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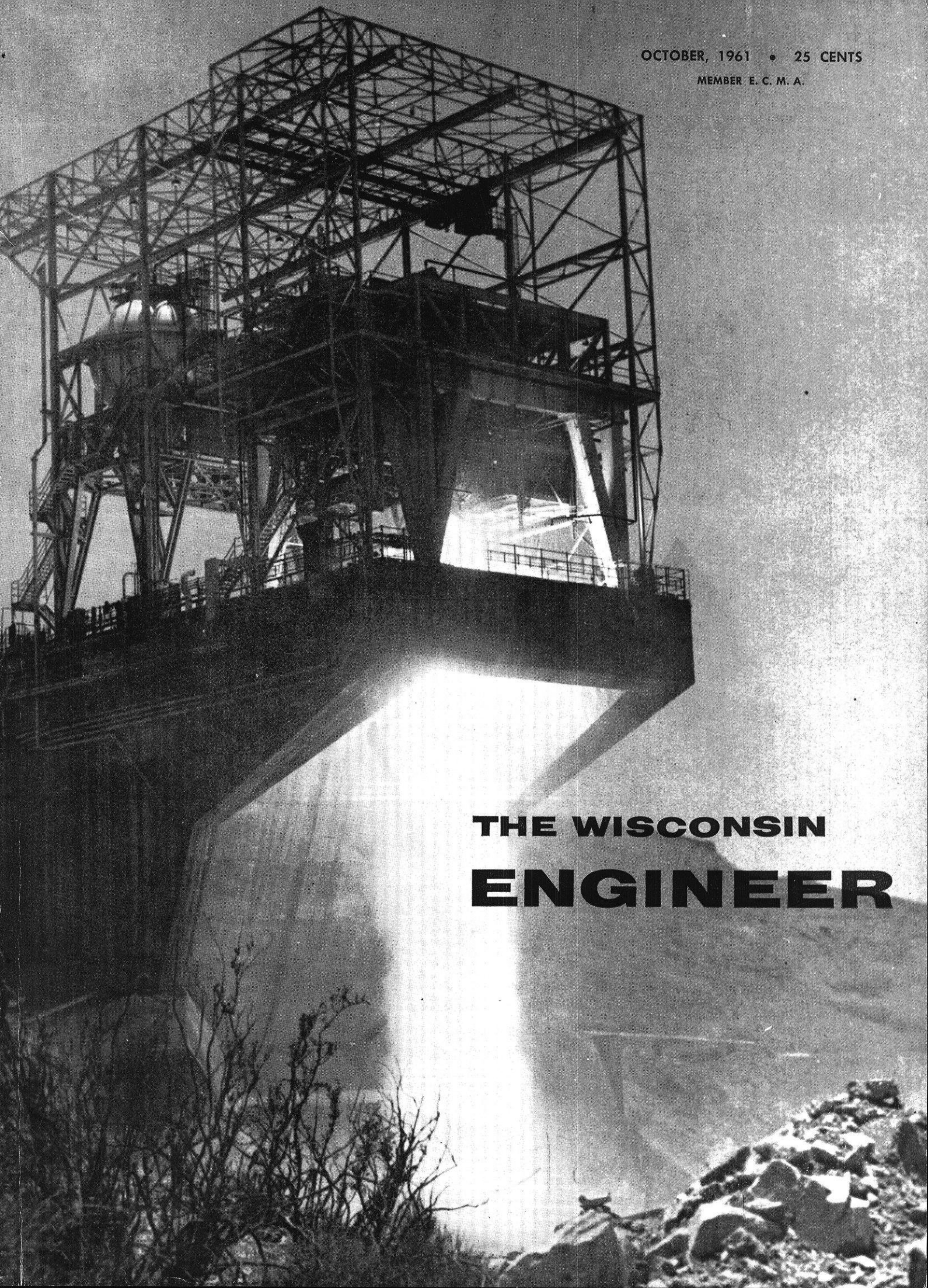
OCTOBER, 1961 • 25 CENTS
MEMBER E. C. M. A.



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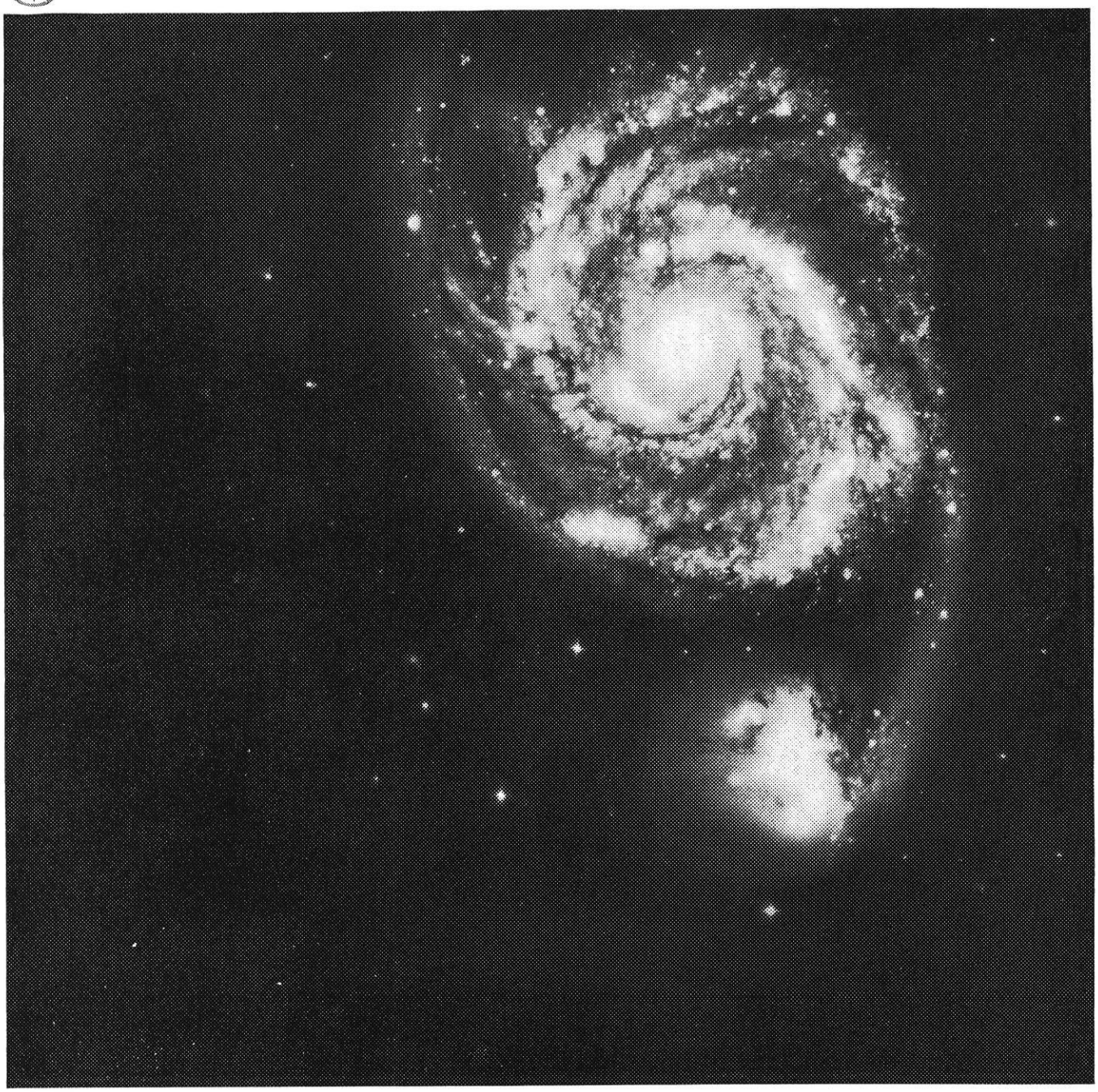

How cold is up? We know that outer space can never be colder than minus 459.72° Fahrenheit—that's absolute zero, the point at which all molecular motion ceases. We don't know what coldness like this will do to materials, but we're finding out. Scientists are using a heat exchanger to produce temperatures as low as minus 443° Fahrenheit. They test materials in this extreme cold and see how they perform. Out of such testing have already come special grades of USS steels that retain much of their strength and toughness at –50° or below; steels like USS "T-1" Constructional Alloy Steel, TRI-TEN High Strength Steel, and our new 9% Nickel Steel for Cryogenics applications. And the heat exchanger to produce the –443° Fahrenheit is Stainless Steel! No other material could do the job as well. Look around. You'll see steel in a lot of places—getting ready for the future. ■ For information about the many career opportunities, including financial analysis or sales, write U. S. Steel Personnel Division, Room 6085, 525 William Penn Place, Pittsburgh 30, Pa. U. S. Steel is an Equal Opportunity Employer. USS, "T-1" and TRI-TEN are registered trademarks.

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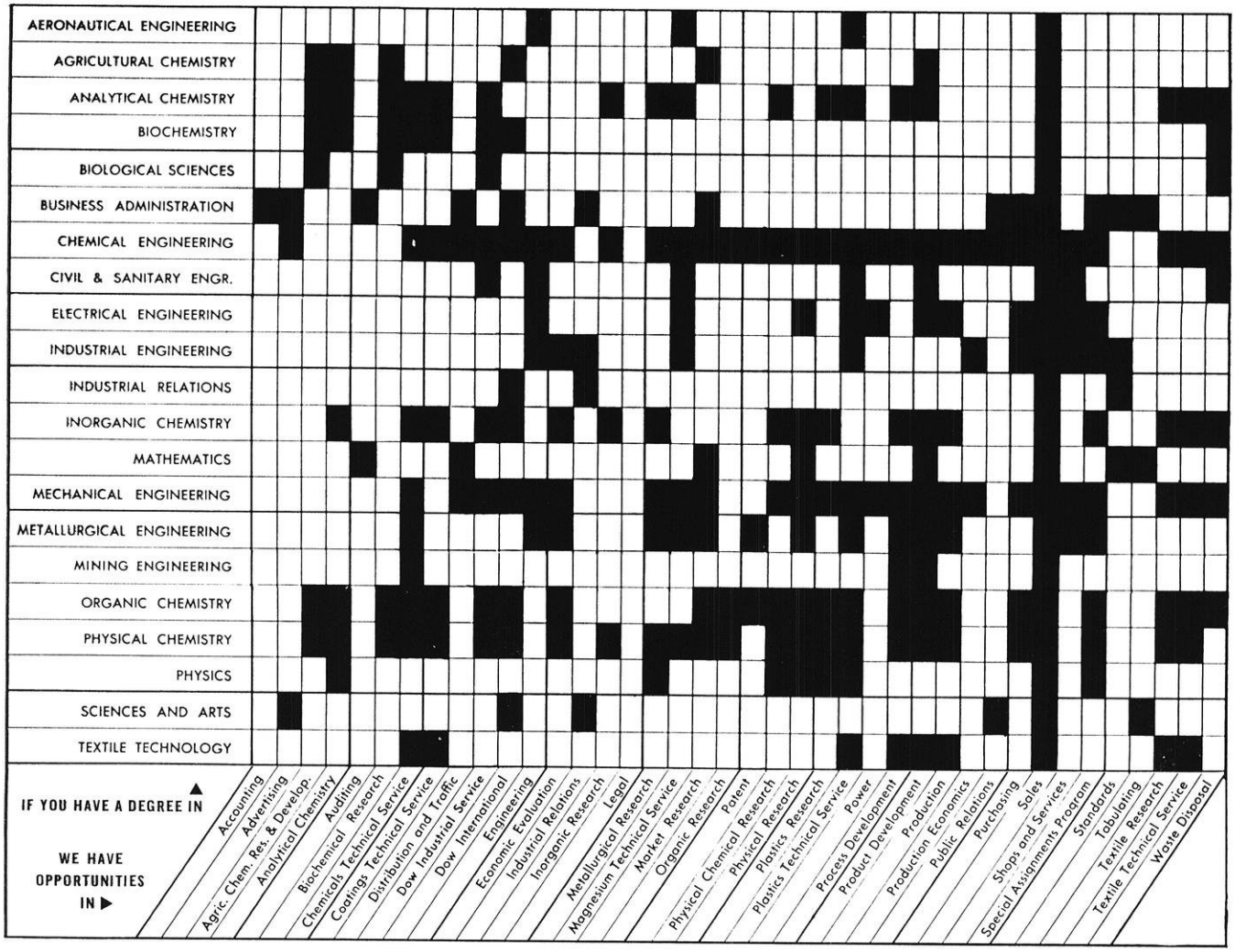

USE THIS CHART TO CHECK YOUR OPPORTUNITIES AT DOW!

We call this an 'opportunities chart.' It shows some of, but by no means covers all, the professional positions available at Dow for college graduates. What the chart cannot show is the keen interest that Dow management takes in the individual. Here, sound technical background and qualities of leadership are soon rewarded. Opportunities abound—on the job and through graduate study.

Dow is currently serving 200 industries varying from medicine to mining, paper to paint, tires to textiles, farming to foundries. Dow has major manufacturing operations in 23 locations in the United States in addition to associated and subsidiary companies. Exploration goes on endlessly at 50 separate laboratories. In addition, Dow has rapidly expanding marketing and manufacturing operations in 28 foreign countries.

Behind every product (and Dow has more than 700) is a story of achievement that comes with *opportunity*. Opportunity for individual and independent work by the people who created the product; by those who developed and engineered its manufacture; by the ones who produced, sold, and serviced it; and by those who continue to improve it.

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Michigan—Midland
Missouri—Allied Laboratories, Inc., Kansas City
Ohio—Dobeckmun Company, Cleveland
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Oklahoma—Dowell, Tulsa
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THE DOW CHEMICAL COMPANY DOW Midland, Michigan

Looking Ahead with Phillips Petroleum . . .

AN EXAMPLE OF GROWTH BASED ON RESEARCH

Phillips Petroleum Company began putting science to work in company laboratories very early in its history. Back when natural gas was still being flared as a "waste" product, Phillips scientists were discovering new, profitable uses for it and the liquids extracted from it. Acting upon this knowledge, Phillips management amassed huge reserves of natural gas when it was still generally considered to be of little use.

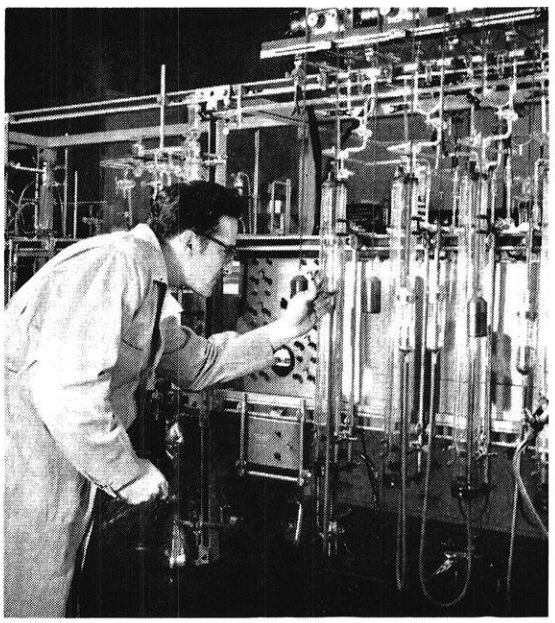
With this foundation of raw materials and technology, Phillips has attained a commanding leadership in natural gas, natural gas liquids, and petrochemicals. This base has been especially valuable in the chemicals field, where intense competition permits a nod of success only to companies with supplies of the proper raw materials and the know-how assembled from long experience and research.

From Phillips intensified emphasis on research and development through the years came many notable, profitable discoveries or developments. Among these are "cold" synthetic rubber; oil furnace carbon blacks; HF alkylation and other refining processes; high density polyolefins, trademarked Marlex; and all-season motor oils.

Three times the company has won the coveted "Chemical Engineering Achievement Award" for its research and development accomplishments, once by itself and twice in group awards.

Although research solves problems and develops know-how, an important measure of its results is patents. For many years Phillips has ranked second in number of patents issued and in total number of U. S. patents owned among all U. S. oil companies. The most recently available figures show Phillips ranks eighth in this respect among companies in all industries in America.

Intensive and consistent research effort has equipped Phillips with a qualified and dedicated research and development team. Although many of Phillips 3,000 scientists and engineers are located at the modern Phillips Research Center near the company headquarters in Oklahoma, others may be found in vital centers elsewhere. These people are thinking and working not only on exciting and challenging projects for the years



ahead, but also to make existing operations more profitable and to quickly commercialize newly developed processes and products. In short, their emphasis is upon converting ideas into earnings.

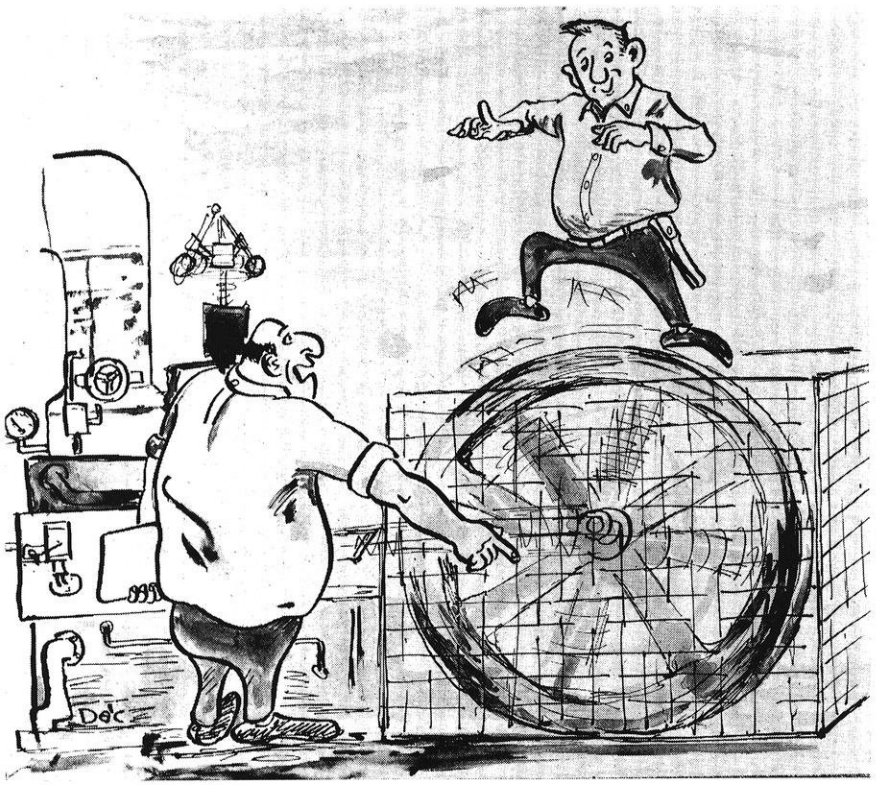
One of the most recent major petrochemical achievements of Phillips research is cis-polybutadiene rubber, trademarked Cis-4. Extensive tests have shown this rubber to be superior to natural rubber in tire tread wear and in other important qualities, including blowout resistance and traction on snow and ice. The company's 25,000 ton per year Cis-4 plant has commenced production. The process has been licensed to others both in the U. S. and abroad.

