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MARCH
1957
The Wisconsin
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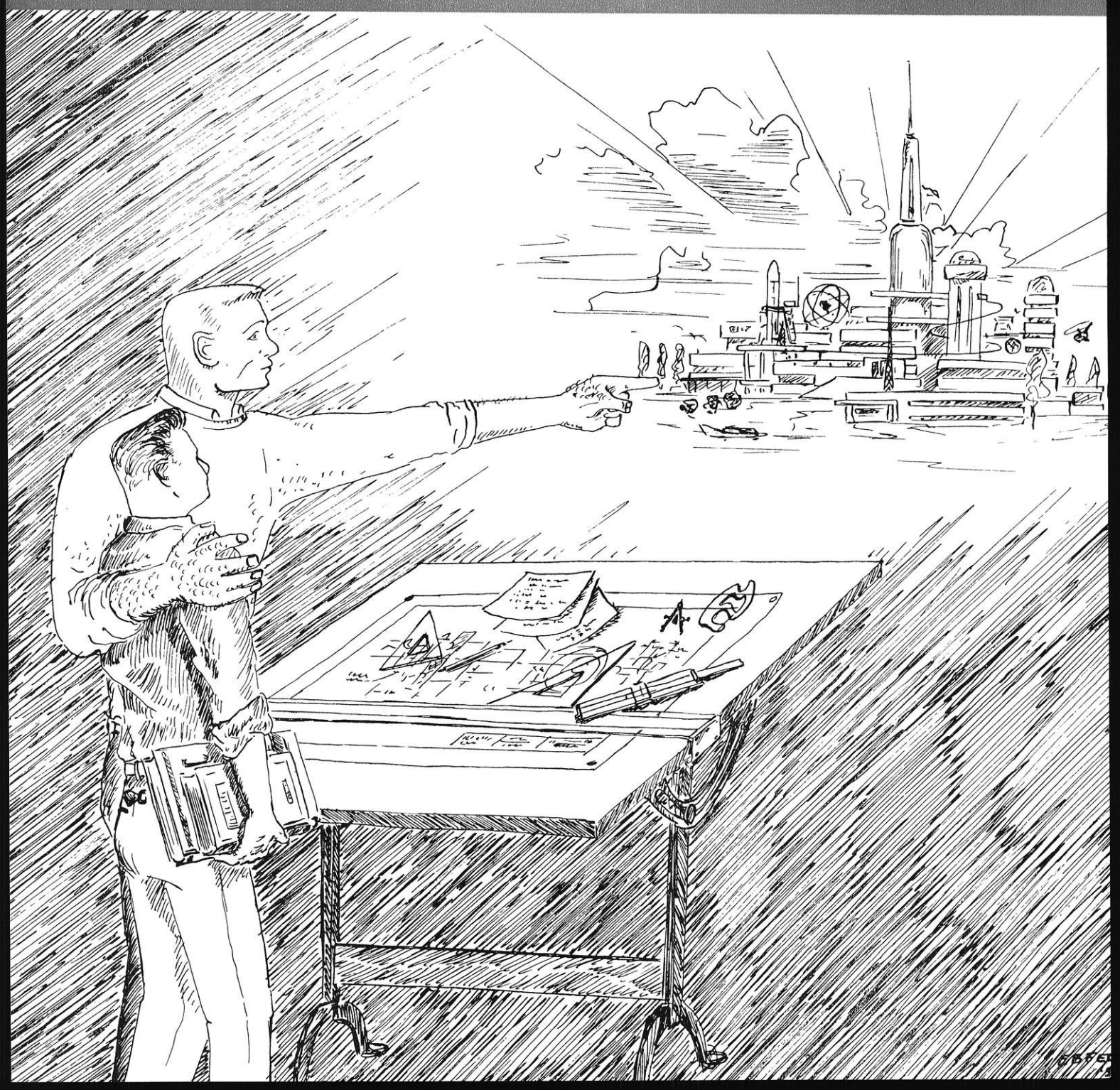
engineer



Robert Lautzenhiser, class of '49, speaks from experience when he says:

"The broad experience and growth possibilities available at U. S. Steel offer a great future with unlimited opportunities."

Following his graduation with a B.S. degree in Metallurgical Engineering, Robert Lautzenhiser joined U. S. Steel as a Junior Metallurgist at the Waukegan Works of the American Steel & Wire Division. Here, he became familiar with the many types of wire and wire products produced, through the practical performance of various physical tests in the metallurgical laboratory.

The knowledge Mr. Lautzenhiser gained of the characteristics of stainless steel wires led to his advancement, in April, 1950, to Product Metallurgist. In this capacity, his duties were of the customer-contact nature. His responsibilities in this work included consultation and the advising of customers regarding the proper steels for their projects.

Mr. Lautzenhiser received his appointment as Product Metallurgist for stainless steel wire in April, 1954. His work on this relatively new product, in which he developed exceptional skills and abilities, resulted in his advancement to Division Metallurgist in July, 1955.

Mr. Lautzenhiser feels that the graduate engineer gains much from the well-planned and complete training program at U. S. Steel. "Furthermore," he says, "the friendly atmosphere and unusually cooperative personal relationships throughout the company are a big help in acquiring the knowledge that leads to advancement and success in one's chosen field."

If you are interested in a challenging and rewarding career with United States Steel, and feel you can qualify, get in touch with your placement director for additional information. We shall be glad to send you our informative booklet, *Paths of Opportunity*. Write to United States Steel Corporation, Personnel Division, Room 1662, 525 William Penn Place, Pittsburgh 30, Pa.

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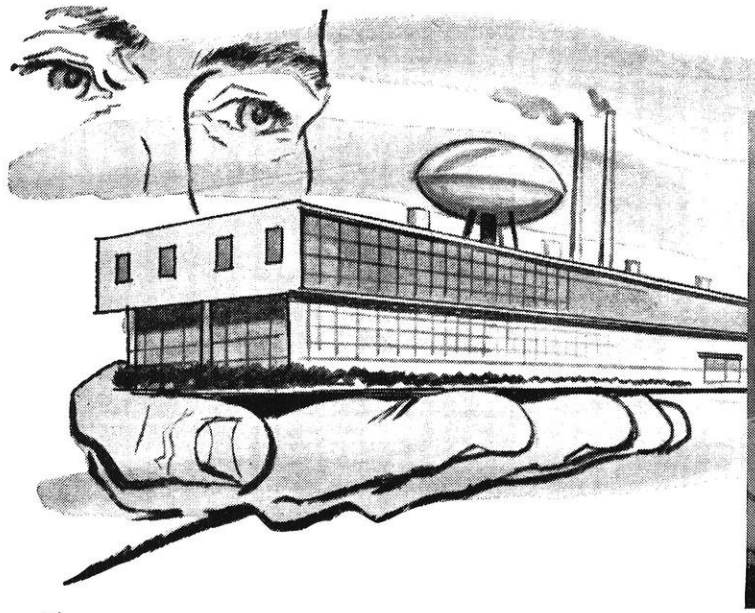

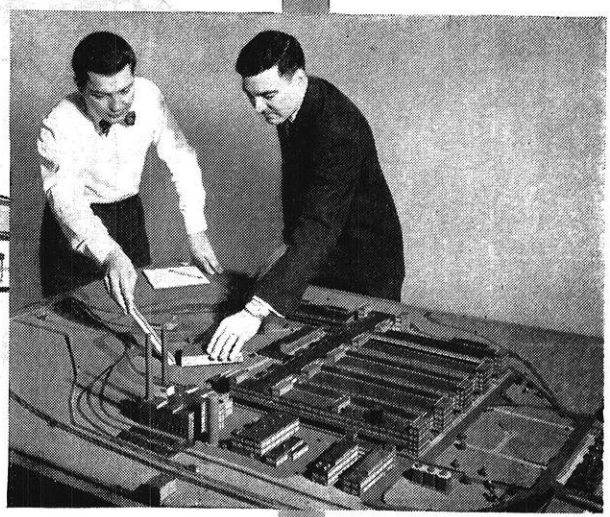

"For I Dipt into the Future Far as Human Eye could See"

Dipping into the future is the business of many a Goodyear engineer. It may be as much as five years from now—or as little as five minutes. But in Plant Planning and Methods, the future is in their eyes and on their minds every waking, working moment.

And if we may say so, the future is in their hands, too. Here's why.

Let us suppose that Goodyear contemplates a new plant – expansion of an established department – or setting up an entirely new one. To Plant Planning and Methods goes the responsibility for laying out the whole project.

Working closely with associates in Plant Engineering, Machine Design and other major departments, they plan everything from the location of the water fountains to the best place to put a huge machine – such as a gigantic curing press. Every detail is visualized and faithfully created on scale layout or model.

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Send for your copy of this free booklet. It describes in detail your career opportunities at Goodyear. Write: Technical Personnel, Dept. 806-W, The Goodyear Tire & Rubber Company, Akron 16, Ohio.

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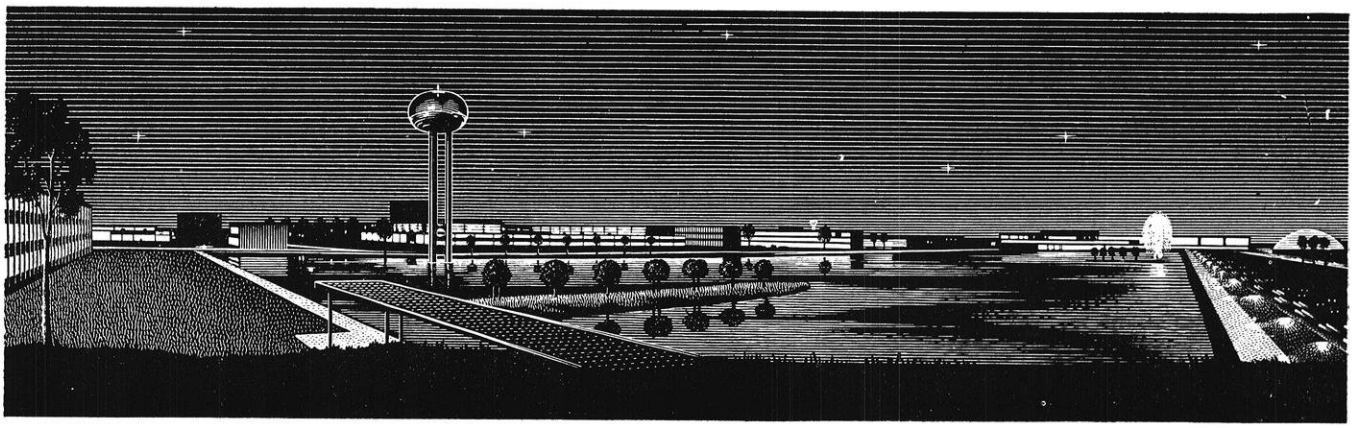

The new General Motors Technical Center ...AND YOU

WHY should the vast new GM Tech Center be of interest to outstanding young engineering seniors?

We'll try to answer that briefly:

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Second, and even more significant, it is testimonial to the increasingly vital role which your chosen profession of engineering plays in the nation's destiny.

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For—as a GM engineer working in any of GM's 34 decentralized manufacturing divisions scattered throughout the land — you would be backed up by the Tech Center resources and facilities in addition to those of your own division.

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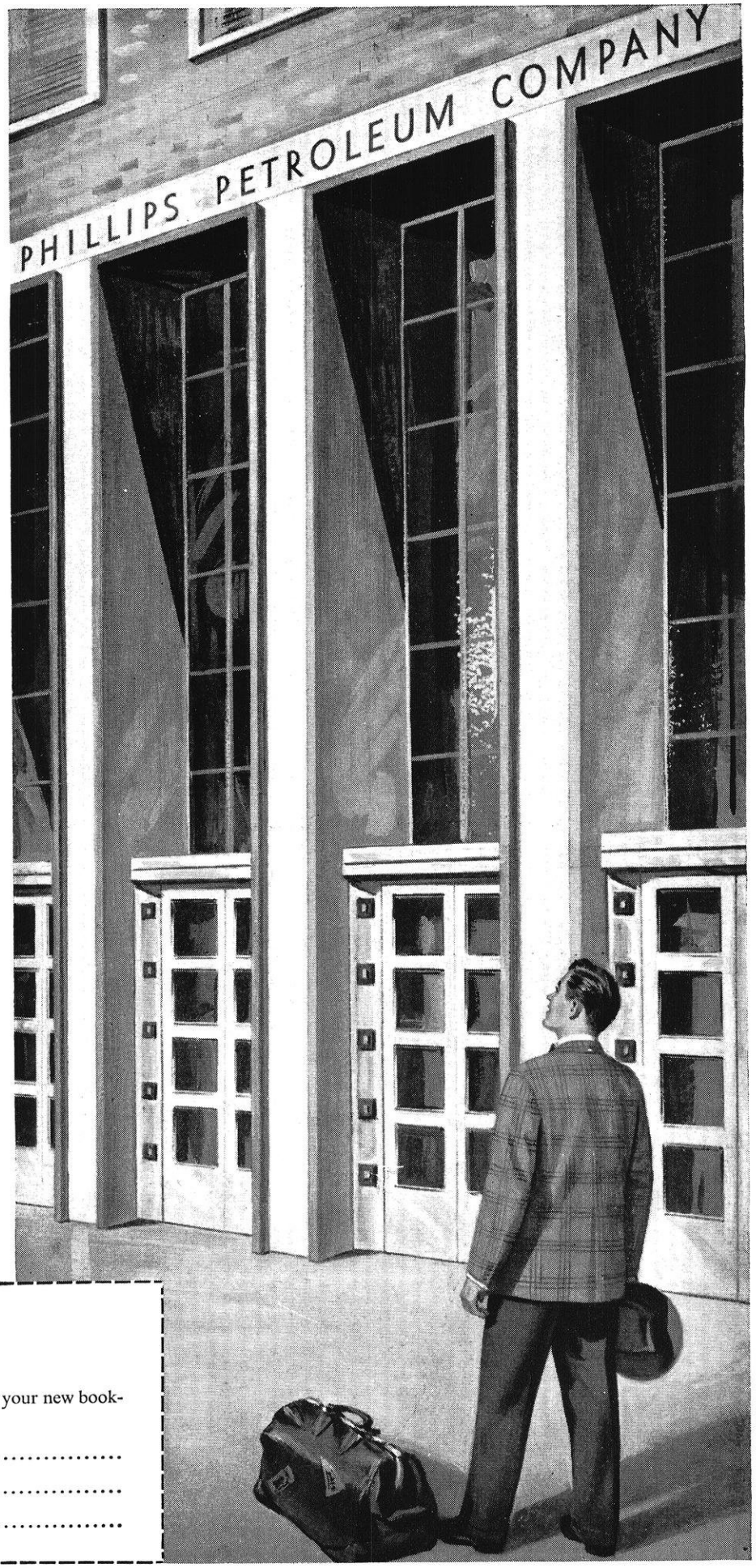

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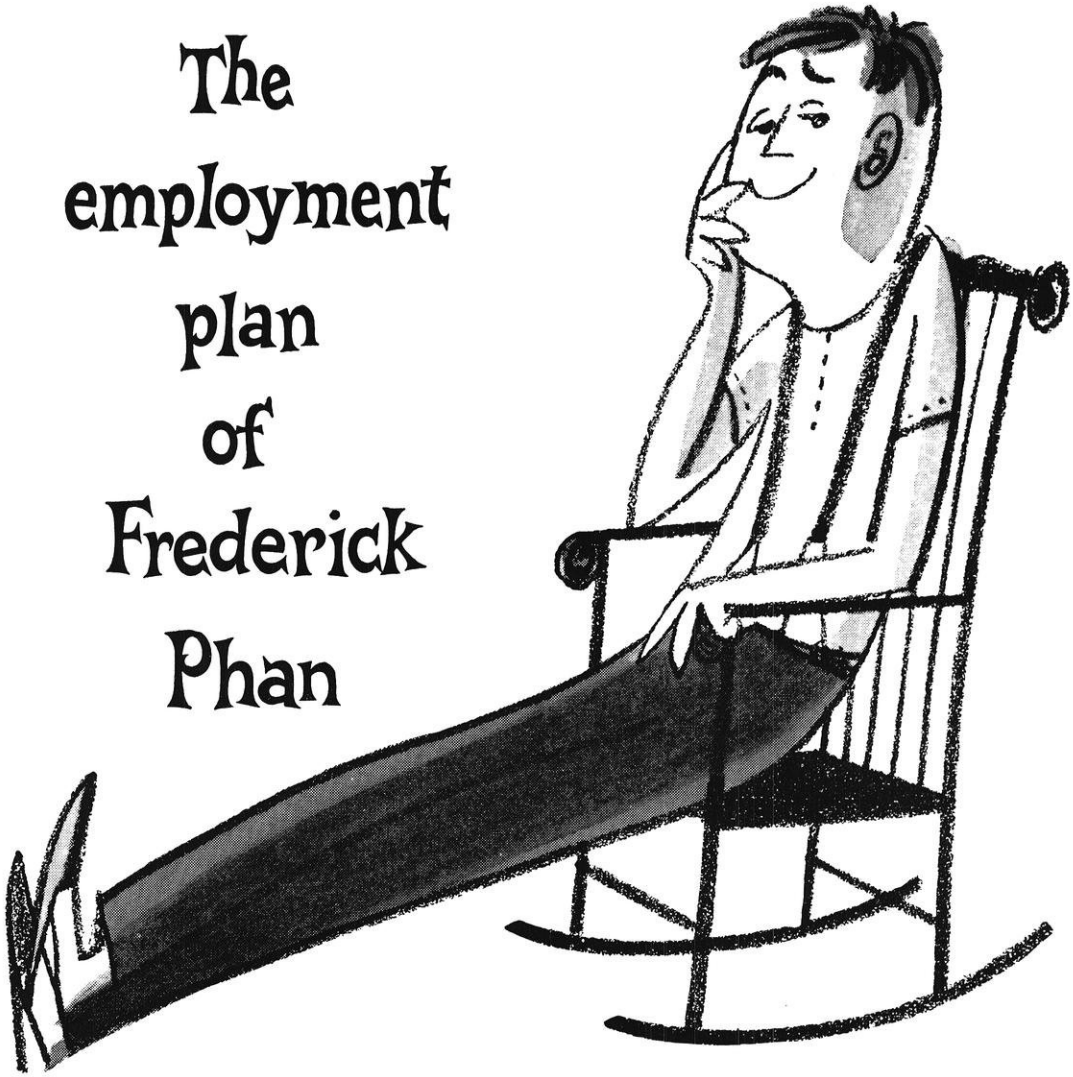
PUBLIC SERVICE ELECTRIC & GAS CO., NEWARK 1, N. J.

The employment plan of Frederick Phan



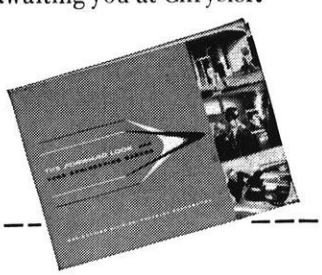
Mr. Phan had a plan. It was really a very simple thing. His idea was to let tomorrow take care of itself. And Mr. Phan, too. People gave Mr. Phan credit for courage but not for such things as groceries, rent and clothing.

Fortunately, most engineers insist on building their own futures. They're not inclined to wear destiny like a millstone. And when they come blessed with a far-ranging spirit and an extra portion of creative ambition, we like to have them with us here at Chrysler.

Engineers so endowed have helped us develop such distinguished automotive *firsts* as push-button driving . . . the first practical automotive gas turbine . . . and many others, all the way back to all-steel body construction and hydraulic brakes. Now they are helping us pioneer beyond the automotive horizon in the dramatic fields of nuclear power and solar energy.

We'd like you to have the facts about an engineering career at Chrysler Corporation. They're all contained in a fully illustrated booklet which you may have absolutely free. Whatever your particular field may be—research, metallurgical, chemical, electrical or mechanical—this booklet will give you a complete rundown on the opportunities awaiting you at Chrysler.

Send for this free booklet today. Use the handy coupon, or simply drop us a card and ask for "The Forward Look and Your Engineering Career."



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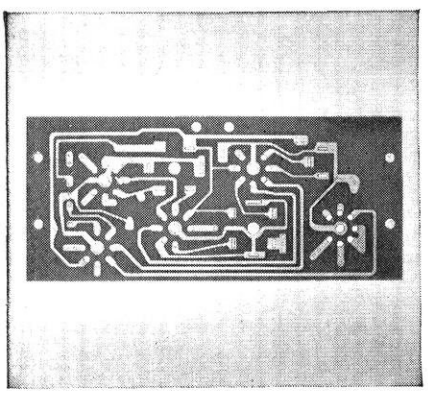
Synthane laminated plastics report for work



Printed circuit for popular television receiver uses a metal-clad Synthane Laminate. Such a circuit eliminates wiring, wiring errors, saves space and weight.

Since the time when the heart of radio was the crystal and cat's whisker, Synthane laminated plastics have been the recommended insulation in the vital and ever expanding communications industry.

Turn on your TV or radio and Synthane goes to work as insulation in coil forms, transformers, tuners, plug-ins, switches, potentiometers, or as the metal-clad base for the entire printed circuit. Synthane also qualifies for important work in radar, sonar and guided missile applications.

Among the varieties of Synthane laminated plastics are several with insulation resistance and dissipation factor capable of controlling TV's high frequencies —even under tropically humid conditions. But Synthane makes over 30 grades—each with its own proportion of useful mechanical, electrical and chemical virtues. You can buy Synthane laminated plastics in sheet, rod and tube form or avail yourself of our complete fabrication service.

We have a number of interesting and informative folders on Synthane properties and applications. A post card will bring them to you promptly. Synthane Corporation, 13 River Road, Oaks, Pa.

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LIGHT WEIGHT

WEAR RESISTANCE

SYNTHANE ...industry's unseen essential

SYNTHANE CORPORATION, 13 RIVER ROAD, OAKS, PA.

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You are making a tough decision . . .

"where shall I start my career . . . which company offers me the best future?"

Your whole career can be affected by your decision, so choose carefully.

We sincerely believe you will make a wise decision in choosing Westinghouse, a company where big and exciting things are happening.

Here you can work with men who are outstanding leaders in fields such as:

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JET-AGE METALS
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and dozens of others

You will have an opportunity to work with a company that is having spectacular growth in many fields . . . giving *you* room to grow.

We value our engineers highly, for we know our growth has been due largely to the high caliber of engineering personnel we have succeeded in attracting. Their development into scientists and managers has resulted in dynamic and progressive planning and policies.

We help you apply your training to industry. You can pick a career in the industry of your choice . . . in the type of work you prefer, and in plants, sales offices and laboratories from the Atlantic to the Pacific. And, you can study for advanced degrees at Company expense.

These are just a few of many reasons why you should choose Westinghouse. If you want more information, ask your Placement Officer for our booklets, or phone or write the Westinghouse interviewer, or Educational Coordinator named below.

Westinghouse

Mr. C. W. Mills
Regional Educational Co-ordinator
Westinghouse Electric Corporation
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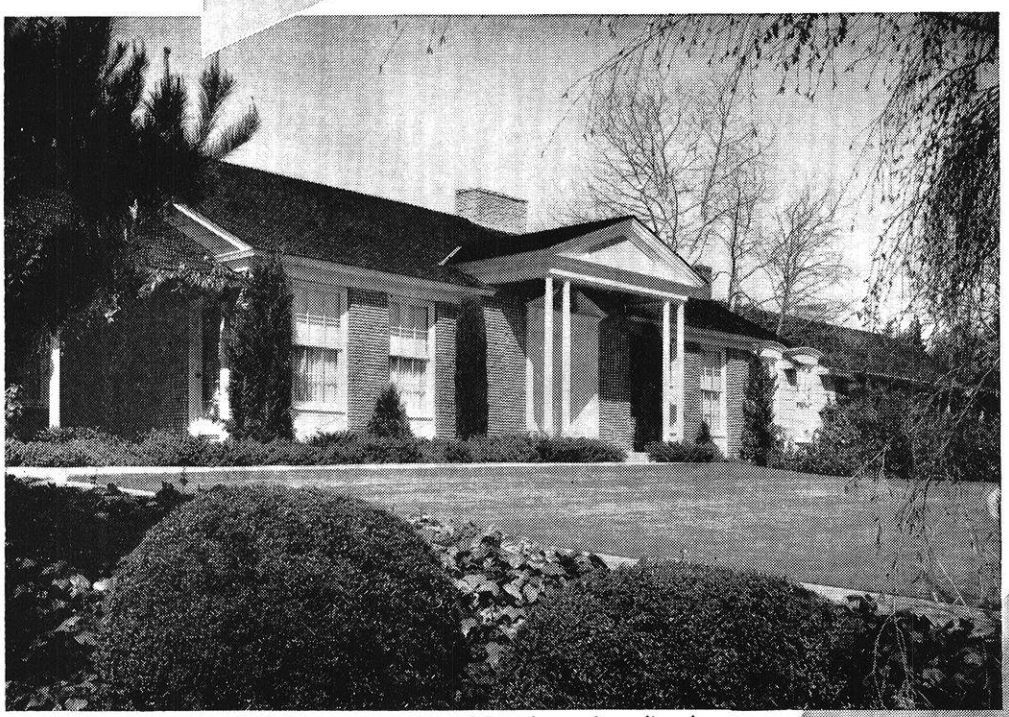
Engineers... Look ten years ahead!



A Douglas engineer lives here

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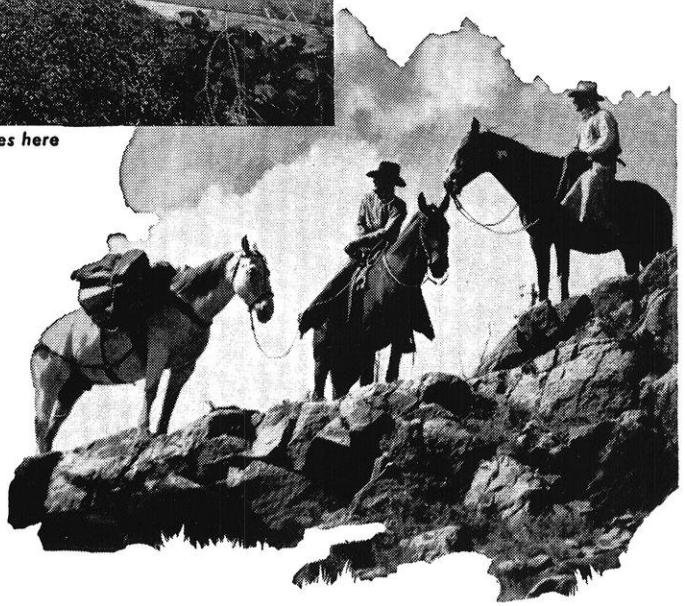

They can...if you start your Douglas career now!

Douglas has many things to offer the career-minded engineer!

...there's the stimulating daily contacts with men who have designed and built some of the world's finest aircraft and missiles!

...there's enough scope to the Douglas operation so a man can select the kind of work he likes best!

...there's security in the company's $2 Billion backlog of military and commercial contracts!

...and there's every prospect that in 10 years you'll be where you want to be professionally, and you'll be in both the income level and geographical location to enjoy life to its full.

Brochures and employment applications are available at your college placement office.

For further information about opportunities with Douglas in Santa Monica, El Segundo and Long Beach, Calif. and Tulsa, Okla., write today to:

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"Engineers like yourselves...

...are finding their widest opportunities in the aircraft industry. Today's accomplishments are merely forerunners of the supersonic and hypersonic aircraft and missiles of tomorrow.

"You're aware of the current demand for engineers, but did you know that the greatest shortage is in the aircraft industry? That's because the challenge of transporting men, materials and armament through the air at constantly increasing speeds involves a greater number of basic sciences than possibly any other field of research and development. In this industry, any area of engineering study offers you a profitable and unlimited future.

"And remember, these engineering opportunities will result in personal satisfaction as well as high returns in salary and security. So between you and me, I'd advise you to consider seriously the aircraft industry as you plan your career."

All across the nation this sound advice is being appreciated by students who are searching for the most promising careers in engineering. With time and space being vastly diminished by today's aircraft and missiles, and by those to come, possibilities for creative engineering at Northrop Aircraft, Inc., are unequalled anywhere.

At Northrop such vital projects as the Snark SM-62, first intercontinental guided missile, and Northrop's new supersonic jet trainer, the world's fastest flying classroom, will continually spark your interest and enthusiasm. Northrop research accomplishments include automatic guidance controls for missiles and manned aircraft, significant advances in the field of boundary layer control, new type materials for strengthening aircraft and missile components, and integrated ground support systems for the most advanced flight equipment.

In Northrop's new multi-million-dollar engineering center you will be working in ideal, modern surroundings with leading engineers and scientists who will encourage your initiative and ideas.

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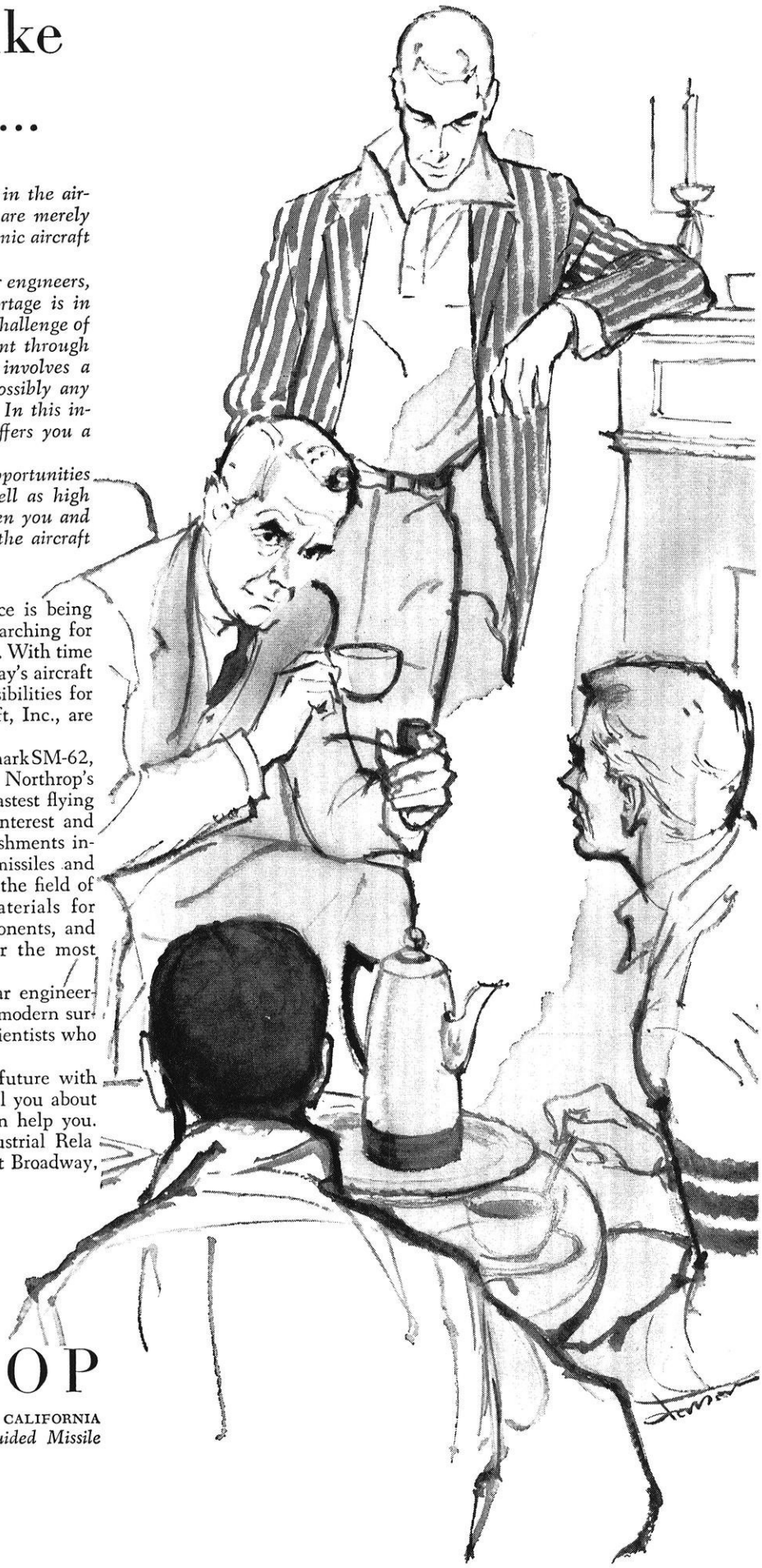

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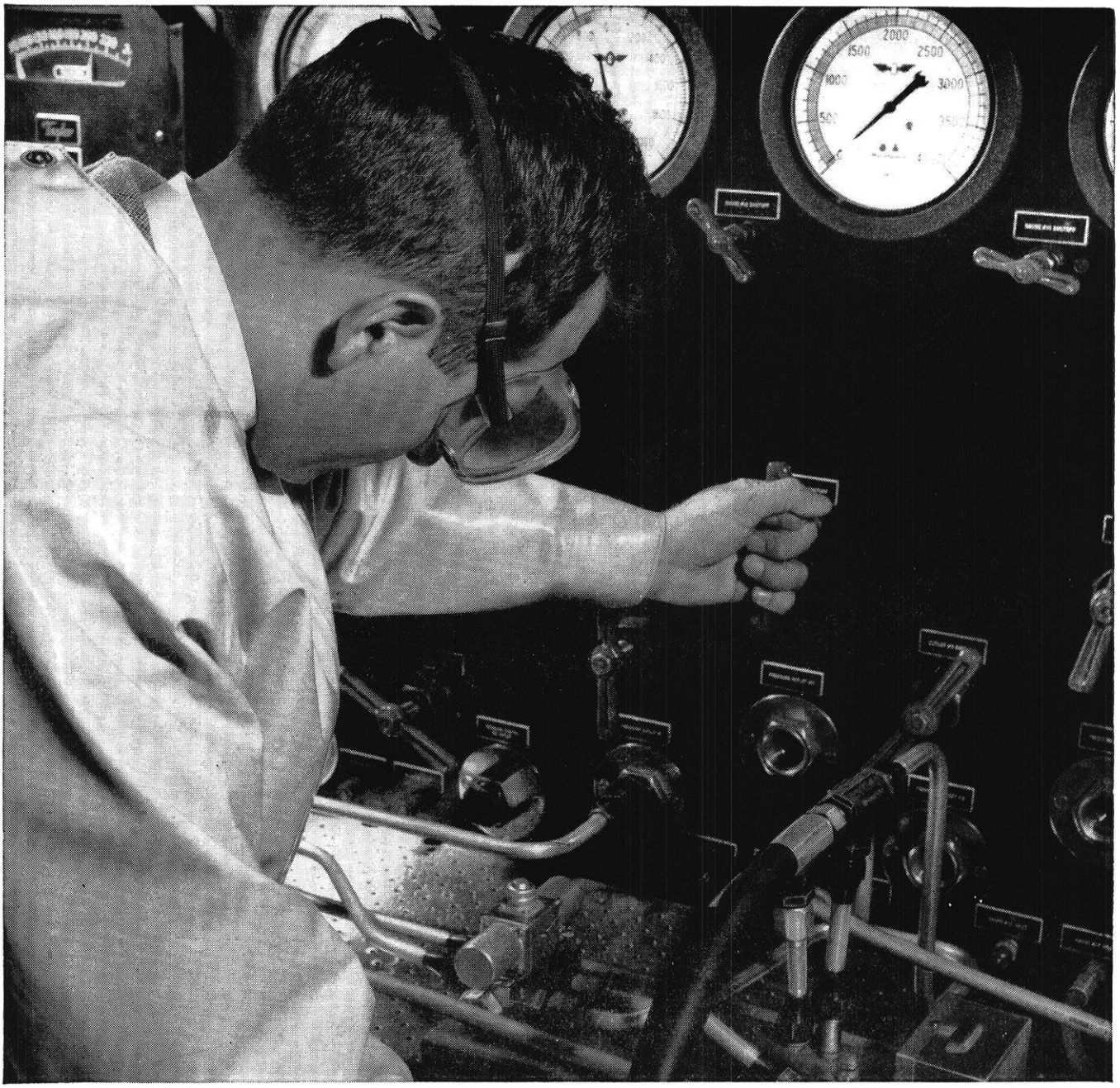

Engineering? Or **IMAGINEERING?**

Many capable engineers are perfectly content to go through life doing routine jobs over and over again. Frankly, such engineers wouldn't be interested in Sperry—and Sperry wouldn't be interested in them!

▪ Engineering, at Sperry, requires a combination of fine technical training plus *imagination* — the desire to help solve anticipated problems of the future and pioneer in new methods and developments. You can see the results of such "imagineering" in the impressive list of Sperry "firsts" in such exciting fields as missiles, inertial guidance, radar, computers, microwaves and gunfire control systems.

▪ A career with Sperry offers many advantages. Good pay, of course. The opportunity to participate in the really important developments of these critical times—working with the acknowledged leaders in their fields. Your choice of location at Sperry plants in Long Island, Florida, California, Virginia and Utah—close to excellent colleges where you can get advanced training *with Sperry paying your full tuition.*

▪ Your Placement Office will tell you the times when Sperry representatives will visit your school. In the meantime, get more of the Sperry story by writing direct to J. W. Dwyer, Sperry Gyroscope Company, Section 1B5.

Sperry engineer tests hydraulic servo valves for high temperature service on jet engines.

