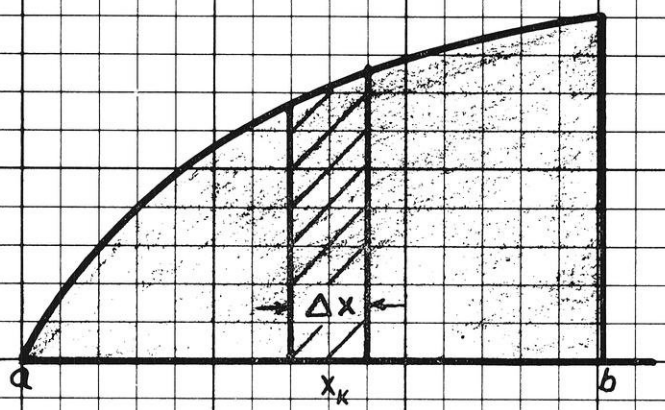
# The Wisconsin engineer. Volume 64, Number 2 November 1959

Madison, Wisconsin: Wisconsin Engineering Journal Association, [s.d.]

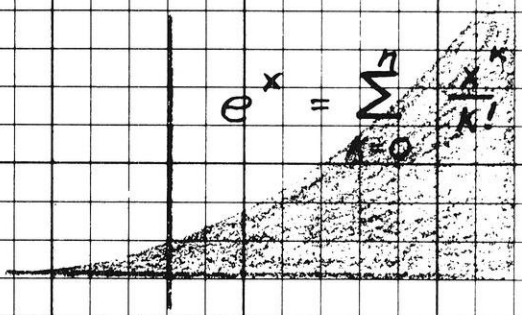
https://digital.library.wisc.edu/1711.dl/7P3DBZ6M5SIJV8I

NOVEMBER
1959
The Wisconsin
25¢

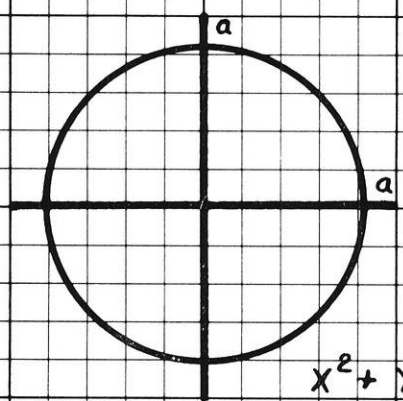
# engineer

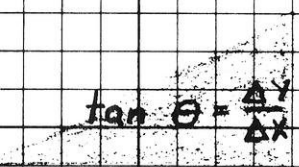


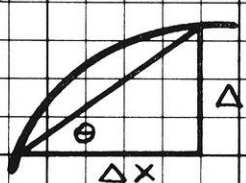

$$\lim_{n\to\infty} \sum_{k=1}^{n} f(x_k)\,\Delta x_k = \int_a^b f(x)\,dx$$




$$0 \rightarrow \infty$$



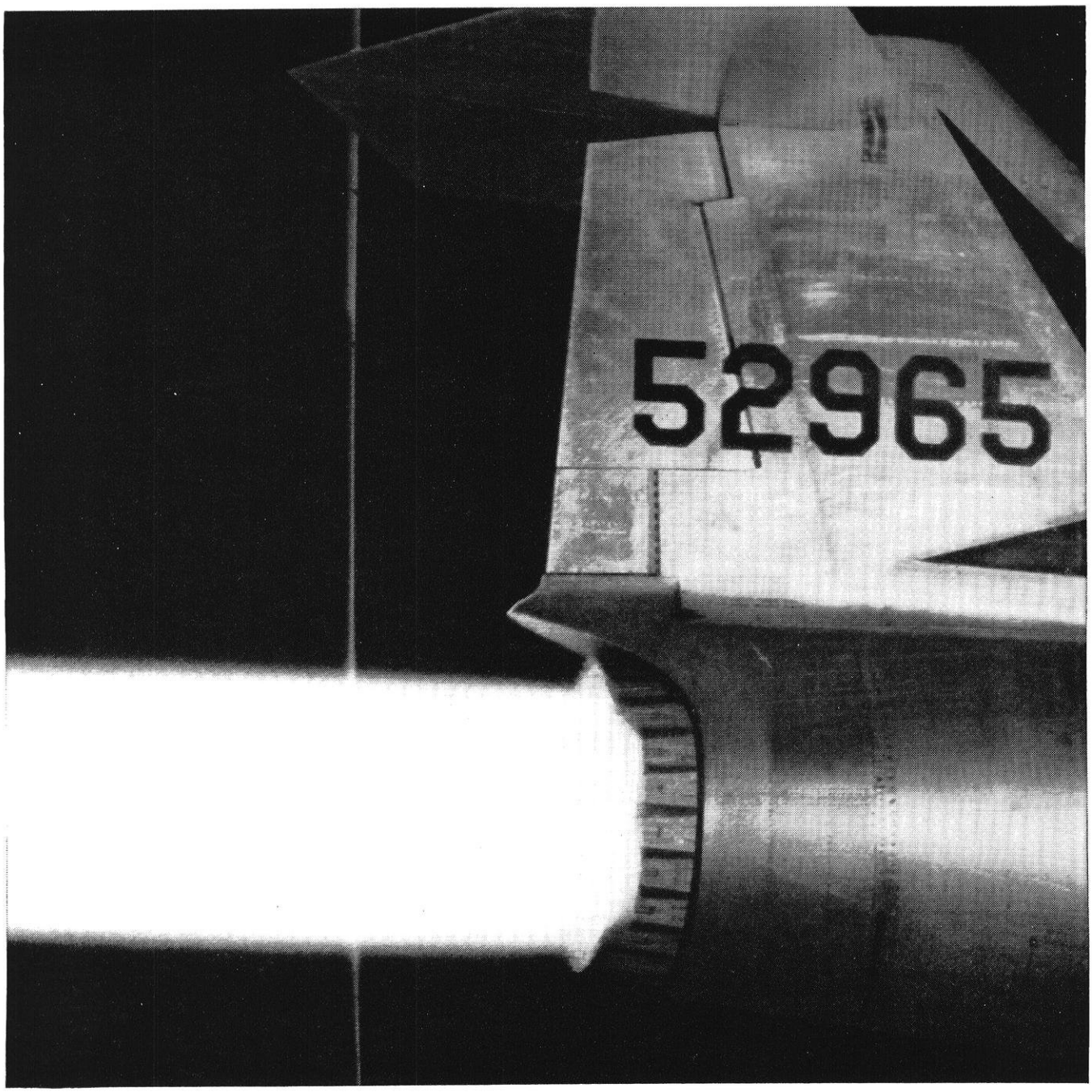

$$a(b+c) = ab + ac$$

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 v}{\partial x^2} = 0$$

$$\nabla \cdot (\nabla \times \vec{v}) = 0$$

$$\frac{dy}{dx} = \lim_{\Delta x \to 0} \frac{f(x+\Delta x) - f(x)}{\Delta x}$$

MATHEMATICS
THE ENGINEER'S LANGUAGE




**Under fire,** the performance of men and machines depends on what they are made of. United States Steel makes the materials for the machines, whether it's a very tough armor plate, or heat-resistant alloy, or Stainless Steels.

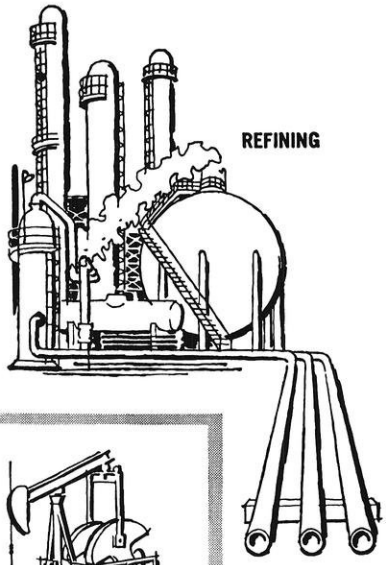
You might be interested in some of the USS steels developed specifically for aircraft and missiles:
USS Strux, an alloy steel with close to 300,000 psi tensile strength primarily for aircraft landing gears;
USS Airsteel X-200, an air-hardenable alloy steel with 230,000 psi yield strength for aircraft sheet and missile applications; USS 12MoV and USS 17-5 MnV Stainless Steels for high-speed aircraft and missiles;
Stainless "W", a precipitation-hardenable Stainless Steel.

New "exotic" metals, new methods for making them, present an exciting challenge. Men willing to accept this challenge—civil, industrial, mechanical, metallurgical, ceramic, electrical or chemical engineers have a future with United States Steel. Write to: United States Steel, Personnel Division, Room 2316,
525 William Penn Place, Pittsburgh 30, Pennsylvania.

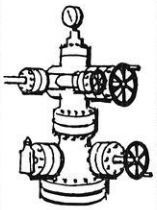
*USS is a registered trademark*

USS **United States Steel**

COMPUTER PROGRAMMING



REFINING



NATURAL GAS



PRODUCTION

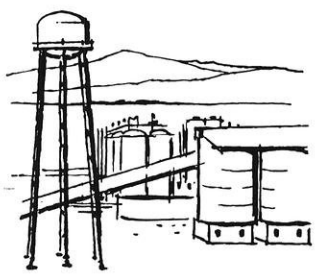
PETROLEUM PRODUCTS

EXPLORATION

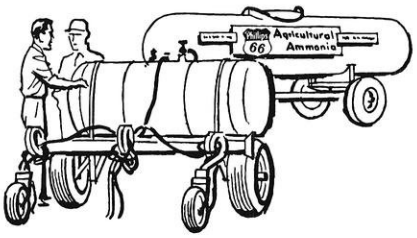
LAND & GEOLOGICAL

CARBON BLACK

RESEARCH & DEVELOPMENT

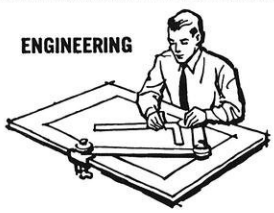


URANIUM MINING & MILLING

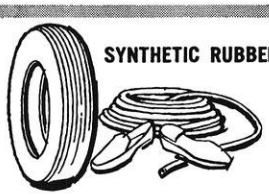


FERTILIZERS

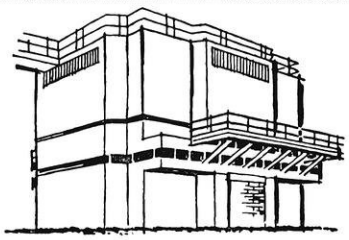
PLASTICS



ENGINEERING



SYNTHETIC RUBBER



ATOMIC ENERGY

# Phillips Petroleum Offers Outstanding Career Opportunities in the Field of Your Choice

Phillips Petroleum Company is one of America's largest and most widely diversified producers of petroleum, natural gas, natural gas liquids and petrochemicals. Having recently completed a billion-dollar expansion program, Phillips is now entering a new period of growth.

Phillips is a research and engineering-minded company, where one out of every eight employees is a technical graduate! These men are working on such broadly diversified projects as synthetic rubber, atomic energy, fertilizer, rocket fuels, plastics and new processes for improved motor fuels, lubricants and other petroleum products.

Other Phillips scientists and engineers are specializing in the fields of geology, geophysics, computer programming, market development, refinery production and pipeline construction.

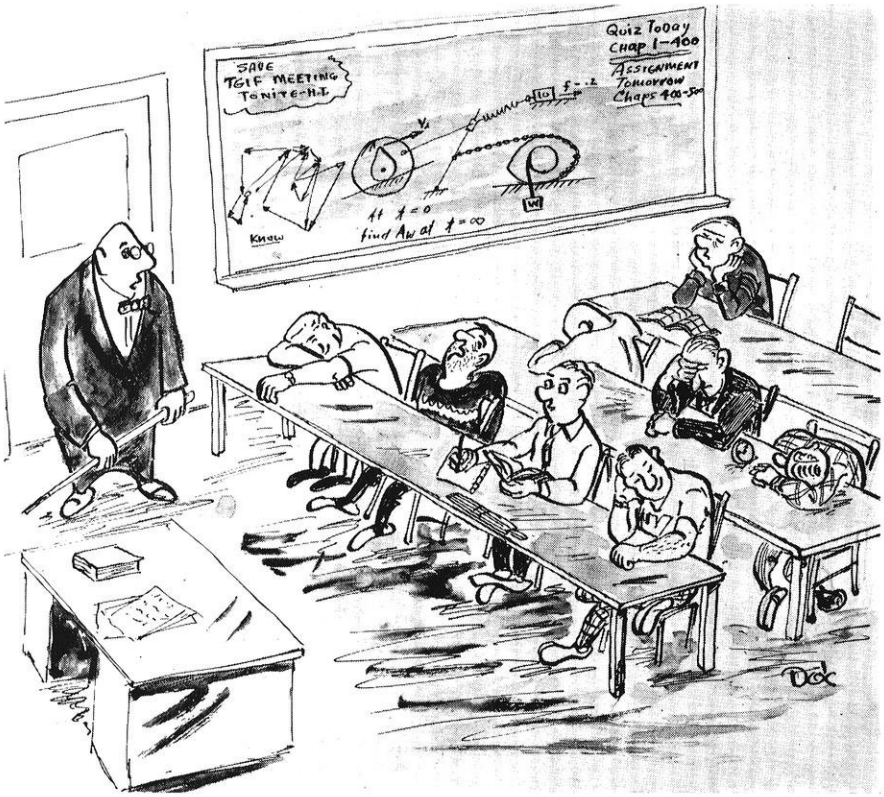
Phillips policy of promotion and transfer from within is creating opportunities for young engineers and scientists who will be our key men of tomorrow.

Write *today* to our Technical Manpower Division for our latest brochure . . . and when the Phillips Representative visits your campus be sure to arrange for an interview through your Placement Office.

**PHILLIPS PETROLEUM COMPANY**

**Bartlesville • Oklahoma**

PHILLIPS 66




Mr. O'Connell! What is a freshman doing in a senior class?




## EDITORIAL STAFF

**Editor-in-Chief**
DONALD D. ROEBER me'60

**Associate Editor**
KARL LONNGREN ee'60

**Art Editors**
RICHARD JONES ee'61
DAVID W. SHARP met'61

**Layout Editor**
DARELL MEYER ee'61

**Copy Editor**
TOM ROTH met'60

**Article Editor**
LEROY LUTZ ce'60

**Secretary**
LYNNE ANSELMAN ee'62

**Staff**
LARRY CEPEK ce'61
FLOYD GELHAUS ee'60
BOB HELM ce'61
CHARLES VEEN me'60
TOM SOBOTA ee'60
ALLAN DAHL me'60
DAVID O'CONNELL me'60
WM. HUEBNER che'61
DON NORRIS ee'60
TODD DEUTSCH me'61

## BUSINESS STAFF

**Business Manager**
SALLY TRIELOFF me'60

**Advertising Manager**
ARLYN ALBRECHT ce'60

**Staff**
ROBERT DOUGHERTY ee'61
FRITZ HASLER me'63
JEFF HOEHNE me'61
JOHN TRALMER met'61

**Board of Directors**
GEORGE SELL, Chairman
J. L. ASMUTH, Faculty Advisor
HOWARD B. DOKE
Mechanical Drawing
DAVID J. MACK
Mining & Metallurgy
R. N. WHITE
Civil Engineering
W. K. NEILL
Member at Large

Volume 64 NOVEMBER 1959 Number 2

# WISCONSIN ENGINEER

*The Student Engineer's Magazine*
FOUNDED 1896

## Features



## Departments



## Cover

*The competent engineer uses three languages—verbal, mathematical and graphical. His assignments sometimes dictate that he use one, or perhaps two, of these languages more often than another. Yet, all three must be at his command. For the engineer visualizes the forces of nature, he creates in his mind a product or process, and finally he must communicate his thoughts to others. The choice of his means of communication may be determined not by his preference but by the subject matter or by the recipient of the information.*

*In this issue's cover, the engineer's knowledge and use of the mathematical language are symbolized by the integrations, differentiations, series and curves. The central zero to infinity represents the vastness of scope in which he must be able to use this language.*

**MEMBER OF**
**ENGINEERING COLLEGE MAGAZINES ASSOCIATED**

*Chairman:*
STANLEY K. STYNES
Wayne State University
Detroit, Michigan

*Publishers' Representative:*
LITTELL–MURRAY–BARNHILL, INC.
369 Lexington Ave.
New York 17, New York

Second Class Postage Paid at Madison, Wisconsin, under the Act of March 3, 1879. Acceptance for mailing at a special rate of postage provided for in Section 1103, Act of Oct. 3, 1917, authorized Oct. 21, 1918.

*Published monthly from October to May inclusive by the Wisconsin Engineering Journal Association, 333 Mechanical Engineering Building, Madison 6, Wisconsin*

**Subscription Price**

$1.25 PER YEAR . SINGLE COPY 25¢

# *Thinking far up the road ...in electronics*

*The automatic highway, demonstrated in this working model of General Motors experimental Auto-Control System, is an electronic marvel that takes over steering, speed, braking and obstacle detection for drivers.*

GM positions now available in these fields for men holding Bachelor's, Master's and Doctor's degrees:
Mechanical Engineering
Electrical Engineering
Industrial Engineering
Metallurgical Engineering
Chemical Engineering
Aeronautical Engineering
Ceramic Engineering
Mathematics
Industrial Design
Physics • Chemistry
Engineering Mechanics
Business Administration
and Related Fields

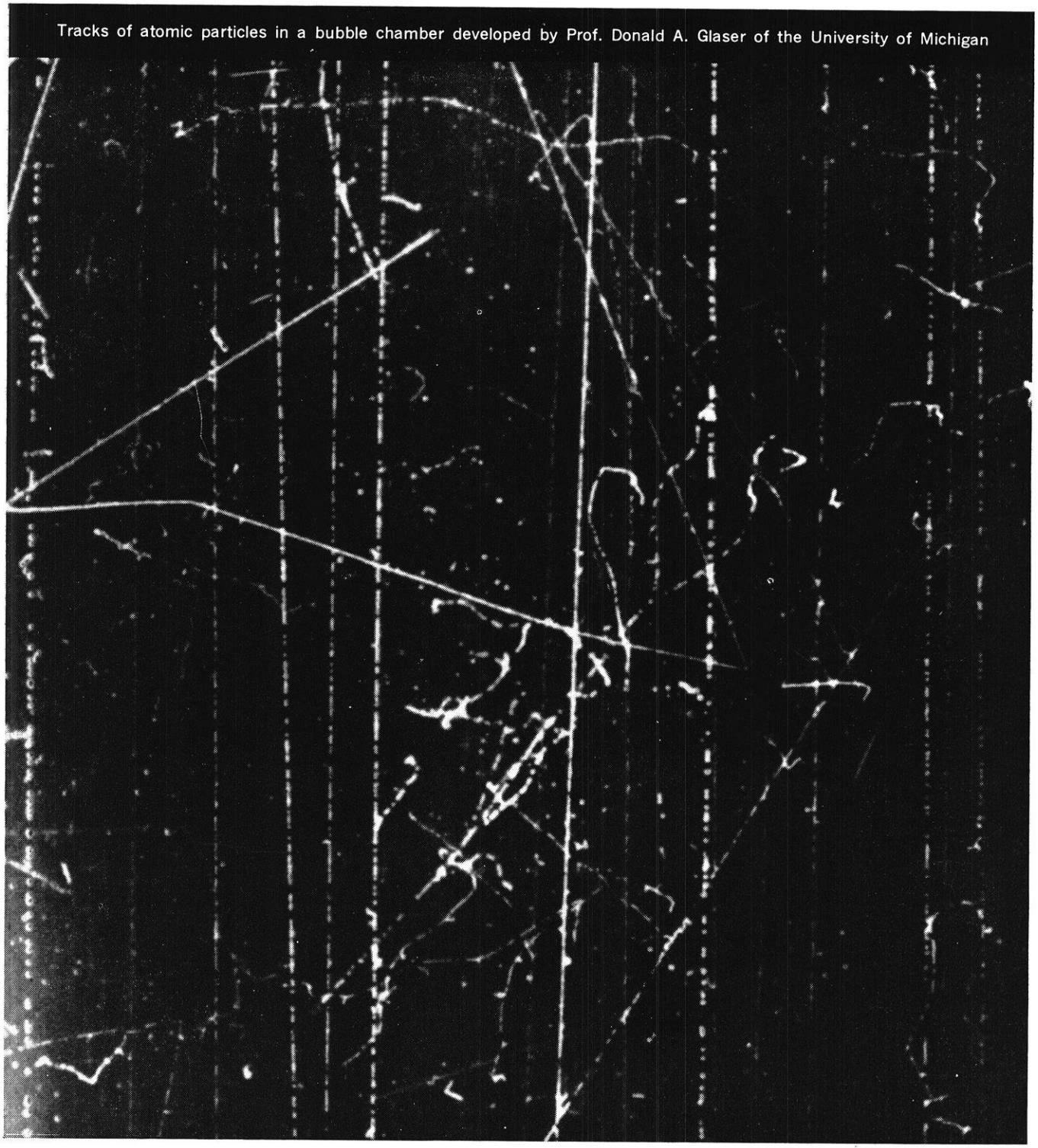
If you're thinking ahead in the field of science or engineering, General Motors is the place for you. Here are many challenging opportunities for young men who want to do things, do things better, solve problems on projects that probe into the future.

Among many available fields and products in which GM engineers and scientists work are: electronics, rocket propulsion, automotive, solar energy, astronautics, diesel engines and household appliances.

GM has plenty of room in which you can grow. As you move forward, you take on jobs of greater responsibility in your Division and can bridge across to positions of responsibility in other Divisions of the Corporation. And if you wish to continue with advanced studies, GM offers financial assistance.

For more information on a fine position with an exciting future, write to General Motors, Personnel Staff, Detroit 2, Michigan.

**GENERAL MOTORS**



Tracks of atomic particles in a bubble chamber developed by Prof. Donald A. Glaser of the University of Michigan

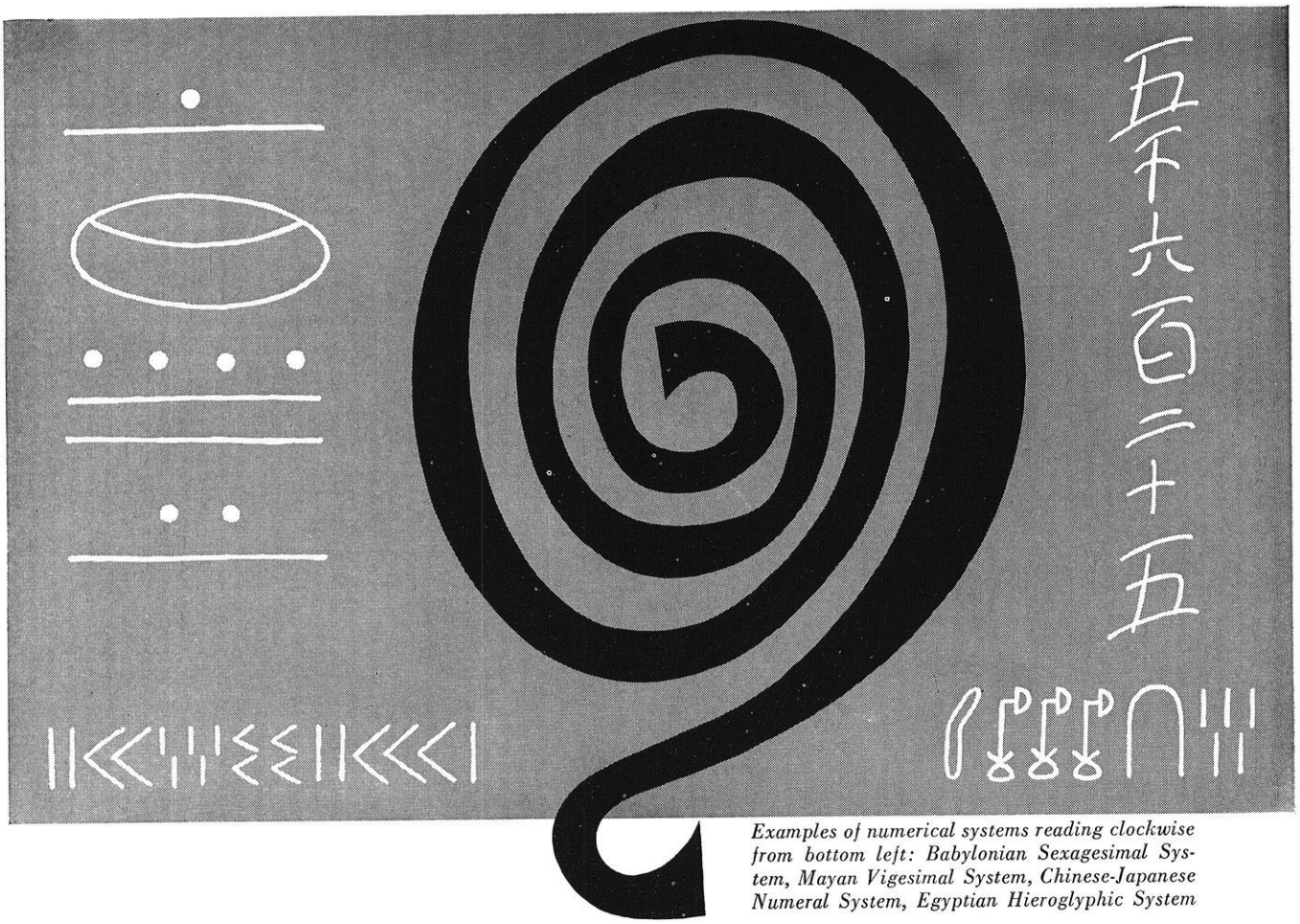
# ATOMIC POWER and DETROIT EDISON

A vast new source of energy—from the atom—is of major interest at Detroit Edison. The advances already made indicate that the electric power industry is on the threshold of exciting new developments in atomic electric power.

Detroit Edison personnel are playing a leading role in these developments. One such project is the Enrico Fermi Atomic Power Plant near Monroe, Michigan. Here many of our men are assigned to the Power Reactor Development Company and the Atomic Power Development Associates in the design and construction of the world's largest breeder reactor. This is but one example of many scientific pioneering achievements which provide continuing challenges to young engineers in the electric power industry.

**THE DETROIT EDISON COMPANY**

*Detroit 26, Michigan*



*Examples of numerical systems reading clockwise from bottom left: Babylonian Sexagesimal System, Mayan Vigesimal System, Chinese-Japanese Numeral System, Egyptian Hieroglyphic System*

# undetermined X multipliers

Ideas never go begging at Sylvania. They are taken up in 22 laboratories and 45 plants, examined rigorously and put to test. Should they fail, they fail for lack of merit and not from neglect. * * In our organization, a vast fund of ideas build up — ideas on electroluminescence, on information theory and data transmission for space flight application, on the properties of matter that will extend semiconductor device operational parameters, and the ultimate conductivity of alloys in supercold environments. These are our undetermined multipliers — theories and methods which, when proved and put to use, multiply man's capabilities and leisure. * * If you would work in this algebra of human creativeness — in areas that may hold promise of fruition for future generations, as well as in fields where goals are much nearer — if you would do this, focus on Sylvania, now embarking on new programs of expansion enhanced by its recent merger with General Telephone Corporation.

*Graduates at all degree levels in science & engineering will discover Administration, Research, Development, Manufacturing and Marketing careers at Sylvania in:*

LIGHTING • RADIO • TELEVISION • HI-FI • ECM • ELECTRONICS • SEMICONDUCTORS • PLASTICS • PHOTOGRAPHY • AIRBORNE DEFENSE • RADAR • COMMUNICATIONS & NAVIGATION SYSTEMS • MISSILES • COMPUTERS • CHEMICALS • METALS & WIRE • PHOSPHORS

Sylvania's laboratories and plants are situated in 13 states across the nation. Salaries are excellent, benefits are intelligently broad and include wide opportunity for advanced schooling.

To learn more about these opportunities, see your College Placement Officer or write us for a copy of "Today & Tomorrow with Sylvania."

**SYLVANIA**

Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

730 Third Avenue — New York 17, N. Y.

LIGHTING • TELEVISION-RADIO • ELECTRONICS • PHOTOGRAPHY • CHEMISTRY • METALLURGY

# DOW is tomorrow-minded

# **people** . . .

A chemist, with his mind on his own specialty exclusively, might say: "The chief raw materials for Dow products are sea water, brine, petroleum, coal, oyster shells." Up to a point he would be right. But in fact he would be overlooking the most important ingredient of all—people of a certain exceptional kind and quality of mind.

Let's look at a quick profile of the kind of person Dow looks for. His mind and ambitions are not limited by the dimensions of the job he is doing. His horizons take in tomorrow, while he does his job well today. Problems appear to him in a dynamic context of both today *and* tomorrow. The "big picture" is not just a cynical phrase to him.

This broader view makes him plan well—for his family as well as for his job. As the phrase goes, he is "a good provider." He owns his own car. Chances are he owns his own home. Along with some 80,000 others he has invested in Dow stock because he believes in his company and wants to back up that belief with cash.

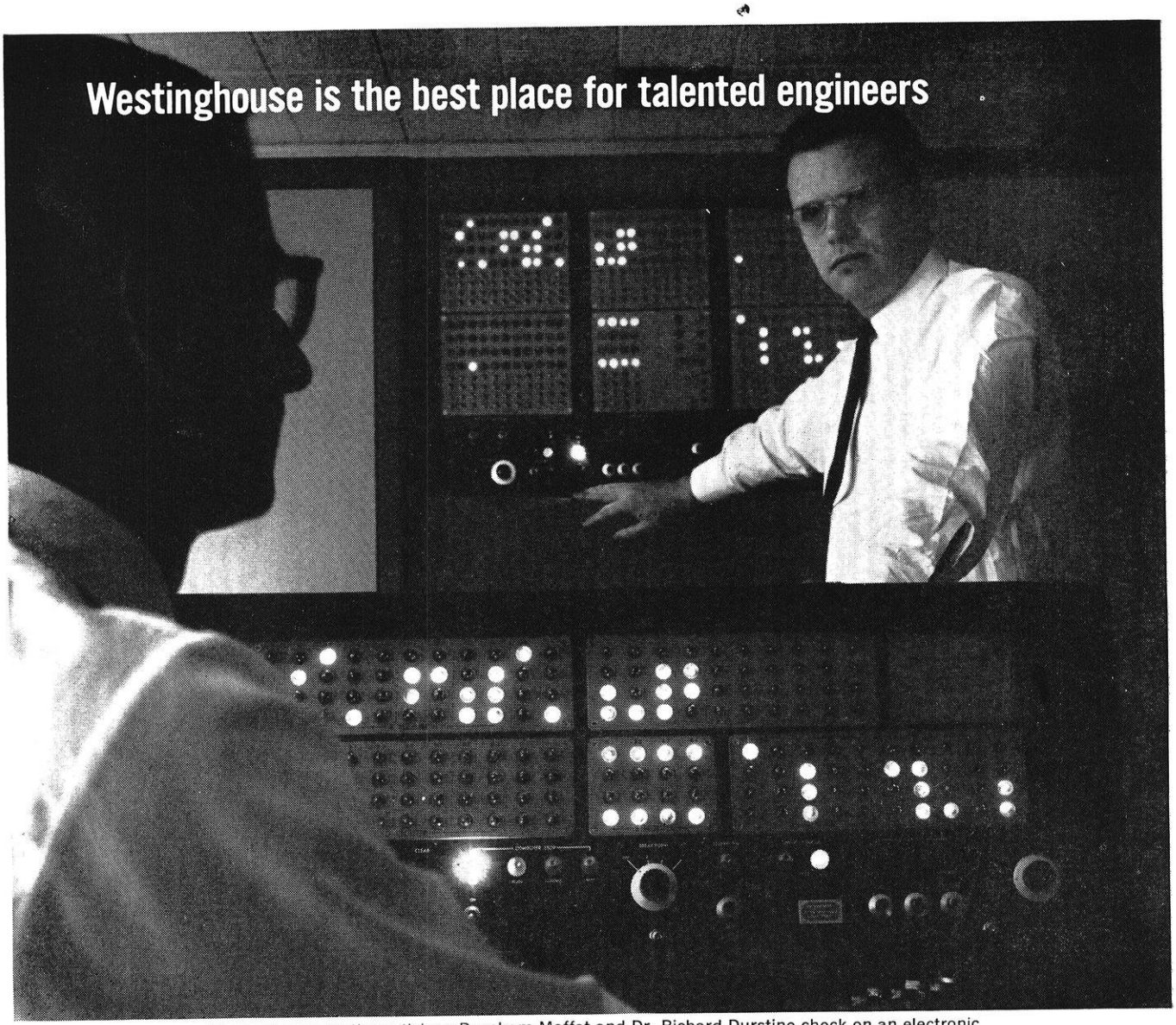
He is a builder at work or in his community. He gets a kick out of creating new things. Such products as Saran Wrap*, Separan* for the mining industry, the new fiber Zefran*, and others. Making things that do some important job for the human community, better than it has ever been done before, gives him a real thrill.

Not everyone who works for Dow, whether at Midland or the other 23 United States locations (plus 23 foreign and 5 Canadian), fits this profile. But by and large most of those who do well tend to. Though they have more than their share of "creative discontent," they have found a good place to grow, and work out their hopes, plans and ambitions.

If you would like to know more about the Dow opportunity, please write: Director of College Relations, Department 2427FW, THE DOW CHEMICAL COMPANY, Midland, Michigan.

*TRADEMARK

**THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN** DOW




Westinghouse mathematicians Burnham Moffat and Dr. Richard Durstine check on an electronic computer working out solutions to a heat transfer problem for the company's Atomic Power Division.

# The Mathematics Department helps you to use high-speed computers to solve your problem

The Mathematics Department helps Westinghouse engineers take advantage of modern methods of mathematics and new developments in this field. If new techniques are needed to use a digital computer for solving an engineer's problem, these men will develop them.

This department, the second of its kind in American industry, is staffed by 15 Ph.D.'s, 3 M.S.'s, and 6 B.S. mathematicians. Among other accomplishments, it is credited with developing OPCON, an electronic brain for optimizing control of processing systems. OPCON won for Westinghouse the 1958 Industrial Science Achievement Award of the A.A.A.S.

Supporting the work of about 150 other mathematicians with operating divisions, the Mathematics Dept. is actively studying industrial logistics (called OR or Operations Research by some), fatigue of metals (pioneering work using statistical techniques), equipment and system design, and a variety of other challenging problems.