There is always an undisclosed backlog of discoveries and inventions to which Phillips scientists are giving "finishing touches" prior to commercialization. Some now or soon emerging are a new jet fuel additive solving a vexing aircraft problem, a new polypropylene process, and a better seismic prospecting method.

Research is one reason for "Looking Ahead With Phillips."

PHILLIPS PETROLEUM COMPANY, Bartlesville, Oklahoma

PHILLIPS 66



Aw Right Stupid! Dat's not what I meant by being familiar with the equipment!

MEMBER OF ENGINEERING COLLEGE MAGAZINES ASSOCIATED

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VOLUME 66, NUMBER 1

OCTOBER, 1961

THE WISCONSIN ENGINEER

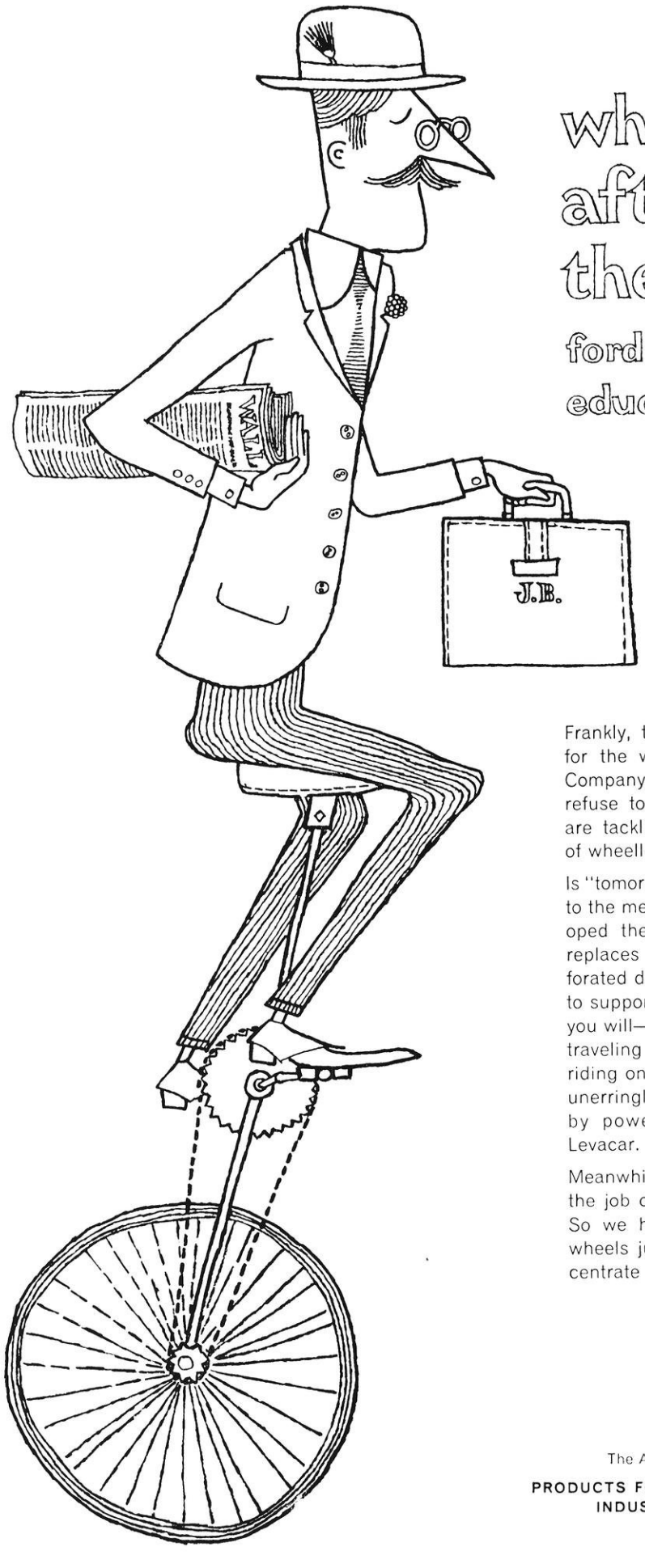
The Student Engineer's Magazine Founded in 1896

ARTICLES

DEPARTMENTS

THIS MONTH'S COVER

EDWARDS, CALIF., August 16, 1961—More than one million pounds of thrust streams from F-1 rocket engine during first series of tests here of complete flyable system. F-1 is free world's most powerful space booster engine; may launch first manned expedition to the moon. It is being developed by Rocketdyne, a division of North American Aviation, Inc., under technical direction of NASA's Marshall Space Flight Center.



what comes after the wheel?

ford motor company's educated guess

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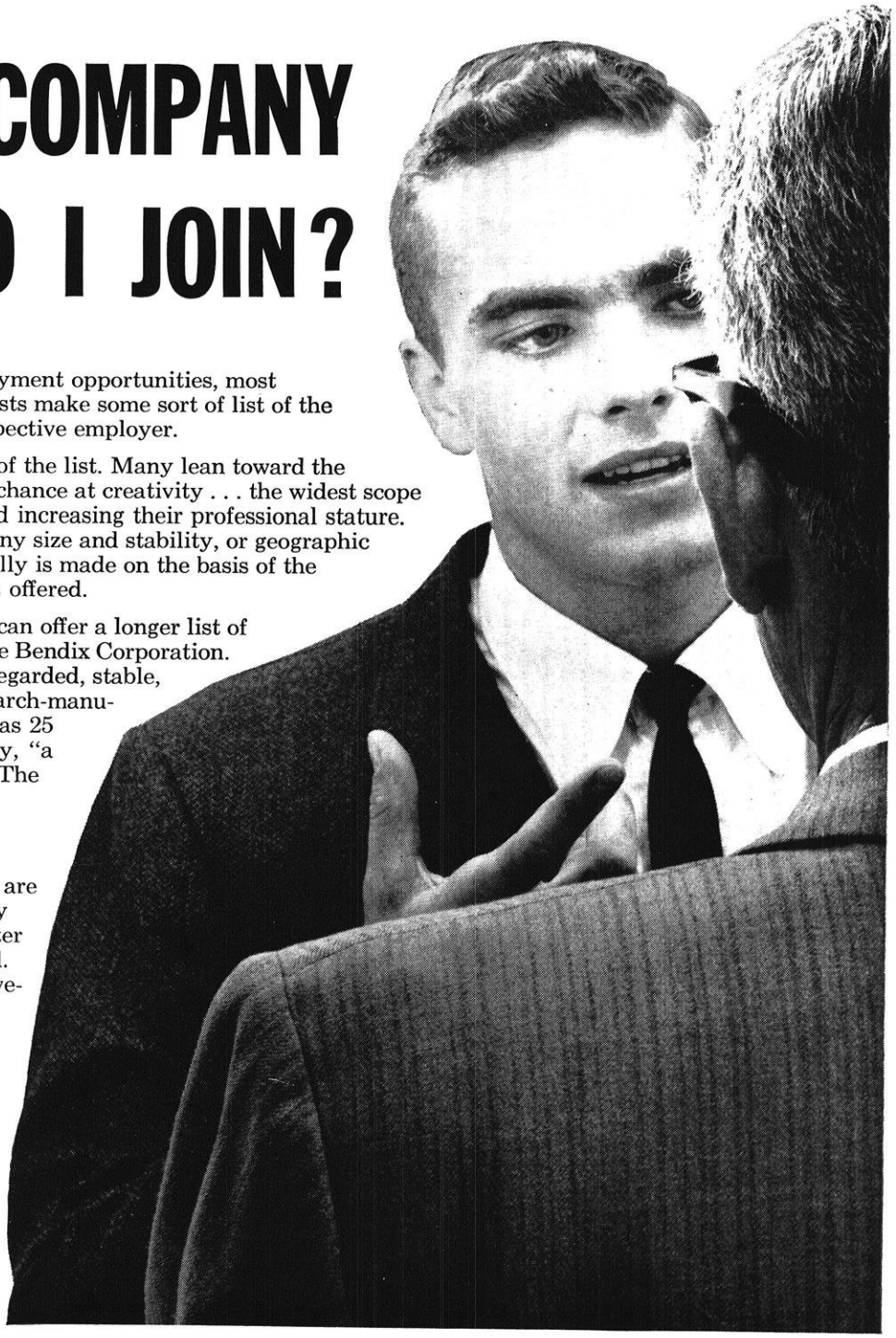

When there is a choice of employment opportunities, most graduating engineers and scientists make some sort of list of the advantages offered by each prospective employer.

Some men put salary at the top of the list. Many lean toward the company offering them the best chance at creativity . . . the widest scope for developing their interests and increasing their professional stature. Others favor job security, company size and stability, or geographic location. The final choice generally is made on the basis of the biggest "package" of advantages offered.

Probably no organization today can offer a longer list of employment advantages than The Bendix Corporation. One of the world's most highly regarded, stable, and diversified engineering-research-manufacturing corporations, Bendix has 25 divisions which produce, literally, "a thousand diversified products." The wide geographic spread of these divisions can be seen in the listing below.

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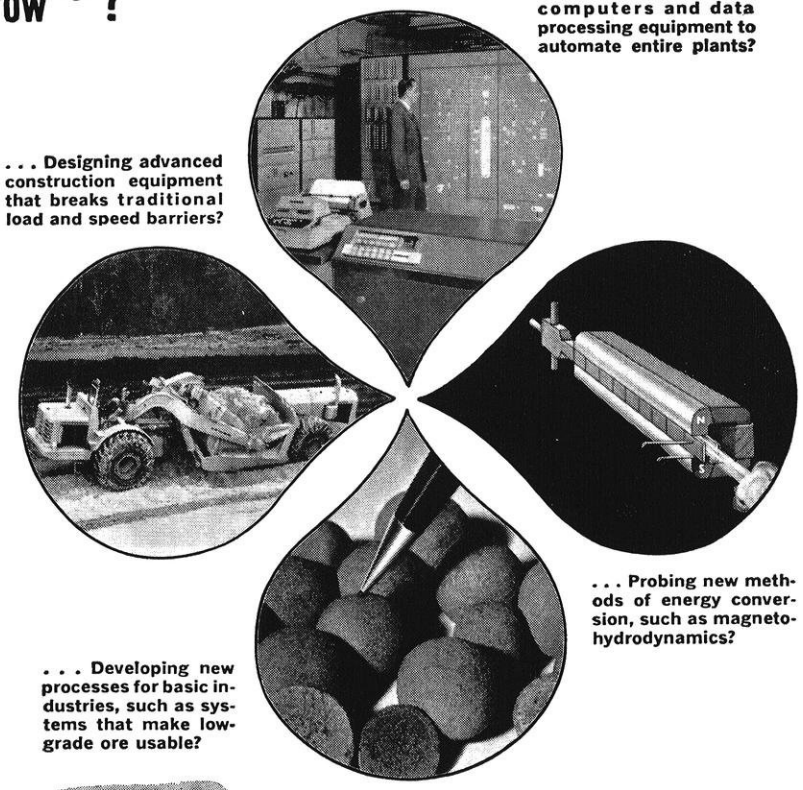
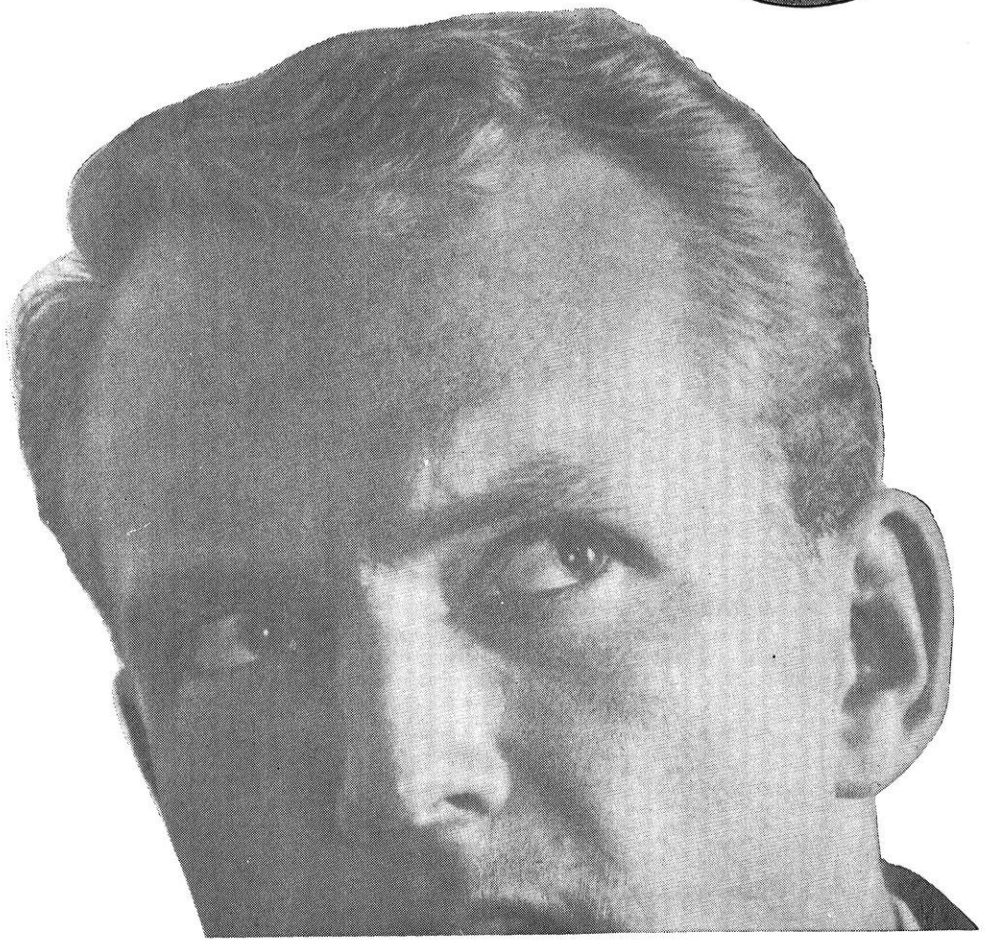


. . . Applying electronic computers and data processing equipment to automate entire plants?

. . . Designing advanced construction equipment that breaks traditional load and speed barriers?

. . . Probing new methods of energy conversion, such as magneto-hydrodynamics?

. . . Developing new processes for basic industries, such as systems that make low-grade ore usable?



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Rambling With The Editor

Every June thousands of graduates are faced with the problem of meeting their military obligation. This problem is becoming more acute with every move made in the so-called "Cold War". Because of the Berlin situation, Uncle Sam is preparing again. Where do you stand in his present plans?

Defense Department officials have decided not to draft college students enrolled in school at this time. This merely postpones the problem until graduation. What then? Let's look at the ways in which you can meet your obligation.

The draft is one answer; although it is by far the least sensible. Being forced to serve in a capacity that would not give you the opportunity of using the training you received in school, would hardly benefit you or the country.

Enlisting, upon graduation or perhaps at school in an Rotc program, allows one to choose the service and usually the field. This could be very satisfying and valuable if your training and their work is of the same nature.

Receiving a deferment would be answering the problem by simply avoiding it. Unfortunately, not everyone is able to receive or arrange for a deferment from military service. Deferments are granted for two main reasons—physical disability or employment in a critical civilian job. Many young men employed in teaching, engineering, science, and medical technology are receiving deferments because of the critical nature of their employment. There is a good chance that you may receive such a deferment.

Make sure that you have looked into this problem thoroughly before your class graduates. Check with your draftboard on your classification at least once a year to make sure that you are able to finish your education without interruption. Also, arrange for the University to send verification of your enrollment to your board every September. This can be taken care of at B 3 Bascom. RGN

Foamed Aluminum

by Roy G. Elmhorst

ALUMINUM was first foamed by Dr. Benjamin Sosnick in 1948 by using mercury as a foaming agent. This foaming agent was extremely difficult to control, as well as dangerous to work with, so this process wasn't adaptable to commercial production.

The Air Force, which was hunting for light-weight materials for aircraft construction at this time, became interested in foamed aluminum. This interest resulted in a Research and Development Contract, sponsored by the Air Force, and issued to the Bjorksten Research Laboratories of Madison, Wisconsin.

Five years and $100,000 later the Bjorksten Laboratories achieved a successful method of foaming aluminum. The process was largely worked out by John Elliot, a plastics technologist, and was brought into continuous production by William S. Fiedler.

Since aluminum doesn't have a "gooey" stage between a liquid and a solid, foaming it is much the same as trying to foam ice. Air was first tried as a foaming agent, but without success. Aluminum was finally foamed successfully by dispersing gas forming solids through the molten aluminum[2]. This process allowed production of castings and long "loaf" shaped pieces but wasn't adapted to production of sheets.

COMMERCIAL PRODUCTION OF FOAMED ALUMINUM

Following publication of the product's development in Time Magazine, the Wall Street Journal, Business Week, as well as various trade journals and scientific publications, many hundreds of inquiries were received by the two companies licensed to produce foamed aluminum and by Bjorksten Laboratory requesting additional information. In view of the tremendous interest in the product, the owners of the LOR Corporation commenced negotiations to purchase the patents. In April of 1959 an agreement was reached with Bjorksten Laboratories whereby LOR purchased all patents and patent applications, and all technical data and proprietary rights. A contract was made with Bjorksten Laboratories whereby they were able to design and construct a plant capable of producing Foamalum panels in large quantities. This plant has now been completed and, under the supervision of the Foamalum Corporation, is ready to start production.

PRODUCTION OF FOAMED ALUMINUM

Materials Used

Foamed aluminum is made from alloy 1100 aluminum containing from 0 to 69% magnesium, 0 to 2% iron and 0 to 2% copper. Titanium and zirconium hydrides are currently being used as the foaming agents. A complex rotary furnace and mold arrangement is used to mix the foaming agent with the molten metal and control the foaming.

The new plant at Madison, Wisconsin, utilizes a completely automatic process to produce 20 million pounds of foamed aluminum per year with only two men in attendance.

Processes Used

The hydride suspension is mixed with the molten aluminum and held at a suitable temperature (around 657° C) for a few minutes while the hydride releases hydrogen and foams the metal with an action much like that of baking powder raising biscuits. The hydride suspension is made under pressure at slightly above solidification temperature. Pressure is released when foaming should start, and the mixture is poured into the panel molds which have been heated to prevent premature cooling of the metal. Gas formation is rapid and it subsides quickly, but before the foam has a chance to collapse the mold is quenched with a water spray, causing the metal to "set" instantly. This process has been developed to produce panels up to

4 by 8 feet in size which vary in thickness from ½ inch to 1 inch. By varying the temperature, amount of hydride added, and the mixing action, foam can be produced ranging in weight from 1/17 to ⅓ that of solid aluminum.

DESCRIPTION AND PROPERTIES

1. Foamed aluminum, or "Foamalum" as the product is known, is a metal containing a plurality of non-intercommunicatin voids, or, in other words, it is formed from a mass of tiny, hollow aluminum spheres. The physical properties of foamed aluminum are similar to the alloy from which it is made.

2. Foamalum can be made from pure aluminum or from any of several aluminum alloys. The physical properties of the product can thus be altered by use of different alloys.

3. It can be produced in densities varying from 10 pounds per cubic foot (about as light as balsa wood) to such higher densities as may be required up to solid aluminum of approximately 166 pounds per cubic foot.