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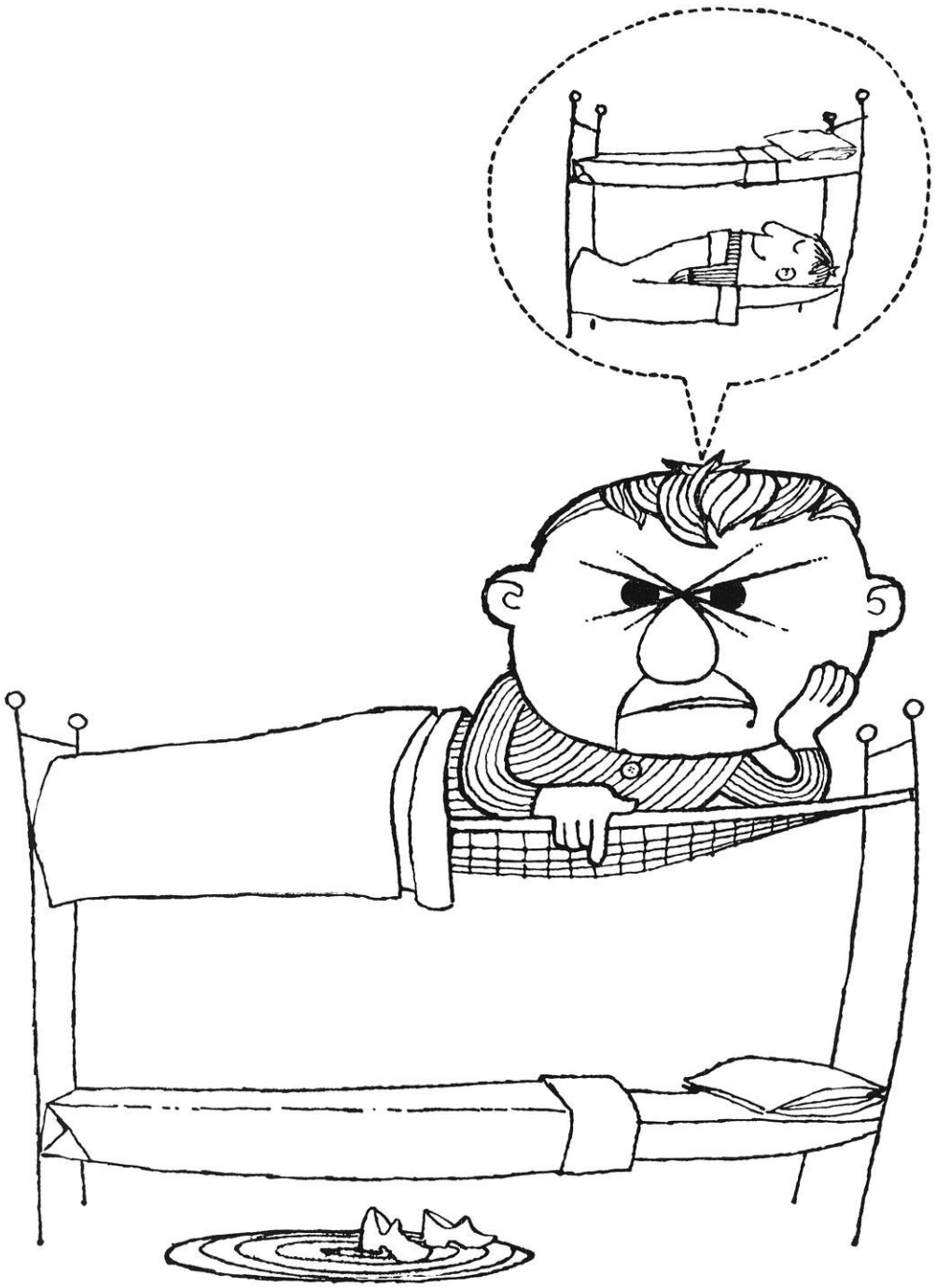


IF YOU'RE THE DISCONTENTED TYPE,

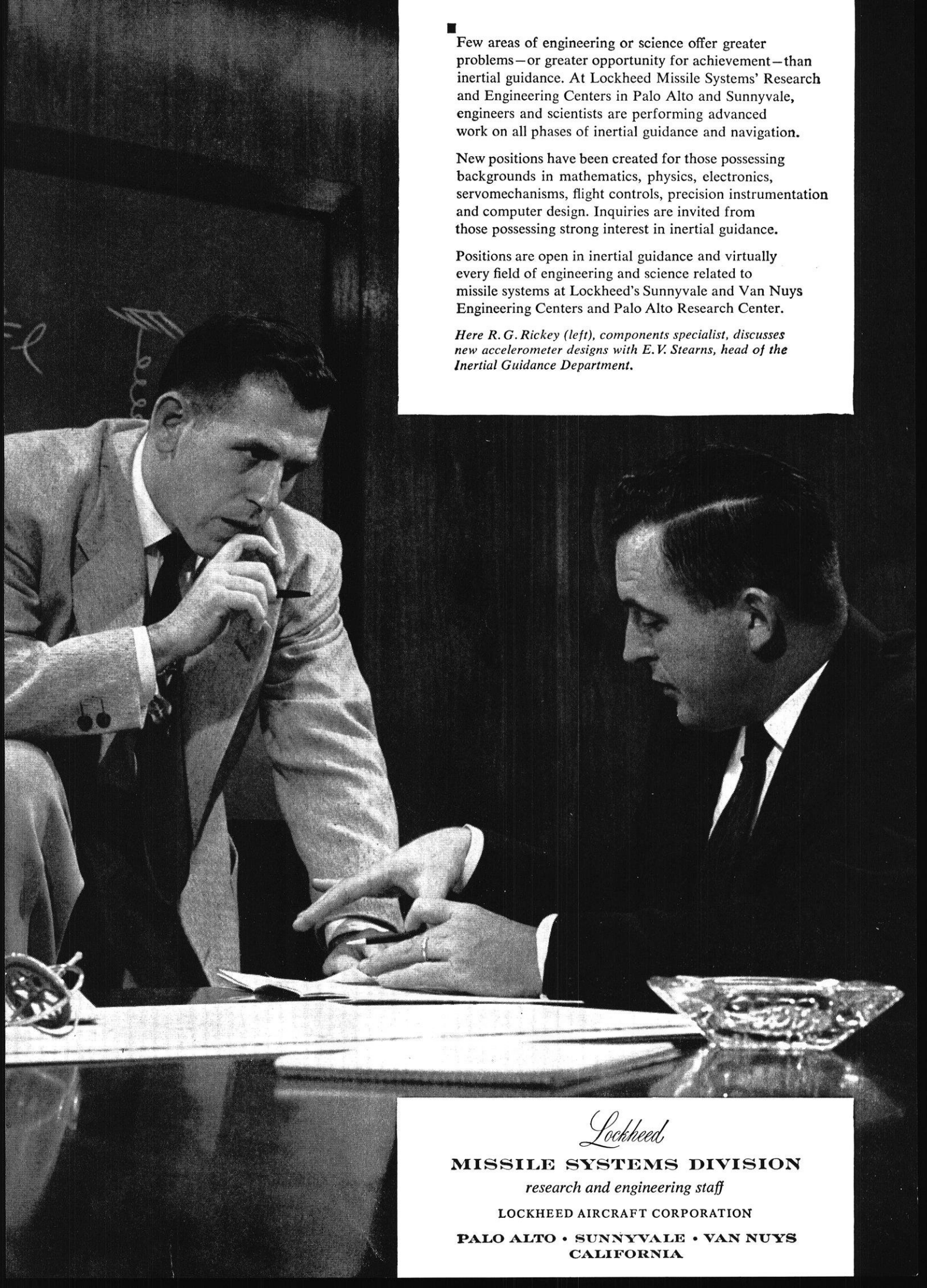
COME TO WORK FOR US!

We want YOU! The kind of engineer who's never contented with the usual, "accepted" way of doing things. The kind of engineer who's always searching for an approach that's new, different, better. The Creative Engineer!

What company offers the most to this "discontented" type of engineer? We believe it is The Standard Oil Company of Ohio! We are engineering-minded. Seven per cent of all our employees are engineers. One-half of the president's staff—our top management—are engineering graduates. Our training programs for engineers are among the most complete in the country. And as a Standard Oil of Ohio engineer, you would be working in one of America's largest and most challenging growth industries—oil!

So before you decide on any company, look into Standard Oil of Ohio—where creative engineering counts! Contact the placement director of your school. Or write Mr. E. G. Glass, Standard Oil Company (Ohio), Midland Building, Cleveland, Ohio.

THE STANDARD OIL COMPANY (OHIO)



Few areas of engineering or science offer greater problems—or greater opportunity for achievement—than inertial guidance. At Lockheed Missile Systems' Research and Engineering Centers in Palo Alto and Sunnyvale, engineers and scientists are performing advanced work on all phases of inertial guidance and navigation.

New positions have been created for those possessing backgrounds in mathematics, physics, electronics, servomechanisms, flight controls, precision instrumentation and computer design. Inquiries are invited from those possessing strong interest in inertial guidance.

Positions are open in inertial guidance and virtually every field of engineering and science related to missile systems at Lockheed's Sunnyvale and Van Nuys Engineering Centers and Palo Alto Research Center.

Here R. G. Rickey (left), components specialist, discusses new accelerometer designs with E. V. Stearns, head of the Inertial Guidance Department.

Lockheed

MISSILE SYSTEMS DIVISION

research and engineering staff

LOCKHEED AIRCRAFT CORPORATION

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Volume 61 MARCH 1957 Number 6

WISCONSIN ENGINEER

The Student Engineer's Magazine

FOUNDED 1896

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Cover

An imaginative sketch by E. Bennett Felix.

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Rambling WITH THE EDITOR

Engineering—What's That

The Meaning of the term "Engineering":

For the past one hundred and thirty years prominent persons have attempted to define the term "Engineering". An early definition by Thomas Tregold (1828) stated that "Engineering is the art of directing the great sources of power in nature for the use and convenience of man." From this rather general concept, many specialized ideas of the meaning of engineering have been developed. We hear of such thoughts as the art of constructing, the art of organizing, the science of economy, the art of efficient dealing with materials and forces and the conscious application of scientific principles. In more recent definitions of the term, engineering is assuming a new ideal of professionalism. This is pointed out in the definition of Ralph J. Smith (1956) when he states that "Engineering is the professional art of applying science to the efficient conversion of natural resources to the benefit of man." We see then, that the term "Engineering" is equally as dynamic and sensitive to change as the subjects it involves. Engineering has evolved into a truly professional art as well as a science for the benefit of mankind.

Engineering in Everyday Life:

Today, the daily life of the average American is unbelievably dependent upon the engineering developments about him. Science and technology have yielded a standard of living unsurpassed by any civilization in history. Faster and safer transportation is within the economic reach of almost every one. We have devices to do the washing of clothes, dishes and floors in our homes. Inexpensive energy is at our disposal for heating, cooking and lighting. We have telephones for convenient communication and radio and television for entertainment and education. Improved sanitation methods including water purification and waste disposal techniques have helped to increase the life expectancy from fifty years in 1900 to seventy years in 1950. Engineers, scientists and inventors have increased production, shortened the working hours and increased the amount of goods available to each person. There are over 500,000 engineers composing the backbone of our industrialized society, working for a better tomorrow through science and technology.

The Student In Engineering:

Preparation for the engineering profession can offer an inspiring challenge to the high school graduate. One has merely to look at the many branches of engineering to see the many and varied choices for future development. Equal opportunities can be found in mechanical, electrical, chemical, metallurgical, aeronautical, civil and nuclear engineering. Today, there is a great demand for young engineers, the compensation for his efforts are high, and his place in society is indisputably essential.

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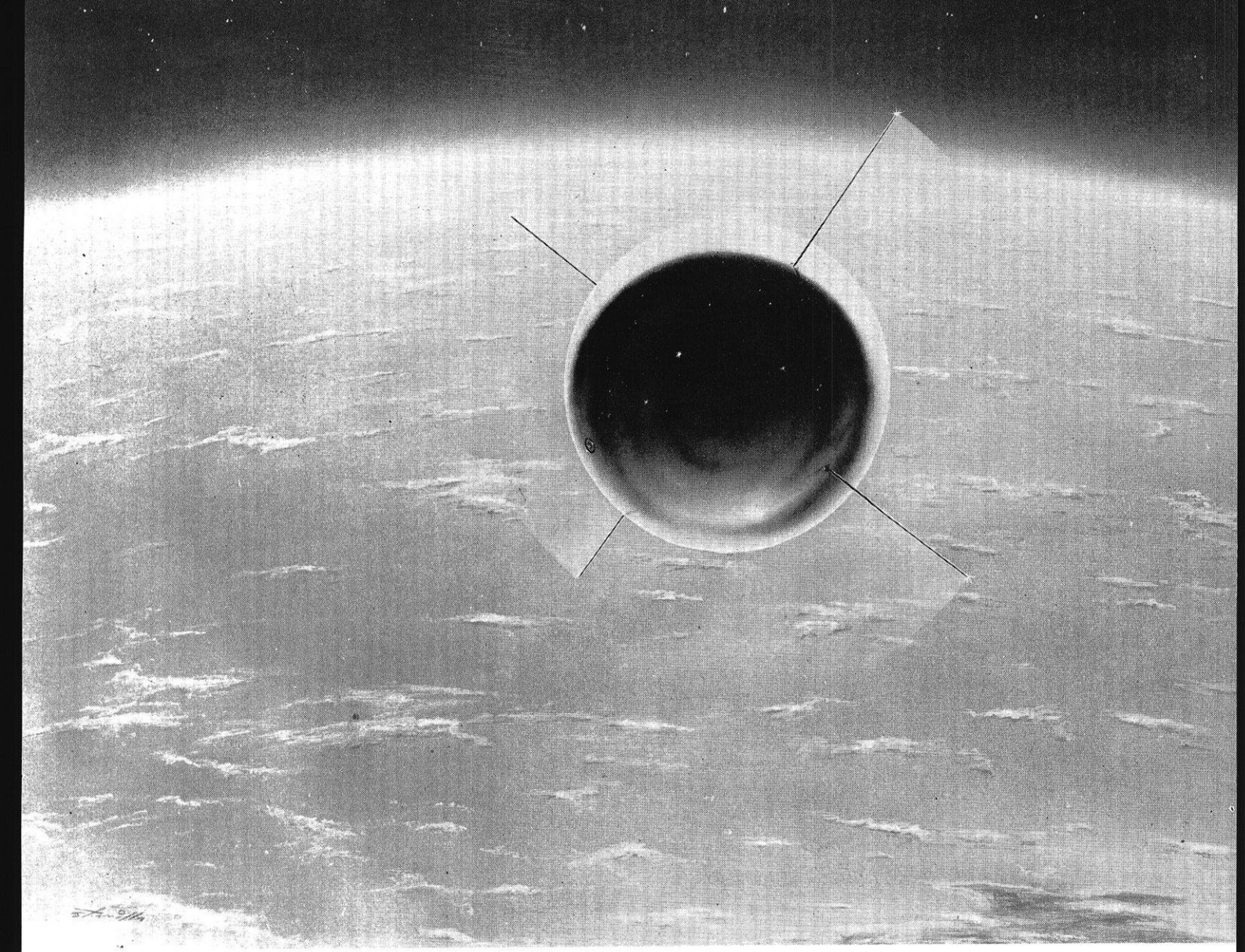


HORIZONS UNLIMITED

The artificial earth satellite, Project Vanguard, is man's first milestone in space. Its inception, structure, and flight plan are discussed in this month's feature article.

by John L. Hilgers e'57

Sometime in the near future a new object will appear in the heavens. It will not be conspicuous like many of our other heavenly bodies, but it will be observable to those who know just when and where to look for it. And as men lift their heads and catch a glimpse of the body racing across the sky, they will feel the excitement of witnessing a great historical event. For the tiny object circling the heavens will be man's first milestone in space—an artificial satellite, an earth-born baby moon shining with the reflected light from the sun.

This small unmanned, earth-circling satellite is part of an integrated, unprecedented plan for the study of man's physical environment which will be conducted

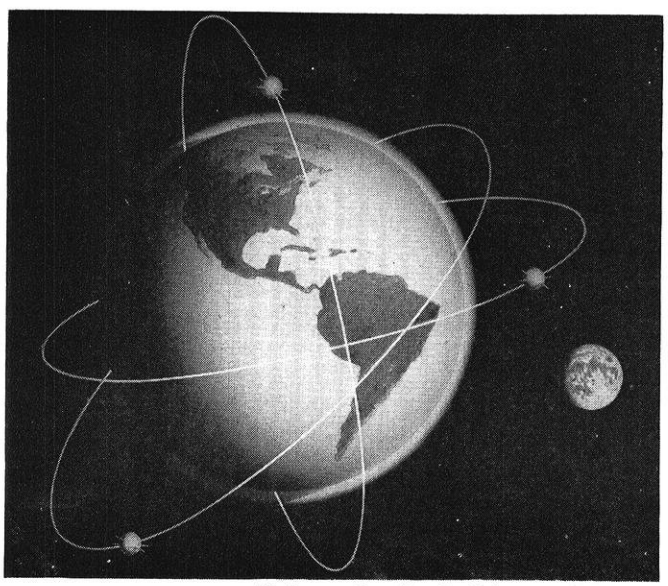
by some forty nations during the period termed the International Geophysical Year, 1957–1958. This eighteen month period has been chosen because it is expected to be an interval of increased solar activity and sunspottedness which have various effects on the earth and its atmosphere.

A solar show of this type will not occur again for eleven years. Only through this world-wide study embracing those fields of geophysics in which observations must be conducted simultaneously over the earth, can we achieve significant progress in our understanding of the earth and its atmosphere.

Because of advanced rocket studies, our scientists became very interested in the satellite proposal, and with President Eisenhower's approval they have gone to work enthusiastically to tackle the problems that a project of this nature presents. The project is now being accomplished under the code name of Project Vanguard, a joint Army–Navy–Air Force program under Navy management. The mission of Project Vanguard is to place satellites, possibly ten in all, in orbits around the earth, to determine the orbits, and to obtain useful scientific information from these satellites.

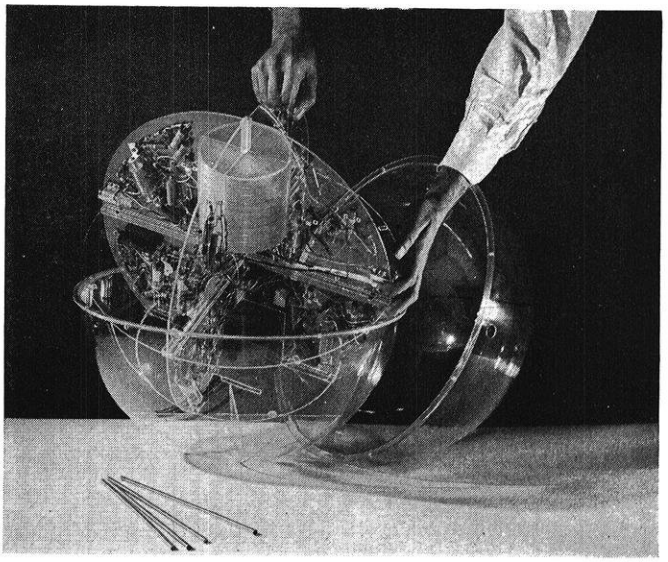
Before discussing the prospective plans and limitations of the satellite program, it is necessary to understand just what scientific information these earth circling vehicles are expected to obtain, since the whole design is centered around the instrumentation required for observing and relaying this information from the satellite to the earth. In general, the possible uses of the satellites as a platform for scientific research are limited only by imagination, but certain basic experiments will be required of the first satellites.

Pressure, temperature, and density readings of the upper atmosphere will be some of the primary measurements. Since the satellite is expected to stay in its orbit for a reasonable length of time, these readings can be taken at intervals over this extended period.



Photos courtesy Popular Science and Martin

Typical orbits for the satellites.



A technician makes last minute adjustments.

This has never been done before. The density of the upper atmosphere will be measured by optically determining the drag on the satellites at their resulting altitudes.

The chemical and ionic composition of the upper atmosphere will be determined by spectrographic and mass spectrometric means.

Radiation studies will be conducted with emphasis on ultraviolet radiation, X-rays, and cosmic rays. The recording of solar spectra will be of utmost importance at these high altitudes since the ultraviolet and X-ray regions of the spectrum are barely visible on the surface of the earth due to their absorption in some of the lower ion layers in the atmosphere. Special attention will be given to the solar spectrum behavior during solar flares.

Tiny meteorites, specks of dust only a few thousandths of an inch in diameter, are constantly bombarding the earth's atmosphere. These particles are called micrometeorites and are believed to contribute to some degree to the ionization of the ionosphere. A satellite will be able to read their first impact and count them by means of scintillation counters.

Measurements will also be conducted via the satellites to determine the effect of the current flow in the ionosphere on the earth's magnetic field.

Finally, the satellites will be used to study the surface of the earth for mapping and for weather prediction.

These studies, which can be made by tracking from the ground by radio and optical means, apply to all satellites. However each satellite will probably have a "personality" all its own. So many research projects have been suggested that no one satellite could possibly carry the necessary instruments for all of them.

Measurement of many of these characteristics has already been achieved by the use of rockets, but they have only been spot checks since the rockets remain in one particular region for only a few minutes, and

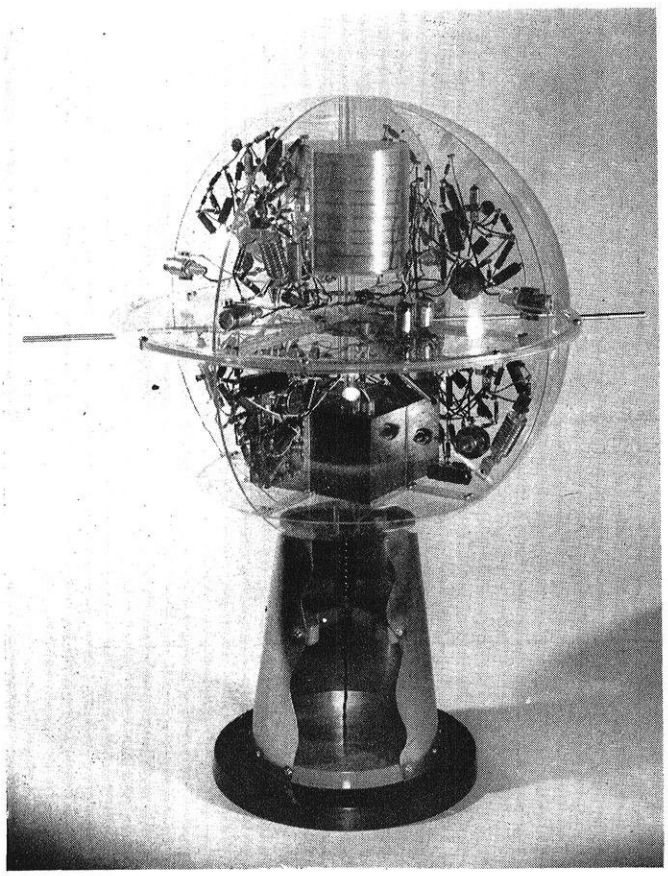
their total time of flight is very short. The long term flight of the satellites, therefore, will be of much greater scientific value. It is felt that a successful experiment in solar ultraviolet radiation alone would be adequate reward for all the heartaches and efforts necessary to put the satellite in flight.

What sort of object will the first satellite be like? It need not be very large to be useful. The size will depend to a great extent on the nose diameter of the rocket which will carry it to its orbit. A sphere twenty inches in diameter appears likely. This is large enough to carry a reasonable amount of instruments, and it would be visible for optical observation even at three hundred miles above the earth.

The spherical shape mentioned above is scientifically desirable. It always presents the same shape surface in the direction of forward movement, no matter how it may spin or turn—an important factor to scientist who will be measuring the air drag on the satellite to obtain accurate data about the density of the air at high altitudes.

The material of the outer shell may be aluminum, thin stainless steel, or plastic coated with a reflecting material. The final choice has yet to be made, but the surface will be of a highly reflecting nature so that under proper conditions, it will be optically observable.

The weight of the "bird", a nickname given to the satellite, is the most critical of the physical characteristics. A maximum value of thirty pounds has been assigned. A brief explanation of how this weight figure was determined will be given later.



The finished model.

Each satellite must carry instruments in order to perform the experiments required of it. The nature of the experiments to be performed by the first "bird" and the equipment needed is still being determined. It is apparent, however, that no means will be available to recover the first satellite and its equipment before it is destroyed in its descent into the dense, lower atmosphere. A transmitter is therefore necessary to radio the information to the ground stations. Such transmitters, as well as the electronic research equipment, will require a power supply. Mercury batteries have been suggested because they give best energy for weight.

Let us consider the problems and limitations encountered in planning and designing the first artificial satellite and its launching equipment.

The first problem is to determine the altitude, velocity, direction, and weight of the sphere in order that this project will produce a satellite instead of a meteorite.

Eleanor Pressly of the National Research Foundation has calculated that a satellite weighing two pounds per square foot of cross section would not girdle the earth even once if it started out with the circular velocity at an altitude of one hundred miles. This short lifetime is due to the intense drag produced by the dense air at this altitude.

At two hundred miles, it would fly about the earth for about fifteen days before falling to the earth; at three hundred miles the atmosphere is so thin that the satellite would stay aloft for almost a year. This means that a thirty pound satellite must be shot two hundred miles or higher if it is to be of any value. A nominal circle of three hundred miles has been chosen as the intended orbit.

In order to achieve this circular orbit and to remain there, the "bird" must have sufficient velocity so that its kinetic *energy* will balance the earth's gravitational *pull.* At a velocity of seven miles per second the object would escape from the earth's gravitational pull and fly off into space. On the other hand, a velocity of, say, four miles per second would allow it to fall closer to the earth on the opposite side from the launching point, giving it an elliptical orbit which it could not long maintain.

The speed required to keep it in a circular path around the earth is estimated to be about five miles per second or over 25,000 feet per second.

Two important directions must also be imparted to the "bird" once it has reached its ultimate altitude. First, it must be propelled in a precisely horizontal direction, or it will again follow an elliptical instead of a circular orbit. Secondly, it must be launched in a precisely calculated and controlled direction with respect to the equator or the poles, so that we may know its

path around the globe and place observing stations accordingly.

Although the weight of the satellite is an important factor in determining the altitude and velocity needed to keep the "bird" in a circular orbit, the importance of its weight becomes more apparent in rocket calculations. It has been proven that, with the best current design techniques, it will take one thousand pounds of power plant, structure, and guidance to place each pound of satellite in an orbit. A balance between economics, available techniques, and equipment needed in the satellite has established the weight to be thirty pounds.

The second main problem is to design and build a rocket which will impart these conditions to the satellite, and to choose the proper and best method of launching.

The primary considerations for determining the type of rocket for Project Vanguard are the number of stages to be used and the choice of vehicle combination.

The first and basic choice is the number of stages. A theoretical analysis of staging shows that, for the same gross weight and payload (weight of satellite), two stages gives a thirty-three per cent velocity gain over one, the gain for three stages is forty-five per cent, and is only seventy per cent for an infinite number of stages. When the added complexity of multistaging is considered, it would appear that any more than three or four stages is difficult to justify.

A one stage rocket that could fly all of the way into the orbit would be the simplest configuration. Such a rocket is not realizable with propulsion that can be obtained now or in the near future through chemical combustion. Therefore, only two- and three-stage combinations, with the reservation that a four-stage would be admissable, have been considered.

The second decision, choice of vehicle combination, refers to the number of stages needed to be guided. This decision can and does influence the character of each stage, its size and complexity and whether it should employ liquid or solid propellants.

The three-stage combination falls into three categories, depending upon the method of guidance, which also has profound influence regarding the ascent trajectory.

In the first system, only the first stage is guided and it provides all of the potential energy to the system. It will reach its coasting zenith at the orbital altitude, and it will furnish only a small part of the circular velocity. The remaining two stages are unguided and will fire in sequence providing the major share of the orbital velocity.

This type of trajectory is inefficient and the first stage would tend to be too large. Furthermore, this system requires high precision in the first stage since any error in pointing is magnified by the high velocity component contributed by the last two unguided stages.

In the second system the first two stages are guided; the third stage is unguided and fires at second-stage zenith.

The third system contemplates guidance in all three stages in a gradual powered ascent to the orbit. The difficulty here is that guidance components must be carried in the third stage where the weight penalties are ten times as great as in the second stage.

Two-stage combinations are derived readily from the three-stage systems described previously. Two categories are considered. In the first, the first stage is guided and provides all of the potential energy. As it orientates itself in the orbital zenith, the second stage is fired, making up the deficit in orbital velocity. This system is fairly simple, but it has not been developed well enough yet.

The second system is now obvious—both stages guided. This would require both stages to be larger, but it would make less demands upon guidance precision.

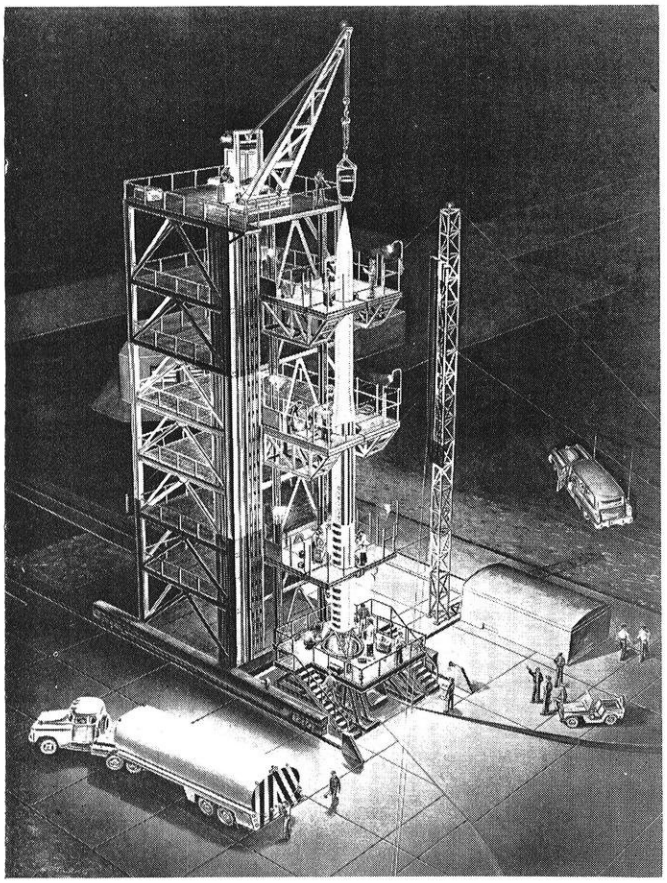
After careful thought and consideration, Project Vanguard has selected a three-stage rocket with the first two stages guided and the third stage unguided as their launching system. It is believed that this system represents the smallest vehicle combination consistent with the present state of rocket development.

The Vanguard rocket has already been designed and is under construction. The composite vehicle is cylindrical and without fins. It is seventy-two feet long with a forty-five inch first stage diameter and a thirty-two inch second-stage diameter. The gross weight ready for launching is approximately 22,000 pounds.

The first stage is a liquid-propellant rocket similar to the Viking, but with substantial improvements. The major components of the first stage are two propellant tanks and a single power plant and accessory section. The tank walls are the external skin of the first stage. The power plant can be tilted, as in the Viking, to control the vehicle's orientation and flight path. Guidance information is obtained from an inertial reference system carried in the second stage, and the major propellants are liquid oxygen and gasoline.

The second stage is a liquid-propellant rocket that attaches to the forward end of the first stage. The propellants, nitric acid, and unsymmetrical dimethylhydrozine are fed directly to the motor from high pressure tanks also intregral with the airframe's skin. The guidance system for the entire vehicle will be in the forward section of this stage.

The second stage also contains the turntable on which the third stage is mounted and which allows the third stage to be spun into stabilization before ejection. Mechanisms and fittings for ejection are also in the forward section of the second stage.



A specially-built ramp is used to aid the technicians.

the earth's surface), and the third stage will be given a spin for stabilization since it contains no guidance system. When the second-stage zenith is reached the third stage will separate and fire. This third stage will contribute the final velocity necessary to maintain the satellite in its orbit. At this point no further control of the vehicle can be exercised. Separation of the satellite and the third stage will occur after third-stage burnout.

Although every possible method is being considered to place the satellite in a circular orbit, it is not likely that this will be accomplished in the first try owing to the accumulation of errors in the second-stage orientation, in sensing the second-stage zenith, and in the third-stage stability. Moreover, the vehicle is being designed to have a final velocity in excess of that required for a circular orbit—this excess represents an essential margin of error. An elliptical orbit will therefore result.

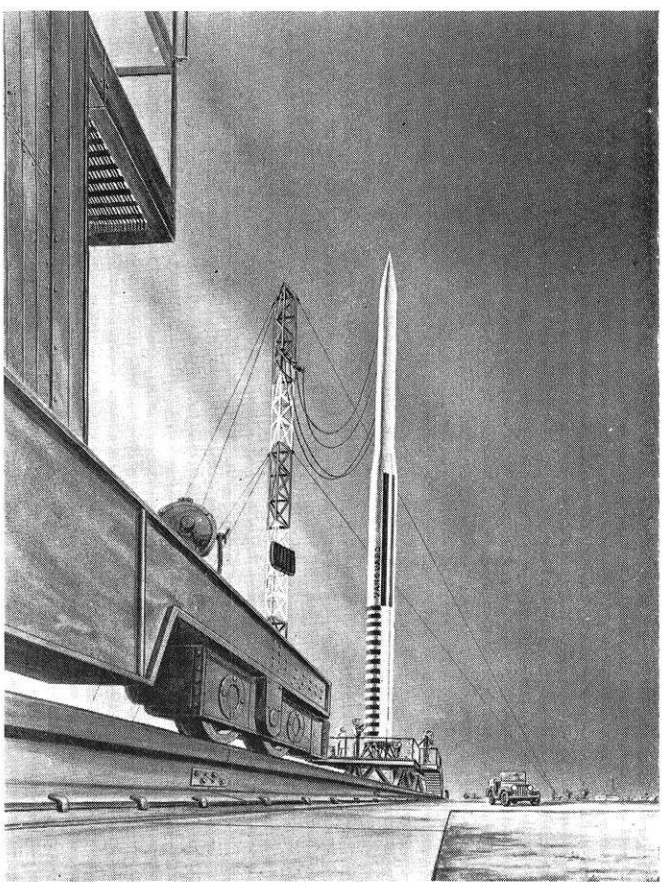
It has been shown that an error of one degree in elevation angle, with proper cutoff velocity, will increase the apogee (point on the elliptical orbit farthest from the earth) and diminish the perigee point (point on the elliptical orbit closest to the earth) by about sixty-five miles. The effect of an error in cutoff velocity, for zero error in elevation angle, will increase the apogee point or decrease the perigee point by sixty nautical miles per one hundred feet per second of ve-

The third stage is a solid-propellant rocket that is unguided. Several propellant formulations are being tested—the final choice has not yet been made. The satellite is attached to the front end of the third stage and may be separated when the orbital velocity has been obtained. It is apparent then that the third stage must reach orbital velocity and, if separated from the payload, will itself become a satellite.

The ascent trajectory for the three-stage Project Vanguard vehicle will be as follows: The rocket will take off vertically under first-stage power. It will ascend in a smooth curve tilting gradually from the vertical in the direction of the intended orbit. At about thirty-six miles above the earth, the first-stage burnout will occur. The rocket at this time will be traveling at an angle of forty-five degrees to the vertical. The first stage will separate; the second stage will immediately ignite and proceed under power to about 140 miles.

At burnout it should have sufficient velocity for ascent to three hundred miles altitude and a horizontal velocity that is about half of the required orbital velocity. No separation will occur at the second-stage burnout; the second-third-stage combination will coast forward a distance of about seven hundred miles in ascending to the three hundred mile mark.

During the coasting period the vehicle will be brought to the correct orientation (roughly parallel to



The ramp is moved away on its track.

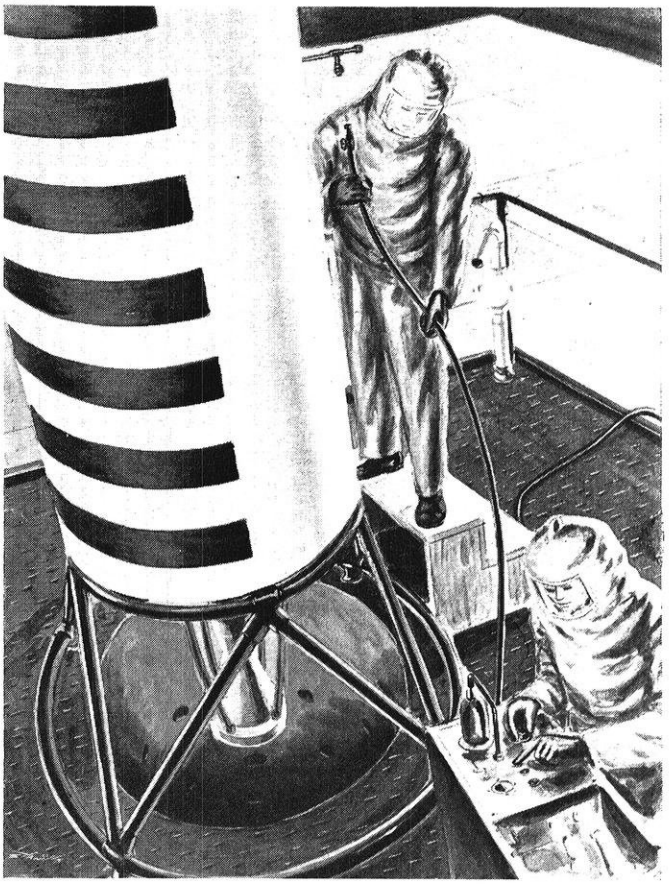
locity error in excess of or less than the required circular velocity.

If the resulting satellite orbit lies within a perigee of two hundred miles and an apogee of 1,400 miles, then the launching vehicle will have accomplished its mission.

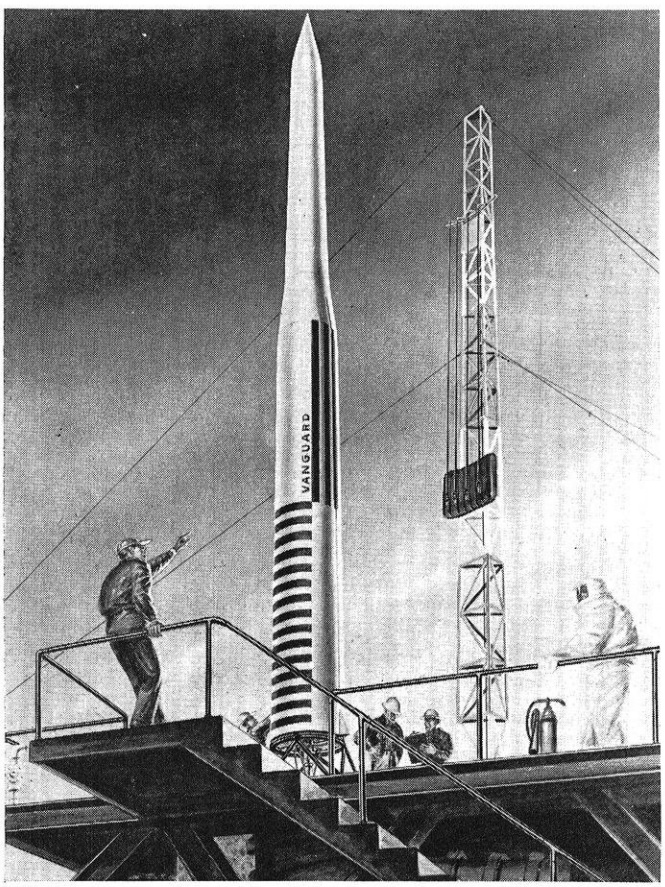
The success of the artificial earth satellites as scientific vehicles will depend largely on the ease and accuracy with which they may be tracked. At the present time there are only two methods of tracking: optical observations and telemetering. Since the life of the batteries used to power the transmitter in the process of telemetering is shorter than the expected life of the satellite and since the success of telemetering requires that we be able to predict its orbit at any particular instant, optical observations will be extremely important.

Optical tracking will not be easy. The orbit of the "bird" will be at an angle to the Equator. Its path will wind in kind of a sine curve back and forth across the equator, and the crossing points will change from one trip to the next because of the earth's rotation.