The young engineer at Westinghouse isn't expected to know all of the answers. Our work is often too advanced for that. Each man's work is backed up by specialists—like the men in this Mathematics Dept. Even tough problems are easier to solve with this kind of help.

If you've ambition and real ability, you can have a rewarding career with Westinghouse. Our broad product line, decentralized operations, and diversified technical assistance provide hundreds of challenging opportunities for talented engineers.

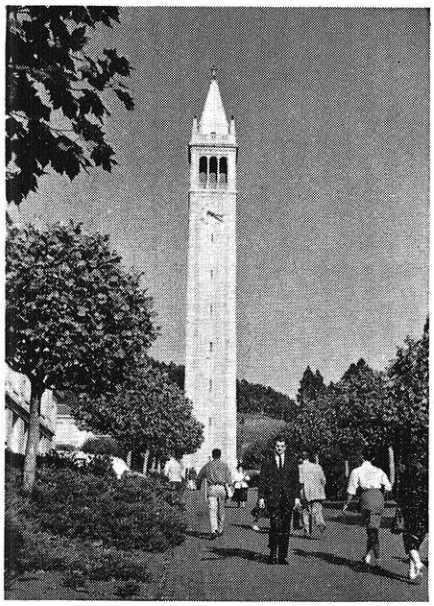
Want more information? Write to Mr. L. H. Noggle, Westinghouse Educational Dept., Ardmore & Brinton Roads, Pittsburgh 21, Pa.

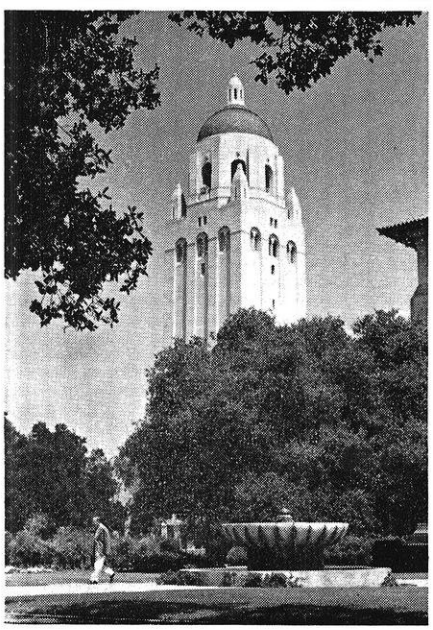
YOU CAN BE SURE... IF IT'S

**Westinghouse**

WATCH WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS
CBS-TV FRIDAYS

# An Announcement of Importance to Engineering and Physical Science Majors





**Lockheed Missiles and Space Division** is engaged in a broad spectrum of scientific exploration. The Division has complete capability in more than 40 areas of technology – from concept to operation.

Diversity of the work areas is typified by the programs in such fields as: magnetohydrodynamics; space medicine; oceanography; sonics; propulsion and exotic fuels; metallurgy; advanced systems research; manned space vehicles; reconnaissance; optics and infrared; electromagnetic wave propagation and radiation; electronics; physics; chemistry; mathematics; computer design; aero and thermo dynamics; test; design and operations research and analysis.

**PROJECTS**—Current major projects include the Navy POLARIS Fleet Ballistic Missile; the DISCOVERER program; MIDAS and SAMOS; Air Force Q-5 and X-7 and the Army KINGFISHER. PROJECT MIDAS is an early warning infrared system against ballistic missile attacks, based on the use of satellites. PROJECT SAMOS is designed for the development of an advanced satellite reconnaissance system. DISCOVERER, MIDAS, and SAMOS are programs of the Advanced Research Projects Agency under the direction of the Air Force Ballistic Missile Division with Lockheed as systems manager.

**LOCATIONS**—You have a selection of two of the choicest living areas in the country at Lockheed. Headquarters for the Division are at Sunnyvale, California, on the San Francisco Peninsula. Research and development facilities are located in the Stanford Industrial Park in Palo Alto and at Van Nuys, in the San Fernando Valley of Los Angeles. Testing is conducted at Santa Cruz and Vandenberg AFB, California; Cape Canaveral, Florida; and Alamogordo, New Mexico.

Together, the Division's facilities occupy more than two million, six hundred thousand square feet of laboratory, engineering, manufacturing and office space and provide the latest in technical equipment, including one of the most modern computing centers in the world.

**OPPORTUNITIES FOR ADVANCED EDUCATION**—For those who desire to continue their education and secure advanced degrees Lockheed maintains two programs. The Graduate Study Program permits selected engineers and scientists to obtain advanced degrees at the company's expense while working part time at Lockheed.

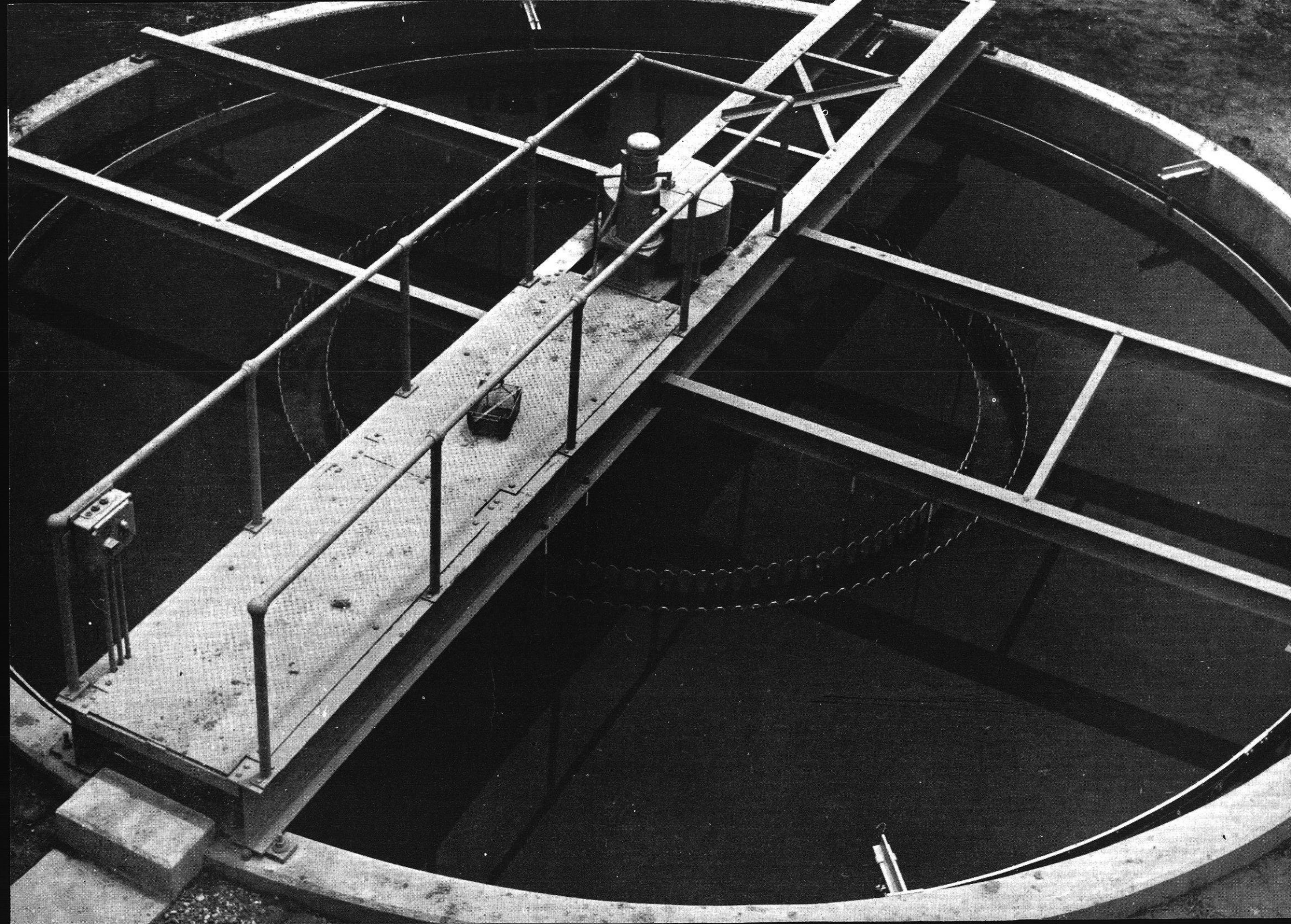
The Tuition Reimbursement Plan remits fifty per cent of the tuition for approved evening courses for salaried employees who are working full time.

**For Information** regarding career opportunities at Lockheed, please write Professional Placement Staff, Dept. K-96, Lockheed Missiles and Space Division, 962 West El Camino Real, Sunnyvale, California, or see your Placement Director for date of Lockheed campus visit.

**Lockheed** / **MISSILES AND SPACE DIVISION**

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA

CAPE CANAVERAL, FLORIDA • ALAMOGORDO, NEW MEXICO • HAWAII



# *Rambling* WITH THE EDITOR

## How To Not Get An Education!

A talk I heard recently by Professor Wm. Erickson, Director of Cornell's Electrical Engineering School, on the above subject, has set me to thinking about the University of Wisconsin students, (I use the term very loosely), who seem bound for this very objective. The following steps which will help these "students" to NOT get an education are not my own nor are they Professor Erickson's; they have been tested by actual practise and have been shown to be very effective.

The basic steps in the quest to not get an education are as follows:

1. Select your courses on the basis of flunk rate, easy course content, absence of late afternoon or Saturday classes, and notoriously easy instructors. If you base your choice on intelligent analysis you might find courses that would teach you something to prepare you for a successful professional career and a happy personal life.

2. Copy the work that must be turned in. If you read assignments and study theories you might obtain some usable knowledge. After you have copied someone else's problems, call up one of the campus coeds, her teachings may be much more interesting. Besides this you will have someone to think about in that dry old thermo lecture tomorrow.

3. Go to class only for exams or quizzes. If you attend class regularly you might be forced to participate in class discussions which could lead to a better understanding of the subject. What the heck! it's only costing you or your parents about $8.00 per class period to NOT get an education. Go ahead and cut classes. You can always get an excuse from the infirmary; how can they tell if you have a headache or a hangover? They just love patients who can be cured by their inexhaustible supply of that wonderful cure-all, the aspirin.

4. Always take an antagonistic attitude towards your professors. When going to lectures, (assuming he takes attendance), it is important to stomp into the room, crash down in your seat, then slouch down and assume your half-awake position and DARE the professor to get through to you. Always be prepared with the latest reading matter, the Daily Cardinal, Playboy, Lady Chatterley's Lover, etc.

5. Study for exams by memorizing problems on old exams. There is always a chance a professor might repeat a question. Often you can pull a "D" in a course without even learning a thing. Always do your studying for 24 hours immediately before your exam, otherwise you might have a clear head and be able to analyze the problems and think through a solution. This method also prevents the retention of any knowledge so you may have a blank mind with which to approach your next six weeks.

Always start weekends on Thursday night and never crack a book until the next Monday morning. Never go to Friday afternoon classes, there are more interesting things to do.

Follow the above rules and you will assuredly NOT get an education. Violation of many of the above methods might prove to be disastrous. You may get the engineering education that you should be here to obtain.

DONALD ROEBER
*Editor*

**Clarifier or circular sedimentation basin used in sewage treatment to reduce the content of settleable solids in the sewage.**
**—Courtesy of Yeomans Brothers Co.**

# Safeguarding Health Through Sewage Treatment

*by K. G. Berget*

**The treatment of sewage is one of the more important factors that is contributing to our advancing way of life, yet it is one of the least known.**

ONE of the greatest needs of a modern city is an adequate water supply. Next in importance to this is the proper disposal of the used water and of solid wastes. Proper disposal is the subject of this article. Methods and equipment necessary for the treatment and disposal of sewage are presented in this report in order to give the layman an insight into what is involved in sewage disposal.

Sewage is a liquid waste; sewerage is a comprehensive term, including all construction for collection, transportation, pumping, treatment, and final disposition of sewage; a sewer is a channel that conveys sewage.

Sewage is disposed of by discharging it into a body of water; by spreading it on the surface of the ground or immediately beneath the surface; by discharging it into drainage wells; or by discharging it into otherwise dry channels from which it may soak into the ground or flow ultimately into a body of water. However, some form of treatment to prepare sewage for ultimate disposal is necessary. It is this preparation treatment that is dealt with in this paper. The solid matters removed by treatment may be buried, burned, dumped into water or used for a commercial purpose such as fertilizer filler.

The stages of sewage treatment are taken up here in chronological order. The various methods possible for each stage of treatment are presented as each stage is explained. Stages that are discussed are: preliminary stage involving separation processes; secondary treatment where oxidation and chlorination take place; further treatment of the separated constituents; and disposal of the solids and liquid effluent.

The report is intended to give a general picture of the treatment processes in sewage disposal and it does not present the theory and specifications necessary for the design of sewerage plants.

## PRELIMINARY TREATMENT

The first stage of sewage treatment is separation of suspended solids from the liquids. Coarse solids and mineral matter are removed by bar racks and grit chambers respectively. Finer suspended matter can be removed by various methods employing sedimentation tanks, septic tanks, and screening devices.

## BAR RACKS

Where sewage is to be pumped, matter large enough to interfere with the operation of the pump must be removed. The removal of coarse suspended solids is done by use of bar racks.

A bar rack removes sticks, rags, paper, or any large solids from the sewage. This type of separator consists of metal bars placed one-half to three inches apart. They are placed in the screening channel leaning downstream at an angle from 45 to 60 degrees with the horizontal. Inclination facilitates cleaning. For small plants the racks are cleaned by hand, using rakes, but in most modern plants provision is made for mechanical cleaning. The rakes, which are attached to an endless chain, revolve slowly and carry the material collected from the bars to the high part of the circuit where it is swept off into a trough running transversely across the channel.

Bar racks are used in most disposal plants. They are standard equipment because disposal operations require pumps and bar racks are needed to protect these machines.

## GRIT CHAMBERS

Grit is heavy material such as sand, gravel, and cinders and it may contain 10 to 40 per cent organic matter. The reasons grit must be removed are: to prevent the loading of treatment works with inert matter which might interfere with the operation of the plant; to protect the pumps and screens from undue wear; to prevent the collection of grit deposits in channels

laid with flat slopes or in siphons.

Grit is removed by a settling process in grit chambers. A grit chamber is an enlarged channel in which the velocity of flow is so controlled that only heavy solids are deposited while the lighter organic matter is carried forward in suspension. The required velocity of flow is between one and three feet per second and is kept constant by use of a proportional flow weir. This weir device is designed so that the rate of flow is proportional to the depth of flow on the crest of the weir.

The grit chamber is wider and deeper than the pipe leading to it; this reduces the velocity of flow to the desired rate. Near the bottom of the grit channel the sides are sloped toward the center concentrating the grit in a small area, thus facilitating cleaning.

For small plants cleaning is done by directing the flow through another channel while removal of the grit is done by hand labor. For larger operations mechanical dredgers are used.

Grease and oil in sewage cause an objectionable surface film and interfere with the operation of the treatment plant. They form deposits on the walls of sewers and treatment tanks to which other suspended matter adheres. Grease and other sewage matter sometimes conglomerate into balls which pass undigested through treatment tanks; the grease protects other matter from decomposition.

Oil and grease are removed by skimming them from the surface. This can be done at intervals by hand with the use of wire gauge supported on frames; special skimming tanks are used with large operations. Revolving arms are used for skimming in these special tanks. In some skimming operations compressed air is discharged into the sewage at the bottom; the air causes the grease to separate out and rise to the surface.

## SEPARATION OF MEDIUM AND FINE SUSPENDED SOLIDS

After coarse suspended solids are taken out, fine solids are removed from the liquid. A settlement process known as plain sedimentation is one method. This process works on the principle that when water is motionless, particles of specific gravity higher than that of water fall out.

In any settlement tank the maximum sedimentation occurs when the velocity of flow is zero. In practice however it is better to keep the sewage in continual motion during its passage through the plant; the bulk of the suspended matter should be removed without stopping the flow altogether. Three types of plain sedimentation tanks are in use.

### Horizontal Type Tank

A horizontal flow sedimentation tank is a long narrow one, the length varying from three to ten times the breadth and the average depth is six to ten feet.

Liquid entering or leaving the tank should not cause disturbance to the sediment. For large installations the inlet and outlet are made in the form of weirs extending the width of the tank.

The sewage is retained in the tank from two to four hours depending on the length of the tank; the tank must be long enough so that the velocity is not more than one fourth to one half inch per second.

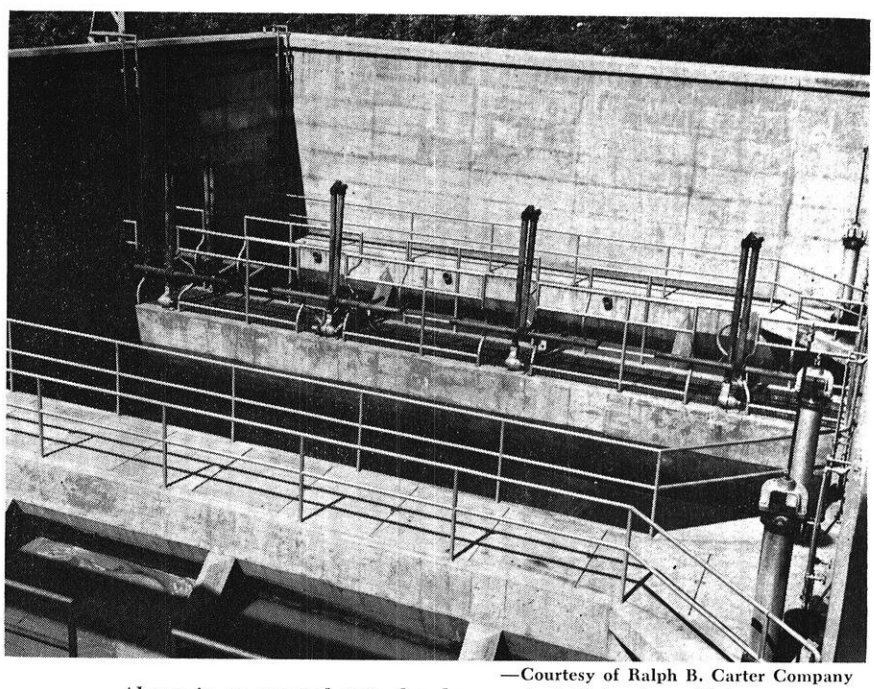
Some operations require hand removal of sludge at intervals. However most modern plants have machine operated scrapers. The scraper pushes the sludge into a hopper at one end of the horizontal tank. A pipe is set with its lower end near the bottom of the hopper and the outlet is three to five feet below the sewage level. The three to five foot head pushes the sludge up the pipe by hydrostatic pressure.

### Vertical Flow Tank

Vertical tanks are deep tanks into which the sewage is admitted below the surface. The effluent is discharged into troughs built around the top of the tank. The sides are made vertical near the top and slope deeply in the lower part to facilitate gravitational removal of the sludge. The sludge is removed from the tank by hydrostatic pressure through a pipe reaching to the bottom as was described above in the hopper used with the horizontal tank. The inlet spreads the sewage as it enters the tank by means of a bell mouth on the inlet pipe surrounded by baffle plates.

On entering the vertical flow tank particles of suspended matter are borne upwards in the liquid. As they rise, their upward velocity slows and at a certain level there is a neutral plane where the motion of the particles is stopped. Here, suspended matter coagulates and when the density of the mass becomes great enough it falls to the bottom in the form of sludge.

*(Continued on next page)*



—Courtesy of Ralph B. Carter Company

**Above is an aerated grit chamber used at Columbus, Ohio.**

# Sewage Treatment

*(Continued from previous page)*

Vertical flow tanks remove less organic matter than horizontal tanks do. Their advantage is that the surface area occupied is small. However, depths of thirty feet are necessary, so suitable ground must be used for their construction. Due to the steep slope of the bottom of the vertical tank, no mechanical provision for sludge removal is necessary.

### Radial Flow Sedimentation Tank

A radial flow tank is a shallow tank in which the diameter is large in relation to the depth. The sewage comes in at the center and passes radially outward to a weir over which it flows into the collecting channel which completely surrounds the tank. The heavier particles settle out at the relatively high velocity near the inlet while the lower velocities near the outlet weir enable most of the finer matter to settle.

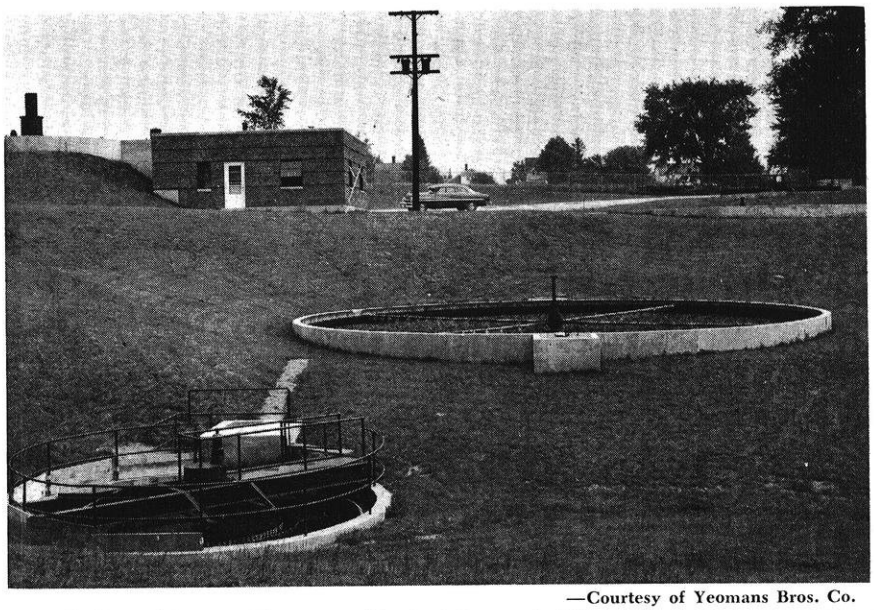
The sludge is collected in a conical shaped pocket located at the center directly below the inlet. Power driven scrapers are used to move over the gently sloping floor and push the sludge into the central pocket. An outside ring is provided to collect the finest settleable particles. There are independent scrapers in this ring which push the fine sludge into four pockets constructed equi-distant around the outside. The sludge from these pockets is discharged by the hydrostatic head of the liquid into the central pocket through the pipes shown.

A rack screen surrounds the central inlet chamber. It has vertical bars which deflect the heavier solids into the sludge pocket; they produce a thorough mixture of the inflowing sewage and equalize the flow through the tank.

## SCREENING

Fine screening is another method for separating fine suspended solids from the liquid.

Not many screening plants are being built because settled sewage is of better quality. However, the settling process is better, in places where there is not enough space for settling tanks, fine screens are used in their place. Even though screening plants are of little importance to new disposal installations, they will be discussed here because many old sewage works of this type are still in use.



—Courtesy of Yeomans Bros. Co.

**Over-all view of Sewage Treatment Plant at Denmark, Wisconsin. In foreground there is a trickling filter. Next is filter and clarifier with digestor in background.**

The band screen consists of an endless perforated belt which passes over upper and lower rollers.

The screen is a disk with its axis inclined, with about two-thirds of the disk immersed. The sewage passes through small openings in the disk leaving the solids on the upper surface. As part of the disk moves out of the water, revolving round brushes move over the face and push the solids into a hopper for removal.

The drum screen is a cylinder of perforated plates which rotates on a horizontal axis at one revolution in two minutes. Brushes move the collected solids from the screen into hoppers for disposal.

## SEPTIC TANK

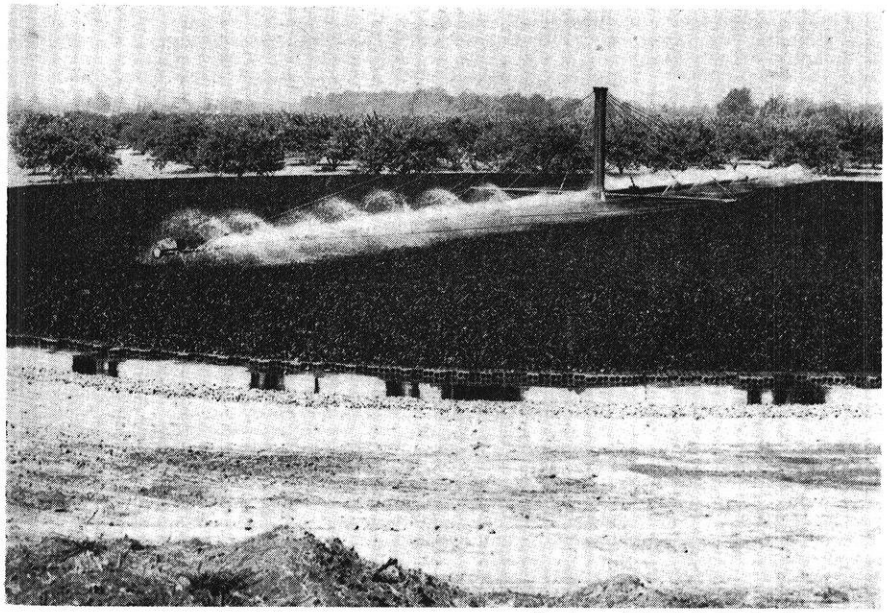
Septic tanks are used for more than simply separating solids from liquids, but because they are a development of the sedimentation tank, they are discussed here along with the various separation processes.

Sludge becomes stale or septic when it is allowed to remain at the bottom of a sedimentation tank long enough for exhaustion of the oxygen to take place. A septic tank is simply a settling tank where sludge is left for a time to deteriorate by the action of bacteria. Bacteria cause partial gasification and liquification of the solids contained in the sewage and sludge. The sludge is reduced in volume, is denser, and has smaller water content than that from an ordinary sedimentation tank. Septic tanks are not for complete digestion, but they are convenient for storing sludge over long periods of weeks or months; this quality makes them useful in small installations where frequent sludging is impractical.

When sludge is removed from septic tanks it is often very objectionable. The effluent has large amounts of suspended matter and it emits foul odors. For these reasons the septic tank is not used in large municipal plants.

The principle of the septic tank is used in the two story tank called an Imhoff Tank.

As the sewage flows slowly through the sedimentation chambers the settling solids fall to the bottom and pass through a slot into the digestion chamber below. The openings between sedimentation chambers and the digestion chamber are trapped to prevent any gases given off by the septic sludge from passing up into the sedimentation chamber. Ventilators are used to carry off the gases. In the digestion chamber the sludge undergoes putrefactive decomposition, and when this is almost complete the sludge settles to the bottom and is withdrawn without in-



—Courtesy of Ralph B. Carter Company

**Above is a large trickling filter bed in operation.**

terfering with the continuous operation of either compartment.

### SEPARATION BY CHEMICAL PRECIPITATION

Chemical precipitation is not discussed here as a specific method of separating the fine solids from the liquid, for it may be used along with any of the processes considered above to aid in the coagulation of the suspended and colloided solids, so that they might settle more rapidly and completely. Other functions of chemicals in sewage disposal are: to condition the sludge for dewatering, to sterilize and to control odors.

Commonly used chemicals are: lime, ferrous sulphate, aluminum sulphate, ferrozone, sulphuric acid and chlorine. Sewages differ greatly and are complex so that the best chemicals to use on a specific sewage are determined by testing.

### SECONDARY TREATMENT

Secondary handling involves the treatment of the liquid obtained from the separation processes discussed above. Screens and sedimentation methods illustrated above remove 95 per cent of the settleable solids in sewage, but 60 or 70 per cent of the original organic matter in the form of colloids and suspended solids still remains.

Oxidation is used in the secondary treatment of the liquid to reduce the organic content. Atmospheric oxygen, aerobic bacteria, and a contact surface are the essentials for the oxidation process. The contact surfaces remove the colloided matter, and the aerobic reduction that follows forms carbon dioxide and nitrates from the organic matter. Common methods of oxidation include: irrigation, filtration, and an activated sludge process.

### IRRIGATION

Irrigation with sewage consists of turning it onto land, where it soaks through the soil; clarification and oxidation take place. During the purification with aerobic bacteria contained in the soil, the carbon is changed to carbon dioxide; the nitrogen changes to nitrous acid which combines with mineral bases; urea, the most common sewage form of nitrogen, is converted to ammonia which is oxidized to nitrites and nitrates.

In the use of the irrigation process, sewage must be turned on a given piece of land intermittently so that when the oxygen in the soil is exhausted, there is a chance for the soil to fill up again with air after which the process can again go on properly. It is to be remembered here that 50 to 80 per cent of the settleable solids have been removed from the sewage before it is applied to the land.

Irrigation with sewage involves the laying off of land in furrows about three feet apart; as much sewage as can be absorbed in thirty minutes is discharged into the furrows. The land is plowed to a depth of one foot each year to promote growth of crops and to prevent water logging of the soil.

### FILTRATION

Sewage filtration consists of very slow motion of thin films of liquid over the surfaces of particles that have spaces between them sufficient to allow air to be in contact with the films. The colloids and fine suspended matter in the sewage adhere to the surfaces of the filter particles and are slowly worked on by bacteria, worms, and other forms of animal life present.

Commonly used sewage filters are: intermittent sand filters, contact filters using coarse grains, and trickling filters also using coarse grains.

#### Intermittent Sand Filters

Sewage sand filters consist of beds of sand underlaid with coarse sand and gravel and with tile bottom underdrains to remove the effluent. The top layer of fine sand has a depth of two to four feet. From one to six inches of sewage are distributed over the filter surface by means of wooden troughs. The oxidation process occurs as is described in the general filtration explanation above. By the use of this type of filter, 90 to 98 per cent of the organic matter is removed. Disadvantages of the intermittent sand filter are that it requires a large land area and is costly.

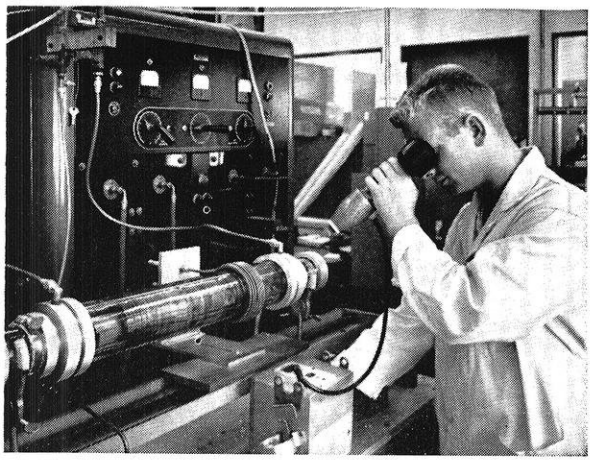
#### Contact Filter

This type of filter consists of a water tight tank filled to a depth of from four to eight feet with crushed stone or slag (1½ to 2½ inch size).

The effluent from a previous process, such as from some form of settling tank, is slowly admitted to the filter and left in contact for some time. After slowly draining, the filter is left empty to allow air to fill the space between the particles. The procedure is then repeated. Three or four such cycles may be run per day.

*(Continued on page 60)*

# Checking Einstein with



**Purity Plus**—*Hughes Products Division engineer checks semiconductor materials to insure purity.*

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

# an atomic clock in orbit

**To test Einstein's** general theory of relativity, scientists at the Hughes research laboratories are developing a thirty pound atomic maser clock *(see photo at left)* under contract to the National Aeronautics and Space Administration. Orbiting in a satellite, a maser clock would be compared with another on the ground to check Einstein's proposition that time flows faster as gravitational pull decreases.

Working from the new research center in Malibu, California, Hughes engineers will develop a MASER (Microwave Amplification through Stimulated Emission of Radiation) clock so accurate that it will neither gain nor lose a single second in 1000 years. This clock, one of three types contracted for by NASA, will measure time directly from the vibrations of the atoms in ammonia molecules.

Before launching, an atomic clock will be synchronized with another on the ground. Each clock would generate a highly stable current with a frequency of billions of cycles per second. Electronic circuitry would reduce the rapid oscillations to a slower rate in order to make precise laboratory measurements. The time "ticks" from the orbiting clock would then be transmitted by radio to compare with the time of the clock on earth. By measuring the difference, scientists will be able to check Einstein's theories.

In other engineering activities at Hughes, research and development work is being performed on such projects as advanced airborne systems, advanced data handling and display systems, global and spatial communications systems, nuclear electronics, advanced radar systems, infrared devices, ballistic missile systems...just to name a few.

The rapid growth of Hughes reflects the continuous advance in Hughes capabilities—providing an ideal environment for the engineer or physicist, whatever his field of interest.

ELECTRICAL ENGINEERS AND PHYSICISTS

Members of our staff will conduct

CAMPUS INTERVIEWS

NOVEMBER 20, 1959

For interview appointment or informational literature consult your College Placement Director.