4. The cell size can be from 1/64 to 1/4 inch.

5. Since it is aluminum, it will not rot, rust, or be the prey of insects or rodents.

6. Foamalum can be sawed, nailed, cemented, screwed into, soldered, brazed, porcelainized, enameled, anodized, or welded.

7. It can be cast into intricate shapes. Cast objects are covered with a fairly smooth skin, the thickness of which is determined by temperature control. These castings have been made in various types of permanent, sand, and shell molds.

8. At an 11 pound density it has almost 500 times less thermal conductivity than solid aluminum. The conductivity varies with the density, but at a density of 40 pounds per cubic foot (¼ that of solid aluminum) it has been shown to have a conductivity of only 1/80th that of solid aluminum.

9. Foamed aluminum can be pressed into various shapes without destroying the cell structure.

10. It picks up strength as it is compressed, and tests indicate that original compressive ingot strength of aluminum is reached at only ½ the weight of solid aluminum.

11. Tests conducted with Foamalum denote that the metal has 1/2 the tensile strength at only 1/5 the weight of solid aluminum.

SPECIFICATIONS

As was mentioned before, Bjorksten Laboratories were given the contract to construct a plant at Madison, Wisconsin, capable of producing foamed aluminum panels. The products produced at this plant were to meet the following specifications:

(1) At least one 4′ by 8′ by ½″ panel, having a density of 12 pounds per cubic foot.

(2) At least one panel with the same dimensions stated in (1) except having a density of 20 pounds per cubic foot.

(3) At least one 4′ by 8′ by 1″ panel, having a density of 12 pounds per cubic foot.

(4) At least one panel having the same dimensions as stated in (3) except having a density of 15 pounds per cubic foot.

(5) At least one panel, having the dimensions and density of any one of the panels listed in (1) to (4) above, and with the surfaces stippled or indented so as to permit a coating of plaster to be applied and held securely thereto.

(6) Three series of panels (corresponding respectively to those listed in (1) to (4) above) 50 panels to a series produced consecutively within an 8 hour period, at least 90% of which have the dimensions and density and otherwise meet the specifications for the respective panels so selected.

USES OF THE PRODUCT

It is apparent that the properties of foamalum are sufficient to enable this product to replace solid aluminum in many of its present day uses as well as to create new fields for uses of aluminum. Many applications of foamalum as a basic material for home, industrial, marine, and specialized construction appear to be economically feasible as determined by marketing surveys. These uses depend on its rot and rust free characteristics, its lightness, and its fireproof insulating properties.

Home Construction

For home construction its uses include outer and inner walls; roof decking; and ceiling, roof, floor, and wall tiles. In these capacities it offers fast and easy construction while still allowing the more conventional finishes such as wallpaper, plaster, etc. to be applied. According to a home construction firm in Orlando, Florida it has these advantages: building time is cut in half through use of panels, and better insulation is achieved through use of sandwich constru

(Continued on page 40)

About the Author . . .

Gerald is in electrical engineering and is from Pulaski, Wisconsin.

The Profession of Industrial Design

By T. J. Mohs me'62

THE job of an industrial designer today is a great challenge. In this era of super super-markets and mammoth drug stores, what determines which brand of soap or tissue a housewife will pick off the shelf to buy? What is it about the design of a tractor that makes it look more capable and durable to the farmer? These are questions that industrial designers strive to answer. Their job is to design products in such a way that greater volume of sales will be gained through increased overall product appeal.

Although appearance is an important factor that today's designers must consider they must also design with an eye to usefulness, cost of manufacture, safety, ease of maintenance and convenient handling. Some designers say a product should be designed not only to have "good looks" so that people would want to buy it, but it should be so pleasing that it is uplifting to the human spirit. All industrial designers, however, will agree with the late Gilbert Rohde in saying, "Good design must be built in and not draped on".

Although the number of industrial designers in this country is small, there are indications that future growth of the profession is certain. With the increase in the country's production there will be a corresponding demand for men to enter this field.

THE BEGINNING OF AN INDUSTRY

Behind all man-made articles there has been design effort of some sort. Even before the Industrial Revolution some effort was put into the design of articles such as carpets, furniture, glass, and tools like the spinning wheel and the loom. After the Industrial Revolution, however, in the early nineteenth century, an ever-increasing number of mechanized contrivances came into existence. The inventors were so concerned with making the product serve its function that they had no inclination to bother with such trifles as balance of form and harmony of color. The manufacturers of carpet sweepers, telephone sets, washing machines and automobiles first had to prove their products useful, labor-saving, and comparatively trouble-free if their products were to survive on the market. Soon these products were accepted as commonplace by the public and were being mass produced. This was when the need for industrial design came into being.

Origin of Need

There were two prime reasons for the combining of art and industry; mass sales of identical objects and competition. As long as a new device was still a curiosity, the public was mainly interested in how it worked and what it would do. It was not being produced in large numbers and the proud owners either were not aware that their "functional" machines were ugly and clumsy looking, or they did not care. When their function was no longer in question, it became evident that much could be done to improve the design.

During the 1920's, there was tremendous industrial expansion. Purchasing power was at its height. People began to realize that electricity could be used in the home for labor-saving devices as well as for light. The material standard of living was increasing rapidly for the mass of people with moderate incomes. They found that they, too, could afford luxuries such as electric washing machines and radios. It was a seller's market, but as the decade drew to a close, it became evident that competition would soon make an end to easy sales. At that time only a handful of industrial designers were struggling on their own for recognition from big business.

Then came the depression, and the executives of industry finally realized that they must find a new means to increase their sales in order to survive in the market.

Acceptance and Growth

It was at this time, during the depression, that the industrial designers found themselves accepted and in great demand in the inner

folds of industry. This was the real beginning of the field of industrial design as we know it today.

With the reduction of its purchasing power the public came to insist that the few things it did buy must provide true value. Products with costly gingerbread effects lost popularity. It was the work of the designers to smooth out the unattractive bumps and to make the product clean and esthetically pleasing.

Almost from the beginning, however, some industrial designers like Dreyfuss and Teague argued that they should do more than simple styling. Some companies permitted them to "design in depth" which is to shape the products from their inception not only with regard to their beauty but also to their cost, safety, and ease of maintenance. Most manufacturers, however, continued to use industrial designers strictly as facelifters. Then came World War II, and interestingly enough, the United States Government brought in the industrial designers to work as "human engineers" or specialists who would see to it that products, such as guns for example, were built to fit the anatomy. After the war, when big industry began to apply "modern design" to office and industrial machines, there were many new opportunities which gave the industrial designer a new and even more important place in industry.

THE DESIGNER'S PLACE IN INDUSTRY

The whole profession of Industrial Design is so new and so rapidly changing that it is hard to give one example of the type of work industrial designers do or where they fit into industry. Sound product planning is of utmost importance to manufacturers. Products that are to be sold nationwide to people of different age groups and social status must be carefully designed to please the greatest number of people. The research that leads to product planning and design is an increasing function of industrial design.

Scope of Field

Many consulting or free lance design firms can boast that they have designed items as varied as locomotives and caterpillar tractors, toothpicks and perfume bottles. This is true because, since the late forties, the industrial designers have broadened their field horizontally. They not only supply services to manufactures of consumer products but they do work for machine tool and other capital goods manufacturers. In a search for business many industrial design firms have also been servicing medium and small companies. Some firms now are not only designing products and packages but are performing a bewildering variety of assignments for both government and industry. These services include, for instance, being consultants for long-range product planning, and redesigning the visual symbols that make up the corporate image. An example of the work of industrial designers now being done for the government is the study of the human needs and requirements for civic auditoriums and cultural centers.

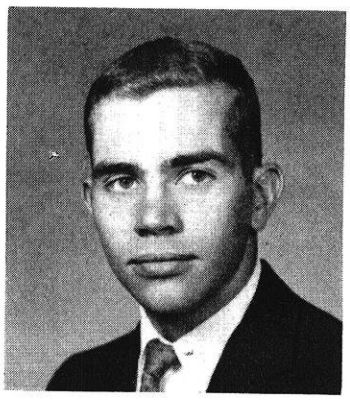
In less than a generation, industrial design has come a long way from merely restyling products.

Preparation for Design

Designers are hard-working men who depend far less on sudden insight than on painstaking analysis and careful planning to help the manufacturer "visualize" a proper solution to a design problem. Sound product planning must first concern itself with the man and the woman who will buy and use the product. What is the attitude of these consumers toward the product? What are their needs, their tastes, and their expectations? For example, what are a secretary's opinions of the typewriter she uses? What is it about the washing machine that annoys the housewife? The first step the designer takes is to find out just what a buyer wants in a product.

It is extremely important for the manufacturer to be sure that the product he makes will be accepted by the public. With stiff competition that is present in most fields of manufacturing and the high cost of changing tooling and sales details, it is very harmful for those manufacturers who come out with a product that is not accepted by the public.

Industrial designers study all aspects of the problems involved in the design of a product. There are two general classes of preliminary research used. (A) Research information gathered from existing data, and (B) research information determined from original data. Much factual information can be found in existing publications. It is the easiest method of obtaining data; and therefore, used whenever possible. Caution must be exercised, however, as the industrial designer must be careful to get information which is both reliable and up-to-date. Listed be-



About the Author . . .

T. J. Mohs, a senior in mechanical engineering, hails from Madison, Wisconsin. He is a member of A.S.M.E.

low are some of the sources which the designer might use in gathering existing data.

1. Surveys previously made by the designer's client
2. National Publications
3. Trade Publications
4. Trade Associations
5. Newspapers
6. Universities
7. Government Publications

Because there is so much material in which only a few articles may be helpful, it is necessary that designers have experience gathering information by this method.

Research information derived from original data must be carefully analyzed. Very often existing information will not answer questions of proper design. It then becomes necessary for designers to conduct consumer research. This research can be done by the design firm or the designer, in the case of a simple problem. In the case of a national problem of design which deals with many types of people, a specialized research organization can be contracted for the job. Research information derived from this means requires careful analysis.

The following is an example of the research used in designing a wall-hung refrigerator.

> The designer finds out how many walls in the average United States home will support a wall-hung refrigerator's weight. The industrial designer does market observation. This is visiting stores to learn what color, shapes and refrigerator accessories the customer wants. In addition, he might pretest his design by setting a model in a store and asking people if they like it. If the public is noncommittal, he might hire an expert in motivational research to discover what the subconscious reaction of the customers have to his design.

The field of research has become more and more important to the industrial designer. Because a manufacturer has such a large investment in the design of a product, it is important that the research informaion is accurately gathered and objectively analyzed.

Design Elements

A realistic approach to designing a product starts with the function of a product, then the method of manufacturing, and then the material to be used. The slogan, "Form follows function" can be applied to most any design problem. If a woman is going to use the product, consideration should be given to her size and strength. A vacuum cleaner, for example, should not only be designed so it can be made light in weight but it should look light as well, for psychology plays a great part in designing. Products for men should be designed with the same consideration. They should look strong, durable and masculine. Products such as machine tools and office equipment should be designed to look clean, efficient and reliable.

To be able to create a design the industrial designer must know the theory of design, which entails knowing the various types of lines and shapes that can be used to accomplish the desired effects.

Once the requirements of function have been met and the ideal design is made, it must often be modified slightly so it can be manufactured more economically. During this stage of design industrial designers often work with the manufacture engineers. They decide which method of production is most practical and if necessary, alter the product accordingly. Closely related to the determining of process is the choosing of a material to be used. Materials should be chosen with consideration to both production methods and the desired effects. They should be used with regard for their own characteristics. For example, if a product can be molded from plastic, it should not be designed to resemble a product that is made of cast iron.

After considering these approaches one can see that before a designer can create a design that complies with factors of practicability and consumer acceptance, he must have a special talent and education.

EDUCATIONAL NEEDS OF THE INDUSTRIAL DESIGNER

By now the question may arise: just what type of an education must an industrial designer have? There are three fields of study pertaining to this profession, none of which should be neglected. Industrial designers must at the same time be artists, engineers, and merchandising experts. Their training should equip them with a grasp of each of these fields.

Merchandising

Considering industrial design in its three aspects, merchandising is, to many in the field, foremost in importance. Design is a changing thing. The styles that sell this year may not sell next year. To guide his client in the critical selection of a product that has consumer appeal, the industrial designer must be an observer of human habits, desires, and hopes. This broad knowledge must be based on training in general psychology applied to consumer and merchandising problems. This training should be followed by courses on merchandising which are sufficiently detailed to enable him to understand the point of view of department store, chain store, and mail order buyers. It is important, therefore, to acquire a grasp of the accepted principles of merchandising and of research methods to determine public opinion and trends. Designers also should have a general understanding of economics and some specialiazed study of typical consumer and service industries. The training should include a survey of advertising techniques and business training, and should touch on business law and patent law. In addition to having adequate training in merchandising, industrial designers must gain some familiarity with art on a popular level so that he can deal with trends in style and fashion and understand their influence on the market.

Engineering

The extent to which an industrial designer must understand engineering is difficult to define. While industrial designers are not in competition with engineers, they continually deal with them.

Industrial designers must be able to understand engineers and be able to think creatively in technical situations. This means that they must be aware of functional as well as esthetic solutions to every kind of manufacturing process and material. To design a product that can be manufactured economically designers must know about different processes such as casting, stamping and machining. No matter how esthetically pleasing a style, it would not be a good design if the cost of mass production of the designed product were too high.

Therefore, training for this profession should include basic mathematics, physics, chemistry, mechanics, and mechanical design courses. The training should include all aspects of drafting which would be covered in mechanical, isometric and perspective drawing. Preparation for an industrial design career also should include training in methods of research into materials and processes.

Creative Design

The third main field in which industrial designers should be trained is, of course, that of art and design. The training in this field can appropriately be broken down into two main categories: first, the history and theory of art forms, and second, applied arts.

Industrial designers should have a solid background in history and theory. The student should take courses in art history to become familiar with historical styles and their relation to contemporary trends.

Art training for the industrial designer is of great importance. Learning to draw and to express creative ideas on paper and in clay are basic requirements. Courses should be taken in free-hand drawing and various techniques such as air brush, pastel painting and clay modeling. There should be a course in the theory of color and its psychological aspects.

To insure the greatest effectiveness, thorough training is necessary in the field of industrial design, a profession that has had such a great impact on our social and economic systems.

THE DESIGNER'S INFLUENCE ON OUR SOCIAL AND ECONOMIC SYSTEMS

Since the beginning of industrial design there have been remarkable strides in manufactured items both through advancements in technology and improved design. The nation has been noticeably influenced by the men who have made it their job to increase the sales of a product through better design.

Effect on Economy

There is a feeling among some people that industrial designers hurt our economy by always changing the design of products. They feel that this can be harmful to the country because by rapid obsolescence our country's resources will be depleted. Industrial designers argue that there can be no progress without change and change is what brings about obsolescence. A higher obsolescence keeps the country's employment and purchasing power at a maximum through increased production. These, in turn, combine to increase the standard of living.

Effect on Industry

Although there are many companies that maintain a design department within their structure, most industrial designers are employed by independent consulting firms. Only when a company is large and changes designs regularly can it afford designers on a full time basis. Automobile manufacturers are a good example of this. The main advantage of a company design department is that its members can work intimately with the firm's engineers, market specialists and product planners.

There are many advantages to hiring free-lance designers. There is completion among the trade, as in anything else, and motivation for giving the best to each job is is evident. Small and medium size companies can pick and choose the firm of designers which can produce what they need for the price they can pay. The free-lance views the company's product objectively from an outsider's position. He is not biased by politics of a company, and is more confident of recommending radical changes. Some of the most famous designers have been free-lancers. If the designs have been good, business for the company booms. If the designs have been poor, the company may fail.

Effect on the People

The industrial designer has had influence on nearly every phase of life in the United States. By his work the housewife has better tools to work with in her job of housekeeping, tools that are better looking and easier to use. Progress has been made in designing articles which adapt the design to the material used. Maintenance of articles is easier since many designs simplify the lines of the product, and emphasis has been on smooth surfaces for easy cleaning. Line and proportion have become important in everyday living because of the awareness brought about by in industrial designers.

Industrial design is still so new that it would be difficult to predict how the profession will change in future growth. It is generally accepted that there is considerable room for expansion, but that, by its very nature, it can not absorb as many people as professions such as engineering, medicine, law and teaching. It is an interesting profession and those who look forward to the study of industrial design will find it rewarding.

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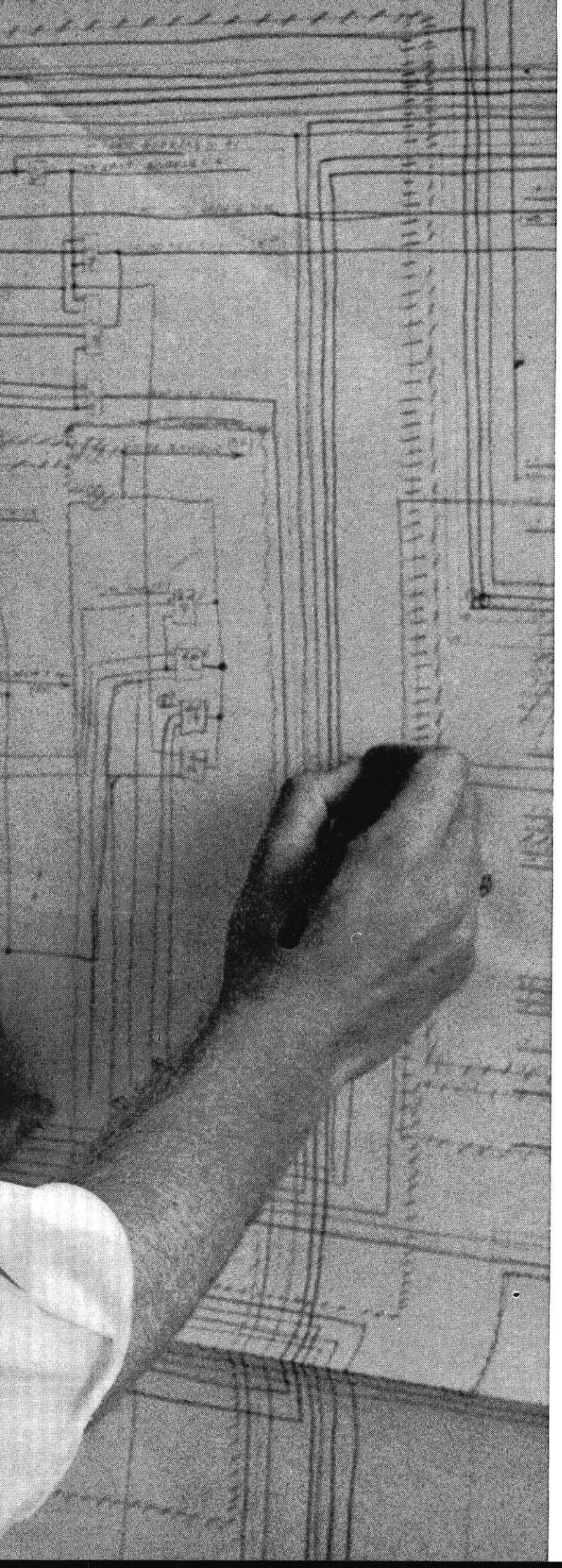

Paul Farbanish (B.S.E.E., Lehigh '58) is a development engineer who had design responsibilities for IBM solid state 1401 computer system.