The satellite's flight will also be influenced by the equatorial bulge (the radius of the globe being thirteen miles longer at the equator than at the poles), for the excess mass will speed it up and shift its path slightly as the object comes closer to the equator. As a result, this man-made moon will come up and go down at different points on the horizon every crossing, and there will be fifteen separate crossings per day.



The fueling is done last.



A last-minute check is made.

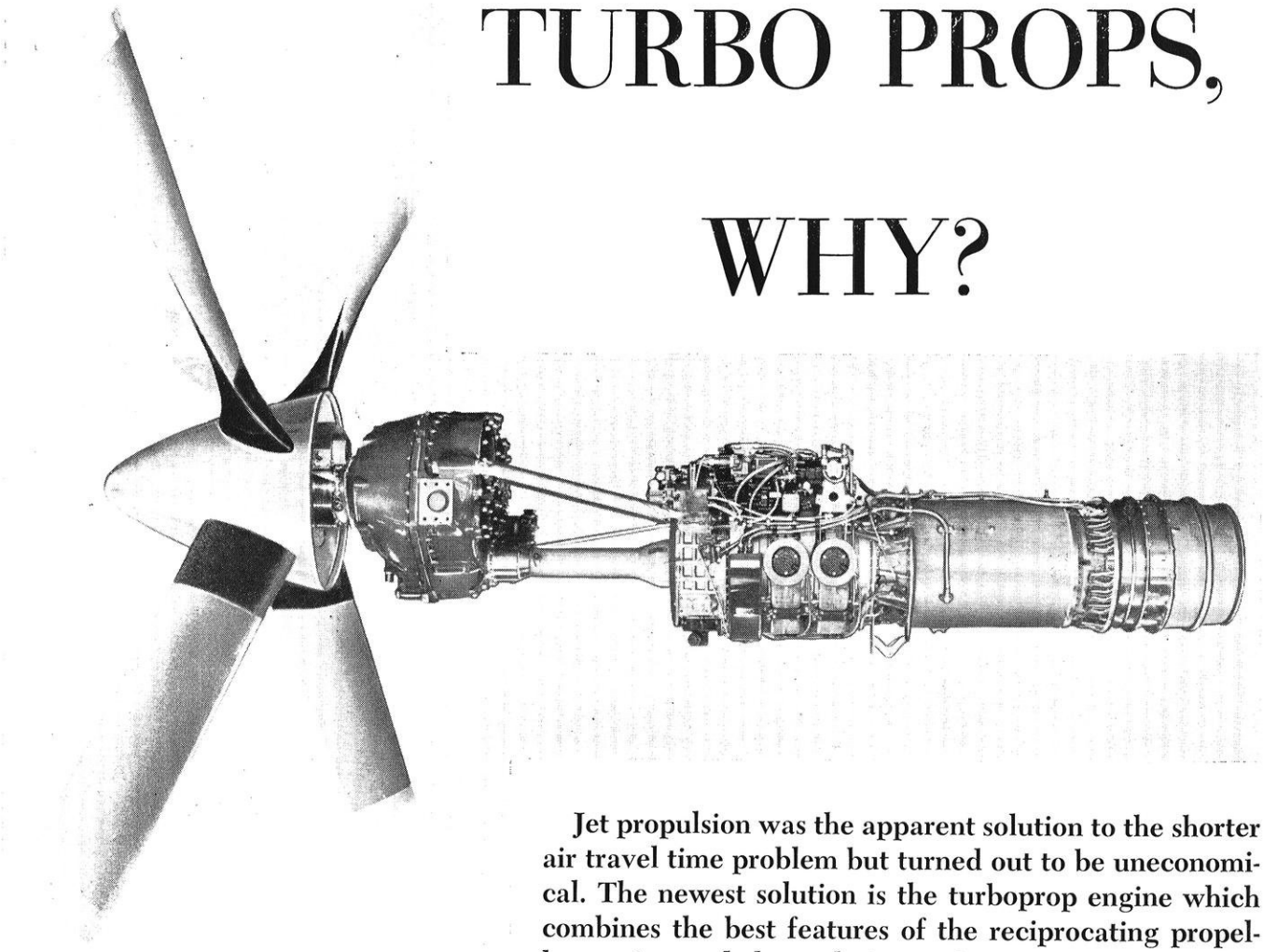
It is estimated that the satellite will swing only as far north as the thirty-fifth or possibly the fortieth Parallel, which runs westward through Philadelphia to a point north of San Francisco. The best observing conditions in terms of sky transparency will be generally at latitudes approximately plus or minus thirty degrees. Hence it will be desirable to place chains of observing stations around the earth at these two latitudes.

But even the inhabitants of these zones of visibility cannot expect to see the new heavenly body as regularly as they see our natural moon, for it can be seen only when it passes overhead at twilight, morning or evening. The average station will probably have an opportunity to observe the satellite during a morning or evening twilight period approximately once a week.

The satellite surface, as mentioned previously, will be shiny, and hence will shine with light reflected from the sun. At best, however, the light will not be bright —merely equivalent to that of a sixth-magnitude star; the dimmest star visible to the unaided eye. Further-

(Continued on page 84)

TURBO PROPS, WHY?



Jet propulsion was the apparent solution to the shorter air travel time problem but turned out to be uneconomical. The newest solution is the turboprop engine which combines the best features of the reciprocating propeller engine and the turbojet engine.

by Fred Wensing m'58

In this vast world, with nations and cities separated by vast stretches of land, mountains, and water, the need for fast economical travel is apparent. At present, the fastest way to travel is by air in modern propeller driven airplanes. Due to the period or age we live in, people are always seeking methods and machines by which travel time can be decreased.

With the development of jet propulsion, a solution appeared to be found, but it was then discovered that jet propelled aircraft were not the best economical solution. Similar to the jet engine, due to the power plant, is the turboprop engine. This type of power plant seems to fulfill the requirements necessary to power our modern transport planes.

At the present time, the people backing the turboprop engine are fighting for its existence in this apparent jet age. This article will try to explain the turboprop engine and describe the fight this potential industry is making to establish itself as the best mode of traveling by air.

The following steps will be covered in order to show the effort being made by the aircraft people to develop the turboprop engine as a power plant for present day air travel:

1. A general description of the turboprop engine.
2. Development of the turboprop engine.
3. Comparison with other types of engines.
4. A general historical picture of this engine.

The turboprop engine is essentially a gas turbine which rotates a shaft upon which a propeller is attached. There are three basic power plants, the single shaft turboprop, the free turbine turboprop, and the dual rotor turboprop.

Each turboprop engine has five main components: speed reduction mechanism, compressor, combustion chambers, turbine, and propeller.

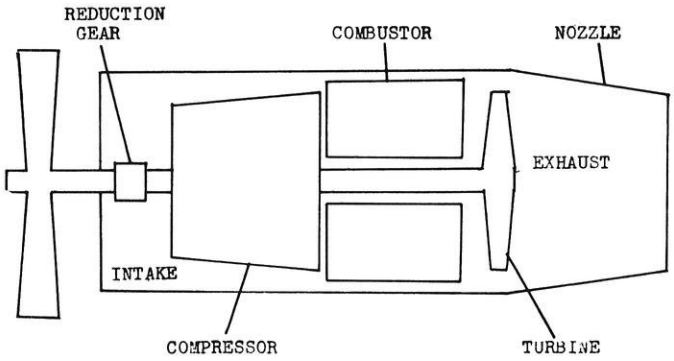


Fig. 1.—Single shaft turboprop.

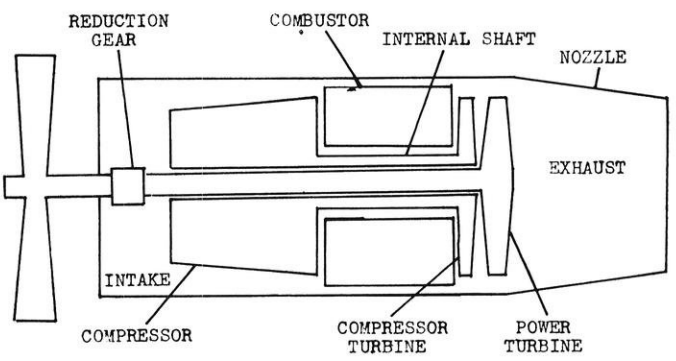


Fig. 2.—Free turbine turboprop.

The power section shaft speed of 13,820 rpm is reduced to the rated prop shaft speed of 1,106 rpm by a 12.5 to 1 reduction. Speed stepdown occurs in two stages: a primary of 3.125 to 1 by spur gear and a secondary of 4.0 to 1 by planetary gearing. The reduction gear housing is cast magnesium and has a total weight of about 450 lbs.

More than 30 lbs. of air per second is handled by the 14 stage axial flow compressor at a compression ratio exceeding 9 to 1 at rated power and standard sea level conditions. Compressor wheel, blades, and stators are made of steel.

The combustor has six stainless steel liners in a one-piece outer shell. There are two igniters in diametrically opposed liners.

The turbine is a four-stage unit. The first three stages of the four stainless steel wheels carry cast GMR–235 blades. The last stage has 8–816 blades. The stator blades also are cast GMR–235.

A three blade propeller is used on this engine. The propeller has a diameter of 13.5 feet. The propeller regulator is mounted on the rear of hub, rotates with it and incorporates a self-contained hydraulic system with integral governing. The propeller spinner incorporates de-icing and anti-icing by means of rubber boots on the spinner shell.

The engine has a total weight of 1,610 pounds. The length is 145 in. and has a 27 in. width. The frontal area of the engine is 6 square feet.

It is necessary now to learn how power is obtained from a turboprop engine for propelling an aircraft. First, air is drawn in the front of the engine and passed to the compressor. Then it is compressed and delivered to the combustion section of the gas turbine. Here fuel is added and the mixture of fuel and compressed air is burned.

Energy released by the expanding gases is absorbed by the turbine which in turn converts the energy to shaft horsepower and drives the propeller (through the reduction gear-box, the compressor, and the engine accessories.) About 10% of the turboprop engine's propulsive force is jet-thrust, but the remainder comes from the propeller.

The use of the turboprop engine in military planes at the present time has not been very extensive. This is due to the fact that the Defense Department is more concerned with speed than with economy. One factor which has led the Services to become interested in the turboprop engine is the fact that jet propelled planes require large airfields for take-off and landing purposes. These airfields have to be extremely large when used by large jet transport planes.

When a plane takes off, it requires a given amount of thrust, which is less than the thrust available at the plane's cruising speed. The difference between the available thrust and the required thrust is the thrust useable for climb or acceleration.

Because of the propeller characteristics, the turboprop engine will have two to three times the thrust of the turbojet available for take-off, where both have the same air handling capacity through the engine. This extra available thrust enables turboprop planes to take off and land at airports inaccessible to turbojet planes.

This factor is very important to the military services because of the volume of necessary manpower, equipment, and supplies that are shipped by planes to places that have small airfields.

Due to the tremendous effort that has been made in developing the components of a turbojet engine, it has been found that much of this work can benefit the turboprop engine. Thus by jet propulsion research and development, if better turbine blade cooling can be

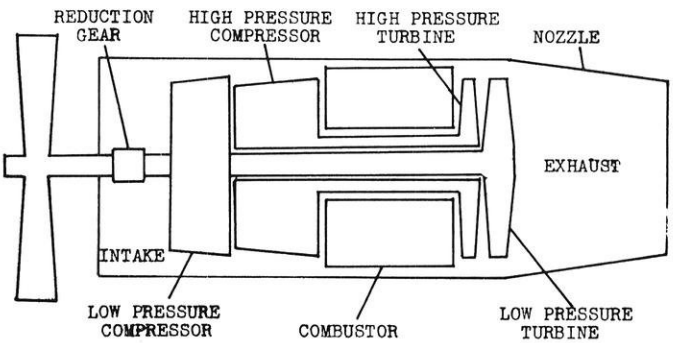


Fig. 3.—Dual rotor turboprop.

Planes which are now using turboprop engines.

had and better compressor and turbine efficiencies obtained, and also by decreasing the weight of the turboprop, even greater advantages can be obtained from the turboprop engine.

When the jet transports were developed for the military services, it was figured that the same type of plane could be used by the airline companies. Most airline flights are of the short variety (500 miles and under), and with jet transports it is necessary to fly at high altitudes in order to obtain the best economy. Thus for short flights the jet transports would not be flying long enough at high altitudes to justify their use. Therefore, the plane did not work out, and the airlines still were looking for a new plane that was faster, more flexible, and more economical than the transports presently used. This need was the opening that the people who were backing the turboprop engine were looking for.

At present, most of the large companies in the aircraft industry are developing turboprop engines and designing planes on which these engines can be placed. One company has also designed and built conversion kits in order that two of its present models can have their present piston engine replaced with turboprop engines.

This conversion kit is estimated to cost approximately $300,000. This may seem like a large cost, but it would provide an airline with a turboprop plane for about half the cost of a new fully equipped plane.

The building of turboprop airplanes for private use is still in the future. Turboprop planes for the individual owner will be possible when the development of turboprop engines has advanced much further. This advancement in development should proceed very rapidly with both the military services and airlines showing great interest in turboprop planes, and with the growing competition in the aircraft industry to fill these demands.

In order to make this comparison, two types of engines will be compared with the turboprop engine: the compounded reciprocating engine and the turbojet engine. These comparisons are based on comparable engines.

At present, the compounded reciprocating engine is used on most standard transport planes. When used on such planes, its top speed is approximately 360 miles per hour; with the same plane equipped with turboprop engines, top speed would be about 460 miles per hour. This will give approximately 100 miles per hour increase in air speed. This figure can be increased as better propellers are developed.

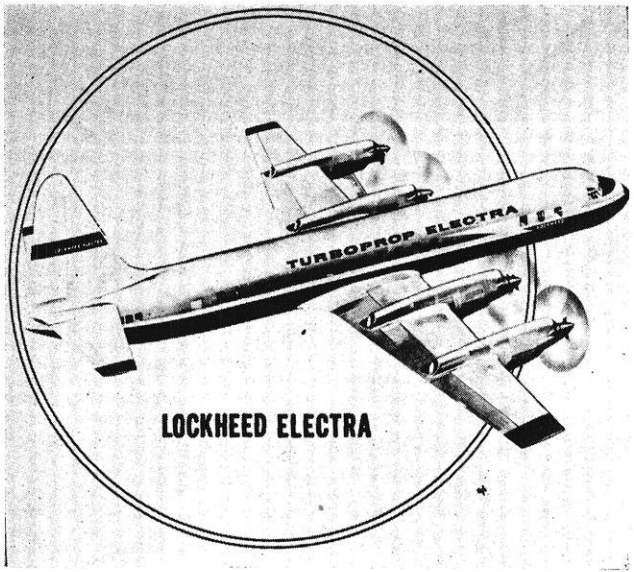
Although the turboprop engine has a slightly higher fuel consumption rate, the range of the turboprop transport will be greater due to the increase in load capacity that it will be able to carry.

With the development of the turboprop engine, the fuel consumption rate has been steadily decreasing. In the near future, it is conceivable that the fuel rate will be better than it is possible to obtain with the standard compounded reciprocating engine. Along with the fuel consumption, it is necessary to consider the cost of the fuel. In the turboprop engine, it is possible to use cheaper fuel, which will cut down the cost of fuel compared to that for the compounded reciprocating engine.

In the compounded reciprocating engine the power output is limited to about 4,000 shaft horsepower. With the turboprop engine, it is estimated that it will be possible to increase the power per engine to about 15,000 shaft horsepower. With this increase in power per engine, it will enable the building of faster and larger airplanes without increasing the number of nacelles beyond the optimum.

This increase in power per engine also gives the planes more power for quicker and shorter takeoffs and landings. By increasing the size of the aircraft, more passengers and cargo can be carried at reduced cost.

Comparing the weight of the two engines, it is found that the turboprop engines are more attractive because they provide high power in relatively small and light weight packages. For example, turboprop engines now



Planes which are now using turboprop engines.

flying produce well over two shaft horsepower for each pound of engine weight, whereas the best reciprocating engines deliver slightly better than one shaft horsepower per pound of engine weight.

In the turboprop engine, it is possible to ues some of the compressed air from the compressor for cabin pressurization and aircraft de-icing and as a power source for driving auxiliary equipment. With the standard type engine, additional electrical motors are necessary to perform these tasks.

The turboprop engine also has a reduced noise and vibration level which results in greater comfort to the passengers and crew and less maintenance.

Further comparing the turboprop and turbojet engines, it is already known that at present the turbojet has greater possibilities as far as speed is concerned, present day turbojets having speeds in excess of the speed of sound. Although the turbojet is faster, it also has a greater fuel consumption rate. The low fuel rate of the turboprop engine is obtained at lower altitudes, which reduces the development problems involved in flying transport planes at 40,000 feet and above. Because of its lower fuel consumption, also, the range of the turboprop-powered transport of a specified gross weight will be nearly twice that of the turbojet-powered transport of similar weight.

As previously mentioned, the turboprop engine has more thrust available for takeoffs than the turbojet engine. This higher propulsion efficiency during takeoffs and the use of the propellers for braking during landings permit safe operation of the turboprop off shorter length runways. Under present conditions, the turbojet transport is limited to certain airfields because of the space needed for takeoffs and landings.

Another feature of the turboprop is the reversability of the propellers which makes possible aborted takeoffs and landings in icy runways.

Another comparison between the turboprop and the turbojet engines is the amount of noise caused by the gases as they leave the jet nozzle. In the turboprop engine, the velocity of the gases as they leave the jet nozzle is much lower than that of the turbojet; therefore, the turbojet is considerably more noisy. Because of this noise, the jet transports have been barred from landing at airports around New York City.

Because of the propeller, propeller shaft, and speed reduction mechanism, the turboprop engine is considerably heavier than the turbojet engine. It is also more complicated and more awkward to install in an aircraft.

It can be observed by the comparisons made with the two types of engines that the turboprop-powered transport has great possibilities, especially when one considers that most of the development of the turboprop engine has taken place in the last few years. At present, it is only possible to guess at the real potential of the turboprop engine.

When gas turbines were first developed for the propulsion of aircraft, the turboprop engine was placed on the shelf in favor of the pure jet engine. This was during World War II and the preceding conflicts, which demanded planes that could fly at very high speeds. Therefore, the pure jet engine was developed as fast as possible.

The turboprop engine has now been removed from the shelf and the aircraft industry has been pushing its development. This has come about by the failure of the jet transport to fill all the requirements specified by the military services and airlines. It has been found that turboprop transports will provide the qualities that are required, such as increased speeds, better economy, greater flexibility, less noise (than jet), less vibration (than reciprocating engine), and improved landing and takeoff qualities.

In the future, the turboprop engine may become an even more important power plant than at present. By improving turbine and compressor efficiencies, reducing the weight of the engine, and developing better blades, the advantages of the turboprop engine should continue to grow. **THE END**

SCIENCE HIGH-

Edited by Ted Witzel e'57

POST-FREE SPACE

A spectacular timber dome just completed at Bozeman, Mont., is the latest recordbreaker among wood structures being built throughout the country to provide large areas of post-free space for spectator sports.

With a 300-foot diameter, the main arena of Montana State College's new physical education center passes all records for long span in buildings of glued laminated timber construction, according to the National Lumber Manufacturers Association.

Large enough for football and baseball practice, the building seats up to 15,000 persons for other sports.

The dome structure is a dramatic webbing of glued laminated arches and purlins soaring to 90 feet at the center. It rests on columns standing outside the perimeter wall of the area. Lumber required for the dome system, which was fabricated and erected by Timber Structures, Inc., amounted to 150,000 board feet, or enough to build 15 average size homes. The giant arches were manufactured in segments 51 feet long and shipped by rail.

Economy was a major factor in selecting glued laminated wood construction, according to the architects, Fred Willson and Oswald Berg, Jr., of Bozeman, since the nearest bid in another material was nine per cent higher.

"Other factors in favor of wood were its beauty in its final form and color, low maintenance, fire resistance of heavy timber construction, permanency and ease of erection," they reported. "Still other points we had to consider were humidity effects on the structure, dimensional stability and changing temperatures, elimination of painting maintenance by prestaining, time factors in erection and availability of material."

Construction of the arena met a fast-paced nine-month schedule so that it could be ready for the opening of the 1957 basketball season. Erection of the dome itself took only ten weeks. The arches were assembled on the ground in pairs with purlins, sub-purlins and cross bracing in place. The pie-cut shaped sections were then hoisted to position by two 100-foot boom cranes.

In addition to practical values, the timber dome system produced a structure of classic lines and esthetic appeal on both exterior and interior. This is acknowledged as one of the most difficult problems confronting architects in designing fieldhouses for the nation's schools and colleges. Glued laminated construction is currently being used for many types of large buildings, including sports arenas, schools, churches, hangars, warehouses and supermarkets.

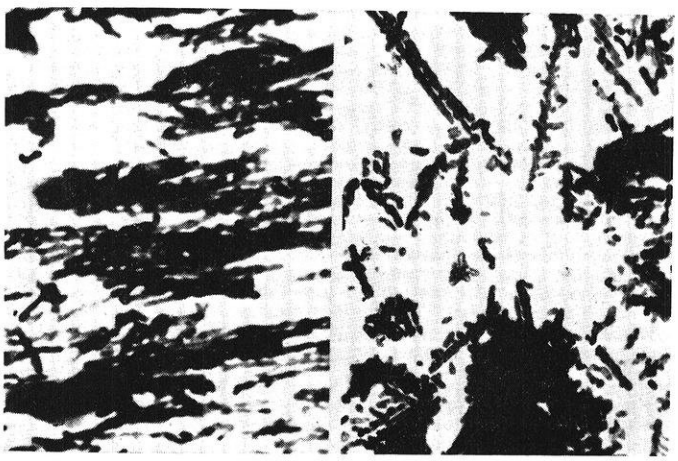
Timbers of glued laminated Douglas fir presented a dramatic pattern of structure and shadow as Timber Structures, Inc., roofed this building in time for the 1957 basketball season. It's the main arena of Montana State College's new physical education center at Bozeman, Mont. World's widest span timber structure, the arena is 300 feet in diameter. Giant wood arches rise to 90 feet at center.

MAGNETIC LOG JAM

Working with invisible iron "dust," General Electric researchers have created a revolutionary and potentially super-strong magnet.

Dr. T. O. Paine, of the company's Instrument Department told

LIGHTS



Magnetic Log Jam—Iron "dust," used by General Electric in making of new magnet, is shown under powerful electron microscope, magnified 100,000 times. This new material derives potential super-strength from researchers' ability to "break up" the magnetic log jam (left) and line up the minuscule particles (right) to achieve optimum strength.

the American Association for the Advancement of Science that the unique properties of this magnet are achieved by precisely controlling the size and shape of individual iron particles so small that there are more than a billion billion in a pound.

Dr. Paine said that, theoretically, the ultra-fine particle iron magnet can be made ten times stronger than the best available magnets. Already experimental magnets have been made equal to the strongest commercial magnets, he added.

The new magnet will result in electric instruments that are smaller, lighter, more accurate and more rugged, making possible significant advances in instrumentation. It will help us make better photographic exposure meters, aircraft instruments and other products using permanent magnets.

This development opens whole new vistas to the design engineer because the iron particles can be embedded in plastics, metal, rubber or glass. The magnets are easily machined, drilled, tapped, soldered, and molded precisely into any desired shape.

Ordinary iron is used in the form of sub-microscopic elongated particles to make the new magnet. This leads to another far-reaching benefit, the saving of strategic metals like nickel and cobalt—heavily used in making most magnets. Elimination of cobalt makes possible the application of magnets in nuclear reactors, where magnets containing cobalt cannot be used because of high induced radioactivity.

SPECIAL ULTRAVIOLET CLOSED-CIRCUIT TV SYSTEM PROVIDES IMMEDIATE COMPARATIVE DATA ON LIVE NORMAL AND CANCER CELLS

A new application of closed-circuit television that provides immediate comparative data of chemical activity within live normal and cancer cells was reported recently.

The new technique, made possible by a developmental RCA ultra-violet-sensitive TV camera tube, is undergoing experimental examination at the National Institutes of Health, Bethesda, Maryland.

The RCA ultraviolet TV system is being used with a high-power microscope and an electronic oscilloscope to obtain direct observations and oscillographic measurements of the metabolism of living cells, according to Dr. George Z. Williams, Chief of the NIH Clinical Pathology Department.

The successful application of ultraviolet television to medical microscopy and oscillographic spectroscopy, Dr. Williams said, gives promise of new speed and facility in the analysis of cells and tissue. The system introduces numerous advances in cell research:

1. For the first time, it enables researchers to observe and take motion pictures, simultaneously, of chemical activity within living cells.

2. It makes possible microscopic study and analysis of hundreds of living cells in only a fraction of the time formerly required.

3. It makes possible direct observation and rapid, accurate measurement and identification of certain chemical changes within the cells.

"The ultraviolet television-microscope-oscillographic system has proven of value in studies of living cellular material and possesses definite advantages over other available techniques. The shortened exposure to the narrow bands of ultra-violet reduces cell

damage and avoids artificial absorption changes. Direct observation facilitates rapid search of large numbers of cells and other material, and provides better selection of desirable specimens for oscillographic and other studies."

The overall ultraviolet equipment chain, devised by Dr. Williams, includes an ultraviolet light source, a high-power microscope, the RCA broadcast TV camera with ultraviolet camera tube, a monitor, an oscilloscope, and various motion picture cameras for filming images on both the TV monitor and the oscilloscope.

In operation, the ultraviolet light source is focused on the specimen under the microscope. The RCA camera is mounted so that it "peers" through the eye-piece of the microscope. Sensitive to ultraviolet, it "sees" and transmits to the monitor an image of the cell and the action and reaction of its ultraviolet-absorbing chemicals, both those normal to the cell and those induced artifically or by disease.

"In its present stage of experimentation," Dr. Williams said, "the ultraviolet television-microscope system must be considered as a developmental technique, but one which holds important implications for future medical research. It offers significant possibilities also as an important diagnostic medium, for rapid determination of the nature of a diseased cell by direct ultraviolet TV observation and measurement of the rate, scope, and shape of abnormal chemical changes." (For P.A.M.H.)

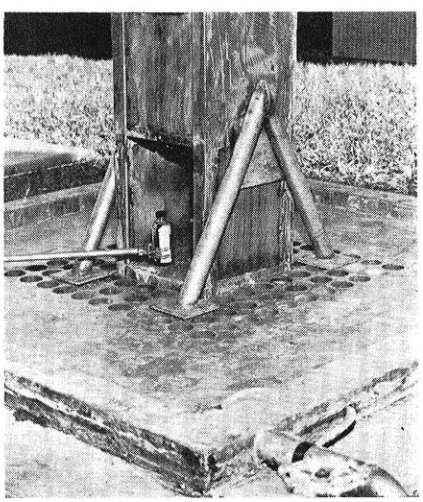
UNUSUAL GAMMA IRRADIATION FACILITY IN OPERATION

A new gamma irradiation unit has recently been placed in operation by the Radioisotope Department of the Operations Division at Oak Ridge National Laboratory. The new unit makes space available in the sub-surface Cobalt–60 storage installation for irradiation of materials in an intense gamma field. One feature of the new unit is that samples can be irradiated in air rather than under water, as is done with many gamma irradiation devices now in operation.

Cobalt–60 decays with a half-life of 5.3 years. This new facility is designed to utilize the radiation energy from Cobalt–60 slugs awaiting shipment to customers. Under normal storage procedure the benefit of this radiation would otherwise be lost. The radiation field from 85,000 curies of Cobalt–60 now stored in the unit has been measured at 1,100,000 roentgens per hour. Since it is expected that the amount of Cobalt–60 in storage will vary between 85,000 curies and 300,000 curies, the gamma field will be recalibrated as the loading changes.

Materials to be irradiated are placed in a 10–1/2 in. by 10–1/2 in. by 12 in. space at the bottom of a 5–1/2 ft. long concrete shielding plug. Access to the space is through a maximum clear opening of 8–1/2 in. by 8–1/2 in. cross-section. Once samples have been inserted in the compartment at the base of this plug it is lowered into the unit and these samples are exposed to the intense radiation field. Samples requiring special connections, as in a circulating loop system, cannot be irradiated at the present time because of the design of the shielding plug. However, two tubes are provided in the plug for leads to instruments in the irradiation zone.

The Cobalt–60 slugs are stored in ninety-two stainless steel tubes arranged in a square pattern surrounding the irradiation chamber. The entire unit is below ground, with a top shield composed of high density concrete and lead. Removal of the heat generated by absorption of radiation in the tubes, shield, and samples being irradiated is accomplished by an air stream flowing through the plenum around the tubes. It is estimated that almost 5,000 watts, or enough to heat two rooms or an average house, will be generated by the radiation heating at a loading of 300,000 curies.

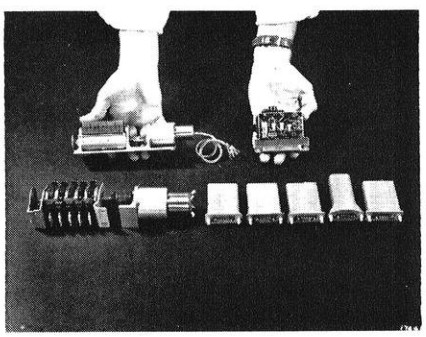


This new gamma irradiation unit was recently placed in operation at Oak Ridge National Laboratory.

AIRBORNE COMPUTERS REDUCE

Airborne computers, the devices that from radar information predict target position and direct guns accordingly, are on a weight and size reduction program.

The Westinghouse Electronic Tubeless Analog Computer (WETAC) is a typical example. A major element of this computer, the instrument servo, consists of an amplifier, a servo motor, gear box, and a bank of potentiometers.



New computer components.

Weight of the servo amplifier was reduced from 33 to 4 ounces. The new all-transistorized amplifier replaces five molded units using vacuum tubes. The transistors are silicon to operate through a wider temperature range, and the amplifier also employs a feed-back loop to correct for any temperature deviations in transistor characteristics. Another advantage of the transistorized circuit is the low power consumption. This is especially true during nulls, when the power consumption of the transistorized amplifier is about

one watt—the previous system required 40 watts.

Size reduction was also aided by fewer total components—39 for the original version to 24 for the transistor servo. This includes such items as resistors, capacitors, diodes, and transformers. For example, six tubes in the original version have been replaced by five transistors.

SCIENTISTS USE 'WHISKERS' TO STUDY FORCES BETWEEN ATOMS

One of modern science's oddities —highly pure and perfect metal crystals known as "whiskers"—are enabling scientists to gain new insight into the enormous forces which bind atoms together.

In a paper delivered during the seventh New York meeting of the American Association for the Advancement of Science, Dr. R. L. Eisner, Westinghouse research physicist, described a new technique for evaluating these forces by measuring the tensile strength of whiskers of iron and silicon.

Dr. Eisner's technique is one of the most accurate methods known for pulling apart the tiny crystals and measuring directly the applied stress and the amount of strain they undergo. Precise, delicate equipment is required, Dr. Eisner said, because the tiny strands of metal may be 40 millionths of an inch or less in diameter—about one hundredth the thickness of a human hair. Use of the method, the Westinghouse scientist reported, has cast new light on the nature of the interatomic forces which give all metals their ultimate strength.

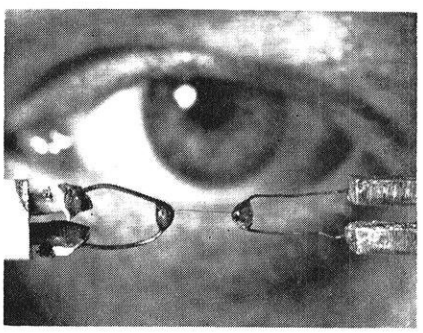
"In whiskers, a metal exists in a perfect condition," Dr. Eisner said. "In contrast, any ordinary piece of metal contains countless millions of structural imperfections. Under stress, it is these imperfections which govern how and when the metal will break. They mask any attempt to measure the much larger forces which hold the metal atoms themselves together.

"By conducting tensile tests on whiskers, where these imperfections do not exist, we can pull the individual atoms far enough apart, without breaking, to get a measure of the interatomic forces. This enables us, for the first time, to check modern theories of interatomic forces."

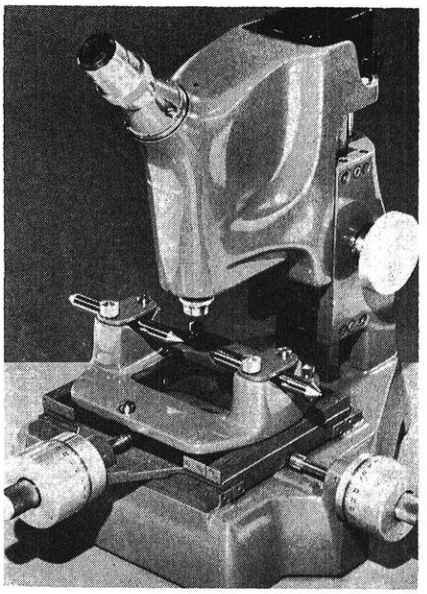
In Dr. Eisner's whisker experiments, only a small force—less than one hundredth of an ounce—is required to pull the average whisker apart. This force, which must be controlled and measured with unusual accuracy, is obtained by a light-weight pendulum about 12 feet long. The whisker is "clamped" between the bob of the pendulum and a special "take-up" screw. As the screw is tightened, the whisker pulls the pendulum from its vertical position. Each millionth of an ounce of pull displaces the handling pendulum exactly the same amount—about one ten-thousandth of an inch.

The stretch of the tiny whisker is measured by reflecting a beam of light from flat optical mirrors attached to the clamps at each end of the whisker, to form an "interference pattern." As the whisker stretches, the mirrors move and cause changes in the pattern similar to the changing "rainbow" colors seen in soap bubbles or thin films of oil. These changes are electronically amplified and analyzed to disclose the amount of stretch. The technique accurately measures changes in whisker length down to less than one millionth of an inch.

"Our experiments reveal considerable data about interatomic forces," Dr. Eisner said. "We have found that, freed of the limitation imposed by impurities and imperfections, these forces give iron a strength of more than half a million pounds per square inch.



Scientists use "whiskers".



Toolmakers and machinists will use the new Bausch & Lomb Toolmaker's Measuring Microscope for fast, accurate measurement of jigs, templates, tools and all types of finished parts.

NEW MICROSCOPE FOR TOOLMAKERS AND MACHINISTS ANNOUNCED

A new microscope for use by machinists and toolmakers in the inspection and measurement of tools, drill jigs, templates and finished parts has been announced by the Bausch & Lomb Optical Co.

Called a Toolmaker's Measuring Microscope, the new instrument offers significant improvements over existing shop microscopes. According to the manufacturer, it provides versatility, convenience, sturdiness and accuracy previously unavailable in its price bracket.

Major advance lies in a unique illuminating system. The illumination source is built-in and the beam of light is directed down through the microscope objective, giving true vertical illumination. A collective mirror under the stage plate reflects the light back into the body tube. As a result, both the surface and the contour of parts may be viewed simultaneously.

Standard magnification is 35X, but different objective and eyepiece combinations may be used to obtain other magnifications. A 7/5X protractor eyepiece, and centers which can be aligned with the eyepiece cross-hair are available for increasing the versatility of the instrument. THE END

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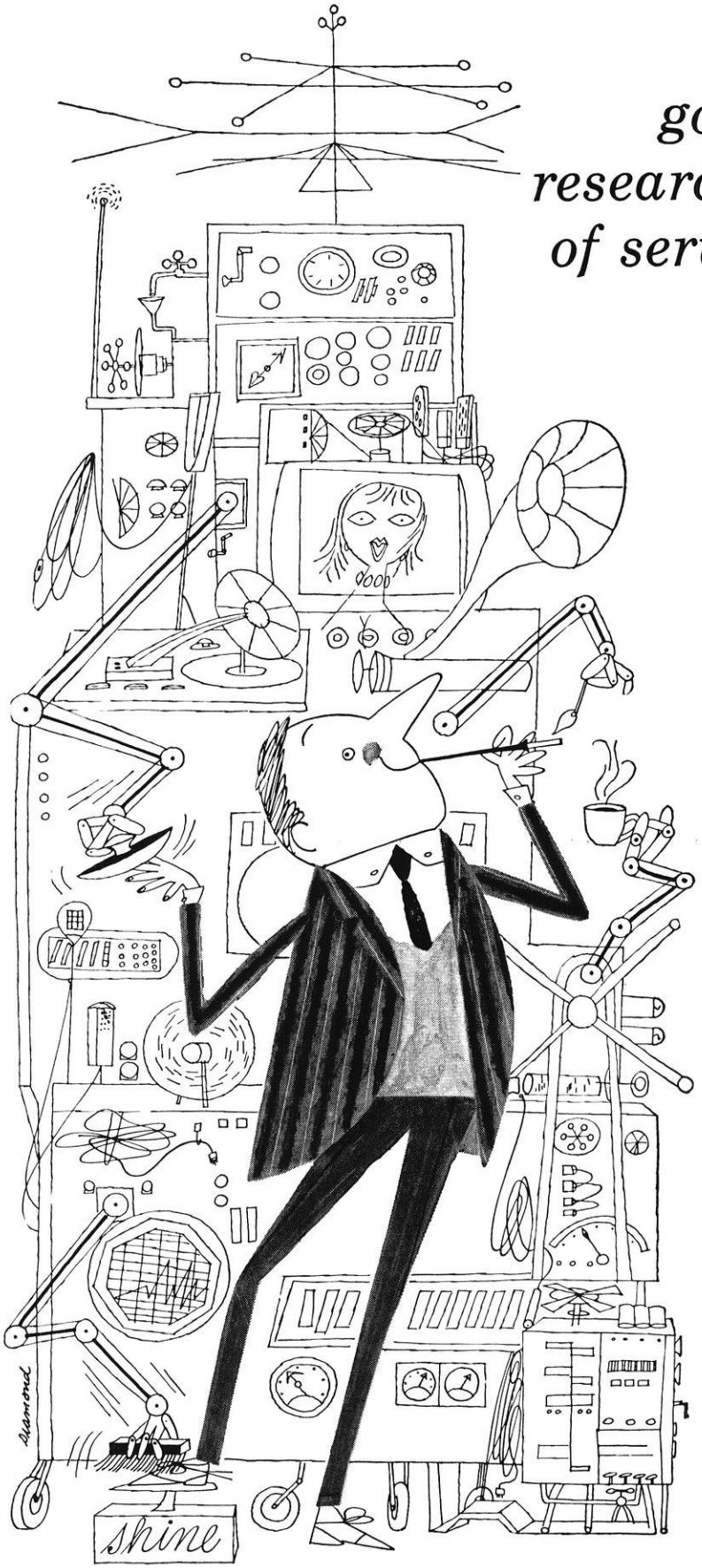

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ENGINE EARS

by Pete DeWitt che'60

DR. KNIGHT GETS AWARD

In the Glycerine Research Awards Contest third award ($200 and honor plaque) was won by Dr. Stanley G. Knight, University of Wisconsin professor of bacteriology, for his research establishing glycerine triacetate (triacetin) as a new fungicide (*Glycerine Facts*, December 15, 1956). In evaluation studies of triacetin ointments and lotions as fungistatic agents, 58 out of 80 patients afflicted with superficial fungus and allied infections of the skin, nails and scalp were cured, and most of the remaining patients showed definite improvement.

