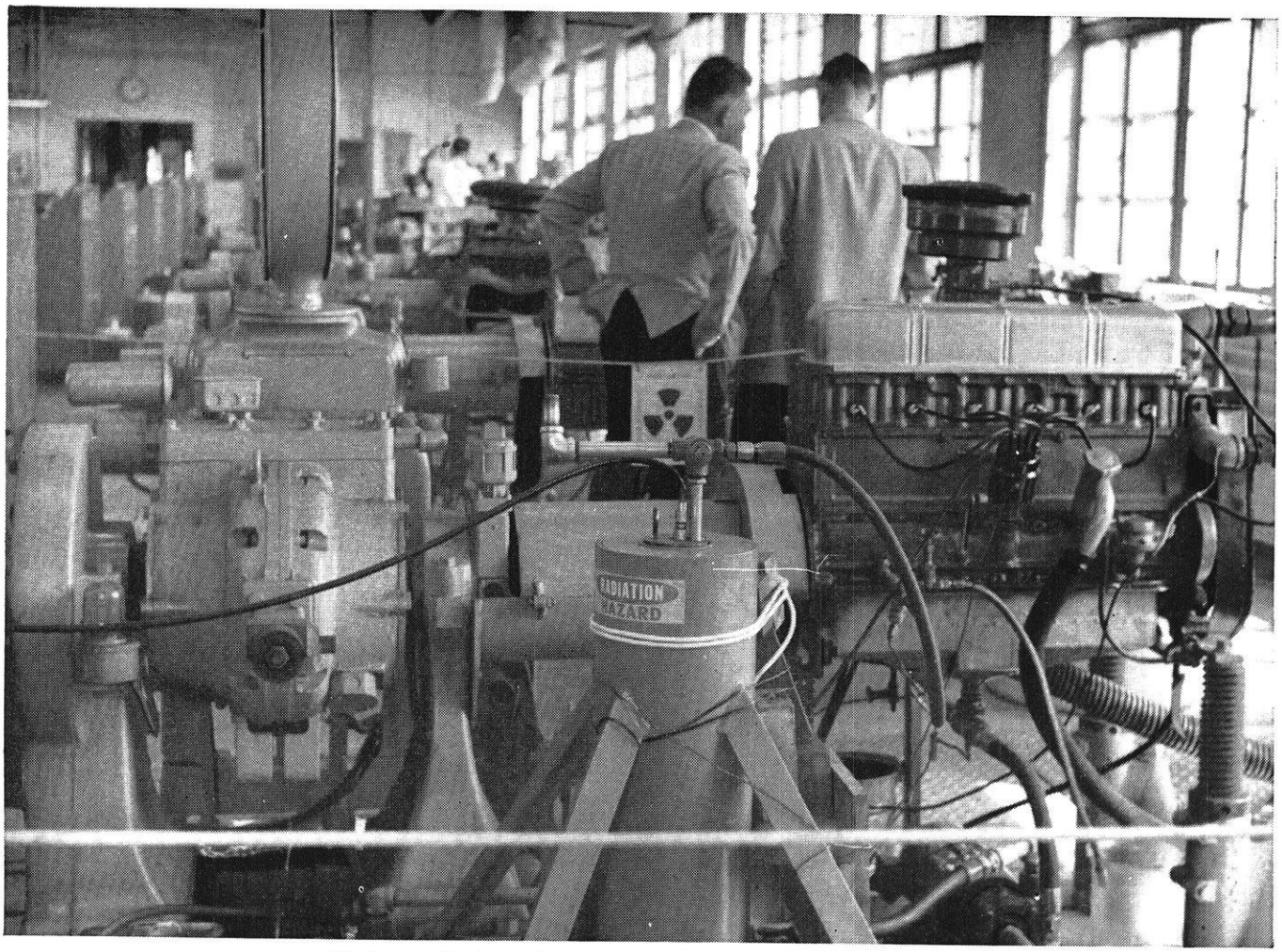

Modern and advanced engines log up hundreds of test hours daily in Standard's automotive laboratory at Whiting. Radioactive carbon traces deposits in the guarded engine (foreground).