HE'S MAPPING NEW WAYS TO BEAT TRAFFIC JAMS IN LOGICAL SYSTEMS

A computer system must be versatile. The IBM 1401 system, for instance, might go to work in a radiation lab, a stockbrokerage office, an air operations center, a refinery, or any one of a hundred other places. Demands upon the individual units of the system will vary widely.

Paul Farbanish analyzed the loads placed on the system by different applications. One of his assignments was to design new and alternate ways for data to move from unit to unit with the greatest speed and reliability.

Like many an engineer at IBM, his responsibility ranges over a wide technical field. To do his job he became familiar with many challenging areas of electronics. Within the 1401 system alone he dealt with circuits, data flow control, input-output, storage, etc.

If a young engineer wants to move rapidly into the most advanced areas of electronics, he would do well to consider IBM. In the fast-expanding world of data systems and its many peripheral fields, a man is given all the responsibility he is able to handle. New ideas and new ways of doing things are not only welcome but actively encouraged.

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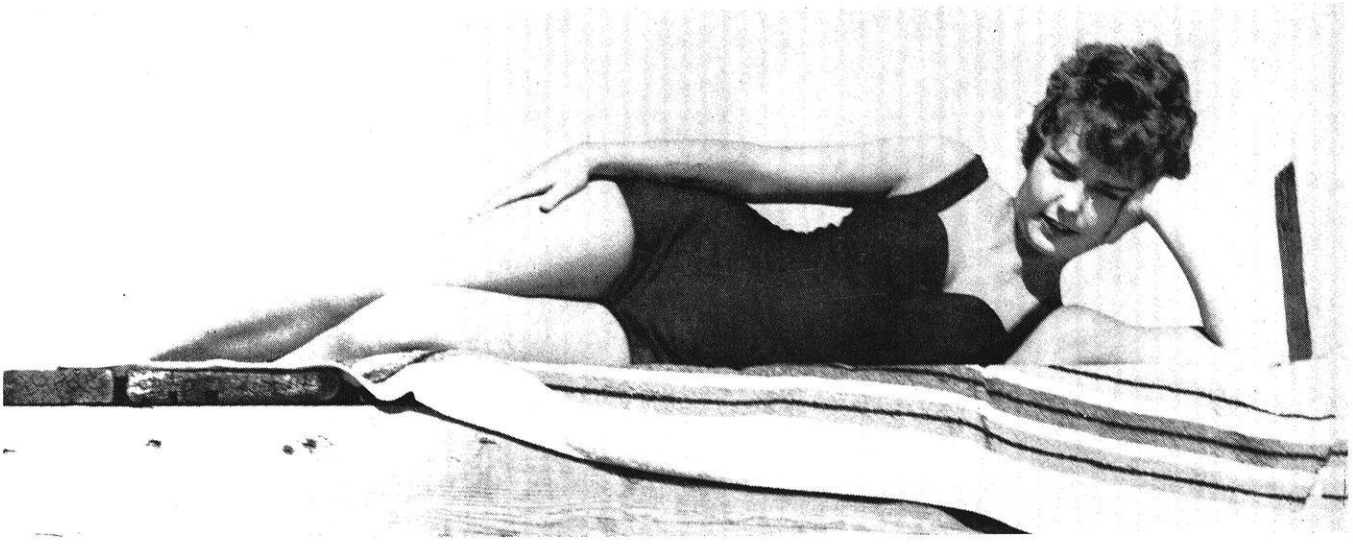
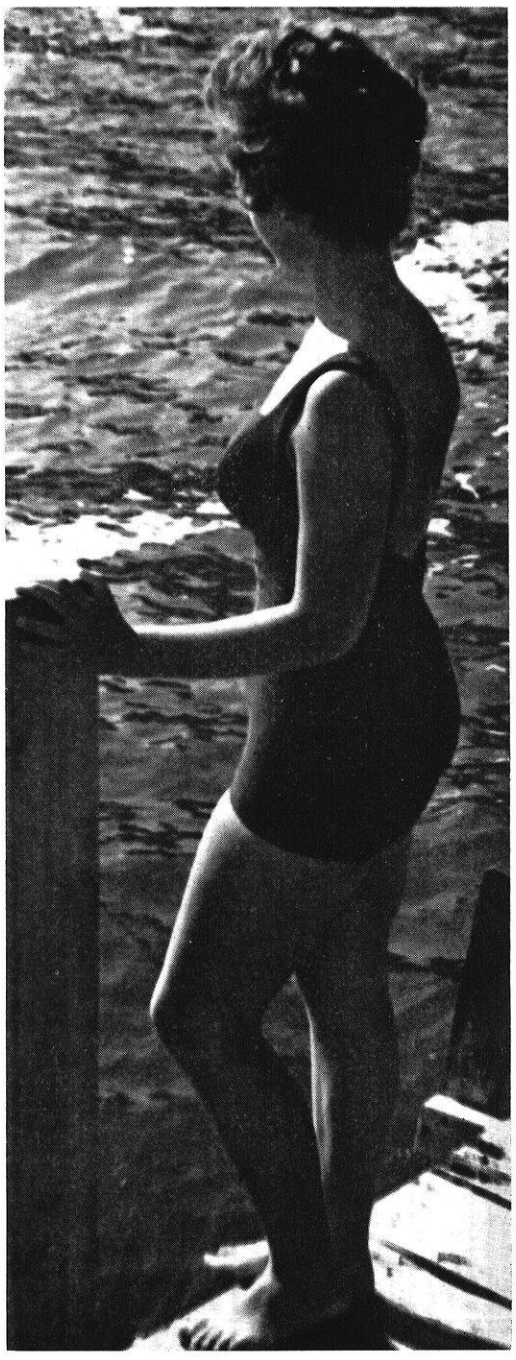


Girl of the Month

FRANCES SATHER



Memories of summer come back, a summer when we met Francie on the Union dock. Now we can look to next summer when we will have the chance to eye the "girl of October" as she goes to the beach once again.

The water was warm and a beautiful smile warmed the air and the hearts of all the men that were around to see a girl out for an early morning swim. Ah, such beuaty isn't easily forgotten. Maybe one of the very industrious engineers could design a pool for the "engine" campus so we wouldn't have to go through the winter months without seeing Francie on cold mornings. Winter in Madison would be bearable then.

We'll be swimming with you in the future where we can be near Francie.

Aerial Photography for Civil Engineers

by Gerald F. Wesolowski ce

INTRODUCTION

SOME time during your past years in school you have probably heard of photogrammetry. As the word indicates, there are cameras and photographs involved, but what it doesn't reveal is that airplanes are now being used quite extensively to take these photographs.

There are two main types of photographs, terrestial and aerial. Just as the names imply, terrestial photographs are taken with a stationary camera fixed to the Earth, and aerial photographs are taken with special cameras from an airplane. Both types have their advantages and disadvantages. The aerial photograph is known best for its speed and economy, whereas the terrestial photograph has better accuracy.

TYPES OF AERIAL PHOTOGRAPHY

Aerial photography and its photos can be classified in a number of different ways. "Vertical" and "oblique" are the two main types of photographs. As their names imply, vertical and oblique photos are derived from the directions their optical axis are held during the shot.

This can be subdivided further by classifying photography as normal-angle photography and wide-angle photography. The angle concerned is that at which the apex of the usable cone of light rays enters the lens of the camera. (See fig. 1).

In normal-angle photography the apex angle ranges between 50° and 70°. An angle ranging between 80° and 100° is used for wide-angle photography. Ordinarily the aerial camera lens has an apex angle of approximately 90°.

Wide-angle photography is commonly used for government and public jobs. The Armed Forces use normal-angle photography for nearly all of their needs. A normal-angle photograph is best for constructing a mosaic—an assemblage of aerial photographs which have been trimmed and matched to form a continuous photographic representation of a portion of the Earth's surface.

Vertical Photographs

The vertical photograph is the most important of aerial photographs and is the easiest to work with. A vertical photograph is that which has been taken when the optical axis of the camera was held approximately perpendicular to the mean surface of the Earth. Tilt, as shown in fig. 2, is that angle between the plumb line and the optical axis of the camera. The tilt angle should not exceed 3°.

$$\text{tilt} < 3°$$

Note also on fig. 2 that the points of intersection of the light rays do not coincide. This will cause a scale discrepancy. However, unless the work being done is extremely particular, the tilt of the photograph is usually disregarded. This is exceptable because the tilt angle is very small compared to the distances involved. For example, the tilt is usually about 2° and the flying height of the airplane is approximately 5,000 feet, depending upon the use of the photograph.

Oblique Photographs

An oblique photograph, sometimes simply called an oblique, has its optical axis tipped from the plumb line between 30° and 60°.

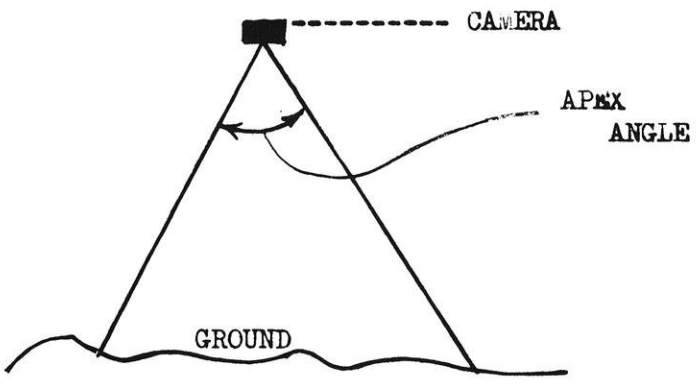


FIG. I: FIGURE ILLUSTRATING THE APEX ANGLE

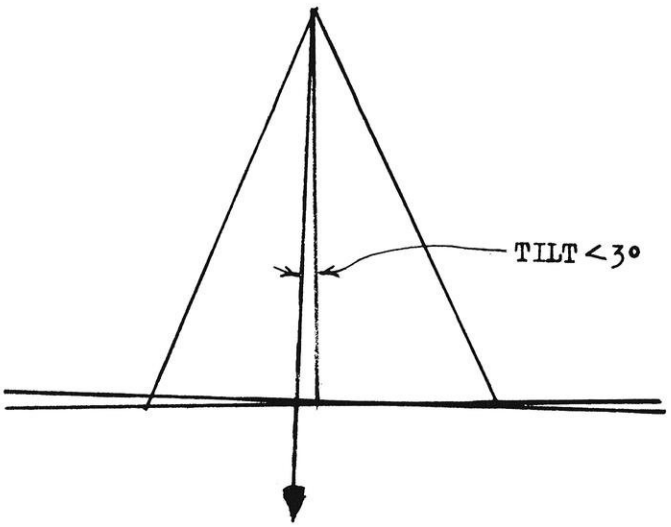


FIG. II AMOUNT OF TILT

There are both high obliques and low obliques.

High Obliques. An oblique which contains the apparent horizon of the earth is termed a high oblique. High obliques are not used very often. Their principle use is to show relative positioning to some structure or site the public is familiar with. For instance, if a close-up of a specific building near Chicago was wanted, the optical axis of the camera could be tipped to include the famous Prudential Building.

Low Obliques. A low oblique is one which the apparent horizon does not show. Low obliques are used quite extensively with trimetrigon and convergent photography, which are discussed later in this report.

Miscellaneous. Trimetrigon photography is done with a system of three different cameras synchronized to take pictures at the same time. As shown in fig. 3, the area photographed lies in a plane perpendicular to the flight line. The center camera gives a vertical photograph and the two side cameras are set at a specific angle to the plumb line to give two low obliques.

(top view)

A pair of low obliques taken in sequence along a flight line in such a manner that both photographs cover essentially the same area, as shown in fig. 4 below, are called convergent photographs.

USES OF AERIAL PHOTOGRAPHY

The uses of aerial photography are many and are increasing from year to year. Engineers in industry are finding the use of aerial photography very helpful. Those engineers who work for various governmental agencies have found that their work is greatly reduced by the use of it. Mapping, for instance, is one of the prime uses of aerial photography.

Uses for Engineers in Industry

Determining Building Sites. A Civil Engineer working for a large company may be called upon to give a suitable location for a new building the company is planning

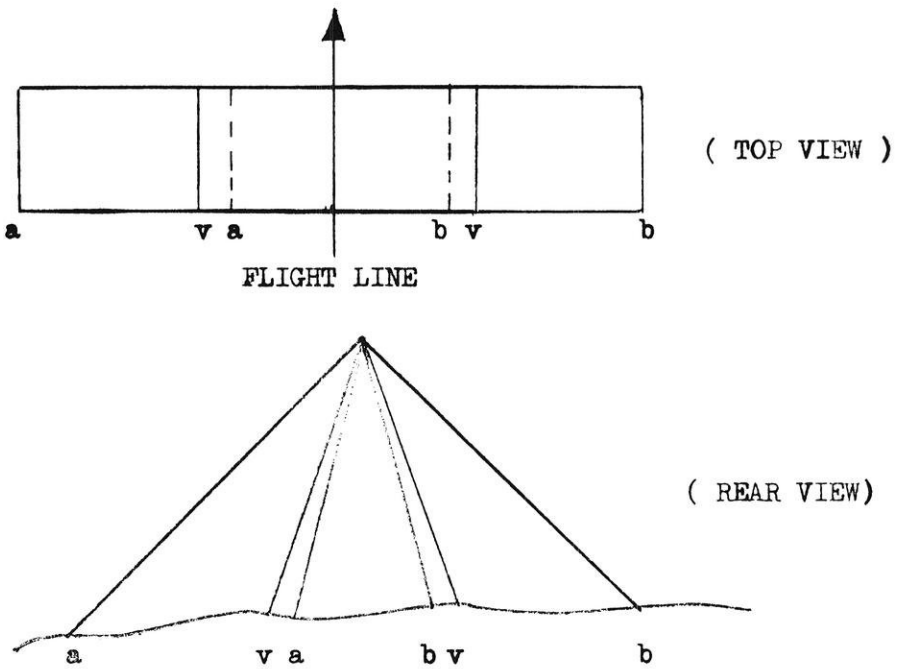


FIG. 3 TRIMETRIGON PHOTOGRAPHY

Convergent photos are very useful when examining a plot of land stereoscopically. In stereoscopic viewing each eye is allowed to focus on the same object, but on different photos and in different positions. Aerial photographs are usually viewed stereoscopically to give the viewer a more exact picture of the layout of the terrain.

Most aerial photography is done by flying parallel flights across an area. The photos taken during a flight should have a 60 per cent overlap in the direction of the flight and 30 per cent on each side. This is done so that the photos can be examined stereoscopically.

to erect. Without the use of aerial photography he would have to get together a small party of men and begin to run surveys on a few choice places he has in mind. However, with the use of aerial photography and a few select maps the party of men can be completely dispensed with and much more area could be examined. Elevations, types of soil, and drainage could all be determined from the photographs.

Examining of Structures. If, for example, an engineer wanted to do some research for a building he is planning to build and wanted re-

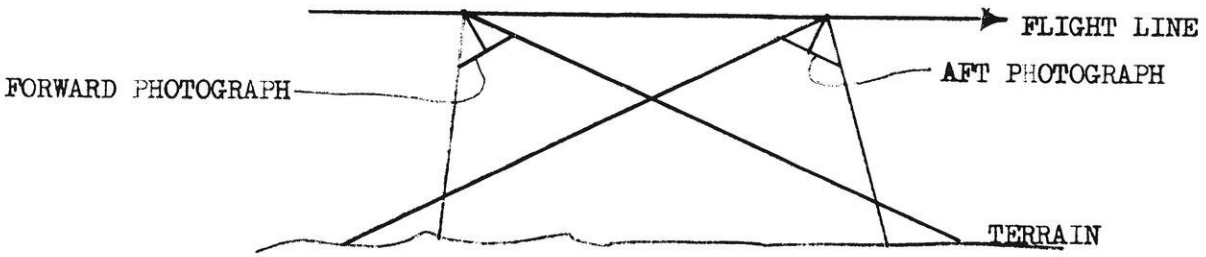


FIG. 4 CONVERGENT PHOTOGRAPHY

lated information from existing buildings of the same type, he could determine the scale of his photographs. With the scale known he could then calculate the height of buildings. (For detailed information and sketches on how this can be done, refer to the appendix.) By scaling the sides he could easily determine the overall dimensions of the buildings. The photo is very helpful when information is needed about the building materials. This, of course, could not be done at a very high flying height, unless special cameras with longer focal lengths would be used.

Uses for Engineers in Government Work

Most of the United States has been photographed from the air at least once. This is very helpful when information is needed for the construction of maps. The study of natural terrain, traffic, and highway and canal building sites can be carried on much better with the aid of photos.

Study of Natural Terrain. With a slight background of soils one can determine the types of soil present from photos. Photos can be very misleading to those who have had no experience with photo interpretation. For example, loose ground will appear nearly white on a black and white photo, and tightly packed soil will appear darker. Low land will appear darker than higher land because of the moisture content in the soil. The actual type of soil can many times be determined because erosion is quite evident on a photo. If the soil is sandy with a little clay, the drainage patterns are very evident. Vegetation can many times indicate to the viewer what type of soil is present. For example, sagebrush and the lack of trees indicate desert-like conditions.

Study of Traffic. With the ever-increasing number of automobiles, Civil Engineers must prepare new methods and ways to keep the heavy flow of traffic moving. Again aerial photography can be helpful. If a series of photos are taken of a city during its rush hours at a relatively low altitude, accurate vehicle counts can be made. By knowing the number of vehicles on specific streets, new roads and intersections can be planned accordingly.

Study of Highway Locations. It is noteworthy that highway engineers have been active in adapting aerial surveys to ever-widening fields of usefulness in the planning, location and design of highways. The earliest use of aerial photography in highway location was as a supplement to the usual ground reconnaissance surveys. These ground reconnaissance surveys were conducted by a party of 4 or 5 men. The purpose of these surveys was to bring back elevations and all other important land features which must be considered before construction of a highway. Generally, a profile of the centerline of the proposed route would be determined. All information gathered by these surveys can be found on aerial photographs in a much more efficient manner within the boundaries of acceptable error.

Determination of Canal and Irrigation Ditch Sites. Much careful consideration and planning must be done before any canal or ditch is started. By studying aerial photographs, drainage patterns can easily be determined. If the terrain is rough and the ditches aren't going to be surfaced, then a gradual slope and big turns must be used to prevent erosion.

Determining Distances for Land Surveys. Land distances can be determined quite accurately with a few control points between the ground and the photo. Usually for this type of work the flying height is relatively low. By merely knowing the scale of the photo, distances and accurate land boundaries can be determined. This work is accurate because all distances are measured by projecting all points into a common horizontal plane.

Construction of Maps. The construction of maps is one of the prime uses of aerial photography. There are the planimetric, topographic, and mosaic. A planimetric map is one which shows the horizontal positioning of selected natural features, whereas a topographic map also shows relief in measurable form, usually by contours. A mosaic can simply be described as one big picture of a given land area composed of a number of continuous photographs.

A planimetric map is made by scaling a photo for distances then transferring them onto a paper for mapping. However, the construction of a topographic map from a photo is not so simple. A complicated "plotter" is used to determine the elevations from the map and plot them for the construction of contours. These "plotters" are extremely expensive and only large universities, companies, and government land survey offices have them.