HUGHES ANNOUNCES WORK-STUDY PLAN FOR UNDER-GRADS

Start of a work-study program for engineering undergraduates, with full payment of college tuition and related expenses for students while they work part-time in their chosen fields, was announced today by Hughes Aircraft Company, Culver City, Calif.

Hughes, largest electronics manufacturer in the West, produces electronic armament control systems used in U. S. and Canadian all-weather jet interceptors, as well as the Falcon guided missile and commercial products. Under its scholarship program, established in 1953, the company currently has nearly 900 employees studying for bachelor's and master's degrees, plus another 20 studying for doctorates.

Cooperating in the new program, called the Hughes Work-Study Program for Undergraduate Engineers, are Loyola University of Los Angeles, the University of Southern California and the University of California at Los Angeles.

Applications are being accepted only in writing and should be addressed to Hughes Aircraft Company, Training Dept., Box 45426, Airport Station, Los Angeles, Calif. Information is also available at the Training Department office at 2060 East Imperial Highway, El Segundo.

NATIONAL ELECTRONICS CONFERENCE FELLOWSHIP

A $2,500 fellowship for graduate study in electronics has been established by the National Electronics Conference.

The colleges and universities participating in the program are Illinois Institute of Technology, Northwestern University, and University of Illinois as sponsors, and Michigan State, Purdue, Michigan, Notre Dame, and Wisconsin as cooperating institutions.

The sponsoring group also includes the American Institute of Electrical Engineers and Institute of Radio Engineers, with the Radio-Electronics-Television Manufacturers Association and Society of Motion Picture and Television Engineers as participating members.

Winner of the award will be announced about April 1. Conference president Dr. C. E. Barthel Jr., assistant director of Armour Research Foundation, said the decision will be made upon excellence of past scholastic record, participation in extra-curricular activities, and the quality of the proposed study program.

Applications are available through the office of the National Electronics Conference, 84 E. Randolph St., Chicago 1, Ill. Applications must be submitted before March 1. The offer is open to students at all colleges and universities.

INSTITUTES

AUTOMATIC CONTROL FOR PROCESS INDUSTRIES
April 9–10

The economic aspects of process control and process control analysis will provide a theme for this institute. Specific control problems relating to process industries will be discussed along with possible solutions. This institute will be of interest to process engineers, manufacturing engineers, plant engineers, and electrical engineers.

Fee: $20.00. Ralph D. Smith, Institute Coordinator.

WORK MEASUREMENT
April 11–12

Current information pertaining to the use of auto-measurement or mechanizing of time study, application of incentives to short run jobs, time study training techniques, statistics in work measurement, new work simplification approaches, and machine interference determination will be discussed in this institute. Industrial engineers and time study personnel will find

(Continued on page 91)

BEGINNING ENGINEER'S DREAM

Within months the first man-made earth satellite will be launched by Martin.

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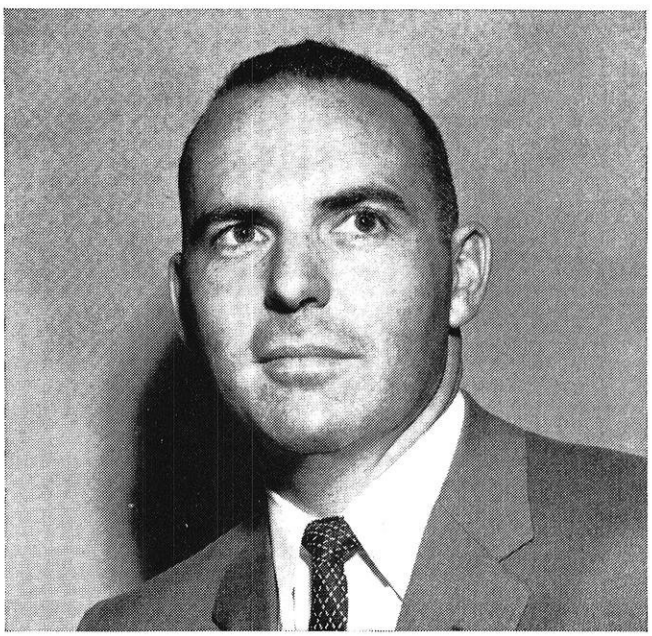
JOSEPH J. DRECHSLER
B.S. in Mechanical Engineering, 1948, Johns Hopkins University

Joe Drechsler, after 8 years with Baltimore Gas and Electric Company, is now Assistant Superintendent in a department with over 450 employees

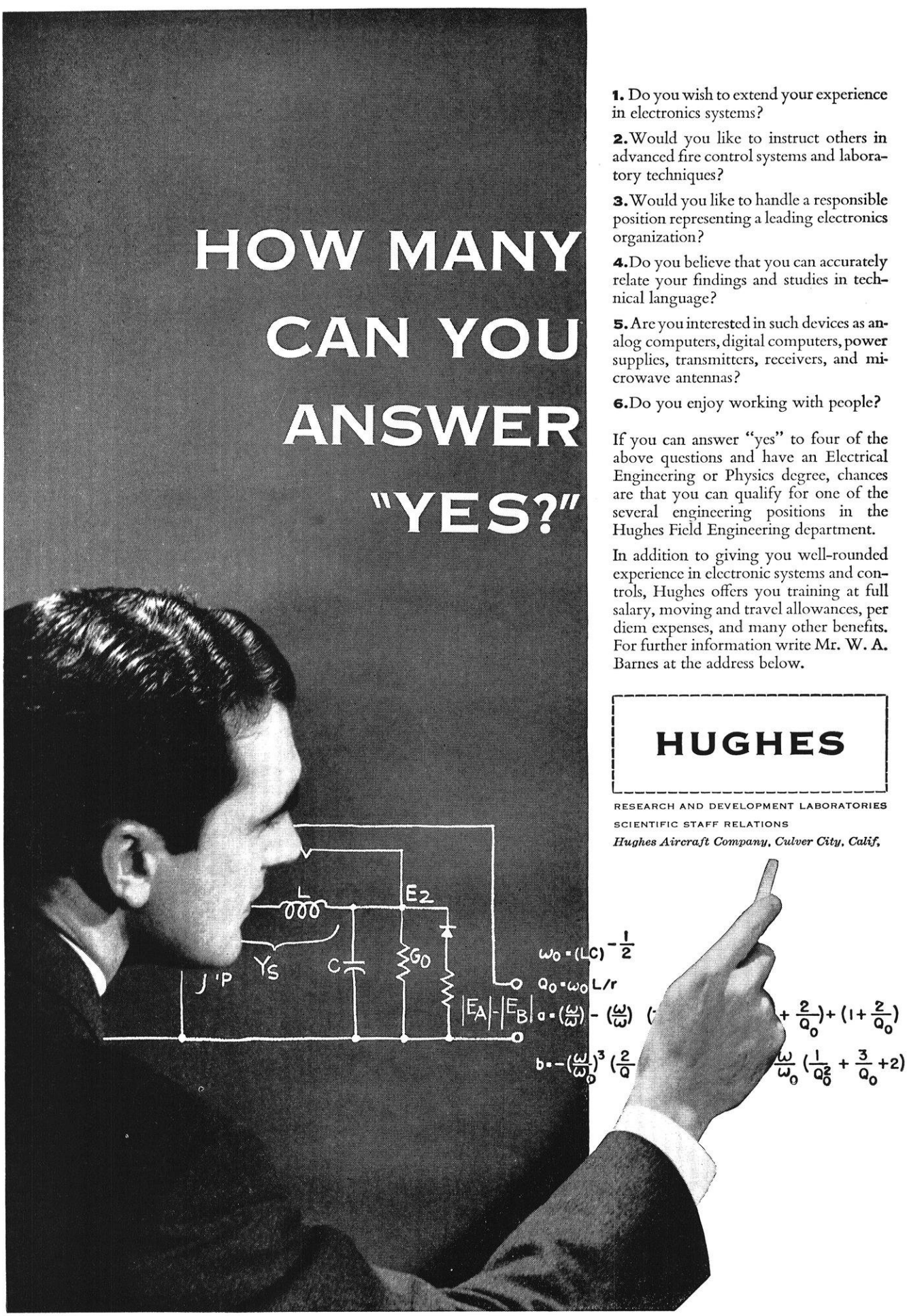
After completing the company's Student Engineering Training Program, Joe spent one year in the Gas and Steam Testing Laboratory. He was then promoted through various levels of engineering and supervisory assignments, to his present job of Assistant Superintendent on April 1, 1956. This department has over 450 employees and is responsible for the installation and servicing of industrial, commercial and domestic gas appliances on customers' property, and the installation and servicing of gas and steam metering and pressure recording equipment.

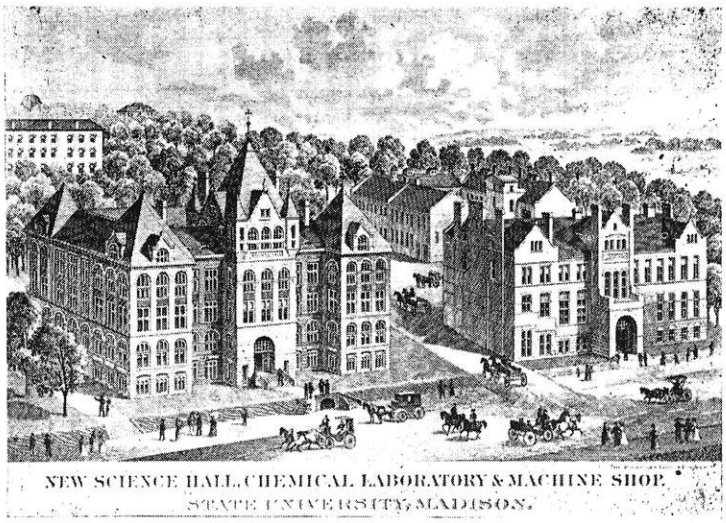
ROBERT K. VON DER LOHE
B.E. in Industrial Engineering, 1948, University of Southern California



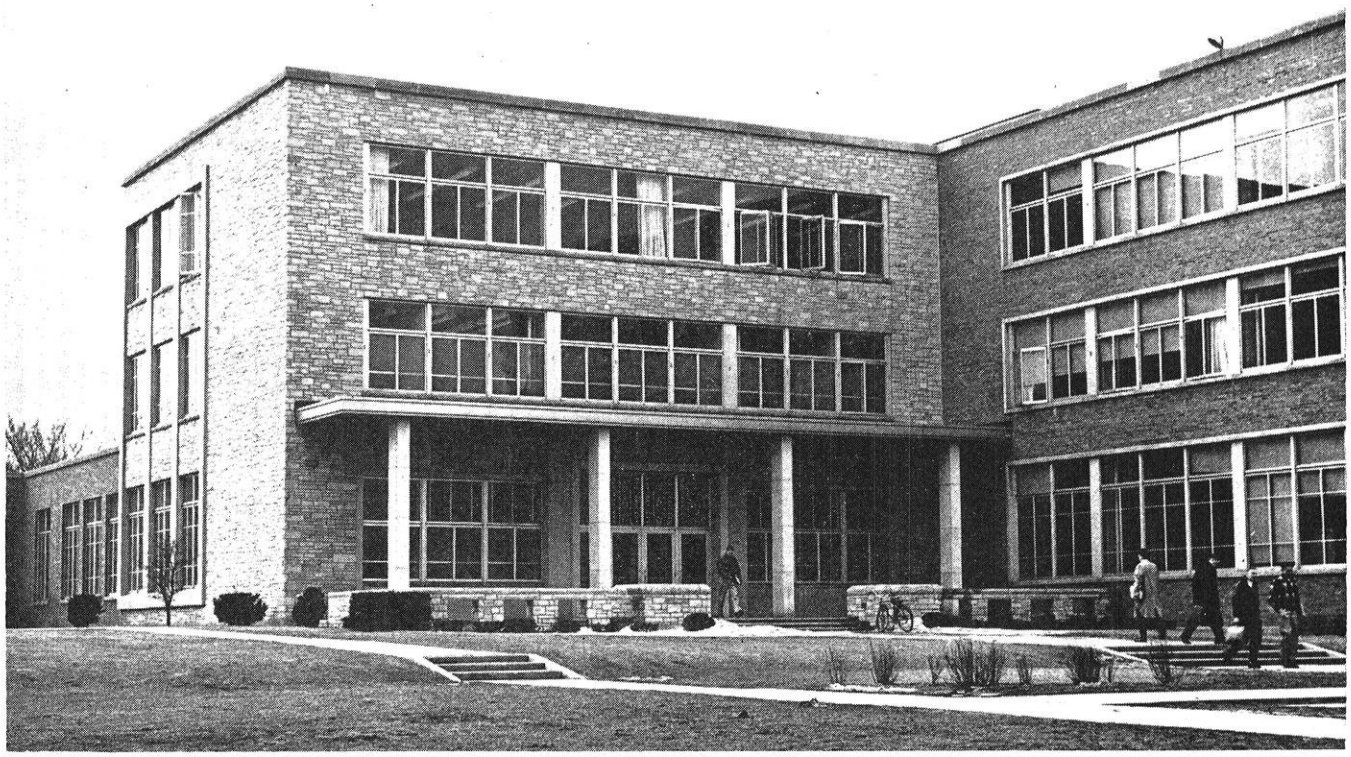
In just 6½ years with Southern Counties Gas Company of California, Robert K. Von Der Lohe has become Manager of Commercial and Industrial Sales

After two years with a construction engineering firm, Bob Von Der Lohe joined the gas company and began his steady climb to his current position. Starting as an assistant technician in 1950, Bob has moved up through the jobs of industrial sales engineer and staff representative-industrial sales, to his present post as Manager, Commercial and Industrial Sales. Bob does more than "sell" industries and commercial operations on the use of gas. He also supervises a staff which advises restaurant and hotel owners on ways to improve their gas operations and over-all productive efficiency.





THE OLD—



AND THE NEW.

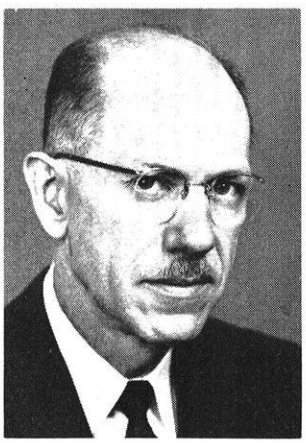
High School Section

Compiled by Dick Peterson m'57

We of the Wisconsin Engineer staff want to take part in relaying all the information we can concerning engineering, to the high school student contemplating engineering as a career. To accomplish this we have asked a group of the top educators at this university to comment on engineering and its advantages and to give a concise resume of the opportunities available in the five different fields of engineering. The section is concluded with a series of typical questions asked by high school students thinking of enrolling in engineering school.

Should I Be An Engineer

by Kurt F. Wendt
Dean, College of Engineering



Kurt F. Wendt.

On almost every hand today one hears about the critical shortage of engineers. As a result we receive hundreds of requests for information about the engineering profession. What is engineering? What does the engineer do? Should I be an engineer?

Engineering is the art and science directed toward the adaptation of materials found in nature into useful forms, and the harnessing and conversion of natural forces into useful power by efficient and economical means.

The profession is commonly divided into six major fields: chemical, civil, electrical, mechanical, mining and metallurgical engineering, each with many subdivisions. Recently the special field of nuclear engineering, which really builds upon all the other fields, has come into prominence, especially at the graduate level.

Manufacturing and processing of substances from raw materials through carefully controlled chemical and physical changes comprise the field of chemical engineering. The main divisions are: (1) unit operations, including such physical problems as transportation of fluids and solids, heat transfer, absorption of gases, drying, distillation and filtration; (2) unit processes which involve making changes through chemical reactions; and (3) process control and instrumentation.

Civil engineering, the oldest branch, at one time included all engineering of a non-military character. The main divisions are structural, sanitary, hydraulic, and transportation engineering. Buildings, bridges, dams and tunnels are designed and erected by the structural engineer. Water supply and sewage disposal systems are the concern of the sanitary engineer. The control and distribution of water for power, irrigation, flood control, and water supply are in the field of hydraulics. The transportation engineer designs the roadways and terminal facilities for motor vehicles, railroads, and aircraft.

Electrical engineering has two main divisions: power engineering, which is concerned with the generation, transportation, and application of electrical energy; and the broad field of communications and electronics which includes telegraph, telephone, radio, radar, television and control. The electrical engineer is responsible for furnishing much of the power used in industry, for lighting of all types, for the design of many labor-saving devices in our homes and for much of the control equipment of modern industry, for medical equipment such as X-rays, and for such interesting developments as the new high-speed electronic computers.

The mechanical engineer deals chiefly with the design and construction of machines for the generation or transformation of power, and for the production of other machines. Power generation, particularly steam and gas power, internal combustion engines, tool and machine design, heating, ventilating, refrigeration and industrial planning and management are the common subdivisions within the field.

The mining engineer searches for and extracts all classes of minerals from the earth. The field naturally divides itself into three parts: mining geology, concerned with discovery and exploration; mining engineering, involving design, construction and operation of plants for the recovery of ore from the earth; and mineral dressing, dealing with the development and operation of processes for the separation of the valuable minerals from associated wastes. The metallurgical engineer extracts metals from their ores and subsequently refines and combines metals to produce alloys possessing special properties.

Regardless of field or function, many areas of work and a large variety of duties are common to all engineers. For this reason you will find many courses common to all engineering curricula. As in any profession, success in engineering demands integrity, industry, perseverance, courtesy, and good personality. In addition, interest in and strong aptitude for mathematics, the sciences, and written and oral expression are of primary importance. If you possess these qualities and aptitudes, find the duties of engineers attractive, and are willing to work hard, you can become a successful engineer. The demand for men and women with sound engineering training is great. The rewards, materially and in personal satisfaction, are substantial.

Why Consult an Oracle?

by Prof. C. M. Brown
Director of College of Engineering High School Research Program

Prof. C. M. Brown.

Since the days of the famous oracle, located at Delphi in Greece, men have always searched for ways to foretell the future. People even pay advertised seers to read their chances in the leaves at the bottom of a tea cup.

Perhaps, you have wished that there were oracles today to which you might go to find out what profession you should follow so that you could be happy and be the kind of a success you want to be. If you assume the personal responsibility of taking the basic subjects in high school and making averages which will enable you to enter any college or university, then when you graduate from high school, you will never need an oracle.

All of the professional careers open to you, if they require academic preparation; demand college training. It is very obvious that every person who wishes to prepare for such a profession must go to college. To enter a college means that you must present your high school credits which show that you have completed successfully certain specified courses such as English, mathematics, foreign language, science, etc.

Right now you cannot decide what you want to be. All high school students have that difficulty. High school years are the time to explore your interests under the guidance of those capable of helping you correlate your interests with your aptitudes. To make a decision is a challenge to everyone. That was why even kings who had decisions to make consulted oracles.

Suppose that you are going to the store to make a purchase. You don't know how much the article you select will cost. You have to buy the article when you go to town. It is the last day of the sale. You must pay cash. If the most complete and expensive model has been advertised for twenty-five dollars, and the others are in lower price ranges according to attachments, how much money will you take with you for this purchase? You don't need any oracle or reader of tea leaves to tell you, "twenty-five dollars." It is just common sense.

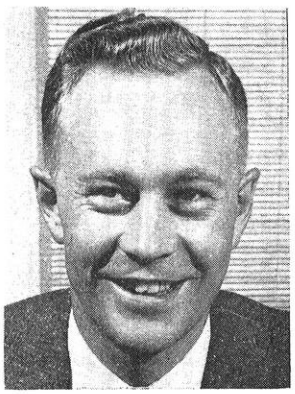
Suppose we apply common sense to what we might call taking enough high school credits of superior achievement rating to college to pay for entrance into any professional school. That is precisely what you have to do. Buy your way into college with the quality and quantity of your academic earnings or "high school credits." You will need all the credits in the various subjects that the most rigid entrance requirements for any college or university may demand. Then you will be free to make a last minute decision and pay for it in entrance requirements just as you would have been able to make the purchase of any model of the article we mentioned above—because you took enough cash to pay for the most expensive one.

Here are the basic requirements which will enable you to enter practically any college or any university. Yes, these credits will admit you to the college of engineering. English, 3–4; algebra, 1½; plane geometry 1, solid geometry ½, trigonometry, ½; physics, 1; chemistry, 1; foreign language, 2; history, 1.

You can readily see that there will be plenty of opportunity for you to take other things in which you are interested as you complete the sixteen units required for graduation. Making sure that you have the minimum requirements so that you can choose colleges and careers at will when you graduate from high school does not "cramp your style." On the contrary it will give you the confident feeling which everyone has who knows that he has enough money in the bank to pay bills when due. Just like having accident or hospital insurance. You do not need to go to Delphi to consult the oracle to arrive at this conclusion. It is just common sense.

Career Opportunities in Engineering

by James A. Marks
College of Engineering, Placement Director



James A. Marks.

The present day demand for engineers is so great and has been so well publicized that it is hardly necessary to elaborate on that point. Perhaps more important than the present situation, however, is how long will the demand for engineers last and how will it affect those who contemplate a career in engineering. One scientific study predicts that there will be a shortage of engineers for twenty years!

Even disregarding the defense effort civilian industry is making almost fantastic technological advances. This has resulted in a need for far more engineers than in the past. The ratio of engineers to other employees has been rising rapidly, especially since World War II. Consequently there is little need to question the advisability of studying engineering from this standpoint.

There have been some unusual results of this demand for engineers, however. Ordinarily, if a product is in great demand there is a tendency for quality to decrease. In such a situation the natural reaction is to speed up production and this usually results in lower quality. In engineering colleges, however, just the opposite has happened. More and more students are entering engineering; so many in fact that there aren't enough teachers, classrooms and laboratories to accommodate everyone. Consequently, only the better students can stay in engineering. Therefore it is more important than ever that the high school student prepare himself as thoroughly as he can before starting college by taking all of the mathematics and science courses he possibly can, as well as English and social studies.

On the brighter side, the demand for engineers has forced starting salaries higher and higher. It is not unusual for the graduating engineer to receive a first year salary of $6000. There is every reason to expect that these salaries will continue to rise at least as much, if not more, than general income levels rise. Certainly engineers can expect handsome financial rewards in the years to come.

Of course salary should not be the prime reason why anyone should choose a career in engineering—or in any field, for that matter. Instead the individual should consider the kind of work he (or she) will be doing and whether or not he will be happy doing it. While this might imply that only those who have a deep interest in things mechanical, for example, would consider engineering it should be pointed out that for many jobs normally considered to be non-engineering in actual practice virtually demand an engineering background.

Sales, production supervision, management, and many other jobs have become exceedingly technical in nature and an engineering education is a real asset in almost any field. Under these circumstances the high school student who has the ability will find an engineering education to be better basic training than perhaps any other field. Even though he's not sure what type of work he would eventually be interested in, an engineering background will always be valuable.

A vital part of engineering that is too often overlooked is engineering education. The demand for engineers will obviously provide more and more opportunities in the teaching of engineering. The individual who would enjoy a career in education and who has the ability to pursue engineering will find an extremely bright future in engineering education.

The placement office of the College of Engineering has expanded along with the increased enrollment of engineering students and the need for engineering graduates. Of course, the primary purpose of the placement office is to provide facilities and information for seniors when they begin looking for a job and give counsel and advice to those who want help.

This spring almost 1000 representatives from companies throughout Wisconsin and all over the country will visit the campus to interview seniors. These companies provide literature and other information about the opportunities available. The seniors examine this material, interview companies that are interesting to

(Continued on page 100)

So You Want to Be An Engineer

by Mary R. O'Keefe and K. G. Shiels
Assistant to the Dean *Assistant Dean*

Professor Shiels and Miss O'Keefe.

In his search to find his real interest in life and to determine the type of training he should pursue in reaching his final goal, the high school student seeking information on engineering as a career has no doubt found in the reading room of his high school library the University of Wisconsin pamphlet entitled, "The Engineer—His Preparation and Work."

In this booklet he has read that engineering may be defined as the application of the principles of science to the development of natural resources, the design and erection of structures, the construction and operation of machines and ways of transportation and communication, and the devising and controlling of physical and chemical processes of manufacture, especially those involving the use of machinery. In recent papers you may have read that a new curriculum on nuclear engineering has been developed to begin next September. The constant study of the College of Engineering to revise and to add up-to-date fields of study is constantly going on.

Without question, the average high school student with a genuine interest in engineering has carried on sufficient research to determine whether he will train for chemical, civil, mechanical, electrical, mining, or metallurgical engineering, and that he has a fair knowledge of their functional divisions.

The profession of engineering should not be confused with the work of the skilled workman or artisan, nor should the prospective engineering student think that manual dexterity or an interest in things electrical or mechanical necessarily indicate engineering ability. A better measure of probable success in engineering is his aptitude in science and mathematics. The student whose grades in high school have ranked him consistently in the upper third of his classes, particularly in science and mathematics courses, probably has the capacity for engineering training. Coupled with this should be a liking for science as far as he studied it, and a lasting curiosity about the reasons which underlie methods and results. He should find mathematics easy to understand for it is the engineer's most valuable tool.

To assist the prospective engineering student to make the best possible start in his college course, I can give no better advice than to begin to review algebra early this summer in such a manner that he has the fundamentals well mastered. Mathematics 51, the first engineering mathematics course, requires one and one-half years algebra and one year plane geometry. Some high school students may not have taken their third semester of high school algebra, in which case it would be profitable for them to take the course (Mathematics 50) by correspondence this summer with the University Extension Division. When you are admitted to engineering, all freshman engineers will be given an algebra test. Those who do not pass the test are required to take Mathematics 50 (sub-freshman mathematics), thus falling one semester behind in the regular mathematics courses.

You will note that I suggested you review algebra early. This summer the University of Wisconsin will inaugurate a new plan for pre-registration of new freshmen. In this plan students who have been issued permits to register will be invited and encouraged to attend a one day program at Madison during the period from July 15 to August 23, 1957. At this time students will meet their registration consultant, plan their program for the fall period, and take the usual physical, psychological, and placement tests. All students who have submitted their high school records and have been granted permits to enter the University will be sent complete information regarding this program by the Office of Admissions.

In their freshman year all engineers carry chemistry, drawing, English, and mathematics, in addition to

(Continued on page 100)

Chemical Engineering

by Professor R. A. Ragatz
Chairman, Chemical Engineering Department

Professor Ragatz is a true native of Wisconsin, born in Prairie du Sac, receiving his BS, MS, and Ph.D. at the university, the latter in 1931. He has done some specialty work in Plastics and is now in the process of writing a book.

Basically, the work of the chemical engineer consists of translating the laboratory discoveries of the research chemist into large-scale manufacturing operations. The research chemist generally works at a laboratory bench; his equipment is usually made of glass; his product yields are small, usually a few grams at most. The chemical engineer, on the other hand, designs, constructs and operates the large-scale equipment needed to produce the desired material in commercial quantities. Chemical engineering transforms our laboratory discoveries into commercial realities.

The chemical engineer plays a key role in the manufacture of synthetic rubber, petroleum products such as high-octane gasoline, fuel oil, lubricating oils, greases and asphalt, synthetic fibers such as Nylon, Orlon, Dacron, Acrilan and Vicara, synthetic detergents, soaps, insecticides, weed killers, sulfa drugs, antibiotics such as penicillin, a host of "petrochemicals" such as toluene, formaldehyde, ethyl alcohol, ethylene glycol, and benzene, paper and paper products, and plastics. The list could be extended much further. In all of the foregoing manufacturing enterprises, research chemists and chemical engineers form a coordinated team.

The manufacturing processes in which a chemical engineer usually engages are generally quite complex and require a series of processing steps, some of which are chemical in nature and some of which are essentially physical in character. Typical chemical processes are oxidation, reduction, hydrogenation, nitration, sulfonation, chlorination, hydrolysis, alkylation, and polymerization. Typical physical processes are handling of materials, fluid flow, transfer of heat, crushing and grinding, mixing, filtration, drying, absorption of gases by liquids, evaporation, solvent extraction, crystallization, distillation. Chemical engineers select the appropriate chemical and physical operations needed to make the desired product, work out the best conditions of operation for each step, design the necessary equipment, and finally operate the plant.

In a large company employing many chemical engineers, the work carried out by a particular individual may be restricted to one of the following general types of work: development, production, maintenance, process control, inspection, testing, design, construction, technical sales and customer service, administration. In a smaller company employing a few chemical engineers, a given individual's duties may encompass several or all of the foregoing types of work.

The Department of Chemical Engineering has excellent instructional facilities. The new Chemical Engineering Building occupied in the fall of 1952, has well-equipped undergraduate laboratories for instruction in unit operations, chemical manufacture, process measurements and control, electrochemistry, plastics, Senior special problems projects, and technical analysis. Laboratories for graduate research are also provided.

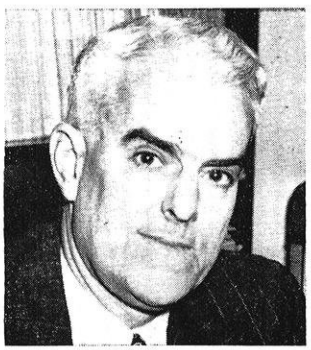
The curriculum in chemical engineering is accredited both by the American Institute of Chemical Engineers and the Engineers' Council for Professional Development. It is under constant scrutiny, and changes are made to keep pace with the requirements of our rapidly expanding chemical industry.

Employment opportunities are excellent, and starting salaries are at an attractive level. However, since Wisconsin has relatively few chemical industries with the exception of the paper industry, most of our graduates in chemical engineering secure employment outside of the state.

← **Chemical engineers working on complicated distilling apparatus.**
—Courtesy General Electric

Civil Engineering

by Prof. James G. Woodburn
Chairman, Civil Engineering Department



Prof. James G. Woodburn has been Chairman of the Department of Civil Engineering since 1949. He was born in Bloomington, Indiana, and received his BA and MA from Indiana University, his BS from Purdue, and his PhD from the University of Michigan. He taught at the State College of Washington for several years before coming to Wisconsin. He has specialized in Hydraulic Engineering and the legal phases of engineering, and is co-author of the Hydraulics text used in several university courses.

Civil engineers have always been connected with the development of transportation systems. The great advance in the nineteenth century was in the building of our railroads, which will employ many engineers in both operation and maintenance. The mid-twentieth century sees continued expansion of highways, airlines, and pipelines. The growth of highway traffic that has resulted from population growth and establishment of new cities and industries has led to the rapid building of expressways and tollroads. The development of airports and allied facilities, not only in this country but all over the world, has been phenomenal. Pipelines are coming to be a highly favored mode of transportation for petroleum products and natural gas. The civil engineer occupies a prominent place in the planning, surveying, designing, constructing and operating of all these transportation facilities.

Another field that continues to be very attractive to civil engineers is that of structures. There is increasing demand for more housing, shopping centers, office space, public buildings, factories, and other structures of all kinds, both large and small. Civil engineers are associated with architects in the design and construction of large steel and concrete buildings, with contractors in the design and building of homes and apartments, and with public agencies in city planning, redevelopment of slum areas, and laying out of parks and playgrounds. Most spectacular in the field of structural engineering is the construction of great bridges. Many have been built, others are under construction, while still longer and larger ones are being planned for the near future.

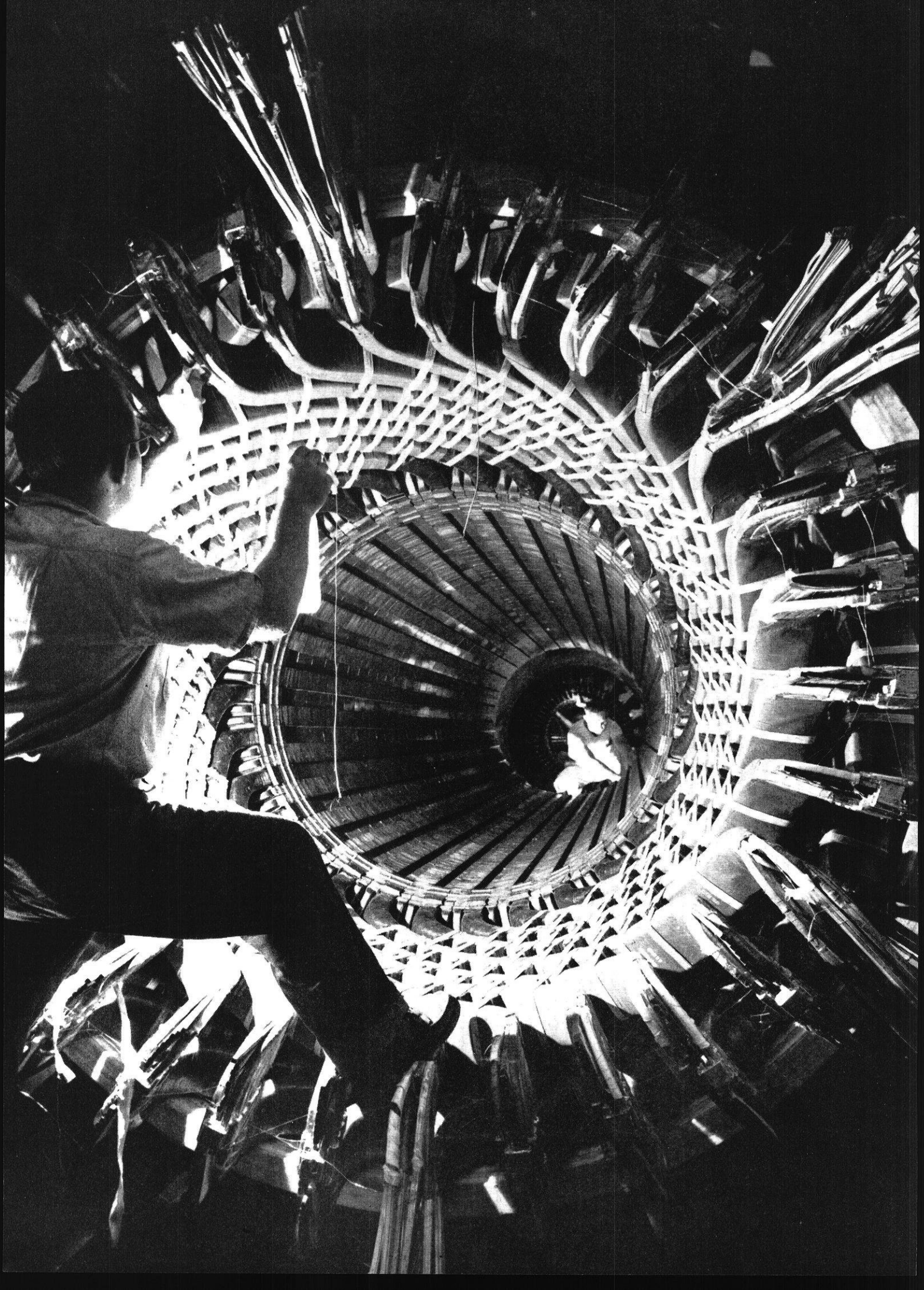
With growth in population comes also increased demand for civil engineers to provide safe and adequate public water supplies and to build sewerage systems and treatment plants which will return waste waters to the streams in a form least harmful to fish and other wild life and most satisfactory from the standpoint of use of the lakes and streams by the public. Civil engineers design and build flood control works to prevent or reduce damage from floods, improve river channels for the benefit of navigation, and provide port facilities for both inland and foreign shipping. Water power plants are designed by civil engineers and built under their guidance. Many engineers are engaged in land reclamation, either by the draining of low swampy lands or by bringing irrigation water to dry lands from rivers or reservoirs through miles of canals and aqueducts.

Many civil engineers also find work as surveyors. Surveying is one of the first jobs to be done when an engineering project is undertaken. Surveys must be made to aid in determining the most economical and feasible routes for highways, irrigation canals, and pipelines. Such surveys have been greatly speeded by aerial mapping. There must be surveys of sites for bridges, buildings, dams, and airports. The proper laying out of housing and other municipal developments depends largely on detailed surveys of the proposed sites. Surveyors also locate property lines and determine areas, and thus help to settle disputes between land owners. Much of our country's area still remains to be mapped in detail and many surveyors are engaged in that work.

As with any profession, the future of civil engineering depends on maintaining a continuing supply of young persons who are eager and qualified to enter that profession. The usual road to becoming a civil engineer leads through years of training in a college of engineering. The colleges cannot operate without teachers, and there are many opportunities these days in the engineering teaching profession for young people who have done well in their college work, who have gone ahead to take graduate work, and who also have acquired some practical experience. **THE END**

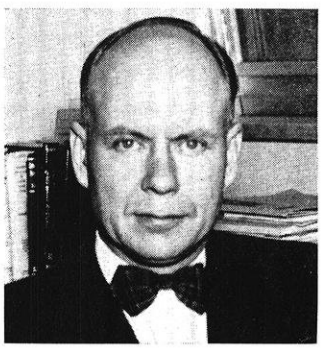
← Hoover Dam.

—Courtesy Allis Chalmers



Electrical Engineering

by Professor H. A. Peterson
Chairman, Electrical Engineering Department



Prof. Harold A. Peterson has been Chairman of the Department of Electrical Engineering since 1947. He is from Essex, Iowa, and received his BS and MS (with high distinction) from the University of Iowa. He is a Fellow in AIEE, a Senior Member of IRE, and a member of several other engineering societies. He also holds eight patents in the field of electrical engineering.

Electrical Engineering is a young profession and, therefore, a young man's profession. In 1882 the first electric generators were put in operation. The first electric generator driven by a waterwheel was put in operation in Appleton, Wisconsin, on September 30, 1882. Since that time growth and development of the profession have been phenomenal. Today the American Institute of Electrical Engineers (AIEE) has over 45,000 members. This is more than any of the other founder societies. In addition there are over 37,000 members of the Institute of Radio Engineers (IRE).