*The West's leader in advanced ELECTRONICS*

**HUGHES**

HUGHES AIRCRAFT COMPANY

*Culver City, El Segundo, Fullerton, Newport Beach Malibu and Los Angeles, California; Tucson, Arizona*

# Subscription TV

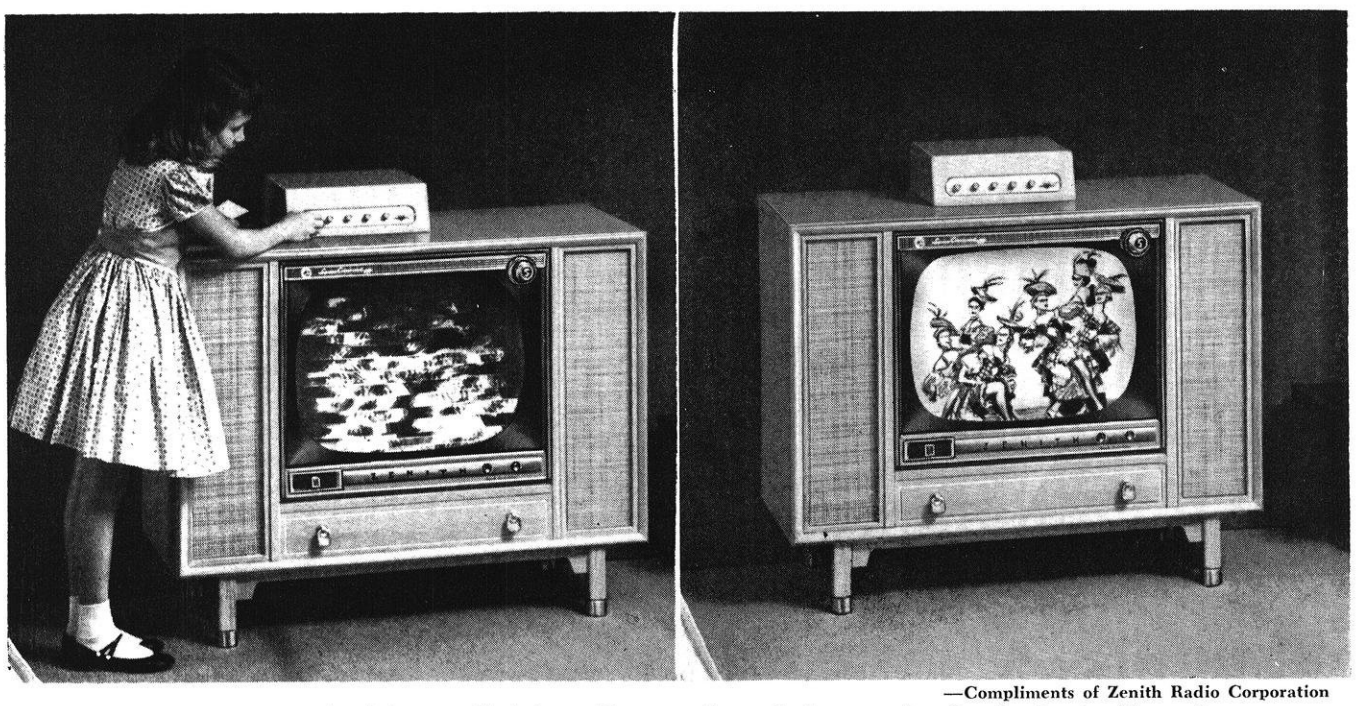
*by Robert W. Trefz, C.E. '61*

SUBSCRIPTION television is a system whereby those people who wish to can see a better class of video entertainment in their own homes, provided that they are willing to pay the cost of this entertainment. They may see first run movies, top sports events, and Broadway plays in the comfort of their own living rooms. It is the intent of the sponsors of subscription television that it should be used as a supplement to our present television system and to the motion picture theaters.

Actually, there are many questions that have to be answered before subscription television can become a reality. First of all, a decision must be made as to which one of the three major systems should be used. Secondly, what types of programs should be given to subscription television and what types should be reserved for free television must be decided.

### The Zenith System

The subscription television system that has been developed by the Zenith Corporation is one of the more popular of the three systems that are being tested at the present time. Under the ideal situation, the Zenith system will employ the principle of broadcasting a scrambled picture (as will the other three systems). The decoder, a box through which the scrambled picture signal is sent, contains groups of electrical circuits which unscramble the picture signal. Since each movie will have a different scrambling pattern, the decoder will have to be set at a different setting for each new program. This is done by turning a battery of five knobs, each with seven different settings. These code settings are contained within a punch card that the subscribers receive through the mail. For each program there is a punch mark, behind which is found the correct settings. To prevent people from "beating the system," each decoder will have slightly different circuits, thereby requiring the use of different settings on all decoders in a area. There is, however, a remote possibility that someone will guess the right combination, thereby cheating the company out of its fee. This is not thought to be a very great problem since there are sixteen-thousand different combina-



—Compliments of Zenith Radio Corporation

**Pictures are transmitted in scrambled form. Picture and sound clear up after decoder is set with number from the subscriber's decoding card.**

tions that can be made with the decoder. Because of this large number of combinations it seems very doubtful that many subscribers will be lucky enough to find the right combination very often.

With the Zenith system the billing is quite simple. After a rental fee for the decoder is paid, the subscriber is billed according to the number of punches that have been made in his card. Since these cards are small and light, it is extremely practical to make all business transactions through the mail. Besides making the process of billing much cheaper by eliminating the need for door to door collections, the use of the mails is much more convenient for the subscribers.

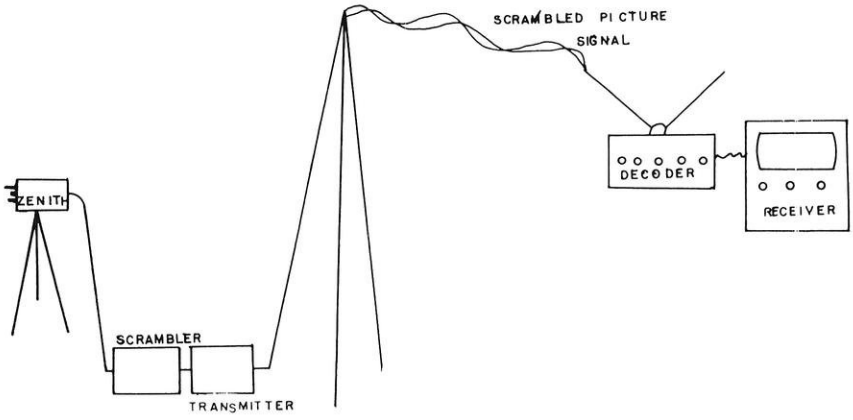
An alternate method of distributing the code numbers to the subscribers is to have the subscribers telephone a special operator who will, at the same time make a record of what code for which program the subscriber has received. This would eliminate the need for the punch cards, but would involve the hiring of extra help. This method has been proven very successful on small scale tests, but it is generally agreed that in areas of large numbers of subscribers this method would not be practical.

### The Skiatron System

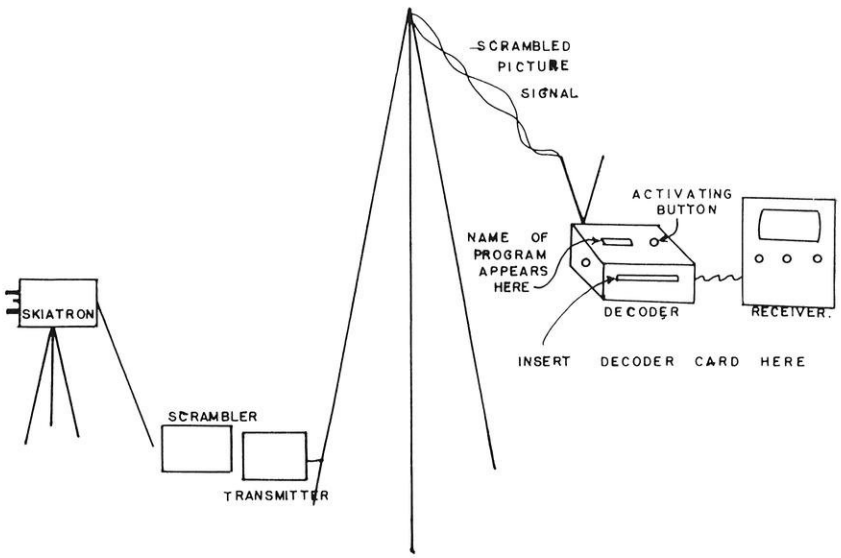
The Skiatron system will operate in the same manner as does the Zenith system except for the decoder. With the Skiatron system the decoder is activated by a card containing printed circuits which the subscriber receives through the mail. The viewer inserts this card into the decoder until the program desired appears in a little window of the decoder. At this point the viewer depresses a button that puts the correct decoding cricuit into the circuit carrying the scrambled picture and automatically marks the card to show which programs are seen. After the circuits on the card are used the card is returned to the company to facilitate billing.

### The Telemeter System

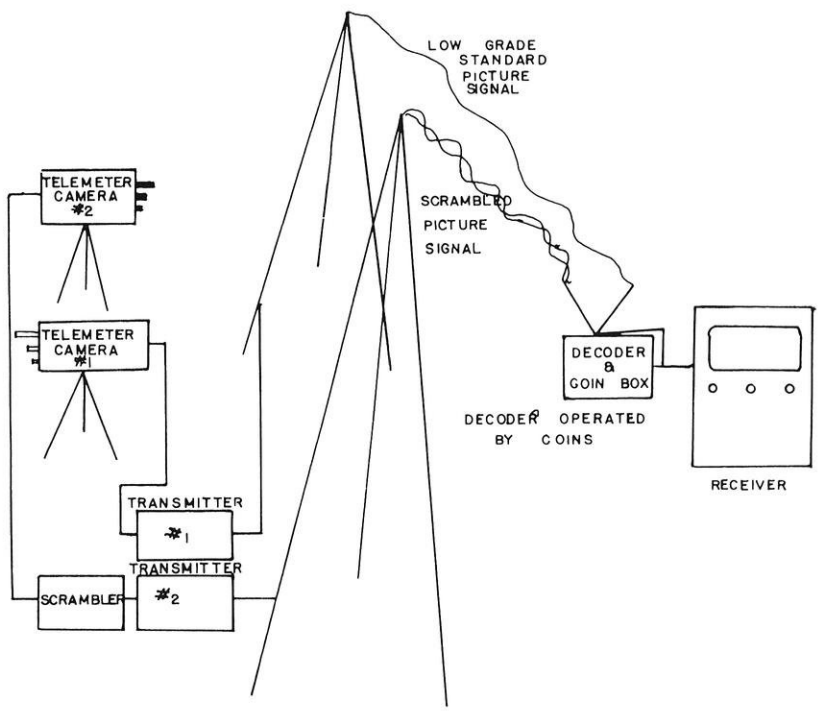
The Telemeter system is by far the most complicated of the three systems from the technical standpoint. It is the only system that requires the installation of completely new broadcasting equipment, for




The Zenith System.




The Skiatron System.




The Telemeter System.

this system involves the broadcasting of two different pictures at the same time. This is done by sending out the two pictures over the same channel at slightly different frequencies. The first of these pictures is free and is the "Barker." That is, this picture advertises the main picture. This picture will be of a low quality and will have no other use but as an advertising medium. If the subscribed wishes to see the main picture he must turn on the decoder by inserting coins in a timer switch. Besides the timer switch and coin box, the decoder also contains a memory unit that credits the subscriber with any time that might be due to him if he does not wish to view an entire program.

There is not billing for this system as such since it is on a pay as you go basis. By eliminating the need for billing, another problem arises, however. That is the need for having people go from house to house to empty the coin boxes and to refill the memory unit with fresh tape.

On small scales, the use of the complex broadcasting equipment can be eliminated by using telephone cables to carry the signals. Because of the high cost of telephone transmission cable, this alternate method is not practical on a large scale.

### Subscription Television Field Tests

By far the most famous test of subscription television is that of Bartlesville, Oklahoma. This is where the Telemeter people tested their system while everyone watched to see how the general acceptance of subscription television would be.

The experiment began in October of 1957, with the company offering twelve first run and thirteen second run movies a month to its 550 original subscribers. For this service, the subscribers were charged a flat rate of $9.79 per month. These films were shown continuously from 1 P. M. to 11 P. M. over closed circuit telephone lines with the feature changing every two or three days. In an attempt to create more interest the rates were soon changed to $3.50 base cost per month plus $0.65 for every movie viewed in excess of six per month. As a final attempt to save the experiment the service was cut to four hours per night with five films offered each week at a cost to the subscribers of $4.95 per month. Even this did not work and the experiment finally ended in June of 1958 in failure.

The reasons that subscription television in Bartlesville did not meet with better public acceptance are:

1. Many people felt that they could see the same pictures on free television if they would wait.
2. Others missed the excitement of dressing up to go out to the movies.

Subscription television experiments in other areas had better results. The Telemeter testing in the Palm Springs, California, area seemed to be quite successful. Here the 574 subscribers watched first run movies, football games, and Broadway plays from the comfort of their own livingrooms. For this service, the subscribers were willing to pay anywhere from $1.00 to $1.35 to see these shows. The critics given the following reasons for the success in this area:

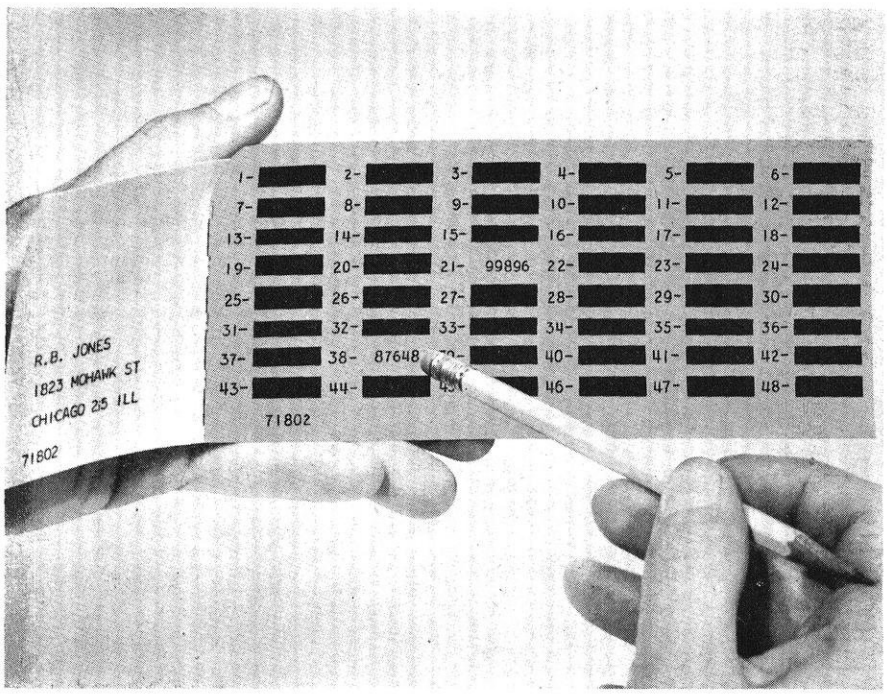
1. There was much more variety of programing in Palm Springs than there was at Bartlesville.
2. Palm Springs, being a modern metropolitan area, had less trouble adapting itself to this new mode of entertainment.

In the Chicago area, the Zenith system met with much the same success as was found at Palm Springs. Of the five hundred people who paid an average of $8.00 per month to see first run movies in their own homes, only two expressed any dissatisfaction with the system.

### Advantages of Subscription TV

By far the greatest advantage of subscription television is that it is able to provide a better grade of programming, since it will have a greater budget with which to work. At present, the greatest handicap of free television is that its sponsors cannot afford to pay much more than one-third of the one million dollars that the average Hollywood production costs. Another great advantage of subscription television is that it will be completely devoid of advertising. A third advantage that is claimed by subscription television is that the added competition that this system will provide will have a very good influence on the quality of free television programming.

*(Continued on page 62)*




**With the Zenith system, to reveal the decoding number for a specific telecast, the subscriber erases the screen over that listing. He then sets his decoder to the appropriate number.**

# How to advance through lateral movement

THE LATERAL PASS is a perfect example of how to get ahead by first going sideways. And lateral movement is a philosophy we use at Koppers.

Here's how it works. Let's say you're a new employee at Koppers. We give you a specific assignment. You find it exciting, challenging. You do a good job. But do we leave you there? Not at all. Once you understand the products and the function of that particular operation, we try you on a different assignment. Here, again, you'll find the work new and stimulating.

You'll never be buried at Koppers. You'll never stand still intellectually. Moving from one operation to another, you'll move ahead. Your assignment won't be to learn just a job, but a vast, diversified corporation. Your compensation? Advancement, responsibility, success.

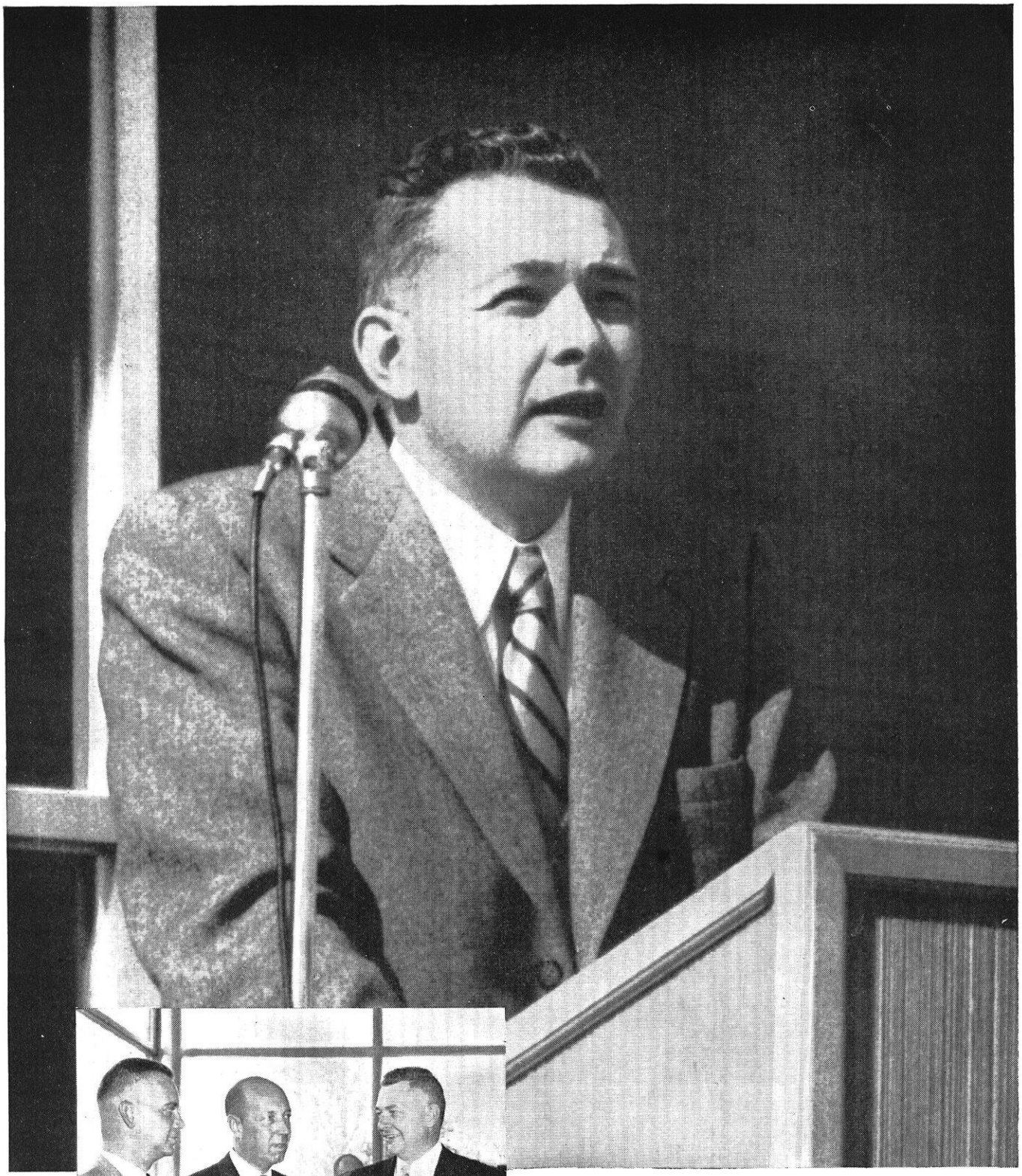
Your youth won't be held against you. Neither will short tenure. If you have the ability and the desire to get ahead, you'll move fast! Our system of continuous appraisal and evaluation is your guarantee of that.

Koppers is so widely diversified that you can almost name your job. Want to work with chemicals, jet-engine sound control, plastics, sintering plants, wood preservatives, road surfacing materials, electrostatic precipitators? Interested in research? Production? Sales? These are only a few of the fascinating opportunities at Koppers.

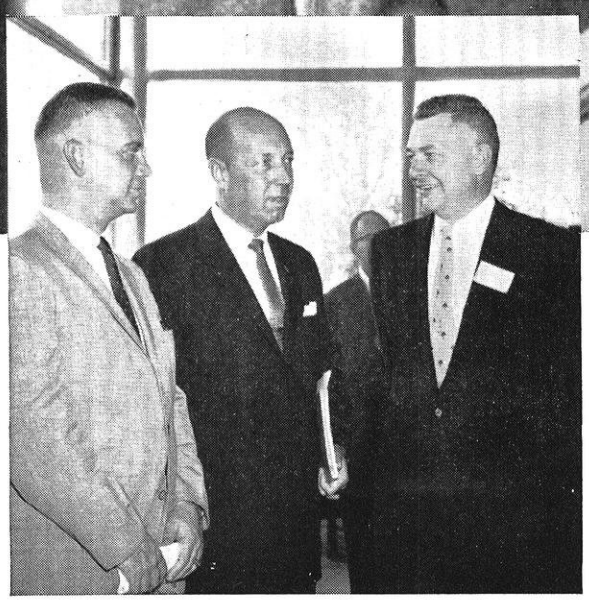
Why not find out how you can fit into the Koppers picture? Write to the Manager of Manpower Planning, Koppers Company, Inc., Pittsburgh 19, Pennsylvania. Or, see your College Placement Director and arrange an appointment with a Koppers representative for the next recruiting visit.

**KOPPERS**

KOPPERS



Could this be a picture of you tomorrow? In the fall of 1958, it was Jack Carroll, principal speaker at the opening of Electronic Associates' modern new plant in Long Branch, N. J.



Jack Carroll (*right*) discusses the new equipment he has just seen during a visit with Henri Busignies, President of ITT Laboratories (*center*) and Anthony Pregliese, ITT Public Relations.

# YOU...

## *An Editor of a Top Engineering Publication?*

### JACK CARROLL, MANAGING EDITOR OF *ELECTRONICS MAGAZINE*, ROSE TO A TOP POST IN LESS THAN TEN YEARS

***Are Jack Carroll's shoes your size?***

"If it's scope you want, try keeping on top of everything that's hot in electronics," says John M. Carroll, ELECTRONICS' Managing Editor at McGraw-Hill Publishing Company.

A Lehigh B.S. graduate in 1950, Jack has become an industry authority in less than 10 years. "Knowing that the industry itself is looking to your magazine for the word on things is the most stimulating part about it. It's your job to get the thinking of the men behind everything that's new in the field. You work with the top of the profession. What engineer can resist that?"

***Wrote in College***

In his senior year at Lehigh, Jack got his first real taste of writing as editor of the college newspaper. He joined McGraw-Hill as editorial assistant on ELECTRONICS in 1950, took a 17-month "leave" in Korea, then became assistant editor in 1952 and associate editor in '54.

"By then I'd got my M.A. in physics at Hofstra on the McGraw-Hill Tuition Refund Plan, where the company pays half the cost. And since I was promoted to managing editor in 1957, I've been working after hours on my doctorate in engineering science at N.Y.U. This is an engineer's outfit. You grow right along with your industry at McGraw-Hill," says Jack.

"The engineer who chooses a McGraw-Hill career need have no fear of winding up in a corner on one part of one project. You work with the new . . . the experimental . . . the significant. Sitting down with the leaders of your field is part of the job. Your assignment? Interpreting today's advanced thinking for the rest of your field."

***McGraw-Hill Tuition Refund Plan***

All of our editors have the opportunity to continue their education in their chosen fields under the McGraw-Hill Tuition Refund Plan. Physics, economics, aerodynamics, and business management are typical of the courses they may choose.

***You May Be The Right Man***

How about writing experience? It helps, but if you like to write—and engineering is your profession—that's the main thing.

Would you like to learn what opportunities McGraw-Hill offers in your field? Write for "Careers in Publishing At McGraw-Hill." Tell us about your background, college record, outside activities and why you seek a career in engineering journalism.

Write to: The Editorial Director, McGraw-Hill Publishing Co., Inc., 330 West 42nd Street, New York 36, New York.

**McGraw-Hill**

PUBLICATIONS

# Utilization of Solar Energy

*by Lee H. Zimmerman, ME '61*

**Solar energy has a great future as a potential source of small-scale power for our mechanized society. The economical utilization of this power remains a challenge to the engineer.**

MAN, as long as he has lived on earth, has been constantly searching for new and better sources of energy. The discovery and utilization of the energy locked in coal, oil, natural gases, and various other sources have led to the development of society which is enjoyed today. At the present time, however, man is faced with perhaps the biggest problem in his history. The old supply of fuels is being depleted at such an alarming rate that new sources of energy must be found if he intends to continue his present mechanized way of living.

The source most likely to fill the future needs of small-scale power is that obtained directly from the sun. The idea of direct utilization of solar power is not a new one, and various historical records show that many solar devices were invented in the past.

There are two main devices used to collect solar energy—the flat-plate collector and the focusing collector. The former collects both direct and diffuse radiation and can be mounted as an integral part of a building. It is cheap and easy to construct, but only low temperatures can be obtained. The latter uses mirrors to collect and concentrate a large amount of solar energy on a small area. It is expensive to construct and hard to maintain, but the temperatures obtained can be very high in many cases. Flat-plate collectors are used primarily in home heating, while focusing collectors are used in solar furnaces and other high-temperature devices.

Solar energy may be stored in two ways. In thermal storage, a medium such as water is heated during the operation of the solar collector and acts as a reservoir when the collector is not in operation. In chemical storage, a salt with a low melting point and high heat of fusion is used. The salt is melted when the collector is in operation, and when the collector is not operating the salt fuses giving off a certain amount of heat.

Many devices can be made which will be able to use solar power. Among these are solar engines, solar ovens and cookers, refrigeration units, and stills.

The future of solar energy is bright at the present time due to new developments and the increasing scarcity of old fuels. Only time and experimentation, however, will tell how bright that future will become.

## TYPES OF COLLECTORS

At the present time we have two main types of devices for the collection of solar energy. These are the focusing collector and the flat-plate collector.

### Flat-Plate

A flat-plate solar collector consists mainly of a flat surface of high absorptivity which collects the solar energy and a heat-transfer medium which removes the heat for useful purposes. In this system the heat-transfer mechanism consists of copper tubing coated with black insulation. The heat is collected by the black insulation and is transferred to copper tubing through which water flows. The copper tubing being an excellent thermal conductor transfers the heat to the water which in turn may be utilized in a variety of ways. The sys-

tem is surrounded by an insulating jacket to prevent conducting losses and glass cover plates to prevent convection and reradiation losses. The reduction in heat loss from the absorbing surface to the atmosphere far exceeds any transmission losses, resulting in a net gain in the total heat collected.

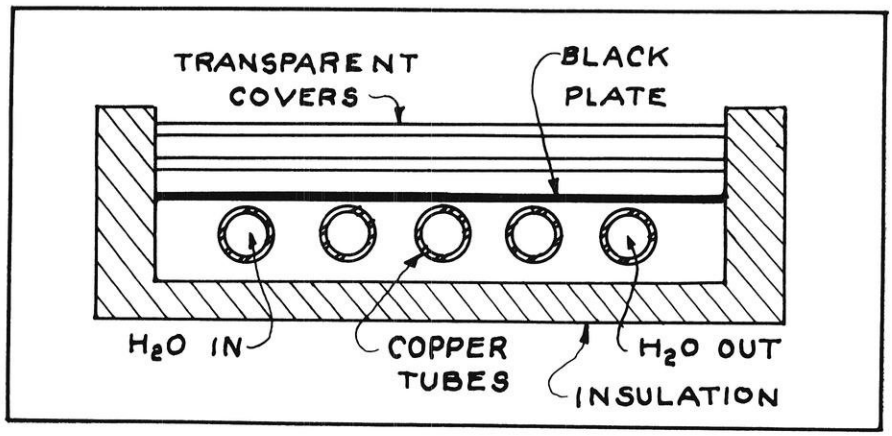
The optimum number of plates depends upon the intensity of the incident and the temperature of the heat collection. The relationship between cooling loss and the number of plates is given by the equation:

$$HC = C(t - t_a)^{1.3}$$

Where HC is the cooling loss in BTU per sq. ft. per hour, t is the temperature of the system in °C, $t_a$ is the ambient temperature in °C, and C is a constant, dependent upon the number of plates. Values of C are tabulated below:

| Number of plates | C |
|---|---|
| 1 | 0.42 |
| 2 | 0.30 |
| 3 | 0.22 |

It is generally accepted that two plates give the most economic results considering the cost of a third plate and actual reduction in cooling loss obtained.



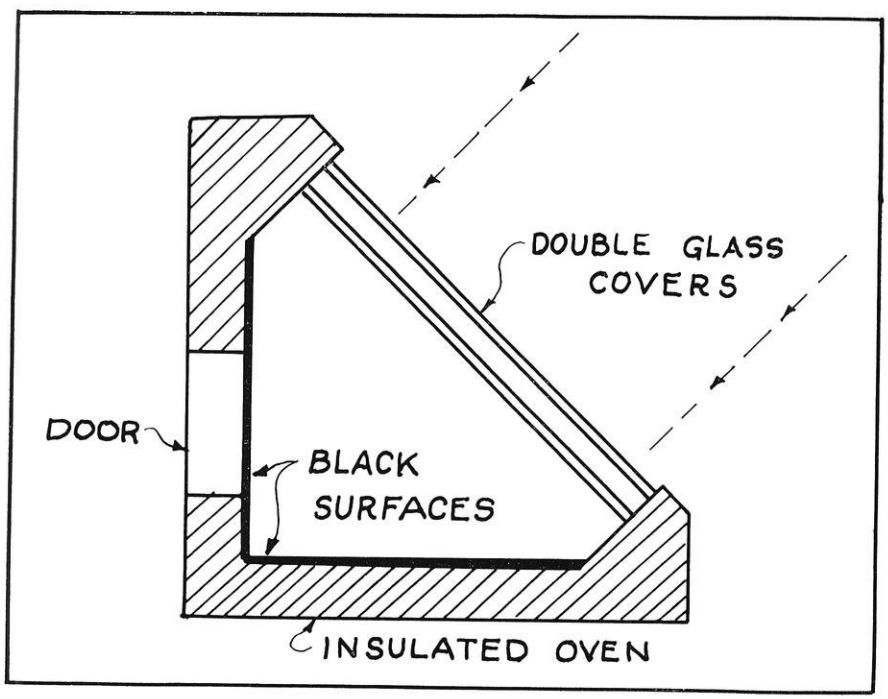

Flat plate collector. (M.I.T. $H_2O$ Heater)

The overall energy balance equation for a flat-plate solar collector may be given by:

$$HRT\delta = g_o - g_u + g_e$$

Where H is the rate of incidence of solar energy on the horizontal plane, R is the ratio of solar radiation on the tilted surface to that on the horizontal surface, T is the transmittance of the system of glass cover plates, $\delta$ is the absorptivity of the receiver, $g_o$ is the rate of absorption of energy by the receiver per unit area of collector, $g_u$ is the useful collected energy and $g_e$ is the rate of heat loss from the collector per unit area.

Flat-plate collectors have a distinct advantage over other types in that they collect both direct and diffuse radiation, and therefore do not have to be oriented to follow the path of the sun. They are also least expensive construction wise of the collecting devices. The big drawback is that only relatively low temperatures, up to 300° F, may be obtained. Flat-plate collectors are in moderate use in Florida and California at the present time as heaters in homes.



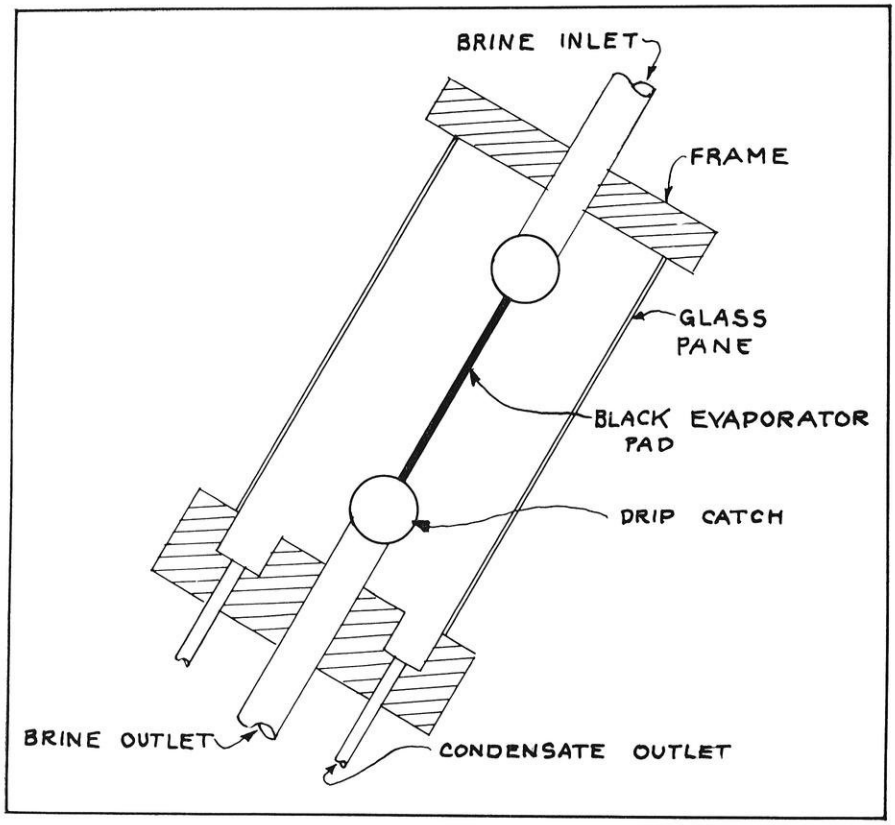

Solak oven.

### Focusing

The focusing-type of solar collector is essentially a flat-plate device surrounded by curved or multiple flat reflecting surfaces which concentrate direct solar radiation on a small area. Since this type of collector is dependent upon direct radiation, it must be oriented to follow the sun to obtain any kind of performance.

The most common of the focusing collectors is the parabolic reflector, which focuses on a point and must be oriented on two axes of rotation. Parabolic reflectors are capable of producing high temperatures, up to 4000° C, and are used in solar furnaces and other high temperature devices.

Another type of focusing collector is the cylindrical-parabolic reflector, which focuses on a line and requires but one axis of rotation. This type is less efficient than




Solar distiller.

the parabolic reflector, not being able to obtain as high temperatures, but due to its lower cost is often used where moderately high temperatures are desired.

The primary consideration in the construction of a focusing collector is the high cost of the reflecting surface. In older types aluminum or copper were the principal materials used. They were so expensive and hard to maintain that for a while there was little hope that a reflecting-type collector could be produced cheaply enough for practical use. Recently, new surface materials of metallized plastics such as polystyrene or polyethylene, which are inexpensive and easy to clean, have been developed.

