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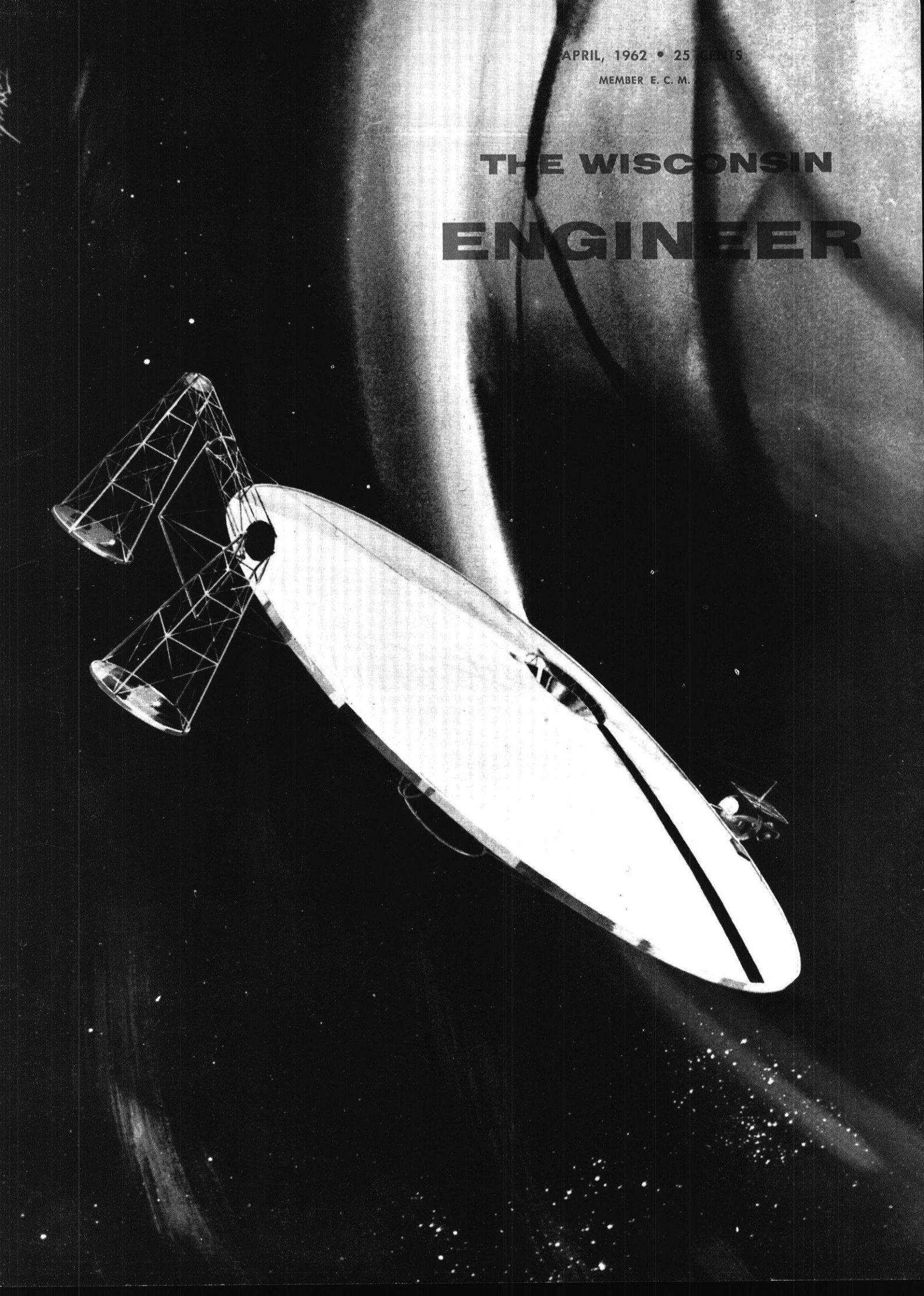
APRIL, 1962 • 25 CENTS
MEMBER E. C. M.

THE WISCONSIN ENGINEER



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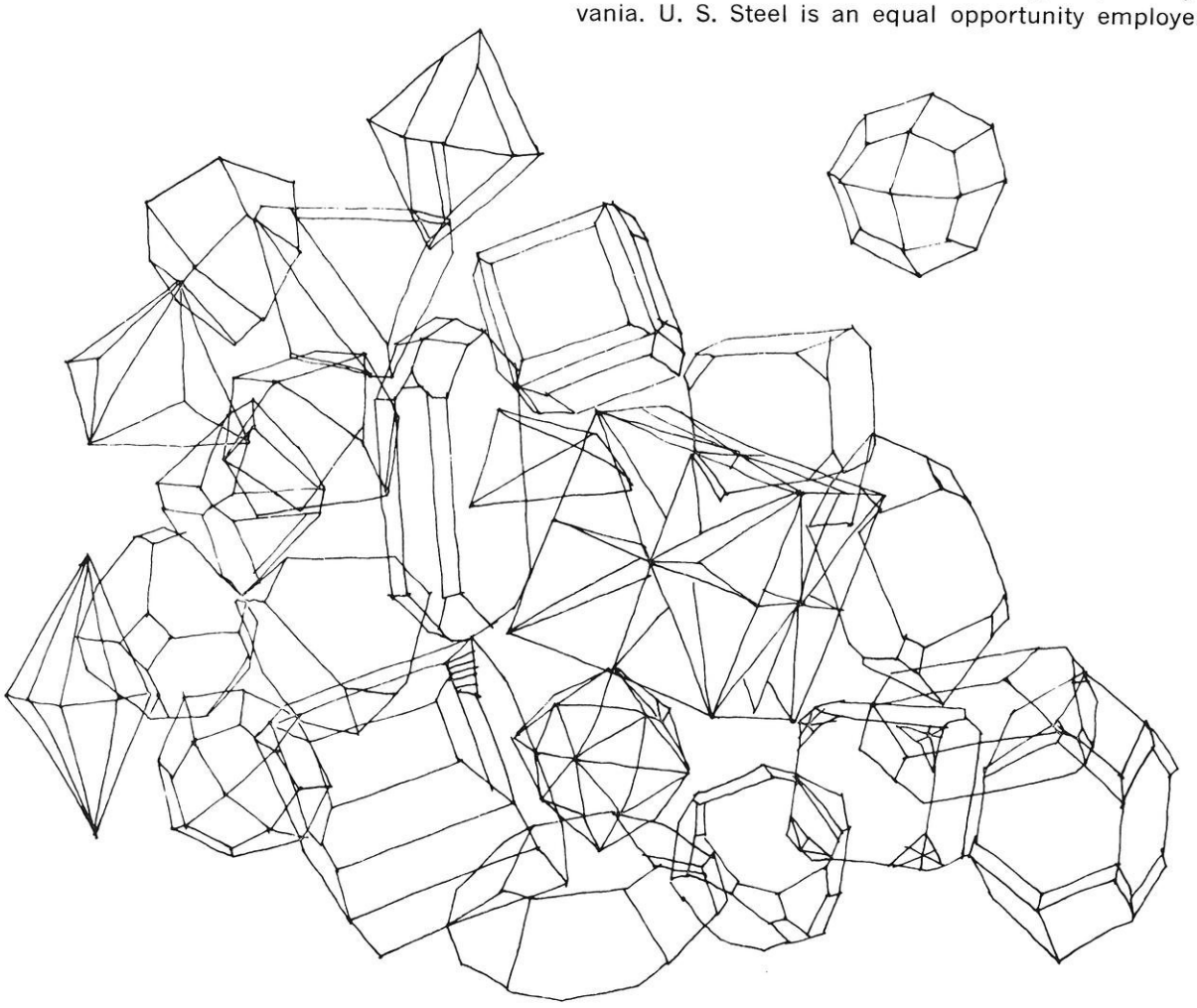

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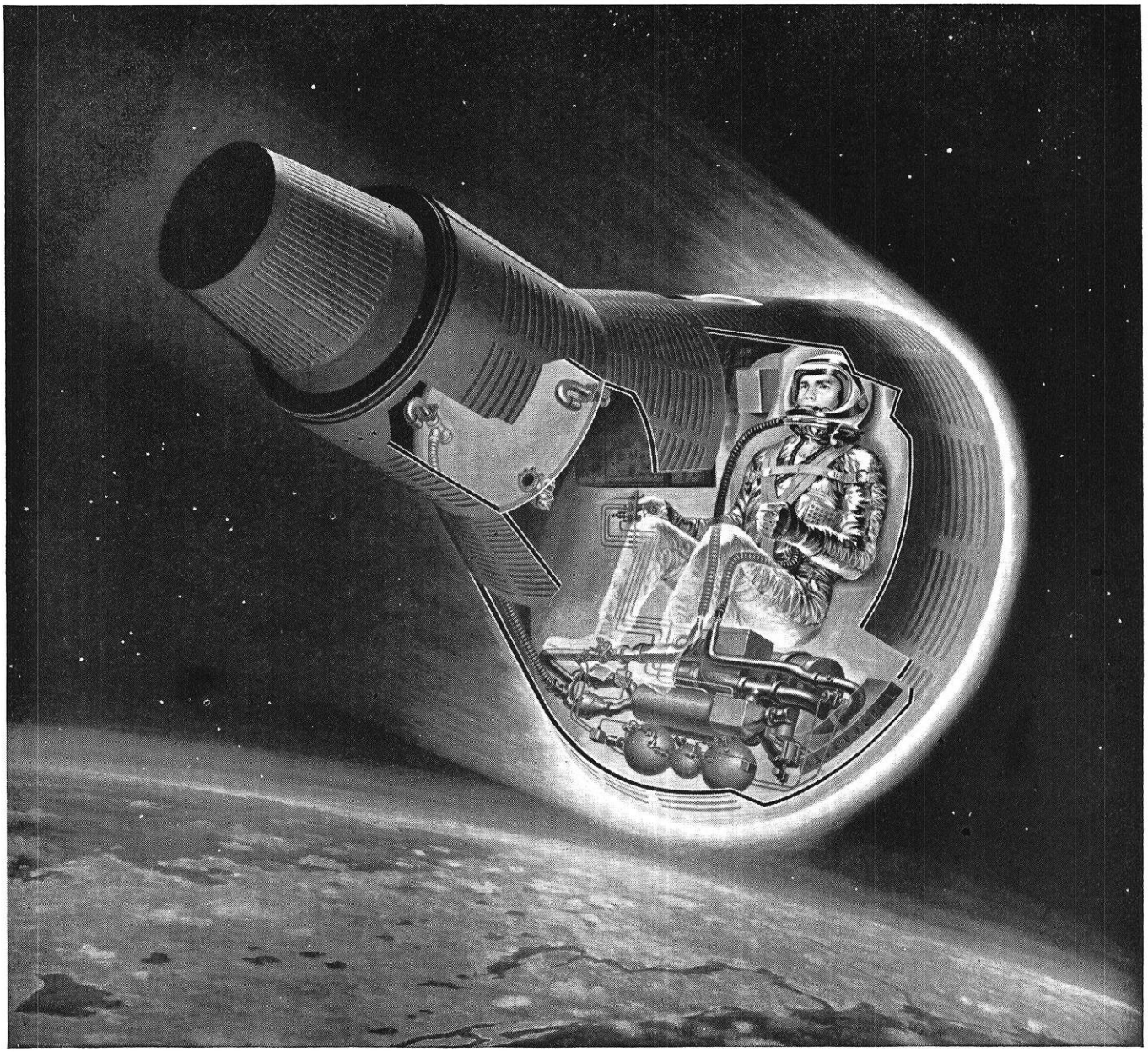

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VOLUME 66, NUMBER 7 APRIL, 1962

ARTICLES

THE WISCONSIN ENGINEER

The Student Engineer's Magazine Founded in 1896

FEATURES

THIS MONTH'S COVER

This is an artist's concept of the "Martian Explorer," fourth mission of the Boeing Company's PARSECS program, or Program for Astronomical Research and Scientific Experiments Concerning Space. The Explorer would be constructed at a station orbiting Earth and would be launched toward the planet Mars to observe the surface of that planet and transmit pictures and data to Earth. —Boeing Airplane Company Photo.

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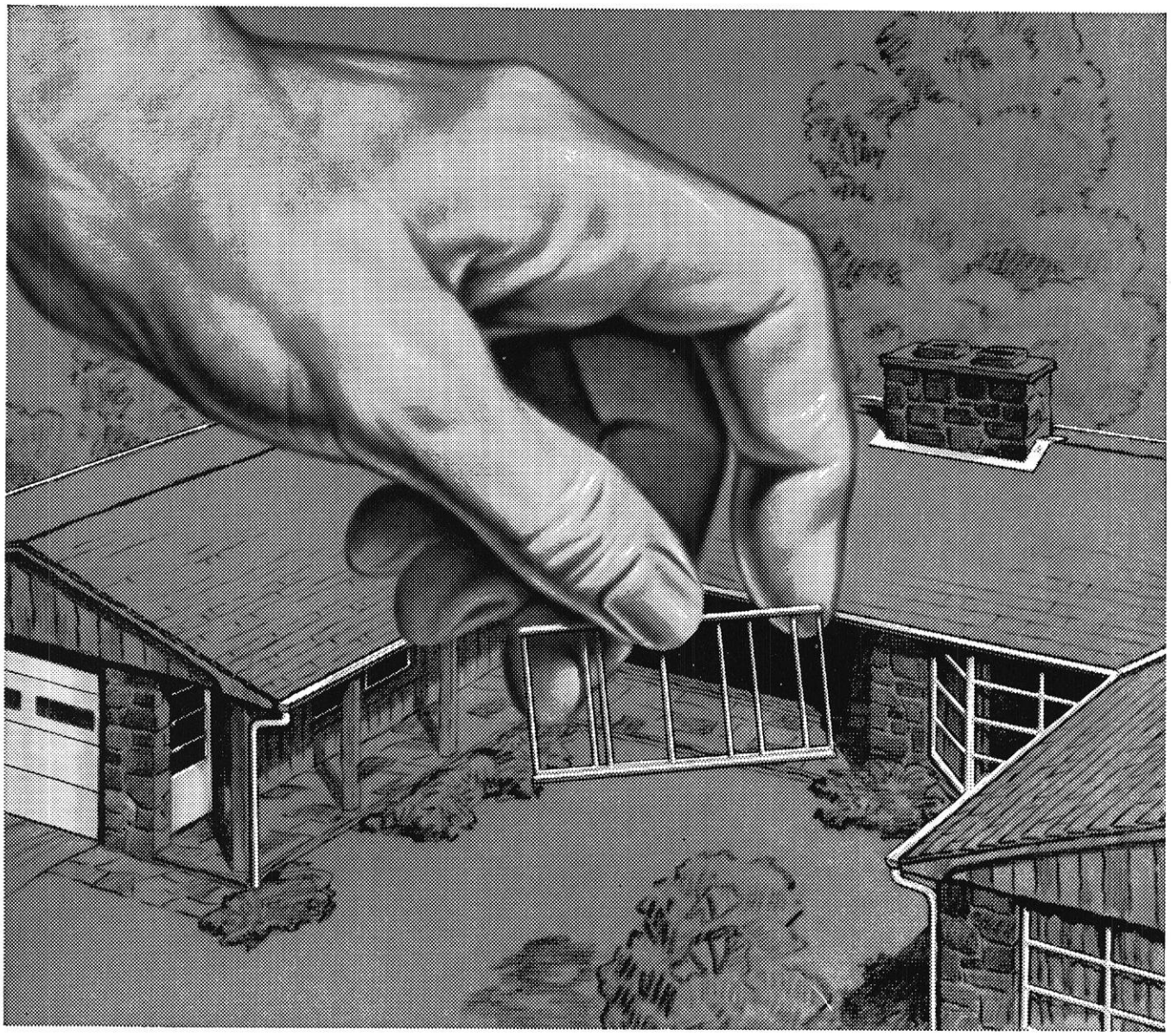

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UNION CARBIDE

...a hand in things to come

CHARLES F. PETERS

After forty-five years of dedicated work to the field of Welding and the University of Wisconsin, Mr. Charlie Peters is retiring. Mr. Peters came to the University in 1916, to teach Blacksmithing and Welding. Nearly thirty years ago the subject of Blacksmithing was removed from the Curriculum and thereafter Charlie devoted full time to the teaching of Welding.