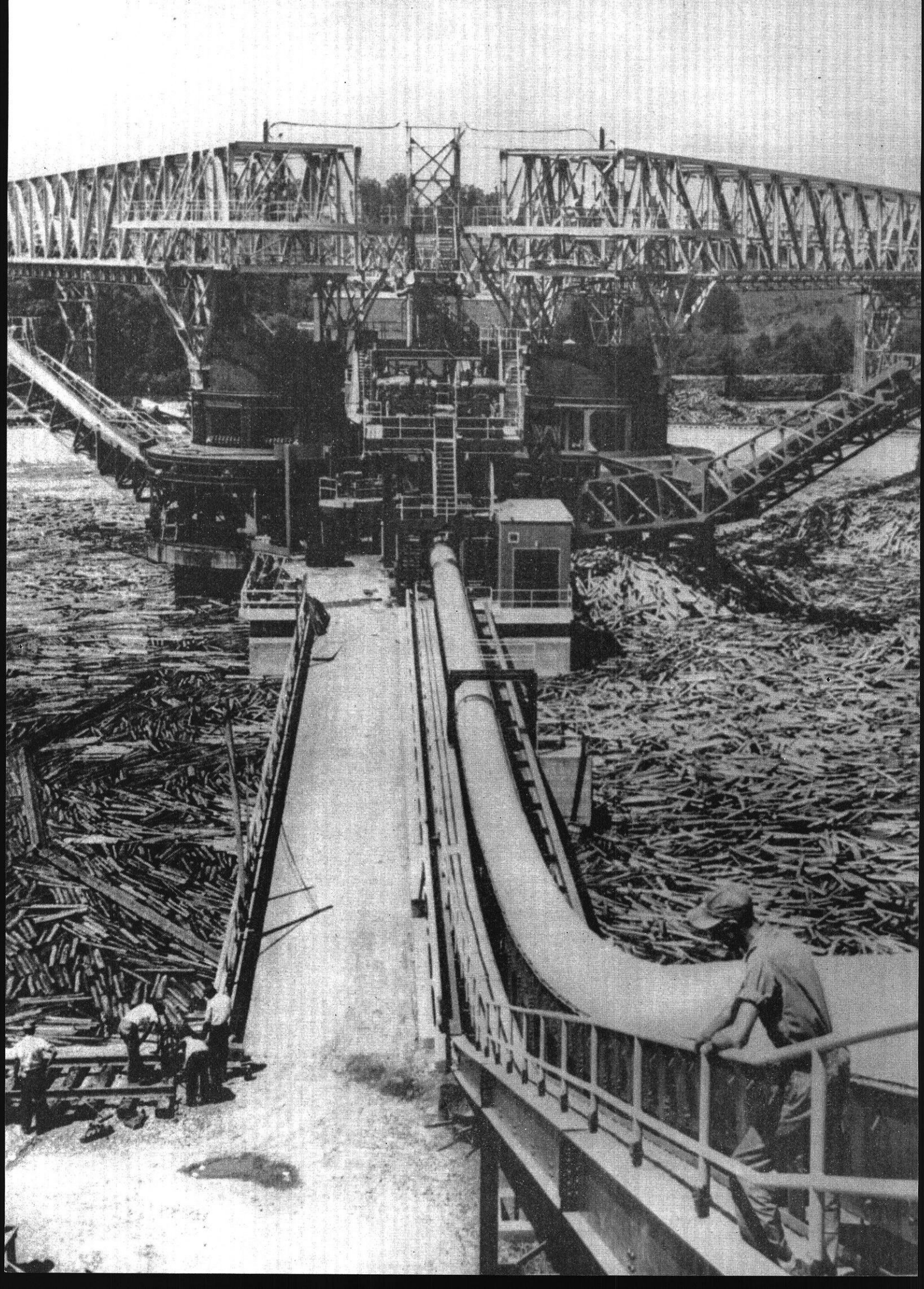
A few generations ago, electricity was available in the homes of only a few. Today it is available in almost every home. Electrical engineers have been largely responsible for bringing this about. Today heavy tasks around the farm home, and other tasks in all homes, can be done quickly, efficiently, and without drudgery. The benefits of radio and television have been brought to many homes. These are some of the more obvious consequences of electrical engineering. Many others are less obvious and very complex such as the control of guided missiles, gunfire control, automatic pilots, transistors, and high speed electronic computing devices. Much imagination and keen insight along with advanced training in science and mathematics are required for creative work in these areas.

These windings will generate 250,000 kilowatts at 24,000 volts—both record highs in this country.
—Courtesy Westinghouse

At the University of Wisconsin our facilities in the Engineering Building are among the best in the country. Our course of study in electrical engineering is constantly under surveillance so that improvements can be made from time to time to keep in step with the needs and demands of industry.

There is a joint student branch of the AIEE–IRE on the campus with a faculty member in charge as branch councilor. This student branch elects its own officers, holds regular meetings, and sponsors activities of interest to student engineers. It affords a means for orienting students with regard to professional activities within the AIEE and IRE following graduation.

The University of Wisconsin offers excellent opportunities for study in electrical engineering. Young men and women with good high school records and a real interest in science and mathematics would do well to consider enrolling in this course of study which leads to a most interesting professional life of basic importance to our economy and security. **THE END**



Mechanical Engineering

by Benjamin Elliott
Chairman, Mechanical Engineering Department

Prof. Ben G. Elliott has been Chairman of the Department of Mechanical Engineering since 1948. He was born in North Platte, Nebraska, and received his BS and MS from Rose Polytechnic Institute, and a degree of ME from the University of Wisconsin. A Fellow in ASME, he has been vice-president of this society since 1953. He was Director of the National Society of Professional Engineers from 1951 through 1954, and is active in numerous other engineering and civic organizations. He has also written several textbooks on the automobile.

Mechanical Engineering is that special branch of the engineering profession concerned primarily with the design, production and operation of all types of machines, tools, prime movers, equipment and manufactured products.

The mechanical engineer designs, develops and produces our "machine tools" which are the foundation of our extensive industrial system. He is also responsible for the production of the vast quantities of energy which constitute the very life blood of our present day economic and industrial society. A current problem involves the practical application and utilization of nuclear and solar energy. He also plays a major part in designing, producing and operating the elements of our vast systems of transportation and communication —automobiles, trucks and buses, locomotives, trains, aircraft and ships.

In the defense of our country and its freedom, the mechanical engineer plays a key position. He designs and develops our jet aircraft, rockets, guided missiles and armament.

The mechanical engineer is a highly important factor in our great process industries—petroleum, coal, gas, iron, steel, paper, lumber and forest products. He has become an integral part of the great printing industry and the production of our newspapers and periodicals. Another important activity of the mechanical engineer involves the handling, moving and packaging of the endless list of everyday articles commonly known as consumer goods.

Many aspects of mechanical engineering have gone into the construction and operation of this automatic log extractor.
—Courtesy Westinghouse

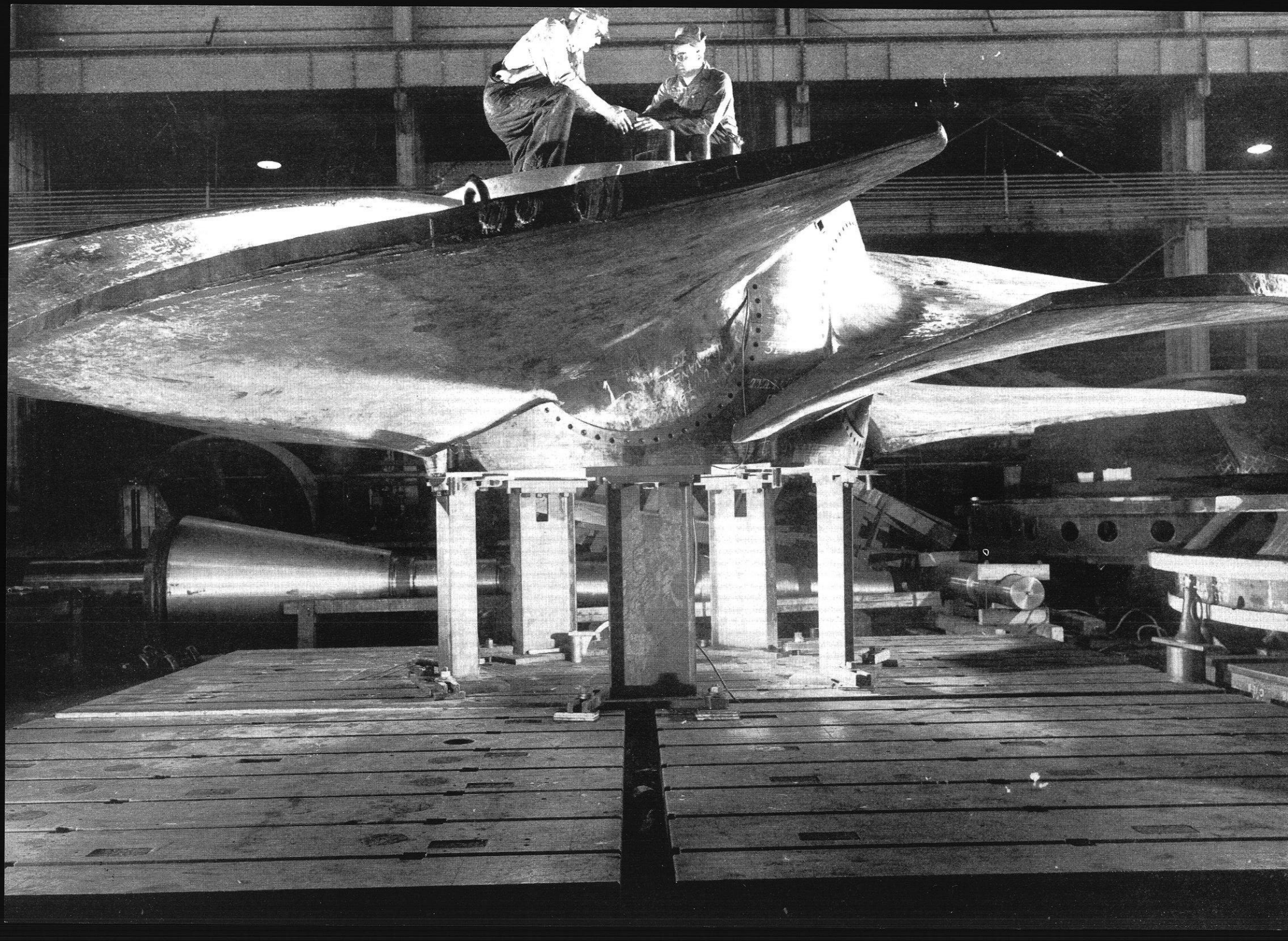
In the home, the mechanical engineer has been responsible for the "domestic revolution" which has brought into the home the products of research and development—heating, cooling, air conditioning, refrigeration, kitchen and laundry equipment and power tools of all types. He has electrified and mechanized the home as he has the farm.

A prospective mechanical engineer should have a pronounced interest and proficiency in mathematics and the physical sciences, should have imagination, an interest in exploring new ideas and an inherent desire to "create" and "build".

A career in mechanical engineering usually begins by enrollment in an accredited college of engineering. The subject matter studied includes basic courses in mathematics, mechanics and materials, chemistry, physics, thermodynamics, drawing and design, shop and industrial processes, economics and accounting procedures, language, speech, technical writing and human relations.

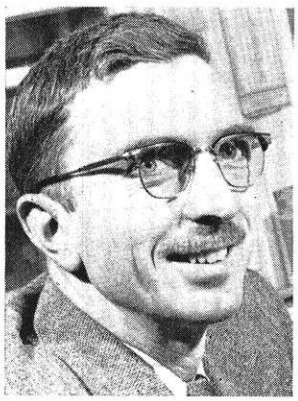
In addition to preparing a young man or woman for an interesting and profitable technical career, an engineering training is extremely valuable in other fields of activity. Many engineering graduates go into business, commerce, agriculture, law and public service. Many engineers occupy responsible executive and administrative positions in industry, business and government.

The future for properly trained engineers is excellent. Opportunities are numerous, starting salaries are high and advancement depends only upon capacity and ability and the willingness to work hard.



Mining and Metallurgical Engineering

by Professor P. C. Rosenthal
Chairman, Department of Mining and Metallurgy



This is Professor Rosenthal's second year as department head. He received his BS and MS in Metallurgical Engineering from the University of Wisconsin. He has been very active in the AFS and ASM, being chairman of several committees. He was co-author of "Principles of Metal Casting" and has just completed another book.

If you were to examine a list of the elements and their properties you would find that the majority of them would be classified as metals. Further investigation into the use of these metals would reveal that almost everyone of them has some commercial application in the pure or alloyed form. A more intensive study, such as would be gained in a mining or metallurgical engineering program of courses, would establish that even many of the non-metals such as oxygen, carbon, phosphorus, etc., play an important part in metal processing and alloying. Thus the mining or metallurgical engineer deals with a wide variety of elements and combinations thereof, and must understand the chemical and physical problems associated with their preparation and use.

Utilization of metals begins with the discovery and development of mineral wealth. This is the work of the mining engineer. The curriculum for mining engineering includes, in addition to courses in mine evaluation, development, and ore removal, related courses in geology, mineral concentration and chemical processing. There are also courses in related fields such as hydraulics, surveying, electrical engineering, and heat and power.

One option of the curriculum in this field concentrates on the geological aspects of mining. The graduate from this program is referred to as a geological engineer and would be primarily concerned with finding and exploring new ore bodies or oil fields. He would estimate the economic value of the ore and determine how it might best be extracted from the earth.

The mining engineer designs, constructs, and operates mining properties. He, in effect, begins where the geological engineer leaves off because his principal tasks are associated directly with the mining operation. He plans the method of removing the ore, designs the transportation system and handles related problems of ventilation, power supply, etc.

In the petroleum field, the counterpart to the mining engineer is the petroleum engineer. His job is to plan and operate the oil-drilling and pumping equipment and arrange for the storage of the crude petroleum. He should also be familiar with methods used to locate new petroleum fields.

Once the ore is removed from the earth, it must be processed further before the metal can be extracted. This is called mineral beneficiation, mineral dressing or mineral concentration. This field represents the link between mining on the one hand and metallurgy on the other. The mineral dressing engineer designs and operates plants for the separation of the valuable minerals from the waste products. This field is becoming increasingly more important as the richer ore deposits become exhausted and lower grade ores must be utilized. In Wisconsin, for instance, the use of the available low grade ores awaits development of economical methods for concentrating these ores to higher iron contents. The mineral dressing engineer uses many methods and devices for concentrating ores such as gravity separation, "heavy media" separations, and flotation. His program of study is much the same as that

(Continued on page 100)

← **Assembled Kaplan propeller type runner for hydraulic turbine.**

Courtesy Allis Chalmers

What's Your Question?

High school students have many questions concerning requirements and activities of college life. Following are questions and the respective answers pertaining to student life at the University of Wisconsin.

What educational program does the University of Wisconsin offer?

Students have the opportunity to study in almost all major areas of endeavor, including the humanities, arts, sciences, and social studies. In addition, preprofessional and professional opportunities are available in engineering, commerce, teaching, medicine, law, pharmacy, and many allied fields. All told, the University offers over 1,200 courses from which to choose.

What are the admission requirements?

The general method of admission is by presenting a certificate of graduation from an accredited high school with the recommendation of the principal. Sixteen units are the fundamental requirement, which must include one unit of algebra and one unit of geometry.

Does the University have an official grading system?

The University of Wisconsin marks on an alphabetical basis with the grade points per credit as follows:

"A" (Excellent) .....4 grade points per credit
"B" (Good) .....3 grade points per credit
"C" (Fair) .....2 grade points per credit
"D" (Poor) .....1 grade point per credit
"F" (Failure) .....0 grade point per credit

What are the semester fees?

In all colleges and schools except Law and Medicine the fees are $90 per semester for a resident of the state and $250 for a nonresident.

What housing arrangements are available?

Housing accommodations for single students include: University Residence Halls, Co-operative houses, sororities, fraternities, the University YMCA, International House for graduate men, and rooms in private homes throughout the residential sections of the city. The University Housing Bureau is the clearing center for all student housing information and is located at 434 Sterling Court.

Does the student have any supervision in the planning of his courses and program?

Yes, the University operates on an advisory system whereby each new student is assigned a faculty adviser. The adviser is expected to help the student in the choice of his course and in the selection of a well-balanced program.

Is there additional counseling service available to students?

A trained staff is available to counsel students regarding personal, vocational, or academic problems. The Student Counseling Center is located at 740 Langdon Street.

What provisions do the University provide toward the maintenance of the health of the student body?

The services of the Department of Preventive Medicine and Student Health are available to students who are regularly enrolled in the University of Wisconsin. The Student Clinic and Infirmary are located in the West wing of Wisconsin General Hospital.

Are scholarships available for undergraduate students?

There are many scholarships available to deserving students. Scholarship information and application forms may be obtained from the Office of Admissions, 166 Bascom Hall.

Is there an ROTC program?

Freshmen and sophomores are required to take basic Army, Navy, or Air Force ROTC. Eligible Junior students may apply for advanced training.

Are student loans available?

Loans for educational purposes in amounts up to $250.00 are made for periods of less than a year to students in good standing, who have established a satisfactory academic record of at least one semester at the University of Wisconsin.

What are the possibilities of obtaining part-time work?

The Student Employment Bureau is often able to locate some kind of part-time work for those who desire it. Its address is 435 N. Park Street.

Does the University operate any Extension Divisions?

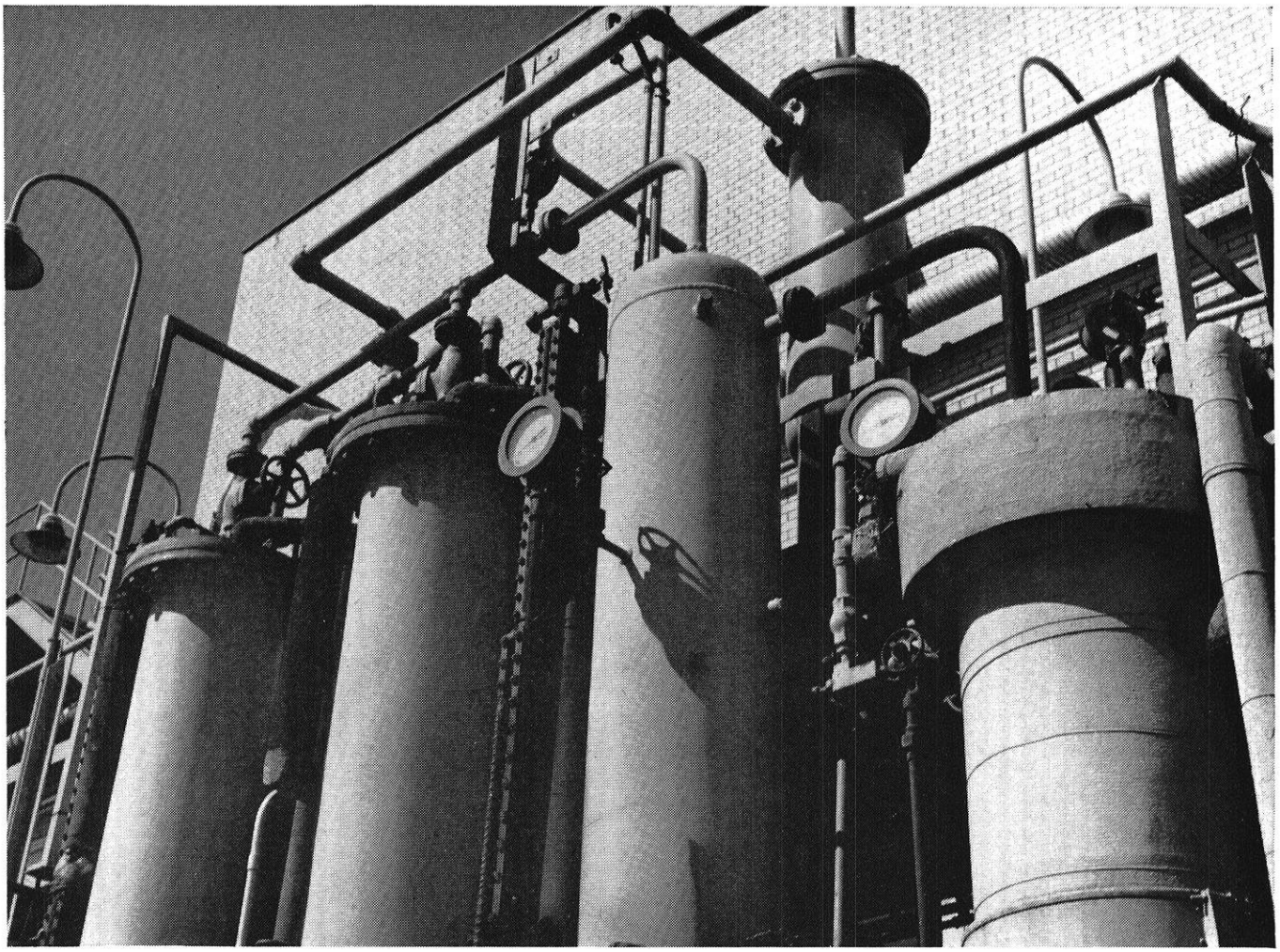
The University of Wisconsin operates Extension centers in Sheboygan, Milwaukee, Racine, Wausau, Green Bay, Kenosha, Manitowoc, Menasha, and Marinette.

How are the library facilities?

There are more than a dozen libraries, the chief among them being the Memorial Library and the Library of the State Historical Society.

Are there sororities and fraternities on campus?

There are sixteen sororities and thirty-four social fraternities on campus, with all but one maintaining resident houses for their members. In addition, there are many professional fraternities.



One of many pilot plants at Standard's Whiting Laboratories. Scientists and engineers frequently take new processes from the "bench-scale" all the way to final field application.

Like to try on this man's shoes?

DONALD PLAUTZ belongs to the group of engineers at Standard Oil's Whiting, Indiana, Research and Engineering Laboratories who are fitted by training and talent for a process engineering career. His fraternal affiliations include Phi Eta Sigma, Tau Beta Pi, Phi Lambda Upsilon and Theta Tau.

B.S. (University of Wisconsin); M.S. (Ohio State); Ph. D. (University of Illinois), all in chemical engineering, Dr. Plautz has utilized this training in carrying out varied responsibilities on development of the Ultraforming process. He has operated pilot plants, correlated data, prepared process manuals, and assisted in the initial operation of new Ultraforming units.

Ultraforming is an intricate refining process which Standard invented, patented and makes available to other refiners, as licensees, to provide increased yields of high octane gasoline.

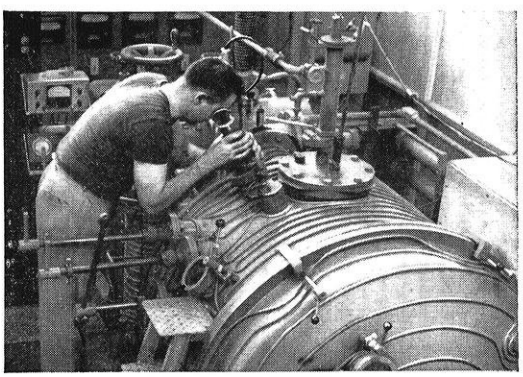
Perhaps you're not ready to try on this man's shoes yet, but Standard Oil offers outstanding career opportunities to college men in almost all fields of science and engineering.

Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois

STANDARD

What's doing....



Vacuum melting has opened up new horizons for development of alloys. Here, a Pratt & Whitney Aircraft metallurgist is shown as he supervises preparation of an experimental high-strength nickel-base alloy, melted and cast under high vacuum.

Induction melted heat of high-temperature alloy being poured in P & W A's experimental foundry. Molten metal is strained into large water tank, forming metal shot which is remelted and cast into test specimens and experimental parts. Development and evaluation of improved high-temperature alloys for advanced jet engines is one of the challenges facing metallurgists at P & W A.

at Pratt & Whitney Aircraft in the field of Materials Engineering

The development of more advanced, far more powerful aircraft engines depends to a high degree on the development of new and improved materials and methods of processing them. Such materials and methods, of course, are particularly important in the nuclear field.

At Pratt & Whitney Aircraft, the physical, metallurgical, chemical and mechanical properties of each new material are studied in minute detail, compared with properties of known materials, then carefully analyzed and evaluated according to their potential usefulness in aircraft engine application.

The nuclear physics of reactor materials as well as penetration and effects of radiation on matter are important aspects of the nuclear reactor program now under way at P & W A. Stress analysis by strain gage and X-ray diffraction is another notable phase of investigation.

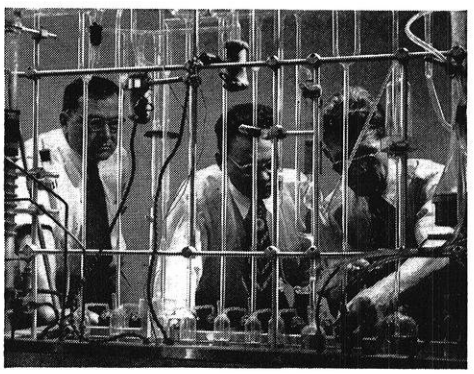
In the metallurgical field, materials work involves studies of corrosion resistance, high-temperature mechanical and physical properties of metals and alloys, and fabrication techniques.

Mechanical-testing work delves into design and supervision of test equipment to evaluate fatigue, wear, and elevated-temperature strength of materials. It also involves determination of the influence of part design on these properties.

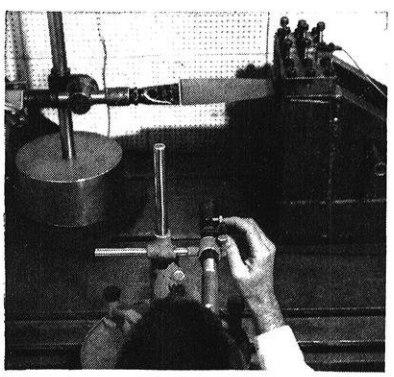
In the field of chemistry, investigations are made of fuels, high-temperature lubricants, elastomeric compounds, electro-chemical and organic coatings. Inorganic substances, too, must be prepared and their properties determined.

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

Engineer measures residual stress in a compressor blade non-destructively, using X-ray diffraction. Stress analysis plays important part in developing advanced aircraft engine designs.



The important effects of gases on the properties of metals have been increasingly recognized. Pratt & Whitney chemists are shown setting up apparatus to determine gas content of materials such as titanium alloys.



P & W A engineer uses air jet to vibrate compressor blade at its natural frequency, measuring amplitude with a cathetometer. Similar fatigue tests use electromagnetic excitation.

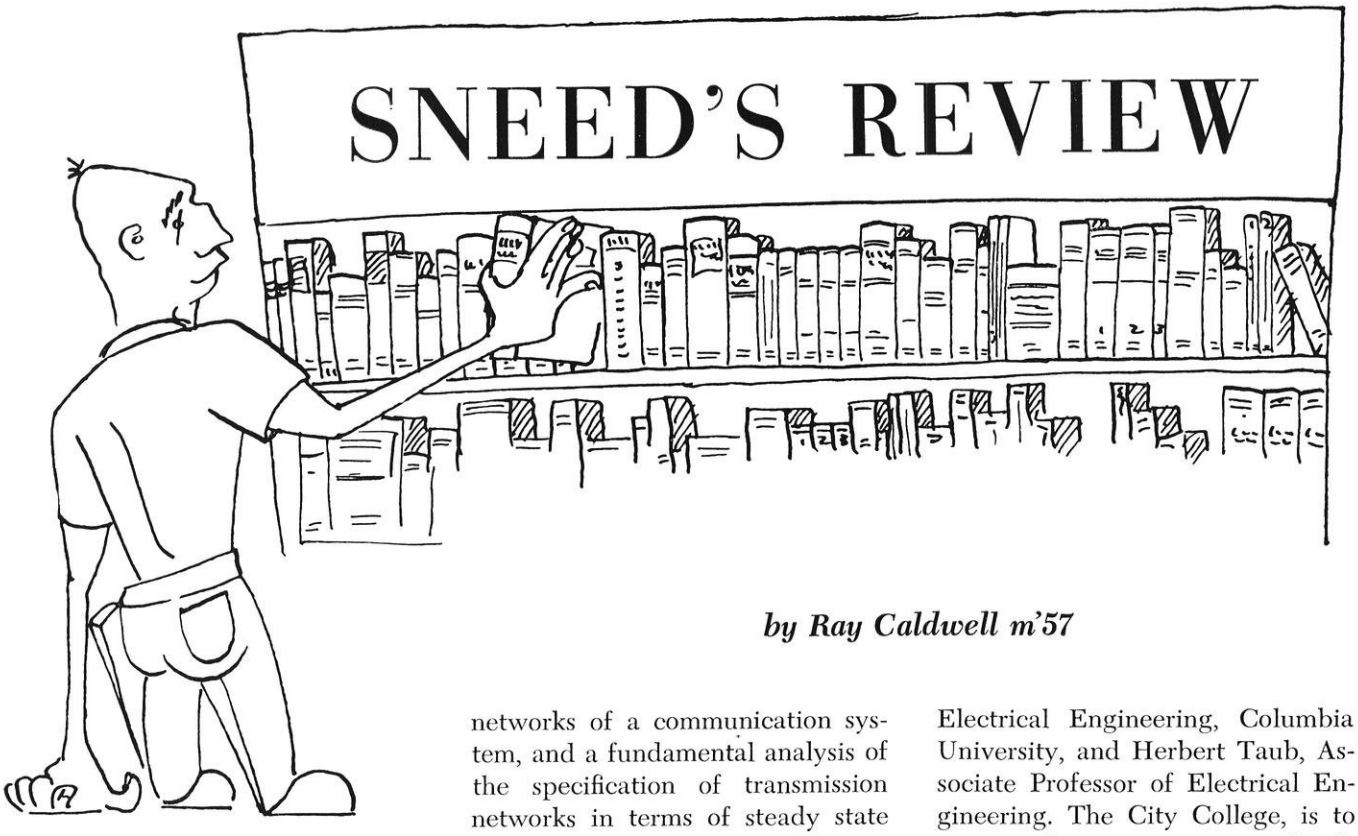
World's foremost designer and builder of aircraft engines

PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

EAST HARTFORD 8, CONNECTICUT

SNEED'S REVIEW



by Ray Caldwell m'57

COMMUNICATION ENGINEERING

Third Edition—By W. L. Everitt and G. E. Anner

McGraw–Hill. $9.00

This standard work, written by W. L. Everitt, Dean, College of Engineering, University of Illinois; and G. E. Anner, Associate Professor of Electrical Engineering, University of Illinois., is noted for its clear, step-by-step analyses of the major problems confronting the communications engineer. In the third edition, emphasis is placed on the area which must precede the study of all other divisions of communication, namely, the fundamentals of linear-network analysis and synthesis, including the use of unilateral elements. In order to demonstrate the design requirements which are imposed on the linear portions of communications systems networks, both an analysis of various types of modulation and the transformation of transients from the time of frequency domain are developed.

The new Third Edition features a general discussion of the nature of signals, elementary information theory and principles of modulation, in order to establish the fundamental requirements which must be met by the linear transmission networks of a communication system, and a fundamental analysis of the specification of transmission networks in terms of steady state and transient response, Fourier Transforms, and zero-pole analysis.

REACTORS

Series II, Volume I—Edited by R. A. Charpie, D. J. Littler, D. J. Hughes and M. Trocheris

McGraw–Hill. $14.00

R. A. Charpie (Oak Ridge), D. J. Hughes (Brookhaven), D. J. Littler (Harwell), and M. Trocheris present here a series of review papers on the present state of the reactor physics. Included in the contents are surveys of the design and operating characteristics of the important research reactors throughout the world, including the Soviet Union. All of the power reactor programs are summarized in individual review papers.

Every reactor project is represented in this volume. The surveys have been enlarged to include all the information presented at Geneva. An up-to-date catalogue of reactors is included as well as a subject index.

PULSE AND DIGITAL CIRCUITS

By Jacob Millman and Herbert Taub

McGraw–Hill.

The purpose of the book, written by Jacob Millman, Professor of Electrical Engineering, Columbia University, and Herbert Taub, Associate Professor of Electrical Engineering. The City College, is to present the important new developments in the field of electronic circuits over the past ten years.

An analysis is made initially of the response of linear networks, both active and passive, to the types of waveforms commonly encountered in pulse circuits. The basic nonlinearities of tubes and semiconductor devices are described and then the effects of these nonlinearities on waveform transmission are studied. Waveform generating circuits (such as multi-vibrators, time-base generators, blocking oscillators, and phantastrons) are analyzed in detail. Other fundamental circuits or components (such as the transistor, the pulse transformer, the delay line, the binary, gating circuits, timing circuits, voltage comparators, etc.) are carefully considered. Finally, the basic building blocks, with which the reader is now familiar, are assembled into pulse and digital systems such as radar, television, and digital computers.

The book features important circuits are given detailed consideration—they are analyzed on a physical basis to provide a clear understanding of their behavior, and a

(Continued on page 99)



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(with the possible exception of those behind the iron curtain)

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AMERICAN • ANSETT (Australia) • ANA (Australia) • AVENSA (Venezuela) • AVIANCA (Columbia) • BEA (England)
BOAC (England) • BRAATHENS (Norway) • BRANIFF • BRITISH WEST INDIES • BUTLER (Australia) • CAPITAL
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Pocket-size pound of pleasure!

New RCA Transistor Radio

Drop a gentle hint (like enclosing this ad in your next letter home), and come graduation time you could be getting this amazingly ingenious radio.

It's a new RCA Victor Transistor Six, and this one you can really take along anywhere. It's smaller and lighter than the average textbook – and lots more fun.

You can carry it easily in pocket or purse. It weighs a mere 16 ounces, yet delivers a roomful of sound anytime you wish.

The RCA Victor Transistor Six is battery-powered and uses six long-lasting transistors. The cabinet is long-lasting, too. It's the fabulous, *guaranteed nonbreakable* "IMPAC" case. Cabinet colors include antique white, charcoal and spruce green.

And note the price—now just $49.95!

This beautiful little bargain is typical of the extra value engineered into every product of RCA. For, almost without exception, these achievements in electronics begin at the David Sarnoff Research Center in Princeton, New Jersey. Here the scientists and engineers of RCA continually seek—and very often find—practical and dramatic new ways to bring you ever-better "Electronics for Living." Tmk(s)®

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

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WISCONSIN SOCIETY OF PROFESSIONAL ENGINEERS

ENGINEERS' CREED

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

I PLEDGE

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

NATIONAL ENGINEERS' WEEK

Engineers' Week Chairmen and their Committees are to be congratulated on the excellent programs which they put into action during National Engineers' Week. For 51 weeks of the year, the engineers go about their business with no thoughts of glory. The contributions which they constantly make to lighten our daily tasks and the part which they play in raising our standards of living are more or less taken for granted. The public needs to be reminded of these contributions from time to time. Our "Engineers' Week" committees by means of displays, speeches, TV and radio have done much to raise the level of our profession.

NATIONAL ENGINEERS' WEEK

Mr. A. G. Behling, President
Wisconsin Society of Professional Engineers
3251 South Taylor Avenue
Milwaukee 7, Wisconsin

Dear Mr. Behling: It is a pleasure to participate in the celebration of *National Engineers' Week* and to send greetings to all engineers in this State.

One of our great resources is the talent and skill of our engineers in directing the conversion of our physical resources into the ultimate products that are beneficial to our citizens. Their efforts have resulted in a constantly increasing standard of living and have provided a continuing impetus to help maintain our cherished freedom.

This week will direct our attention to the engineering profession and permit us, once again, to appraise the position of engineering in our way of life.

Sincerely yours,
VERNON W. THOMSON
Governor

Minutes of the Meeting of Board of Directors

By unanimous action the Board of Directors wishes to express its appreciation to Karl O. Werwath and his committee for the excellent program that they developed for the 14th annual meeting and also votes a commendation to Karl O. Werwath and his committee.

Willard S. Cottingham was appointed to complete the unexpired term of Richard C. Clark (deceased) as National Director. The State Society will now authorize the payment of the expenses of one National Director's expenses at the same rate that the National Society reimburses a National Director to their meetings.

The President of WSPE, with consultation of his Directory Committee, was empowered by board to authorize up to $1500 for publication of directories sufficient to provide each member and new member with a free copy. Additional copies may be made available to functional group members in quantities which they subscribe and agree to pay for at a price not less than the cost of the directory. President is empowered to confer with functional groups on makeup of a directory.

A resolution will be directed to the National Society that the eminence clause in the Ideal Registration Law be deleted. This is to be worded with the advice of our attorney.

Attorney Coates reported that the attorney who represented Kenneth Lemke asked about some reimbursement for his time.

The Board reaffirms prior action which authorized payment of fees for only the Society attorney, a representative of Heft, Brown and Coates, Racine, Wisconsin.

(Continued on page 68)

Meet the President

LEO J. JESELUN

President, Southeast Chapter

A graduate of the University of Wisconsin with a Bachelor of Science in Mechanical Engineering in 1941, Leo J. Jeselun, President of the Southeast Chapter, is the subject of the March Meet the President Series. He was born in Kenosha and it is in that city that he now resides. Mr. Jeselun is employed as a mechanical and electrical engineer for American Motors Corporation. He was employed from 1941 to 1943 as a field engineer for Johnson Service Co. He then joined Nash–Kelvinator (now American Motors Corp.) in 1943.

Leo Jeselun has served W.S.P.E. as chairman of the program committee, he was chairman of the 1956 summer Conference and served on the registration promotion committee. He has been a participant in the annual power conference held in Chicago.

Mr. Jeselun is a Charter member of the Wisconsin Alumni Club of Kenosha. He also served this organization as vice president and member of the board of directors. While at the University, Mr. Jeselun was president of the Wisconsin Chapter of Triangle Fraternity.

Fishing, bowling and golf occupy some of Leo Jeselun's spare time. He also enjoys watching football.

W.S.P.E.

(Continued from page 66)

Meeting was recessed until Saturday, January 26, 1957.

At recessed meeting Past President Ayres was authorized to make arrangements for a program whereby representatives of the Registration Board present the certificates of registration at area meetings.

Next meeting Engineer Society of Milwaukee Building at 9:30 A.M. on March 16, 1957.

Respectfully submitted,
HAROLD N. KINGSBURY
Secretary-Treasurer

Financial Statement for the Year 1956

STATEMENT OF FINANCIAL CONDITIONS AS OF DECEMBER 31, 1956

Assets:		
Cash	$1,664.52	
Bond Purchase Value as of June 30, 1956	3,275.30	
		$4,939.82
General fund balance 1/1/56	$4,071.69	
1956 Net Gain	868.13	
		$4,939.82

SUMMARY OF OPERATIONS

General Operations:		
Receipts		$24,975.74
Remittances		14,835.25
Available for general operations		$10,140.49
Conventions:		
Receipts	$ 2,962.27	
Expenses	4,507.19	
Loss	$ 1,544.92	
Net Gain:		
Bond Value		88.40
Net Gain:		
Bank Account		779.73
Net Gain	$	868.13

EXPENSES OF SECRETARY'S OFFICE

Secretary's Honorarium	$ 1,200.00
Secretarial Help	596.34
Social Security	35.93
Security Bond	30.00
Petty Cash	200.00
Stationery and Printing	488.90
Addressograph and Mimeographing	116.64
Supplies and Miscellaneous	343.16
Telephone and Telegraph	11.94
Total	$ 3,022.91

GENERAL EXPENSES

President's Expenses	$ 18.63
Board of Directors Expenses, Minutes of Meetings, Engineer Week Pins, Legal Fees	942.27
National Rep. Expenses	351.28
Total	$ 1,312.18

EXPENSES OF COMMITTEES

Awards	$ 35.28
Auditing	55.00
Defense	0.00
Education	38.08
Ethics and Practice	0.00
Fees and Classifications	32.00
Legislation	0.00
Membership	170.45
Nominating	175.42
Program	134.60
Publication	1,647.19
Directory	0.00
Public Relations	0.00
Registration Promotion	182.00
University Cooperating	0.00
Interprofessional	0.00
Total	$ 2,595.96

During the course of this past year January 1, 1956 to December 31, 1956 the Board of Directors held ten regular meetings to carry on the business and direct the activities of the Society. Minutes of these meetings were forwarded to all committee chairmen, the presidents and secretaries of each chapter, the National Representatives, and the regular members of the Board of Directors.