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LAMONT ELTINGE is a group leader in the Automotive Research Division of Standard Oil's great Research and Engineering Laboratories at Whiting, Indiana. He and his group dig freely and fruitfully into just about every area you can think of in diesel, automotive, gas turbine, and jet fuels. Current studies range from air pollution problems arising from diesel smoke to laboratory use of radioactive carbon tracers for the basic study of deposits in gasoline engines.

Mr. Eltinge earned his B.S. in mechanical engineering at Purdue in 1947. He is a member of SAE, Tau Beta Pi, Sigma Tau, and Pi Tau Sigma. Along with the important contributions he makes to Standard as a regular member of our team, he finds time to attend Illinois Institute of Technology where he recently received his M.S., and takes an active interest in church work.

Lamont Eltinge and hundreds of young men like him are going places and doing things at Standard Oil. Each concentrates on his own special field of interest and experience, but none is limited to it. Chemists, metallurgists, engineers, physicists and others maintain a continuous relationship for the broad exchange of ideas. Perhaps you, too, would enjoy membership on Standard's team of engineers and scientists.

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STANDARD

Engine Ears

(Continued from page 32)

from the University of Wisconsin Student Section. John Bollinger, President, Robert Gehr, Vice President and Faculty Advisor Otto Uyehara attended the convention through the courtesy of Hamilton Standard Division of United Aircraft.

"Free Exchange of Knowledge —Path to the Future," was the keynote of this years gathering. Presentation of more than 300 technical papers filled the six day session, covering the recent developments in nuclear power plants, design of tomorrow's air terminal facilities, fatigue in metals, air pollution, industrial safety and management and the use of helicopters as flying cranes to move heavy equipment in open areas.

In conjunction with the ASME convention was the annual Power Show, Automation Show and International Conference on the Fatigue of Metals.

Recognition of honors and awards conferred at the members and students luncheon was the presentation of the Charles T. Main Award, Undergraduate Student Award and the Old Guard Prize. Awards and honors presented to senior members and honored guests were presented at the formal banquet at which Donald S. Quarles, Secretary of the Air Force was the guest speaker.

REPORT ON THE NOVEMBER MEETING OF THE A. I. Ch. E.

DAVID D. COWARD

"Problems in the Heavy Inorganic Chemical Industry", was the topic enlarged upon at the November meeting of the A.I.Ch.E. and speaking on this topic was Mr. L. G. Nussbaum of the Food Machinery and Chemical Corporation. To begin, Mr. Nussbaum traced his company's growth as typical of the chemical industry in the expanding postwar economy and cited a few of the little published decisions which may later affect a company's growth.

One of the specific examples mentioned was the development of a new continuous process for the production of carbon disulfide when faced with the continuing unfavorable operational economics of the existing process.

To everyone's interest, a considerable amount of time was devoted to the aspect of human relations in engineering. Upon being questioned, the speaker enumerated several examples of employer-employee problems in which he was faced with the choice of using either logic or emotion.

In response to further questioning, Mr. Nussbaum concluded by evaluating a person's ability to write clear and concise engineering reports as playing an important role in that person's future advancement. THE END

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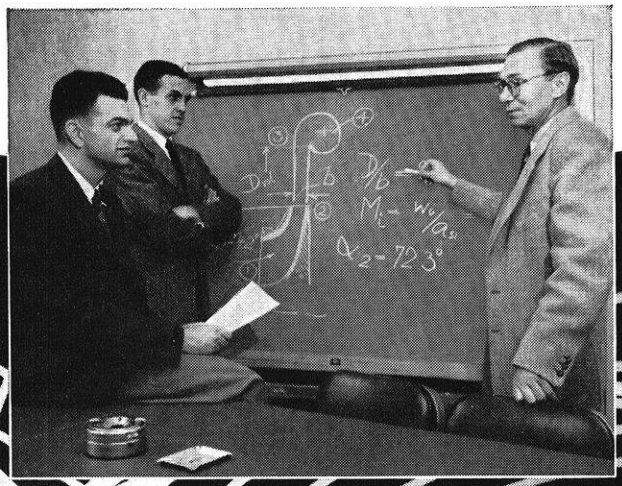
To the engineer who intends to blaze *new* trails...