### Energy Storage

After collecting the solar energy it must be stored in some way; therefore it is necessary to consider the aspect of energy storage. At the present time there are two generally accepted methods in use; thermal storage and chemical storage.

### Thermal

Thermal storage consists of heating a medium such as water which will act as a heat reservoir when the solar collector is not in operation. Two media for storage of heat have been tried experimentally. The first makes use of insulated tanks of water which are heated during the day by the flow of heat-transfer fluid from a flat-plate collector. At night, this heated water may be pumped through radiators to continue the heating process.

In the second method, gravel is heated by hot air from the collecting device during the day, and in turn heats the air when the device is not in operation. Both of these have been used in the United States and Canada.

### Chemical

Chemical energy storage consists of melting a salt which has a low melting point and a reasonably high heat of fusion. When the energy supply from the solar collector is cut off, the salt will begin to fuse and for every pound that does, a certain amount of heat will be given off. This may be transferred to the system to maintain the heating cycle. Two examples of salts with the desirable properties are Glauber Salt which melts at 95° F and has a heat of fusion of 104 BT per pound and disodium phosphate diodecahydrate which melts at 97° F and has a heat of fusion of 94 BTU per pound.

The capacity of a thermal storage unit is dependent upon such factors as the time of storage, the amount of auxiliary energy required to insure a constant source of heat and a minimum storage temperature. The capacity of a chemical storage unit is also dependent upon the cost of the salt and its durability.

### Solar Devices

Now that the basic principles of energy collection and storage have been considered, some of the specific applications and devices will be discussed. As previously mentioned, the greatest possible future use of solar energy is in the heating of homes. One-third of the total United States energy demand is for home heating. In fact, according to a Truman administration report in 1950, it is estimated that there will be 13 million solar-heated homes in our country by 1975.

### Solar Cooker

Solar energy is utilized directly in solar ovens and solar cookers. The solar cooker is a very simple device consisting of an altazimuth mounting which supports a parabolic reflector and a cooking vessel. The rays of the sun are focused on a point directly beneath the vessel, thus providing the necessary heat for the cooking. The altazimuth mounting may be directed by hand to obtain the direct rays of the sun. Such cookers are in use in India at the present time and sell for about $15.00.

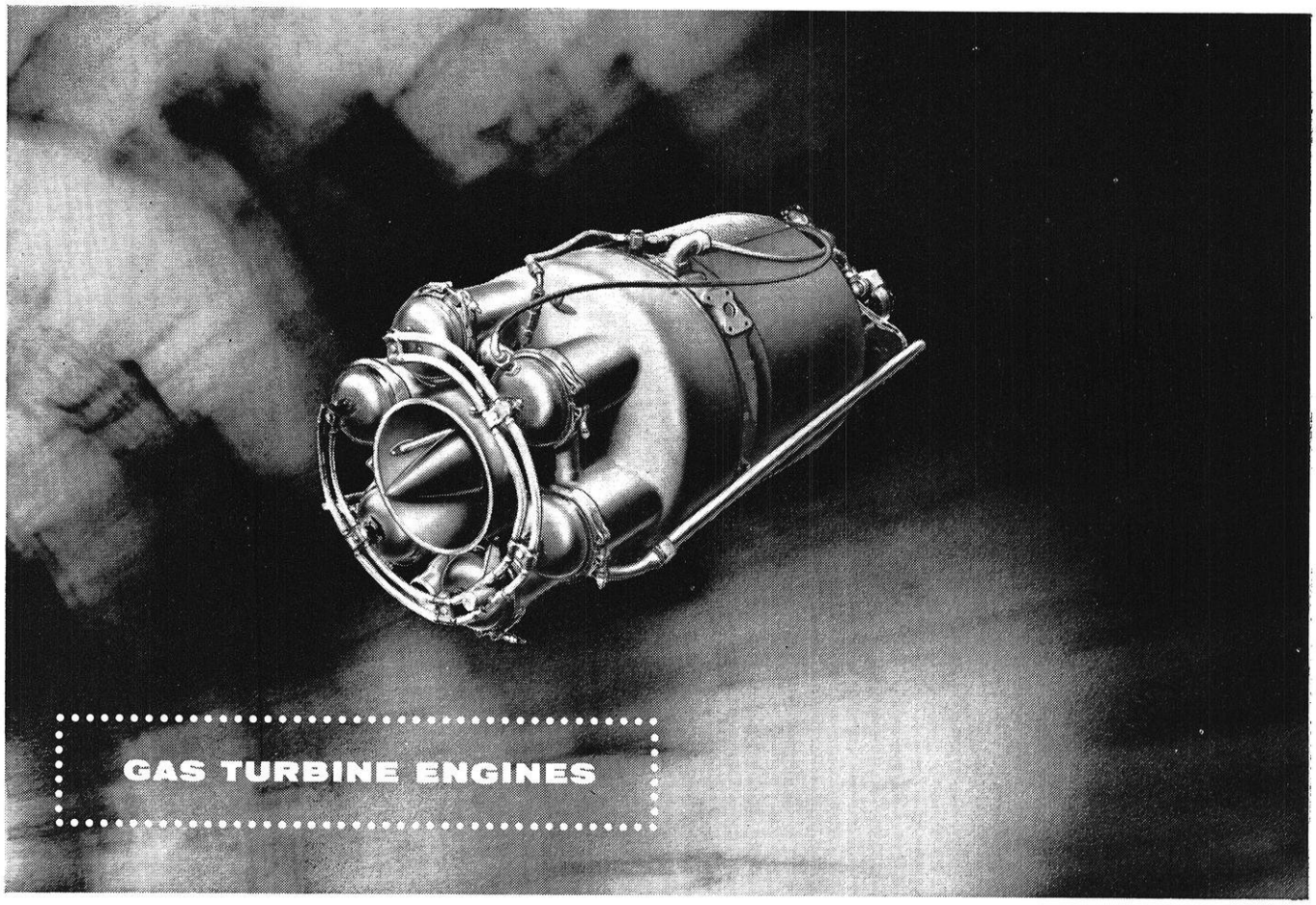
### Solar Oven

A solar oven is essentially the same type of device except that the heating area is enclosed by an insulated material and glass covers. Black surfaces absorb the energy from the rays of the sun which strike the device, thus providing the necessary heat for cooking. The solar oven makes use of both direct and diffuse radiation, and does not require an orientation system to follow the sun.

### Freezer

Another useful application of solar energy occurs in the field of cooling and refrigeration. There is an excellent correlation between

*(Continued on page 64)*




• The small gas turbine is an important aircraft support item used primarily for starting jet engines and providing on-board auxiliary power. The high compressed air and shaft outputs for its small size and weight mark it as an important power source for common commercial use. AiResearch is the largest producer of lightweight gas turbines, ranging from 30 H.P. to the 850 H.P. unit pictured above.

## EXCITING FIELDS OF INTEREST FOR GRADUATE ENGINEERS

Diversity and strength in a company offer the engineer a key opportunity, for with broad knowledge and background your chances for responsibility and advancement are greater.

The Garrett Corporation, with its AiResearch Divisions, is rich in experience and reputation. Its diversification, which you will experience through an orientation program lasting over a period of months, allows you the best chance of finding your most profitable area of interest.

*Other major fields of interest include:*

• **Aircraft Flight and Electronic Systems** — pioneer and major supplier of centralized flight data systems and other electronic controls and instruments.

• **Missile Systems**—has delivered more accessory power units for missiles than any other company. AiResearch is also working with hydraulic and hot gas control systems for missile accessory power.

• **Environmental Control Systems** — pioneer, leading developer and supplier of aircraft and spacecraft air conditioning and pressurization systems.

Should you be interested in a career with The Garrett Corporation, see the magazine "The Garrett Corporation and Career Opportunities" at your College placement office. For further information write to Mr. Gerald D. Bradley...

THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

*Los Angeles 45, California • Phoenix, Arizona*

*Systems, Packages and Components for:* AIRCRAFT, MISSILE, NUCLEAR AND INDUSTRIAL APPLICATIONS

## Leonardo da Vinci...on experiments

"I shall begin by making some experiments before I proceed any further; for it is my intention first to consult experience and then show by reasoning why that experience was bound to turn out as it did. This, in fact, is the true rule by which the student of natural effects must proceed: although nature starts from reason and ends with experience, it is necessary for us to proceed the other way around, that is — as I said above — begin with experience and with its help seek the reason.

Experience never errs; what alone may err is our judgment, which predicts effects that cannot be produced in our experiments. Given a cause, what follows will of necessity be its true effect, unless some external obstacle intervenes. When that happens, the effect that would have resulted from the cause will reflect the nature of the obstacle in the same proportion as the obstacle is more or less powerful than the cause."

—*Notebooks, circa 1500*

*THE RAND CORPORATION, SANTA MONICA, CALIFORNIA*

A nonprofit organization engaged in research on problems related to national security and the public interest

# SIX PERTINENT QUESTIONS TO ASK THE ALCOA RECRUITER WHEN HE VISITS WISCONSIN

## *Here's What You May Want to Ask About Opportunities at Alcoa*

1. Where can I go in Alcoa with my type of degree?
2. In what part of the country would I be located?
3. What kinds of training programs will I participate in at Alcoa?
4. What are my starting salary prospects?
5. Will Alcoa pay my moving expenses?
6. What are my chances for advancement with Alcoa?

## *And Here's What We Answer:*

1. There are openings at Alcoa each year for graduates with many types of degrees. Graduates in mechanical, metallurgical, electrical, industrial, chemical and civil engineering have a wide choice of opportunities in engineering, production, research, development or sales engineering. There also are openings for chemists for research and for business administration and liberal arts graduates in accounting and sales.

2. Geographical location will depend on your field. New engineering, production and accounting employees are assigned to one of 30 Alcoa operating locations throughout the nation. New sales engineering and sales administration employees, after completing a six-month training program, go to one of Alcoa's 72 sales offices. If your field is sales development or process development, you will be located in New Kensington, Pa., or Cleveland, Ohio. Main research laboratories are located in New Kensington, with branches in Cleveland, East St. Louis, Ill., Massena, N. Y., and Chicago.

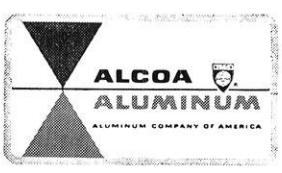
3. Alcoa has a training program for each new employee. Engineering and production training involves orientation and rotation of assignments for approximately one year. Sales training is conducted in sales offices and in nine plant locations over a six-month period. Accounting training calls for rotation of assignments for 18 to 24 months.

4. Alcoa's starting salaries are competitive with those of other companies. An initial salary is established for a basic four-year degree. Additional credit is given for outstanding personal qualifications, advanced educational training, military service and previous work experience. Future salary progress is based on your own performance and growth potential.

5. Alcoa pays transportation and moving expenses for you and your family. This applies to your first and all subsequent assignments.

6. Alcoa personnel policies assure individual recognition for you. They include regular performance appraisals, individual opportunity for advanced management training, confidential and individual salary consideration and promotion entirely from within the company.

If you'd like to find out more about employment opportunities with Alcoa, contact your placement officer to arrange a campus interview. Mutual interest will result in further interviews at an Alcoa location. For more details immediately, write Manager, College Recruitment, 810 Alcoa Building, Pittsburgh 19, Pa., for the new booklet, *A Career for You With Alcoa.*




Your Guide to the Best in Aluminum Value

For exciting drama watch "Alcoa Presents" every Tuesday, ABC-TV, and the Emmy Award winning "Alcoa Theatre" alternate Mondays, NBC-TV

# Synthetic Diamonds

**The recent development of synthetic diamonds is one of the important discoveries of our time. Synthetic diamonds can not be used for jewelry, but they have unlimited industrial value.**

*by Charles B. Pope, ME '60*

## HISTORY OF SYNTHESIZING DIAMONDS

THERE have been many attempts at making diamonds throughout the years, but few of them have been considered anything but frauds. These attempts, however honest they were, suffered from the theory of the day that diamonds could not be made by man.

### Initial Attempts at Synthesizing Diamonds

The first recorded claim of making diamonds was by J. B. Hannay in 1880. He claimed that he had synthesized diamonds by heating a mixture of hydrocarbons, bone oil, and lithium at red heat in a sealed wrought iron tube. A great many difficulties were experienced in the experiment because of exploding tubes; only three out of eighty held. Hannay identified his results as diamonds because they had a density of 3.5 grams per cubic centimeter and a carbon content of 97.85 per cent.

There was a great deal of doubt about Hannay's results. This is brought out in an article in the CHEMISTRY NEWS in 1906 in which Hannay takes the Encyclopedia Britannica to task for calling his diamonds carborundum. However, diamonds believed to be Hannay's were X-rayed at the British Museum by Bannister and Lonsdale and found to be true diamonds of a rare type.

Another man to claim he made diamonds were Henri Moissan. He dissolved sugar charcoal in molten iron and quenched the solution in cold water. This supposedly crystallized the carbon under the great internal pressure generated by contraction as the mass cooled from the outside. The result was traces of a transparent material having the optical properties of diamonds. Moissan therefore concluded that he had made diamonds.

In 1920, Sir Charles Parsons confirmed Moissan's work. However, in 1928, C. H. Desch wrote an article in NATURE saying that Parsons had been misled.

The majority of the debate about the synthesizing of diamonds was based on Hannay's and Moissan's work until after World War II.

### Further Advancements

Through the years people came to believe that the manufacture of diamonds was impossible. This belief was retained until after World War II, when Percy W. Bridgman of Harvard University began experimenting with extremely high pressures. Bridgman tried to produce a diamond but lacked the high temperatures required. Bridgman's work, although it was unsuccessful, renewed interest in high pressure and temperature work, and also in synthesizing diamonds. He was awarded the Nobel Prize in 1946 for his efforts.

Although Bridgman's experiments renewed interest in the synthesizing of diamonds, people still believed that it was impossible to reproduce an actual one. This belief continued until February of 1955, when General Electric displayed its diamonds. There has been no doubt as to their authenticity.

### Vilella and Tomarkin's Claims

Soon after General Electric had announced its discovery, two men claimed that they had synthesized diamonds in much the same manner. One of these men was a Swiss born biophysicist named Tomarkin and the other was a graduate of chemistry from San Juan, Puerto Rico, named Vilella. Their process was similar to General Electric's but on a smaller scale. They converted a barn in northern New York into a laboratory, and used a 300 ton press as their source of high pressure.

They claim that in the fall of 1952 they first synthesized diamonds, but as it was only in the form of dust, they were going to withhold their fiindings until they could produce larger diamonds. Their results were analyzed by the Polytechnical Institute of Brooklyn and found to be true diamonds.

## PROPERTIES AND TYPES OF DIAMONDS

The properties of diamonds are quite outstanding and unique. These properties not only make them valuable as ornaments, but also as tools of industry.

### The Properties of Diamonds

The first property of a diamond that usually comes to mind is its hardness. It is a well known fact that diamonds can scratch glass; in fact, diamonds can scratch any substance known to man. The only substance, on the other hand, that can scratch a diamond is another diamond. A second property is its lustre. The lustre is caused by the diamonds high index of refraction. Its index is 2.419 as compared to that of glass which is 1.4

A third fairly important property is the diamond's high thermal conductivity. It is of the same thermal order of magnitude as metals and 50 to 100 times higher than quartz or ordinary rocks. In fact, it is even better than iron or copper.

Other important properties are:

1. Its unique X-ray diffraction pattern.
2. Its density of 3.5 grams per cubic centimeter.
3. Its inertness to chemical attack at room temperature.
4. Its poor electrical conductivity.

## THE VARIOUS TYPES OF DIAMONDS

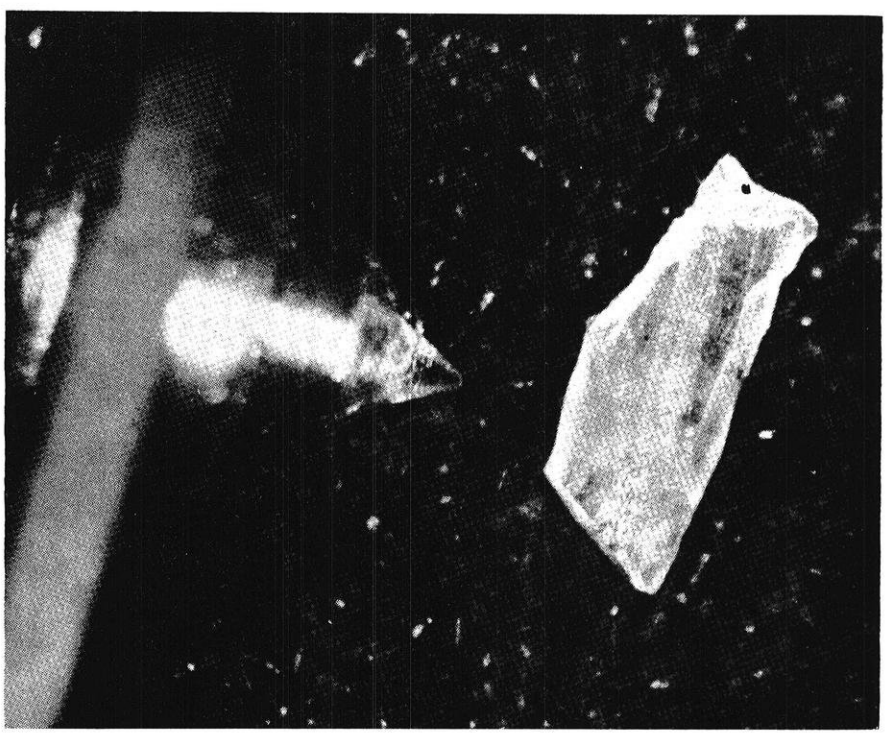
There are several types of diamonds. The most familiar of these is the *gem*, which is blue-white and flawless. Anything smaller than a "chip" is in the industrial class no matter what its color or how clear it may be. Other forms of diamonds fall into the following classifications:

1. The *Bort* is an imperfectly crystallized or coarse diamond. This classification often includes the fragments left in cutting gem diamonds. It is a general term used to designate diamonds for industrial purposes.
2. The *Ballas* is a variety of stone having no well defined cleavage planes, and is exceptionally tough.
3. The *Octahedral diamond* is one having eight sides and natural cleavage planes. Each of the eight sides is an equilateral triangle.
4. *Carbonado* are black diamonds used for cutting tools.
5. *Diamond* dust is composed of finely pulverized diamond particles.

A difference in *gem* diamonds was discovered a few years ago. The majority of gems, about 95 per cent, do not glow when subjected to ultraviolet light. These diamonds are called type 1. The remaining diamonds do glow under ultraviolet light, and therefore fall into the second, or type 2, group. However, all of the diamonds in the second group are not the same. One type, 2A, stops glowing as soon as the light is removed. The other type, 2B, is phosphorescent or, in other words, continues to glow for a short time after the light is removed. Type 2B is the most stable of the diamond family and is the only one that conducts electricity.

## THE GENERAL ELECTRIC PROCESS

On the 15th of February, 1955, the General Electric Company announced that it had successfully synthesized diamonds. At first it was thought that the diamond industry would be completely revolutionized. However, as more information such as their size and cost was released, the public's first impression was changed. Although the diamonds were small and their cost was high, Dr. Guy Suits, G. E. Vice President and Director of Research called the synthesis of diamonds "one of the landmarks in man's search for knowledge about his world."



**Here is the largest synthetic diamond in the world as compared with a phonograph needle.**

### The Basic Problems Confronting the Scientists

Although the scientists knew that their efforts in experimenting with high temperatures and pressures would not be in vain, they were pessimistic about their success in making diamonds.

They knew that the most favorable conditions for making diamonds would be high pressure and temperatures. This is because carbon is a very refractory element and the diamond is the most dense form of carbon. However before any extensive research was begun, they had to find out the magnitudes of these pressures and temperatures. The reasons they had to be established first are: to find whether the physical conditions required would be possible, and to get an indication of the equipment that would have to be developed or obtained.

The first thing the scientists had to work with was the phase diagram for carbon. Only parts of the phase diagram are accurately established by experiments. The boundary between graphite and vapor at low pressures is very well established. However, the boundary between graphite, liquid, and vapor at high pressures is not fully accepted.

Although some of these boundaries are not firmly established, it is known that the diamond exists in the graphite-stable region if the temperatures are from 2250° to 3150° F. When the diamond is heated to temperatures above 3150° F at low pressure, it rapidly changes to graphite. This change is because the agitation is sufficient to cause the atoms to break loose from the diamond lattice and regroup in the more stable graphite form.

From the previous observations, it seemed quite feasible to produce diamonds in the region of 600,000 to 1,500,000 lbs. per sq. in. and 1350° to 5000° F. Therefore, with these figures established, the scientists were ready to start the actual work.

### The Pressure Chamber

The main factor which limits the pressure that can be reached is the pressure vessel itself. Most of the ultra-high-pressure generators are based on the principle of pushing a piston into a cylinder. If the gaskets are sound, the limiting factor is the strength of the piston and the cylinder. Just making the cylinder walls thicker does very little after the walls reach a certain thickness. After much experimentation, a system of supporting critical parts was developed which allowed pressures of at least 1,500,000 lbs. per sq. in. and temperatures up to 5000° F for long periods of time.

The problem of measuring extremely high pressures was solved by measuring the changes of electrical resistances of various metals. The metals used had rapid changes of resistance during phase transitions.

The temperatures were measured by the use of thermocouples, melting points of materials, change of electrical resistance in wires, Curie point of magnetic materials, thermocolor paints, etc.

### The Press and Its Operation

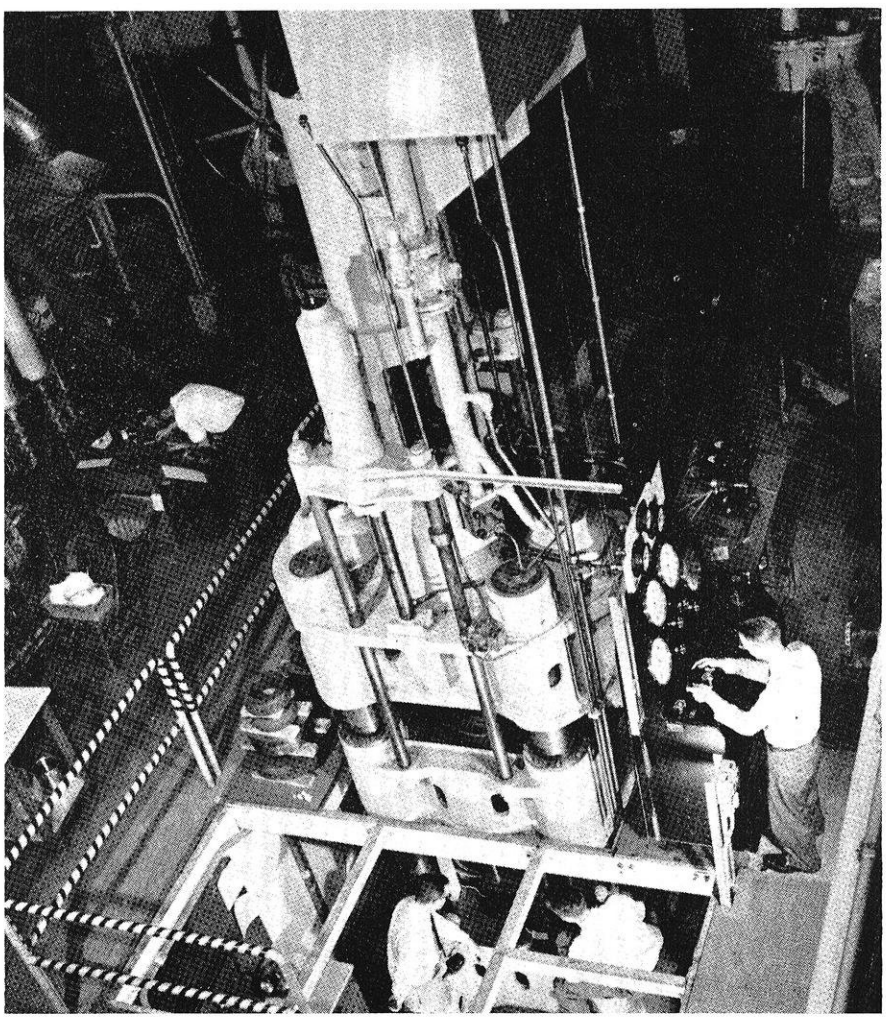
A 1000 ton hydraulic press was used to supply the pressure. This press was built by the Birsboro Steel Foundry and Machine Company. The pumps, valves, and controls used were built by Towler Brothers Ltd. of England.

A carbonaceous compound was placed in the cylinder and the heat and pressure were applied. There is no information available as to just how many times this took place before the diamonds were synthesized, but the right combination was finally found and success was attained.

### The Size of the Diamonds Produced

The largest diamond that has been produced so far is 1.2 mm long. This diamond required sixteen hours of high pressure and temperature to form. A 0.1 carat diamond was produced in a matter of minutes. Before this diamond was broken up, dozens of triangular faces could be seen. The edges of these faces have been as large as ½ mm long. That diamonds of this size are useful is illustrated by the fact that over ½ of the industrial diamonds used each year are of this size or smaller.

*(Continued on page 62)*

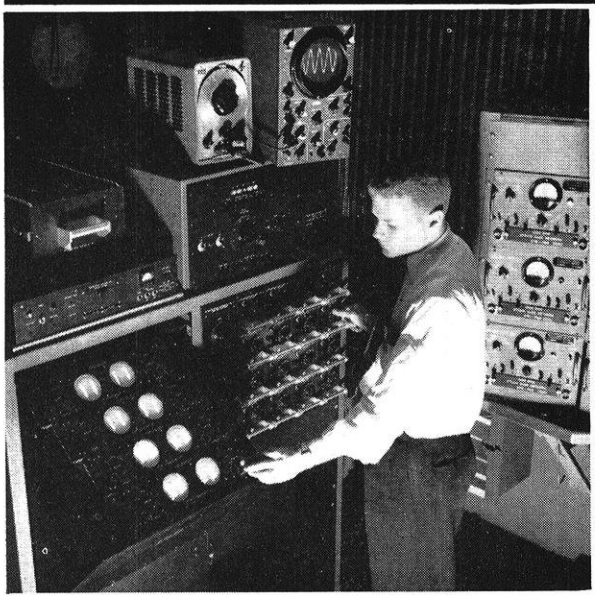


**A 1000-ton press used for achieving needed high pressures. First man-made diamonds were made on a press like this.**

# engineers

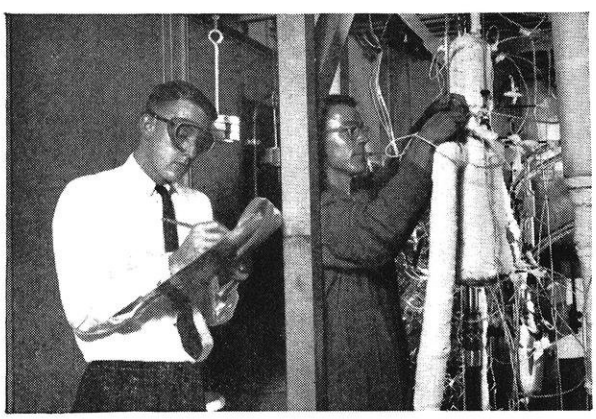
## and what they do

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



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

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



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

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

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

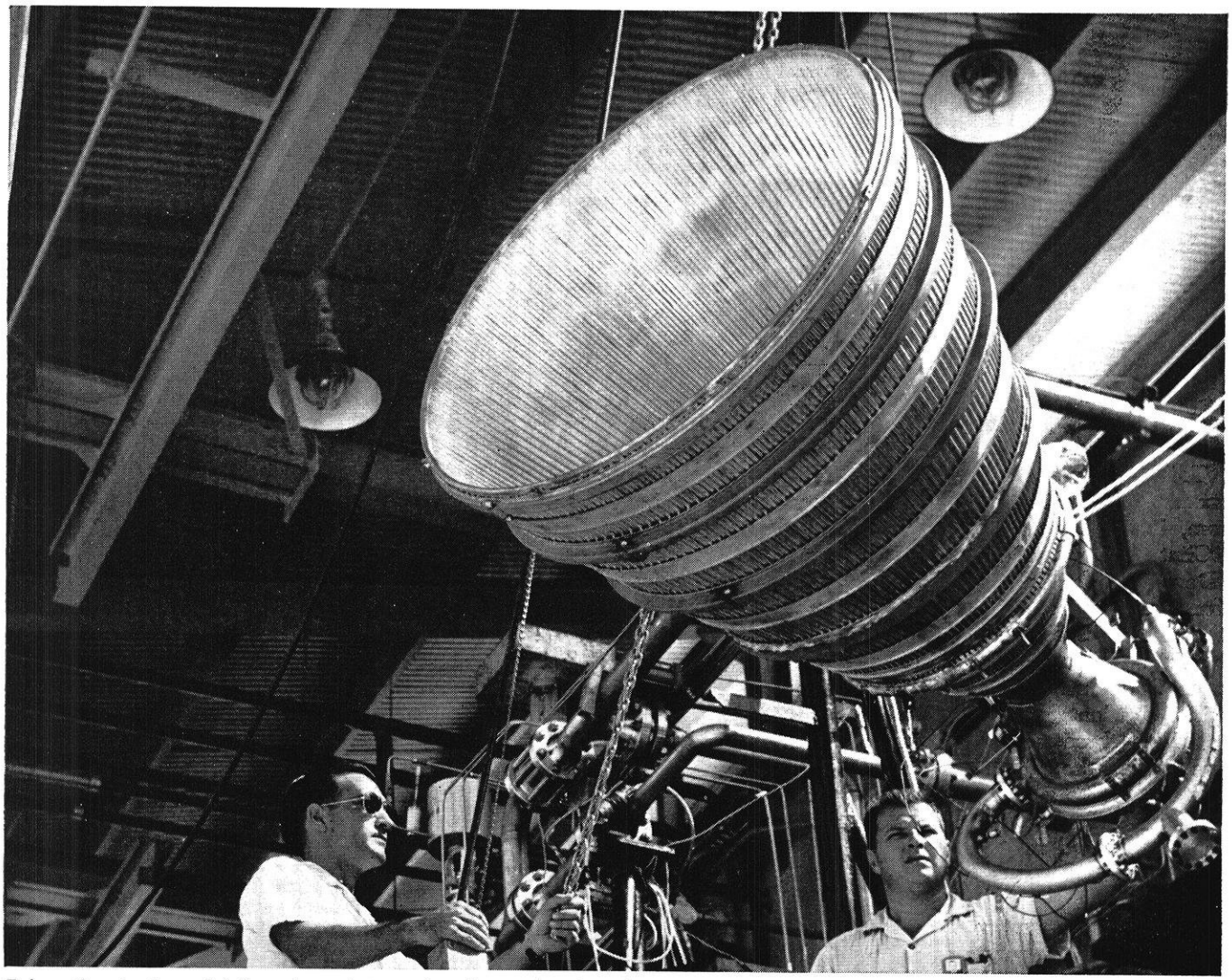
ANALYTICAL ENGINEERING Men engaged in this activity are concerned with fundamental investigations in the fields of science or engineering related to the conception of new products. They carry out detailed analyses of advanced flight and space systems and interpret results in terms of practical design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

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

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

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

# t Pratt & Whitney Aircraft...



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

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

**PRATT & WHITNEY AIRCRAFT**

Division of United Aircraft Corporation

**CONNECTICUT OPERATIONS — East Hartford**

**FLORIDA RESEARCH AND DEVELOPMENT CENTER — Palm Beach County, Florida**


# ENGINE EARS

*by Bob Helm, CE '61*

### TRIANGLE FRATERNITY

As the football season draws to a close, the Triangle members can look back on a very successful fall. The Triangle pledge class has six members including: Bill Fagerstrom, Dick Hussa, Jim Schwefel, Clint Solberg, Dave Cavil, and Dave Schonke. Informal rushing functions are being carried on for the next pledge class.

The Triangle football team is off to winning season with victories over Psi Upsilon and Delta Tau Delta. With three games left on the schedule, the Triangles are looking forward to a playoff berth.

A number of rushing smokers have been planned for the future with various speakers from faculty and industry. The purpose of these gatherings is to give members, pledges, and rushing guests a look at what industry has to offer at the end of their school years.

Triangle has hosted parties after every home football game with the biggest event so far this fall being the Marquette party. Forty Triangles from the Marquette chapter were on hand to drown their sorrows in view of the outcome of the football game.

Triangle officers for this year include:

President .....Forest Dowling
Vice President.....Donald Roeber
Recording Secretary.....Leo Feller
Corresponding Secretary ...Jack Mercer
Treasurer .....Wayne Johnson

### POLYGON BOARD

To all Engineering Students!

Although I'm not new on the U.W. scene, you may be, or perhaps I'm just new to you, so introductions are necessary. I am the Polygon Board and I am the student government of the University of Wisconsin College of Engineering. You've met me, now how do I meet you? One way is through the student activities of the Engineers but more important, I and my members get to know you through the individual societies which give me my membership. Here is my membership and their societies: A.I.E.E.—Don Martell and Myron Noth; I.R.E.—Dan Donohoo and Duane Ritchie; A.S.M.E. —Dave Gantenbein and Bill Fagerstrom; S.A.E. — Dennis Witte; A.S.A.E. — George Kerckhove; A.I.Ch.E.—Larry Dodge and Warren Haug; A.S.C.E.—Willard Peters and Dick Theil; A.I.M.E.—Jim Knabe and Tom Mueller; and my president is Bob Onan. We (my members and I) would like to have you come and join us at the society of your field and get to know other people in your field. We want you to take part in the running of your Engineering Campus and you can do this by going to your society meeting and finding out what's being planned and voicing an opinion one way or the other, this is the only way my members have of knowing your desires. As a start for your information of what is going on, here is a little explanation of some things under consideration now.

#### Outstanding Senior Award

One of the biggest projects of the year is the Outstanding Senior Award. It is just what it states; an award to the outstanding senior chosen on the basis of scholarship, activities, leadership, and character. Watch the bulletin boards around the Campus for the notices concerning this and especially when and how nominations can be made. Be thinking of your candidate for Outstanding Senior.