Meetings were held in Milwaukee, Fond du Lac, Madison and Genoa City (Nippersink Manor) on the following dates:

January 7, January 26, March 3, April 7, May 4, June 16, July 14, September 14, October 27 and December 8, 1956

At the Summer Conference the membership revised the constitution to provide for a retirement classification, a clarification of a delinquent member, and the reinstatement of a member.

(Continued on page 74)

STATEMENT OF OPERATIONS 1956

Receipts					
Dues (Back, Current, Advance) and Admission Fees				$22,256.50	
Contributions				900.00	
Miscellaneous				934.45	
Total General Receipts					$24,090.95
Less Remittances to National and Chapters:					
	Dues	New Members	Total		
NSPE	12,212.00		12,212.00		
Fox River Valley	361.75	44.00	405.75		
Southwest	539.75	98.00	637.75		
Southeast	150.25	10.00	160.25		
Milwaukee	920.25	58.00	978.25		
Wisconsin Valley	95.75	14.00	109.75		
Northwest	134.50	12.00	146.50		
Western	134.50	16.00	150.50		
Lake Superior	8.00	8.00	16.00		
Waukesha	8.50	10.00	18.50		
					$14,835.25
Conventions:					
Total Convention Receipts				2,962.27	
Total Convention Expenses					4,507.19
Disbursements					
Expenses of Committees				2,595.96	
Expenses of Secretary's Office				3,022.91	
General Expenses				1,312.18	
Total Disbursements					6,931.05
Bank:					
On Hand Dec. 31, 1955				884.79	
On Hand Dec. 31, 1956					1,664.52
				$27,938.01	$27,938.01

Presentation of citations to outstanding high school science teachers. Recipients were William V. Lieske, Solomon Juneau High School, Milwaukee; Allie F. Schwartz, East Troy High School, East Troy; Major Paul Hegner, St. Johns Military Academy, Delafield. Pictured left to right, Dean Wendt, University of Wisconsin, College of Engineering; Mr. Lieske; Miss Schwartz; John Gammell, Chaiman, W.S.P.E. Education committee; Major Hegner; Dean Drought; Dean Zeeland.

CAREERS WITH BECHTEL

GORDON ZIMMERMAN, *Chief Process Engineer, Refinery Division*

PROCESS ENGINEERING

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

QUESTION: *Mr. Zimmerman, as I understand it, the young engineer joining the Process Engineering Department of the Refinery Division has starting assignments that permit immediate and direct application of the principles he learned in college?*

ZIMMERMAN: That is true. He is immediately assigned to work under the direction of an experienced process engineer who becomes his mentor through most of his training period.

QUESTION: *What will be the nature of his work?*

ZIMMERMAN: It will be fairly technical. Before I go into detail, perhaps a brief description of process engineering might be helpful. We're sometimes called the "Bechtel shock troops." That's because we often go into action before a contract has been signed, not only on refineries and chemical plants, but sometimes on power jobs and pipelines as well. On oil and chemical projects, for example, we determine far in advance of actual construction what materials are to be processed and the end product or products sought. Thus there are always new developments to consider and new and fascinating problems to solve. There is never any monotony in the work we do.

Getting back to the new process engineer—in effect, he becomes a calculator for his mentor who sets up problems and turns them over to his protege for solution. The young engineer handles sketches, diagrams and tabulations of information which he returns to the experienced engineer.

QUESTION: *In other words, the young man has no responsibilities other than to his supervisor and himself?*

ZIMMERMAN: That is right. He is given a wide variety of assignments and problems and is trained carefully in procedures and process design methods that are not possible to learn in college.

QUESTION: *Isn't this a somewhat different method of training than is followed in other Bechtel divisions?*

ZIMMERMAN: Yes. It is made necessary by the fact that colleges cannot possibly keep up with the fast-changing methods involved in process engineering. They can teach the principles, but the engineer must learn the methods by actual work with his mentor "looking over his shoulder."

QUESTION: *For how long a period does this close supervision last?*

ZIMMERMAN: It's difficult to generalize where so much depends on the individual. Usually it lasts from a year to eighteen months. During this period the young man is progressing steadily to more difficult and interesting assignments and to more and more individual responsibility.

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

Write for new brochures showing the wide variety of projects Bechtel builds throughout the world.

Address: John F. O'Connell,
Vice President, Industrial Relations
220 Bush Street, San Francisco 4, Calif.

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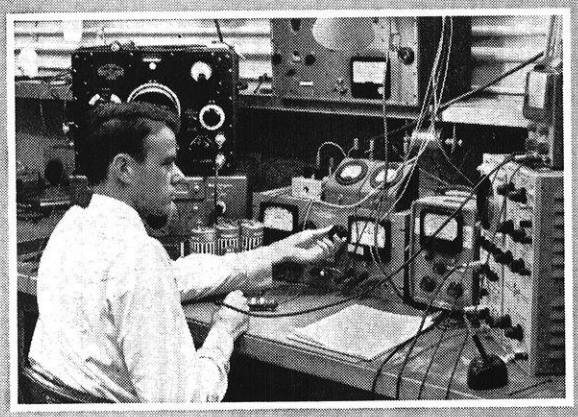
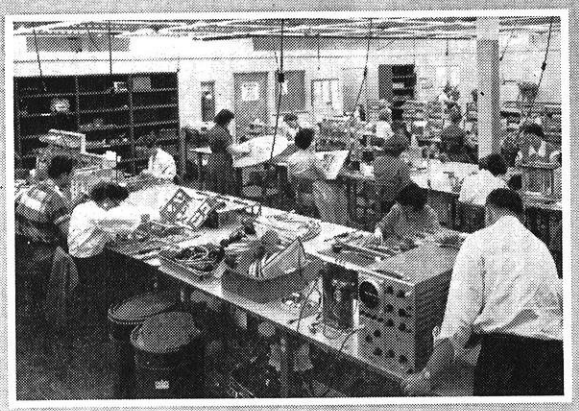
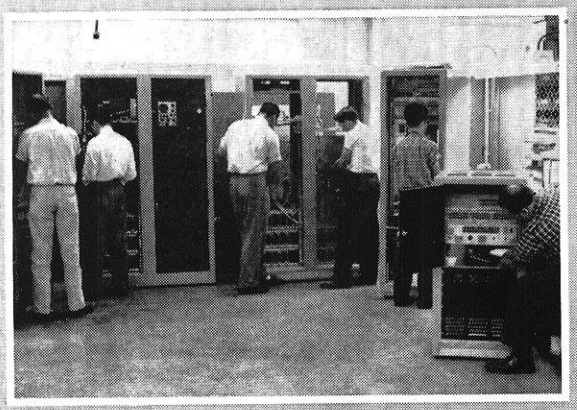


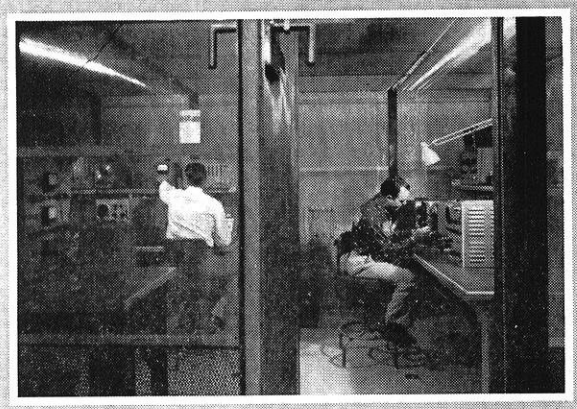
RESEARCH AND DEVELOPMENT



PILOT LINE PRODUCTION



FINAL ASSEMBLY



TESTING IN SCREEN ROOM

COMMUNICATIONS at Ramo-Wooldridge

Communications activities at The Ramo-Wooldridge Corporation include research, development, and manufacture of advanced types of radio communication systems, ground-reference navigation systems, and electronic countermeasure systems. Major programs are in progress in each of these fields.

New and unusual techniques have been employed to provide systems having a high order of security in the transmission of information, broad flexibility in combating unfavorable signal propagation conditions, and substantially greater information capacity per operating channel.

Some of the techniques used have made possible an increased range for given levels of transmitter power and reliability of communications. Others have provided specific advantages in very long distance communications or in operational situations requiring unique signaling capabilities. Developments in navigation systems have resulted in new equipment that is suitable for the guidance of aircraft at long ranges from their bases.

In the work currently under way, some systems are in the laboratory development stage, some in the flight test stage, some are in production. Several types of systems developed and manufactured by Ramo-Wooldridge are in extensive operational use.

Openings exist for engineers and scientists in these fields of communications activities:

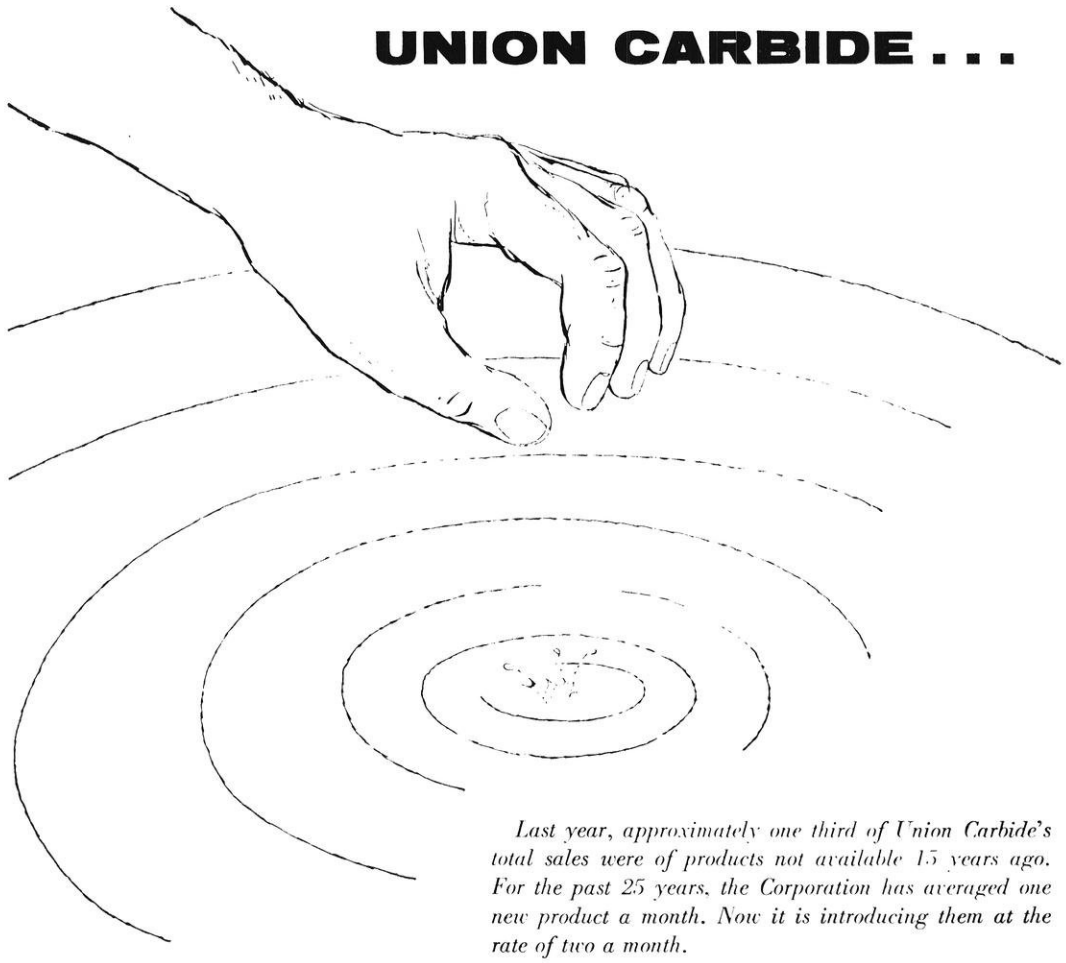
- Systems study and analysis
- Airborne transmitters
- Transistorized video and pulse circuitry
- Airborne receivers
- Reconnaisance systems
- Digital communications systems

The Ramo-Wooldridge Corporation

5730 ARBOR VITAE STREET • LOS ANGELES 45, CALIFORNIA

Ideas grow and grow at

UNION CARBIDE . . .



Last year, approximately one third of Union Carbide's total sales were of products not available 15 years ago. For the past 25 years, the Corporation has averaged one new product a month. Now it is introducing them at the rate of two a month.

Ideas born in Union Carbide Laboratories grow . . . from exploratory and fundamental research to applied research and product and process development . . . through pilot plants to production to sales. In all these fields the Divisions of Union Carbide need engineers, chemists, physicists, and business and liberal arts majors. For more information write Co-ordinator of College Recruiting.

UCC DIVISIONS INCLUDE:

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

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

No blue sky...just to back up our belief that you and Collins

We're going to build a proposition which we believe deserves your most serious consideration, if you are a mechanical or electrical engineer. This proposition is built on pure and simple fact—no high flown promises or broad generalities. Our proposition: you and Collins should get together. We present these facts to support it.

FACT NUMBER 1:
Collins Radio Company's sales have increased 10 fold in each of three successive seven year periods. 1933 sales were $100,000; 1940 sales, $1,000,000; 1947 sales, $10,000,000; 1954 sales, $100,000,000, and 1956 sales, $126,000,000. (Note graph.) This company *has grown, and is growing* at a phenomenal rate. Total employment is 9,000 of which 24% are research and development personnel.
You grow when the company you work for grows.

FACT NUMBER 2:
As shown in the graph at right, the employment of research and development personnel has increased steadily despite fluctuation in sales. Notice that even during periods of national sales regression Collins continued to strengthen its engineering staff.
Collins has based its growth on the solid foundation of stability in the engineering department.

FACT NUMBER 3:
At Collins, the ratio of engineers to total employees is extremely high, far higher than the average among established companies engaged in both development and production. First and foremost, Collins is an engineering company.
Engineering is king at Collins—never takes a back seat to production expediency.

FACT NUMBER 4:
Collins' reputation for quality of product is universally recognized. It has led to Collins' phenomenal sales record. At Collins there is no compromise when quality is at stake.
If you're the man we want, you'll get real satisfaction out of this quality-consciousness.

FACT NUMBER 5:
Electronics is Collins' only interest. In no way is it subsidiary to the manufacture of industrial or consumer products. Collins builds electronic equipment, not airplanes or vacuum cleaners. Every research, development and production facility is devoted to progress in electronics.
If electronics is your interest, you'll like the climate at Collins.

FACT NUMBER 6:
There is a limitless variety of fields and types of work for the Collins engineer. Recent Collins work in air and ground communication, and aviation electronics include developments in transhorizon "scatter" propagation; single sideband; microwave and multiplex systems; aircraft proximity warning indicator; aviation navigation, communication and flight control; broadcast; and amateur equipment.

There is big opportunity for <u>your</u> special talents.

Right now we are prepared to offer you a technical or supervisory assignment in one of many interesting fields. And the sky *is* the limit as far as responsibility and salary are concerned.

You will work in one of Collins' new research and development laboratories located at Cedar Rapids, Iowa; Dallas, Texas; and Burbank, California. Offices and subsidiary companies are located in New York; Washington, D. C.; Miami; Knoxville; Seattle; Hickman Mills, Missouri; Toronto, Canada; London, England; and South America.

All your moving expenses are paid. Company benefits are tops in the industry.

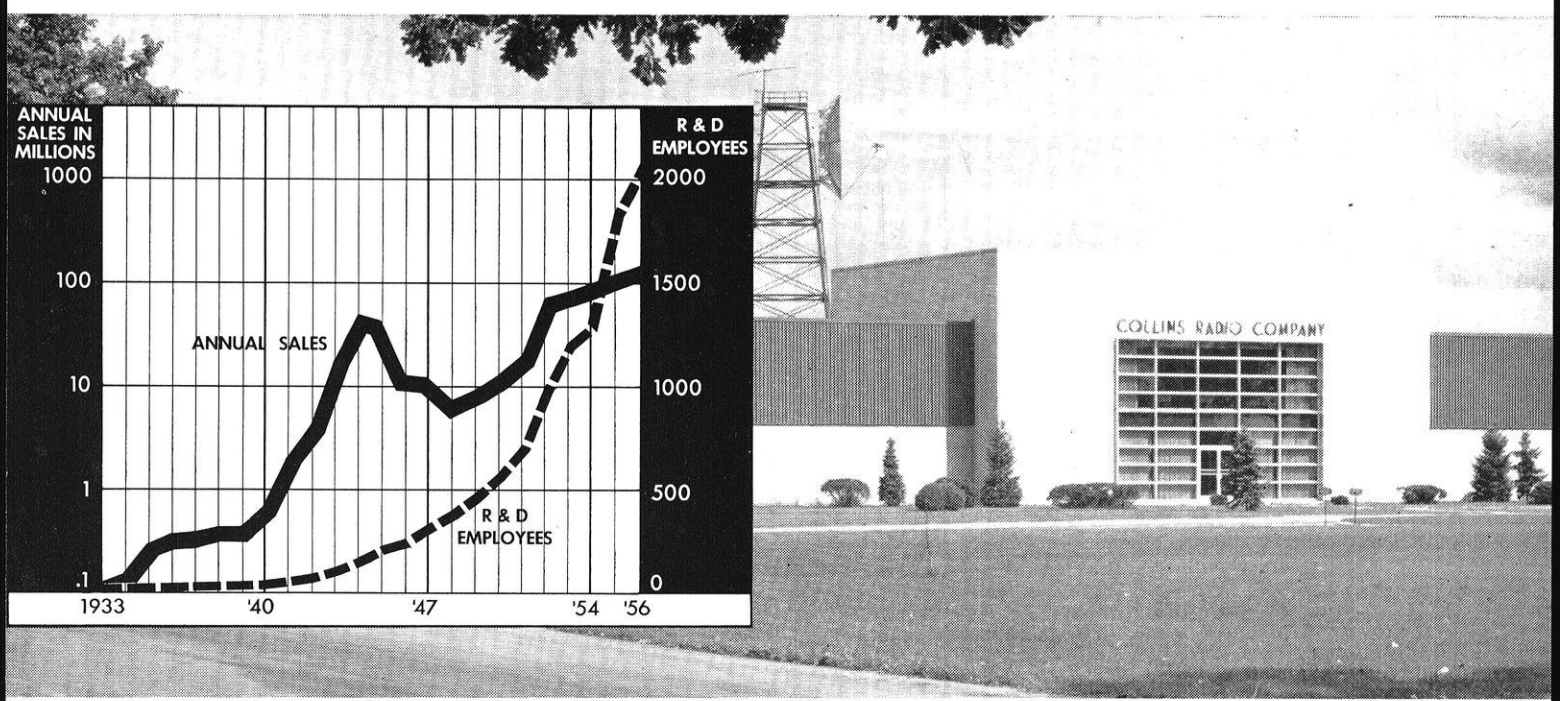
We repeat—if you are a mechanical or electrical engineer, you and Collins should get together. Take the first step now, for more information, write:

L. R. Nuss
Collins Radio Co.
Cedar Rapids,
Iowa

Fred Aiken
Collins Radio Co.
2700 W. Olive Ave.
Burbank, California

Harold McDaniel
Collins Radio Co.
1930 Hi-Line Drive
Dallas, Texas

black and white facts should get together



This graph shows the relationship between sales and employment of engineering personnel at Collins. Notice the steady increase in research and development employment despite sales fluctuations.

Collins new research laboratory building at Cedar Rapids, Iowa. Air-conditioned, shielded against radio waves, completely equipped.

Collins

CREATIVE LEADER IN ELECTRONICS

COLLINS RADIO COMPANY • CEDAR RAPIDS • BURBANK • DALLAS

COLLINS

W.S.P.E.

(Continued from page 68)

MEMBERSHIP REPORT

January 26, 1957

Total Members and Affiliate Members as of January 28, 1956		
Members	1,150	
Affiliate Members	119	
Total	1,269	
Losses since January 28, 1956		
Deceased Members	16	
Dropped (Non Payment)		
Member	39	
Affiliate		6
Resigned		
Member	62	
Affiliate		5
Transfer to other states	1	
	118	11
Change of Classification		
Affiliate Members to Members		15
Members to Retired	4	
Additions		
Members	112	
Affiliate Members		31
Reinstatements		
Member	7	
Affiliate		1
Total Members, Affiliate Members and Retired Members		
Members	1,159	
Dues Exempt	3	
Retired	4	
Affiliate Members	125	
	1,291	

BOARD OF DIRECTORS ACTIVITIES

The following applications for members and affiliate members were accepted by the Board of Directors. To these new members we extend our most hearty welcome.

Name and Position	Address	Reg. No.	Sponsor
SOUTHEAST Arthur Gerard Budnik Park Engineer City of Racine	3662 Carter St. Racine, Wis.	E-6008	N. C. Johnson
SOUTHWEST Robert Charles Kraft Eng. Design and Super. Weiler & Strang	810 Univ. Bay Dr. Madison 5, Wis.	E-5643	J. J. Weiler
Reinstatement John Gordon Thompson City Engineer City of Madison	1811 Jefferson St. Madison 5, Wis.	E- 565	P. A. Johnson
MILWAUKEE Robert Eul Meiling CE III, Expressway Div. Milwaukee County DPW	9626 W. Dakota St. Milwaukee 19	E-5648	J. Lovercio
FOX RIVER VALLEY Donald O. Barth Ass't. Chief Eng. Unit Structures, Inc.	Unit Structures Inc. Peshtigo, Wis.	E-6078	J. C. VanDyke
Robert Earl Radtke County Highway Eng. Fond du Lac County Highway Dept.	22 S. Seymour St. Fond du Lac, Wis.	E-6243	E. Bray

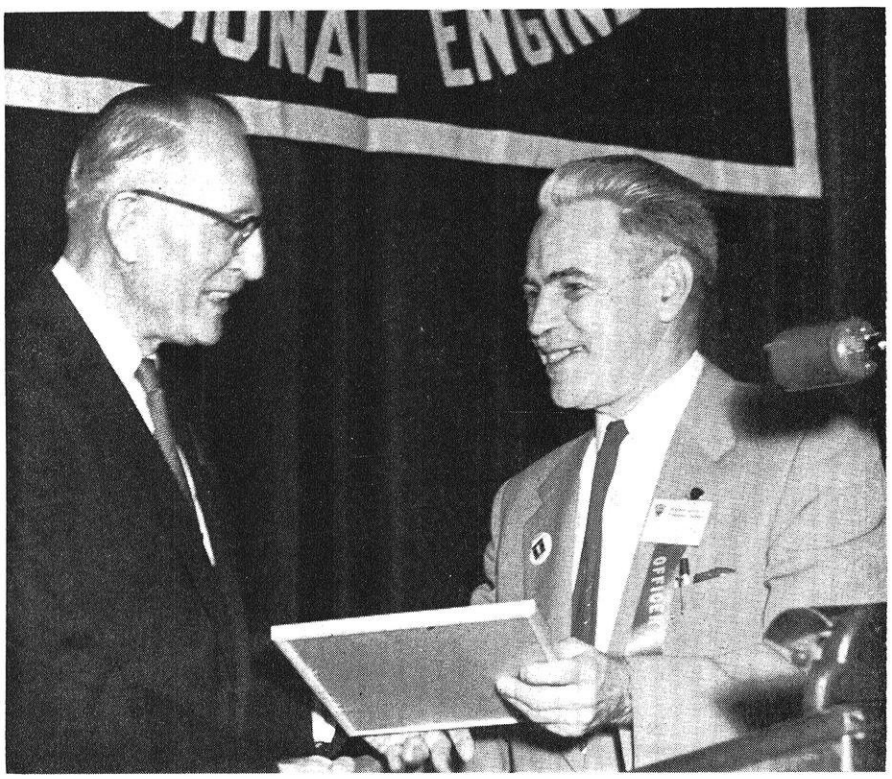
WESTERN CHAPTER

The program for the annual meeting of the WSPE at Milwaukee was outlined by WSPE vice president Clifford Nelson at the Western chapter's January 15 meeting. Among those attending the meeting were to be president James Johnson, Frank Carlson, Clifford Nelson and Carl Wahlstrom.

Announcement was made of the transfer of Merlin Eklund to the Eau Claire office of Northern States Power Company.

The following officers have been elected for the coming chapter year: John Mangan, president; E. Ted Neubauer, vice president; Robert Koenig, secretary-treasurer; Richard Brindley, director for three years, Manford Hanson, director for two years; and Norman Moser, director for one year.

After the business meeting, program chairman Richard Brindley introduced Ted Neubauer, chapter member and chief engineer in charge of reciprocating compressors at The Trane Company in La-Crosse, who traced the development of the reciprocating and centrifugal compressors in the air conditioning industry. Neubauer cited the trend from the low-speed bulky unit to the modern high-speed and quiet-operating compressor as exemplified by Trane's Centravac.



George P. Steinmetz was named the outstanding engineer of 1956 by the Wisconsin Society of Professional Engineers at the Annual Banquet January 25, 1957. Steinmetz (left) is shown receiving the certificate from A. G. Behling, W.S.P.E. President. The certificate read, "In recognition of the eminent services and professional contributions of George P. Steinmetz to the Engineering Profession, to the Society as committee chairman, Director and President, to the Military Affairs of the Nation and to the Public Welfare, awards this Testimonial."

Slides were shown on the relative horsepower per ton requirements for the various sizes of machines, and the graphical results indicated the new freon refrigerants such as F–113 have contributed much to the increased efficiency of both types of compressors.

Neubauer emphasized the role of research in compressor development and stated that still further progress was being made toward improved machines.

FOX RIVER VALLEY CHAPTER

HERBERT C. NELSON

Mr. George P. Steinmetz, chairman of the Wisconsin Public Service Commission, was the principal speaker at the Fox River Valley Chapter meeting at the American Legion Club, Oshkosh, on Feb. 20. Mr. Steinmetz discussed the implications of the 1957 Engineers' Week slogan "Engineering, America's Greatest Resource".

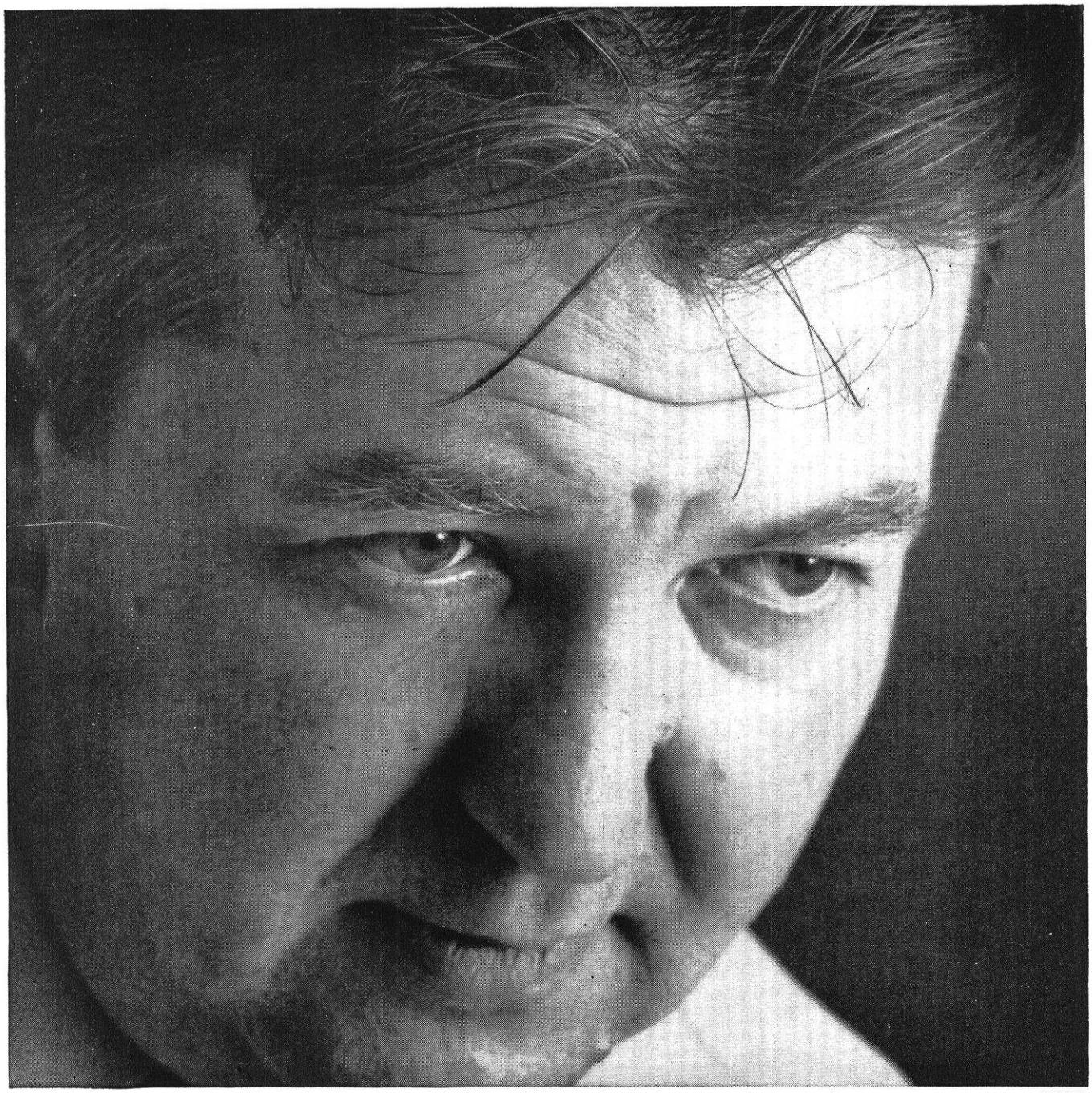
Mr. R. W. Frazier of Oshkosh was in charge of the local arrangements.

WISCONSIN VALLEY CHAPTER

Many and varied activities were sponsored by the Wisconsin Valley Chapter in observance of National Engineers' Week. A special dinner meeting was held at the Wausau Hotel on February 20, 1957. After this, a High School Engineering Career Night was organized for all interested high school students from the three Wausau high schools. The film "The American Engineer" was shown followed by a panel discussion covering the various fields of engineering.

A display featuring the tools of the engineering profession, President Eisenhower's letter, and posters was placed in the Wisconsin Public Service Corporation's downtown window in Wausau. In addition to this speakers were offered to the high schools.

(Continued on page 78)



YAVNO

...on the second language

"Our first language is English. Our second is Mathematics. Not all of us are truly bilingual, but probably all are versed in a few concepts of Mathematics — that of a function, for example. The majority of us know those fields of mathematical analysis which developed with the physical sciences well enough to use them as the principal tools of our professions. A minority of us — the professional mathematicians — have pushed on to ground which may never become a public park, but parts of which are clearly exciting. Some strive to master electronic computers which already compress thousands of arithmetical operations into a second. Others, with the sharpest tools of modern Mathematics, carve out fields for use where human elements and decisions are paramount, and for use on problems which could be solved by enumeration, if life were long enough — life of the Universe, that is."

— J. D. Williams, Head of the Mathematics Division

THE RAND CORPORATION SANTA MONICA, CALIFORNIA

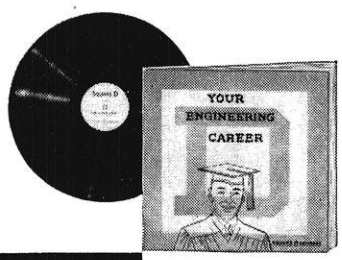
A nonprofit organization engaged in research on problems related to national security and the public interest

We'd like to send you this record!

No matter what branch of engineering you're following—no matter which phase of engineering interests you most—we want you to know SQUARE D and what we have to offer. Of special interest to you, we believe, is the "*human touch*" side of our Company. There are some things you simply can't evaluate in terms of cold facts and figures. A company's basic philosophy, for example ...its attitude and approach to its customers and to its working team.

The "*Human Touch*" record we want to send you deals with some of those intangibles—musically. We think you'll enjoy it.

mail this coupon for your "*Human Touch*" record



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I'd like a "*Human Touch*" record and a copy of Square D's brochure, "YOUR ENGINEERING CAREER"

I am primarily interested in ☐ Research, Design & Development Engineering ☐ Manufacturing Engineering ☐ Sales Application and Field Engineering

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SQUARE D COMPANY

W.S.P.E.

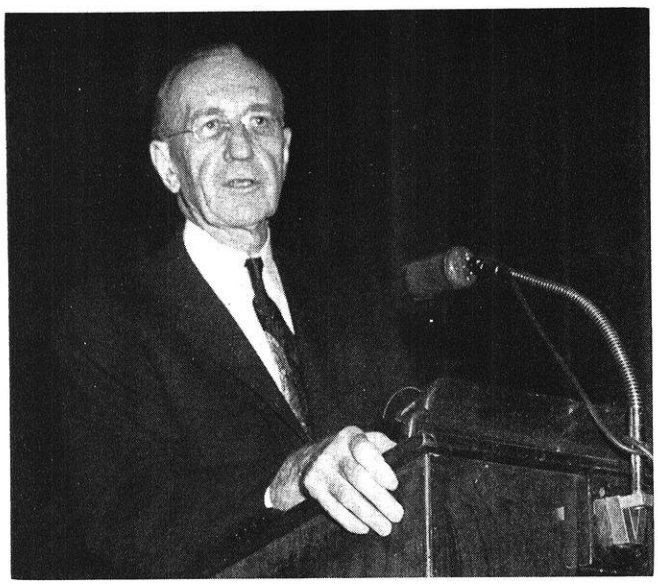
(Continued from page 75)

SCENES FROM THE 14TH ANNUAL W.S.P.E. CONVENTION

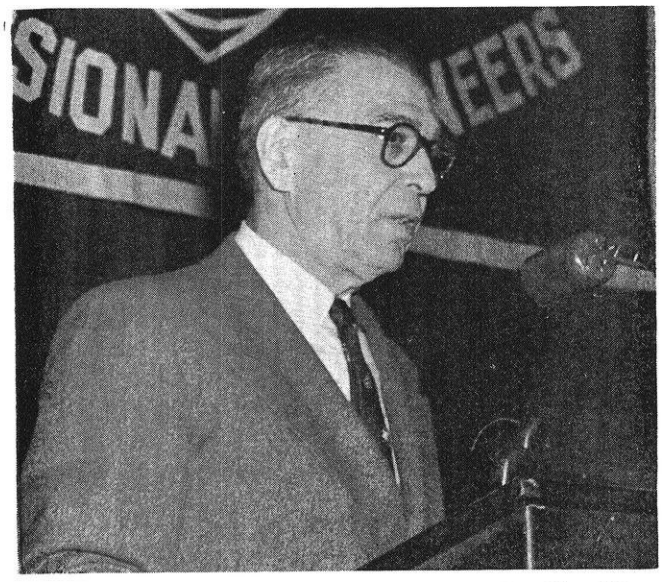
JANUARY 24, 25, 26, 1957

W.S.P.E. officers for the coming year were elected at the Saturday afternoon meeting of the Annual Meeting. Shown left to right are, Harold N. Kingsbury, secretary-treasurer; A. L. Genisot, President; Harold Trester, Second Vice-President; Clifford Nelson, First Vice-President.

Robert J. Rhinehart, President of N.S.P.E., spoke on "Today's Professional Engineer" at the Friday night banquet.



Dr. Howard L. Bevis, chairman of the president's national committee for the development of scientists and engineers, spoke of the shortage of scientifically trained personnel in this country.



Major Gen. J. S. Bragdon, special assistant to President Eisenhower and national coordinator of public works planning, spoke at the Friday night banquet on the need for co-ordinated planning of public works.

Progress and Diversification

AT PITTSBURGH PLATE GLASS COMPANY

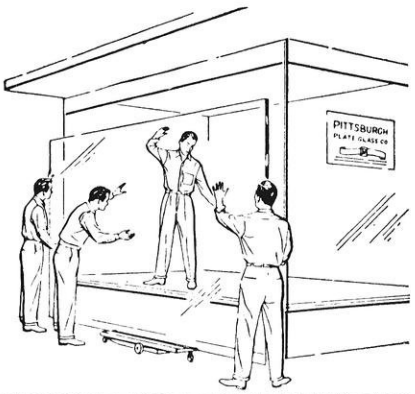
The year 1956 was a good one for the Pittsburgh Plate Glass Company—and the Company looks confidently to 1957 as another year of progress in its widely diversified fields of operations.

PAINTS & PLASTICS

Many new products, including Duracron acrylic enamel were introduced in 1956 for both consumer and industrial use. Additional capacity is being planned in 1957 for Selectron Plastics, a series of versatile thermosetting resins.

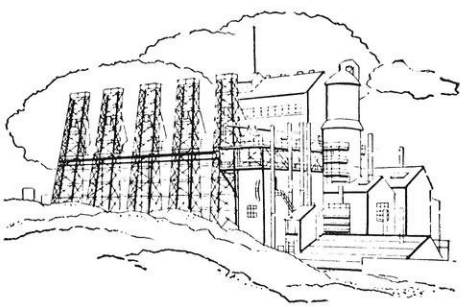
GLASS

Window and plate glass plants operated at capacity in 1956. Partial production was started at Pittsburgh Plate's new Cumberland, Md., plate glass plant.



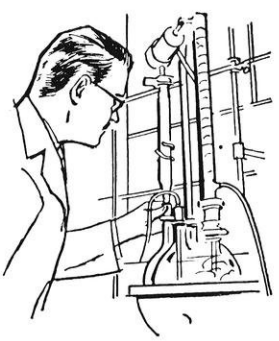
CHEMICALS

During 1956, wholly-owned subsidiary, Columbia-Southern Chemical Corporation, began operating a titanium tetrachloride plant at Natrium, W. Va. A new trichlorethylene plant was completed at Barberton, Ohio.



FIBER GLASS

Production facilities for both Superfine and textile fibers were expanded during 1956 at the Company's Shelbyville, Indiana plant.



RESEARCH & DEVELOPMENT

Expanded facilities in new and modern laboratories, plus growing budgets, assure new and improved glass, paint, chemical and other products. New techniques and equipment, perfected by research and development teams, are helping speed production. These forward-looking programs not only mean continued progress at Pittsburgh Plate and Columbia-Southern, but also better products and service for the customer.

OUTSTANDING CAREER OPPORTUNITIES

Progress and diversification at Pittsburgh Plate is providing excellent career opportunities for qualified graduates. If you are interested in putting your talents and initiative to work where they will be respected and rewarded, by all means look into your career possibilities with Pittsburgh Plate Glass Company. Write to General Personnel Director, One Gateway Center, Pittsburgh 22, Pa.