Six inch long compressor-turbine assembly in a midget AiResearch air expansion refrigeration unit which operates at 100,000 r.p.m., can drop temperature more than 600° F. in a second.

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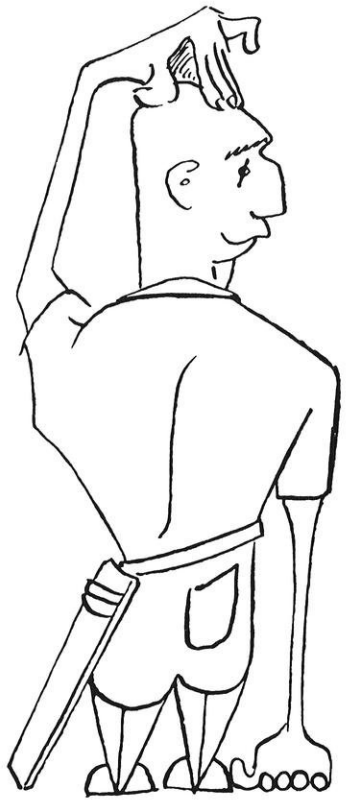
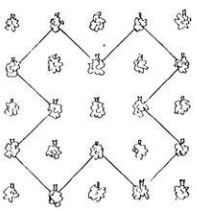
So You Think You're SMART!



by Sneedly, bs'61

Well, how many of you were able to figure out how Sneedly told J. C. Strauss and Bogall Cornell to build their fence? Here's the solution:



Last week Sneedly learned that one of the EE instructors, Allen Scidless, had given his students a rate and distance problem as an extra credit assignment. He did this after one of his best pupils, Norm Rosepanko, had made the statement in class that the whole universe was composed of nothing but electric circuits. Sensing that his pupils needed a bit better appreciation of the broadness of the field of engineering, he assigned the entire class the problem of determining how to count the number of steps visible at a given time on an escalator when the steps are continually moving.

Norm enlisted the services of one of his friends, Barney Ray, and the two set out for one of the Madison stores to observe the problem at first hand. When they arrived at the base of the escalator, they were rather disturbed to learn that the Christmas shopping ritual was in full swing and that the escalator was so crowded with giggling hill students that data taking would be impossible.

Barney solved this problem by shouting "thermodynamics" at the top of his lungs. This outcry caused an exodus from the immediate area and N o r m and Barney stepped unto the moving escalator. At this very moment however, the girls in the group noticed their dangling slide rules and ran toward them, arms outstretched, lips puckered, and eyes sparkling. Norm and Barney, fully realizing the consequences of such an attack, began to walk hurriedly up the moving escalator.

Barney, who had experienced such attacks before, walked so fast that he took two steps for each step Norm took. After reaching the second floor the two ran down the fire escape and thus were saved. Luckily each man had enough presence of mind to count the steps he took going up the moving escalator. Barney took 21 steps and Norm took 28 steps.

In desperation they came to Sneedly and told him of their misfortune. But Sneedly told them they had plenty of data to determine the number of steps visible at a given time. What is the answer and how did Sneedly arrive at it?