#### St. Patrick's "Weekend"

St. Patrick's Day is being turned into a whole weekend this year. We would like to see the *whole Campus* at the dance on Saturday night of the big weekend. The button design contest, the beard contest (longest, most devilish, most colorful, etc.), and the basketball tournament between the Engineering societies are all set up to make this the biggest weekend of the year for the Engineers and we would like to make it the biggest on (and for) the whole campus.

#### Summer Employment

We are in the process of setting up a special program to help Engineers in their search for summer jobs. The Engineers (especially the juniors and the sophomores) will be given some aids to find jobs. We recommend that those who are interested check in the Engineering Placement Office. As time progresses more companies are reporting their desires for summer workers to the Placement Office.

#### Suggestion Boxes

As many of you have noticed, there are three suggestion boxes on

the Engineering Campus; one in the E.E. building, one in the M.E. building, and one in the Drawing building (T-24). These are for your suggestions for changes or additions to the Campus and *no* suggestion is trivial.

This is it for this time but we'll see you in the societies.

From the 'Board'.

### ASME

The student branch of the American Society of Mechanical Engineers was organized by the National Society to give to student engineers opportunities to become acquainted with the practical side of engineering work and as means of contact between the students and practicing engineers. While the courses that the student engineer takes in college provide a good technical background for his chosen profession, they can not give him an accurate picture of himself as he will be after graduation. The next best thing to a magic mirror, then, is contact with engineers and with industrial concerns, and so, the main purpose of the A. S. M. E. is to help out by providing part of this contact.

Contact is accomplished in a number of ways, among which is the magazine "Mechanical Engineering," published by the Society, and with which the student may keep up on late developments in all fields of mechanical engineering. Also, during the meetings, discussions of engineering subjects, job opportunities, or problems of young engineers starting in industry are held between members and often with the aid of guest authorities. Here, excellent experience in public speaking and handling meetings may be obtained. One of the major activities of the Society is the sponsoring of field trips to nearby plants and other places of interest so that the student can see for himself the way things are done in industry and how the theoretical problems of his courses apply to actual situations.

The student branch is also designed to benefit industry in that it gives to the student engineer a little bit of "know-how" about his field and help him to better understand the role he is to play in his profession.

In these ways, the Student Branch of the A. S. M. E. at Wisconsin stands ready to help students whose interests seek out the many fields of mechanical engineering.

The Student Branch at the University of Wisconsin has an active year planned, including meetings, a picnic, a faculty night, a dinner meeting, lectures, movies, a speech contest, and many activities still in planning. This years officers are:

Jerry Jennings, President
Dave Hoffman, Vice President
Carles Veen, Treasurer
Sally Trieloff, Recording Secretary
Don Roeber, Corresponding Secretary
Dave Gantenbein and
Bill Fagerstrom, Polygon Representatives

Any M.E. interested in membership may contact any of the officers or inquire at the *Wisconsin Engineer* office, 333 Mechanical Engineering Bldg.

### AIEE–IRE NEWS

The first meeting of the student section of the American Institute of Electrical Engineers and Institute of Radio Engineers, held September 23, 1959, began with President Bill Dachelet introducing other officers.

Professors Koehler and Swift spoke on the advantages of joining either or both of the organizations.

Committee chairman include:

Mike Holly and Jim Vandehagen, Membership
Dan Donohoo, Program
Bob Lange, Refreshments
Karel Olson, Paper Competition
Frank Florence, Display case
Bob Baltes, Publicity

Don Martell, holdover Polygon Representative, gave a rundown on our position on the Engineering Exposition. We netted $200.00 while taking second place prizes.

The electronics meeting at Chicago in October was announced. The members decided to have their regularly scheduled meeting every month and an intermediate one about every two weeks. The character of these meetings will be more socializing along with movies.

There were enough refreshments for the 55 members and guests attending.

Officers of the AIEE–IRE include:

Bill Dachelet, President
Don Donohoo, Vice President
Carl Much, Recording Secretary
Duane Ritche, IRE Polygon Representative
Myron Noth, AIEE Polygon Representative
Karel Olson, IRE Corresponding Secretary
Bob Baltes, AIEE Corresponding Secretary

### SAE ACTIVITIES

Although "automotive" is the middle name of SAE, the word is broader than Webster's definition as "self-propelling." Automotive pertains not only to cars and trucks; but, also to missiles, satellites, aircraft, tractors, farm machinery, nuclear fission, body engineering, transportation, maintenance, fuels, and production techniques. If it moves on the ground, through the sea, in the air, or into outer space, it is the concern of SAE. It is the aim of the Student Chapter of the Society of Automotive Engineers, through the monthly journal, meetings, and trips, to keep its members up to date on as many of the above subjects as possible. To be more specific, a bus trip to the American Motors Proving Ground and talks on turbo jets, styling engineering, and missiles are being planned. Come and "rub elbows" with those actually engaged in the various automotive fields.

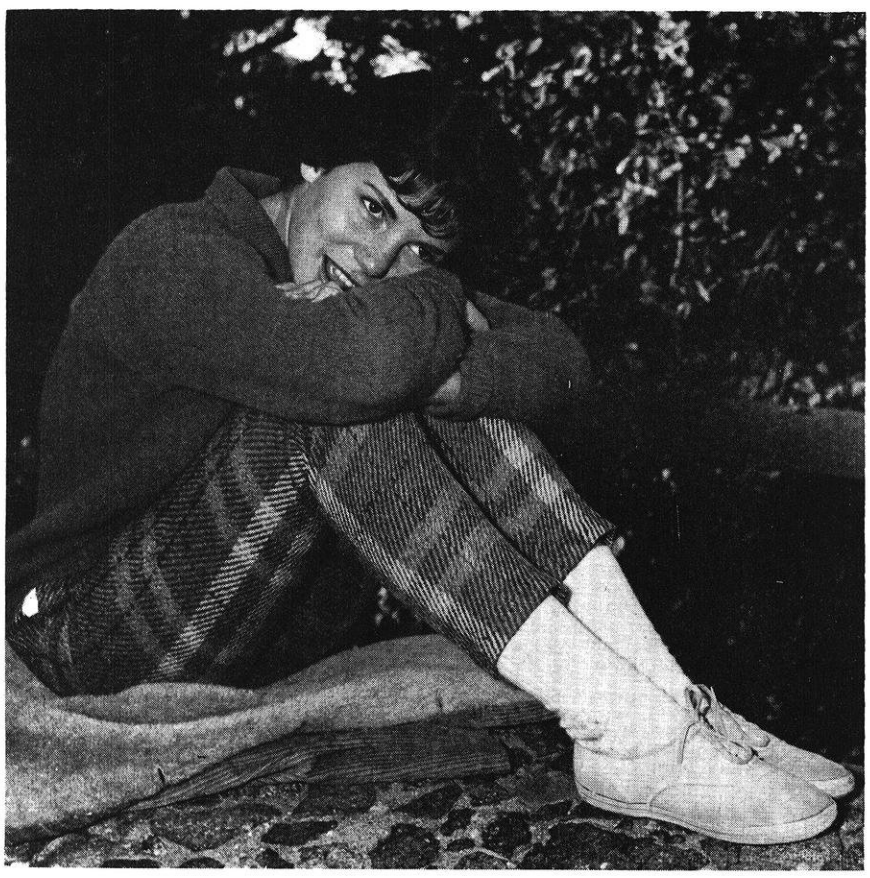
### KHK NEWS

Kappa Eta Kappa, under the direction of President Al Spangler, is again in the thick of the University of Wisconsin's social life. Pledging activities are in full swing. The KHK "Kick-off" party after the Stanford football game began a full schedule of parties. The professional aspects of the Fraternity are realized in that several prominent speakers have been invited to entertain the brothers on Monday evenings.

The officers of KHK include:

Al Spangler, President
Mike Stanke, Vice President–Executive Board
Gene Flath, Recording Secretary

*(Continued on page 63)*



# Engineers Gi

*When the frost is on the pumpkin and the football game is won,*

*You'll find our girl of the month looking very nice indeed.*

(We know it doesn't rhyme, but what can you expect from a tired old caption writer?

Barbara Sherman is the name of the young lady who is thoughtfully contemplating the arrival of brisk autumn. She majors in art education

—Photo by Peter N. Gold

# )f The Month

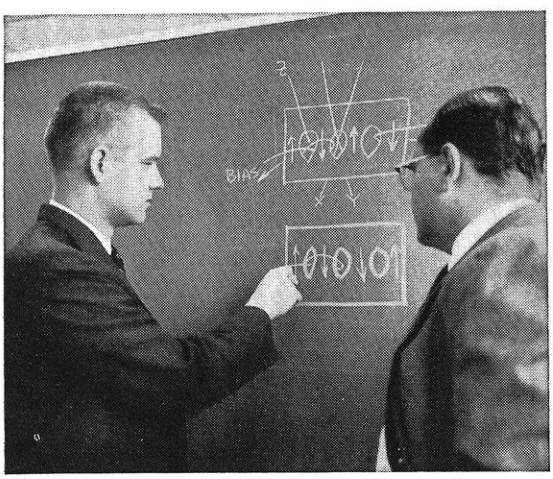
and no matter how you look at it, she does well in art, as these two pages testify.

On campus, Barbara may be found at Villa Maria, but her home is in Milwaukee.

*Here is a suggestion while you're stuck studying equations,*
*Open up your Engineer, it helps on all occasions,*
*Especially if there's a girl like Barbara Sherman inside.*
*(This one does rhyme, we'll have to confide!)*

# Product Development at IBM

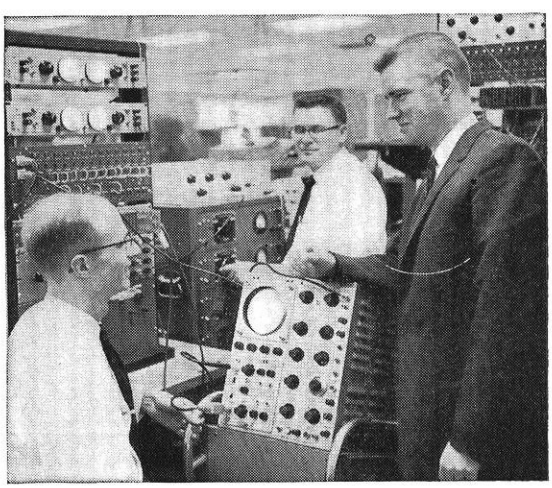
IBM Engineer Richard R. Booth explores electronic frontiers to develop new, faster and larger storage devices for tomorrow's computers.



**Computing time cut from six months to one day**

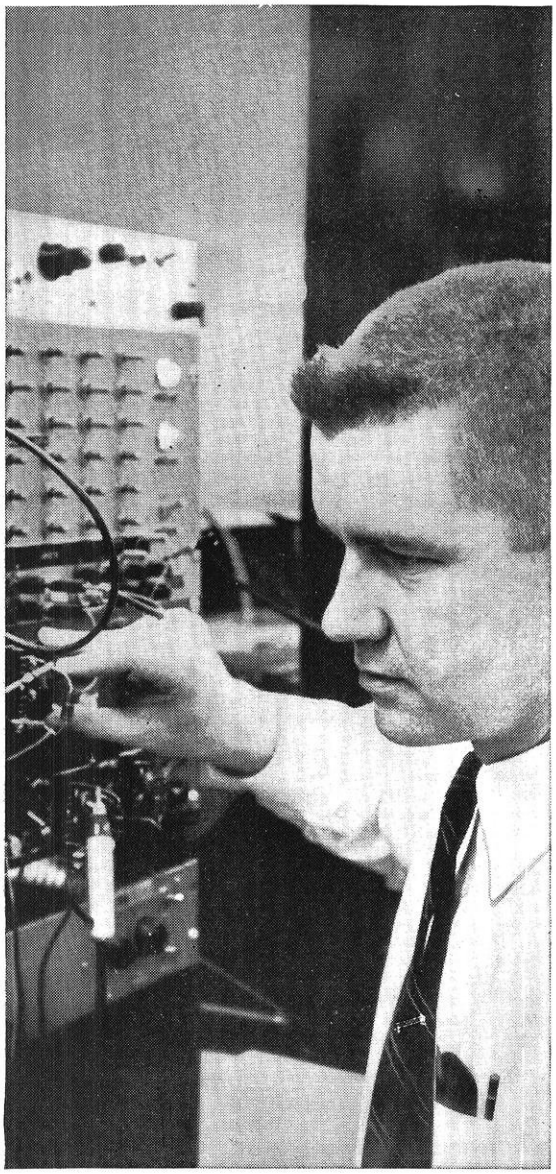
"My job is to design and develop new, high-speed storage devices for a powerful new computer that will perform, in one day, operations requiring six months on present equipment," said Dick Booth as he began a typical day recently. A product development engineer at the IBM Laboratories in Poughkeepsie, N. Y., he started his morning with a conference on a product of great interest to him: a magnetic core storage device with a nondestructive read-out feature. For an hour, he discussed with circuit design engineers the logical devices needed for the register—such as magnetic core drivers and sense amplifiers. Should such devices not be available, the group would work on designs for new ones.

Dick Booth next met with members of the Magnetic Materials Group to establish specifications for the magnetic core memory elements to be used in the register. He also discussed with the group the development of equipment to test the memory elements. "This magnetic core register is based on an original idea of mine," he explained. "When you have a worthwhile idea, you will be given a free hand in proving it out, backed by IBM's resources — plus the assistance of skilled specialists."



**Increasing responsibility**

At 10:30, Dick Booth reviewed the status of the entire project with the two engineers, two technicians, and one logic designer who make up his team. "My present position is staff engineer," he explained. "It's the second promotion I've had since I joined IBM three years ago with a B.S.E.E. degree from the University of Illinois. I know that there are plenty of other opportunities to move ahead. Furthermore, parallel advancement opportunities exist for engineers in either engineering development or engineering management."



**Preparing for the future**

In the afternoon, Dick Booth went to the 704 Computing Center to supervise some complex precision computations. "You see how quickly the 704 arrives at the answers," he said. "The computer being developed is expected to multiply more than 500,000 fourteen-digit numbers a second and add them at the rate of one million a second. The computer may be used for design computations for reactors, as well as calculations of satellite behavior. Of course it should have hundreds of other applications."

At 3:30 P.M., Dick Booth attended a weekly class on Theoretical Physics that lasted until 5:00. Afterward, he commented, "You know, IBM offers excellent educational opportunities both in general education and for advanced degrees. One of the engineers in my group has just received his Master's degree from Syracuse University, after completing a postgraduate program given right here at the IBM Laboratory."

**A chance to contribute**

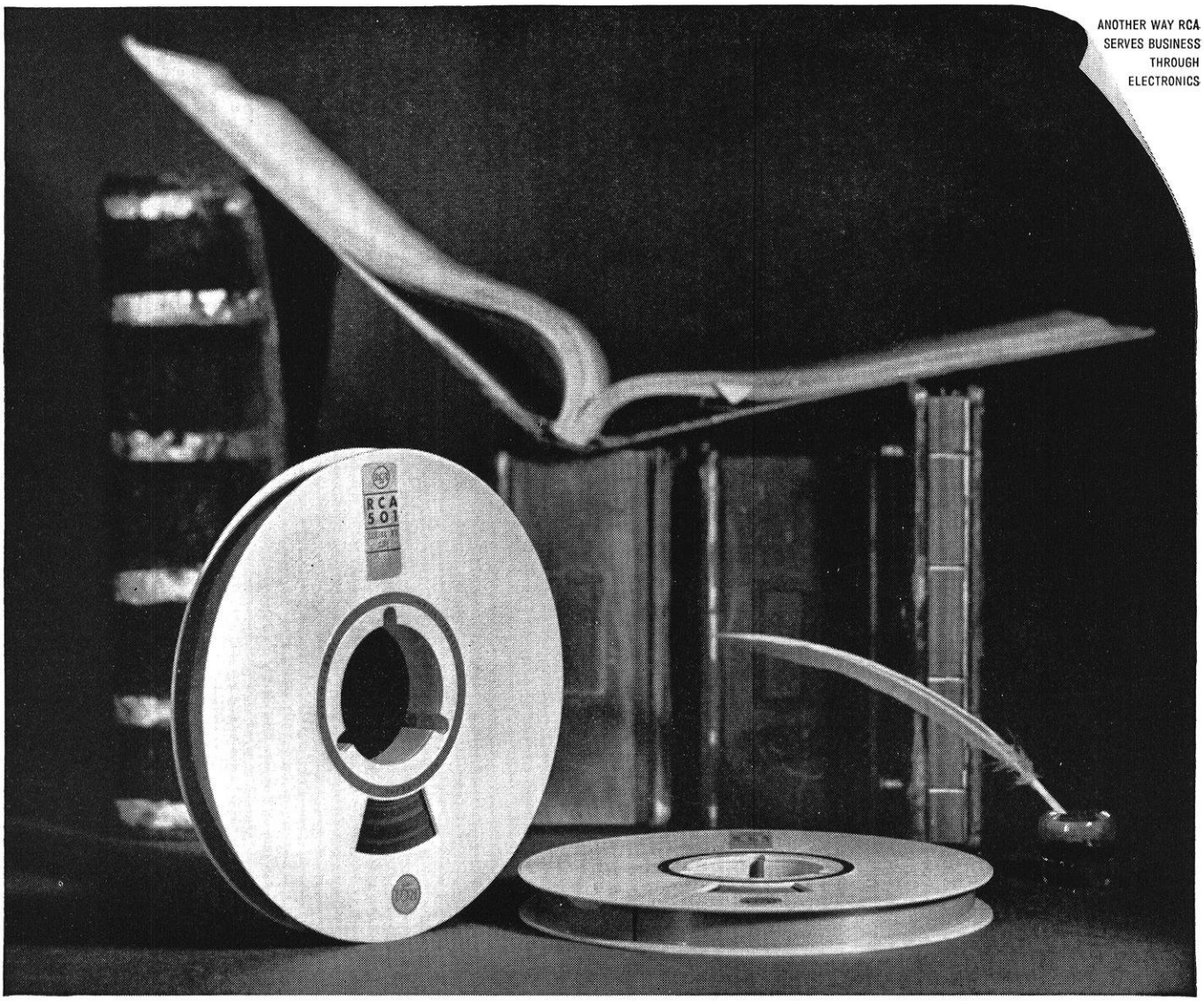
As he was leaving for the evening, he said, "Yes, I'd recommend an IBM career to any college graduate who wants to exercise his creative ability. IBM will appreciate his talent and he'll have the opportunity to work with specialists who are tops in their fields. I doubt that he'd be able to find a more sympathetic and stimulating atmosphere. Furthermore, he'll have the added incentive of contributing to vitally important projects . . . projects that will take him to the frontiers of knowledge in computer electronics."

* * *

Talented college graduates will find exciting, rewarding careers at IBM. Excellent opportunities are now available in Research, Development, Manufacturing, Applied Science, Sales, and Administration. Find out from your College Placement Office when our interviewers will next visit your campus. Or, for information about careers of interest to you, write to:

**Manager of Recruitment**
**IBM Corporation, Dept. 839**
**590 Madison Avenue, New York 22, N. Y.**

**IBM®**




## RCA Electronics creates the "501" to streamline the paper work of business—it reads, writes, figures and remembers on tape

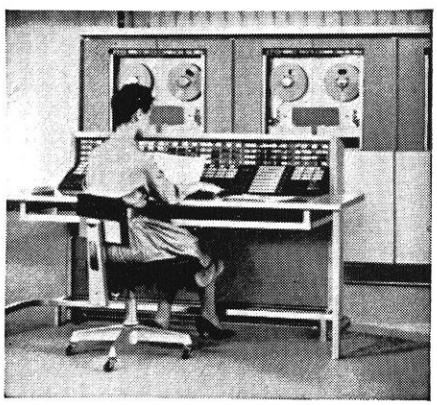
Much of today's traffic jam in paper work is being eliminated by electronic data processing. But to build a system that would be practical and economical for even medium-sized organizations was a job for electronic specialists.

To solve the problem, RCA drew on its broad experience in building computers for military applications and combed its many laboratories for the latest electronic advances that could help. The result was the RCA "501" high-speed electronic data processing system—the most compact, flexible, and economical ever built. It is a pioneer system with all-transistor construction for business use.

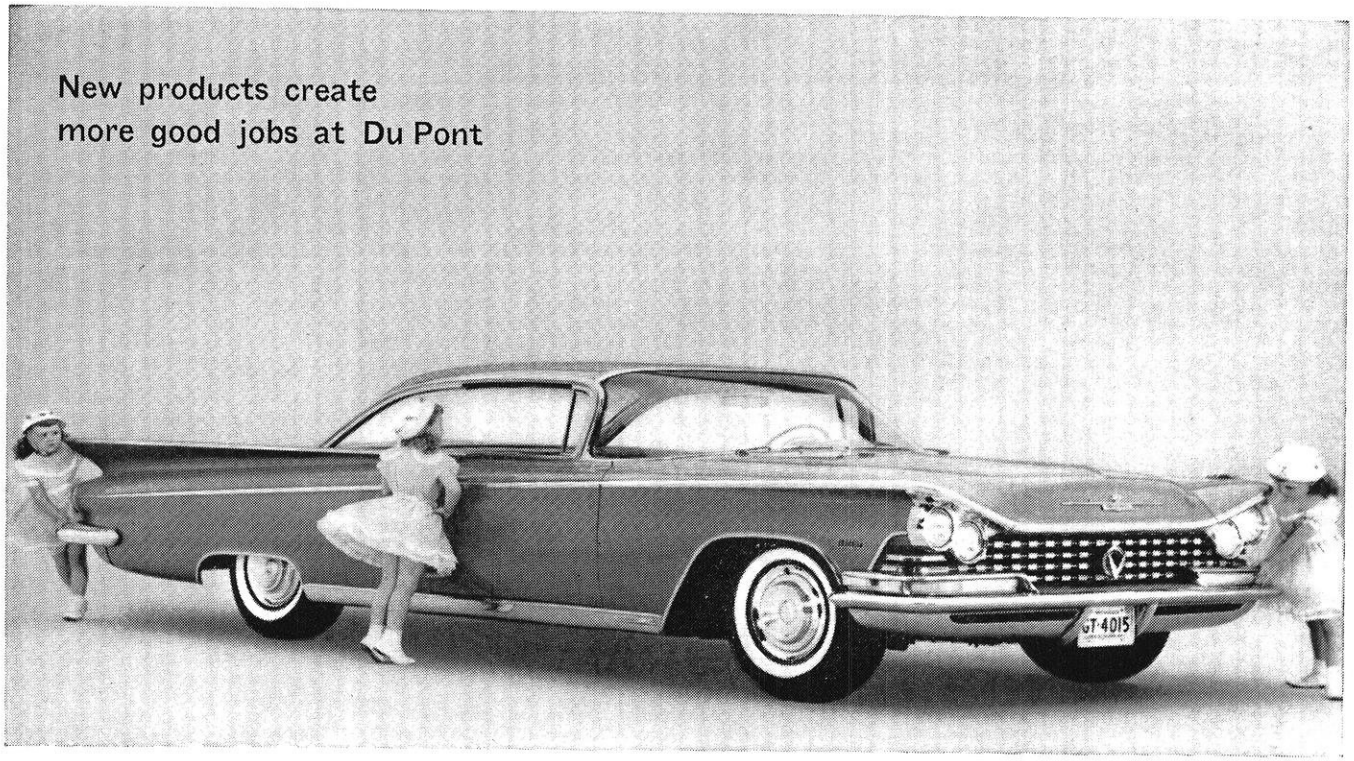
The "501" cuts out paper work bottlenecks for many government agencies and businesses, from stock brokerage firms to public utilities, banks, insurance companies, and steel mills.

It "remembers" millions of letters, numbers, and symbols that are "read" onto its magnetic tapes by such things as punch cards and paper tapes. In a fraction of a second, it can do thousands of calculating, sorting, and comparing operations—and checks each step. Finally, it writes such things as bills, reports, payrolls in plain English at 72,000 characters per minute.

This economical and practical answer to an acute business problem is another way RCA Electronics is helping to simplify the growing complexity of business.



RADIO CORPORATION OF AMERICA




# HOW LONG WILL IT STAY BRIGHT AND SHINY?

That depends, for the most part, on its finish. The most dazzling cars on the road today wear gleaming coats of Du Pont "Lucite"* acrylic lacquer. For "Lucite" stays bright and beautiful three times longer than the best conventional finishes.

Like hundreds of other products developed through Du Pont research, "Lucite" has created all kinds of new jobs. Jobs in the laboratory. Jobs in production. And jobs in sales and marketing. *Good* jobs that have contributed substantially to the growth of Du Pont and the prosperity of our country.

It's an old story. But it's truer today than ever. For the very nature of our business makes research pay off, giving us the courage to "obsolete" products when better ones are found. This is probably why our sales have increased more than tenfold during the last twenty-five years. And for every dollar we have spent on research during these years, we have been able to invest three in new production facilities.

What does all this have to do with you?

For qualified bachelors, masters, doctors, career opportunities are greater today at Du Pont than ever before. There is an interesting Du Pont future for metallurgists, physicists, mathematicians, electrical and mechanical engineers, and other technical specialists, as well as for chemists and chemical engineers.

You probably won't discover a "Lucite," nylon or neoprene, or develop a revolutionary new process, your first year. Nobody expects you to. But you will be given responsibility from the very start, along with training that is personalized to fit your interests and special abilities. Our advancement policies are based on the conviction that you should work at or near the top of your ability. For as you grow, so do we.

If you would like to know more about career opportunities at Du Pont, ask your placement officer for literature. Or write E. I. du Pont de Nemours & Co. (Inc.), 2420 Nemours Building, Wilmington 98, Delaware.

**"Lucite" is Du Pont's registered trademark for its acrylic lacquer.*

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

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

# SCIENCE HIGHLIGHTS

*by Donald Norris, EE '60*

### SPUD, A STORED-PROGRAM UNIVERSAL DEMONSTRATOR FOR COMPUTER TRAINING

Considerable difficulty is usually encountered by the notice in understanding how stored-program information processing systems operate and how they can be programmed. Conventional teaching tools are inadequate for this task, while the use of a commercial computer for demonstrations tends to overwhelm the novice because of its speed and complexity. A satisfactory solution has been found in SPUD, a stored-program relay machine designed and built at Bell Telephone Laboratories specifically as a teaching aid in engineering training programs. It is complicated enough to stimulate the novice, but still easy to grasp in its entirety.

SPUD is a miniature information-processing machine under the control of a program stored in a punched card. When this card is inserted in the machine, metallic contacts close wherever holes have been punched on the card.

The program card contains 32 9-bit word locations. Instruction words are read out of the program memory, one at a time, in synchronism with a clock pulse. The clock pulse may be generated automatically every second or it may be generated manually.

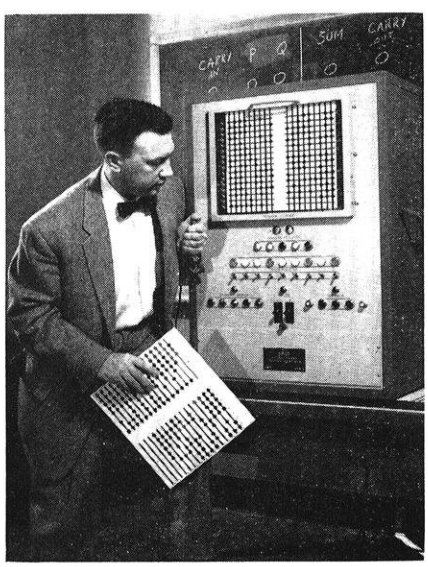
The instruction that is read out is stored in an order register, and displayed on nine lamps on the front panel. Toggle switches under these lamps are used to manually control the order register. Three modes of operation are possible: automatic word with manual clock, manual word with manual clock, and automatic word with automatic clock. The mode of operation is selected by means of a rotary switch.

An order translator interprets and executes the instruction in the order register. It also determines the address of the next order to be read. This address is stored in an address register; after the disappearance of the clock pulse, it is transmitted to the program memory. The address is displayed on the front panel in both binary and decimal form. Five bits of erasable memory which are individually controlled are used to record information for later use.

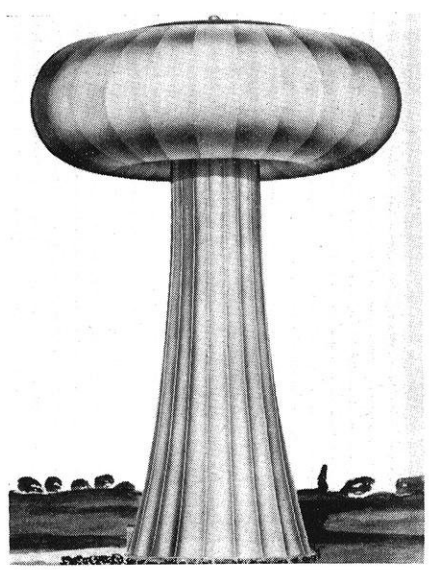
Information is fed into the machine via two input keys. The machine gives out information as 3-bit words displayed on the front panel. When the machine gives an output, it locks itself to make subsequent clock pulses ineffective, and sounds a buzzer to attract the attention of the operator. The operator acknowledges the output by pressing a release push button under the input keys. This action extinguishes the output lamps, shuts off the buzzer, and unlocks the machine.

The machine can execute 25 different types of instructions. Among them are instructions to read or write in a memory element, to read an input, to transfer unconditionally, to match an input and a memory element, and to give an output. Using these instructions, many interesting programs can be written to perform logical or arithmetic operations.

The machine was designed by M. Raspanti, an instructor in Bell Laboratories switching training program. J. B. Worth, also of Bell Laboratories, did the mechanical design. Its over-all dimensions are 24 x 34 x 12 inches, its weight is 110 lbs.




Mr. Raspanti, the designer, holds a card program for the SPUD.



The Aquatore, all-steel water storage tank, has a capacity up to 3 million gallons.

## NEW DESIGN WATER TANK

A new design in large capacity elevated water storage tanks for municipal and industrial use, which features a single central supporting column, was recently announced.

The Aquatore is the first new design in large capacity elevated water towers in almost a quarter century and eliminates the unsightly struts and tie-rods required on conventional tanks for large-capacity installations, according to Root.

Capacity of the Aquatore ranges from 300,000 gallons to 3 million gallons and more. It is designed for large-capacity municipal installations as well as for special industrial applications.

The Aquatore is the largest water tower design ever to use only a single supporting column. The first Aquatore is scheduled for construction late this summer.

Major advantages of the Aquatore include:

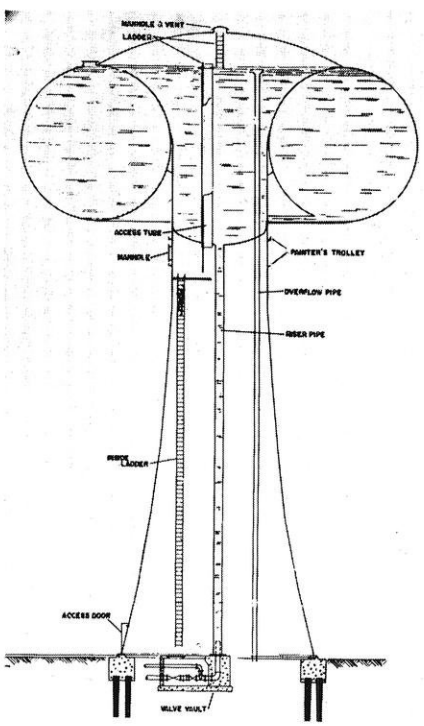
1. Clean, distinctive appearance. The fluted center column of the Aquatore and its clean, simple lines make it a pleasing landmark for erection in parks, residential areas or the center of town.
2. Lower maintenance costs. Elimination of difficult-to-paint struts, tie-rods, balcony floors and rails and other protrusions means lower maintenance costs.
3. A more constant water pressure. As compared with conventional water towers, the Aquatore offers a significant reduction in the head range of the actual storage tank. This permits comparable water pressure at less height and provides upwards of 35 per cent less variation in water pressure.
4. No pump house needed. Because pumping facilities can be installed within the column, the cost—and the detracting appearance—of a separate pump house is eliminated.
5. Other advantages include less height (because of the lower head range) where airplanes and airfields are a consideration; reduction in snow-load and wind-load because of smooth tank surface and a single foundation.

The Aquatore is named after its unique torus-shaped tank, first of its size.

The Aquatore is like a giant water doughnut, and the column extends up through the hole of the doughnut, so to speak. The name stems from the Latin word for water (aqua) and the engineering term for doughnut (torus).

Although there is no limit to the capacity in which the Aquatore can be constructed, 3 million gallons is ordinarily considered the largest practical capacity for most applications.

Dimensions for a typical Aquatore with a capacity of 1,500,000 gallon capacity would include a torus tank 94 feet in diameter and 34 feet in height (head range); and a column diameter of 46 feet at the ground narrowing to 23 feet at the tank. The height of the central supporting column is dependent on the water pressure required, local terrain and other factors although a normal column height is 100 feet. The supporting column is a "dry riser" which is not used for water storage except in the topmost portion, at the level of the torus-shaped tank.




Schematic diagram of the "Giant Water Doughnut."

## STAINLESS STEEL BUMPER

Tests have just been completed on a new type—longer lasting, better looking—bumper that will never pit or peel and that may someday be on your automobile.

The bumper is made of Type 301 stainless steel clad on both sides of a mild steel center, made in the form of a sandwich. The most recent tests were completed on the special stainless steel automobile bumper, which was found to be in excellent condition after more than two years in service.

Various field tests are conducted bi-monthly, with comprehensive tests being completed at the beginning of each year on the test bumper. No pitting, peeling, or corroding was found on the stainless steel surfaces, which are highly corrosion-resistant.

It is not expected that either solid stainless or clad stainless steel will be used on next year's cars. Experimental work on clad material is still going on and the quality bumper will probably be on one of your future cars.

The test bumper is on the car of an executive of Allegheny Ludlum Steel Corporation, and is one of six bumpers made for testing. Others have been through destructive tests during the past two years, and some have been put on external testing areas. Bumpers on today's automobiles are made of a mild steel with a coating of chrome flashing.

Automotive companies have expressed interest in the test on the stainless steel clad material, and have been investigating the use of both the clad and solid stainless steel for bumpers for some time.