No one knows how many students Mr. Peters has taught Welding to in the past forty-five years but it will run into several thousands. Many well-known engineers stop by the Welding Laboratory each year to renew their acquaintance with a teacher they give credit to for helping to make their engineering career a success. Mr. Peters has taught Welding to students from all Engineering Colleges at the University of Wisconsin as well as the Agriculture College.

His outside interests have included most of Wisconsin's varsity sports. He is an ardent football fan and never misses a basketball game.

As a charter member of The American Welding Society he has missed only one meeting since its beginning in 1954.

We of the *The Wisconsin Engineer* would like to thank him for his contributions to the University and to wish him the best of luck in the future.

Rambling With The Editor

April means many things to many people but to your editor it has special significance. Specifically it is one month from graduation, time for yours truly to hand over his position to next year's editor and also time to reflect over the past school year.

The job of putting out a magazine every months gets to be a drag at times but issues like our December one gives me a lift just as much as I hope it does you. I could apologize for not following up with something as nice or better but I am sure you can understand that that would be quite a task. Incidentally that issue was a sell out.

Looking back over my college career I am glad that I decided to work on the *The Wisconsin Engineer*. The experience I have gained is something that can only be obtained thru participation in an extra-curricular activity. This experience consists of meeting and working with others at a near professional level. Though such an observation may sound trivial to many of you underclassman I am sure that many of my fellow graduating seniors will vouch for its importance.

Participation in an engineering society, fraternity or publication gives you the opportunity to develop leadership abilities and to gain valuable experience in working with others. This sort of participation may comprise the only real asset you have upon which a college recruiter can judge your qualities of leadership. Don't underestimate the importance of outside activities.

I would also like to introduce next year's co-editors: David Cress and Gerald Twentyman. I would also like to thank my staff, Professor Sell, and everyone else who has contributed to the magazine.—Roger Nehrbass.

Electromagnetic Radiation

When a Wave and When a Particle

by R. W. Gerber

ELECTROMAGNETIC radiation behaves sometimes as though it is a group of waves and sometimes as though it is a stream of particles. Since these two modes of behavior are explained by two quite different theories, Maxwell's electromagnetic wave theory for wave behavior and classical mechanics theory for particle behavior, the problem arises of when to consider the wave nature and when to consider the particle nature. Quantum mechanics solves this problem by considering the notions of a particle and a wave simultaneously in a theory of the radiation field and concludes that it is the discontinuous distribution of energy in the field and the uncertainty of the motion of particles of matter that is responsible for the two modes of behavior.

Particle Nature and Wave Nature

An ordinary electric circuit problem and the Compton effect offer illustrations of the wave nature and the particle nature, respectively, of electromagnetic radiation. An ac voltage is applied to a length of wire, as shown in fig. (1).

Maxwell's equations describe a continuously oscillating electric field in the wire which accelerates and deaccelerates the electrons, creating an ac current. For the Compton effect, in fig. (2), a beam of hard, monochromatic x-rays is directed on a scattering material of low atomic number, such as carbon. Experimental evidence shows that the beam does not behave according to wave theory, but instead that it can be considered as a rain of particles. These particles, called photons, are traveling at the speed of light with an energy $h\gamma$, where h is Planck's constant and γ is the frequency associated with the beam. The interaction between a photon and an electron in the scattering material is then treated as a two body problem in relativistic mechanics. From the conservation of energy and momentum theorems, the wavelength of the scattered radiation is

$$\lambda_0 = \lambda_0 + \frac{h}{mc}(1 - \cos\circ)$$

See fig. (2)

which agrees completely with experiment. Furthermore, it is found that the recoil electron and the scattered photon were created at the same time. These two experimental facts demonstrate strikingly the particle nature of the radiation.

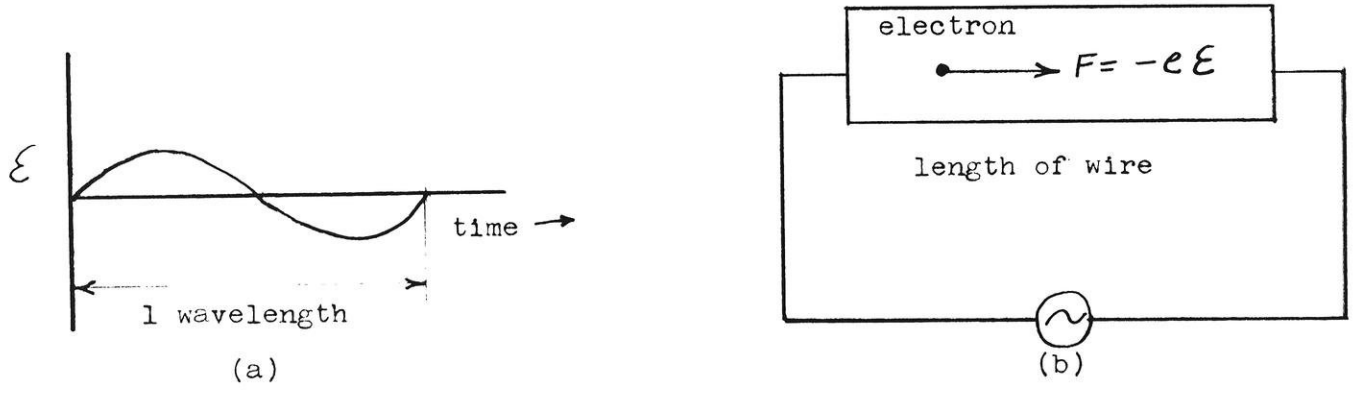

Fig. 1.—Wave treatment of current in a wire. (a) an ac voltage sets up a continuously oscillating electric field. (b) An electron is subject to a force, $F = -e\epsilon$, creating an ac current.

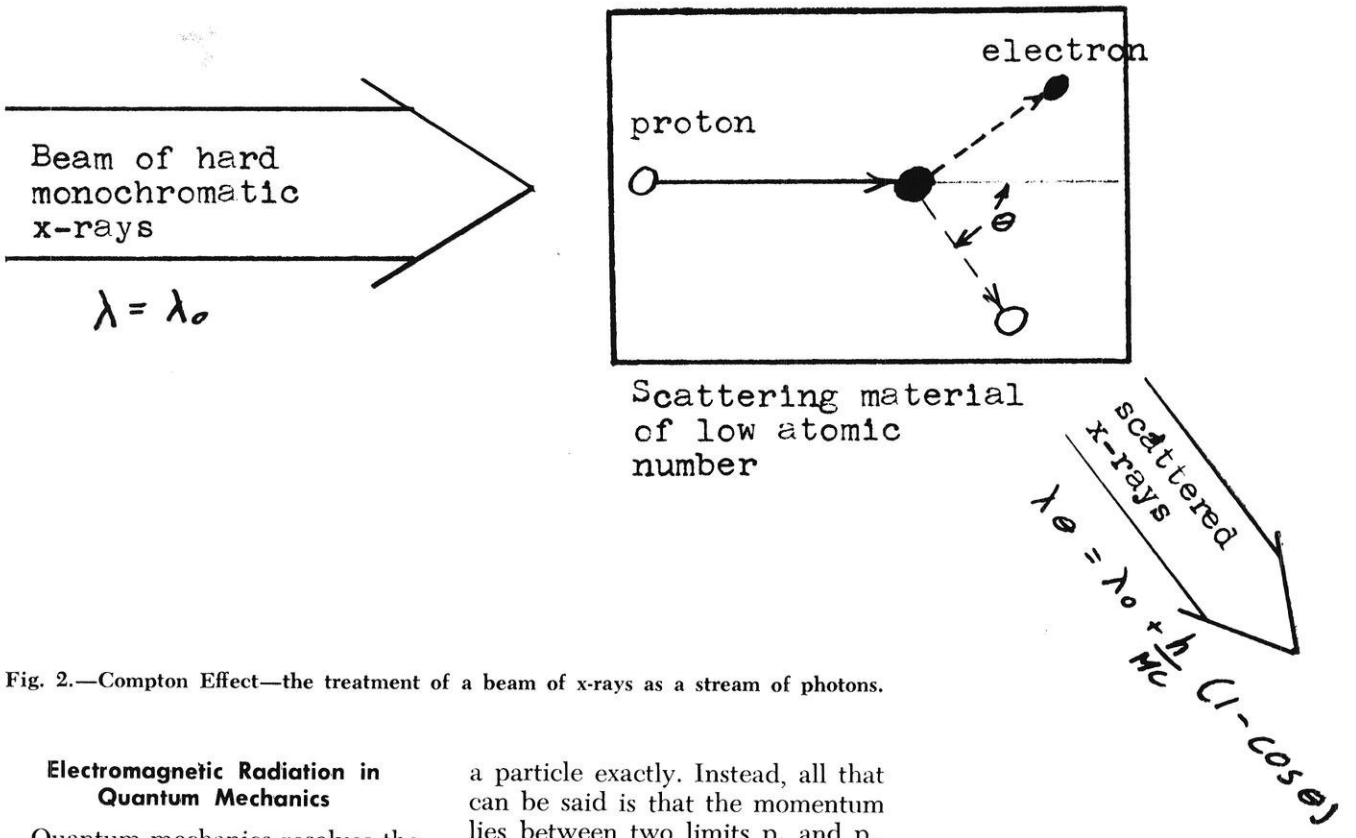

Fig. 2.—Compton Effect—the treatment of a beam of x-rays as a stream of photons.

Electromagnetic Radiation in Quantum Mechanics

Quantum mechanics resolves the two apparently conflicting properties of electromagnetic radiation by considering the radiation as a steam of photons accompanied by a wave. Whenever energy is exchanged between the radiation field and matter, it is exchanged discontinuously, in a finite lump which is called the photon. The energy of the photon is given by $h\gamma$, where γ is the frequency given by the old wave theory as contained in Maxwell's equations. The presence of γ in the photon theory shows an inherent connection between the discontinuous concept of the photon and continuous concept of the wave. In quantum mechanics this connection is provided through the wave which accompanies the photon. The wave is essentially a probability function, whose magnitude at a given point gives the probability that the photon exists at that point. Heisenberg incorporates the concept of probability in his uncertainty principle

$$\Delta p \Delta x \geq \frac{h}{2\pi} \qquad (1)$$

For a general particle in nature, Δp is the uncertainty of its momentum and Δx is the uncertainty of its location. Δp (or Δx for the case of location) represents the impossibility of measuring the momentum of a particle exactly. Instead, all that can be said is that the momentum lies between two limits p_1 and p_2, where $\Delta p = p_1 - p_2$. The uncertainty principle thus limits the precision with which p and x can be measured simultaneously—the more certain that p is determined, the more uncertain that x becomes.

Criteria For Wave and Particle Behavior

The concepts of discontinuity and uncertainty lead directly to the criteria for deciding when the particle nature of electromagnetic radiation becomes important and when the wave nature prevails. In this paper the uncertainty principle as it applies to radiation is ignored, since only its application to matter is essential in determining the criteria. For simplicity the electron is chosen as the representative particle of matter, although the discussion applies to any particle.

From eq. (1) the uncertainty of the momentum of an electron is at least as large as

$$\Delta p_e = \frac{h}{2\pi\Delta x}$$

The momentum of the photon is given by

$$P_p = \frac{h\gamma}{c} = \frac{\lambda}{h}$$

where λ is the wavelength associated with the photon. Consider the photon striking the electron. If the photon is to behave as a particle it must produce a definite, observable effect on the electron. If the effect of the collision can not be detected by experiment, the concept of a collision between two particles has lost all meaning. Thus if the photon is to behave as a particle

$$P_p >> \Delta P_e$$

$$\frac{h}{\lambda} >> \frac{h}{2\pi\Delta x}$$

or $$\lambda << \Delta x \qquad (2)$$

For clear cut particle behavior, the wavelength of the radiation is shorten than the dimensions of the region in which the particle is supposed to be located.

On the other hand when

$$P_p << \Delta p_e$$

only the statistical behavior of many photons is important. Instead of undergoing discontinuous changes in momentum, the electron appears to be accelerated continuously, as though it is reacting to Maxwell's field vectors. For wave behavior

$$\lambda >> \Delta x \qquad (3)$$

or the electron is definitely located within a region much smaller than a wavelength.