* * *

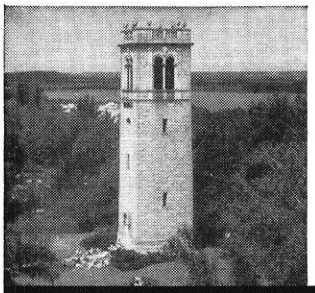
The other day Sneedly heard about a young and adventurous fellow whose great-grandad left him nothing m u c h but the logs from the old salt's seafaring days. The young fellow never quite got up courage enough to toss the books out, and one day was leafing idly through them. Stuck between two pages he found a much-folded paper which read as follows:

"Sail to 16 North latitude and 16 West longitude where thou wilt find a deserted island. There lieth a large meadow, not pent, on the north s h o r e of the island where standeth a lonely oak and a lonely pine. There wilt thou also see an old gallows on which we once were wont to hang traitors. Start thou from the gallows and walk to the oak counting thy steps. At the oak thou must turn right by a right angle and take the same number of steps. Put here a spike in the ground. Now must thou return to the gallows and walk to the pine counting thy steps. At the pine thou must turn left by a right a n g l e and see that thou takest the s a m e number of steps, and put another spike into the ground. Dig halfway between the spikes; the treasure is there."

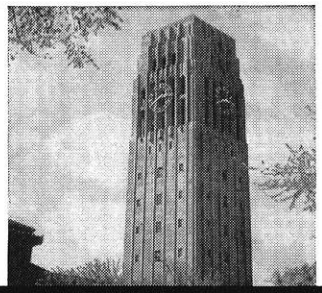
The instructions were quite clear and explicit, so our boy chartered a ship and sailed to the S o u t h Seas. He found the island, the field, the oak, the pine: indeed, he found everything he was looking for but the gallows. Rain, sun, and wind had long since t a k e n away all trace of the wooden structure. How did our hero find the treasure?

* * *

Remember, send your solutions to these problems and any of your favorite problems, along with solutions, to Sneedly at *"The Wisconsin Engineer"*. **END**



WISCONSIN



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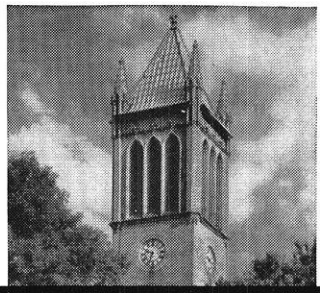
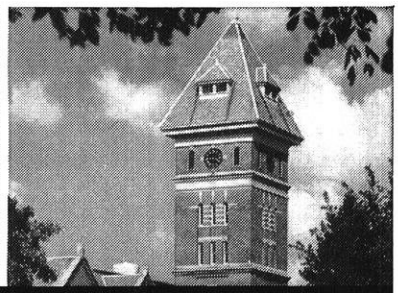
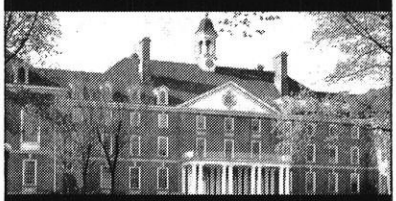