Miscellaneous Uses. Among the most widely used phases of photogrammetry are the minor, but still important uses. The common layman is not acquainted with reading complicated maps, whereas everyone can interpretate a photo with little effort.

The determination of types of soil is important to the Department of Interior. The type of soil in a given area can be determined with great accuracy, provided the viewer has had a good background in soils. Experts can now determine the types of soil to depths up to 6 or 10 feet.

With the use of aerial photographs, a petroleum geologist, who formerly spent about 90 per cent of his time and effort in keeping himself located and oriented on the ground and 10 per cent of his time on geology, is now able to reverse these percentages.

Large lumber companies are using aerial photos for timber evaluation. This can be done by observing relative sizes between trees. Experts in the field can approximate the number of board feet in a given area with great accuracy.

IMPORTANCE OF AERIAL PHOTOGRAPHY

Aerial photography came with the development of the airplane. Thus photogrammetry is only about 50 years old. During those 50 years it has developed from practically no use at all, to vast uses by corporations as well as governmental agencies. Its first real test came during the construction of the T.V.A. dam system. The particular area which was to be used was quite desolate and therefore there were few good maps, if any, of certain areas. The engineers in charge decided to photograph the area from the air and use these photos to make their maps, which turned out to be very successful.

Reduced Costs

Reduction of costs in all the fields previously mentioned has been the most important factor for its growth. On recent work in Massachusetts, for example, the average cost of aerial topographic maps was $680 per mile for a strip 6000 feet wide; whereas costs for ground surveys and plotting were about $1500 per mile for a strip only 500 feet wide. On a cost-per-mile basis, comparable maps made by ground survey methods will rarely cost less, and will usually cost more than photogrammetric maps.

Reduced Time and Labor

With the ever-increasing wages of the working man, time is of great importance to the contractors who have the jobs. The relative use of aerial photos is largely an economical question involving the size of the project, the character of the terrain, and the availability of existing photographs to suitable scale.

AERIAL PHOTOGRAPHY VS TERRESTIAL PHOTOGRAPHY

Advantages

Terrestrial photography utilizes horizontal or oblique photographs, whereas aerial photogrammetry utilizes vertical or oblique photos. Another important difference in the two methods is the positioning of the camera—stationary for terrestrial, and movable for aerial.

From aerial photographs awkward grading quantities can be estimated with great accuracy. A 7600 foot project in Connecticut shows discrepancies of 1.4 per cent in cut and 1.2 per cent in fill. This illustrates the slight error involved when substituting aerial photographs for the usual profile surveys when making earthwork estimations on highway projects.

It is possible to locate transmission lines, or pipeline routes completely from photographs, but not roads without the aid of a topographic map. However, topographic maps can be made from photographs. A road can almost be layed out completely with the use of photos.

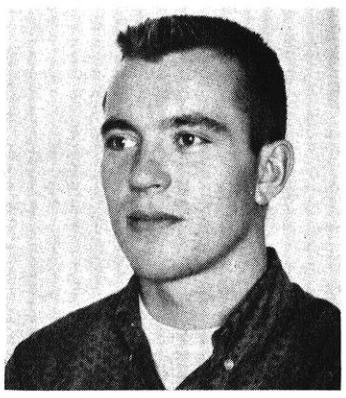
Aerial photography has an extremely big advantage over terrestrial photography, because it is much quicker to take the shots with an airplane than to run a precise traverse with the terrestrial camera, sometimes called a phototheodolite. From higher altitudes, the photos cover a much larger land area and therefore, more surrounding detail can be picked up on these photos.

Land owners bordering a proposed highway site may become disturbed by surveyors as the preliminary surveys are being run. Sometimes this leads to hard feelings and controversy before the road is even approved. With aerial photogrammetry, the proposed route can be studied without knowledge of it by the land owner. When the route is shown to the land owner, photos are displayed before him to illustrate exactly what is going to be done and how much land will be used.

Disadvantages

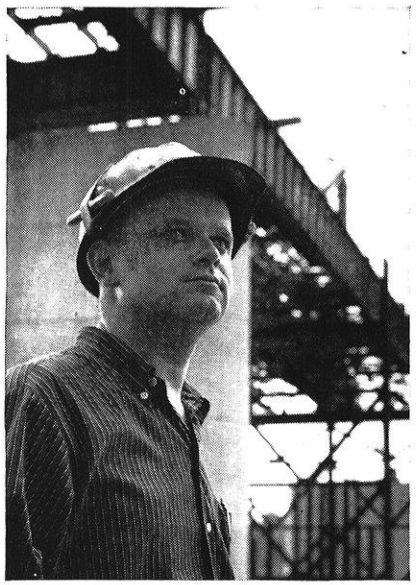
An important factor to remember when using aerial photographs is the error involved during the taking and interpretation of the photos. Errors are due to a num-

(Continued on page 40)



About the Author . . .

Gerry Wesolowski, a junior in civil engineering from Pulaski, Wisconsin, became interested in aerial photography as a result of a C.E. course. He is unmarried and is active in the Newman club.



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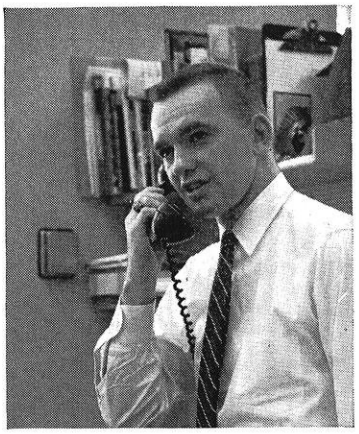


What it is and how it works

The Loop Course is our program conducted annually for selecting and training qualified college graduates for careers with Bethlehem Steel. It was established 40 years ago. From the very beginning, it included an observational circuit (or "loop") of a steel plant, ergo the name. Many men holding key positions with Bethlehem today entered the company through the Loop Course.

Promotion from Within—The Loop Course is specifically designed to provide management personnel. Since it is our policy to promote from within, it is vital that competent men, well-grounded in our practices and policies, be available to fill management openings as they occur. And, due to Bethlehem's steady growth, there has been no lack of opportunities to advance.

The Basic Course—Every looper attends the initial five-week course held at our home office in Bethlehem, Pa., beginning early in July. He attends orientation lectures, listens to discussions by management men on all phases of company operations, and makes daily trips through the local steel plant. At the end of this period he has a sound basic knowledge of the Bethlehem organization.

Their First Assignments—At the end of the basic course, loopers receive their first assignments. Ordinarily a large majority report to our steelmaking plants, where they attend orientation programs much like the initial one at Bethlehem, but more specialized. During this period plant management closely observes each looper's aptitudes and interests, with the objective of assigning him to the department or job for which he appears to be best fitted, and corresponding as closely as possible to his educational background and work preferences.

Specialized Training—Loopers selected for sales, mining, shipbuilding, research, and the company's administrative departments, proceed from the basic course to specialized training programs varying according to the type of work.

Preparing for Advancement—As the looper gains in ability, experience, and knowledge, and as openings occur, he is moved into positions of increasingly greater responsibility. The company expects and encourages the looper to produce, to make steady progress. Regular reports as to his work and progress are made to department heads—and annual reports to divisional vice-presidents—throughout his career.

Emphasis on Technical Degrees—Because of the nature of Bethlehem's activities, the greatest demand is for men with technical degrees, especially those in mechanical, metallurgical, industrial, electrical, chemical, civil, and mining engineering.

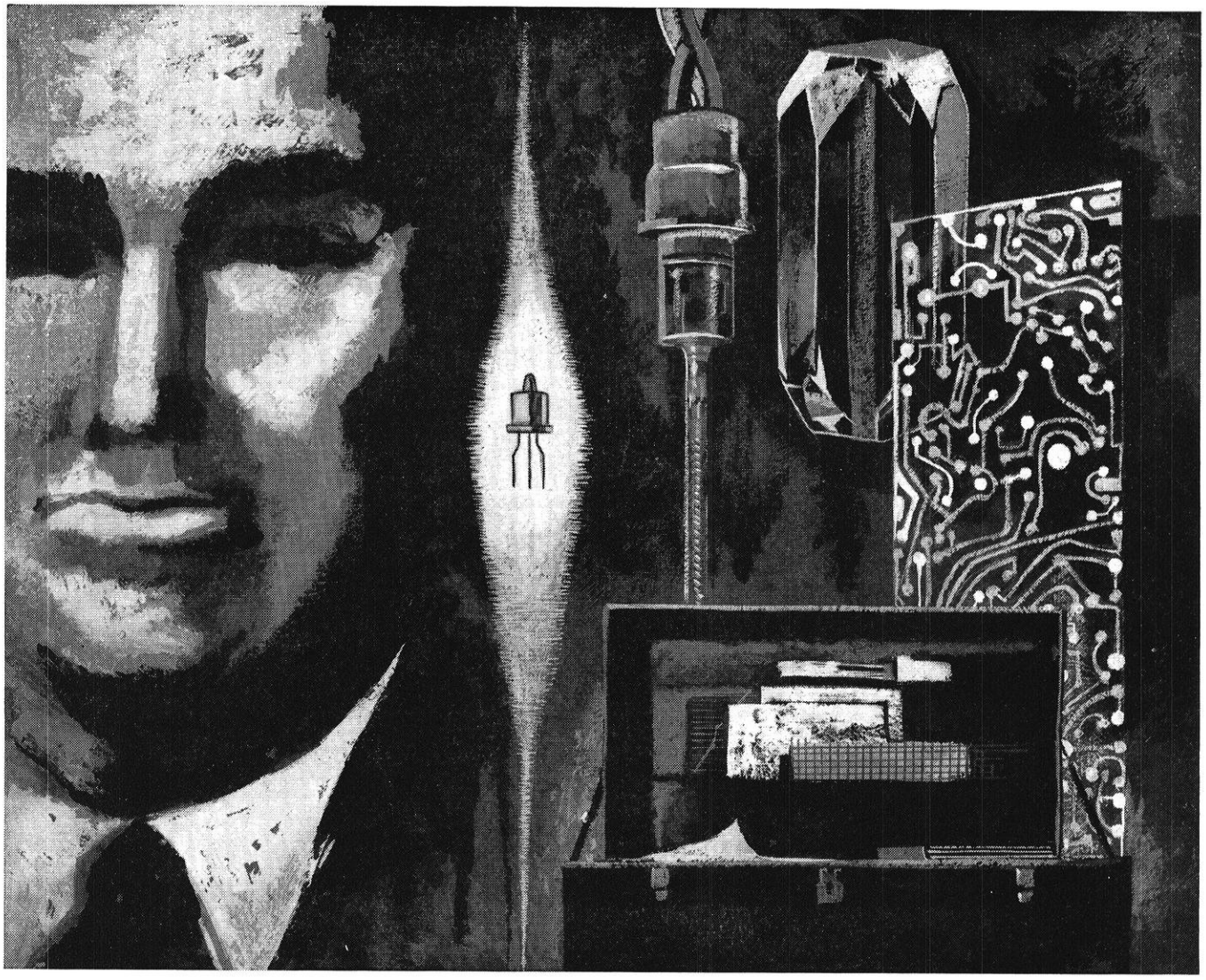
Read Our Booklet—The eligibility requirements for the Loop Course, as well as a description of the way it operates, are more fully covered in our booklet, "Careers with Bethlehem Steel and the Loop Course." It will answer many questions undergraduates may have. Copies are available in most college placement offices, or may be obtained by writing to Manager of Personnel, Bethlehem Steel Company, Bethlehem, Pa.

All qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

Steel

BETHLEHEM STEEL

BETHLEHEM STEEL



Quality is the key to success at Western Electric

Admittedly, our standards are high at Western Electric. But engineering graduates who can meet them, and who decide to join us, will begin their careers at one of the best times in the history of the company. For plentiful opportunities await them in both engineering and management.

As we enter a new era of communications, Western Electric engineers are carrying forward assignments that affect the whole art of telephony from electronic devices to high-speed sound transmission. And, in the management category alone, several thousand supervisory jobs will be available to W.E. people within the next 10 years. Many of these new managers will come from the class of '62.

Now's the time for you to start thinking seriously about the general work area that interests you at Western Electric, the manufacturing and supply unit of the Bell Telephone System. Then when our representative comes to your campus, you'll be prepared to discuss career directions that will help make the interview profitable.

After a man joins Western Electric, he will find many programs that will aid him in exploring the exciting course of his career — while advancing just as fast as his abilities allow. And he'll be secure in the knowledge that he is growing with a company dedicated to helping America set the pace in improving communications for a rapidly growing world.

Challenging opportunities exist now at Western Electric for electrical, mechanical, industrial, and chemical engineers, as well as physical science, liberal arts, and business majors. All qualified applicants will receive careful consideration for employment without regard to race, creed, color or national origin. For more information about Western Electric, write College Relations, Western Electric Company, Room 6105, 222 Broadway, New York 38, New York. And be sure to arrange for a Western Electric interview when our college representatives visit your campus.

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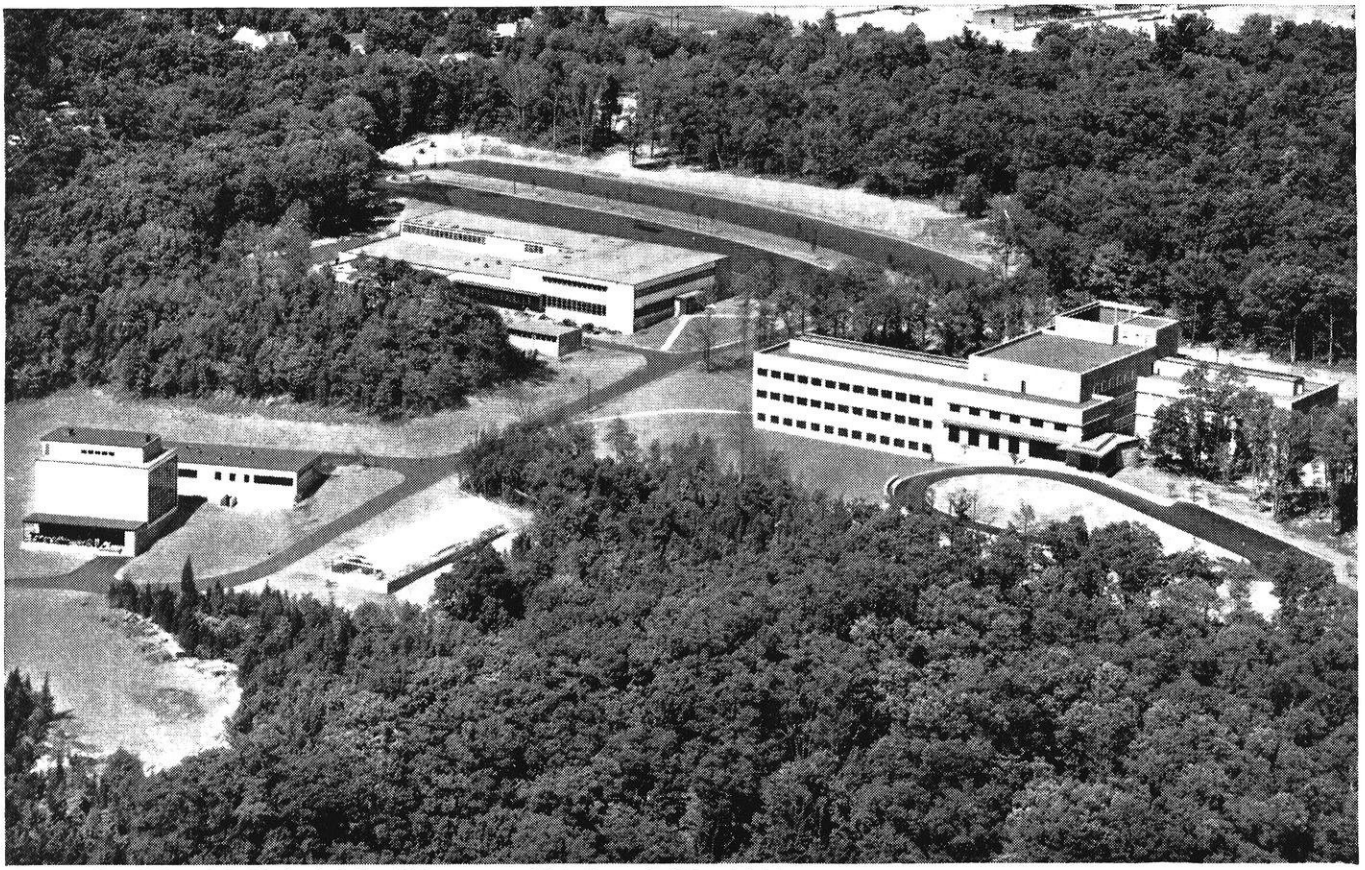


Chemical Eng. Bldg. at left; Mechanical Eng. Bldg. at center; Main Research Bldg. at right.

For this great, future-probing

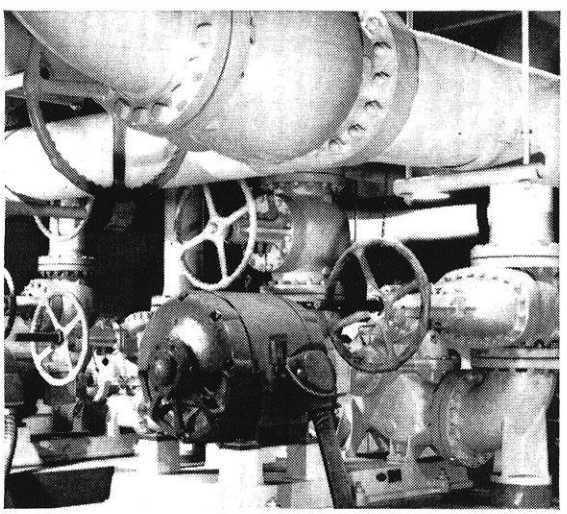
U. S. RUBBER RESEARCH CENTER

JENKINS VALVES assure trouble-free control of the entire piping system

Here, in a complex of modern buildings on a wooded New Jersey hilltop, a staff of over 400 are making tomorrow's miracles out of today's mysteries. Here, they're future-probing the possibilities in rubber and tires, of course. But the quest also covers all the other present-day interests of U. S. Rubber Co. . . . plastics, chemicals, textiles, and endless uses of such materials.

The Research Center scientists and building experts controlled the selection of equipment for their $7,000,000 "home." Jenkins Valves were widely used to control the piping systems.

Make the specification "JENKINS" *your* safeguard against valve trouble and the high cost of valve maintenance. *You pay no more* for Jenkins Valves. Jenkins Bros., 100 Park Ave., New York 17.