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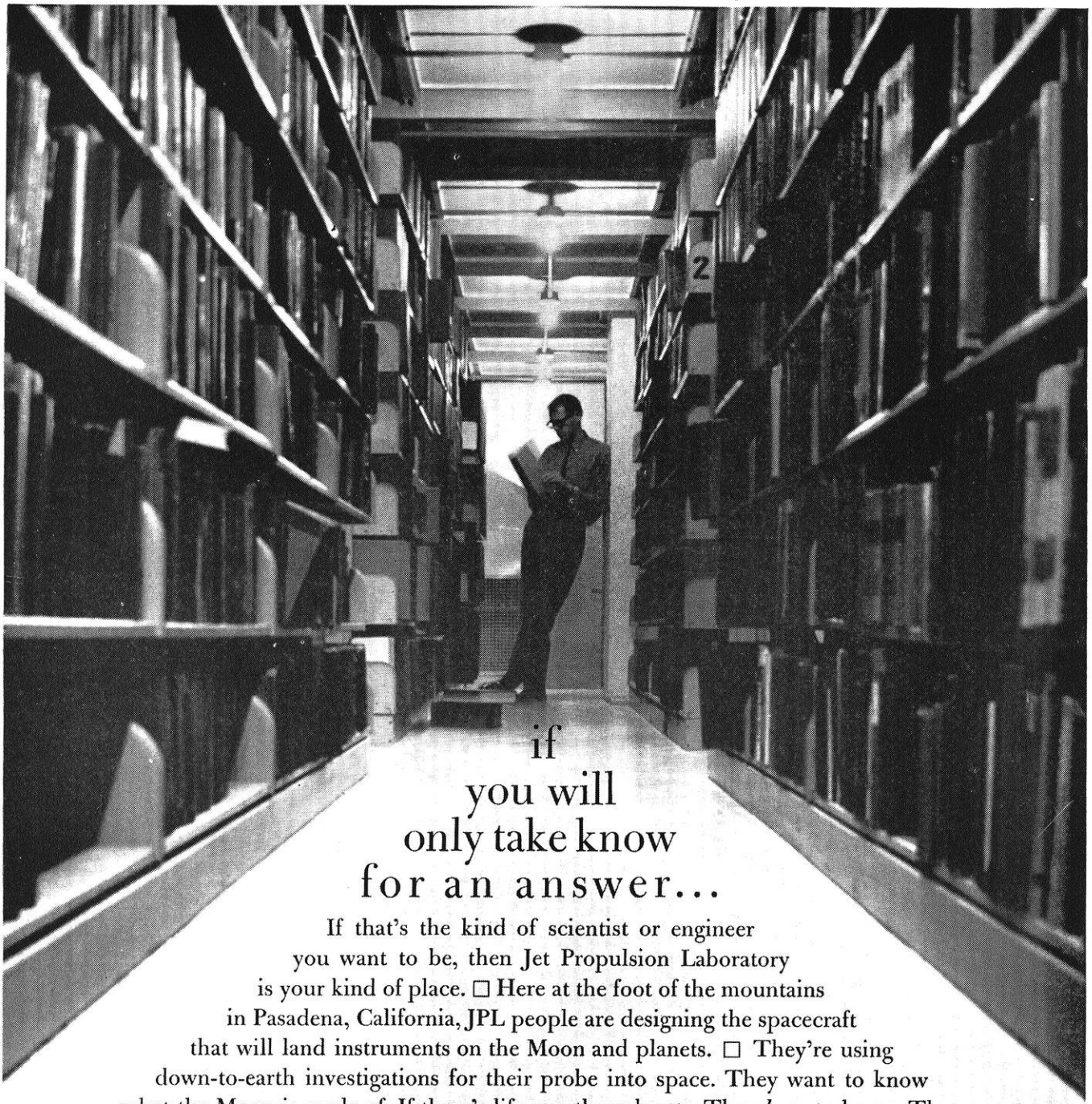

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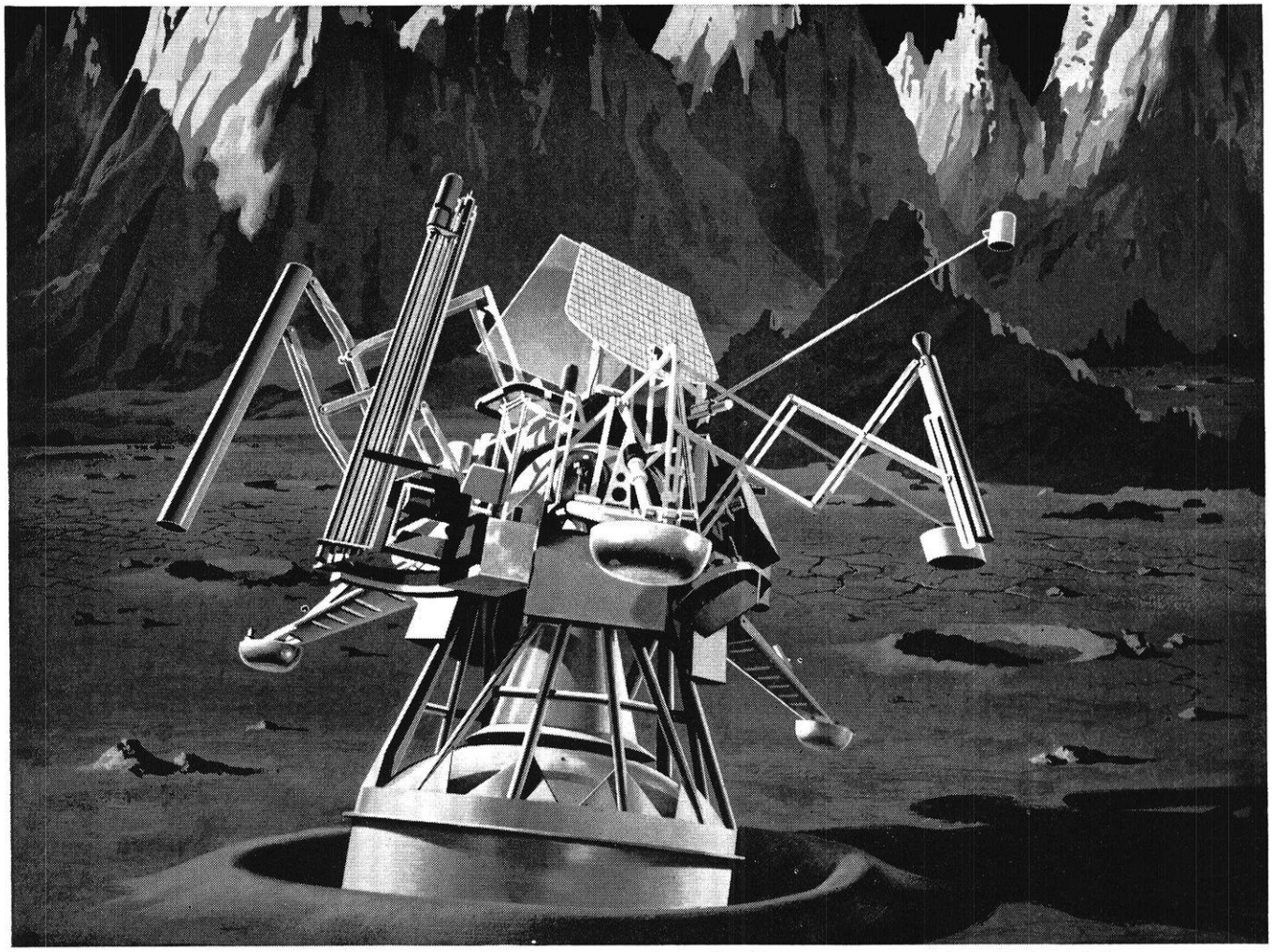
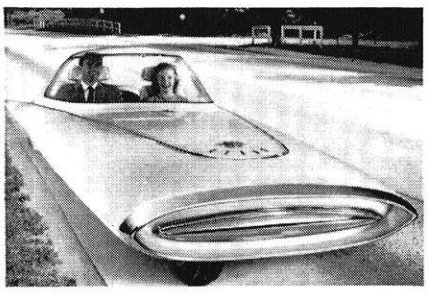
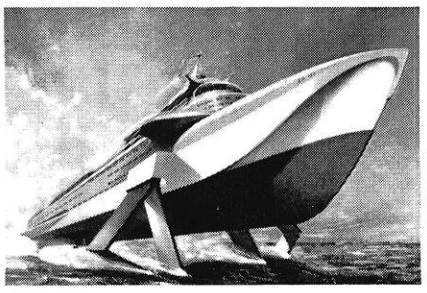


Moon crawler. Early next year, if everything goes according to plan, this spiderlike object — the "Surveyor" — is expected to land on the moon's surface, look at it, feel it, and bite into it. It will have electronic sight and touch more sensitive than a man's, and will transmit to earth direct information on what the moon looks like and what it is made of. What metal will this machine need to survive the moon's extreme cold without getting brittle? What metal can withstand the high temperatures that occur in flight? Engineers will most likely find the answer in Nickel-containing alloys. They offer tremendous resistance to crippling super-cold, stand up in blazing heat.

How Inco Nickel helps engineers make new designs possible and practical



Gyron—dream car that drives itself. A gyroscope would stabilize this two-wheeled vehicle of the future, which envisions automatic speed and steering control. A computer would let you "program" trips on a non-stop highway. For lasting beauty, trim areas would be coated with Nickel-Chrome plating, the bright, corrosion-resistant finish.



Hydrofoil ship—a new concept in seagoing design. Now under development, such vessels are planned to travel 100 m.p.h., skim over the tops of waves like flying fish—lifted aloft by a set of underwater foils, or wings. The metal for these all-important wings? Good bet is a nickel alloy for strength, resistance to corrosion and cavitation erosion.

Whatever his area of exploration, today's engineer knows that Nickel-containing metals can make many new designs perform better. For complex components of a moon surveyor, or the decorative plating of a gyroscopic car, Nickel, or one of its alloys, meets the demands of a wide range of service conditions—makes an excellent choice for products we use today, and for tomorrow's new designs.

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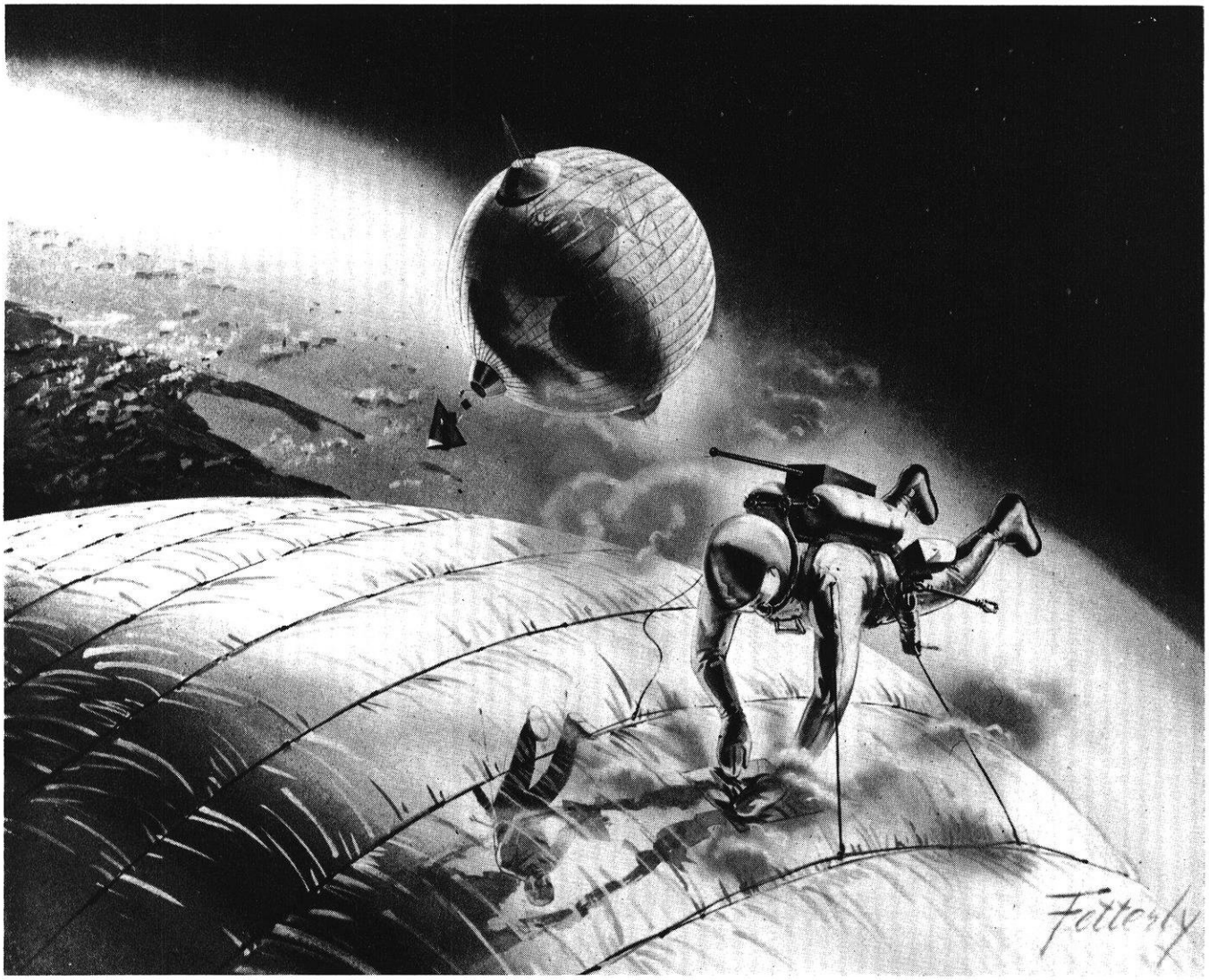

—Boeing Airplane Company Photo

Depicted in this artist's concept are large Earth-orbiting plastic balloons inside of which would be constructed the general-purpose space capsule to be used on the first, third, sixth, seventh and eighth missions of the Boeing Company's PARSECS program, or Program for Astronomical Research and Scientific Experiments Concerning Space. The balloons would contain controlled atmosphere, enabling technicians inside to work without wearing space suits. Atmosphere leaks caused by meteorite punctures would be indicated by the release of colored gases. Such a leak is shown being patched by one man outside and one inside the balloon.

Defining the Space Environment

by William H. Gust

Magnetic Measurements in Space

IT IS generally agreed that the earth is comparable to a bar magnet with poles located in the Arctic and Antarctic regions. While the knowledge of the existence of such a magnetic field is one of the oldest physical phenomena known to mankind, the origin and exact nature of the earth's field can only be postulated.

For several reasons it is very difficult to make an accurate map of the earth's magnetic field. There is superimposed on the main magnetic field a daily variation which is believed to be caused by electric currents in the ionosphere. Magnetic storms and sunspot phenomena also cause some variations in the magnetic field. The recent discovery of the Van Allen radiation belts has led to postulations of currents that could cause magnetic variations at the surface of the earth. The true description of the earth's magnetic field is often masked by the geological irregularities in the earth's crust.

Time correlated magnetic measurements in space and at the earth's surface are needed to establish an understanding of phenomena, and to accurately determine the strength and direction of the earth's magnetic field. Perhaps full understanding will come only with measurements of the lunar field and other planets' magnetic fields. Measurements are now possible based upon the satellite as a research vehicle.

The search coil magnetometer is used to detect and measure the magnetic field intensity. The magnetometer consists of a core wound with 5000 turns of No. 40 copper wire. The coil is mounted so that if the vehicle rotates at two revolutions per second, a cyclical change of flux occurs in the coil which gives rise to a two cps amplitude modulated voltage in the coil. The output of the coil is coupled to a transistorized amplifier tuned to the nominal spin rate of the vehicle. In a uniform and time invariant field, the magnitude of this voltage is proportional to the field component perpendicular to the spin axis of the vehicle. With knowledge of the spin rate of the vehicle and the orientation of the axis of spin, the magnitude and direction of the magnetic field can be determined. The search coil magnetometer has a sensitivity of 10^{-10} webers/meter^2 for a steady field or 20×10^{-10} webers/meter^2 for a varying field.

Once the detection system has been built, it must be calibrated on earth for use in a space environment. The calibration of the magnetometer is accomplished by determining the relationship between a known ambient magnetic field and the coil open circuit voltage. Then the difference in the subcarrier oscillator (SCO) is noted by applying 2cps voltages of different peak to peak values to the coil. Then, since the relation between the open circuit voltage and a known magnetic field is defined, the relation between the transmitted oscillator frequency and the magnetic field is fully defined. Thus the calibration of the search coil magnetometer is completed.

Micrometeorite Impact Rate

Visual and radio observations of sporadic meteor trails in the earth's atmosphere have established the presence in space of small grains of matter ranging in size from a few grams down to 10^{-5} grams. The results of many measurements have indicated that the density of these grains in space is inversely proportional to their mass. Such minute particles provide insufficient ionization in the atmosphere to be studied by radio or optical means from earth stations. Therefore, direct space measurements must be taken to establish the momentum and density spectra of these dust particles. The relatively low density of the micrometeorite population requires a long sampling time in order to make statistically reliable conclusions concerning the interplanetary medium. It is desired to obtain information on the spatial and temporal distribution of micrometeorites in both the high and low momentum levels. This information will indicate whether the particles in each momentum range are uniformly distributed or whether they occur in localized regions of space. Also, the information will help to determine whether or not fluctuations in the density of particles are correlated with the occurrence of meteoric showers as observed on the earth.