IOWA STATE



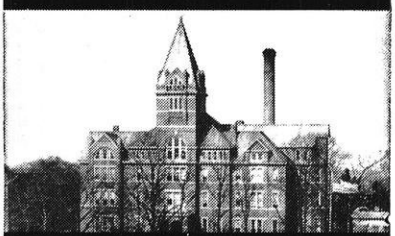
PURDUE

TEXAS A&M

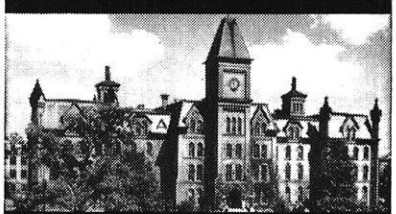


ILLINOIS

PENN STATE

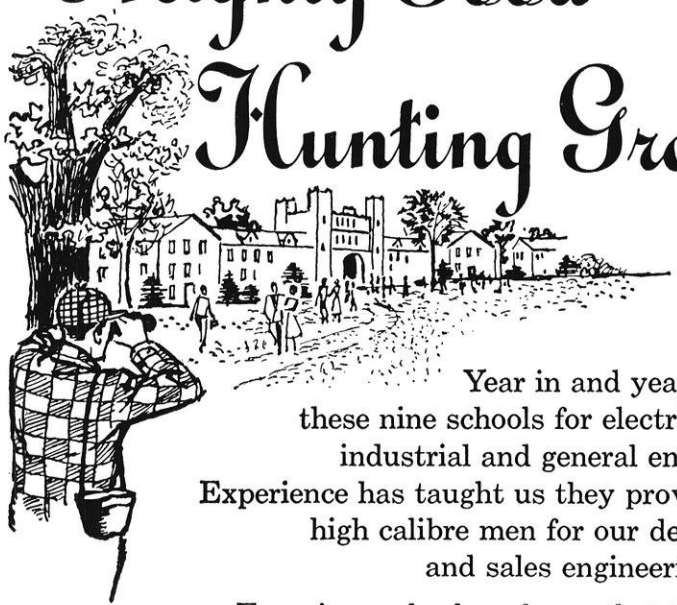


GEORGIA TECH



OHIO STATE

these are Mighty Good Hunting Grounds!



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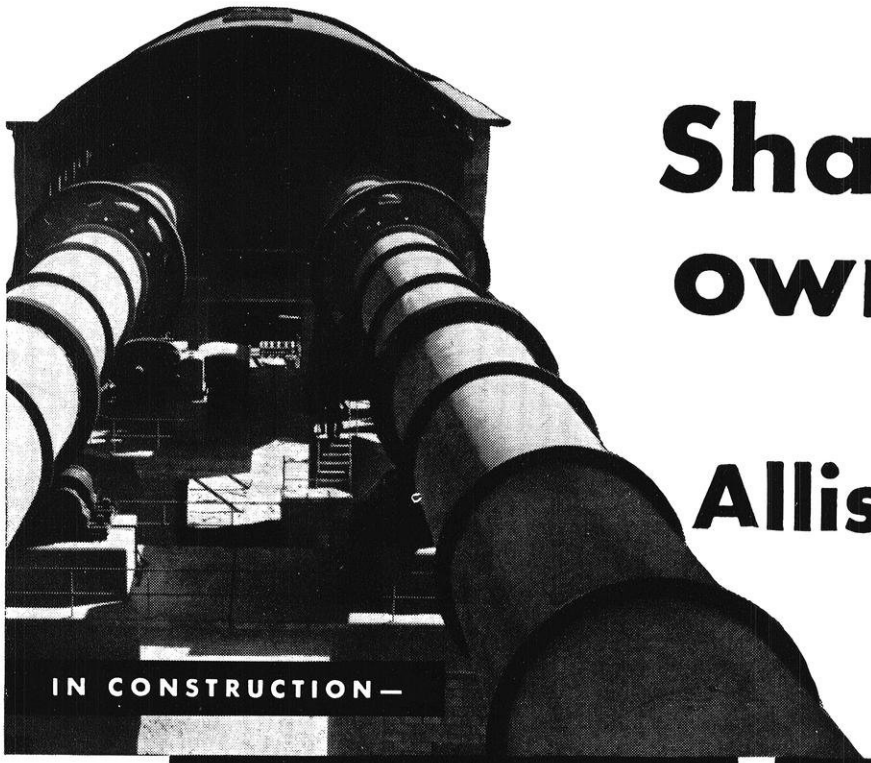