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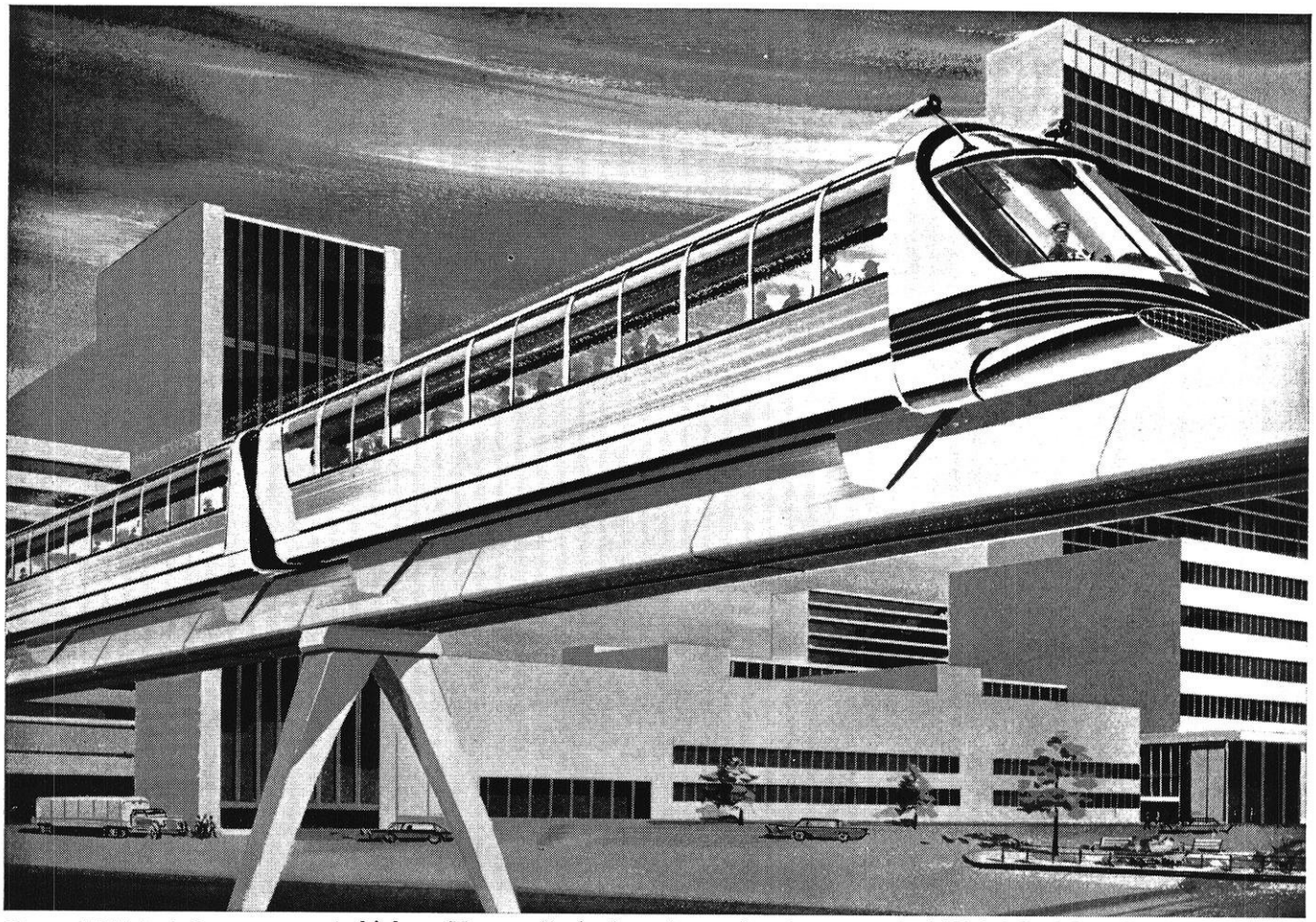

Monorail "Airtrain" — a compact, high-speed transportation system that will be automatic and practically noiseless. Construction is now being planned by leading U.S. cities to provide efficient, low-cost urban transit. Lightweight Monorail design demands strong, weight-saving metals. Logical choice: Nickel-containing materials such as nickel steels for the basic structure, nickel steel castings for underframes, trucks, other load-bearing assemblies. And Nickel Stainless Steel is a natural for skin and trim on cars—its excellent strength-to-weight ratio permits thinner gauge body shells for dead-weight reduction, its handsome finish stays virtually maintenance-free.

How Inco Nickel helps engineers make new designs possible and practical

When engineers design a transit system, a nuclear ocean liner, or a gas-turbine car, chances are Nickel, or one of its alloys can help the equipment perform better. Nickel-containing metals can provide valuable combinations of corrosion resistance, ductility, workability, and strength at extreme high and low temperatures. Over the years, Inco has developed new alloys and gathered data on the performance of materials under demanding service conditions. This data is available to help solve future metal problems.

Write to Inco Educational Services —ask for List "A". You'll find descriptions of 200 Inco publications covering applications and properties of Nickel and its alloys.

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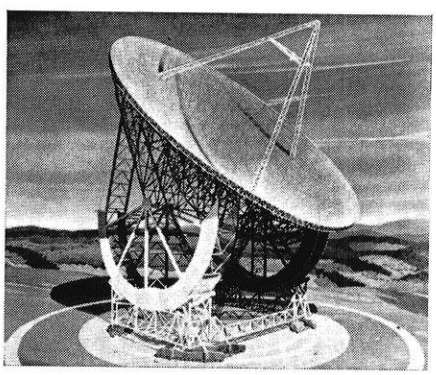
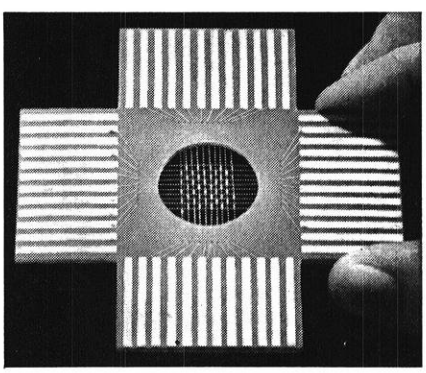


38 billion light years — that's how far this 66-story telescope can "see" into space. Nickel in steel gave engineers a material tough enough to maintain precision in the rotating mechanism even with anticipated 20,000 ton load. Nickel used in steel members provided high strength at minimum weight to support the giant reflector.



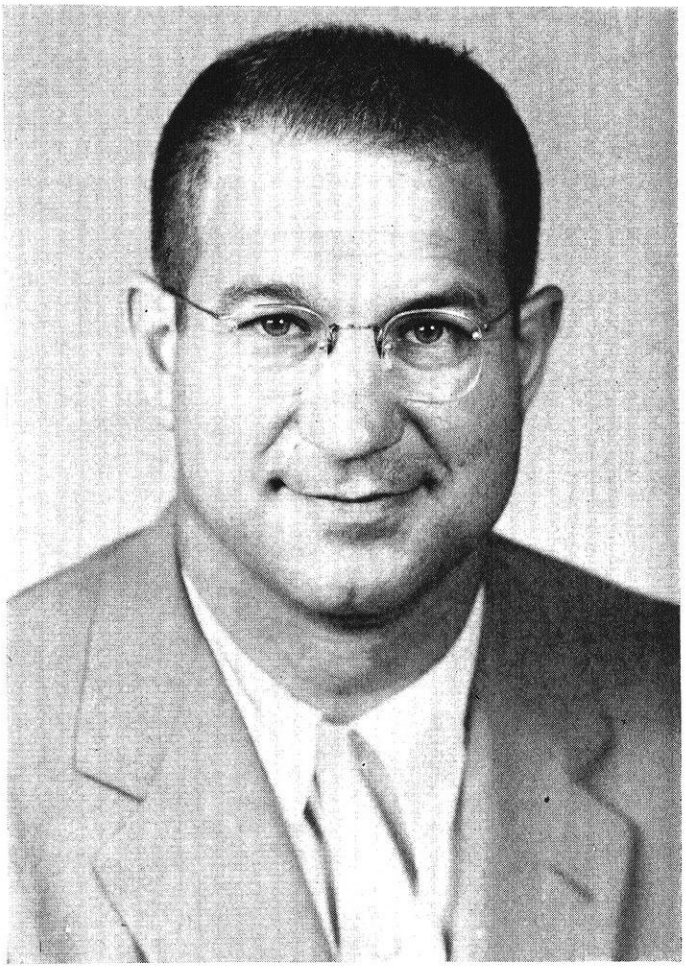
Magnetic memory. This tiny part takes advantage of the unusual magnetic behavior of a twisted high-nickel alloy wire. Interwoven wire can store thousands of "bits" of information magnetically, ready to answer the computer's call. When twisted, this high-nickel alloy shifts magnetization direction from longitudinal to a helical path.

INTERNATIONAL NICKEL

The International Nickel Company, Inc., is the U.S. affiliate of The International Nickel Company of Canada, Limited (Inco-Canada) —producer of Inco Nickel, Copper, Cobalt, Iron Ore, Tellurium, Selenium, Sulfur and Platinum, Palladium and Other Precious Metals.

Introducing . . .

Professor Phillip S. Myers



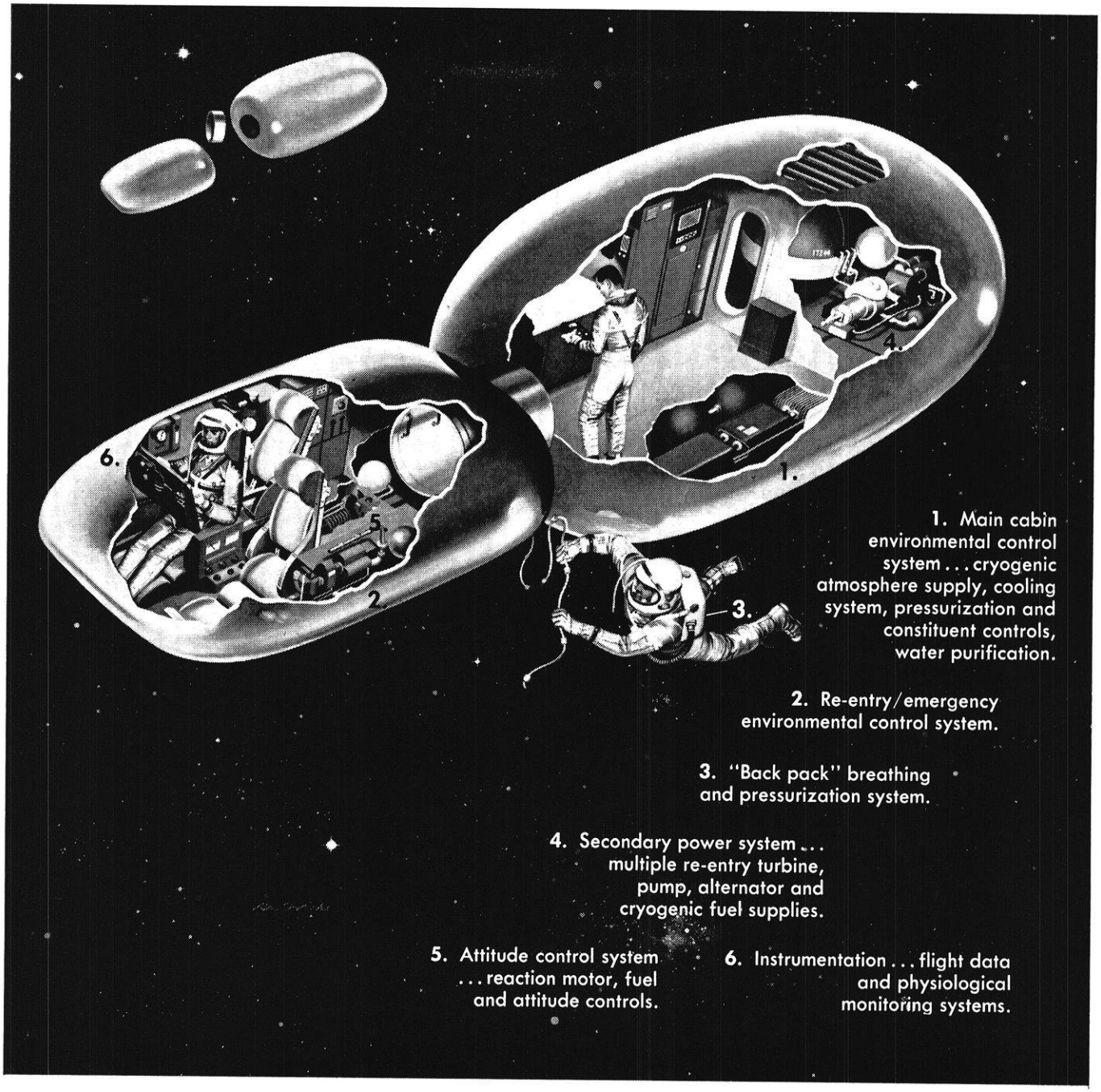
Professor Myers is one of many professors around the engineering campus who remain anonymous to most of the undergraduates. This occurs because he devotes most of his time to teaching advanced courses in thermodynamics and directing the work of graduate students doing research in the same field.

Professor Myers received his high school education at Sinclair Rural High School near Lovewell, Kansas. After receiving a Bachelors Degree in Commerce and Mathematics from McPherson College in 1940 and a Bachelors Degree in Mechanical Engineering with high honors from Kansas State College in 1942, he came to Wisconsin where he was awarded his Masters Degree in 1944 and his PhD in 1947; both in the field of Mechanical Engineering. He has been on the staff at Wisconsin since 1942; attaining his present position of Professor of Mechanical Engineering in 1955.

Most of Professor Myers' research has been done in the field of internal combustion engines. In connection with this work he has coauthored some 19 papers in the field and has helped devise many new devices for the measurement of the high but transient temperatures found inside the cylinders of an internal combustion engine.

Five fraternities claim Professor Myers as a member. They are: Sigma Xi, Phi Kappa Phi, Sigma Tau, Pi Tau Sigma, and Tau Beta Pi. In 1949 he received the Pi Tau Sigma Gold Medal Award for "Outstanding achievement in Mechanical Engineering within ten years after graduation . . ." He is also a member of ASME, SAE (Past Chairman of the Milwaukee Section) and is the holder of a Professional Engineer's license.

His outside interests mark him as an outdoorsman. Among such interests camping, boating and photography hold the three top spots. Professor Myers is the father of three girls and a pair of 18 month old twin boys. That must be some crew to take camping.



Manned space flight requires reliable and efficient thermal and atmospheric systems plus secondary power equipment. Complete, integrated systems (such as those pictured above) are under study at Garrett's AiResearch Manufacturing Divisions. Their design reflects 20 years of leadership in airborne and space systems, including NASA's Project Mercury life support system.

Other project areas at Garrett include: solar and nuclear power systems for space applications; electronic systems, including centralized flight data computer systems; and small gas turbines for both military and industrial use.

An orientation program lasting several months in diversified areas is available to every newly-graduated engineer to aid in his placement. It includes working on assignment with experienced engineers in laboratory, preliminary design and development projects.

For further information about a career with The Garrett Corporation, write to Mr. G. D. Bradley in Los Angeles.

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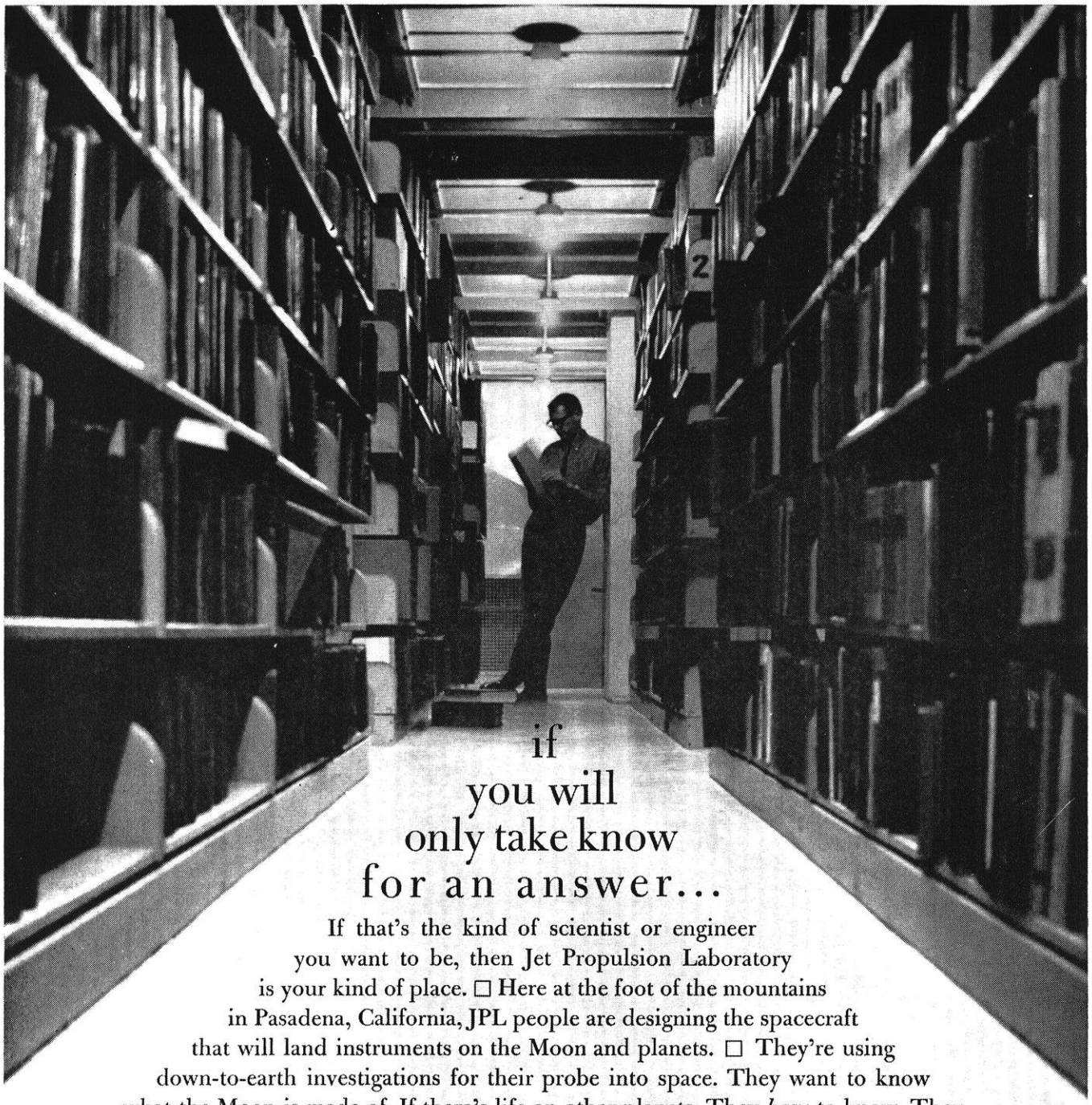

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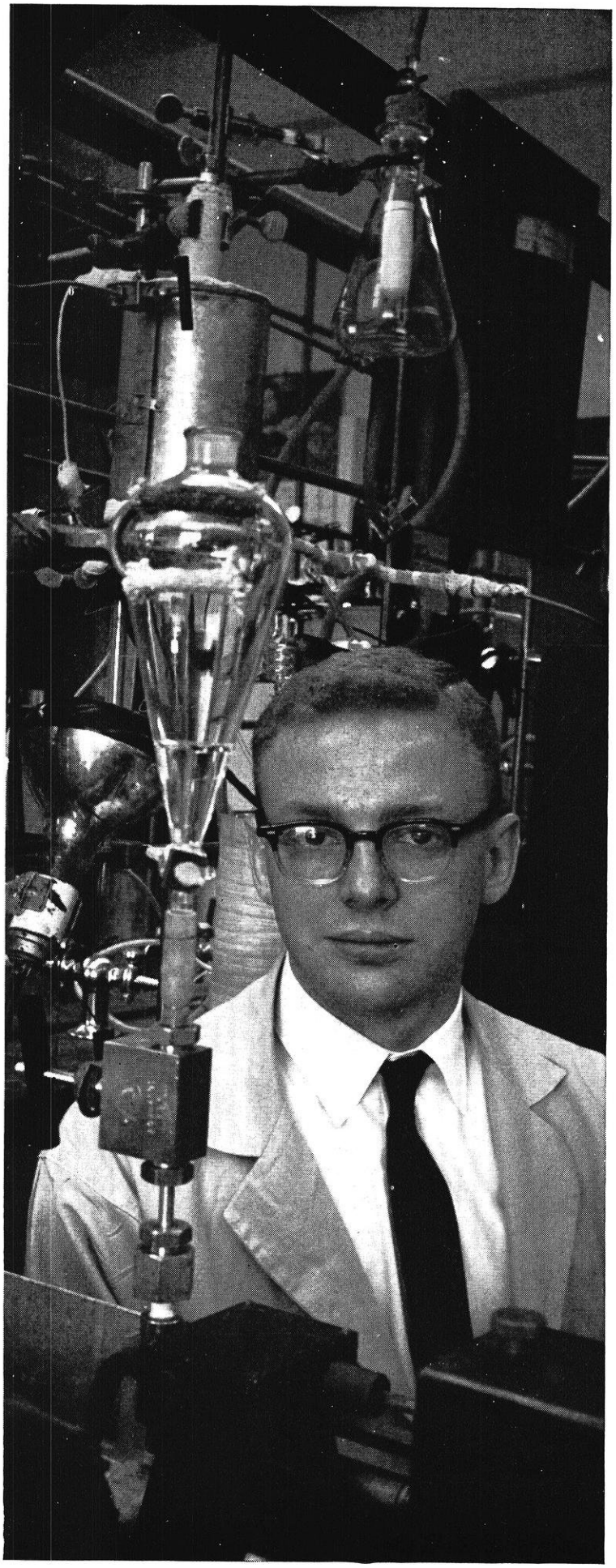

Some straight talk about a career at American Oil

by Roger Fisher

"This Company recognizes the value of varied experience, and encourages you to broaden your knowledge."