The detection system which has been successfully used for the Pioneer series space probes consists of a diaphragm and a microphone pickup, three stages of amplification, detection and logical circuitry. This system separates the micrometeorite flux into high and low sensitivity channels according to the momentum level. A particle striking the diaphragm will transfer its entire momentum (mass times velocity) inelastically to the diaphragm, and the 100kc/s component of the resulting impulse is picked up by a microphone containing a piezoelectric crystal which rings at this frequency. The pulse is then amplified and the resulting envelope modulation is detected. After detection, the pulse triggers a Schmitt trigger circuit, causes a change of state in a flip-flop circuit and charges a step counter which will modulate the SCO. High momentum particles will be detected after only two stages of amplification, whereas the low momentum signal needs the extra stage of amplification before it can be detected. The detection and logic circuitry is similar for the high and low momentum channels.

The detection system was calibrated by dropping small glass spheres onto the diaphragm and noting the modulation of the SCO. The mass and velocity of the glass spheres was determined and therefore the momentum was defined. The threshold level of the system (below which there is no noticeable detection) was found, and therefore the minimum detectable momentum level was determined. By direct observation of the SCO modulation, the momentum spectra can be analyzed.

Radiation Field Intensity

The hazards of manned space flights are quite numerous. However, the problem of providing a man in space with surroundings similar to those encountered on earth (correct air composition, temperature etc.) can be overcome. One potential hazard from which man cannot be effectively protected is radiation. Initial space probes have indicated a belt of high energy radiation surrounding the earth. Since severe biological damage to man or any living organism could result from exposure to a radiation field, data is needed to determine the levels of radiation. Once the types and intensities of radiation prevalent in space are ascertained, it will be possible to study the biological effects of most of these radiations in earth laboratories. The sensor used measures the total energy loss within a given volume, this being the closest approximation to measuring the biological effect of penetrating radiation in a non-biological experiment. The experiment will determine the relative abundance of the different species of charged particles and will indicate their distribution.

The sensor used is called an Ion Chamber. The ion chamber has a movable vane suspended by a silver plated quartz fiber. The capacitance between the electrode pairs is a maximum when the vane is fully meshed with the electrode pairs. If the vane is electrically charged and ionizing radiation enters the chamber, the vane looses some of its charge and turns out

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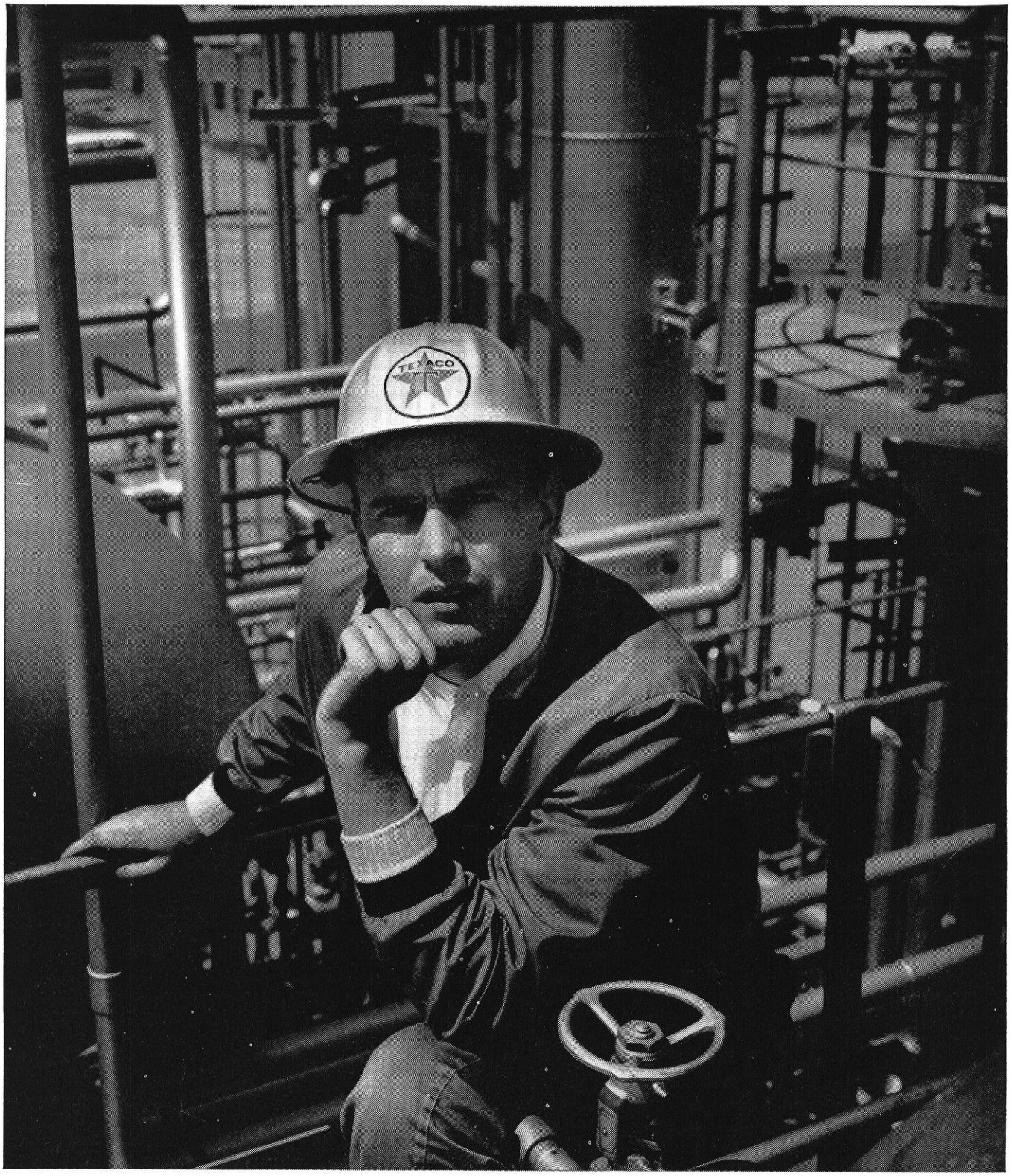

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A MESSAGE FROM KEARFOTT TO DOCTORAL CANDIDATES WHO WILL BE RECEIVING THEIR DOCTORATES FOR STUDIES EITHER IN ENGINEERING OR SCIENCE DISCIPLINES WITHIN THE NEXT FEW YEARS.

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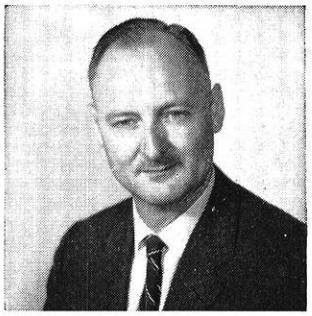

Dr. R. C. Langford, Director of the new Kearfott Research Center, has joined Kearfott after 18 years as R&D Director in a major electronics corporation. He was graduated with a Doctorate as a Swan Research Fellow from the University of London. He is senior member of IRE, a founder member of the American Nuclear Society and a member of the American Rocket Society. An author of technical articles and lecturer, he has also been a member of a U.S. Government committee analyzing Russian accomplishments in the electronic and solid state fields.

Your interest is enlisted in a new scientific community entirely concerned with scientific and technical investigations; totally divorced from administrative or development duties.

Studies will be related as closely as possible to urgent needs of government agencies, determined through personal consultation with their representatives. Particular (but not exclusive) emphasis will be placed on problems bearing on navigation, guidance and control of upper atmosphere, space and undersea vehicles, areas where Kearfott has long held a leadership position in the development of systems and components.

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Radiation Sciences — to increase understanding of plasmas, wave propagation; to fully explore energy conversion, infrared technologies.

Astrospace Environments — to study natural phenomena in order to provide a more perfect understanding of environmental boundaries of space systems.

Hydraulics & Pneumatics — to provide a fuller understanding of fluid technology in dynamic systems.

Guidance & Navigation — terrestrial and celestial — to develop a broader comprehension of the needs of future systems.

Physics — specialists in modern materials research pertaining to solid state, fluid, magnetic and dielectric materials.

Chemistry — to develop and extend range and application of organic materials. Activity will be in both materials and processes.

Metallurgy — to serve as authority on metallurgical properties of modern materials — function-wear, defect propagation and anelasticity.

▶ *Please write Dr. Langford at length about your interests and past work. Copies of thesis or papers will be appreciated — and returned, if desired.*

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Analysis of an Asphalt Athletic Running Track

by D. K. Kussow

RECENTLY a new type of athletic running track has appeared on the market. It has a resilient surface made of an asphalt composition. The University of Wisconsin completed construction of such an asphalt running track a year and a half ago. It was the second of its type in the world and the first in a northern climate. They have had absolutely no frost problem and according to Thomas Bennett, assistant track coach, "it has proven satisfactory from every standpoint".

BASIC DESCRIPTION OF NEW ASPHALT TRACK

With the production of the new asphalt surfacing materials has come new techniques for their application in the construction of athletic running tracks. Much of the procedure is the same as the asphalting of tennis courts, school playgrounds, etc. The grading, construction of forms, and laying of sub-base and macadam base are done according to normal construction procedures. Very little will be said about these processes, as good construction companies are very familiar with them.

Athletic running tracks have always been made of cinders and the approaches of cinders or clay. Differing radically in both appearance and structure is the new asphalt running track. It is made largely of two new surfacing materials—Grasstex and SAF-PLA—both of which are layed on top of the previously mentioned bases.

Grasstex has a fibrous asphalt composition. Because the company that makes Grasstex does not di-

An aerial photograph of Wisconsin's asphalt track.

vulge its constituents, a good assumption would be that it contains a fibrous hemp impregnated with an asphalt. This composition makes for a very resilient and durable surface layer. As Grasstex is primarily an asphalt composition, it requires the same basic procedures in its application as used in most asphalt work. It can be obtained from the F. C. Feise Company.

SAF-PLA is a pre-treated rubber crumb, mixed with asphalt. It consists of rubber pellets specially coated to prevent absorption of an asphalt binder, and therefore remains compacted and adherent to its base. This rubberized surfacing material is designed to eliminate injuries from falls. The application of SAF-PLA is a very new procedure requiring methods dissimilar from those used in most asphalt work. Consequently, details of its application will be discussed. SAF-PLA can be obtained from the U.S. Rubber Reclaiming Company.

The running track is built up over a compacted sub-base, depending upon climatical and soil conditions. Requirements for this sub-base can be determined from local state highway departments. The principle layers of the track that follow are:

1. a 6 inch asphalt penetration macadam base
2. a ¾ inch stone filled asphalt sheet leveling surface
3. ¼ inch GRASSTEX
4. ⅛ inch SAF-PLA

When completed, the hard-surface asphalt track has the appearance of a smooth asphalt road. A first impression is that it is just as hard, but softness or spring can be felt by pressing down on the surface with the thumb. A definite "give" can be felt.

ADVANTAGES

When this new surfacing was introduced several years ago, it immediately placed the cinder track in secondary importance. This new track is so superior in every way to the old cinder type that no comparative disadvantages can be found. Its advantages are numerous. These advantages lie in competition, construction, and maintenance. The only consideration necessitated by this new track is a new track spike for competition shoes. This spike is discussed in the appendix.

Competition

The most interesting advantages of this new track to the athletes who use it are its early use in the spring and consistent fast condition. The track is ready for use as soon as it is free from snow. Since all lanes and the various start, finish, and hurdle lines are painted on, the entire track is ready the first day of practice. No time is lost waiting for the surface to dry or for the chalking of lanes, etc. Once the track is ready for use, it remains that way. Where a cinder track was unusable for days after a hard rain, this new track is ready for action only a few minutes after the heaviest rain.

Sure footing combined with good traction on a level surface makes the new track extremely fast. What is even more important is the fact that it remains fast in all types of weather. The all-weather surface provides the necessary consistency to running conditions, so conducive to better performance.

Very important to the athlete is the way in which his legs react to the running surface. Because the rubberized or fibrous asphalt composition provides a very resilient running surface, it is easy on the legs. The very definite "give" to the track prevents the soreness to the legs and feet so often present in hard cinder tracks.

Construction

Cinder and clay running tracks always had undesirable construction characteristics. Their acceptance has been through necessity. Clay and cinders are difficult to obtain and expensive to process. Even more difficult is the construction of a good cinder track. It takes time. A good, fast cinder track needs plenty of time to settle and form a compacted running surface. This often takes a couple of years of time and hard work. The new asphalt track eliminates all this. The constituents of this new track are easy to obtain. Their cost compares favorably with those of a top quality cinder track. Of even greater value is the short time it takes to build a good, fast asphalt track. As soon as the construction is finished, the track is ready for use and in excellent shape. No lengthy periods of time are needed for the track to reach top condition. The completion of construction assures an excellent running surface.

Maintenance

Possibly the biggest advantage of the new track lies in its maintenance. Very little is required. Where a cinder track needed a continual rechalking of lanes and starting and finishing lines, the new track needs none, as all of the lanes, etc. are painted directly on the surface immediately following construction. They are permanent. Between track meets, a cinder track needs to be rolled as its surface became loose and chopped up. An asphalt track needs no attention. The only attention that it needs is after large holes are punctured in the surface, as, for example, when starting blocks are dropped or when a hurdle is knocked over. Such holes are easily repaired with a fluid bituminous material called "weather coating". To fill in holes, it is poured on the track, squeegee fashion, across the damaged area to permit filling. The entire track is surfaced with this "weather coating" upon completion of construction.

GENERAL CONSTRUCTION PROCEDURE

Asphalt running tracks follow a construction procedure similar to all asphalt work involving playgrounds, tennis courts, etc. The only variations of the work occurs during application of the new surfacing material, SAF-PLA.

Sub-Base

The sub-base area should be well drained and thoroughly compacted —all roots, sod, mulch, etc. removed. New fills should be allowed to settle. As has been stated before, the compacted sub-base of any track depends on climatical and soil conditions, which most local state highway departments will be happy to determine.

Wooden Forms

The construction of wooden forms follows the usual procedure. However, a word of caution can be

(Continued on page 26)

Architect and Consulting Engineer: J. & G. Daverman Co., *General Contractor:* Beckering Construction Co., *Heating, Air Conditioning Contractors:* Holwerda-Huizinga Co. and Vander Wall-Troske Co.

STEELCASE, INC. ... A Synthesis of New Ideas

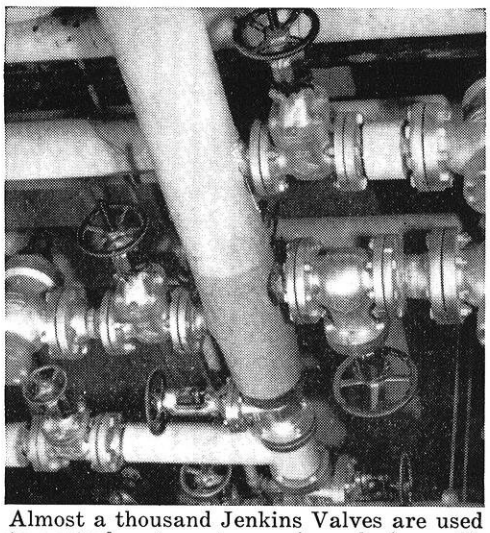
But for control of piping systems ...
time-proved JENKINS VALVES were specified

Widely noted for its imaginative styling of office furniture, Steelcase, Inc. required that its new quarter-mile long home be the epitome of newness and originality.