PAINTS • GLASS • CHEMICALS • BRUSHES • PLASTICS • FIBER GLASS

PITTSBURGH PLATE GLASS COMPANY

Mulling Over these Questions about your First Job?

Check Republic Aviation's Answers

Will the company I choose boost my professional reputation?

A REPUBLIC has been pioneering new concepts in aircraft design for over 25 years. Our present production plane is the most advanced fighter-bomber in the U. S. Air Force—the incredible F-105 Thunderchief. Our Guided Missiles Division is investigating the upper atmosphere and advanced satellite problems; and have created the first portable, inexpensive rocket, Terrapin.

Are the assignments interesting?

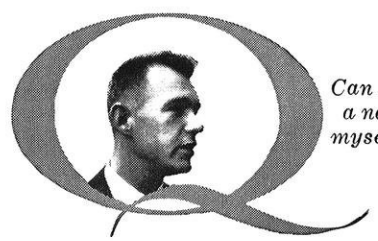
A Our engineers are working ten years ahead . . . which means that every project you're assigned to is at a research or developmental level. And you get a crack at responsible assignments from the start . . . modern facilities to test out your ideas . . . with engineering aides to do the routine work.

Are there good men on the team?

A Well — for one — there's Alexander Kartveli, Vice President, Research & Development, who sparked the Thundercraft series. There's Dr. Theodore Theodorsen, for another — among whose accomplishments is the theory of wing-flutter — who heads our Scientific Research Group . . . and there are hundreds of other engineers and scientists of major stature.

Does the location suit a modern way of life?

A You'll live on Long Island with its fabulous beaches and parks — less than an hour from New York City's cultural and entertainment facilities . . . giving a man the best combination for a well-rounded life...and enough money to enjoy it — coupled with a benefit program that's a model for the industry.



Can I make a name for myself?

A Only you can answer that . . . and your talent is the key. But everything that is possible for a company to do — for you to achieve your maximum potential — REPUBLIC does . . . including attendance and presentation of papers at professional meetings and advanced studies at prominent universities and colleges.

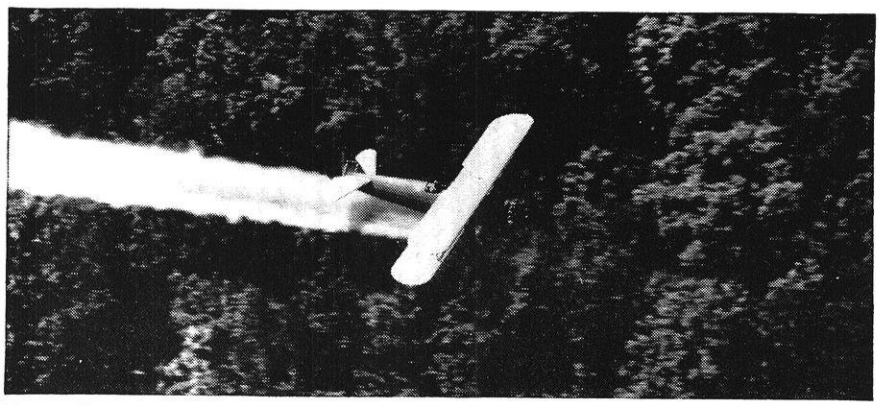
To find out all about our brand new and unique training program see the Republic man when he visits your campus. Make an appointment now with your placement director.

or you may address your inquiries to:

Mr. George R. Hickman
Engineering Employment Manager
Farmingdale, Long Island, New York

REPUBLIC AVIATION

- *farming forests*
- *chromyl chloride*
- *aluminum chloride*



Farming Forests

As Joyce Kilmer put it, "Only God can make a tree," but we are not immodest in saying that now science can make it grow better and faster.

This is the revolutionary concept of silviculture: treating a tree as a crop —for its cellulose content. Its purpose is to make available more and cheaper pulp and paper products.

Forestry has long been held back by the concept that a tree will grow, if it just has enough water. For years we have practiced extractive forestry by cutting down our natural, virgin forests for wood products. When this area is restocked, or when it is farmed and then returned to the growing of trees, the growth is inferior, because plant foods — nitrogen, phosphorous, potassium — have been lost from the soil.

The solution to this problem is simply putting food back into the soil, but most foresters have felt that giving trees nutrients is generally impractical.

To determine exactly how practical it is to fertilize trees, Allied Chemical's Nitrogen Division sponsored a five-year study at North Carolina State College. This pioneering work, just being completed, indicates beneficial effects of plant food on Loblolly pine.

Other recent studies have revealed that fertilization produces a 40 to 65% increase in tree growth, cutting years off the growing cycle of pulp wood. By speeding a tree's growing time, the forester gets a faster turnover of capital and shortens the time the tree is exposed to danger from fires or pests.

Growth is the most dramatic indicator of forest fertilization. But there are many more advantages: an increase in sap and nut production, and in the quality and quantity of seeds; a healthier tree, better able to stave off fungus and pest attacks; a better root system and thicker foliage, making the tree more efficient.

Aerial fertilization is an important economy, for dusting planes can "feed" hundreds of trees in a day.

What is believed to be the first aerial application of a complete fertilizer to a forest recently took place at Rutgers University Dairy Research Farm at Beemerville, N. J. The test, on an 11-acre stand of red pine, was by Rutgers' Forestry Department and Allied's Nitrogen Division.

Fertilizers currently being used in forest studies are ARCADIAN 12-12-12 —a balanced, granular (nitrogen-phosphorous-potash) combination, ARCADIAN UREA 45 — a high analysis, pelleted, 45% nitrogen fertilizer, and ARCADIAN nitrogen solutions.

In conjunction with its field studies, Nitrogen Division is also sponsoring the first world-wide bibliography of forest fertilization with a grant at the College of Forestry of New York University at Syracuse.

This definitive work contains over 600 references, and the important point is that most of them relate studies which show a favorable response to forest fertilization. The Allied Chemical-New York University bibliography demonstrates that it is technically feasible to fertilize our forests. The Allied Chemical-North Carolina test demonstrates that it is economically feasible.

ARCADIAN and SOLVAY are Allied Chemical trademarks

Chromyl Chloride

A new chromium chemical—with many unique properties—has been developed in a high grade of purity by Allied's Mutual Chemical Division.

Chromyl chloride (CrO_2Cl_2) is a volatile liquid, characterized by its cherry-red color, soluble in carbon tetrachloride and similar solvents. In undiluted form it is a strong oxidizing and chlorinating agent, reacting so vigorously with many substances as to cause ignition.

In suitable solvents, many controllable and selective reactions may be carried out between organic materials and chromyl chloride. It is a starting material for making chromium organic compounds, some of which have unique and useful properties as surface coatings and bonding materials.

Until recently, the researcher needing chromyl chloride was required to prepare it himself. Mutual Chemical has since put this interesting chemical in pilot plant production.

Aluminum Chloride

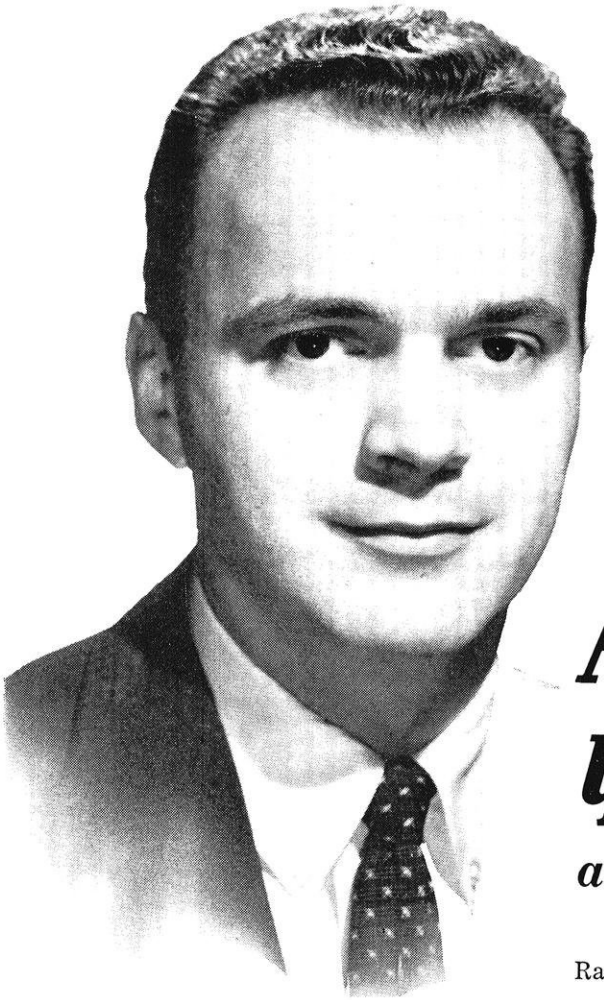
We can only suggest the variety of uses to which aluminum chloride ($AlCl_3$) can be put. It is, for example, a catalyst in chemical synthesis; it promotes reactions in the production of dyestuffs and intermediates, insecticides and pharmaceuticals; most recently, it is finding use for the first time in aluminum plating.

The older and perhaps more often thought of application is in the Friedel-Crafts reaction. SOLVAY anhydrous aluminum chloride is produced as a high quality crystalline solid and is shipped in a variety of granulations.

Creative Research

These examples of product development work are illustrative of some of Allied Chemical's research activities and opportunities. Allied divisions offer rewarding careers in many different areas of chemical research and development.

ALLIED CHEMICAL
61 Broadway, New York 6, N. Y.



Follow the lead of Ralph Posch,
B.M.E., Class of '51

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MR. C. A. BESIO, *Supervisor*, Engineering
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INCORPORATED, Dallas, Texas

Ralph supervises supersonic power system design . . .

Consults on engine accessibility problems . . .

And gets data first-hand.

CHANCE VOUGHT AIRCRAFT
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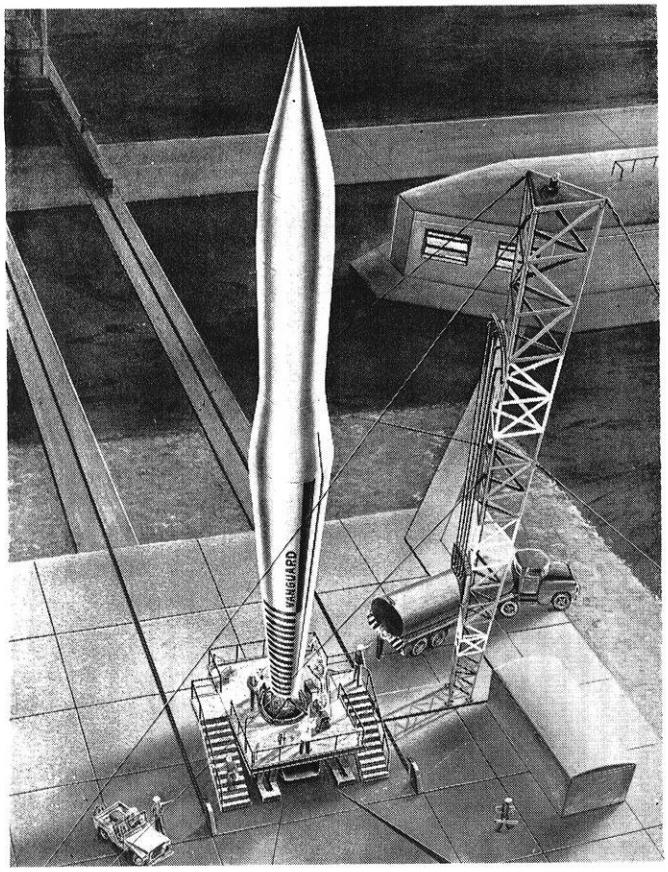


A last minute inspection before launching.

Satellite

(Continued from page 27)

more, this faint image will traverse the entire United States in ten minutes being observable at any particular station not more than a minute.

To derive reports from these naked-eye sightings would be exceedingly risky if not impossible. Consequently, groups of observers will band together at designated spots and watch with wide-angle telescopes. The time and position of each sighting will be forwarded to the Smithsonian Astrophysical Observatory where computers will approximate the next orbit. In this manner photographic and telemetering equipment can be set up correspondingly for maximum effectiveness.

A host of physical, geophysical, and astronomical quantities are expected to be obtained from these observations, and the observations will continue to be made as long as the satellite stays aloft.

The next round of problems created by the earth satellite after it is placed in its orbit are those associated with tracking the satellite by radio techniques and with telemetering scientific information to ground stations.

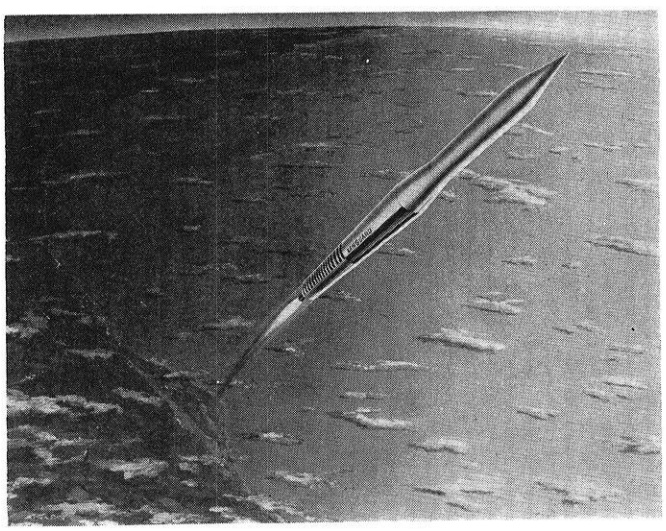
The solution to the first problem is met in the Minitrack System of radio angle tracking developed by the Naval Research Laboratory. "This system utilizes an oscillator of minimum size and weight within the satellite to illuminate pairs of antennas at a ground station which measures the angular positions of the satellite using phase-comparison techniques."

The Minitrack transmitter within the satellite will be a simple minimum weight oscillator with a power output at 108.0 megacycles of between ten and fifty milliwatts. Two developments for this application are currently being tested, one using subminiture low-filament drain vacuum tubes nd the other using transistors. Although the transistor oscillator is one pound lighter, the final choice will depend on the overall operation of the two.

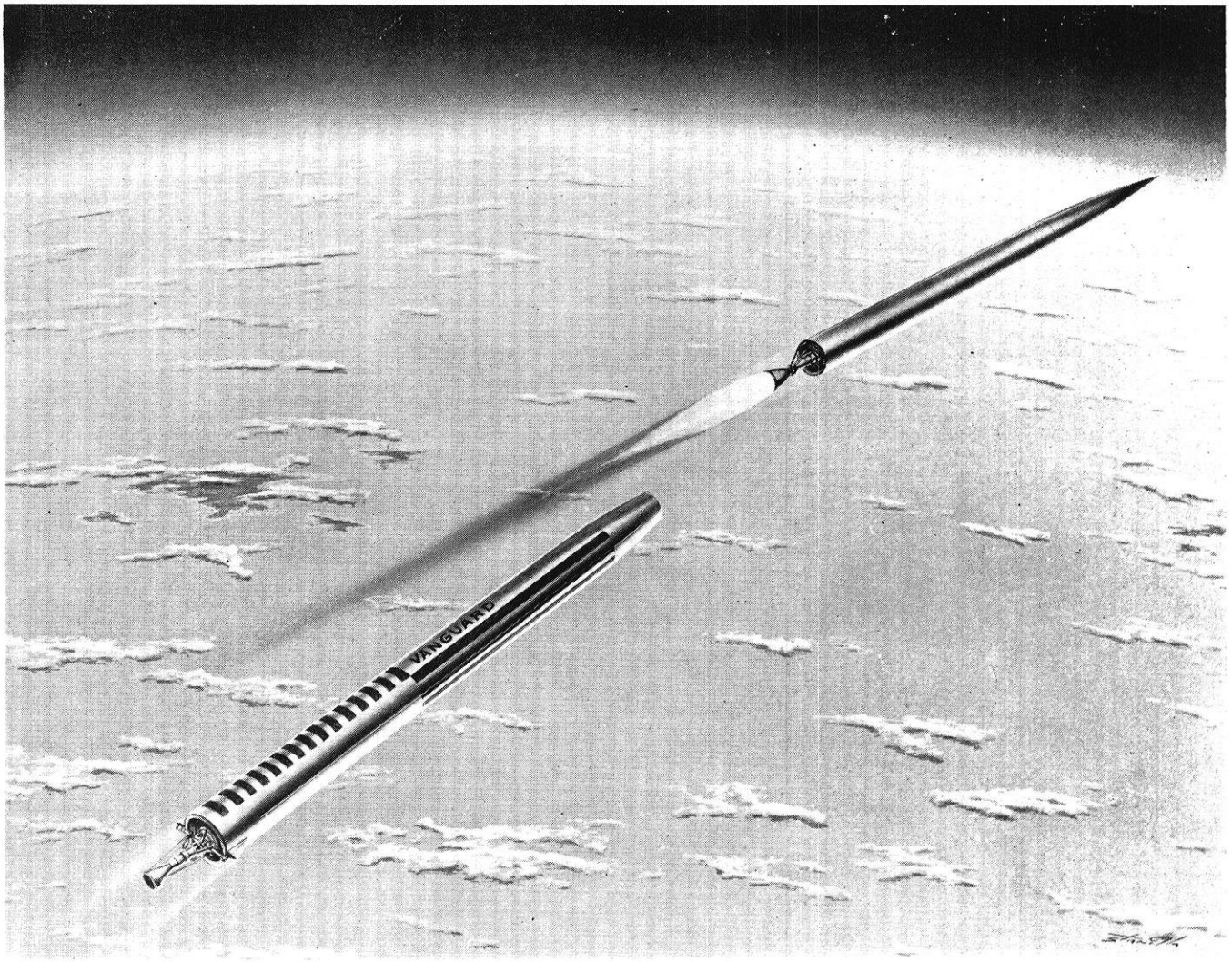
This oscillator will be operating from the time the satellite reaches its orbit until the battery energy is depleted, which, since it consumes little energy, will be about two weeks. During this time, radio tracking of the satellite's path will be undertaken.

Since the process of data transmission from the "bird" (telemetering) requires more power, the second problem was to provide enough power for data transmission for an extended period of time. This problem was solved through a method known as ground command turn-on. This is accomplished by means of a ground transmitter that is energized as the satellite approaches a ground station site.

The satellite will receive the signal by means of a tiny superheterodyne receiver. Upon reception of this signal, the tuned audio amplifier-relay circuit is activated. This relay circuit applies battery voltage to the instruments, the telemetering coder, and the one half watt, code modulated telemetering transmitter, and at the same time removes the low power Minitrack oscillator from the antenna and connects the high power modulated Minitrack oscillator to the antenna. After a delay of about thirty seconds, controlled by the relay circuit, the three circuits are de-energized, and the small power oscillator is reconnected to the antenna.



The rocket under first stage power.



The second stage power plant takes over as the first stage falls off.

By this method the low power Minitrack oscillator and the command turn-on receiver will operate continually for about two weeks, while the telemetering circuits have power capacity for about two turn-ons per orbit of about thirty seconds each, or about three and one half hours total for the two week period.

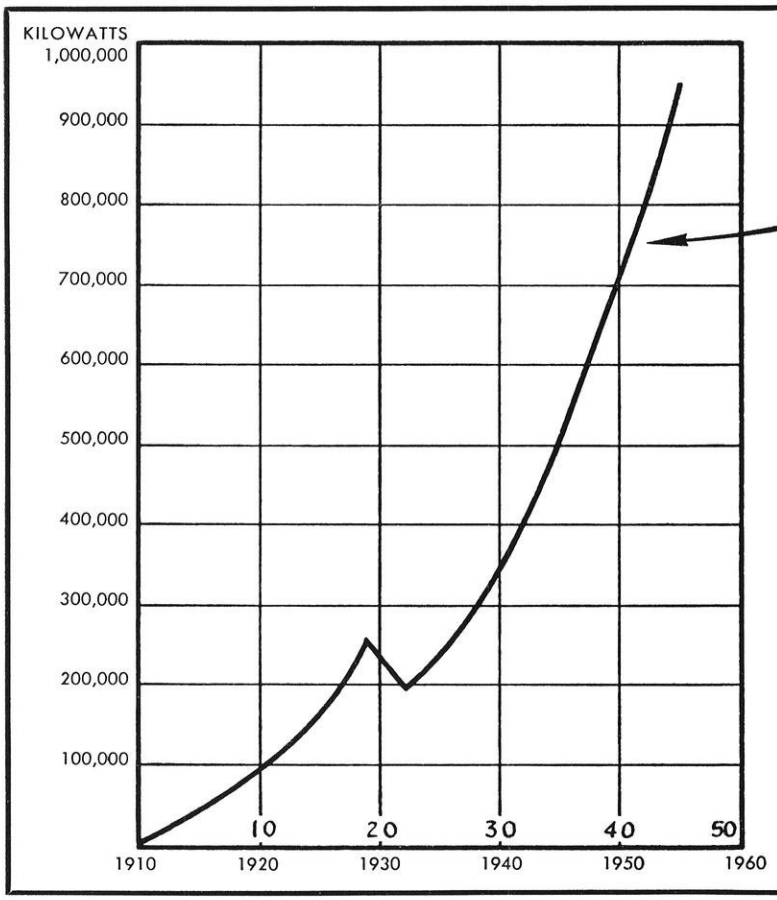
Because it is independent of essentially all weather conditions, visibility conditions, and time of day, radio tracking is much more advantageous than optical tracking. However, radio tracking is possible for only a few weeks due to the energy limits of the power supplies available at the present time, while optical tracking can continue as long as the satellite remains in its orbit.

Methods are being considered employing solar or atomic energy as the power source for energizing the transmitters of the future satellites, and, therefore, a longer operating life will result.

No one knows how long the first man-made moon will stay aloft. It is evident though that forces will eventually cause the satellite to lose its required orbital velocity and it will spiral toward the earth where it will burn up in the dense, lower atmosphere. The three main forces which contribute to its final destruction are gravity, drag, and centrifugal motion. Recent calculations, based on the concept that the first satellite will have the desired elliptical orbit of two hundred mile apogee and an eight hundred mile perigee, say the first man-made moon will have a two hundred day lifetime.

This then is an overall picture of what will be man's first step into the conquest of outer space. The first launching is scheduled to take place at Cape Canaveral, Florida, in January, 1958. Whether this attempt will be a success or a failure is yet to be determined. The scientists and engineers responsible for this project are very optimistic, however, and they are already planning further developments and applications of satellites that will be based on the information obtained from this first launching.

They foresee satellites equipped with photographic or television cameras for surface reconnaisance, radio beam satellites for aids in land, sea, and air navigation, and television relay satellites for use in world-wide television broadcasting. The ultimate goal is a permanent, manned artificial satellite, the home base for interplanetary space travel. **THE END**



$$KW = k\left(\frac{\text{years}}{10}\right)^2 ?$$

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On an average,
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load has
DOUBLED EVERY 10 YEARS

1916 "grads" have experienced this SIXTEEN-FOLD growth:

$$16 = \left(\frac{1956\text{-}1916}{10}\right)^2$$

NOTE the remarkable, exponential-growth curve of Wisconsin Electric Power Company as pictured in the above chart. Not even the deep depression of the 1930's changed it much.

You are invited to begin your engineering career with us. Ride right up to success on an exponential curve like this! An expansion program which contemplates doubling our business and our physical facilities within the next 10 years, presents wonderful career opportunities for young men of skill, vision and initiative.

We need engineering talent in many fields . . . electrical, mechanical, civil, chemical, sales and statistical.

If you have a strong desire to begin using your engineering skills from your very first moment on the job — and to keep on learning as you grow in engineering stature — success is bound to accompany you every step of the way in your Wisconsin Electric Power Company career. Myriads of interest-gripping problems are here for you to solve.

WRITE FOR FURTHER INFORMATION

WE INVITE YOU to find out more about career opportunities at Wisconsin Electric Power Company which serves more than half a million electric customers in 12,500 square miles of Wisconsin and upper Michigan.

Mail the coupon TODAY for more information and for the interesting booklet, "You and Your Future" which describes job opportunities at Wisconsin Electric Power Company. Check the interview schedule at your Placement Office for dates when our representatives will be on your campus.

Mr. Robert Kuchler, Employment and Placement Mgr.,
Wisconsin Electric Power Company
231 West Michigan Street, Milwaukee 1, Wisconsin

Please send me more information about career opportunities at Wisconsin Electric Power Company.

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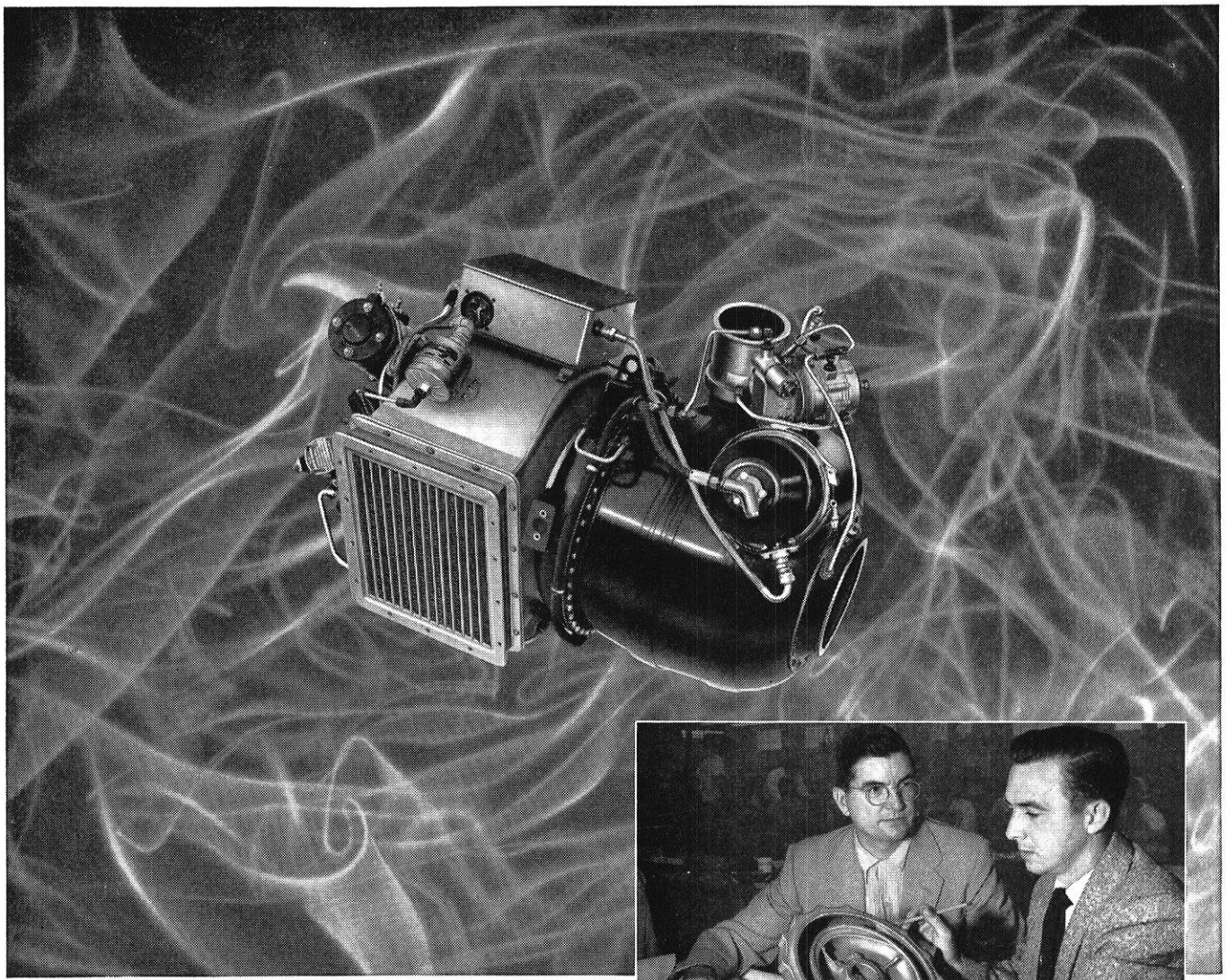
College Recruitment Ad No. 3, 7" x 10"

To the *creative* engineer...



AiResearch two stage lightweight gas turbine compressor provides pneumatic power for aircraft main engine starting and serves as auxiliary power source for a variety of ground and in-flight services.

The rapid scientific advance of our modern civilization is the result of new ideas from creative minds that are focused on the future. Our engineers not only have ideas but have the ability to engineer them into products.

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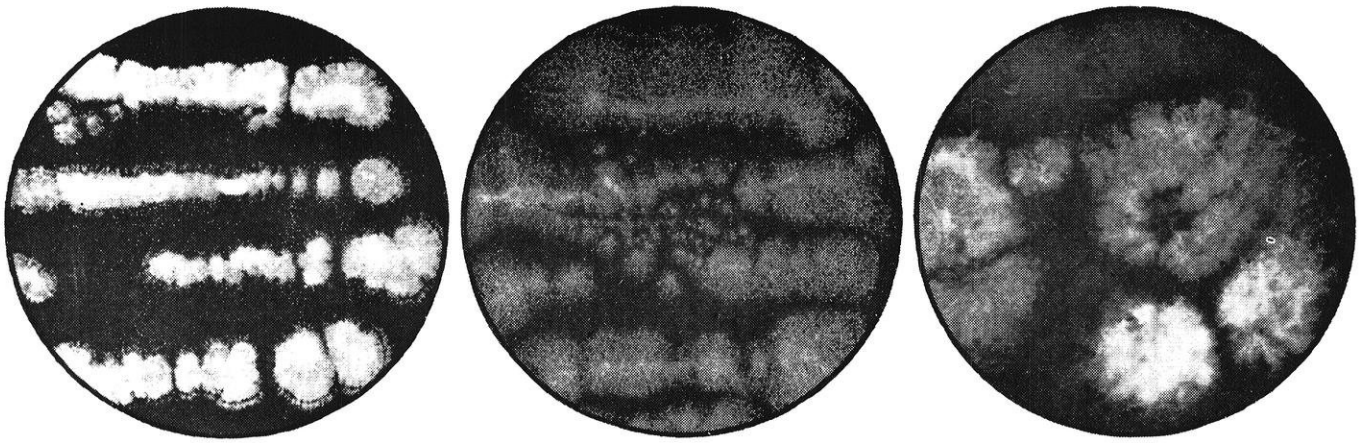
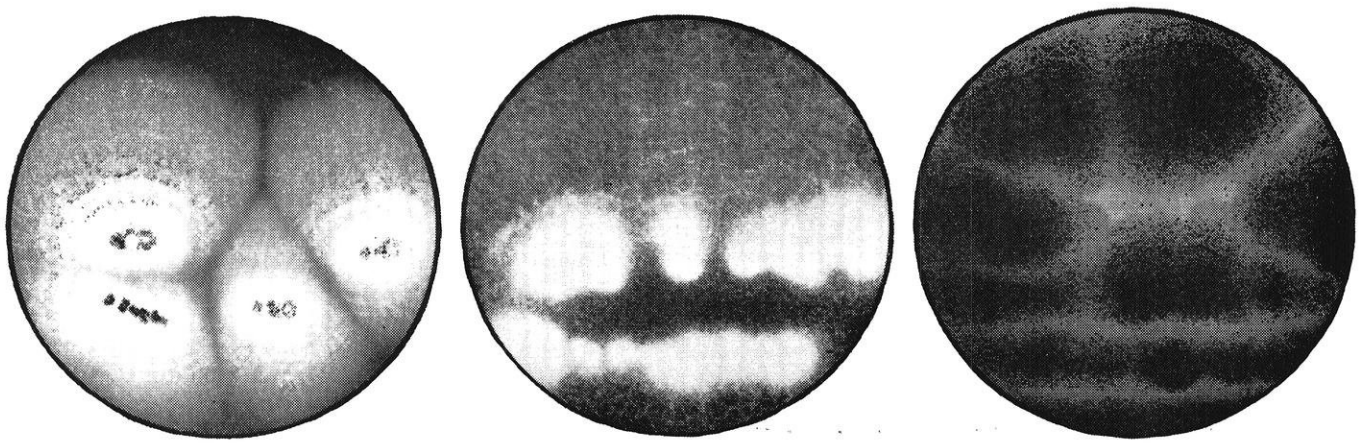


PENICILLIUM CITRINUM | ASPERGILLUS TERREUS | CHAETOMIUM GLOBOSUM



MYROTHECIUM VERRUCARIA | FUSARIUM MONILIFORME | ASPERGILLUS NIGER

And, What Do Fungus Tests Have To Do *with Turbine Aircraft Engines?*

● It's like this. Allison engines today are flying in all parts of the world . . . in sub-zero areas, as well as in tropical areas where the climate is hot and sticky . . . where growth of fungus on electronic parts, for instance, could cause malperformance.

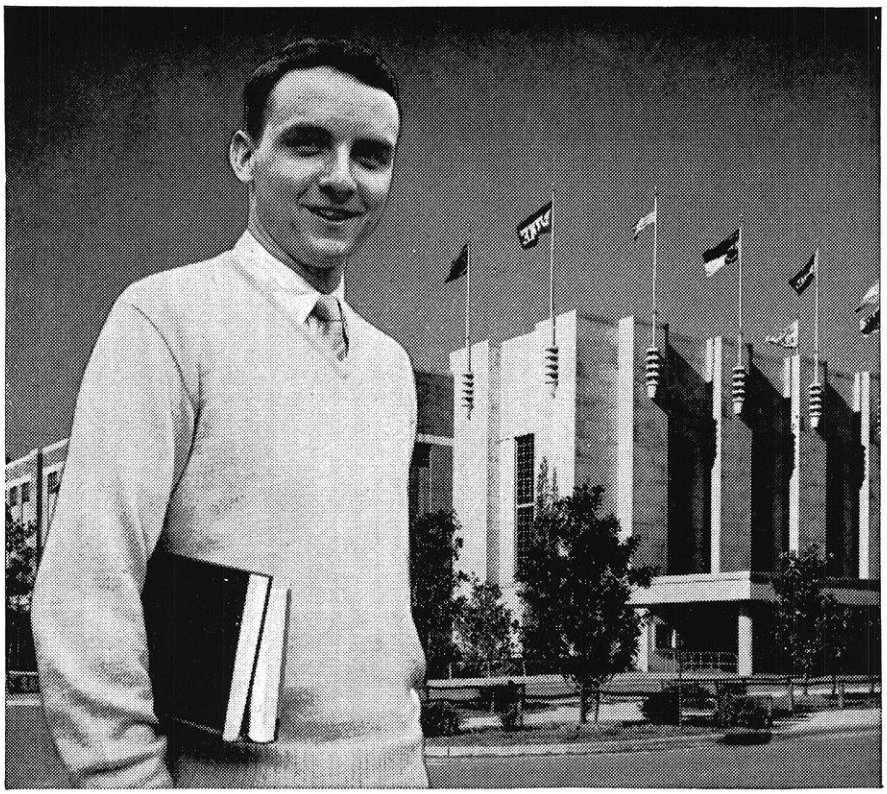
So, the fungus test is one of seven environmental tests conducted on engine components at Allison. Purpose, of course, is to determine whether or not the constituents of the components—such as insulation, or possibly some lubricants—will support fungus. On one engine model, some 50 parts are subjected to the fungus test.

Six types, or clean strains of fungi (above)—representative of those encountered in tropical areas—are kept growing in one of the Allison test labs at all times. Engine components are inoculated with a mixture of fungi spores; then placed in an air tight chamber for 28 days. Specified humidity and temperature conditions are maintained during the required test period. Following the test, components are subjected to a functional test; then disassembled; inspected; decontaminated and returned to the Qualifications Parts Cabinet.

Not too glamorous, this test. But, it does point out the ramifications involved in the production of modern aircraft engines which must perform perfectly under widely varied conditions.

• • •

Allison—a leader in the design, development and production of aircraft engines—is looking for young graduate engineers and technically-trained personnel. Why not arrange for an interview with our representative when he visits your campus. Or, write for information now: Personnel Dept., College Relations, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.



James B. Walker *received his B.S. in mechanical engineering from North Carolina State College in June, 1954, and was working toward his M.S. in the same field when he was called for military service.*

Jim Walker asks:

Can a mechanical engineer make real progress in a chemical firm?

"Pick" Pickering answers:

You might call that a leading question, Jim, but the answer leads right into my bailiwick. I came to Du Pont in 1940, after taking a combined mechanical and electrical engineering course. So I had what you might call a double reason for wondering about my future with a chemical firm.

I soon learned that the success of a large-scale chemical process hinges importantly on mechanical equipment. And the success of this equipment—especially for a new process—depends on (1) Research, (2) Development, (3) Plant Engineering, and (4) Close Supervision. The net result is that a mechanical engineer at Du Pont can progress along any one of these four broad highways to a top-level position.

My own Du Pont experience includes mechanical engineering work in fields as varied as atomic energy, fabrics and finishes, and nylon manufacture. Every one of these brought with it a new set of challenging problems in construction, instrumentation and power supply. And every one provided the sort of opportunities a man gets in a pioneering industry.

So, to answer your question, Jim, a mechanical engineer certainly has plenty of chances to get somewhere with a chemical company like Du Pont.