Roger Fisher, B.Ch.E. from Cornell and Ph.D. candidate from Princeton is one of many young scientists and engineers at American Oil shaping the future for himself, his Company and the industry. At 26, he has earned a Fulbright Scholarship and will take a year's leave of absence to continue his graduate research on solids mixing at the University of Osaka, Japan.

"American Oil is looking for broad-gauge research people," Roger adds. "In the long run, the Company benefits as well as the professional who continues to grow in his own or in several fields of research."

Roger's present assignment at American Oil involves applied research—to plan, design, build and operate bench scale lab equipment, to study the kinetics of catalytic cracking. His is one of many diversified projects at American Oil Company. Chemists, chemical engineers, physicists, mathematicians and metallurgists can find interesting and important work in their own fields.

The ability of American Oil to attract bright young scientists and engineers like Roger Fisher might have special meaning to you. For complete information concerning career opportunities in the Research and Development Department of American Oil, write D. G. Schroeter, American Oil Company, P. O. Box 431, Whiting, Indiana.

IN ADDITION TO FAR-REACHING PROGRAMS INVOLVING FUELS, LUBRICANTS AND PETROCHEMICALS, AMERICAN OIL AND ITS ASSOCIATE COMPANY, AMOCO CHEMICALS, ARE ENGAGED IN SUCH DIVERSIFIED RESEARCH AND DEVELOPMENT PROJECTS AS: New and unusual polymers and plastics • Organic ions under electron impact • Radiation-induced reactions • Physiochemical nature of catalysts • Fuel cells • Novel separations by gas chromatography • Application of computers to complex technical problems • Synthesis and potential applications for aromatic acids • Combustion phenomena • Solid propellants for use with missiles • Design and economics: New uses for present products, new products, new processes • Corrosion mechanisms • Development of new types of surface coatings

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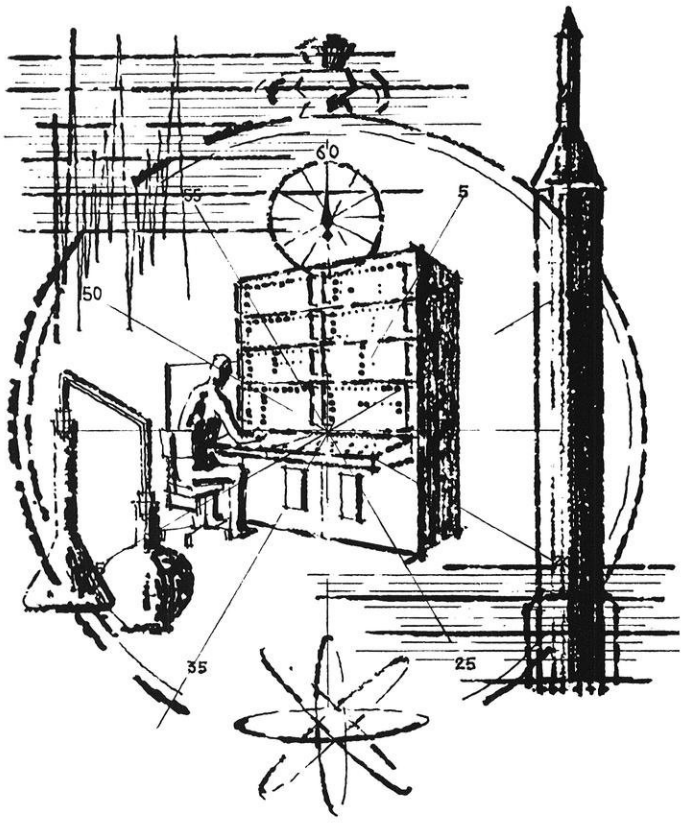


SCIENCE HIGHLIGHTS

by John C. Ebsen ee'65

FALLOUT EQUIPMENT

Experiments recently carried out in England have shown that drunken mice are better able to withstand radiation than sober ones, reports Product Engineering, McGraw-Hill publication. Due to the tests, science has given formal approval to what may be the most valuable item in a well-equipped fall-out shelter.

RIAS SCIENTIST SUGGESTS SOLUTION TO CARBON MONOXIDE IN SPACE SHIP

Unlocking the secrets of green plant life may be a key to man's survival in prolonged space travel, a biochemist said recently.

In searching for these secrets, Emmett W. Chappelle, a research scientist at RIAS, The Martin Company's Research Institute for Advanced Study in Baltimore, has uncovered a possible new solution for protecting future space explorers from toxic carbon monoxide produced within the ship by electrical systems, fuel combustion units, and the occupants themselves.

Chappelle told the symposium on Microbiological Applications for Space Vehicles and Extra-terrestrial Stations at Purdue University here that green plants have the ability to convert the deadly gas, carbon monoxide, into harmless carbon dioxide.

Thus a closed ecological system utilizing green plants could serve the dual purpose of providing oxygen for the space travelers to breathe and of keeping the level of carbon monoxide at non-toxic concentrations.

In his research, supported by the Air Force School of Aviation Medicine, Brooks Air Force Base, Texas, Chappelle found that chlorella, a rather common green algae, performed the conversion most efficiently within the group of 25 plants tested.

Among the higher plants the most effective agent for rendering carbon monoxide harmless was the cucumber, suggesting the possibility that space stations of the future could contain vegetable gardens and possibly small trees.

As a biochemist engaged in basic research with the photosynthesis group at RIAS, he is striving to arrive at a better understanding of the mechanism whereby green plants perform the conversion from carbon monoxide to carbon dioxide.

This reaction, Chappelle believes, is closely related to photosynthesis—nature's process for producing "food" and oxygen from carbon dioxide and water in the presence of light. The resultant oxygen reacts with carbon monoxide in the atmosphere to form carbon dioxide, which can be used further by the plant to continue the cycle.

In his experiments living plant cells were exposed in a closed chamber to carbon monoxide, which had been "labeled" with the radio-isotope carbon-14. Measurements of the amount of carbon-14 in the plant cells indicated the extent of the reaction.

WORTH EVERY PENNY

The first U.S. communications satellite system will cost some $250 million over the next decade, but it'll be worth it, Electronics, McGraw-Hill publication, states. The system will meet coming needs for trunkline communications at a 30th the cost of equivalent cable service today.

MICROWAVE DATA-TRANSMISSION

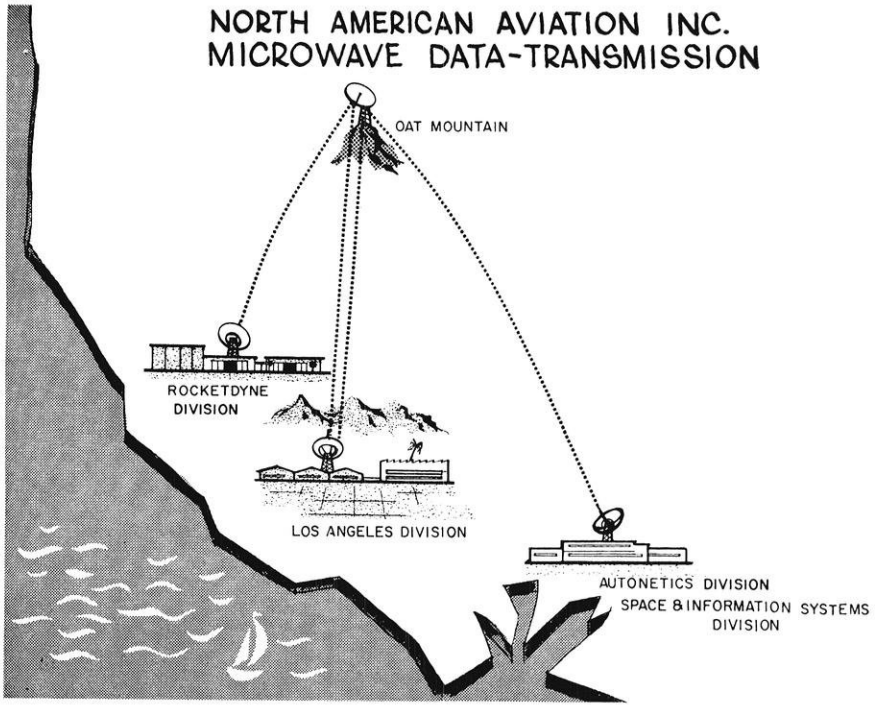
The world's fastest and most reliable commercial application of computer and microwave transmission equipment is in operation today at North American Aviation, Inc.

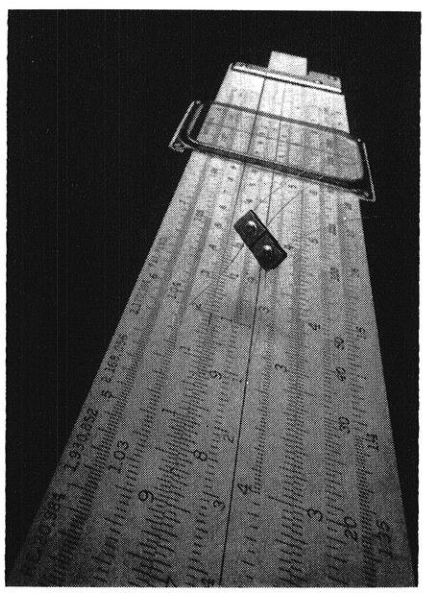
George Bynum, Corporate Manager of Integrated Data Processing, said the system provides the company with an answer to the mounting industrial problem of how to obtain high speed communications to effect fast turnaround time, especially on engineering and high-volume commercial applications. The hookup, expanded from a system installed in 1960, has more than tripled its initial speed.

Bynum said the system provides North American with great flexibility by shifting peak computation loads to IBM 7090 equipment recently installed at the three focal divisions. No longer might equipment be standing idle at Autonetics when Rocketdyne or Los Angeles computers have over-capacity loads.

Newly-installed IBM equipment is capable of receiving and transmitting at full IBM magnetic tape read and writing speed (62,500 characters per second).

Bynum said the system provides a solution to North American's problem of sending great volumes of information over long distances for the purpose of centralizing computer services, balancing computer workloads, and allowing on-line operation of remote terminals.





WESTINGHOUSE SCIENTISTS DEMONSTRATE 'MOLECULAR SLIDE RULE'

Scientists at the Westinghouse research laboratories have demonstrated a unique electronic device which might best be described as a "molecular slide rule." The tiny device electronically performs multiplication and division by a process similar to that used in the familiar mechanical slide rule so widely used for mathematical calculations.

Yet the new multiplier-divider has no conventional electronic components or circuitry.

It is simply a solid slice of silicon about the size of the head of a thumbtack and as thick as a few sheets of paper.

The molecular slide rule is the latest subsystem, or functional electronic block, to be demonstrated by Westinghouse through the principle of molecular electronics.

Molecular electronics is a promising new approach to electronic systems.

It does away with traditional circuits built from arrays of electronic components such as tubes, transistors, resistors, and the like.

Instead, the same function is performed by rearranging the internal structure of a solid semiconductor crystal. Electronic behavior occurring within or between regions in the crystal gives the same effect as an entire electronic circuit (subsystem), or even a whole system.

The multiplying and dividing function performed by the new functional block is equivalent to that done by an array of four separate diodes, or three diodes and a transistor. The functional block, however, is capable of greater accuracy than the assembly of individual components.

The new functional electronic block multiplies by adding together voltages that are logarithms of the quantities to be multiplied. The logarithm of a number is the power to which a fixed base number (usually 10) must be raised in order to equal the number (called the antilogarithm).

The molecular slide rule performs in a similar way, but electronically by means of semiconductor junctions. An electric current fed into a junction gives a voltage across the junction proportional to the logarithm of the current. An input of two currents into two junctions gives a voltage which is their logarithmic sum. The antilogarithm, measured at the output of the functional block, is the product of multiplying them together.

Your Future in Electronics at Hughes

As the West's leader in advanced electronics, Hughes is engaged in some of the most dramatic and critical projects ever envisioned. Challenges for your imagination and development are to be found in such diversified programs as:

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3-dimensional Radars
Plasma Physics, Ion Propulsion
Solid State Materials and Devices
Communications Satellites
Digital Computer Systems
Hydrospace Electronics
Infrared

These are among the more than 500 outstanding programs now in progress at Hughes. These programs require the talents of E.E.'s and Physicists who desire to work with professional scientists in research, development and manufacture.

In addition, Hughes sponsors advanced degree programs for academic growth. These programs provide for advanced degree study at many leading universities.

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CAMPUS INTERVIEWS

November 28, 1961

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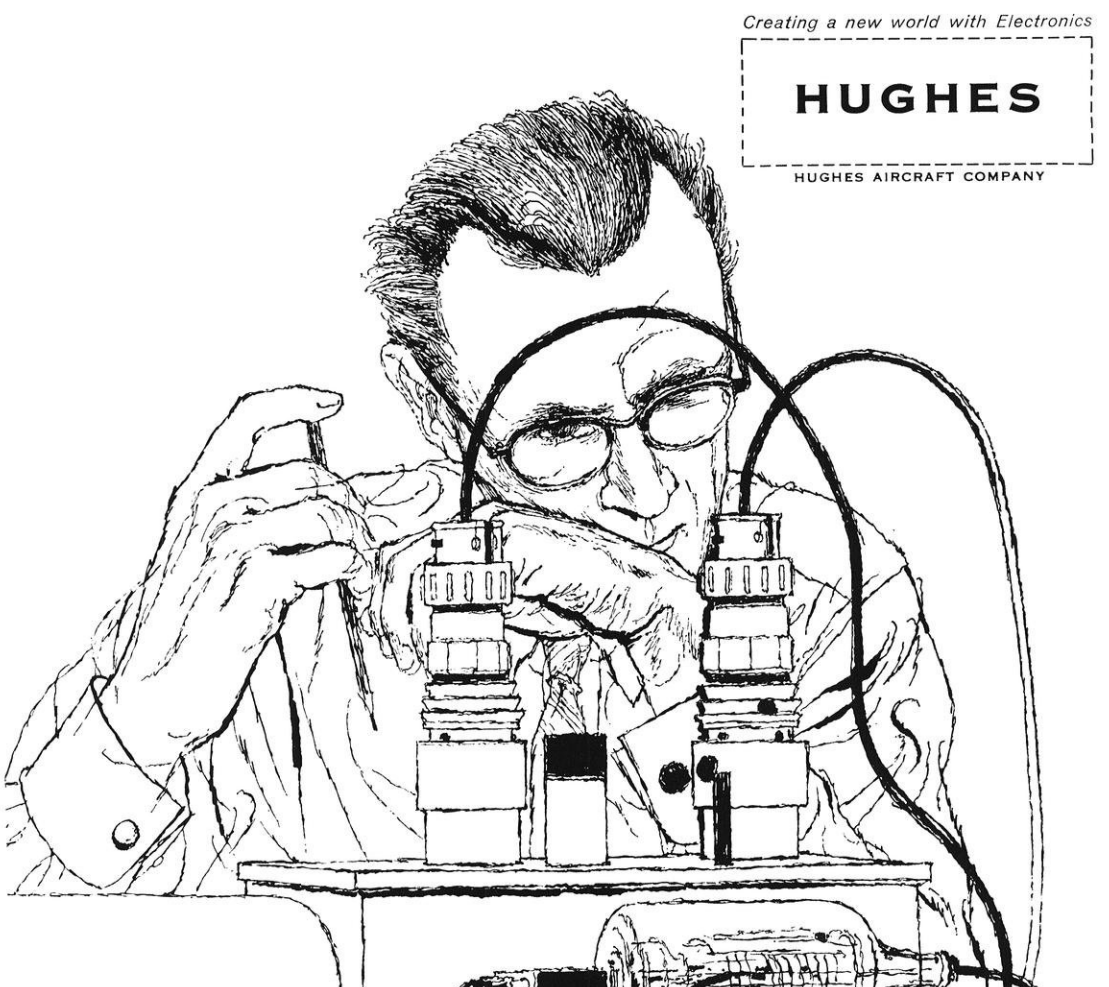


Here is a newly designed beer barrel made by The Benson Manufacturing Company of Kansas City, Missouri. The stainless steel was supplied by Allegheny Ludlum Steel Corporation. The barrel will carry 15½ gallons of the amber liquid.

Foamed Aluminum

(Continued from page 12)

tion. All this is achieved at lower cost than with materials now used.

Industrial Construction

In industrial construction, the uses include those listed for home construction plus curtain-wall panels, room dividers, and many uses where the natural texture surface can add effect.

Marine Construction

Foamalum has numerous applications for marine construction due to its buoyancy and the corrosion resistance of aluminum. Boats, barges, docks, piers, buoys, and airplane pontoons are some of the uses in which this product will give longer life and increased safety over materials now used.

Specialized Uses

Many uses of foamed aluminum are practical in more specialized fields. Some of them are floating covers for oil storage, replacement of "honeycomb" structures in the aircraft and missile industries; radiation insulation; advertising and road signs; truck trailers and railroad cars; and numerous uses as core material.

Of course any such categorized listing as this merely scratches the surface of the possible uses of such a versatile structural material, but it can serve as an aid in envisioning further uses.