Architects and builders answered with many interesting design features. Typical are: Factory windows set above twelve-foot walls to gain flexibility in placement of equipment. Large bays with masonry walls that reduce use of structural steel. Composite steel frame and concrete slab floors, usually associated with bridges.

Perhaps only one "old" idea was followed in building this ultra-modern million-plus square foot facility. In choosing valves to control the piping systems, everyone involved asked for JENKINS VALVES. They wanted the time-proved dependability, long-life and low-cost service that the specification *"Jenkins"* always assures.

EXPERIENCED building men and plant engineers commonly call for Jenkins Valves. Experience shows they *cost less to use ... but no more to buy* than any good valves. For information or assistance with valve problems call in your local Jenkins Distributor. Or write JENKINS BROS., 100 Park Ave., New York 17.

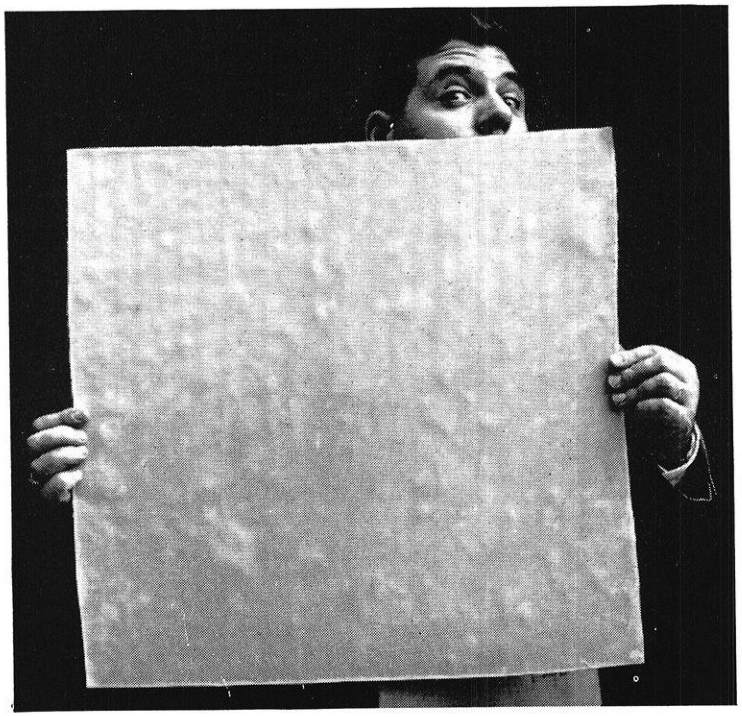


Almost a thousand Jenkins Valves are used to control water, steam, air and air conditioning pipelines.

JENKINS
MOST TRUSTED TRADEMARK IN THE VALVE WORLD
VALVES
JENKINS SINCE 1864
Jenkins Bros

Available from Leading Distributors Everywhere

Our new plastic stops a 30-cal. bullet cold (he hopes)



That plastic sheet is a scant 5/8" thick. But it'll stop a bullet in its tracks. Splaaaat.

Our model is actually one of the inventors, John J. Aclin. He knows it's infallibly bulletproof (but still finds the concept a bit hard to believe). It does work. Really. And the plastic scales in at 1/7 the weight of steel.

In addition to our bullet-stopping plastic, we're working on quite a few other "unbelievable" projects.

Like converting common clay into alumina (already a laboratory reality, now in the pilot plant stage).

Like a shotgun barrel made by winding 500 miles of glass fiber around a thin steel liner (now bagging its share of game around the world).

Like developing more powerful liquid missile fuels (will Olin's hydrazine get us to the moon?).

And getting back to Earth, a chemical agent that arrests grass growth (a long range project that lawn owners are rooting for).

Because we're moving so rapidly, promising graduates enjoy unique career opportunities with Olin. Research gets a healthy budget and research people, a healthy climate.

Most of our research facilities are consolidated in the new Olin Research Center in New Haven, Conn. Where scientists, engineers and technicians work with the men, the equipment and the responsibilities that can bring them to full potential quickly.

For further information on career opportunities, the man to contact is Charles M. Forbes, College Relations Officer, Olin Mathieson Chemical Corporation, 460 Park Avenue, New York 22, New York.

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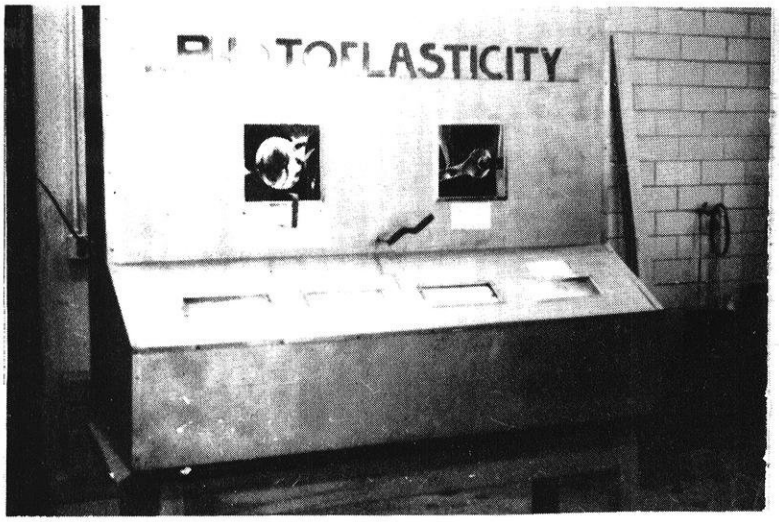

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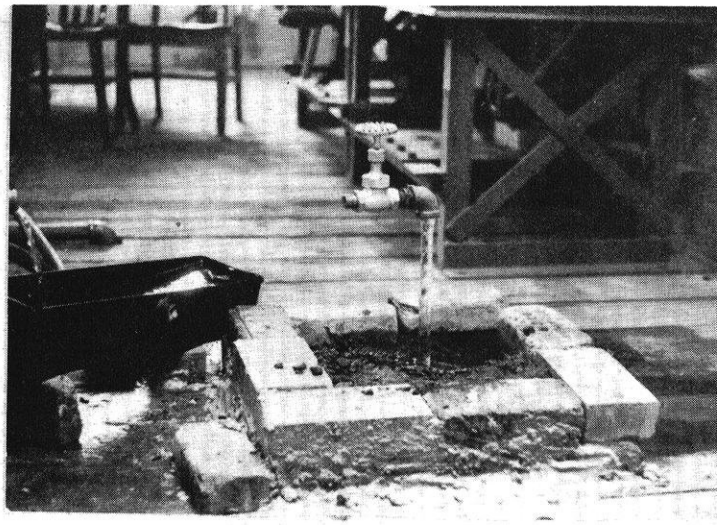

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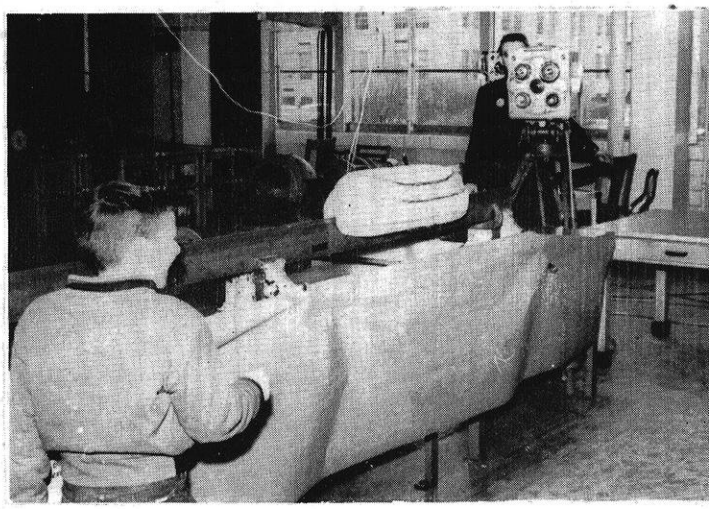

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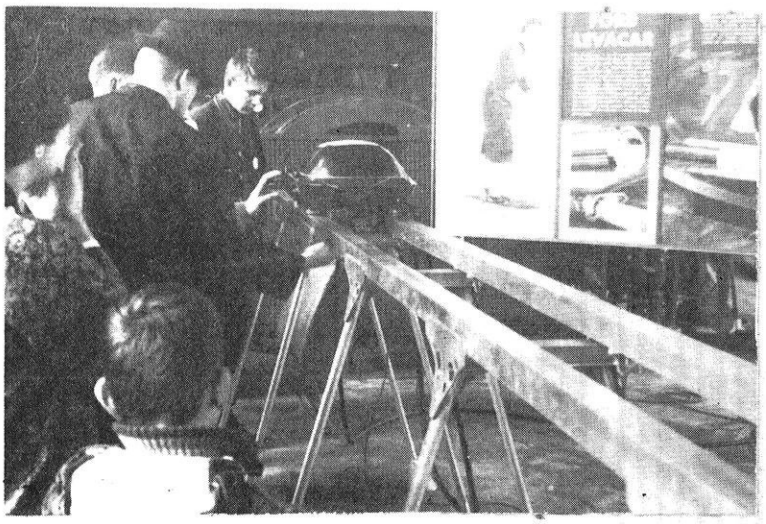

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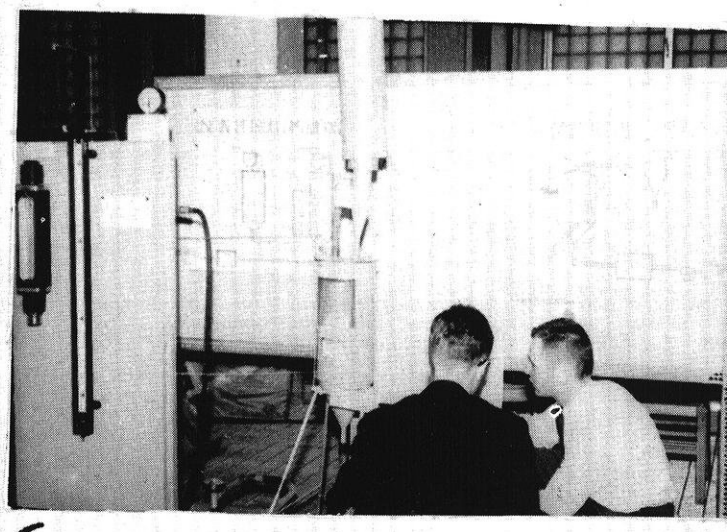


6

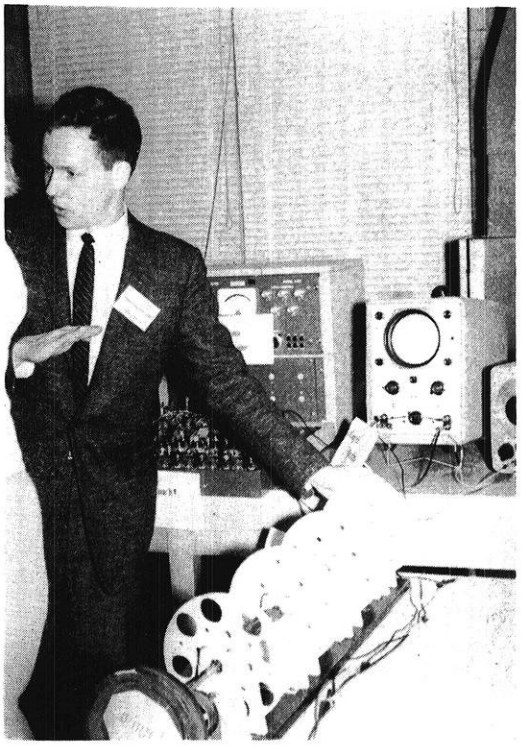
ENGINEERING EXPOSITION 1962

"Engineering For Peace Power" was the theme of this year's show. The show was the biggest ever and drew over 12,000 people which was a new record.

Friday was High School Day and the students also set a new record of attendance, with over 1,000 attending.

The Exposition got its start when the Lawyers lost their spunk in the then annual brawls and egg-throwing to determine if St. Pat was an Engineer or a Lawyer. The Engineers decided on a more profitable showing and the Exposition was born.

The first Exposition was in 1939 and a second followed in 1940. With the start of WW II the Exposition was forgotten and not brought back again until 1953. It was then set on a triennial basis and has been held every three years since.



PICTURES

THIS PAGE

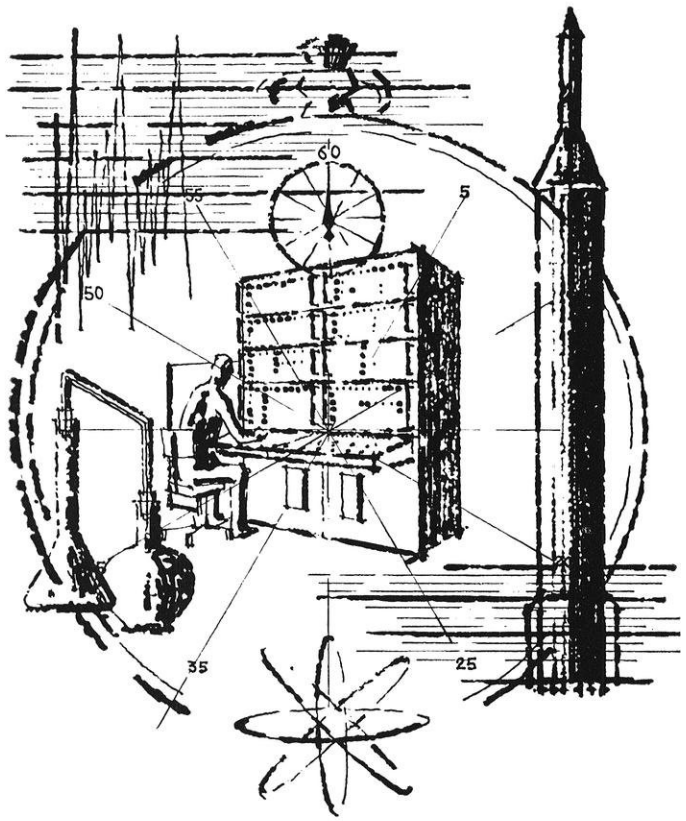
Mathew Myszewski is shown explaining how the Analog Computer simulates the mechanical system shown.

NEXT PAGE

1. *The use of Polarized light to show stress concentrations on a plastic model subjected to varying forces.*
2. *Magic Tap. Water flowing from the tap with no visible means of being connected to a source.*

   How does it work?
3. *These two girls are frying hot-dogs in a pan with ice about the edge, not shown is the coil below it. The exhibit was called "Demonstration of Magnetic phenomenon and its uses in heating", by Triangle Fraternity.*
4. *Linear Motor Powered Monorail by James Mavrogenis and Dennis Krueger. The model monorail is run by a motor which is part in the moving model and part in the track.*

   Shown in the background is the T.V. camera and cameraman sponsored by the U. of Wis. T.V. Laboratory. Persons viewing the Linear motor and T.V. Camera were on T.V. There was a large monitor set off to the right of the camera.
5. *"Leva-Car" by Ford Motor Co. Supported by a cushion of air, the Leva-Car is propelled along the track used to guide it vertically and horizontally. The propelling force is air released through jets at the rear of the car.*
6. *Drying of a granular material with heat and air under pressure. Shown here removing the moisture from table salt by the warm, dry air flowing upward through the material.*



SCIENCE HIGHLIGHTS

by John C. Ebsen 3A'64

SPACE FREEZER

Brig. General Don Flickinger, Air Research and Development Command (ARDC) Surgeon and Assistant for Bio Astronautics, announced the successful completion of the test of the equipment man must have to live in space. The test was conducted at ARDC's Wright Air Development Division (WADD) Aerospace Medical Laboratory, Dayton, Ohio.