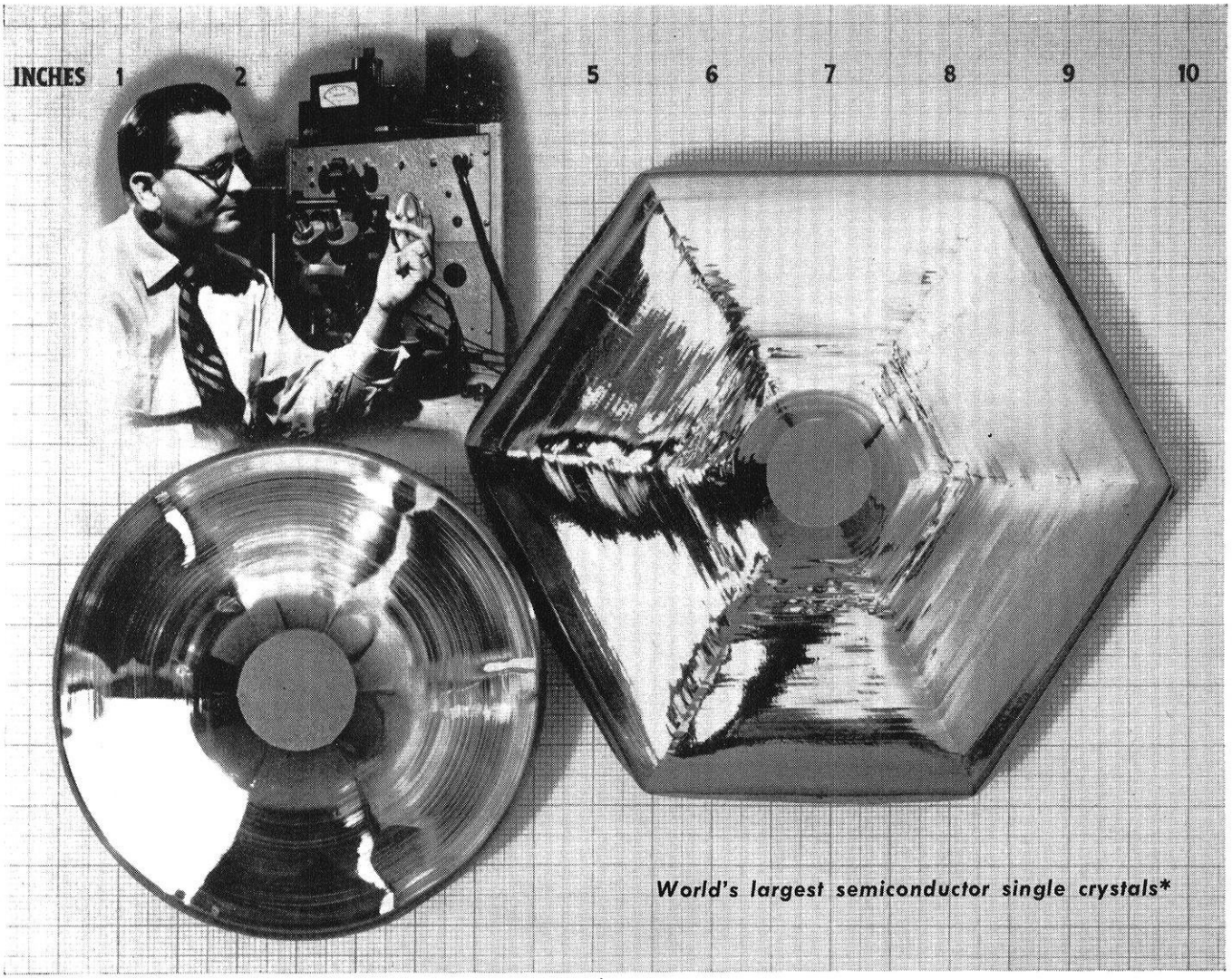
H. M. Pickering, Jr., *received a B.S. in M.E. and E.E. from the University of Minnesota in 1940. He gained valuable technical experience at Hanford Works, in Richland, Wash., and in Du Pont's Fabrics and Finishes Plant at Parlin, N. J. Today, he is Assistant Plant Manager at Du Pont's Seaford, Del., plant, where nylon is made.*

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

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

WATCH "DU PONT THEATER" ON TELEVISION

WANT TO KNOW MORE about working with Du Pont? Send for a free copy of "Mechanical Engineers at Du Pont." This 24-page booklet describes in detail the four broad categories of jobs mentioned by "Pick" Pickering. Typical pioneering problems in each of these four categories are outlined. This booklet briefs a young mechanical engineer on how some of the newest and most challenging problems in his field were solved. Write to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington, Del.



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Engine Ears

(Continued from page 38)

this program to be a valuable source of information.

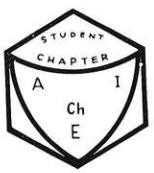
Fee: $20.00. Robert A. Ratner, Institute Coordinator.

ENGINEERING STATISTICS
April 22–26

This is an intensive course in fundamental statistical theory with engineering applications. Emphasis will be placed upon tests of significance, design of experiments, and analysis of variance and regression. The group size will be limited to those with previous training in statistics. Test engineers, industrial engineers, and research personnel will be benefited by this training.

Fee: $35.00. Robert A. Ratner, Institute Coordinator.

SOCIETIES



A.I.Ch.E.

After pondering the fact that the treasury balance had sunk to $628.52 the January business meeting of the Wisconsin chapter of A.I.Ch.E. adjourned to hear the speaker for the evening. From the Rockford, Illinois law offices of Carlson, Pitzner, Hubbard and Wolfe came Mr. H. C. Hubbard to speak on "The Chemical Engineer in Patent Law". If not intent then curiosity it was that prompted the interest in Mr. Hubbard's talk. As an introduction he enlarged upon the premise that the patent system does not exist for the individual but for the benefit of all through the availability of new techniques and equipment. Patents, it was explained, are not issued for new uses of old devices but must involve a genuine "flash of genius". As an example of the latter Mr. Hubbard displayed one of his simpler, newer patented devices, a plastic shrimp sheller, invented by a man familiar with the problems involved in the situation. It was explained that as a result of his contribution the inventor was elevated rapidly through several income tax brackets.

As a means of entering the patent law field other than as an inventor the engineer usually works for the U.S. Patent Office while attending school to obtain his law degree. After this is attained he may enter a patent law office on a salary commensurate with his experience. When his experience increases to the point where his services exceed his salary the Patent Engineer is usually put on a commission basis and from then on his salary is limited only by his ambition.

That the Patent Engineer's life is not a dull one, Mr. Hubbard enlarged upon several of the cases he had had in the past and the methods generally applied to win those cases. It was observed that when a patent infringement suit is to be brought against a company, the plaintiff can usually select the judge he desires to preside over the case by filing the suit in that judge's court. This is half the battle won as most judges have all sorts of precedents to aid them in making the decision hoped for by the plaintiff.

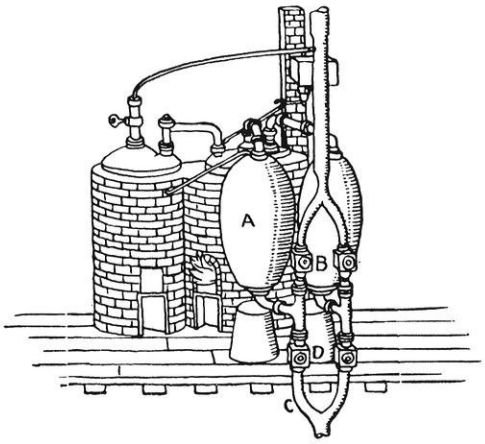
In conclusion Mr. Hubbard enumerated some of the ways used to get around the testimony of even those learned enough to have a Ph.D. All in all it was an evening of surprise and enlightenment.

THE END

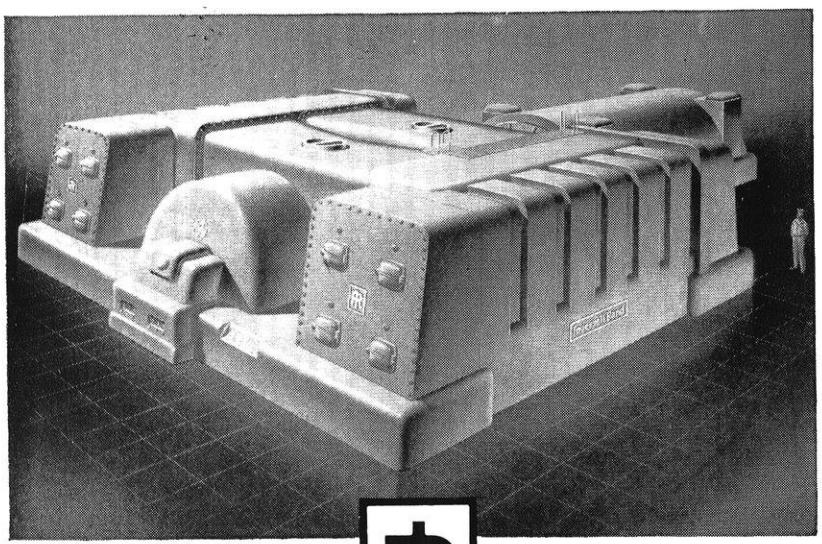
In the 18th CENTURY

this "condensation pump" was a real innovation

DEVELOPED by Thomas Savery in 1698, this water raising engine operated as follows: steam admitted to vessel "A" displaced water in the vessel, forcing it up through check valve "B." Then a stream of water was poured over the outside of vessel "A" causing the steam within to condense. The resulting "vacuum" drew water up through check valve "D," again partially filling the vessel. This cycle was repeated alternately in two vessels — resulting in a crude condenser-operated pump.



TODAY *it's the* I-R rectangular condenser



that's setting the standards of performance in modern steam power plants

I-R Surface Condensers are a vital adjunct to modern, high-pressure steam turbines. Ingersoll-Rand research and engineering over the years have steadily increased condenser efficiency per cubic foot of space, effecting economies in installation cost and station construction.

The forward looking twin shell condenser at the left, integrated with a 191,000 KW turbine, marks another important advance in condenser design by Ingersoll-Rand.

If you're interested in a profitable, progressive career in engineering look into the job opportunities available at Ingersoll-Rand. For further information contact your placement office or write to Ingersoll-Rand.

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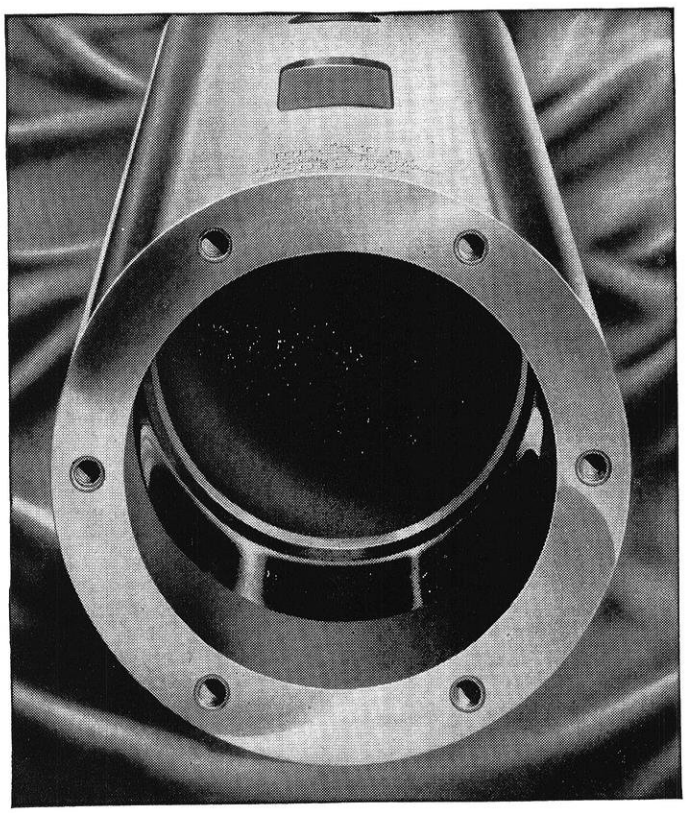
12-475

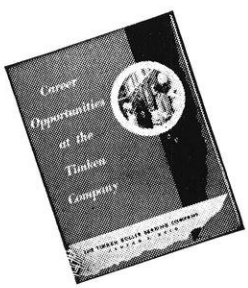
Another page for **YOUR STEEL NOTEBOOK**

Steel that lowered housing costs 26%



THIS part is a housing that must accurately position the spindle of a grinding machine that operates at high speeds. Dimensional stability is of prime importance. The manufacturer machined the part from bar stock. That meant drilling the hole—a costly step. Other factors raised costs even more. The manufacturer couldn't maintain the precise tolerances required and reduce production costs, too.

After studying the problem, Timken Company metallurgists recommended a switch from the bar stock previously used to Timken® seamless steel tubing. Immediate savings resulted. No drilling was required—the hole was already there. Scrap loss was reduced. More parts were produced per ton of steel. One of the annealing operations required with bar stock was eliminated. Stress-relieving operations were devised to insure complete stability of the finished part. Tolerances were held. And final reports showed that the switch to Timken seamless steel tubing cut production cost per housing 26%.



Want to learn more about steel or job opportunities?

Some of the engineering problems you'll face after graduation will involve steel. "The Story of Timken Alloy Steel Quality" will help you learn more about steel. And you might be interested, too, in the excellent job opportunities described in "Career Opportunities at the Timken Company". Drop us a card, ask for one or both booklets. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN *Fine Alloy* STEEL

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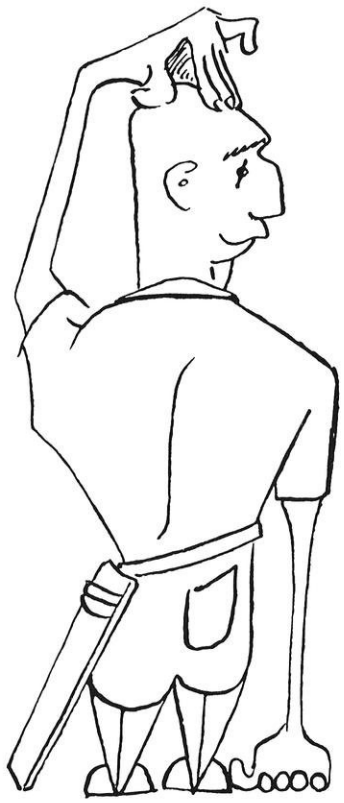
SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

So You Think You're SMART!

by Sneedly bs '61



At long last it has happened! Sneedly has received a perfect solution to one of his problems appearing in *The Wisconsin Engineer.* The problem was the one concerning the young treasure hunter that couldn't find the gallows. It appeared in the December issue and the solution was given in the January issue.

The correct solution was sent in by: Robert Mayer, 807 Oregon St., Green Bay, Wis. Robert is attending the University of Wisconsin Extension Center at Green Bay. His solution was very neat and precise and contained a geometric proof. Sneedly takes his hat off to Mr. Mayer, and the Green Bay Extension. Apparently the instruction given up there is first rate. What's wrong with the rest of you engineers around the state? Are you going to let Mr. Mayer and Green Bay show you up?

* * *

And now for the answers to the problems in the last issue. . . . Say, that's beginning to be an overworked phrase in this department. In fact, Sneedly has decided not to give you the answers. He thinks that too many of you are getting soft by always having the answers given to you in the next issue. If you want to know whether you worked the problems correctly, send in your answers.

* * *

From what *two* locations in the world is it possible to walk one mile south, one mile east, and one mile north and arrive at the place from which you started? One place is easy to find but old Sneedly wagers that you'll have to think to find the second.

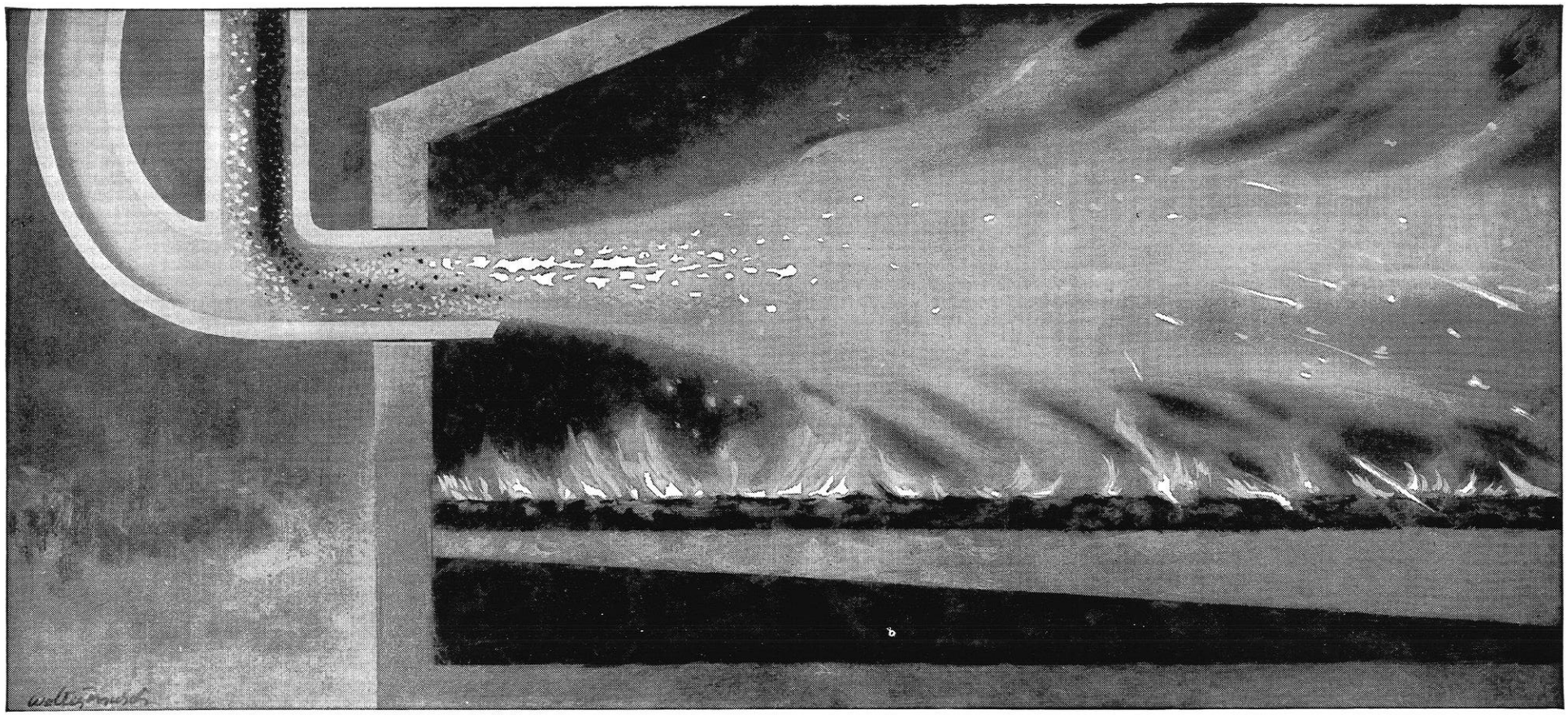
* * *

That great ME, Pete P. Robbins, was contracted to build a fence around the earth at the equator to separate the northern and southern hemispheres. His employer in this venture was the world-famous heat power man, Fred Lowe. Fred, it seems, wanted to put all the jack rabbits in the world south of the equator and keep them there. (He had been frightened by a jack-rabbit as a boy). Pete designed the fence carefully, making sure it was high enough and strong enough to withstand a bounding bunny.

To do the actual construction work Pete employed William "Wild Bill" Ziegler. "Wild Bill" had some trouble with figures and when he had completed the herculean task it was found he had the fence ten feet too long. Pete gnashed his teeth with disgust and said that ten feet would have to be cut off from the fence. "Wild Bill", however, said that 10 feet in 25,000 miles would not make any difference and claimed that the fence could be put up as it was. Sneedly was called in to settle the dispute. The question was this: How high off the ground will the fence be after it is erected, assuming it is an equal distance above the earth all the way around?

* * *

See you next month and don't forget to send in your problems and solutions. **THE END**



An artist's inside look at 1000-ton-a-day oxygen flash smelting furnace of Inco-Canada at Copper Cliff, Canada.

Inco shows

How ores are made to smelt themselves

Important fuel savings . . . plus tonnage sulfur recovery . . . with new oxygen flash smelting process

This is the hot, flaming heart of a new Inco-Canada furnace for treating copper concentrate.

It's an *oxygen flash* smelting furnace.

That means conservation of fuels, conservation of sulfur. That also means efficient extractive metallurgy.

In this new process, you separate oxygen from the air. You blow this oxygen—and fine copper sulfide concentrate—into white-hot furnaces.

The oxygen reacts with the concentrate. Iron and sulfur burn, creating heat. The ore smelts itself, eliminating need of other fuels: copper collects in the matte, iron and rock in the slag.

And the previously wasted furnace gases? These sulfur-rich gases are collected and sold for production of liquid sulfur dioxide, *up to 300 tons a day.*

Oxygen flash smelting is another advance in extractive metallurgy. It's part of a continuing program *to step up production, to keep costs down, through maximum utilization of ores.*

See the new film: "Milling & Smelting." 16 mm color prints loaned to engineering classes and student technical societies. Write Dept. 129e:

The International Nickel Company, Inc., New York 5, N. Y.

INCO 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 and Platinum, Palladium and Other Precious Metals.

Mining and Metallurgy

(Continued from page 57)

of the mining engineer but usually contains less mining and more metallurgical engineering subjects.

After the mineral dressing engineer has completed his work of concentrating the ore, the metallurgical engineer steps in to reduce the ore to the metallic state. In this work he may utilize heat, electricity, chemicals or a combination of these factors. Since this treatment usually involves chemical reactions, this metallurgical engineering field is called chemical or extractive metallurgy. An example of an extractive metallurgical operation is the reduction of iron ore in the blast furnace to produce pig iron, the pig iron being subsequently refined to steel. The large metal refineries scattered through the country all depend upon metallurgists for their design and operation. New processes, increasing use of low grade ores, new metal requirements, etc. have all added to the scope and importance of the work done by the extractive metallurgists.

The alchemists of old were constantly striving to change base metals to noble metals. Had their efforts succeeded they probably would be no less spectacular than the efforts of the present day physical metallurgists who have succeeded in greatly improving the mechanical and physical properties of metals by alloying and special treatments. The physical metallurgist finds opportunities in a wide variety of industries. He may be employed by a metal producer and concerned with the improvement of the properties of the products sold. On the other hand, he may be associated with a metal-consuming industry like the automotive industry, the appliance industry, or the aircraft industry, where his primary job is specification, inspection, and control of the various metals and alloys that are used. There are many additional opportunities in the foundry field, welding, and other metal-processing operations. Besides being engaged in production work the metallurgist may specialize in research, teaching, development work or engineering sales.

New requirements for metals and alloys and other materials that have arisen as a by-product of atomic energy, guided missiles, gas turbines and other high temperature applications have greatly expanded the demand for metallurgical engineers. To prepare for these demands, the curriculum includes a good background in physics, chemistry, and *mathematics*, and a number of courses in alloying, heat treating, metal working etc. These courses also furnish the necessary training in the use of the microscope, X-ray equipment, mechanical testing equipment and related testing methods. Today many of the men who plan a career in metallurgy are also extending their training by doing graduate work for M. S. or Ph. D. degrees. This extra time gives them a better preparation in the fundamentals for the many positions of responsibility that are available.

Sneed's Review

(Continued from page 62)

deep theoretical understanding of pulse and digital circuits is given, while at the same time the treatment is so practical that the book will be immediately useful in the laboratory.

MODERN PHYSICS FOR THE ENGINEER

Edited by Louis N. Ridenour

McGraw–Hill. $7.50

This volume comprises a collection of lectures delivered to an extension course at the University of California, Los Angeles, during the year 1952–1953. It provides the reader who has some degree of technical knowledge with a brief account of some of the more interesting developments in the fundamental science underlying all engineering.

The book has been edited by Louis N. Ridenour, Vice President of the International Telemeter Corporation and Visiting Professor of Engineering at UCLA. He has collected the lectures under three main categories. Part One, The Laws of Nature, covers physics in its narrow definition—what we know of matter, of radiation, and the laws of their interaction. The second part, Man's Physical Environment, discusses the application of physical laws and techniques of investigation to the study of the universe, of the earth, and of the air. The third sections deals with the application of physics to that branch of engineering known as modern electronics.

Here is a book of considerable interest to all technical men in the scientific or engineering fields. Contains articles by Royal Weller, H. P. Robertson, Leonard I. Schiff, Frederick Seitz, Charles Kittel, W. D. Hershberger, Wiliam A. Fowler, R. V. Langmuir, Glenn T. Seaborg, W. K. H. Panofsky, Jesse Greenstein, David T. Griggs, Roger Revelle, Leonard B. Loeb, Walker Bleakney, Simon Ramo, John Bardeen, J. B. Wiesner, and Louis N. Ridenour. THE END

STA  TIC

The E.E.'s Lament

Through the smoke and ozone fumes
The student slowly rises,
His hair is singed, his face is black,
His partner he despises.
He shakes his head and says to him
With words so softly spoken,
"The last thing that you said to me
'I'm sure the switch is open'."

* * *

An engineer from the Bronx was wandering on the Sahara Desert, clad only in his shorts, when he met an Arab astride a camel.

"Where," asked the Arab, "might you be headed?"

"For a swim." responded the Bronx engineer.

"A swim!" was the astonished reply. "Why the ocean is 800 miles from here."

The engineer blinked. "Eight hunnert miles! Wow! Is dis a beach!"

* * *

A politician was campaigning for Indian vote in one of our western states. He promised schools for the Indians. He promised colleges for the Indians. The crowd stood up and all yelled "HOYA!" Heartened by the response he laid aside his prepared speech and promised better roads, hospitals for each tribe, and low taxes Ad Nauseum. Again and again the Indians stood up and shouted "Hoya! Hoya!"

When he finished the speech he toured the reservation. When they were taking a short cut across a pasture the guide warned him, "It's all right, but be careful, we pasture our cattle and horses here. Don't step in the hoya."

* * *

A big buck Indian had just ordered a ham sandwich at a drug counter and was peering between the slices of bread when he turned to the waiter, "Ugh, you slice um ham?"

The waiter replied, "Yes, I sliced the ham."

"Ugh," grunted the Indian, "You dama near miss um."

In the dark of night two safe-breakers entered a bank. One approached the safe, sat down on the floor, took off his shoes and socks and started to turn the dial of the safe with his toes.

"What's the matter with you?" said his pal, "Let's open this thing and get out of here."

"Naw, it'll take only a minute longer this way, and we'll drive them fingerprint experts nuts."

* * *

Everything has been done that could be done to make the meeting a success. A large hall and a good speaker had been engaged. When the speaker arrived he seemed to be in a crabby frame of mind. Looking around he beckoned to the chairman.

"I would like to have a glass of water on my table, if you please," he said.

"To drink?" was the chairman's idiotic reply.

"Oh, no," was the sarcastic retort, "when I've been speaking for a half-hour I do a high dive."

* * *

Walking with a friend one day, a professor passed a large fish shop where a fine catch of codfish with mouths open and eyes staring were arranged in a row. The prof suddenly stopped, looked at them, and clutching his friend by the arm exclaimed: "Heavens! That reminds me, I have a class in EE this hour."

* * *

Seven-year-old Michael, who had a reputation as a little terror, had just finished his first summer vacation at his grandfather's farm. Back in the city, one of the neighbors asked him about his holiday and especially about his grandfather.

"Oh, he's great," responded Michael. "We played a swell game every day. Late each afternoon he'd row me out in the middle of Claytor Lake, throw me over the side of the boat and let me swim ashore."

"Claytor Lake?" gasped the neighbor. "That's a big lake. Wasn't that a hard game for such a little fellow as you?"

"I'll say it was," said Michael, "But the hardest part was getting out of the sack."

Career Opportunities

(Continued from page 46)

them and in most cases visit the companies before accepting an offer. Although many seniors must enter military service after graduation, most companies will hire them, even for just a few weeks, and then grant military leave. Or if the graduate prefers he can use the placement office after returning from service. At any time all College of Engineering alumni can use the placement office if they wish to relocate.

A new approach is also developing in terms of summer employment for engineering students while still in college. Even after the freshman year it is possible to find summer work in some phase of engineering. The placement office has thus become important to students all through their college career, as well as during the senior year. Besides just providing a chance to earn money the student can gain worthwhile experience in summer work and see how his courses are applied in industry. And he may find a special interest in a particular phase of engineering and tailor his selection of courses accordingly. As a result he will be better prepared to continue his career after graduation.

The Engineering Placement Office can be a very important part of the college career of the engineer. Its facilities are always available to the student and he can feel free to take advantage of its services.

High school students have many questions concerning requirements and activities of college life. Following are questions and the respective answers pertaining to student life at the University of Wisconsin.

THE END

So You Want to Be an Engineer

(Continued from page 47)

speech, surveying, or shop, as the particular course may require, making is posible for a student to change his particular branch of engineering without loss of credit at the close of his freshman year. While in the sophomore year, physics and mathematics are common to all engineering courses, it is advisable that a student entering his sophomore year should have determined his real engineering interest in order to avoid any loss of credit in case he transfers.

When you enter college, organize your time, allowing approximately thirty hours per week for study outside the class room, and remember that a good start leads to a successful completion. At the University of Wisconsin you will find yourself one of many students. However, your advisers and your instructors are willing to confer with you and to help you, if you but give them the opportunity. Determined application, systematic study habits, frequent reviews, and the will to do your best will bring you well on your way to your chosen profession of engineering. The life of a successful engineer offers unlimited opportunity for constructive achievement, and engineers are more and more taking an active part in the business and public affairs of the world at large. THE END

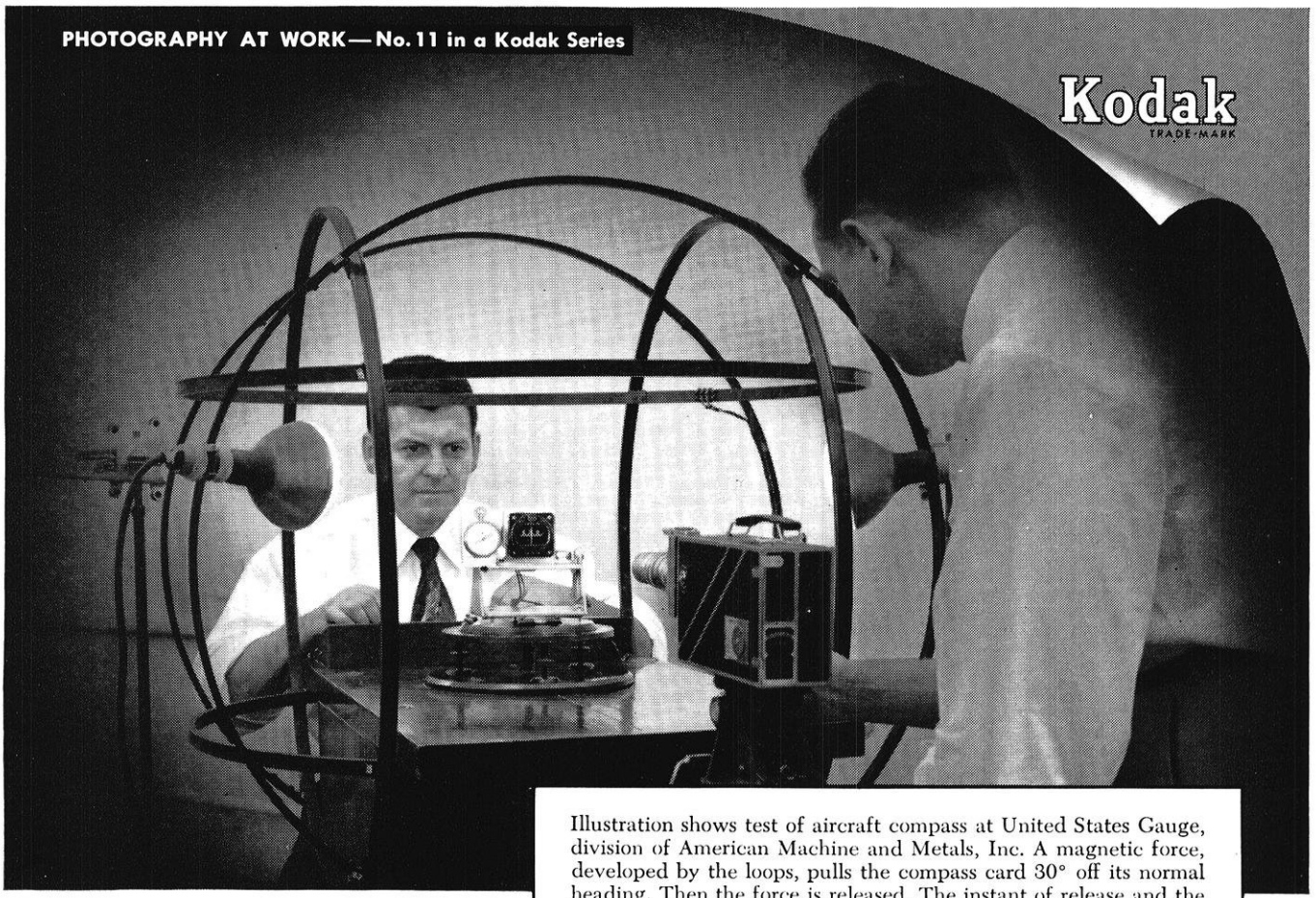


Illustration shows test of aircraft compass at United States Gauge, division of American Machine and Metals, Inc. A magnetic force, developed by the loops, pulls the compass card 30° off its normal heading. Then the force is released. The instant of release and the moment the compass recovers by 5° are both recorded on the film—become positive evidence of proper performance.

Wanted: an inspector with a split-second eye —*photography got the job*

A difference of 2/10ths of a second means the compass passes or fails. So the maker pits it against a stop watch—gets definite proof of performance with movies.

Uncle Sam said this aircraft compass must respond by 5 degrees in not less than 1 second or more than 1.2 seconds. That's only 2/10ths of a second leeway—far too little for human hands and eyes to catch the action accurately.

So, side-by-side, the stop watch and compass act their parts before the movie camera. Then individual frames along the film show the precise instant that the 5-degree mark is reached.

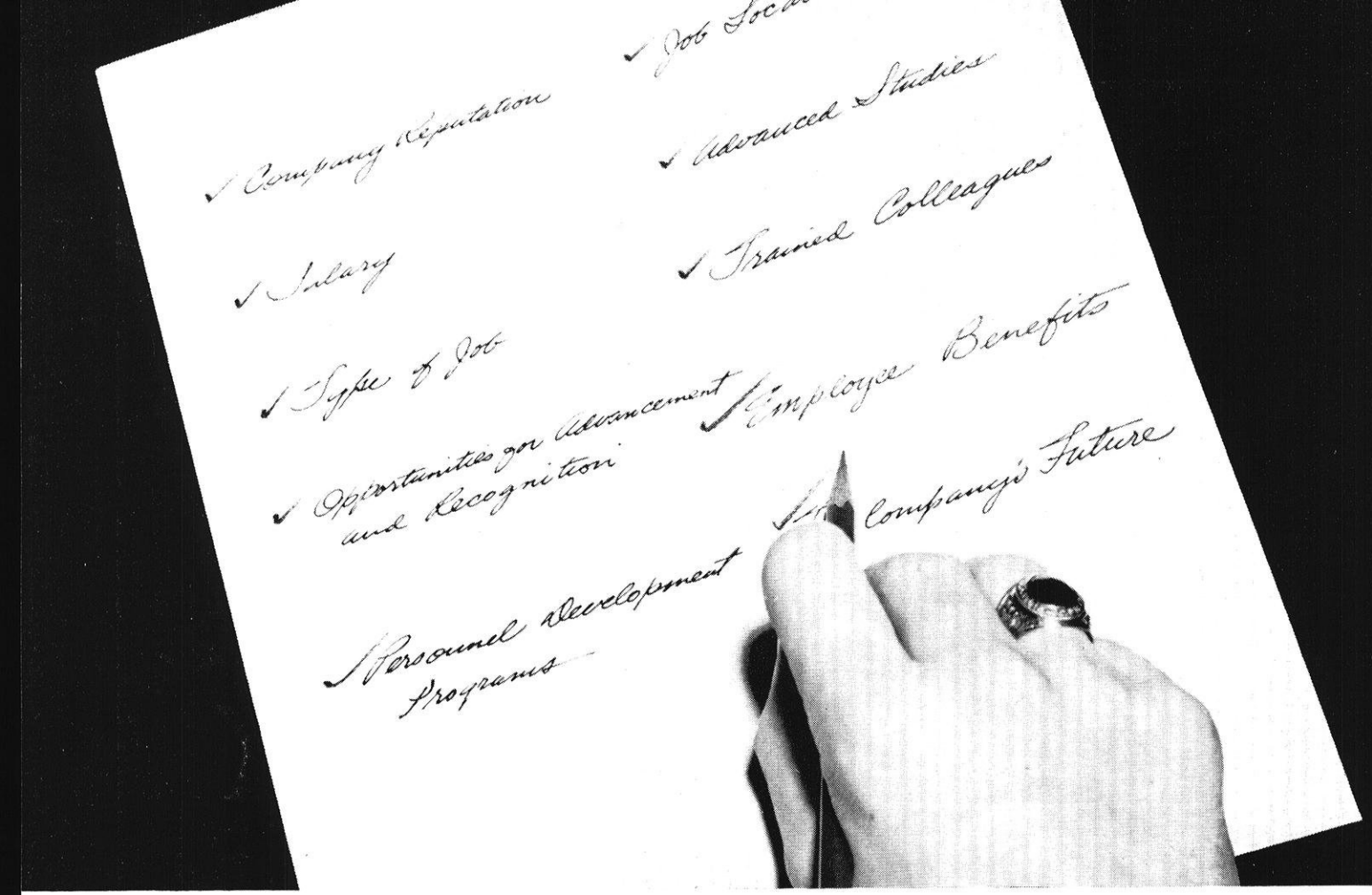
Product testing and quality control are naturals for photography. They are typical examples of the many ways photography works for businesses, large and small. It is improving production, saving time, reducing error, cutting costs.

CAREERS WITH KODAK

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

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

Eastman Kodak Company, Rochester 4, N. Y.



How General Electric stacks up on your job check list

● **COMPANY REPUTATION**—As an engineer, the names of Thomas Edison and Charles Steinmetz should be known to you. These men, who so greatly influenced the industrial surge of our country since the 19th century, are symbolic of General Electric's past and present technological leadership.

● **SALARY**—General Electric's salary program is planned with a long-range view for your career; a well-considered starting salary and merit increases based on your contributions. Through regular counseling by your supervisor you know just "how you are progressing".

● **OPPORTUNITIES FOR ADVANCEMENT**—Through the Company's Personnel Registers, and individual appraisal of your qualifications and preferences, you are considered for all new or related jobs and promotions throughout the Company.

● **TYPE OF JOB**—Based on your personal preferences and abilities, you will work in various marketing, manufacturing or engineering fields. Your technical or managerial experiences may be in any of nearly 100 product departments where you contribute to the engineering, manufacturing or marketing of some of the more than 200,000 G-E products.

● **PERSONNEL DEVELOPMENT PROGRAMS**—General Electric, a pioneer in industrial training programs, hastens your professional development through classroom and on-the-job assignments as a part of the Company's marketing, manufacturing and engineering programs. Specific position placement is also available if your interests are already formulated.

● **JOB LOCATION**—There are opportunities for you as a G-E engineer in 150 cities in 45 states, plus many foreign countries.

● **ADVANCED STUDIES**—General Electric offers to technical graduates the Tuition Refund Program and Honors Program for Graduate Study wherein you may take graduate courses at nearby universities. In addition, G.E. sponsors graduate-level Company courses where top professional men teach in their respective fields.

● **TRAINED COLLEAGUES**—As a G-E engineer, you may be working with outstanding men who are responsible for the envisioning, production, and distribution of such new products as man-made diamonds, high-speed rocket and jet engines, the new heat pump, commercial atomic power reactors and electronic ovens.

● **EMPLOYEE BENEFITS**—General Electric's outstanding benefit program for you and your family includes all the usual life, accident and illness insurance and pension plans, plus a Savings and Stock Bonus Plan and discounts on G-E home appliances.

● **THE COMPANY'S FUTURE**—General Electric's investment in research can mean much to you. Forty-two major Company laboratories, dedicated to invention and innovation, will play a major role in doubling the Company's sales during the next eight years. Only through research is a company assured of future growth. For you, this growth at General Electric means new and challenging technical and managerial positions. General Electric Company, Section 959-3, Schenectady 5, N. Y.

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