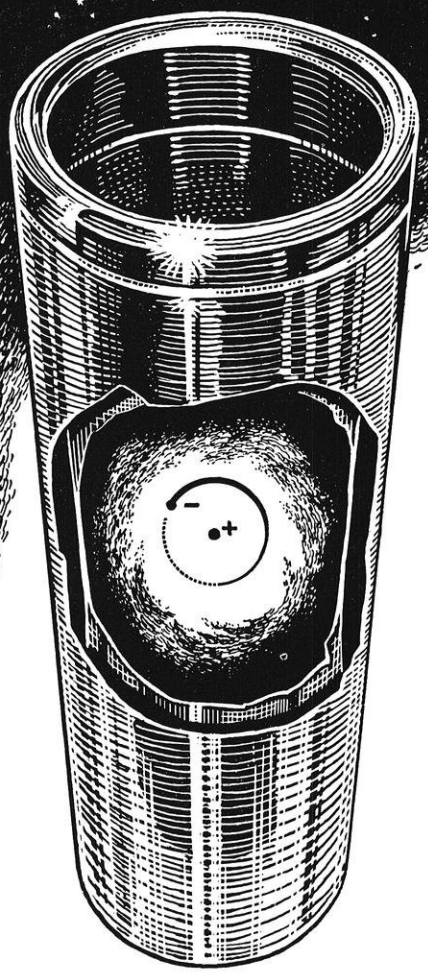
Stainless steel is used on many of the cars today in the form of trim around windows, windshield wiper arms, special belt moldings, wheel covers, and on other areas.

## PERSHING MISSILE GUIDANCE PACKAGE IS DESIGNED

The heart of the inertial guidance system for the new Pershing IRBM is a program transmission servo-package which plays a key role in the ST–120 air bearing gyro stabilized platform. It transmits tilt program pulses from a programming tape to the Pershing steering mechanism, in a

*(Continued on page 66)*

# what is entropy?



Heat lost except at absolute zero?

A measure of disorder?

A statistical probability of state?

The gradient of a scalar?

Macrocosmic phenomenon or microcosmic, too?

The fundamental concept of entropy is involved in many phases of our technology. Hence we have a fundamental need to know everything we can about its significance. This knowledge is critical to our work of energy conversion.

Thus we probe and inquire, search without wearying – call upon the talents of General Motors Corporation, its Divisions, and other individuals and organizations – for a complete appreciation of all phases of scientific phenomena. By applying this systems engineering concept to new research projects, we increase the effectiveness with which we accomplish our mission – exploring the needs of advanced propulsion and weapons systems.

*Want to know about YOUR opportunities on the Allison Engineering Team? Write: Mr. R. C. Smith, College Relations, Personnel Dept.*

Energy conversion is our business

ALLISON

Division of General Motors,
Indianapolis, Indiana


# COLLINS ELECTRONICS— diversification

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

Collins was selected over several companies because it could do the job — economically, with excellent equipment, and provide capable engineering assistance for all phases.

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

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

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

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


**FREE**

C-1

**Professional Placement,**
**Collins Radio Company,**
**Cedar Rapids, Iowa**

Please send me each **Collins Signal** published during this school year.

Name _____

Address _____

City _____ State _____

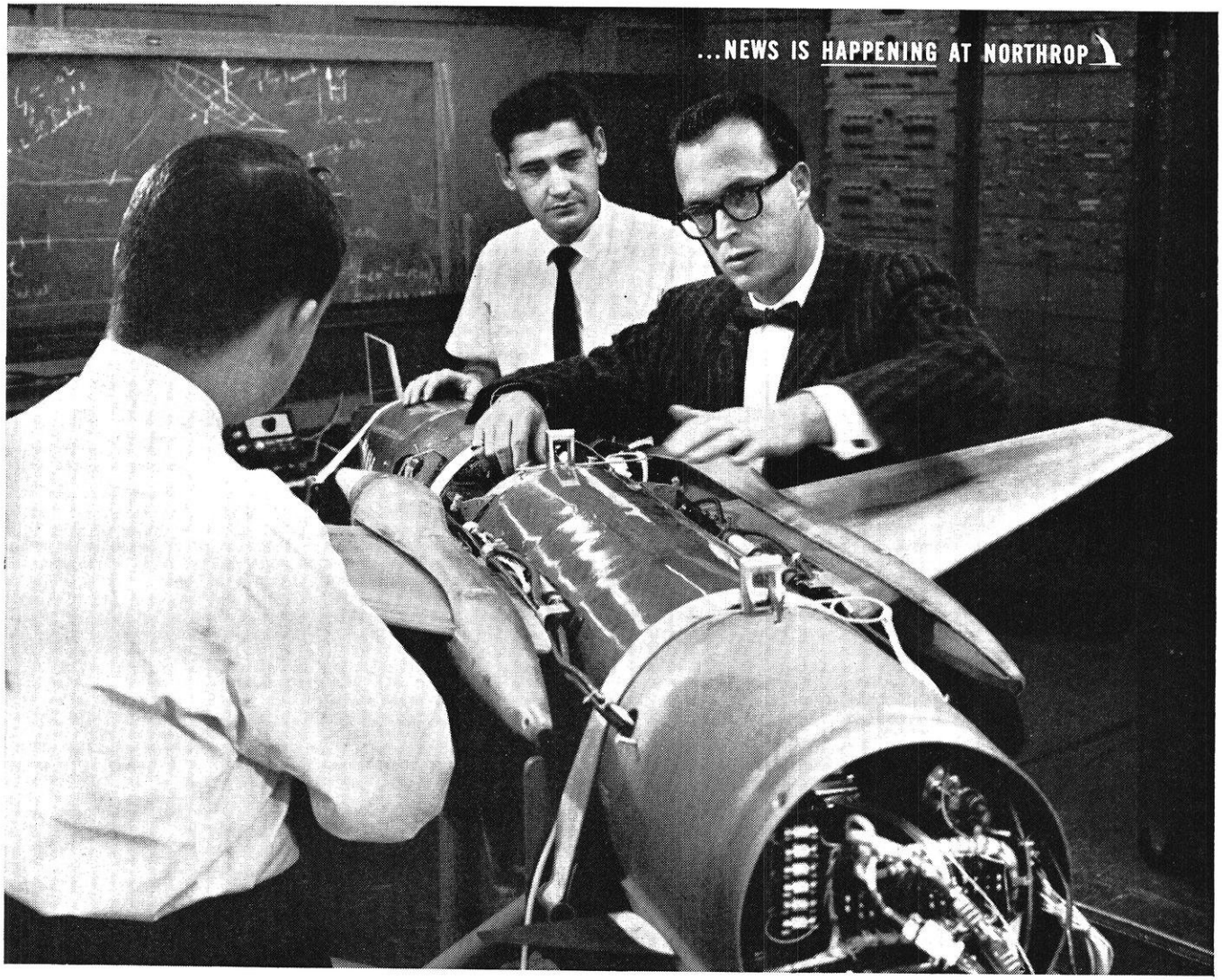
College or University _____

Major degree _____ Minor _____

Graduation date _____

COLLINS

COLLINS RADIO COMPANY • CEDAR RAPIDS, IOWA • DALLAS, TEXAS • BURBANK, CALIFORNIA




*Engineer Larry Klivans reviews the results of a computer-simulated ground checkout of Radioplane Division's near-sonic RP-76 rocket-powered target drone. Formerly at Norair Division, Larry came to Radioplane in 1955. At 31, he is Manager of the Division's 140-man Electronic Support Group, is working toward his doctorate at UCLA.*

# YOUNG ENGINEERS ARE NORTHROP'S NEWSMAKERS!

Northrop Corporation's dynamic and diversified corporate structure creates an ideal work climate for forward-thinking scientists and engineers. Our three autonomous divisions are all in Southern California – are all headed by progressive management eager to examine and try new ideas.

Let's assume that *you* are a man who can qualify for one of our engineering teams – a man who can create history!

**YOU'LL EARN** what you're worth, get increases as often as you earn them – based on your own individual achievements. Our salary structure is unique in the industry; our vacation policy extra-liberal, as are all of our other fringe benefits.

**YOU'LL LEARN** while you earn, with no-cost and low-cost education opportunities at leading Southern California institutions – earn advanced degrees and keep abreast of latest technological advances in your own chosen field.

**YOU'LL WORK** with men who are acknowledged leaders in their fields – men chosen for their own capabilities *and* for skills in guiding and developing the creative talents of younger men. And, these are men who delegate authority, assuring your fair share of credit for engineering triumphs.

**YOU'LL BE FLEXIBLE**–able to apply your talents to the work you enjoy, in the field best suited to your own inclination and ability. Northrop Corporation and its divisions offer wide diversity, with over 30 operational fields to choose from. All offer challenge aplenty – opportunity unlimited!

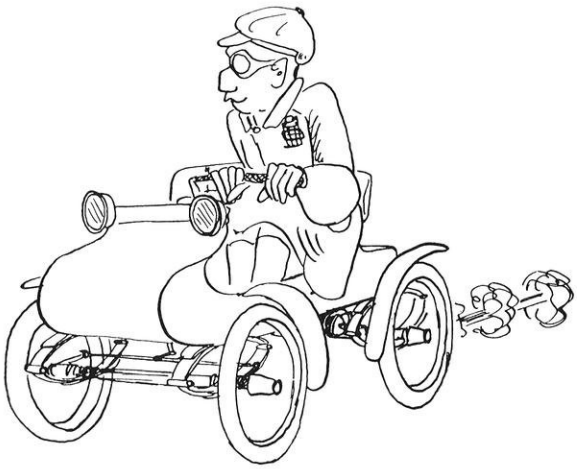
**RADIOPLANE DIVISION.** Creator of the world's first drone family; has produced and delivered tens of thousands of drones for all the U.S. Armed Forces. Now developing ultra-advanced target drone systems for weapon evaluation, surveillance drone systems, and missile systems.

**NORTRONICS DIVISION.** Pioneer in celestial and inertial guidance. Currently exploring infrared applications, airborne digital computers and interplanetary navigation; developing ground support, optical and electro-mechanical, and data-processing equipment.

**NORAIR DIVISION.** Creator of SAC's intercontinental USAF Snark SM-62. Currently active in programs for the ballistic recovery of orbiting man; flight-testing the USAF T-38 supersonic trainer; readying the N-156F NATO-SEATO fighter for flight tests.

**NOW WRITE!** Get full information on Northrop Corporation and all of its Divisions. Then choose the division that offers *you* the most challenge. To reserve your spot where news is *happening,* write: Engineering & Scientific Personnel Placement Office, Northrop Corporation, P.O. Box 1525, Beverly Hills, California.

Divisions of NORTHROP CORPORATION



# THE ENGINEER OF YESTERYEAR

*by Floyd Gelhaus, EE '61*

### JAPAN OF TODAY

**December, 1902**

AT YOKOHAMA, in the erection of a three-story government building a novel, or possibly, very old method of conveying mortar to the top story was used. A system of inclined ways extending from the ground to that part of the building on which work was being done at the time had been erected, and on this structure men were stationed at intervals of about three feet; the system of conveying the mortar from the ground to the top was as follows: The lowest man would gather up a large handful of the mortar, which apppeared to be simply a mixture of mud and straw, and throw it up to the next man, much as one of our atheletes would pot the shot; this man would catch it in one hand and propel it in the same fashion to the next above, and so the process would be repeated until the mortar reached its destination.

### THE NEW THREE-PHASE MOTOR

**January, 1897**

Seven years ago the three phase motor was simply an interesting scientific curiosity. It is still a novel sight to see an armature which has no visible connection, in fact no mechanical connection to any motive power, running as if by magic. However, that revolving mass of iron and copper is more wonderful now as it can do work equal to that of an engine larger than itself. In the last five years the three-phase motor has been developed to such an extent that it takes equal practical rank with its older brother, the direct current motor, and promises, with the aid of long distance transmission, to leave it far behind. Such advance has been made in the design and manufacture of this class of motor, that further progress can come only as a result of careful study and painstaking investigation.

### INTERNAL COMBUSTION ENGINES

**1896–1897**

The first man to propose the use of explosion to obtain power was the Abbe Hautefeuille, the son of a baker at Orleans. To him belongs the honor of designing the first motor in which heat was used for the generation of power.

In 1678, he planned to explode powder in a vessel in communication with water and utilize the vacuum thus produced to lift the water. Other powder machines were designed and built, but during the next 100 years the attention of engineers was turned to steam and the first to design and construct an actual gas engine was John Barber, who took out a patent for one in 1791. His engine consisted of a pump which forced gas with air into a recptacle where it was ignited and from which, combined with steam, it issued through a nozzle against the blades of a paddlewheel.

Up to 1860, the design for engines were numerous and many were built. Certain conditions came to be recognized. The heat generated was so great that it had to be carried off as quickly as possible, and even with water jackets on the cylinder, parts of the engine sometimes became red hot.

In 1866, Otto and Langen brought out an engine somewhat along the lines of Barsanti and Matteucci. The principle of their engine was to obtain the most rapid and complete expansion possible. In theory their premises were true and their engine realized and economy, 26 cu. ft. of gas per H. P. hour, in excess of any engine up to that time, and which compares favorably with engines of the present day.

### PRACTICAL LIFE OF A CIVIL ENGINEER IN RAILROAD WORK

**1900**

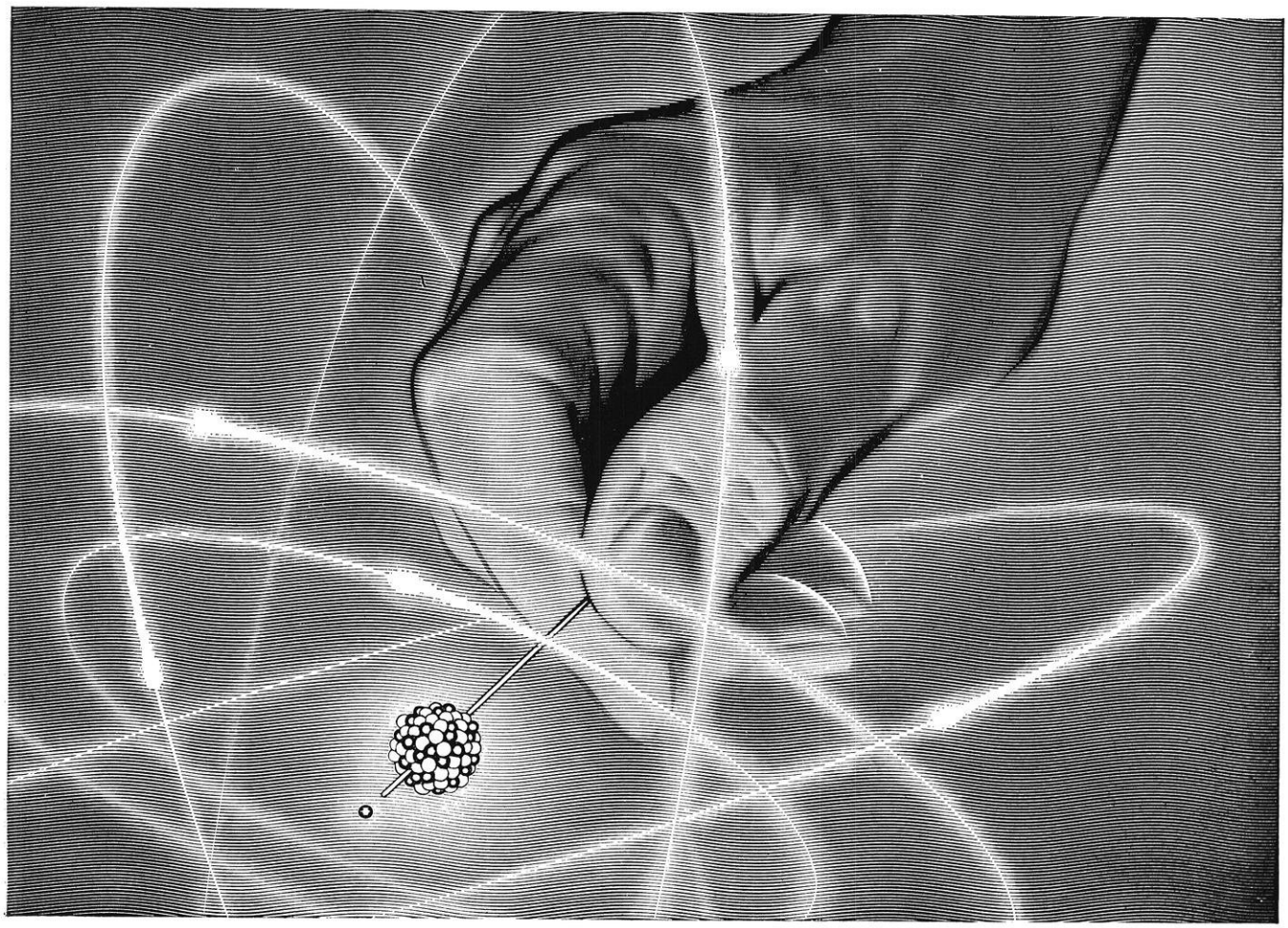
The cost of maintaining main tracks is about $1,000.00 per mile for high speed roads, and about $500.00 per mile for branches or side lines. The methods of track maitenance are similar to a considerable extent on all roads of the same character. The division engineer, whose salary is $1,200.00 to $2,400.00 per annum, has under his track supervisors. These men are in charge of districts varying from 50 to 100 miles in length. The supervisors are paid about $100 per month. They have under them section foremen, who have charge of about five miles of track. The pay of these section foremen varies from $40 to $60 per month. These foremen have under them four or five men for country sections, and up to 20, 30 or 40 men for yards and terminals. These laborers are paid from $1.25 to $2.00 per day according to location.

### PHYSICAL LECTURE ROOM

**1900**

The Physical Lecture Room contains seats for 200. Its equipment is the most modern. The lights are connected with a stage dimmer by the use of which they can be regulated to any desired degree of illumination. By means of curtains

*(Continued on page 52)*



. . . a hand in things to come

# Probing the atom...for you

## *The boundless energy of the uranium atom means a brighter future*

Every day brings the benefits of atomic energy closer to our daily living. It presents a whole new field of exploration for scientists all over the world.

A longer, healthier life is hopefully ahead as radiation is helping doctors learn more about the basic processes of life by revealing how certain elements are put to work by the body. The controlled rays of the atom are also being used to pin-point malignant tissues for subsequent treatment. And radiation studies of how plants absorb nutrition from sun and soil are showing the way to improved food supplies.

These are but a few of the vital jobs being done by radioisotopes —radioactive materials created in atomic reactors at Oak Ridge, Tennessee . . . the great atomic energy center operated by Union Carbide for the U. S. Atomic Energy Commission. The people of Union Carbide will continue their pioneering research in atomic energy—and in the vital fields of alloys, carbons, chemicals, gases and plastics—to bring you a brighter future.

*Learn about the opportunities at Union Carbide in carbons, chemicals, gases, metals, plastics and nuclear energy. Literature is available at your placement office or write to V. O. Davis, Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y.*

UNION CARBIDE

**...a hand in things to come**

## The Engineer of Yesteryear

*(Continued from page 50)*

controlled by a hydraulic device the room can be darkened on turning a valve. There are two stereopticons, the screens for which can be raised or lowered at pleasure. The lecturer's table is fitted with a small Pelton-wheel for operating light machinery. There are numerous other conveniences, all of which help to make this an ideal lecture room.

### STRESS OR STRAIN?

**January, 1897**

The forces R and Q induced in a bar by pulls at its ends are called by some engineers and writers stresses and by other strains. This difference of usage is further confused by a use of the word strain among engineers to denote, among other things, the stretch, s, of the bar due to the pulls at its ends. This non-uniformity of usage is mainly due to the acceptance by some and the rejection by others of Professor Rankine's definitions of these two terms. In the 50's he endeavored to restrict a loose use of the words by defining them precisely. According to him, R and Q are stresses and s is a strain.

The nonconformists as a rule object especially to this definition of the term strain. They argue that strain and stress are from the same root "the Latin STRINGERE, and have the same elemental English significance of a stretching or deforming force or pressure"; that this "inherent meaning" has been "bred in the bone of European races thousands of years" and "scientists may struggle to all eternity to establish" this new meaning of the word strain "in the consciousness of the students but they will never do so." (Have they?)

* * *

"So he met this girl on a blind date and finally married her?"

"Yes, he said that on their first date they didn't know what to do for entertainment, so he flipped a coin."

"Wonder what they did."


# IT'S LITERALLY ALL AROUND YOU!

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

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

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

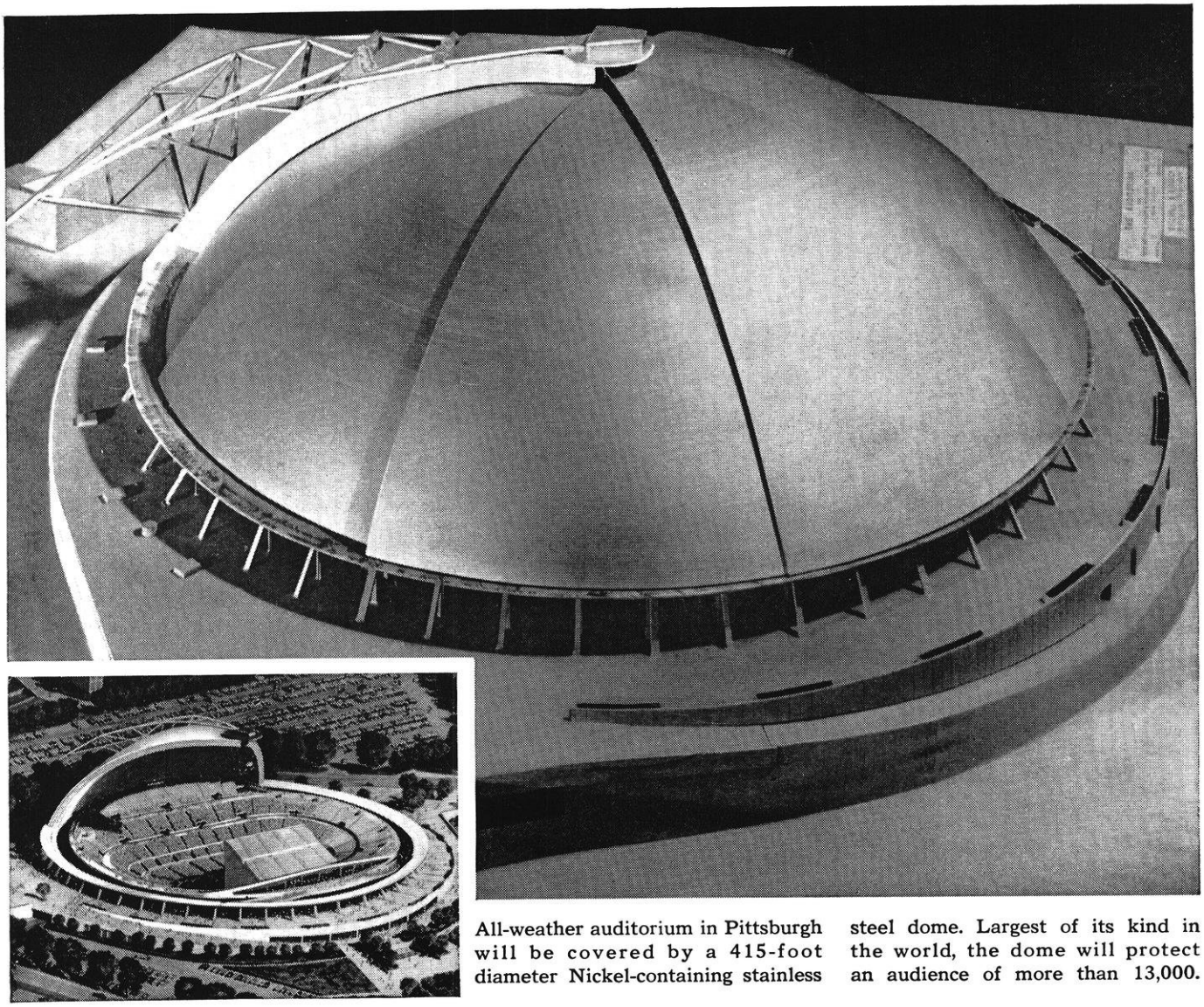
Here, then, is a space age challenge to be met with the finest and most practical engineering talent. Here, perhaps, is the kind of challenge *you* can meet.

**SIKORSKY AIRCRAFT**

*One of the Divisions of United Aircraft Corporation*

**STRATFORD, CONNECTICUT**

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



All-weather auditorium in Pittsburgh will be covered by a 415-foot diameter Nickel-containing stainless steel dome. Largest of its kind in the world, the dome will protect an audience of more than 13,000.

## For Pittsburgh's new auditorium...

# A "push-button umbrella roof" of Nickel stainless steel ...the roof design of tomorrow

Here's the first of a revolutionary new type of roof design, destined to introduce a new concept in building.

*A simple concept, but a daring one.* The domed roof of a building is divided into eight sections which nest together when opened. Push a button, and six of these sections glide quietly together around an outside track.

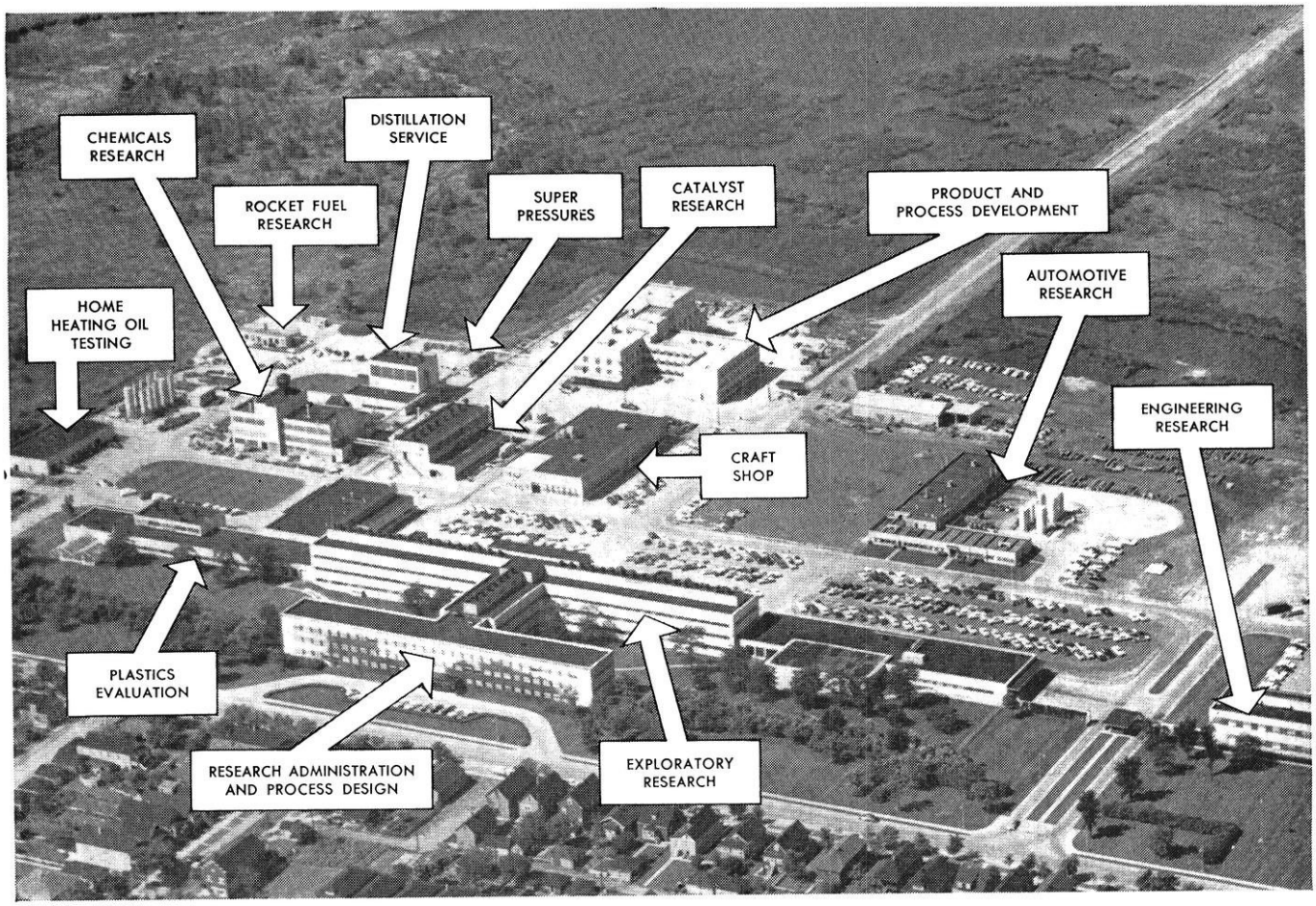
In Pittsburgh's new all-weather auditorium, the push-button umbrella roof can be closed at the first sign of bad weather without disturbing the show. In private homes, a roof design like this could bring the beauty of nature right into the home.

*But what material is lasting enough for a dome like this?* Architects and designers of the auditorium looked into all types of materials. They selected Nickel-containing stainless steel. They selected Nickel stainless because it has the best combination of properties for this purpose. For example it is one of the most weather-resisting, corrosion-resisting metals.

Naturally, this is just one example of how designers are taking advantage of the unique properties of Nickel-containing metals. In the future, however, you may be designing a machine—not a spectacular all-weather push-button roof. You might need a metal that resists corrosion, or wear, or high temperatures. Or one that meets some destructive combination of conditions. Here, too, a Nickel-containing metal could be the answer.

But, whatever your field of study, in the future you can count on Inco for all the help you need in metal selection. Right now, if you'd like to get better acquainted with Nickel Stainless Steel, why not write Inco for "Stainless Steel in Product Design." Write: Educational Services, The International Nickel Company, Inc., New York 5, N. Y.

**Inco Nickel** *makes metals perform better, longer*




**This huge research center** at Whiting, Indiana, is only part of Standard Oil's research facilities. A recently completed technical service and quality control laboratory, not shown here, is the largest laboratory of its kind in the country. In addition, large research laboratories are operated by several affiliates.

# Where the fuels of the future are born!

From time to time, we are asked if gasoline and oil today really are better than they were five or ten years ago. People can't see the difference, smell it, or feel it.

The answer is an emphatic yes. And this aerial view of Standard Oil's research center at Whiting, Indiana, is graphic evidence of the extensive research work that goes on behind the scenes day in and day out.

Thousands of research experts—chemists, engineers, and technicians—work together in Standard's modern laboratories, improving present fuels and lubricants and developing new ones for cars that will not be a reality until about 1965! Rocket fuels, too, are being developed. Standard's development of clean-burning, highly-reliable solid fuels has been a real contribution to America's missile program.

Since our first research laboratory opened 69 years ago, research scientists of Standard Oil and its affiliated companies have been responsible for many major petroleum advances —from making a barrel of oil yield more gasoline to discovering a way to revive almost-dry wells. Each process had the effect of adding billions of barrels to America's oil reserves.

At Standard Oil, scientists have an opportunity to work on a wide variety of challenging projects. That is one reason why so many young men have chosen to build satisfying careers with Standard Oil.

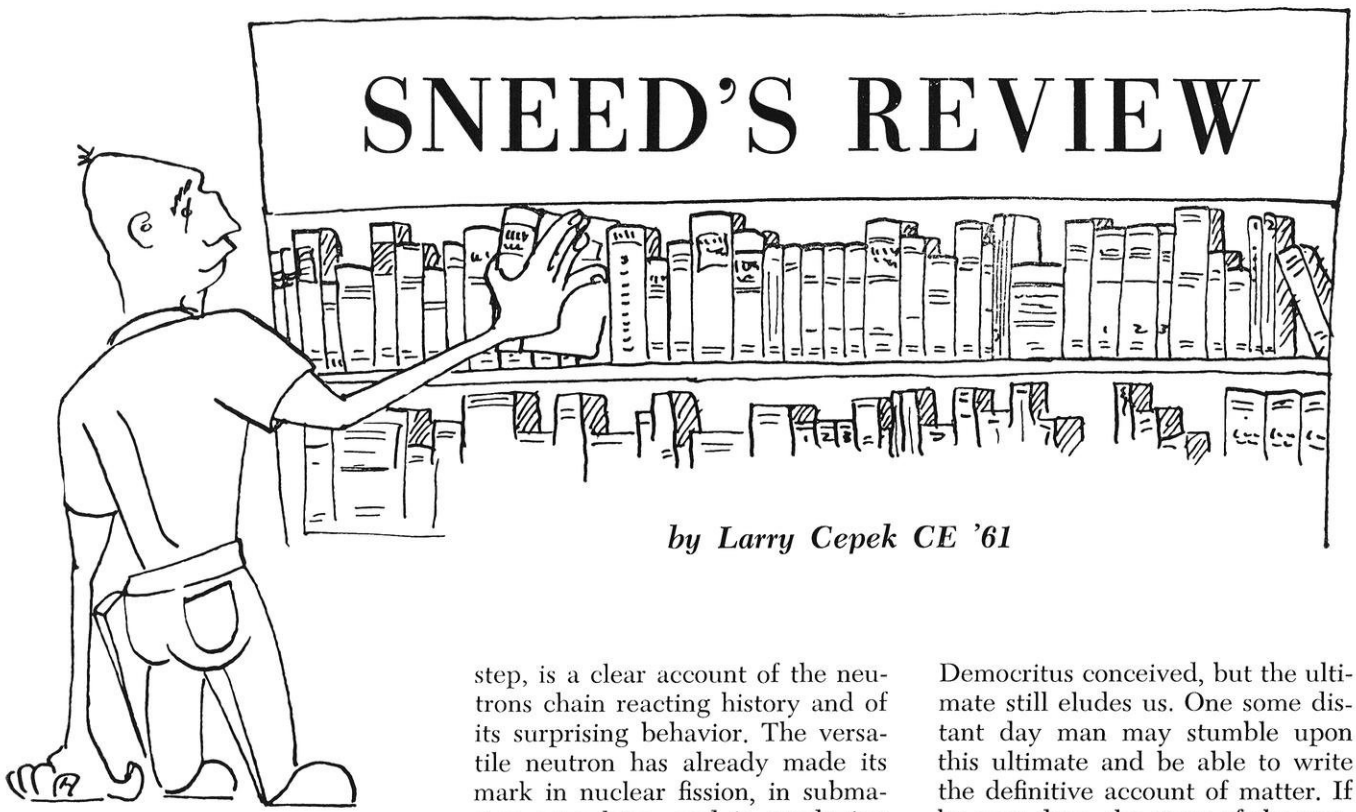
STANDARD

THE SIGN OF PROGRESS...
THROUGH RESEARCH

**STANDARD OIL COMPANY**

910 SOUTH MICHIGAN AVENUE, CHICAGO 80, ILLINOIS

# SNEED'S REVIEW



*by Larry Cepek CE '61*

**ATTENTION STUDENT ENGINEERS!**

*Do you need help in Physics?*

*Do you need reference material for a technical writing course?*

*Do you want a better understanding of the ATOM or the MAGNET?*

*Then maybe one of the books of Science Study Series will help you. The cost for one of these 150 page pocketbook size books is only 95¢.*

*The Science Series books are marked with a *.*

THE Science Study Series is part of a dramatic new program for the teaching and study of physics, originated recently by distinguished American scientists and educators meeting at the Massachusetts Institute of Technology. This series of up to date, authoritative, and readable science books is prepared under the direction of the Physical Science Study Committee of Educational Service Incorporated, and is published in cooperation with Doubleday Anchor Books and Wesleyan University.