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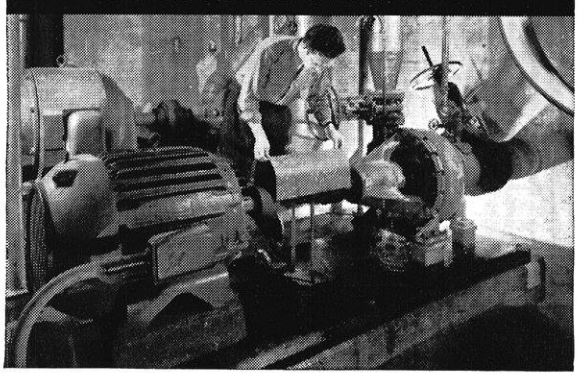
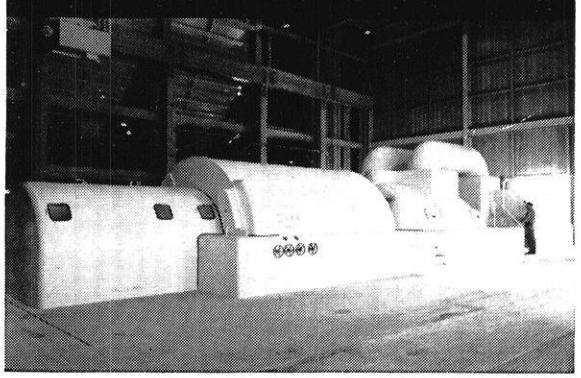


IN POWER—



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STA  TIC

"Folks," said the minister, "the subject of my sermon dis even' is liars. How many in the congregation has done read the 69th chapter of Saint Matthew?" Nearly every hand in the congregation was raised.

"Dat's right," said the reverend. "You is de folks I want to preach to. Dere ain't no 69th chapter of Matthew."

* * *

Instructor: "I suppose you wish I were dead so you could spit on my grave."

E.E.: "Not me, I hate to stand in lines."

* * *

A grocer was standing in front of his store when he saw a driverless car rolling slowly down the street. He ran to the car, jumped in and pulled on the emergency brake with a jerk. As he got out, a little proud, a man walked up.

"Well," said the grocer to the car owner, "I stopped it!"

"Yeah, I know," said the owner, "I was pushing it."

* * *

"Looks like rain," said the tourist to the old-timer at a filling station in an arid part of the West.

"I sure hope so," sighed the old man. "Not for myself," he quickly added, "but for my grandson here. I've seen rain."

* * *

Professor interrupted during important lecture by sneeze.

"Who sneezed?"

No answer.

Prof. "There will be a 4 hour exam tomorrow."

No reply.

Prof. "I guarantee to flunk half the class."

From back of room, "I did it sir."

Prof. "Gesundheit."

It's tough to find for love or money
A joke that's clean and also funny.

* * *

A flight of bombers had ranged far and wide over Germany, spreading tons of propaganda leaflets over the Third Reich.

All planes returned safely to their base except one. Hours passed. Night fell. Still no plane. Finally, its engines were heard. As it landed, the operations officer ran out to the plane. "Where have you been anyway?" he yelled.

"I delivered the leaflets, that's all," was the reply.

"How long does it take you to drop leaflets?"

"Drop 'em?" said the pilot. "We were pushing 'em under people's doors."

* * *

Vacationing motorist (to farmer): How far it is to the next filling station?

Farmer: Nigh onto two miles as the crow flies.

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

* * *

The colonel was lecturing a class of ROTC students.

"A 40-foot flagpole has fallen down," he said. "You have a sergeant and a squad of men. How do you erect the flagpole again?"

The students thought, then made suggestions about block and tackle, derricks and so on.

"You're all wrong," said the colonel. "You'd say, "Sergeant, get that flagpole up.' "

* * *

A Scotsman and an Irishman were on board a ship bound for Scotland.