Mr. Witting described the thermoelectric space refrigerator as composed of two main sections—a chill area operating at 40 degrees Fahrenheit and a larger freezer area operating at zero degrees Fahrenheit. The freezer is divided into eight compartments each of which has nine small sub-compartments for food storage. Each compartment stores one day's food supply, with the eighth acting as a spare. Like the freezer, the chill area is divided into 24 small sub-compartments. This design permits the food to be closely contained inside the refrigerator. In a conventional refrigerator, under the zero gravity conditions of orbital flight, the food would float around in the space inside the food storage compartments.

The new space refrigerator was developed at the Westinghouse new products laboratories under sponsorship of ARDC, USAF, by a team of engineers under the direction of J. D. Meess and in cooperation with Dr. Robert Hayes, WADD engineer in charge of the in-flight feeding equipment aboard the ARDC test capsule. The thermoelectric elements were fabricated at the Westinghouse semiconductor department, Youngwood, Pa.

WHAT'S IN A NAME?

Soon after missiles were developed, an anti-missile missile was produced to ward off enemy projectiles. Now, the U. S. is planning an anti-anti-missile missile missile, reveals *American Machinist/Metalworking Manufacturing*. The small missile would be installed in a large missile to shoot down enemy anti-missile missiles.

SPOT-CHECK ROULETTE

By placing white and black marbles in a gum-dispensing machine, a Houston, Tex., plant is leaving it up to chance to pick cars that will be spot-checked at closing time, Factory, McGraw–Hill publication, states. As a car approaches the gate, a guard works the gum lever, if a black marble comes out, the car is checked; if white comes up, the car is waved on.

A PRIZE FOR WHEELCHAIR

A prize of $5,000 is being offered for the invention of a wheelchair that allows handicapped persons to get around industrial plants and climb stairs unaided, reports *Product Engineering*. The prize was donated by a private citizen but the contest itself is sponsored by

the President's Committee on the Employment of the Physically Handicapped and the National Inventors Council.

The high frequency transistor was developed at Bell Laboratories by R. E. Davis, C. A. Bittmann, and R. J. Gnaedinger. The work was supported in part by the U. S. Army Signal Research and Development Laboratories under Contract No. DA 36-039 SC64618. The amplifier circuits were developed by V. R. Saari, R. J. Kirkpatrick in conjunction also with Messrs. Bittmann and Davis.

LENS DESIGN PROBLEMS SOLVED BY MATRIX ALGEBRA

The National Bureau of Standards has developed under the sponsorship of the U. S. Air Force an improved method that employs matrix algebra in designing optical lenses.[1] In this method, devised by O. N. Stavroudis of the Bureau's optical instruments laboratory, a system of partial differential equations defining optical image formation is written in the form of 4-by-4 matrices. The form of these matrices suggests a new method of designing lenses.

The greatest stumbling block to the lens designer is the difficulty of correlating the aberrations of an optical system with such parameters as the curvatures, separations, and thicknesses of the lenses and the indices of refraction. Thus the design of a lens is ordinarily a trial-and-error process, where values are assigned to the parameters, rays are traced, and the results are used to assign values representing the aberrations.

In the improved method, the aberrations of a lens can be defined in such a way that their relationship to the parameters is explicit. Here the elements of the 4-by-4 matrix represent the total aberrations of an optical system. If X is such a matrix, and the optical system represented by X has two components, then $X = X_1X_2$, where X_1 and X_2 are the X matrices for each of the components. Each X can be further split into additional components. This splitting can go on until the ultimate components are reached; these are (a) a refracting surface with which is associated a "refraction matrix X_R", and (b) the space between two refracting surfaces with which is associated a "transfer matrix X_T".

Most optical systems consist of spherical surfaces separated by homogeneous isotropic media (glass and air). In this case X_T depends on two parameters, the distance between two successive surfaces and the index of refraction of the medium between them, and X_R depends on the curvature of the surface and the index of refraction of the two media on either side of the surface. Thus the X matrix describing the total monochromatic geometric aberration of an optical system can be represented by a product of X_R and X_T matrices.

This principle can be used to set up a matrix equation whose solution is the design of a lens meeting certain prescribed requirements. Describing these requirements in terms of an X matrix and then setting it equal to a product of X_R-type and X_T-type matrices results in the required equation. Such an equation in 4-by-4 matrices is equivalent to a system of 16 simultaneous scalar equations. By assuming rotational symmetry and by making use of the system of differential equations mentioned above that apply to all optical systems, the complexity of the equations of conditions may be reduced.

[1] For further technical information, see Lens design: a new approach, by O. N. Stravroudis, J. Res. NBS 63B, No. 1, p. 31 (July-September 1959). Part of this work was performed at the Imperial College of Science and Technology and included in a thesis submitted to the University of London.

Das Ist Verboten!

At a World War II navy center for training radar operators, we once saw a wall—excuse us, a bulkhead—covered with dials, buttons and switches that controlled a collection of bells, buzzers and lights. A sign read: "Now hear this! If you must twist dials, push buttons or pull switches, do it here. When you get inside, keep your hands off the controls!"

Today, according to the Insider's Newsletter of Washington, this sign is posted outside the computer room of the Los Alamos national laboratory's accounting office:

"Achtung! Alles Lookenspeepers. Das computenmachine is nicht fur gefingerpoken and mittengraben. Ist easy schnappen der springenwerk, blowenfusen, und poppencorken mit spittzensparken. Ist nicht fur gewerken by das dummkopfen. Das rubbernecken sightseeren keepen hands in das pockets —relaxen and watch das blinkenlights."

Sol was startled one morning to hear his son say he was being converted to Christianity. He rushed over to his friend Isaac's house to ask for advice. "Isaac! he cried. "Vot can I do? My son is turning Christian."

"Funny you should say that," Isaac replied. "My son too is turning Christian!"

Greatly agitated, the two ran over to Abraham's. "Abraham!" they shouted. "Vot can ve do? Our sons are turning Christian!"

"Funny you should say that," said Abraham. "My son also has told me he is turning Christian."

The three distraught fathers rushed over to see old Jacob. "Jacob!" they howled. "Our sons are turning Christian!"

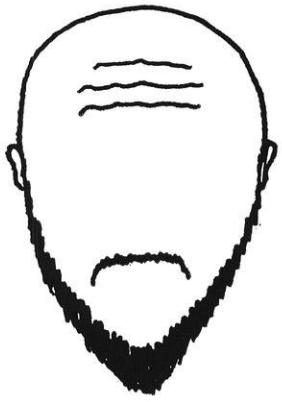
"Funny you should say that!" exclaimed Jacob. "My son has turned Christian too!"

They all ran in desperation to the rabbi. "Rabbi, rabbi!" they screamed. "Our sons are all turning Christians!"

"Funny you should say that!" remarked the rabbi. "My son this morning is also turning Christian." "Vot can ve do?" they asked.

"Let us all go into the synagogue and pray," the rabbi counseled. So they all went into the synagogue and lifted their faces while the rabbi prayed, "Father, vot can ve do? Our sons are turning Christian!"

And from the heavens a great voice thundered, "Funny you should say that . . .!"



BRAIN BUSTER

by L. L. Chambers

Every Sleer is just like every other Sleer. Every Usagle is just like every other Usagle. A Usagle is 20 per cent larger than a Sleer.

One Sleer and one Usagle can combine to form something different, a Broch Gowd. However, every Broch Gowd must be surrounded with at least two Sleer and one Usagle in order to exist. These Sleers and Usagles can act as surroundants for at most two Broch Gowds.

All Jellex contain Usagles. A Jellex is smaller than a Wry Tibbit. Twenty-five Sleer can just fill a Wry Tibbit. If the contents of a Wry Tibbit are combined with the contents of a Jellex, what is the maximum number of Broch Gowds in the final mixture?

* * *

Suppose a passenger rocket leaves Earth for Planet X every day at noon. At precisely the same time a rocket leaves Planet X for Earth. Each trip lasts exactly 132 hours (six days). How many rockets from Planet X will each rocket from Earth meet? Start counting from the instant before the Earth rocket takes off until the instant after it lands on planet X.

Rich Mr. Vanderford buys a bottle of very old French brandy in a liquor store. The price is $45.00. When the store owner hands him the wrapped bottle, he asks Mr. Vanderford to do him a favor. He would like to have the old bottle back to put on dispaly in his window, and he would be willing to pay for the empty bottle. "How much?" asks Mr. Vanderford. "Well," the store owner answers, "the full bottle costs $45.00 and the brandy costs $40.00 more than the empty bottle. Therefore, the empty bottle is . . ." "Five dollars," interrupts Mr. Vanderford, who, having made a lot of money, thinks he knows his figures better than anyone else. "Sorry, sir, but you can't figure," says the liquor dealer and he was right. Why?

* * *

An EE speaks the truth three out of four times, and ME, twice out of three, and a ChemE, once out out of nine times. The EE asks the Chem E whether anyone passed the last Physics quiz. Then the ME says that the EE has affirmed that the ChemE denies that everyone flunked. Physics department records show that an average of one out of every 5 students pass Physics quizzes. If ten students took the test, what are the chances that no one passed.

* * *

3. A young British nobleman was left a treasure map by his great uncle, who had been an explorer. It told of an island, on which there stand only two trees, an oak and a hickory. The oak lies 400 yards due east of the hickory. The map also showed a gallows on the island. The instructions were as follows: "Begin at the gallows and walk to the hickory tree; turn 90 degrees to the left; walk one-half the distance you walked from the gallows to the hickory and place a marker. Start at the gallows again; walk to the oak tree; turn 90 degrees to the right; walk one-half the distance you walked from the gallows to the oak and place a second marker. The treasure is buried half-way between the markers."

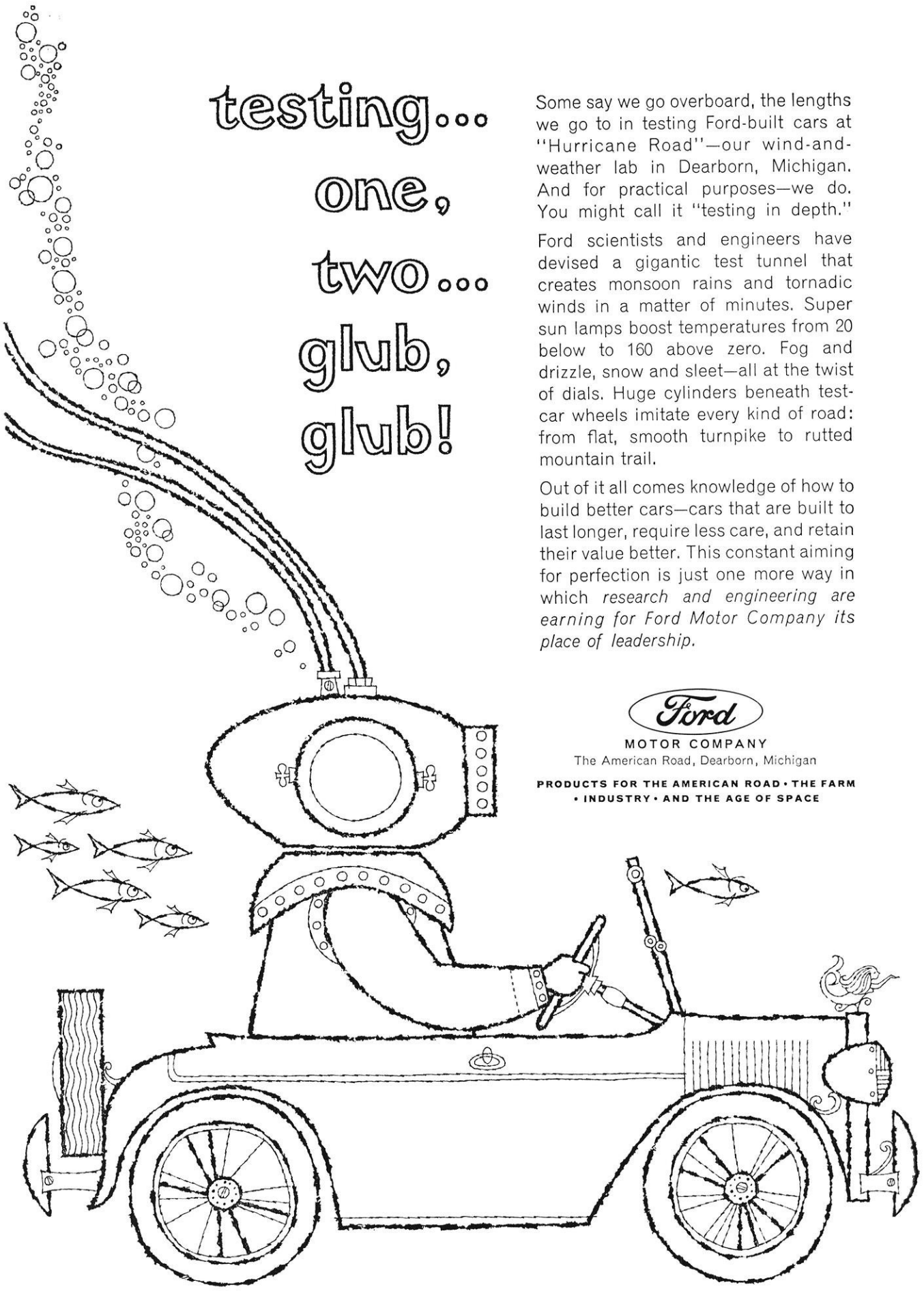
The young man proceeded to the island, which he easily found. The two trees were standing as shown on the map. However, the gallows had long since rotted. The nobleman dug holes all over the island but could not find the treasure. Had he been a Wisconsin Engineer, he should have been able to find the treasure using a little algebra and the complex plane.

testing... one, two... glub, glub!

Some say we go overboard, the lengths we go to in testing Ford-built cars at "Hurricane Road"—our wind-and-weather lab in Dearborn, Michigan. And for practical purposes—we do. You might call it "testing in depth."

Ford scientists and engineers have devised a gigantic test tunnel that creates monsoon rains and tornadic winds in a matter of minutes. Super sun lamps boost temperatures from 20 below to 160 above zero. Fog and drizzle, snow and sleet—all at the twist of dials. Huge cylinders beneath test-car wheels imitate every kind of road: from flat, smooth turnpike to rutted mountain trail.

Out of it all comes knowledge of how to build better cars—cars that are built to last longer, require less care, and retain their value better. This constant aiming for perfection is just one more way in which *research and engineering are earning for Ford Motor Company its place of leadership.*



Ford

MOTOR COMPANY

The American Road, Dearborn, Michigan

PRODUCTS FOR THE AMERICAN ROAD • THE FARM • INDUSTRY • AND THE AGE OF SPACE

Electromagnetic Radiation

(Continued from page 9)

For the two examples given on pages (2) and (3), eqs. (2) and (3) are easily seen to be satisfied. For ordinary circuit problems the electron can be represented as a point with respect to the wavelength of the radiation, as illustrated in fig. (1). This obviously satisfies the relation $\lambda >> \Delta x$ for wave behavior. For the Compton effect the electron is effectively located inside the diameter of an atom. Since λ for hard x-rays is much smaller than the atomic diameter, the relation $\lambda << \Delta x$ is satisfied for particle behavior.