**THE NEUTRON STORY***

The neutron is the most potent, the most useful, and the most enigmatic of all the fundamental particles of matter energy that fascinate today's physicists. Here, step by step, is a clear account of the neutrons chain reacting history and of its surprising behavior. The versatile neutron has already made its mark in nuclear fission, in submarine propulsion, and in producing new radioactive materials for medicine and industry, but its greatest promise will be realized as scientists use it to probe the nature of the sub-microsopic world. Here is what Donald Hughes says about his book:

"To the professional physicist we have taken an elementary view of the neutron, but the absence of mathematical complexities by no means robs our story of value. We have seen what immense contributions the neutron has made, and will continue to make, to industrial and engineering progress and to human welfare. We have followed the neutron through the atoms electron cloud into the very nucleus of matter itself. We have learned to appreciate, if not to master, the astonishingly subtle and sophisticated techniques that today's scientists employ in man's neverending search for the ultimate truth. We have had another revelation of how infinitely intricate are the relationships of subatomic particles, how wondrous the scheme of the universe as revealed in the world of the very small. Since the Greek philosopher Democritus (460 B.C.) applied the word "'atom" to the final particle into which matter could be divided, it has been a concept that has enthralled the minds of thinking men. Today we are far, far within so crude an "atom" as Democritus conceived, but the ultimate still eludes us. One some distant day man may stumble upon this ultimate and be able to write the definitive account of matter. If he ever does, the story of the neutron will be one of the great chapters."

Dr. Donald J. Hughes, an alumnus of the World War II Manhattan District, is a leader in the youthful field of neutron physics. Formerly director of the nuclear physics division at Argonne National Laboratory, he has since 1949 been senior physicist at the Brookhaven National Laboratory, on Long Island, N. Y. He is the author of ON NUCLEAR ENERGY and several scientific books dealing with the nature of the neutron.

**MAGNETS***

In this account of explorations into the world of magnetism, Professor Bitter tells of his lifelong dedication to understanding magnets and the bewildering force they exert. His search has led at one extreme to studies of the magnetic behavior of atoms and nuclear particles, and at the other to defenses against magnetic mines in naval warfare. This is a lively autobiography of a scientist's delight in probing one of the richest fields in all physics.

Francis Bitter was brought up in New York City and first discovered magnetism at Columbia College. He studied physics in Berlin and returned to Columbia for his Ph.D., in the magnetic properties of gases, in 1929.

### ECHOES OF BATS AND MEN*

In 1938, Donald R. Griffin, then a senior at Harvard, took a cage of bats to the physics building, where one of the first laboratories for detecting ultrasonic sounds had been set up. There, for the first time, the high-pitched clicks by which bats navigate were heard. This pioneer experiment has touched off ever-widening research in physical biology, research which has included the investigation of the navigating techniques of animals. ECHOES OF BATS AND MEN is a brilliant report on how studies of bats, porpoises and whirligig beetles and of electronic radar and sonar are now expending man's understanding of physics. Dr. Griffin shows how this knowledge may be applied to help the blind "see."

Donald R. Griffin was born in 1915 in Southampton, N. Y. He grew up mainly around Cape Cod and was educated at Phillips Academy, Andover, Mass., and at Harvard University. Dr. Griffin taught physiology and zoology at Cornell University until 1953, and since then he has been Professor of Zoology at Harvard. His widely acclaimed book LISTENING IN THE DARK was published in 1958.

### HOW OLD IS THE EARTH*

In every age man has tried to penetrate the mystery surrounding the origins and the structure of the earth. Clues have come from study of the earth's thin crust, from analysis of the moon and the planets from earthquakes and volcanoes, but the most promising new avenue, according to Dr. Hurley, is an understanding of the earth's radioactivity. This energy seems to generate the heat, which, as it rises to the surface, lifts the continents and makes the earth's surface buckle and wrench. Radioactivity, besides, gives the modern geologist an incomparable tool. "Each grain of sand, each minute crystal in the rocks about us is a tiny clock, ticking off the years since it was formed."

Dr. Patrick M. Hurley was born in Hong Kong, China, in 1912, and grew up on Vancouver Island, B.C. He received his B.A. and B. Sc. degrees from the University of British Columbia, spent three years prospecting for gold, then pursued graduate study in geology at M.I.T. (Ph.D., 1940). In 1946, Dr. Hurley was appointed to the faculty of M.I.T., where he continues to teach and explore the history of the earth.

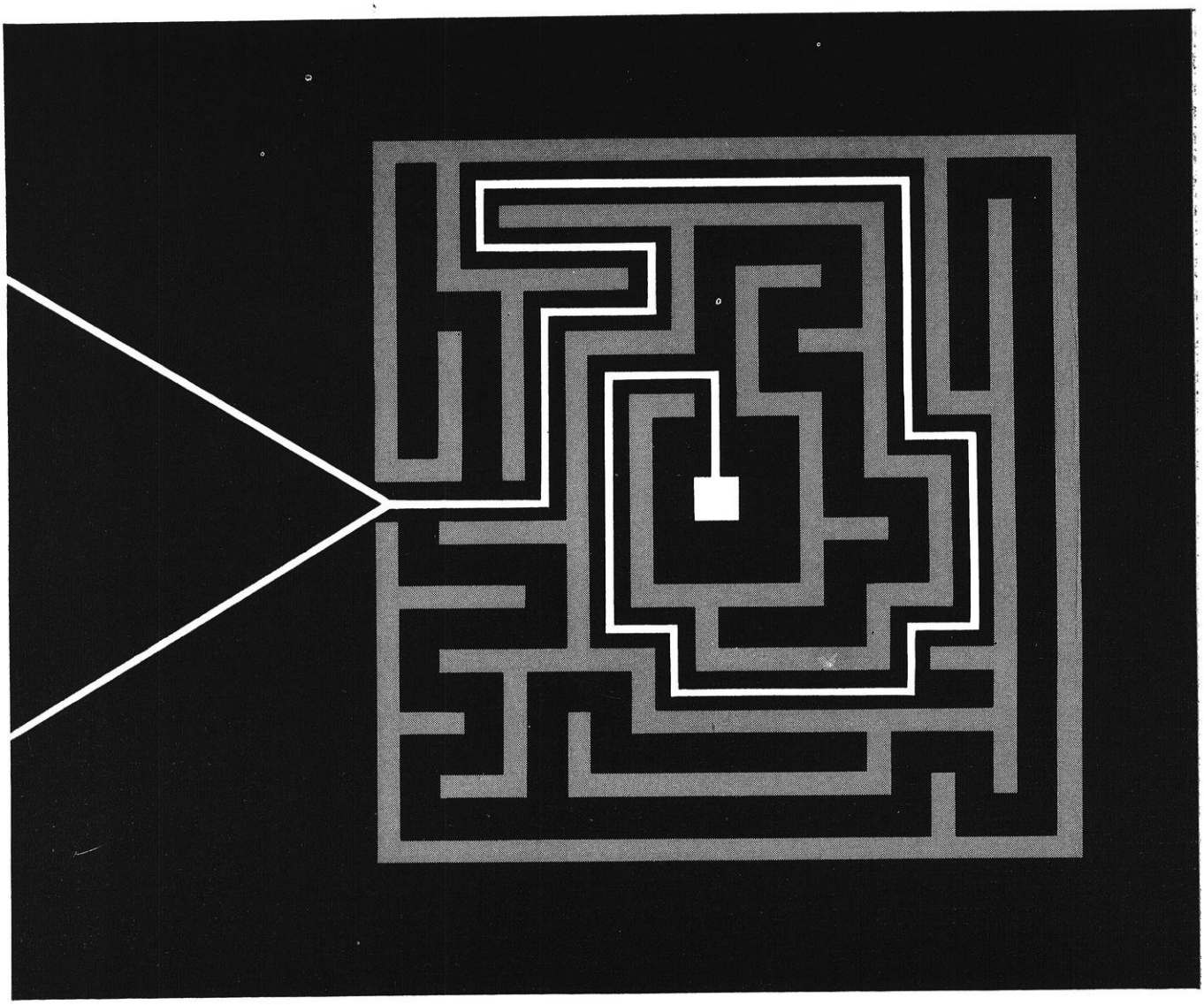
### UP-TO-DATE RUSSIAN–ENGLISH SOLID STATE GLOSSARY

A modern *Russion-English Solid State Glossary,* 90 pages in length, has just been published by Consultants Bureau, Inc., 227 West 17th Street, New York 11, N.Y., priced at $10.00. The Glossary contains over 4,000 terms, culled primarily from several thousand pages of the most recent issues of Soviet physics journals, especially the Journal of Experimental and Theoretical Physics, the Physics Section of the Proceedings (Doklady) of the Academy of Sciences, USSR, and the Journal of Technical Physics.

Included are terms in solid-state theory, crystallography, physics of metals, metallurgy, ferromagentism, semiconductors, etc., as well as some important terms in general quantum theory, reflecting the combined experience of the publisher's physicist-translators also working for U.S. Government agencies, private industry, and the American Institute of Physics.

The *Solid State Glossary* is part of a series of 8 *interim* glossaries on specialized fields of physics being published by Consultants Bureau as a preliminary (in order to meet the current urgent need for Russian–English translation tools) to publication in 1959, of its comprehensive, authoritative, *Russian–English Physics Dictionary.* Prepublication subscribers to the *Dictionary* ($50.00) will also receive upon publication, each of the 8 interim glossaries; each Glossary sells separately at $10.00. The Glossaries, the first three of which are already available, are: Nuclear Physics and Engineering; Solid State; Electronics and Physics; Electricity and Magnetism; Liquids and Hydraulics; Acoustics and Shock Waves; Mechanics and General Physics; Atomic Physics, Spectroscopy, Optics.

THE END



## A RESUME IS A TWO-PARTY AFFAIR

Throughout your engineering career, the name of the first employer appearing on your resume can be as significant as your education. But, in selecting that first employer, you should also consider his resume.

ITT is the largest American-owned world-wide electronic and telecommunication enterprise. To give you an idea of the breadth of our activity . . . there are 80 research and manufacturing units and 14 operating companies in the ITT System playing a vital role in projects of great national significance in electronics and telecommunications research, development, production, service and operation.

The scope and volume of work entrusted to us by industry and the government opens a broad range of highly diversified engineering and technical positions in all areas of our work . . . from tiny diodes to complex digital computer systems and a massive network of global communications.

In addition to the opportunities for work and association with distinguished engineers and scientists, our graduate education tuition refund program encourages engineers to continue their formal training . . . and the facilities for graduate work near ITT locations are superior.

This is an all too brief resume. It would be hard to associate yourself with a company that offers the engineer greater choice of assignment. Write us about your interests — or see our representatives when they visit your campus.

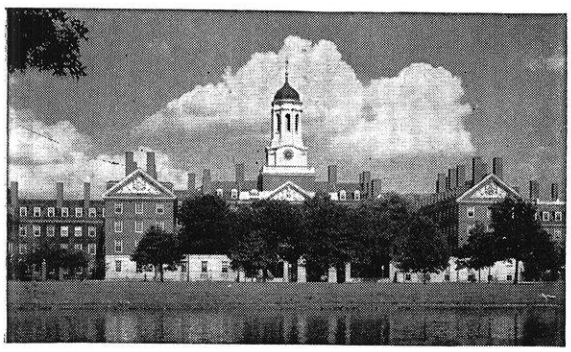
**INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION**

**67 Broad Street, New York 4, N. Y.**

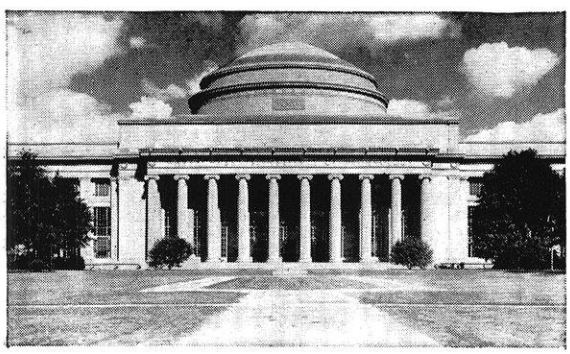
FEDERAL ELECTRIC CORPORATION • INTERNATIONAL ELECTRIC CORPORATION • ITT COMPONENTS DIVISION • ITT FEDERAL DIVISION • ITT INDUSTRIAL PRODUCTS DIVISION • ITT LABORATORIES • INTELEX SYSTEMS, INC. • INTERNATIONAL STANDARD ELECTRIC CORPORATION • ITT KELLOGG DIVISION • ROYAL ELECTRIC CORPORATION • AMERICAN CABLE AND RADIO CORPORATION • LABORATORIES AND MANUFACTURING PLANTS IN 20 FREE-WORLD COUNTRIES

# Raytheon Graduate Program

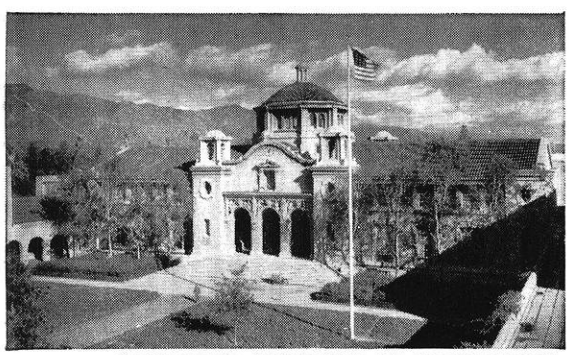
## FOR STUDY AT HARVARD MASSACHUSETTS INSTITUTE OF TECHNOLOGY AND CALIFORNIA INSTITUTE OF TECHNOLOGY IN 1960-61



*HARVARD*



*MASSACHUSETTS INSTITUTE OF TECHNOLOGY*



*CALIFORNIA INSTITUTE OF TECHNOLOGY*

The Raytheon Graduate Program has been established to contribute to the technical development of scientists and engineers at Raytheon. It provides the opportunity to selected persons employed by Raytheon, who are accepted as graduate students by Harvard University, Massachusetts Institute of Technology and California Institute of Technology, to pursue at Raytheon's expense, regular courses of study leading to a master's or doctor's degree in science or engineering in the institution of their choice.

The Program requires, in general, two or three semesters of study, depending on circumstances, with the summer months spent in the Company's research, engineering, or manufacturing divisions. It includes full tuition, fees, book allowances and a salary while at school. Students are eligible for health, accident, retirement and life insurance benefits, annual vacation and other privileges of full-time Raytheon employees.

To be considered for the Program, applicants must have a bachelor's degree in science or engineering, and should have outstanding student records, show technical promise, and possess mature personal characteristics. They may apply for admission to the Program in anticipation of becoming employees of Raytheon.

YOU ARE INVITED TO ADDRESS YOUR INQUIRY to Dr. Ivan A. Getting, Vice President, Engineering and Research, outlining your technical background, academic record, school preference, and field of interest, prior to December 1, 1959.

**RAYTHEON COMPANY, Waltham 54, Mass.**

*Excellence in Electronics* RAYTHEON

# Sewage Treatment

*(Continued from page 15)*

### Trickling Filter

This filter is a six to eight foot bed of broken stone over which the partially clarified liquid effluent is sprayed. As the effluent trickles through the stone it is acted upon by the agents of the oxidation process and is then drained off through the bottom. A feature of this filter is the natural unloading of the humus-like film which builds up on the stone. Due to the unloading action, the effluent contains solids which must be removed by running it through resettling basins.

The trickling filter is the most widely used because of its efficiency, high capacity and good reliability.

Similar effluent distribution methods can be used for any of the filter processes discussed above. These various methods are discussed below as a group.

In most of the older plants, distribution is by means of nozzles fed by pipes. Modern plants have movable distributors. A movable distributor consists of horizontal pipes or troughs which revolve around the center of a circular bed or move back and forth from end to end of a rectangular bed.

The revolving is used extensively because it utilizes the whole filter bed and it operates under a hydrostatic head, thus requiring no pumps.

The filter bed is round, and the underdrainage system is laid radially graded toward the central sump. Four distributing arms radiate from the center and revolve under action of the hydrostatic head. Each arm has a number of adjustable spray nozzles.

### ACTIVATED SLUDGE PROCESS

In this process the sewage, after it has passed through some form of preliminary treatment to remove part of the suspended matter, is mixed with activated sludge to form a mixed liquor. The mixed liquor is subjected to long aeration. The aerated mixed liquor then moves to the final settling tank from which the clear supernatant liquor is drained off the surface to be disposed of. The sludge that collects at the bottom is separated into two portions: one is activated sludge that is returned to the aeration tank; the other portion undergoes further treatment before final disposal.

No one theory of the action in the activated sludge process has been universally accepted. In a summary of the various hypotheses, one authority, Folwell states that: "The process is probably the result of: (a) clarification effected by a base exchange, and partly by bioprecipitation; (b) oxidation by the absorbed organic matter with the aid of bacteria; (c) oxidation of the nitrogeous matter."[1]

### TREATMENT OF THE SEPARATED SOLIDS

The solids separated by the various steps described above usually are given further treatment to reduce their volume and to get rid of offensive odors and other objectionable characteristics.

Screenings are subjected to shredding, to break up any large matters; digestion, to reduce volume; and dewatering to facilitate final disposal.

Sludge consisting of primarily organic matter is digested and dewatered in preparation for final treatment.

### DIGESTION

Sludge stored in digestion tanks is acted on by bacteria which liquify the greater part of the organic solids, and considerable amounts of gas are produced. Eighty degrees is the optimum temperature of sludge digestion, and the process requires three-fourths of a month. Digestion reduces 50 per cent of the organic solids.

The digestion tank has hot water pipes for maintaining the eighty degree temperature. There is also a provision for stirring. Mixing fresh sludge with seeding sludge produces the best results.

### DRYING

Drying is necessary to facilitate handling in final disposal, to prepare for burning if this method is used, and to decrease the sewage volume. Methods for drying sludge include the use of sand beds, presses, vacuum filters, centrifuges, and heat dryers. Drying on sand beds is the simplest, most common method.

### FINAL TREATMENT

The final treatment is the disposal of the products resulting from the above processes; those products being clarified effluent and dried sludge.

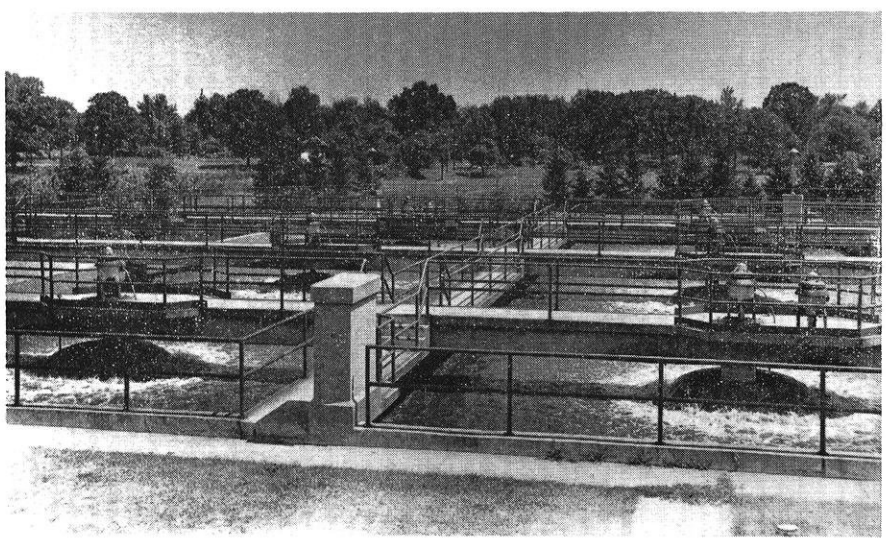
### EFFLUENT DISPOSAL

In most operations the clarified effluent goes directly to a stream or some other diluting medium. Chlorine might be added to further oxidize and disinfect.

### SLUDGE DISPOSAL

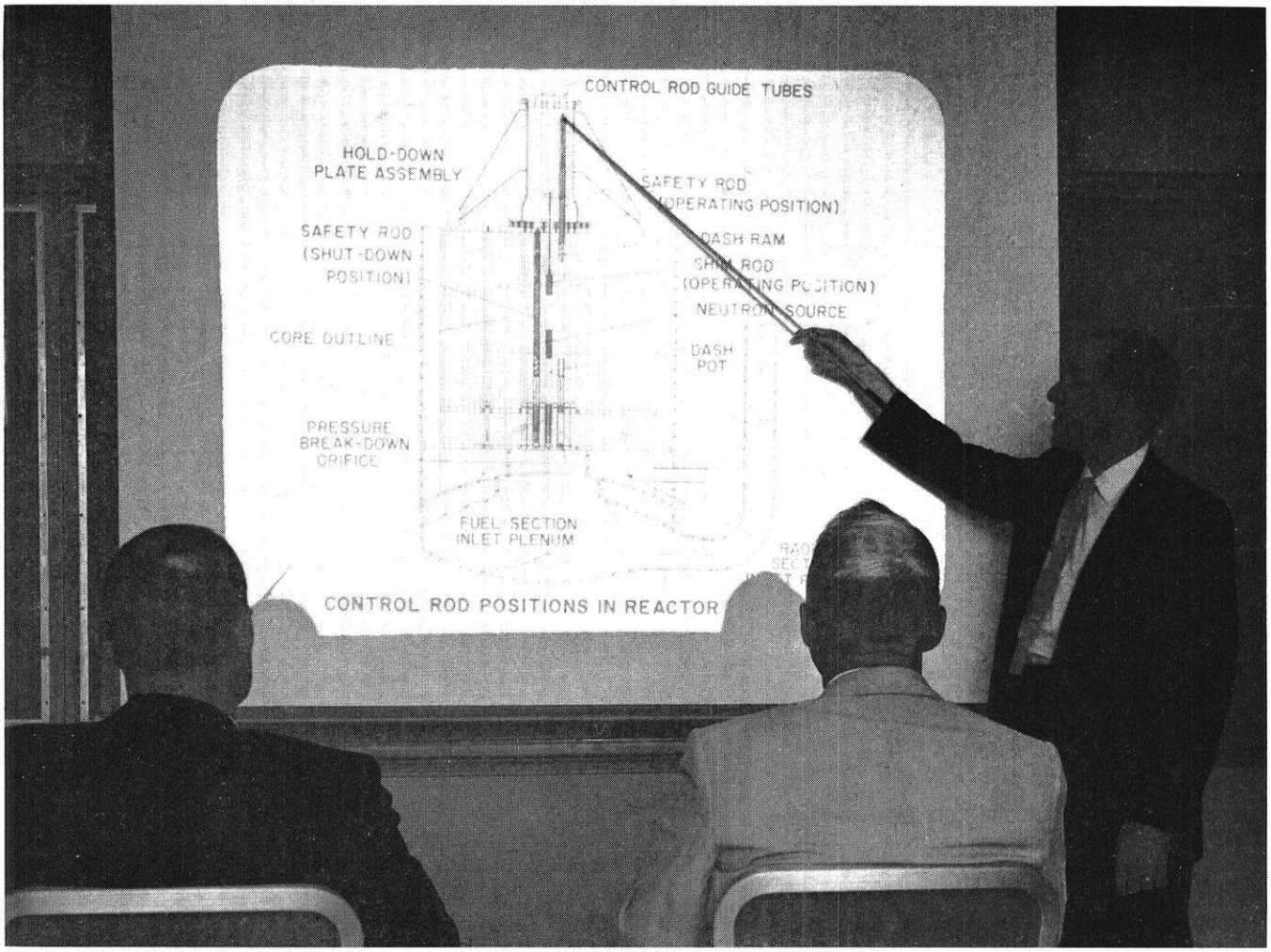
The screenings collected by racks and coarse screens consist of

*(Continued on page 64)*



—Chicago Pump Co.

**Above is a group of aeration tanks, which are a main part of the actuated sludge process.**




# *POWER AND PROGRESS go hand-in-hand . . .*

America's progress depends upon a plentiful supply of electric power . . . and upon young engineers like those shown above who are preparing for the years ahead by learning how to harness the power of atomic energy to the job of producing electricity.

Opportunities for personal progress, too, are to be found in the electric industry. Wisconsin Electric Power Company's far-reaching expansion program requires engineering skills in a wide variety of fields — electrical, mechanical, civil, chemical, statistical, research, sales, administrative, etc.

See our representatives when they visit your campus. Ask for more information about the excellent job opportunities available for engineers.

**WISCONSIN ELECTRIC POWER COMPANY SYSTEM**

Wisconsin Electric Power Co.
Milwaukee, Wis.

Wisconsin Michigan Power Co.
Appleton, Wis.

Wisconsin Natural Gas Co.
Racine, Wis.

# Subscription TV

*(Continued from page 20)*

### Disadvantages of Subscription TV

The primary disadvantage of subscription television is its high cost. The cost of installing the system alone costs in the neighborhood of one hundred dollars per unit. At this rate the equipping of even a small town will require a great amount of capital. In addition to this, the cost of the service also is quite high. Estimates as to the average cost per year per family run from an ultra-conservative $132.00 to as high as $1,156.32. The first of these estimates is based on the theory that about twenty-five per cent of the family's television viewing will be of the subscription type. Also included in this estimate is the assumption that the subscription television system will be operating at peak efficiency. On the other extreme, the second estimate is based on the theory that the subscriber will watch subscription television at the rate of 4.8 hours per day, the present national average viewing time for free television. This second estimate is based on the rates charged during the Zenith testing in Chicago.

Another argument that is used against toll television is that it will not be able to provide a form of entertainment that is very much better than is now provided by free television. To back this statement up we see that sports seems to be well covered by such free telecasts as:

1. The World Series.
2. The Kentucky Derby.
3. The Davis Cup Matches.
4. The Masters Golf Tournament.
5. The Baseball Game of the Week (four games each week).

Also, in the field of good drama, free television has provided the public with such top rate entertainment as:

1. "Antigone"
2. "The Corn is Green"
3. "High Tor"
4. "A Bell for Adono"
5. "Green Pastures"

The problem of what to do with subscription television is indeed a serious one, for the existence of one of our most widely used forms of entertainment and communication depends upon the correct decision.

THE END

# Synthetic Diamonds

*(Continued from page 32)*

### PROOF OF THE SYNTHETIC DIAMONDS

There are two things that must be done in order to identify these crystals as diamonds. They must have a crystal structure identical to that of a diamond and they must be composed of carbon.

The proof of the identical crystal structure was accomplished by using X-ray diffraction patterns. If two crystals have the same structure, they will have the same X-ray diffraction pattern. To obtain such a pattern, the specimen is placed in the path of a narrow beam of X-rays and rotated. The rays deflected by the crystals in certain characteristic directions are recorded on a photographic film. The diffraction patterns of the laboratory diamonds were the same as those of natural diamonds.

The second test was a chemical analysis. It showed the crystals were composed of 85 to 86 per cent carbon and 14 to 15 per cent noncombustible inorganic ash.

Another test, the hardness test, showed that the laboratory diamonds could scratch natural diamonds and all of the hardest materials known to man.

The index of refraction of the man-made diamonds was determined to be between 2.4 and 2.5. Natural ones have an index of refraction of 2.42. However, there are five minerals listed as having an index in this range. Only three of these can scratch glass, and they were eliminated by the X-ray and chemical tests.

The question of whether or not these diamonds were made by man required a special test. Individuals in the laboratory, who were totally unfamiliar with the process, were instructed on how to make the diamonds. Their efforts proved successful, thus proving that the diamonds were produced in the laboratory.

### THE USES AND COST OF SYNTHETIC DIAMONDS

#### Uses

As previously stated, the diamonds that have been produced thus far are much too small for ornamental purposes. However, they are ideally suited for industrial use. One of the larger synthetic diamonds producted could have made several diamond-tipped phonograph needles.

One of the most important uses of diamonds in industry is their use in cutting and grinding. Diamond dust is ideal in these applications.

The Metallurgical Products Department of the General Electric Company, Detroit, Michigan, was assigned the task of testing the man-made diamonds applicability to grinding. They chose a series of laboratory and machine applications to obtain a wide range of common tungsten-carbide grinding applications. Some of these involved fixed-feed surface grinding, tool and cutter grinding, and single-point tool grinding. The results showed that the man-made diamonds were an average of 35 per cent superior to natural diamonds.

This superiority was primarily a result of one characteristic. The crystals of the man-made diamonds are generally blocky and rough-surfaced. The crystals of the natural stones vary widely in shape from flat to blocky surfaces with some elongated particles and are generally smooth.

Since the man-made diamonds have a rough, jagged surface, they tend to stick to the wheel better. This, plus the fact that synthetic diamonds are more brittle, thus presenting new, sharp cutting edges, explains their superiority.

#### The Cost

The cost of man-made diamonds is the primary limitation to industrial uses. However, these diamonds are available to grinding wheel manufacturers, and any wheel user can order a wheel with such diamonds. Pilot-plant production of synthetic diamonds was announced October 22, 1957, and at that time the price was $4.25 per carat. In April, 1958, the price was $3.48 per carat as compared to about $2.80 per carat for natural diamonds. It is hoped that with further development in the process, the price will be reduced to that of natural diamonds.

THE END

## Engine Ears

*(Continued from page 37)*

Karel Olson and
Larry Diefrich, Corresponding Secretaries
Mike Noth, Alumni Secretary–Executive Board
Dan Martell, Treasurer
Carl Much, Assistant Treasurer
Chuck Holderness, Social Chairman
Bob Baltes, Assistant Social Chairman–Executive Board
O. J. Ziemelis, Rushing Chairman

### WHO? ME FLY?

Yes, for college students who want to learn to fly and for those who are already experienced pilots, the collegiate flying club is the answer. At colleges and universities all over the country, students are pooling their resources and getting into the air. Minnesota, Ohio State, Illinois, Michigan, and Purdue are some of the bigger schools in the Midwest that have flying clubs. A surprising number of smaller colleges also have flying clubs.

Almost two years ago, Wisconsin joined the ranks. After many preliminary meetings in the fall of 1957, the club was officially organized as a corporation under the Statutes of the State of Wisconsin, with membership limited to "persons officially connected with the University of Wisconsin or to spouses of such persons." The twenty members each put up $50 toward the purchase of an airplane and flying began in January, 1958. At present, the club has 46 members, 35 of which are active. The members range from freshman to faculty members.

The two plane "air force" consists of a trainer, an Aeronca Champ, and a cross-country ship, a Cessna 120. The Aeronca Champ has a 65 horsepower engine, two seats, the passenger sitting behind the pilot, and is fabric covered. Normal cruising speed is 80 to 85 miles per hour. The Cessna 120 has an 85 horsepower engine with starter and electrical system, and also two seats, but side-by-side. Normal cruising speed is 95 to 105 miles per hour depending on the particular propellor installed. It has a two-way VHF radio with the omni navigation feature and an all-metal fuselage with fabric-covered wings. Both planes are based at Morey Airport at Middleton, about eight miles west of the campus. Morey instructors are available for flying lessons. Transportation is available for those who do not have a car to get to the airport.

What about cost? To fly the Aeronca costs $3.60 per hour of flight time. If a member is flying dual (an instructor is flying with him), the instructor charges $6.00 per hour for his time, making a total of $9.60 per hour dual in the Aeronca. The Cessna 120 costs $5.40 per hour of flight time, solo. Again, if an instructor is flying with you, his $6.00 per hour rate is paid in addition to the solo rate. When a member joins the club he pays a $15 initiation fee and $50 for his share in the club. When a member leaves the club his $50 share is returned. Monthly dues are $4.00 for active members and $1.00 for inactives.

This may sound expensive but to fly a plane at the Madison area airports costs at least $10.00 an hour solo and $15.00 an hour dual when rented from an airport. Buying your own trainer-type plane will cost at least $900 for a plane in fair condition plus several hundred dollars for insurance. If a student joins the club, flies about five hours a month, obtains his private pilots license, and leaves the club nine months after joining, his private license will have cost him $324.00, based on his flying only the required minimum of 20 hours solo and 20 hours dual all in the Aeronca. A logbook, textbooks, maps and flight inspectors fee when he takes his flight test may total from $10 to $15. This is an average cost of $8.10 an hour for flying time. However, from then on if he stays in the club, he may fly the club planes at only the solo rate, which certainly is much less than renting a plane at an airport. A member does not have to fly any minimum number of hours per month but the more he flies, the cheaper the average cost becomes.

For further information, attend one of the club meetings, which are usually held on the second Tuesday of each month in the Union or call Stan Schwantes at AL 6–0786 or Jim Radke at AL 5–7543.

# Solar Energy

(Continued from page 26)

the energy supply and the demand in this field, that is, the need for refrigeration is the greatest when the sun is brightest. The device itself could be either in the form of a low temperature freezing unit for food or a moderate-temperature freezing unit for air conditioning purposes. An ammonia-absorption cycle would be the most suitable in the former, while the latter could be affected by a lithium bromide-water vapor system.

### Air Conditioner

A solar air-conditioner consists of a compressor driven by two turbines, a power unit, and an expansion unit. A fraction of the air from the compressor passes through the solar heater and then to the power-unit turbine. The remainder of the air, after cooling to atmospheric conditions, performs work and is rejected at a temperature below atmospheric. The higher the temperature in the solar heater, the smaller the fraction of compressed air which passes through this part of the circuit, and consequently the greater is the coefficient of performance of the system.

One type of solar absorption cooling system consists of a fluid which circulates through a generator or reboiler absorbing heat from the sun. The operation of the generator is carried out in a manner similar to that employed in modern air-conditioners—a simple heat transfer system.