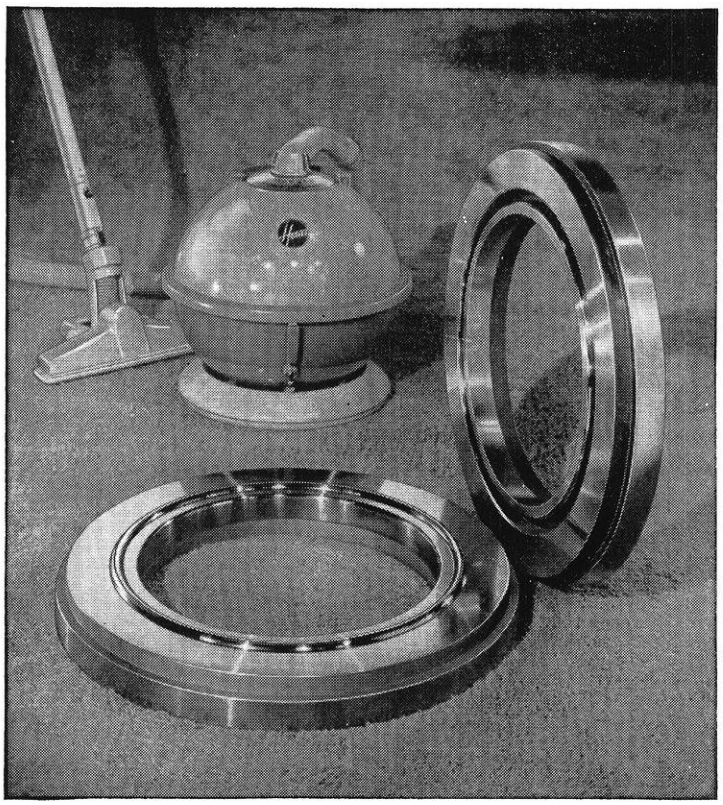
The Scotsman on catching sight of homeland exclaimed, "Hurrah for Scotland."

The Irishman, a bit riled, replied, "Hurrah, Hell."

Scotsman: "That's right, every man for his own country."

Another page for **YOUR STEEL NOTEBOOK**

How to shape a vacuum cleaner like a basketball

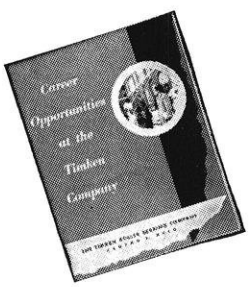


TO make their new vacuum cleaner functional as well as handsome, engineers at the Hoover Company developed a nearly round design. The problem was how to produce it economically.

The first ring dies they used to produce the shape from sheet steel picked up bits of steel and scored following pieces. Production had to be shut down while the dies were polished. Finishing costs ran high.

After studying the problem, Timken Company metallurgists recommended a special analysis of tool steel for the dies. Graph-Mo®, developed by the Timken Company. Minute particles of graphite in Graph-Mo act as a built-in lubricant—keep parts from galling. Diamond-hard carbides in its structure make it wear, give it longer life.

With the new Graph-Mo dies, downtime was cut 50%. Production rolled smoothly. The dies outlasted previous ones 3 to 1. It's another example of how Timken pioneering in fine alloy steels helps solve knotty industrial problems.



Want to learn more about steel or job opportunities?

For help in learning more about steel, write for your free copy of "The Story of Timken Alloy Steel Quality". And for more about jobs at the Timken Company, send for a copy of "Career Opportunities at the Timken Company". Address: The Timken Roller Bearing Company, Canton 6, Ohio.

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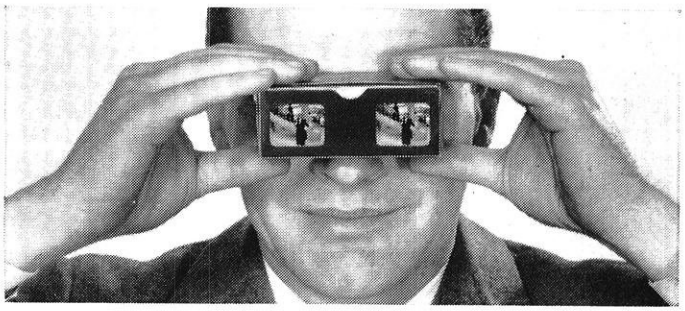