Theories Used to Describe Electromagnetic Radiation

Eq. (2) describes the criterion for particle behavior of electromagnetic radiation. However, the concept of the photon as a particle must not be interpreted too broadly, for there is a fundamental difference between the photon and a particle of mass. When described mathematically, a photon behaves according to Bose-Einstein statistics, where a particle is assumed to have complete symmetry. Ordinary particles of mass obey Fermi-Dirac statistics, where a particle has only half symmetry. Furthermore the photon has a velocity equal to the velocity of light, while a particle of matter is limited by relativity to much lower velocities. To completely describe the behavior of the photon as a particle, quantum mechanics is required.

When λ is the same order of magnitude as Δx, electromagnetic radiation possesses some of the characteristics of a particle and some of the characteristics of a wave. Again, only quantum mechanics can be used to analyze the situation.

When eq. (3) is satisfied, however, electromagnetic radiation behaves exactly as predicted by Maxwell's wave theory, since for this situation quantum mechanics reduces to a statistical consideration of the radiation. To the electrical engineer eq. (3) is extremely important, since it defines the limts within which he can apply Maxwell's theory.

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Defining The Space Environment

(Continued from page 13)

of the space between the electrode pairs. (This is because the air between the plates becomes ionized and therefore loses its' insulating properties). A change of the vane position decreases the vane-electrode capacitance and will increase the frequency of the oscillator to which the chamber is coupled. The change of capacitance through vane movement produces a frequency increase of

$$\triangle F = \frac{\triangle C \cdot f_o}{2 C_T}$$

Where C_T Equals the total frequency controlling capacitance, and where f_o is the operating frequency.

To summarize then, this method uses the ionization currents of the ion chamber to vary the reactance of a frequency determining network of a high frequency oscillator. Then, in accordance with the signal strength, the reactance variation will produce a frequency modulation impressed on the SCO. The operation of the ion chamber requires a minimum leakage of the charge when not exposed to radiation. The use of teflon or polyethylene for suspension of the quartz fiber and the moving vane reduces the leakage so that the frequency drift is only a few cps per hour. This is an important factor since frequency drift can be misconstrued to mean there is radiation entering the chamber and would lead to erroneous results.

The calibration of this detection scheme was accomplished by obtaining graphs of current vs. SCO output at different temperatures. Then the chamber was taken to the University of California where a Cobalt 60 bomb was used to irradiate the chamber with known doses of radiation. The SCO output was recorded and therefore, for a given SCO output, the radiation rate could be determined.

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Running Track

(Continued from page 17)

given. While frost may not get to the track itself, it can do some damage if all the wooden forms are not removed. If left in, they can do serious damage in two ways. First, since the track drains to the outside edge, even a slight raise on it would tend to hold water on the track. Second, they could possibly break the base of the track.

Macadam Base

Using familiar construction techniques, a base, preferably of asphalt penetration macadam of six inches thickness, is layed. On top of this is a ¾ inch leveling course of hot-laid plant-mix such as stone-filled asphalt sheet. A slope of 1 inch in 10 feet toward the outside edge should be maintained for drainage.

Grasstex

A tack coat of RC-2 is now applied prior to the laying of Grasstex. The Grasstex is then layed following procedures used in asphalt work and rolled to a thickness of ¼ inch. Care must be taken to see that the surface is uniform throughout its area.

SAF-PLA

The SAF-PLA rubberized surface is the final layer of the track. It is applied over the Grasstex composition. Application should be by a contractor. The vehicles used are a small mortar or concrete mixer to mix the treated rubber crumb with cutback asphalt, a 3 to 5 ton roller, wheelbarrows, rakes, and brooms.

The first step is the application of a tack coat (RC-2) to the base surface. It must be uniformly spread by a squeegee or sprayed over the base.

The mixing of the rubber crumb with cutback asphalt comes next.

Only small mixes should be used at one time. A typical formula for a four square yard area is:

SAF-PLA ..... 50 lbs. i.e., 1 bag
RC-2 ..... 3 U.S. gallons
Solvent Mix (Stoddard) ... 3 U.S. pints

Stoddard is the solvent used in making RC products. Stoddard naphtha is preferred over gasoline because of its higher flash point and better workability. It can be obtained at any asphalt supplier or refinery. The mixing time should be held to 15–25 seconds and the mixed material should not be allowed to stand.

The third step is the application of a course mixture of SAF-PLA. It should follow immediately after the mixing period. The simplest and easiest method is to use an ordinary rake. Raking should be to a ½ inch thickness, in 3 to 4 foot widths. A concrete float can be used immediately after raking to eliminate surface irregularities.

Following the application of the SAF-PLA comes the first rolling. The first rolling should be a single pass using clean, wet rolls. Tight turns and abrupt changes in direction should be avoided. The roller must be power driven and weigh from 1 to 5 tons. It should not be left standing on the area at any time.

Next comes the application of fine SAF-PLA. The material must be applied dry, brooming in uniformly. It should be permitted to set for at least one-half hour before final rolling.

Final rolling must be done very thoroughly. While the surface is being rolled, the SAF-PLA surface material should be broomed until it is well incorporated in the surface. Dry rolls should be used. Thorough rolling is extremely important to obtain a firm, compact, weather-resistant surface. The seal coat or "weather coating" is finally applied by brushing or spraying. This completes the surface of the track.

After 48 hours, boundary lanes and all lines can be applied. Twenty-four hours after all necessary painting, the holes for starting blocks can be made. The starting blocks are held in place by thin wall piping set 6 inches deep and approximately 6 inches back from the starting lines. The size of the pipe depends on the pin size of the block.

A Fad and a Sport

by Jeff Baxter

Platteville State College

WALKING, running, or jogging along to places miles remote seem to be the latest fad of college students to get publicity for themselves and their schools. A University student walked from the Capitol to the Courthouse in Milwaukee. A Lakeland student jogged from Plymouth to Milwaukee. Both were successful in making the front page.

However, college students aren't the only ones who walk. There is a man in my home town, West Bend, Wis., whose college days were over 35 years ago, but who has been walking 25 to 65 miles many weekends for several years. He does not do it for publicity, for he likes to walk. His name is Bob Lauson and he has an office supply store in West Bend. It is his enjoyment and also a source of some pride to him that he is able to walk his age fifty-nine and even more miles.

He has had some trouble at times trying to convince those on the highways that he prefers to walk instead of taking a ride. The traffic officers have been his chief hazard. For example the one who forbad him "to set foot on the pavement" in spite of the fact that he was half way to Milwaukee from West Bend and his shoes were developing holes.

Then, there was the officer who regarded him suspiciously when he rested under a tree and who wouldn't believe him when he said he was walking from West Bend to Milwaukee for fun.

At one time he had a hard time trying to convince a policeman that the stick with a knob on the end was not the weapon used in a club murder in Milwaukee the night before.

But Bob is a philosopher and studies people and their reactions to his simple sport. When he sees a high hill in front of him he says to himself, "That is like a big job in life. Take it a step at a time and you will get there." And soon he has reached the top.

He had never had a reputation as an athlete in his younger days, but people like to see this rather slight middle aged man walking the highways around West Bend, bound for Appleton, Milwaukee, and surrounding towns during the weekends and singing or whistling some of his favorite tunes that were popular in the twenties when he was a University student.

Fill in your Own Lines

by Ronald Neder

Three notices in a small rural newspaper tell their own story:

April 10th: "For sale: Practically new farm wench in excellent condition. Call 742-R2. Mr. A. Broder."

April 15th: "Correction: Due to an unfortunate error, Mr. Broder's ad last week was not clear. He has an excellent winch for sale. We trust this will put an end to jokesters' calling Mr. Broder and greatly upsetting his housekeeper, Mrs. Smith, who loves with him."

April 20th: "N O T I C E! My w-i-n-c-h is not for sale. I put a sledge hammer to it. Don't bother calling 742-R2, as I have had the phone taken out. I am not carrying on with my housekeeper, Mrs. Smith; she merely l-i-v-e-s here. Signed A. Broder."

* * *

Mottoes

Freshman Girl: "Mother knows best."

Sophomore Girl: "Death before dishonor."

Junior Girl: "Nothing ventured, nothing gained."

Senior Girl: "Boys will be boys."

* * *

Co-ed: "Where did you learn to kiss like that?"

M. E.: "Siphoning gas."

* * *

The plumber was introducing his new assistant to the niceties of the trade.

"Above all," he said, "you must exercise politeness and tact."

The assistant allowed as how he understood about politeness but, "what is tact?"

"Well, son," he replied, "it's this way. If you walk into a bathroom to fix a pipe and a young lady is in the tub, you close the door and say, 'Beg your pardon, sir.' The 'Beg your pardon' is politeness. The 'sir' —that's tact."

* * *

Prof: "That's five times this week that you failed to turn in your assignments. Do you have any comment?"

Bruce: "Yes, sir, I'm sure glad it's Friday."

* * *

A bathing suit—like a barbed wire fence—is designed to protect the property without obstructing the view.

* * *

A sorority is a group of girls living in one house, with a single purpose . . . to get more girls to live in one house, with a single purpose.

* * *

What's the difference between a sewing machine and girl running for a bus?

A sewing machine has only one bobbin.

* * *

An I.E. was discovered by his wife one night standing over his baby's crib. Silently she watched him. As he stood looking down at the sleeping infant, she saw in his face a mixture of emotions that she had never seen before—rapture, admiration, doubt, despair, ecstacy, incredulity. Touched and wondering alike at his unusual parental attitude and the conflicting emotions, his wife, with her eyes glistening, arose and slipped her arm around him. "A penny for your thoughts," she said in a tremulous voice.

He blurted them out: "For the life of me, I don't see how anybody can make a crib like that for $3.49!"

* * *

The dam burst, and the raging flood forced the townspeople to flee to the hills.

As they gazed down sadly at their flooded homes they saw a straw hat float gently downstream for about fifty feet. Then it stopped, turned around, and plowed slowly upstream against the rushing waters. After fifty feet, it turned and moved downstream again. Then upstream again.

"Say," said one of the townsfolk, "what makes that hat act so durn funny?"

"Well, I ain't sartin' sure," spoke up a youth, "but last night I heard Grandpa swear—come hell or high water he was agonna mow the lawn today."

* * *

A lovely coed named Loretta
Loved wearing a very tight sweater;
Three reasons she had:
Keeping warm wasn't bad
But the other two reasons were better.

* * *

A controversial figure is when you're not sure how much of a girl's shape came from a store.

Then there was the Army wife whose husband had been in the South Pacific for three years. She started receiving letters from him in which he told of the beautiful South Sea Island belles, and of their growing fascination for him.

Worried at this, she went to her physician for advice. "Well," said the doctor, "There is a chemical that can be introduced into a man's food to lessen his natural emotions. Here's a prescription; get some of this and put it into some cookies or candy, then send it to him and see what happens." The wife got the chemical and wishing to be certain, put a triple dose of it into some cookies, which she sent to her husband.

She didn't get another letter from him for seven months. When a letter finally arrived, she opened it hurriedly with trembling fingers. The letter began: "Dear Friend . . ."

* * *

"Joshua, will you put down that blasted trumpet and fight like the rest of us."

* * *

St. Peter and God were playing golf one day. St. Peter teed off and hit a long drive straight down the fairway. God hit his into the rough; all of a sudden a rabbit picked up the ball in his mouth and started running toward the cup.

An eagle appeared out of nowhere, picked up the rabbit with the ball still in his mouth, and started to fly toward the cup. When he was just about over the cup a bolt of lightning struck him, knocking him and the rabbit to the ground, whereupon the ball fell out of the rabbit's mouth and rolled into the cup.

After watching this improbable sequence of action, St. Peter turned to God and said, "Are you going to play golf or fool around?"

* * *

Critic: "It strikes me as being an impressive statue, yet isn't that rather an odd posture for a general to assume?"

Sculptor: "It isn't my fault. I had the job half done when the committee decided they coudn't afford a horse for the general."

We point with pride to the purity of the white space between our jokes.

* * *

Patient (to beautiful nurse): "I'm in love with you. I don't want to get well."

Nurse: "You won't. The doctor saw you kissing me and he's in love with me, too."

* * *

Among the chief worries of today's business executive is the large number of unemployed still on his payroll.

* * *

A small boy stood gazing at a horse and wagon while the milkman delivered milk.

When he came out the boy observed, "Mister, that horse will never get you home."

"And pray tell, why not?"

The small boy explained, "He just lost all his gasoline."

* * *

A field engineer, traveling between locations, boarded the sleeper and pulled back the curtains to his berth. He was extremely surprised to find two most personable blondes ensconced there.

After checking his ticket to see that he wasn't wrong, he said, "I deeply regret this, ladies, but I am a married man . . . a man of respect and standing in my community. I couldn't afford to have any breath of a scandal touch me. I'm sorry—but one of you will have to leave."

* * *

Texan rushing up to a salesgirl: "Give me a girdle."

Salesgirl: "Playtex?"

Texas: "I haven't got time. I'm double-parked outside."

* * *

"Statistics are like a bikini bathing suit—what they reveal is interesting, but what they conceal is vital!"

* * *

Two old maids were driving along in the country when a hen pursued by a rooster and not watching where she was going ran under the car.

"Sweet thing," said one of the old maids, "she preferred death."

* * *

Engineers idea of economics: Girls without principle draw considerable interest.

* * *

Then there was the wolf lounging in a New York hotel lobby as an attractive young lady passed by. When his standard come-on brought only a frigid glance, he sarcasmed, "Pardon me. I thought you were my mother."

"I couldn't be," she replied "I'm married."

* * *

One day a little mouse was hurrying across a wheat field when suddenly it was scooped up by a big reaping machine; the poor little mouse was tossed from side to side, and was finally thrown back on the field. Another little mouse came upon his friend lying on the ground, bruised and beaten, and asked him what happened. "I've been reaped," came the reply.

* * *

"Your girl is spoiled, isn't she?"

"No, it's just the perfume she's wearing."

* * *

Each morning an inmate of an asylum borrowed three long books from the library, returning them that same afternoon. One day the librarian gave him the city telephone directory. When he returned with it in the afternoon, the librarian exclaimed, "Don't tell me you've finished that big book already."