### Solar Engines

Solar engines represent still another method of the utilization of solar energy. The drawback here is that it is limited in performance by the Carnot efficiency cycle and the temperature difference obtained is not great enough to make its use feasible.

A flat plate absorber which supplies the major portion of heat is filled with water and heat is transferred to evaporate liquid freon. The freon vapor is superheated in a mirror-concentration absorber and passed to a small high-speed reciprocating engine. The system is reversible.

### Solar Distiller

A device which could find extensive use in arid regions of the earth is the solar distiller. Solar radiation is absorbed by a black pad and is used to evaporate water, which is then re-condensed on the inside of the covers. The system is enclosed by glass panes to prevent convection and re-radiation losses. The estimated cost of water for an evaporator unit today is $1.65 per one thousand gallons with a possible future reduction to $1.00 per one thousand gallons.

Solar power may also be used to produce electric power. The system uses thermopiles with hot junctions on top and air cooled junctions behind the collector. However, the efficiency of such a setup is low, making its use impractical. The method presently used to produce electrical energy rather utilizes the energy of the protons directly. This conversion is made possible by a silicon p-n junction photovoltaic cell which is in use presently in portable radios, trickle battery chargers, and other low power devices. The theoretical efficiency of the silicon converter is 23 per cent, and actual efficiencies of around 11 percent have been obtained experimentally.

### Solar Furnace

The last use of solar energy to be considered is the operation of the solar furnace. In this device paraboloid of revolution mirrors heat target areas to temperatures of 3000 to 4000° C. Solar furnaces are used in the carrying out of certain chemical reactions and in determining phase relationships in high melting materials.

### Summary

All in all, it can be seen that solar energy indeed has great future potential as a source of power for our mechanized society. The relative economic failure of its utilization at the present time can be traced to the high cost of equipment, the low yields of power obtained, and the low cost and ready availability of other sources of energy such as coal and oil. However, due to the present trend toward more expensive fuels, and also due to the various new developments in the solar power field, the future of solar energy is very bright. Only continual experimentation and development, however, will finally show how bright it is destined to become.

**THE END**

# Sewage Treatment

(Continued from page 60)

sticks, rags, light rubbish, and paper. The screenings can be spread out to dry and then burned in the open.

Matter collected in a grit chamber is sand or other mineral matter. It can be disposed of by using for fill.

Incineration is the most sanitary method for disposing of sludge. In this process the dried sludge is mixed with some combustible material such as coal dust and the mixture is burned in a furnace.

Well digested, air dried sludge is a poor fertilizer but some types of activated sludge are high in nitrates and are used in the manufacture of fertilizer.

Some large cities, located on salt water, send the sludge on boats to deep water and dump it where there is little danger that it can pollute the shores.

Burial is another common method of sludge disposal.

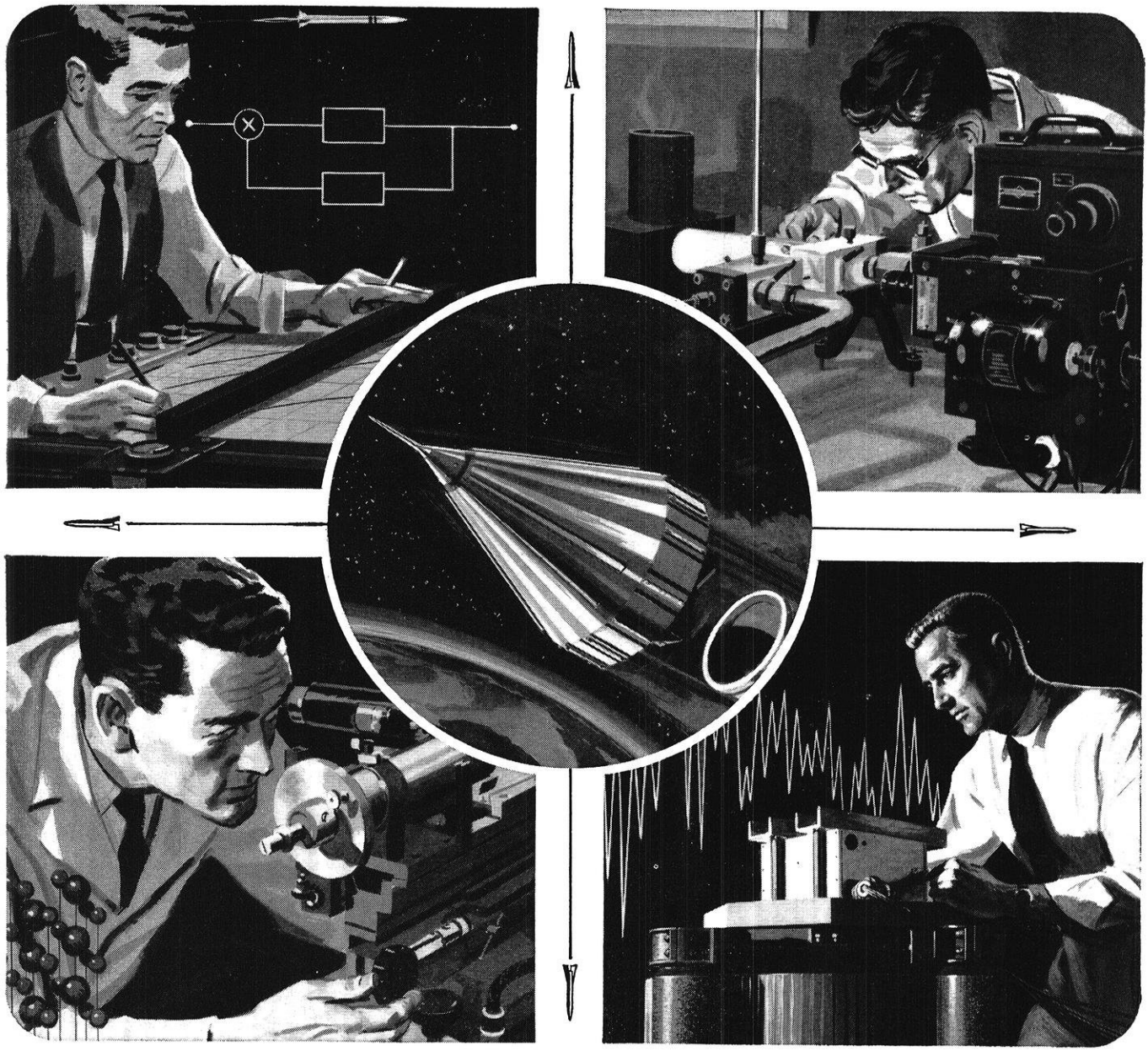
### CONCLUDING SECTION

The subject has been presented by separating it into four stages which when taken together comprise the over-all disposal procedure. The stages are: separation of liquids from solids, treatment of the liquid, treatment of the separated solids, and disposal of the treated effluent and solids. Discussion of each stage included an explanation of its purpose and the results obtained therein.

It has been shown that there are several methods for accomplishing the desired result in each stage. A brief description of these various methods was presented along with the explanation of each stage.

It must be emphasized that there is no one kind of treatment best adapted to all conditions. The selection of particular methods in the sewage treatment procedure must be based upon the study of a number of conditions: the character of the sewage to be treated; the amount of dilution necessary; the amount of money available for construction and operation; the quality and amount of diluting water available; the conditions for the disposal of sludge; and the area available for the treatment plant.

**THE END**



## YOUR TASK FOR THE FUTURE

Since its inception nearly 23 years ago, the Jet Propulsion Laboratory has given the free world its first tactical guided missile system, its first earth satellite, and its first lunar probe.

In the future, under the direction of the National Aeronautics and Space Administration, pioneering on the space frontier will advance at an accelerated rate.

The preliminary instrument explorations that have already been made only seem to define how much there is yet to be learned. During the next few years, payloads will become larger, trajectories will become more precise, and distances covered will become greater. Inspections will be made of the moon and the planets and of the vast distances of interplanetary space; hard and soft landings will be made in preparation for the time when man at last sets foot on new worlds.

In this program, the task of JPL is to gather new information for a better understanding of the World and Universe.

*"We do these things because of the unquenchable curiosity of Man. The scientist is continually asking himself questions and then setting out to find the answers. In the course of getting these answers, he has provided practical benefits to man that have sometimes surprised even the scientist.*

*"Who can tell what we will find when we get to the planets? Who, at this present time, can predict what potential benefits to man exist in this enterprise? No one can say with any accuracy what we will find as we fly farther away from the earth, first with instruments, then with man. It seems to me that we are obligated to do these things, as human beings."*

DR. W. H. PICKERING, *Director, JPL*

jpl

CALIFORNIA INSTITUTE OF TECHNOLOGY

**JET PROPULSION LABORATORY**

A Research Facility operated for the National Aeronautics and Space Administration

**PASADENA, CALIFORNIA**

*Employment opportunities for Engineers and Scientists interested in basic and applied research in these fields:*

INFRA-RED • OPTICS • MICROWAVE • SERVOMECHANISMS • COMPUTERS • LIQUID AND SOLID PROPULSION • ENGINEERING MECHANICS
STRUCTURES • CHEMISTRY • INSTRUMENTATION • MATHEMATICS AND SOLID STATE PHYSICS

***Send professional resumé for our immediate consideration. Interviews may be arranged on Campus or at the Laboratory.***

# Science Highlights

*(Continued from page 45)*

smoothly changing voltage, that corrects for course deviations.

To meet size and weight requirements, engineers had to reduce the package to one-third of its standard dimensions, producing a package 2½ x 2¼ inches and weighing less than 34 ounces.

Housed in the package are essentially two systems, each performing a function in the overall control and guidance of the missile. The first system consists of a stepper motor, dual cams and microswitches, synchro control transmitter and gear train. It ultimately indicates the position of the cynchro control transmitter of this first system via a signal proportional to its shaft angle.

The second system of this assembly consists of a motor rate techometer, synchro control transformer, synchro control transmitter, one dual and one single cam and microswitch together with separate gear trains between the motor tachometer and first synchro, the first synchro and the dual cam-microswitch and the second synchro and the cam-microswitch. From the second synchro to the single cam-microswitch. From the second synchro to the single cam-microswitch is 1:1 gearing. This second system ultimately indicates the position of the synchro control transformer and transmitter.

Backlash between synchro control transmitter and synchro transformer of the second system portion measured at the synchro control transmitter of the first system is 3 minutes maximum. Backlash between the motor and the synchro control transformer is 30 minutes maximum. Basically, four different gear reductions are included in the entire package. Reduction between the steeper motor and the synchro control transmitter is 9:1 and reduction between the motor rate generator and synchro transformer is 100:1. Reduction from the synchro transformer of the first set of cams and microswitches is 3:1 and reduction from the first set of cams and microswitches to the synchro control transmitter is 40:3. A ratio of 1:1 exists from the synchro control transmitter and the single cam and miscroswitch.

The housing of this package is of clear anodized aluminum and bearings are ABEC Class 5 or better. Gearing tolerances are Class 2 or better. The entire unit is designed for operation in ambient temperatures of −55° to +100° C. Unit construction was designed to withstand environmental conditions as generally specified in MIL–E–5272.

## NEW HIGH-STYLE DRAWING DESKS ARE INTRODUCED

A new high-style walnut drawing desk, "The Landmark," has been developed to meet both the functional and esthetic requirements of architects, designers, engineers, and draftsmen.

Unusual features of the new unit is an attached side auxiliary unit which offers convenient tool, catalog and tracing storage and a space-saving working area just a quarter-turn from the desk. The auxiliary unit principle is based on time-and-motion studies which reveal a high correlation between nearness of working tools and materials and productivity.

"The Landmark's" style features are its walnut-paneled sides with contrasting off-white drawing-work surfaces and satin chrome trim. A prototype model, shown for the first time at the recent Design Engineering Show in Philadelphia, was judged one of the exposition's 11 best-designed new products.

Adaptable for either individual office or for prestige multiple installations, "The Landmark" has three basic components: a front table, basic table, and rear reference desk.

The front table can be used alone in an office or to head a row installation. It has an adjustable drawing board but no storage area in front. The basic table combines drawing and reference areas. This unit placed behind a front unit offers a reference surface and storage area for the front man and a drawing surface for the second.

The row can be continued with as many basic tables as required. The last man is furnished with a rear reference desk.

Both the front table and basic table have matching side auxiliary units, available in either left or right hand models. The auxiliary unit adds more than three square feet of reference surface plus storage space for catalogs, reference books, and tracings. Sliding doors with a key lock permits safe-keeping of the auxiliary unit's contents.

Each auxiliary unit has a triple electrical outlet.

Additional features include a 30-inch drawing surface for use with a posture chair, two top sizes with a single base size, concealed top adjusters with satin chrome control and leveling glides in the legs.

Drawing surface is basswood, finished off-white for pencil line contrast. The board has an anodized aluminum pencil trough and a linoleum mounting strip.

Reference surfaces are covered with white plastic laminate for easy cleaning and resistance to wear. Convenient reference and catalog drawers are roller-suspended from the basic unit and rear desk.

Ease of assembly or disassembly, with no sacrifice of structural rigidity, is achieved by knock-down construction with lock pin fasteners.

## CAR GREASE ON WAY OUT

Cars that need no greasing may be on the road by 1963. Citing the drop in the number of chassis fittings, 56 per cent in the past seven years, chassis fittings will drop steadily in cars from 1960 models on, and may reach the zero point by 1963.

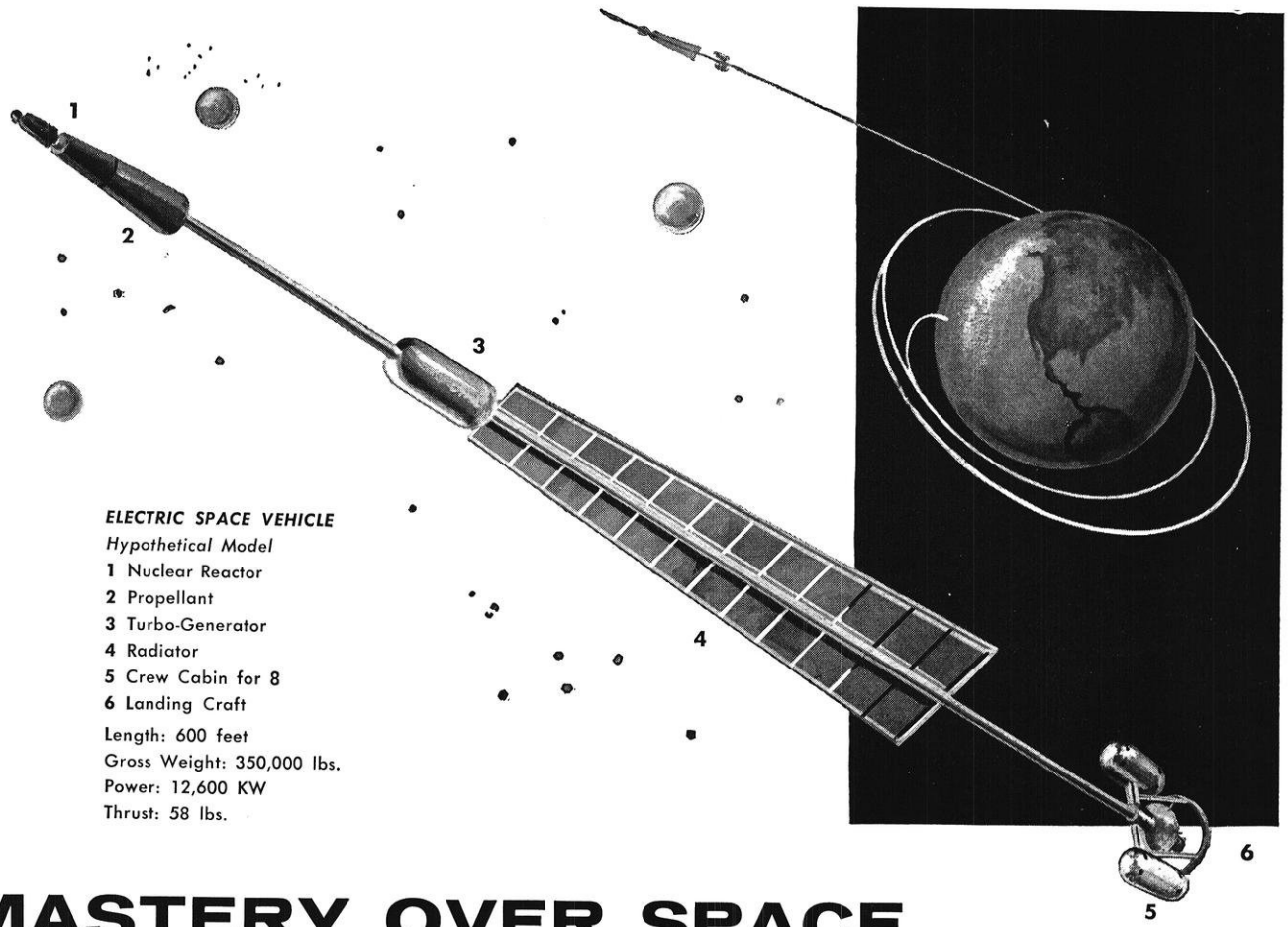
## CASTOR OIL FOR LUBRICATION

London city buses soon will be using castor oil for lubrication of their rear axles. The idea will save the British capital $336,000 annually. Expectation is that the higher initial cost of the castor oil will be easily absorbed by a two-to-three per cent reduction in fuel consumption due to reduced friction.

## BUBBLE GUM TESTS MISSILES

Engineers are using chewed penny bubble gum to find leaky joints in the pneumatic lines of Nike missiles. Soap bubbles and other methods cannot be used because the evidence of leaks does not remain after the line pressure falls. The gum bubbles keep the leak pinpointed.

THE END




***ELECTRIC SPACE VEHICLE***
*Hypothetical Model*
**1** Nuclear Reactor
**2** Propellant
**3** Turbo-Generator
**4** Radiator
**5** Crew Cabin for 8
**6** Landing Craft
Length: 600 feet
Gross Weight: 350,000 lbs.
Power: 12,600 KW
Thrust: 58 lbs.

# MASTERY OVER SPACE

NASA's space efforts are directed toward two specific objectives. First, to make it possible for man to achieve the same mastery over space he has already secured in every other region he has attempted to make his own . . . on the surface of the earth, under it, or in the air above it.

Second, to free man from one additional element of intellectual bondage—that is, to gain for all mankind additional knowledge about the cosmos.

To accomplish these objectives NASA's broadly conceived programs encompass intensive work in the following areas:

Scientific investigations in space by means of sounding rockets, scientific satellites, lunar probes, deep space probes.

Research and development of spacecraft, missiles and aircraft.

Meteorological and communications satellite systems.

Space operations technology — Project Mercury and space rendezvous techniques.

Space propulsion research, including solid propellant rockets, high energy propellant rockets, 1½-million-pound-thrust single-chamber rocket engine, nuclear and electric rocket engines.

Orbiting space laboratories.

# THE FERROUS WHEEL

*by Sneedly, BS '60*

A young man contemplating matrimony wanted to propose and didn't know how, so he went to his dad for advice.

"Well, son," said the old man, "I don't know that I can help you much. With me and your Maw it happened on Sunday evening, when yer Maw and me was asittin' on the sofa. We was just a talkin' along and purty soon yer Maw leaned over and whispered in my ear and I said, "The hell you are," and the next day we were married.

* * *

An old-fashioned gentleman took a modern miss for a ride in his car and after finding a suitable spot to park, kissed her several times lightly on the cheek and then announced, "This is called spooning."

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

* * *

**He: "If I kiss you, will you call for help?"**

**She: "Will you need help?"**

* * *

Butler: "Sir, there's a woman peddler at the door."

Codger: "Excellent, Godfrey, we'll take two."

**A beautiful girl was walking along the sidewalk one evening on her way to the movie. She noticed a small bird lying at the side of the walk with a broken wing. Instead of going to the movie, she took the bird home, bandaged its wing, and fed it. In a few weeks the bird was well enough to fly away.**

**Now let's see you guys find anything dirty in that.**

* * *

According to a story going around in Western Europe, one Prague resident refused to join the outcry against a new Stalin statue in the city's public square.

"Why not a statue?" he said, 'It gives us shade in the summer, shelter in the winter, and an opportunity for the birds to speak for us all."

* * *

**As he felt his way around the lamp post, the overloaded senior muttered, "S'no use, I'm walled in."**

* * *

"Drink broke up my home."

"Couldn't stop it?"

"No, the damn still exploded."

**Chem. E.: "Every time I kiss you it makes me a better man."**

**Co-ed: "Why try to get to heaven in one night?"**

* * *

"Whoever told that guy he was a prof? He just doesn't know how to teach the stuff. Everybody hates him. Every time he tries to explain something he digresses so much that no one can understand what he's talking about. I think he ought to quit teaching and go back to the farm."

"Yeah, I flunked, too."

* * *

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

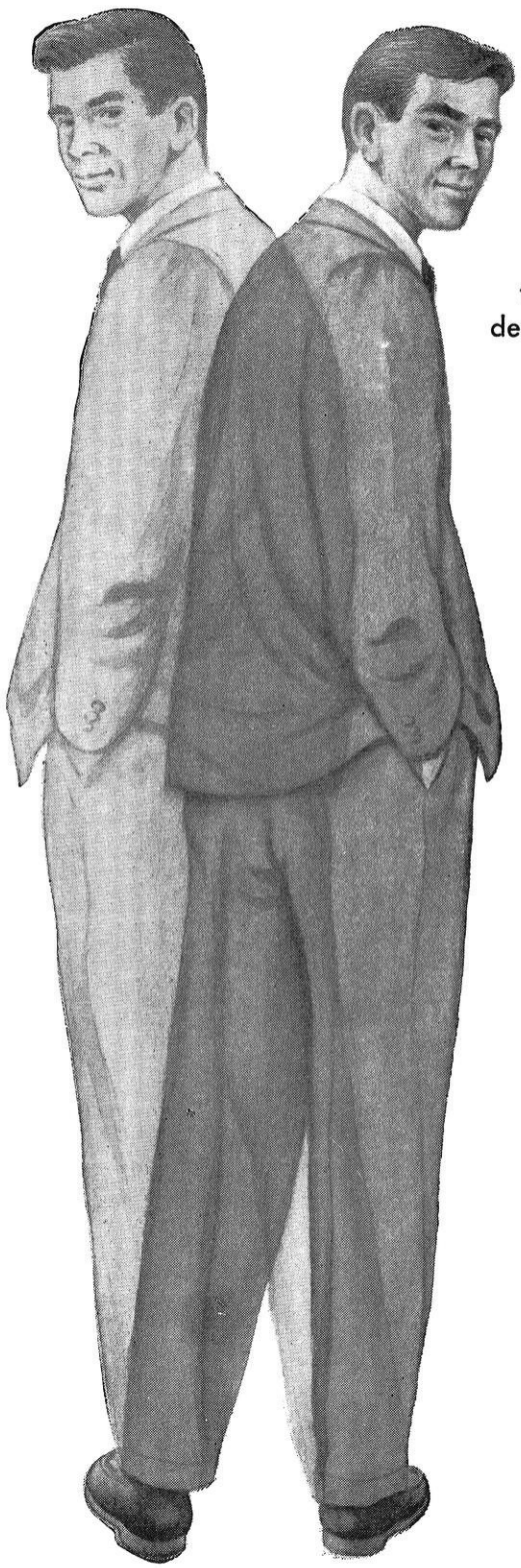
* * *

"May I come in?" he said. It's the room I had when I was in college in '09." "Yes, Sir," he said, lost in reverie. "Same old windows. Same old view of the campus. Same old closet." He opened the door. There stood a girl, greatly embarrased.

"This is my sister," I said quickly.

"Yes, sir. Same old story."

# MEN ...who are Engineers, **look twice** at the many advantages CONVAIR-POMONA offers



NEW PROGRAMS at Convair-Pomona, offer excellent opportunities today for Engineers. Convair-Pomona, created the Army's newest weapon, REDEYE, *Shoulder Fired* MISSILE and developed the Navy's ADVANCED TERRIER and TARTAR MISSILES. Many other, still highly classified programs, stimulating the imagination of the most progressive thinking scientist and engineer are presently at various stages of development.

*Positions are open for experienced and inexperienced Bachelors, Masters and Doctorates in the fields of Electronics, Aeronautics, Mechanics and Physics.*

***ADVANCEMENT*** opportunities are provided for the competent engineer as rapidly as his capabilities will permit in currently expanding programs.

***PROFESSIONAL ENVIRONMENT***—CONVAIR-POMONA'S facility is of modern design and completely air-conditioned. You will work with men who have pioneered the missile industry and are now engaged in some of the most advanced programs in existence.

***ADVANCED EDUCATION*** — Tuition refund is provided for graduate work in the field of your speciality. Company sponsored in-plant training courses offer the Engineer the finest of educational opportunities.

***CALIFORNIA LIVING*** — Suburban Pomona offers lower living costs and moderate priced property, unexcelled recreational facilities, freedom from rush hour traffic and the ultimate in comfort and gracious living.

*Contact your placement office immediately to assure yourself of a campus interview with Convair-Pomona.*
*If personal interview is not possible send resume and grade transcript to B. L. Dixon, Engineering Personnel Administrator, Dept. CM500 Pomona, California.*

## CONVAIR/POMONA
**a Division of**
## GENERAL DYNAMICS CORPORATION
**POMONA, CALIFORNIA**

# So You Think You're SMART!

*by Sneedly, PhD '84*

AT LAST the month of turkey and mince meat pies has arrived bringing with it a welcomed four day vacation. Perhaps some discouraged freshman engineer is considering ending his career at Wisconsin and seeing the Army recruiting officer while home. It is to such misguided souls that I address the following message:

By all means, and at all costs, stick out your four years and get your degree. Then you can go on to graduate school! Let me explain why this should be your most treasured goal.

This year, I have the great misfortune to be living with a graduate student. I say misfortune because a grad student is such a miserable example of good study habits for the hard working undergrad. The typical grad student has a maximum of twelve hours of class a week—if you can imagine such a thing. He does not spend long hours writing tedious lab reports because, of course, he takes no labs. You may have the mistaken opinion that grad students take difficult courses dealing with advanced, complicated material. If you do, you are completely wrong. For instance, let me just mention two of the textbooks my roommate studied for his first three weeks of class work. One was *Baa Baa Black Sheep* by "Pappy" Boyington, the life story of an alcoholic. Whether or not the subject of alcoholism has any special significance regarding grad students is left to the imagination of the reader. The other book, of a more technical nature, was *The Fundamentals of Contract Bridge* by Goren. By the way, as a word of heartfelt advice, never play bridge with a grad student.

Now that you have been enlightened as to the advantages of grad school you are probably wondering if you will qualify for it. To help you decide if you could be happy as a grad student, solve the following problems. If all your solutions are erroneous, you will make an ideal grad.

1. A fortunate civil engineer uses a check to pay for a turkey costing $3.50. The absent-minded clerk mistakes the dollars for cents and the cents for dollars. As a result, the change he gives back is just twice the amount for which the check is written. For what amount was the check written?

2. A commuting professor normally is met by his chauffeur at a specific time and driven home. One certain afternoon, the professor catches a train that arrives one hour earlier than his usual train. Eschewing the local taxi, he begins to walk home. On the way, he is met by his own car making the usual trip at the usual constant speed. The chauffeur drives him home from there, and it is observed that they arrive precisely ten minutes earlier than on a normal day. For how long was the commuter a pedestrian?

3. Two baseball teams, presumably of equal merit, are playing a series of games with the understanding that the first team winning four games wins the series. They have played two games and the Bluesox have won both. What is the probability of the Bluesox winning the series?

Here are the solutions to the problems in the October issue:

1. This problem was so simple it was tricky. You would take just three socks out of the drawer.

2. Sally is 22 years, 8 months old. Setting up and solving one equation in one unknown gives the correct answer.

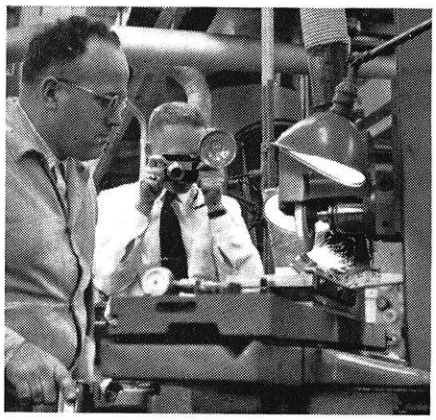
3. This is the exact solution given to me. I do not understand it either. C is greater than 2, and it can not be 4 or more, since C x CHOP would make more than four places. C must be 3, and P is therefore 9. Since C times CHOP equals PORK, K must end in 7 since 3 x 9 equals 27. K is therefore 7. C times H cannot have any "carry-over," since that would spoil the 9 which we know P is. The only number that H can be is 2. Now 3 x H must give us O. O can not be 1, 2, 3, 7, or 9; it is either 4, 5, 6, or 8. Testing we find that O must be 8. The answer is

$$\frac{9867}{3289} = 3.$$

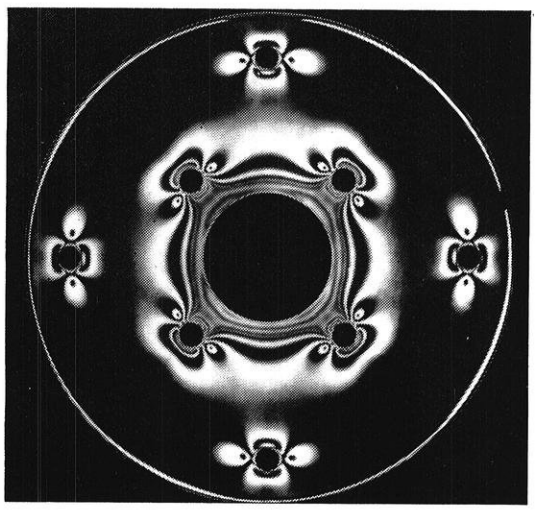
Send solutions and questions to:

SNEEDLY
% The Wisconsin Engineer
Mechanical Engineering Bldg.
Madison, Wisconsin

# From research to finished product–
# Photography works with the engineer



Sparks fly as the plant photographer records a grinding technique for study.



Photoelastic stress analysis helps the design engineer pinpoint areas requiring extra strength.

Giant machines produce a flow of photo-exact engineering drawings—save countless hours of drafting time.

Today photography plays many important roles in industry. It speeds engineering and production procedures. It trains and teaches. It sells. In whatever work you do, you will find photography will play a part in improving products, aiding quality controls and increasing business.

## Careers with Kodak

With photography and photographic processes becoming increasingly important in the business and industry of tomorrow, there are new and challenging opportunities at Kodak in research, engineering, electronics, design and production.

If you are looking for such an interesting opportunity, write for information about careers with Kodak. Address: Business and Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N.Y.

Color transparencies on the production line aid operators in assembly operations—save time and reduce errors.

**EASTMAN KODAK COMPANY**
**Rochester 4, N.Y.**

Kodak
TRADEMARK

One of a series*

## Interview with General Electric's Charles F. Savage Consultant—Engineering Professional Relations

# How Professional Societies Help Develop Young Engineers

**Q. Mr. Savage, should young engineers join professional engineering societies?**

**A.** By all means. Once engineers have graduated from college they are immediately "on the outside looking in," so to speak, of a new social circle to which they must earn their right to belong. Joining a professional or technical society represents a good entree.

**Q. How do these societies help young engineers?**

**A.** The members of these societies —mature, knowledgeable men— have an obligation to instruct those who follow after them. Engineers and scientists—as professional people—are custodians of a specialized body or fund of knowledge to which they have three definite responsibilities. The first is to *generate* new knowledge and add to this total fund. The second is to *utilize* this fund of knowledge in service to society. The third is to *teach* this knowledge to others, including young engineers.

**Q. Specifically, what benefits accrue from belonging to these groups?**

**A.** There are many. For the young engineer, affiliation serves the practical purpose of exposing his work to appraisal by other scientists and engineers. Most important, however, technical societies enable young engineers to learn of work crucial to their own. These organizations are a prime source of ideas — meeting colleagues and talking with them, reading reports, attending meetings and lectures. And, for the young engineer, recognition of his accomplishments by associates and organizations generally heads the list of his aspirations. He derives satisfaction from knowing that he has been identified in his field.

**Q. What contribution is the young engineer expected to make as an active member of technical and professional societies?**

**A.** First of all, he should become active in helping promote the objectives of a society by preparing and presenting timely, well-conceived technical papers. He should also become active in organizational administration. This is self-development at work, for such efforts can enhance the personal stature and reputation of the individual. And, I might add that professional development is a continuous process, starting prior to entering college and progressing beyond retirement. Professional aspirations may change but learning covers a person's entire life span. And, of course, there are dues to be paid. The amount is graduated in terms of professional stature gained and should always be considered as a personal investment in his future.

**Q. How do you go about joining professional groups?**

**A.** While still in school, join student chapters of societies right on campus. Once an engineer is out working in industry, he should contact local chapters of technical and professional societies, or find out about them from fellow engineers.

**Q. Does General Electric encourage participation in technical and professional societies?**

**A.** It certainly does. General Electric progress is built upon creative ideas and innovations. The Company goes to great lengths to establish a climate and incentive to yield these results. One way to get ideas is to encourage employees to join professional societies. Why? Because General Electric shares in recognition accorded any of its individual employees, as well as the common pool of knowledge that these engineers build up. It can't help but profit by encouraging such association, which sparks and stimulates contributions.

Right now, sizeable numbers of General Electric employees, at all levels in the Company, belong to engineering societies, hold responsible offices, serve on working committees and handle important assignments. Many are recognized for their outstanding contributions by honor and medal awards.

These general observations emphasize that General Electric does encourage participation. In indication of the importance of this view, the Company usually defrays a portion of the expense accrued by the men involved in supporting the activities of these various organizations. Remember, our goal is to see every man advance to the full limit of his capabilities. Encouraging him to join Professional Societies is one way to help him do so.

*Mr. Savage has copies of the booklet "Your First 5 Years" published by the Engineers' Council for Professional Development which you may have for the asking. Simply write to Mr. C. F. Savage, Section 959-12, General Electric Co., Schenectady 5, N. Y.*

*LOOK FOR other interviews discussing: Salary • Why Companies have Training Programs • How to Get the Job You Want.

GENERAL ELECTRIC