SUMMARY OF THE VALUE OF THIS PRODUCT

The exceptional lightness of foamalum is its outstanding feature. However, in reviewing its other properties it is seen that many of the desired features of a structural material such as good workability, rust and rot resistance and a good compression and tensile strength-weight compression are present in this product. Is it economically feasible? This question must be answered before any further consideration of use can be made. At present the entire production of foamed aluminum is contracted for well in advance indicating that its usefulness justifies its cost. As new plants are brought into production the retail price should be reduced to around one dollar per pound, which compares quite favorably with other construction materials.

BIBLIOGRAPHY

1. This and other information was taken from brochures published by the Foamalum Corporation, and made available to me by M. L. Roberts, President of the Corp. "Ultra-Lightweight Aluminum Foam", *Modern Metals,* V. 13, Oct. 1959, p. 68–70.
3. "Aluminum Foam Opens New Industry", il *Steel* 144:71 Je 8, 1959.

Aerial Photography

(Continued from page 24)

ber of factors regarding the positioning of the camera. First, the exact horizontal position of the camera cannot be determined. Next, the flying height of the airplane cannot be determined accurately because of air pockets and currents at high altitudes. Another important feature is that almost always there is some tilt in a photo, which can cause great difficulty if it is large. (Tilt was discussed earlier, on page 5 of this report.) Also, clarity in photographs requires good atmospheric conditions—freedom from clouds, mist, smoke, or severe haze. In some parts of the world, such ideal conditions may occur only one or two days of the year. Finally, ground control points for mapping are hard to find if there is snow or tree foilage to a great extent on the photo.

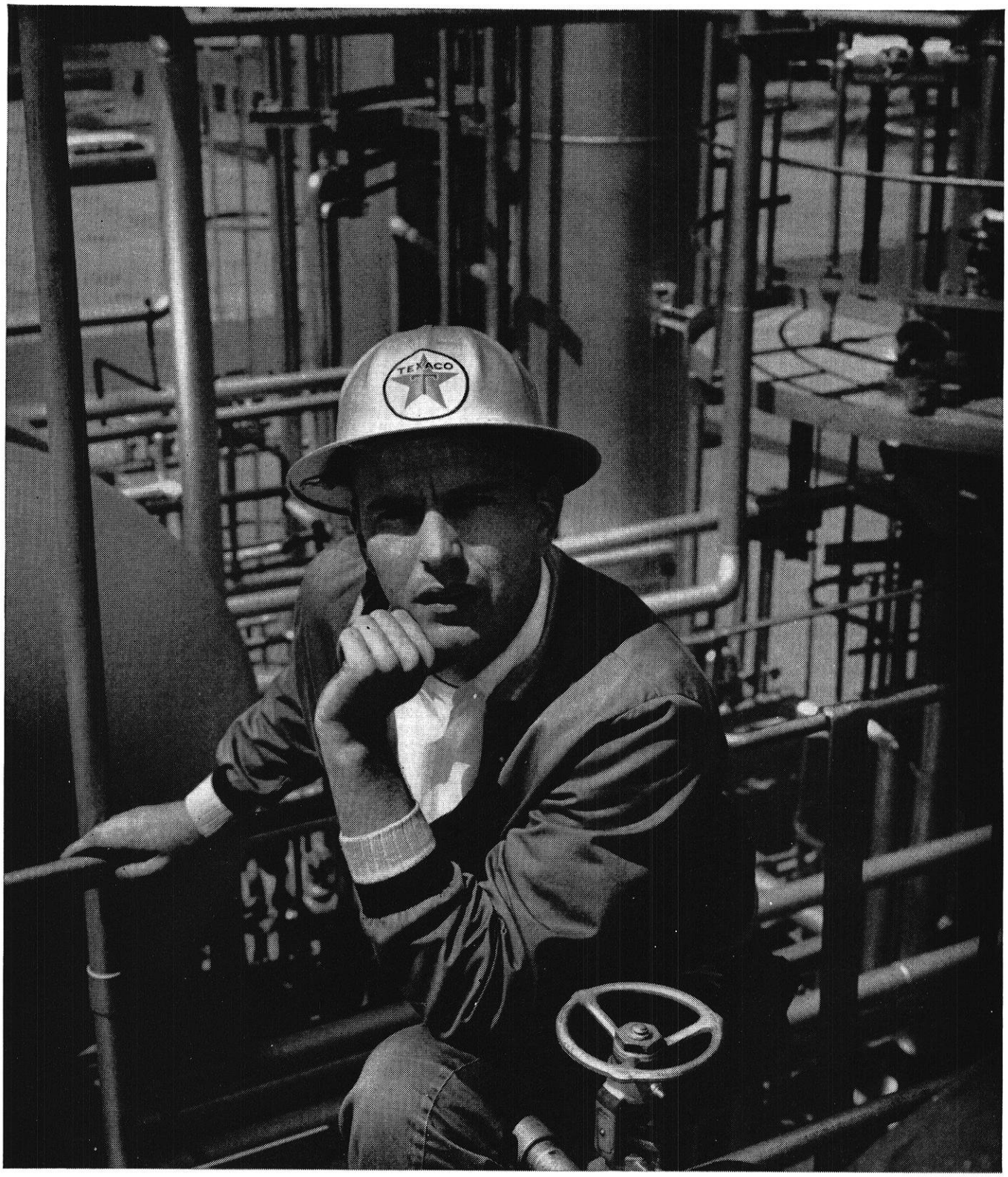
The largest advantage of terrestrial photography over aerial photography is that the camera's horizontal positioning along with its elevation can be determined at any time during a survey. A special type of instrument is used with the camera so that the exact azimuth of the optical axis is known for each photo.

CONCLUSION

The types, uses and the importance of aerial photographs were discussed to a great extent. Aerial photography, terrestrial photography and ground survey methods were compared with each other to illustrate their relative advantages and disadvantages.

Up-to-date information on exist-

(Continued on page 43)



"I've been an engineer with Texaco for over three years now. Hard work? You bet! But it's a challenge—and interesting work, too. As a member of a team assigned to a special project, I'm learning every day, and feel that I'm really contributing. I've found Texaco a good company to be with—a leader in the industry." Build a rewarding career for yourself with Texaco. There are excellent opportunities for young men with any of a wide variety of engineering or science degrees. Contact your placement office or write Mr. J. C. Kiersted, Texaco Inc., 135 East 42nd Street, New York 17, N. Y. Your inquiry will receive prompt and careful consideration.

TEXACO

Qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

Aerial Photography

(Continued from page 40)

ing photographs may be obtained from the Map Information Office of the United States Geological Survey.

If a more detailed description is desired regarding parts of this report, a complete listing of the books used may be found in the bibliography.

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(2) Moffitt, Francis H. *Photogrammetry*, Scranton, Pennsylvania, International Textbook Co., 1959.
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* * *

"Beg your pardon, but aren't you an engineering student?"

"No. it's just that I couldn't find my suspenders this morning, my razor blades were gone, and a bus ran over my hat."

Math Prof.: "Give me an example of an imaginary spheroid."

E.E.: "A rooster's egg."

* * *

On a windy day, a young lady was having trouble keeping her dress down. She noticed a man watching her with interest and she addressed him in an irritated voice.

"It is obvious you are not a gentleman."

The man replied, "It's obvious you are not either."

* * *

"Give me another pound of your ant powder," said the ChE rushing into the store.

"I'm glad to see that you like the powder," said the clerk.

"Yes," snapped the customer, "I've got one ant unconscious with the first pound and I figured I'll be able to kill him with the second."

* * *

Larry: "Do you know what good clean fun is?"

Lou: "No, what good is it?"

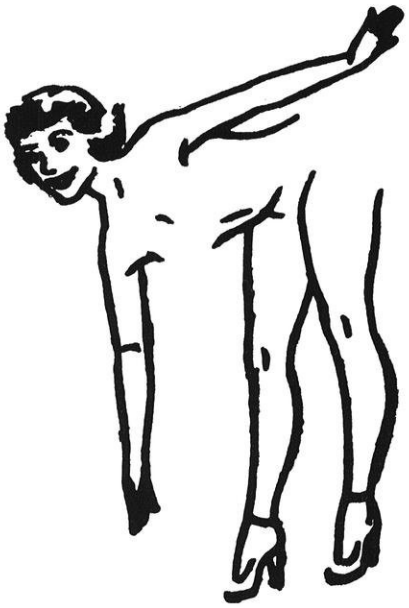
Chemical Analysis of Kiss

Properties: **Ethereal in nature. Taste, sweet: color, colorless to red. Is not affected by water, but reacts strongly to alcohol.**

Occurrence: **Cars, porches, parlors, and parks. In most cases the compound has only a transitory existence, but it may exist for a considerable period of time.**

Chemical Behavior: **It quickly breaks up when exposed to a bright light, but it seems more stable by moonlight. It frequently plays the part of a catalyst producing bonds of a more permanent nature. The appearance of the *parent* compound produces a quick and violent displacement of the individual member of the compound.**

Future Development: **Although it is not new, it is constantly being rediscovered. Very little is known about the nature of the compound, in spite of the fact that many heads are busily engaged on the problem until late every night.**



Fill in your Own Lines

The bride of a talkative fellow complained of his conduct during their honeymoon. She said all he did was jabber, jabber, jabber.

* * *

Have you heard the new radio program about the girl who wanted two bathrooms? It's called "The Wife's Other John."

* * *

The girl on the bus was reading about birth and death statistics. Suddenly she turned to a male beside her and said, "Do you know that every time I breathe a man dies?"

"Very interesting," he returned, "Why don't you try Clorets?"

* * *

Notice to the Milk Depot: We are a little short of milk just now . . . Some of our best cows are out having a bull session.

* * *

One supervisor was telling another, "When I walk through the typist section I feel like a piece of uranium approaching a whole battery of geiger counters. . ."

"What do you mean?" the other man asked.

"The closer I come the faster they click."

I serve one purpose in this school
On which no man can frown
I quietly sit in every class
And keep the average down.

* * *

A young lady with a touch of hay fever took with her two handkerchiefs to a dinner party. She stuck one of them in her bosom. At dinner she began rummaging to the right and the left in her bosom, searching for the fresh handkerchief. Engrossed in her search, she suddenly realized that the conversation had ceased and people were watching her, fascinated.

In confusion, she murmured, "I know I had two when I came in!"

* * *

Susie married an official of the Three-In-One Oil Company. In about two years she gave birth to triplets. Upon hearing this, her sister immediately cancelled her engagement. Her fiance was an official of the Phillips 66 Company.

* * *

Sweet young thing: "Am I the first girl you ever kissed?"

Engineer: "Now that you mention it, you do look familiar."

The M.E.'s wife found her husband in a bar, sampled the highball he was drinking, and demanded, "How can you drink such horrible stuff?"

"See," said the husband, "and all the while you thought I was out having a good time!"

* * *

A vulgar man is one who stares at a co-ed's figure when she's doing her best to display it.

* * *

The quiet little freshman co-ed from the country was on her first college date, and thrilled beyond words. She didn't want to appear "countrified"; she had put on her prettiest dress, got a sophisticated hair-do, and was all prepared to talk understandingly about music, art, or politics.

Her hero took her to a movie, and then to the favorite college cafe.

"Two beers," he told the waiter.

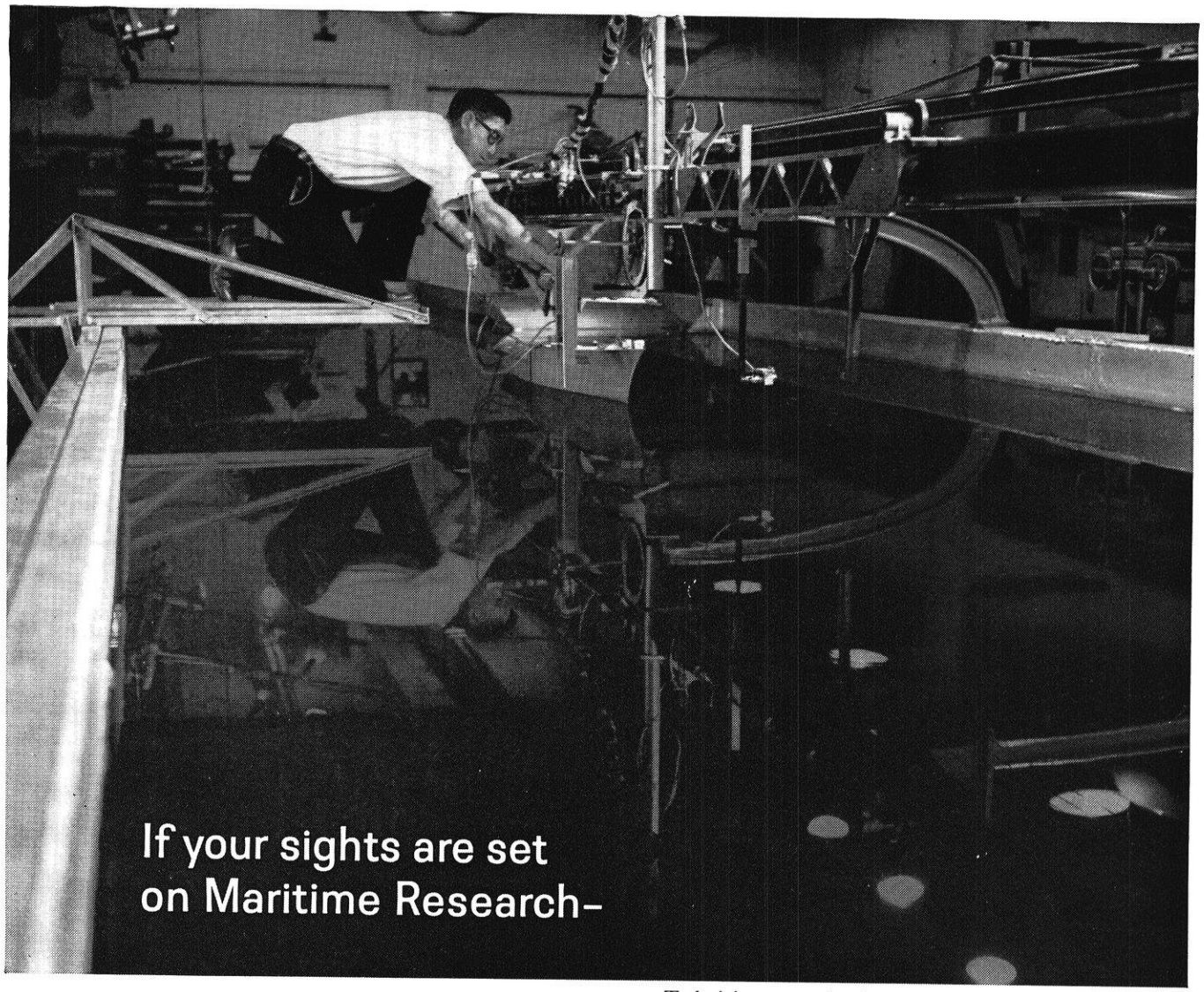
She, not to be outdone, murmured, "The same for me."

* * *

"Did you see that donkey fall down and break his leg?"

"No, did they blame the driver?"

"No, they said it was the asphalt."



Technician preparing for motion-picture studies of a model in the testing tank at Stevens Institute of Technology.

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The engineer designing and constructing vessels finds photography one of his valuable tools. Motion-picture studies of models in tanks help in hull design. Electron microscope plates contribute to the proper metallurgy for propellers and other parts. And radiography checks welded seams of hull plate and piping as well as heavy castings for internal imperfections.

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Interview with General Electric's Dr. J. H. Hollomon

Manager—General Engineering Laboratory

Society Has New Needs and Wants—Plan Your Career Accordingly

DR. HOLLOMON is responsible for General Electric's centralized, advanced engineering activities. He is also an adjunct professor of metallurgy at RPI, serves in advisory posts for four universities, and is a member of the Technical Assistance panel of President Kennedy's Scientific Advisory Committee. Long interested in emphasizing new areas of opportunity for engineers and scientists, the following highlights some of Dr. Hollomon's opinions.

Q. Dr. Hollomon, what characterizes the new needs and wants of society?

A. There are four significant changes in recent times that characterize these needs and wants.

1. The increases in the number of people who live in cities: the accompanying need is for adequate control of air pollution, elimination of transportation bottlenecks, slum clearance, and adequate water resources.

2. The shift in our economy from agriculture and manufacturing to "services": today less than half our working population produces the food and goods for the remainder. Education, health, and recreation are new needs. They require a new information technology to eliminate the drudgery of routine mental tasks as our electrical technology eliminated routine physical drudgery.

3. The continued need for national defense and for arms reduction: the majority of our technical resources is concerned with research and development for military purposes. But increasingly, we must look to new technical means for detection and control.

4. The arising expectations of the peoples of the newly developing nations: here the "haves" of our society must provide the industry and the tools for the "have-nots" of the new countries if they are to share the advantages of modern technology. It is now clearly recognized by all that Western technology is capable of furnishing the material goods of modern life to the billions of people of the world rather than only to the millions in the West.

We see in these new wants, prospects for General Electric's future growth and contribution.

Q. Could you give us some examples?

A. We are investigating techniques for the control and measurement of air and water pollution which will be applicable not only to cities, but to individual households. We have developed, for example, new methods of purifying salt water and specific techniques for determining impurities in polluted air. General Electric is increasing its international business by furnishing power generating and transportation equipment for Africa, South America, and Southern Asia.

We are looking for other products that would be helpful to these areas to develop their economy and to improve their way of life. We can develop new information systems, new ways of storing and retrieving information, or handling it in computers. We can design new devices that do some of the thinking functions of men, that will make education more effective and perhaps contribute substantially to reducing the cost of medical treatment. We can design new devices for more efficient "paper handling" in the service industries.

Q. If I want to be a part of this new activity, how should I plan my career?

A. First of all, recognize that the meeting of needs and wants of society with products and services is most important and satisfying work. Today this activity requires not only knowledge of science and technology but also of economics, sociology and the best of the past as learned from the liberal arts. To do the engineering involved requires, at least for young men, the most varied experience possible. This means working at a number of different jobs involving different science and technology and different products. This kind of experience for engineers is one of the best means of learning how to conceive and design —how to be able to meet the changing requirements of the times.

For scientists, look to those new fields in biology, biophysics, information, and power generation that afford the most challenge in understanding the world in which we live.

But above all else, the science explosion of the last several decades means that the tools you will use as an engineer or as a scientist and the knowledge involved will change during your lifetime. Thus, you must be in a position to continue your education, either on your own or in courses at universities or in special courses sponsored by the company for which you work.

Q. Does General Electric offer these advantages to a young scientist or engineer?

A. General Electric is a large diversified company in which young men have the opportunity of working on a variety of problems with experienced people at the forefront of science and technology. There are a number of laboratories where research and advanced development is and has been traditional. The Company offers incentives for graduate studies, as well as a number of educational programs with expert and experienced teachers. Talk to your placement officers and members of your faculty. I hope you will plan to meet our representative when he visits the campus.

A recent address by Dr. Hollomon entitled "Engineering's Great Challenge — the 1960's," will be of interest to most Juniors, Seniors, and Graduate Students. It's available by addressing your request to: Dr. J. H. Hollomon, Section 699-2, General Electric Company, Schenectady 5, N.Y.

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All applicants will receive consideration for employment without regard to race, creed, color, or national origin.