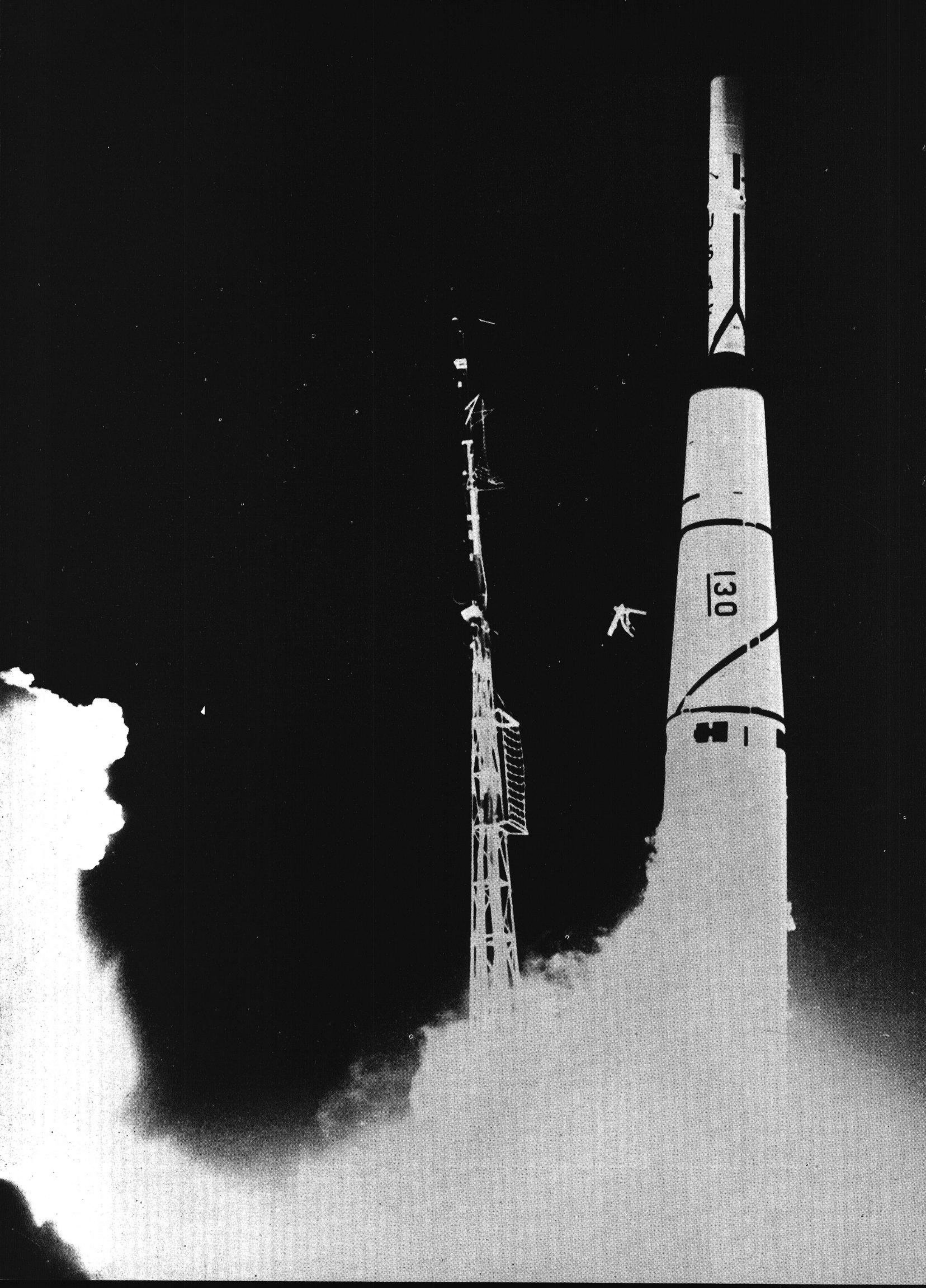
"I certainly have," replied the inmate. "The plot was lousy, but man, what a cast.'. .

* * *

A drunk was sitting at a bar next to a man and his wife. Suddenly the drunk emitted a resounding burp.

"How dare you belch before my wife," thundered the husband.

The drunk got off the bar stool somewhat unsteadily and, with a sweeping bow, said, "A thousand pardons, sir. I didn't realize it was her turn."


130

YES NO **Would you like to choose from a broad spectrum of openings?**

YES NO **Would you welcome an early chance to work on whole projects?**

YES NO **Do you give high priority to fewer steps to the top?**

YES NO **Is choice of geographical location important to you?**

YES NO **Do you tend to prefer a formal training program?**

YES NO **Will employee benefits strongly influence your decision?**

YES NO **Can you handle the challenges of early responsibility?**

YES NO **Do you welcome individual attention by management?**

YES NO **Is job security one of your most important factors?**

YES NO **Is unlimited growth opportunity an important prerequisite?**

Test yourself. Are you a small or large company man?

If you answered "yes" to six or more questions, it indicates that you're strongly attracted by the advantages of *both* large and small companies. If so, you might be especially interested in Babcock & Wilcox.

B&W is certainly a large and progressive company. Its 1961 sales, for example, were more than $300 million. And every year, B&W invests many millions of dollars in research and development. B&W can offer you all the advantages of a large company—formal training program, wide variety of job openings (16 plants in 8 states), plus the security and benefits of a large, 95-year-old organization.

B&W can also be considered a small company. There are 149 larger industrial companies in the U.S. Growth opportunities are enormous. Yet only 57 bachelor-level students will be hired in 1962. This select group will be given an opportunity to work on important projects at an early stage in their professional careers.

Right now, B&W has challenging job openings for both graduate and undergraduate engineers and scientists, including E.E., Ch.E., M.E., Met. E., Cer.E., chemists, and physicists. Why not write for more information? J. W. Andeen, The Babcock & Wilcox Co., 161 East 42nd Street, New York 17, New York.

Babcock & Wilcox


If it isn't fun, don't do it!
There are those who will tell you that the world beyond the academic walls is (a) highly competitive, (b) full of opportunity, and (c) above all, serious business.
Although we are keenly aware of the serious implications of the advanced propulsion work we're doing, at UTC we take a somewhat different view.
We believe that the right man in the right job will *enjoy* what he's doing. He'll find the competition stimulating, the challenge exciting. He'll be eager to get to work in the morning, simply because his work is *fun*. And this enthusiasm is bound to rub off on the paycheck, make no mistake about that.
Now, while you're giving serious thought to your future, we invite you to check out the possibilities here at UTC. For more information, write Jay Waste, Dept. 11
United Technology Corporation
P. O. Box 358, Sunnyvale, California
SUBSIDIARY OF UNITED AIRCRAFT CORPORATION
All qualified applicants considered without regard to race, creed, color or national origin.

Kodak beyond the snapshot...

(random notes)

Densitometry in Lilliput

Photography is art, photography is amusement, and more and more photography is a way of packing information and electronic circuitry. The packing calls for thinking very, very small about photography.

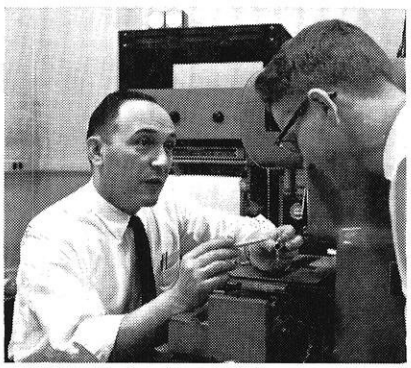
We cannot be blamed for feeling a little wistful as we cheer photography's progress in Lilliput. A remarkably small number of dollars worth of KODAK High-Resolution Plates and KODAK KPR Photo Resist are used up in producing a remarkably large number of solid-state microcircuits.

Fear not for us. We'll make out.

Nowhere will you catch us claiming that this "micro" business is as easy as falling off a log. Indeed, an appreciation of the relationship between the logs of exposure and reciprocal transmittance makes scarcely more than a good beginning toward controlling them on a micro scale. Here the frequency response of a photographic emulsion must be cascaded with the frequency response of the other components in the total picture-handling system.

The game is widely believed to be worth the candle. To shed light on what is really going on, one needs to be able to measure density reliably over an area less than ½ micron wide, scanned in synchronism with a recorder that responds logarithmically.

Not only do we use such instruments, but we build them and sell them for money to others. This benefits science and cheers us up.



GOOD PACKING NEEDS GOOD RESEARCH

From edible lubricants to erasable copying films, plenty of lively careers to be made with Kodak in research, engineering, production, marketing.

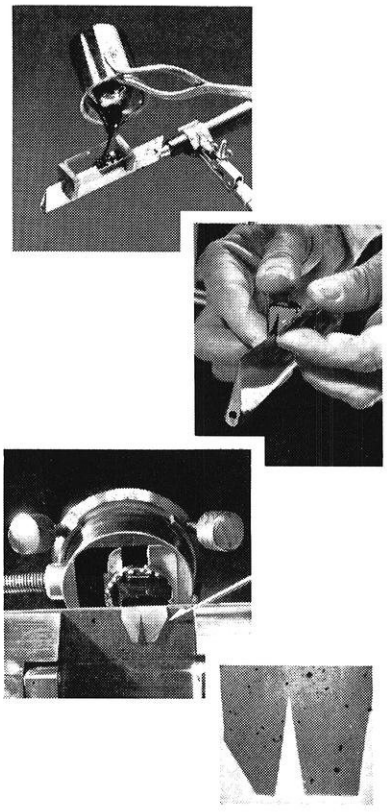
And whether you work for us or not, photography in some form will probably have a part in your work as years go on. Now or later, feel free to ask for Kodak literature or help on anything photographic.

Faithful but flexible

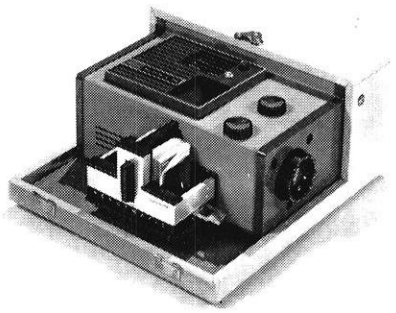
We find the trick shown below helpful in microscopic studies of profile sections along objects like knives. The casting material is our *Epolene C-10* Polyethylene Resin. You pour it at only 100°C. Yet at room temperature the little casting "remembers" its shape so accurately that despite the twist of unpeeling, profile details as small as 0.00009-in. radius are preserved in the sliced sections, and measurements are repeatable to ± 0.00001". Then, if overheating is avoided, you can remelt and reuse the resin for more castings.

The man who came up with this trick is on our payroll to ward off trouble from micro-organisms in making film and paper. He is a microbiologist and has never been asked to contribute to machine shop practice in order to impress the plastics-molding trade.

Life can be devious instead of tedious.



It projects slides!



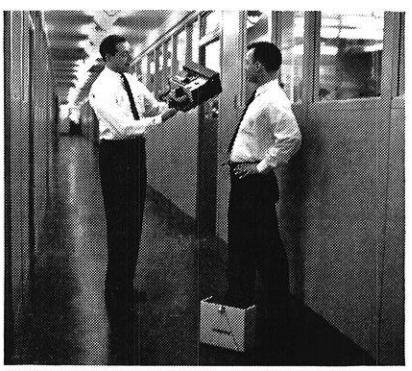
Learned and scientific as we are, we have not lost interest in simple consumer goods.

If you really want to know the truth, consumers are enjoying a simplicity kick at present. We even suspect you of being the type yourself. Otherwise we wouldn't be advertising the KODAK READYMATIC 500 Slide Projector to you.

It doesn't just scream "latest design!" but quietly is.

If you buy like that, you will pay less than $70 for a 500-watt 2x2 projector, complete with case and 4-inch lens, while sacrificing neither optical performance nor ease of slide-changing nor ruggedness of construction.

If you engineer like that, you will have a prosperous career with a manufacturing organization that values its reputation.



GOOD BUYS NEED GOOD ENGINEERING

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An interview with General Electric's W. Scott Hill

One of a series...

Manager—Engineering Recruiting

How to Make the Most of Your First Five Years

MR. HILL has managerial responsibility for General Electric's college recruiting activities for engineers, scientists, PhD's and technicians for the engineering function of the Company. Long active in technical personnel development within General Electric, he also serves as vice president of the Engineers' Council for Professional Development, board member of the Engineering Manpower Commission, director of the Engineering Societies Personnel Service and as an officer or member of a variety of technical societies.

Q. Mr. Hill, I've heard that my first five years in industry may be the most critical of my career. Do you agree?

A. Definitely. It is during this stage that you'll be sharpening your career objectives, broadening your knowledge and experience, finding your place in professional practice and developing work and study habits that you may follow throughout your career. It's a period fraught with challenge and opportunity—and possible pitfalls.

Recognizing the importance of this period, the Engineers' Council for Professional Development has published an excellent kit of material for young engineers. It is titled "Your First 5 Years." I would strongly recommend you obtain a copy.*

Q. What can I do to make best use of these important years?

A. First of all, be sure that the company you join provides ample opportunity for professional development during this critical phase of your career.

Then, develop a planned, organized personal development program—tailored to your own strengths, weaknesses and aspirations—to make the most of these opportunities. This, of course, calls for a critical self appraisal, and periodic reappraisals. You will find an extremely useful guide for this purpose in the "First 5 Years" kit I just mentioned.

Q. How does General Electric encourage self development during this period?

A. In many ways. Because we recognize professional self-development as a never-ending process, we encourage technical employees to continue their education not only during their early years but throughout their careers.

We do this through a variety of programs and incentives. General Electric's Tuition Refund Program, for example, provides up to 100% reimbursement for tuition and fees incurred for graduate study. Another enables the selected graduate with proper qualifications to obtain a master's degree, tuition free, while earning up to 75% of his full-time salary. These programs are supplemented by a wide range of technical and nontechnical in-plant courses conducted at the graduate level by recognized Company experts.

Frequent personal appraisals and encouragement for participation in professional societies are still other ways in which G.E. assists professional employees to develop their full potential.

Q. What about training programs? Just how valuable are they to the young engineer?

A. Quite valuable, generally. But there are exceptions. Many seniors and graduate students, for example, already have clearly defined career goals and professional interests and demonstrated abilities in a specific field. In such cases, direct placement in a specific position may be the better alternative.

Training programs, on the other hand, provide the opportunity to gain valuable on-the-job experience in several fields while broadening your base of knowledge through related course study. This kind of training enables you to bring your career objectives into sharp focus and provides a solid foundation for your development, whether your interests tend toward specialization or management. This is particularly true in a highly diversified company like General Electric where young technical graduates are exposed to many facets of engineering and to a variety of product areas.

Q. What types of training programs does your company offer, Mr. Hill?

A. General Electric conducts a number of them. Those attracting the majority of technical graduates are the Engineering and Science, Technical Marketing and Manufacturing Training Programs. Each includes on-the-job experience on full-time rotating assignments supplemented by a formal study curriculum.

Q. You mentioned professional societies. Do you feel there is any advantage in joining early in your career?

A. I do indeed. In fact, I would recommend you join a student chapter on your campus now if you haven't already done so.

Professional societies offer the young engineer many opportunities to expand his fund of knowledge through association with leaders in his profession, to gain recognition in his field, and to make a real contribution to his profession. Because General Electric benefits directly, the Company often helps defray expenses incurred by professional employees engaged in the activities of these organizations.

Q. Is there anything I can do now to better prepare myself for the transition from college campus to industry?

A. There are many things, naturally, most of which you are already doing in the course of your education.

But there is one important area you may be overlooking. I would suggest you recognize now that your job—whatever it is—is going to be made easier by the ability to communicate . . . effectively. Learn to sell yourself and your ideas. Our own experience at General Electric—and industry-wide surveys as well—indicates that the lack of this ability can be one of the major shortcomings of young technical graduates.

**The kit "Your First 5 Years," published by the Engineers' Council for Professional Development, normally sells for $2.00. While our limited supply lasts, however, you may obtain a copy by simply writing General Electric Company, Section 699-04, Schenectady, New York.*

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