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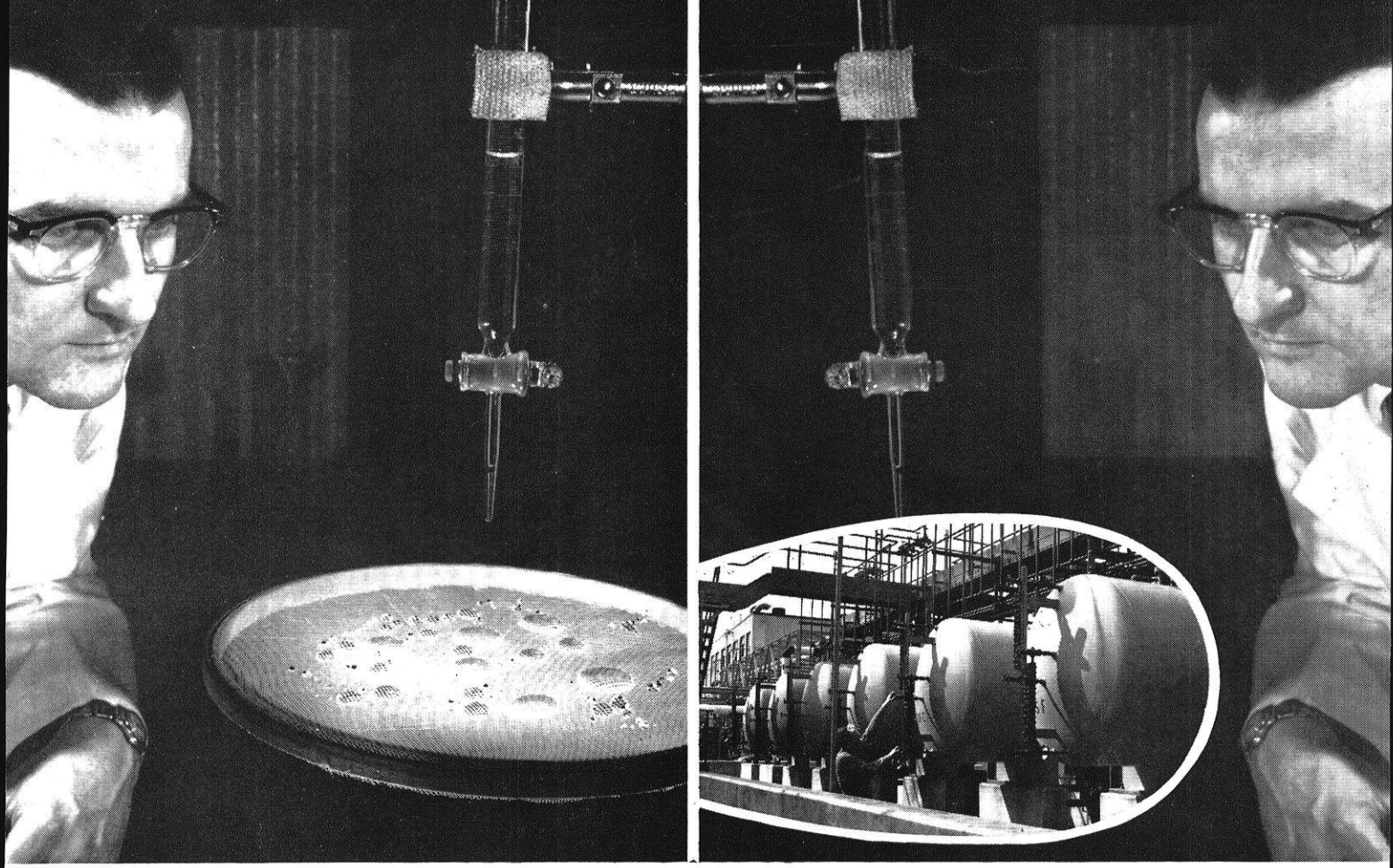

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The development of silicone chemical materials is an example of G-E research being translated into a growing new business. From a laboratory curiosity in 1940, silicone research has evolved into a major business at the Waterford, N. Y. plant. Expansion into the silicone field is just one area where research has opened rewarding careers in engineering, manufacturing, and technical marketing for qualified technical personnel.

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