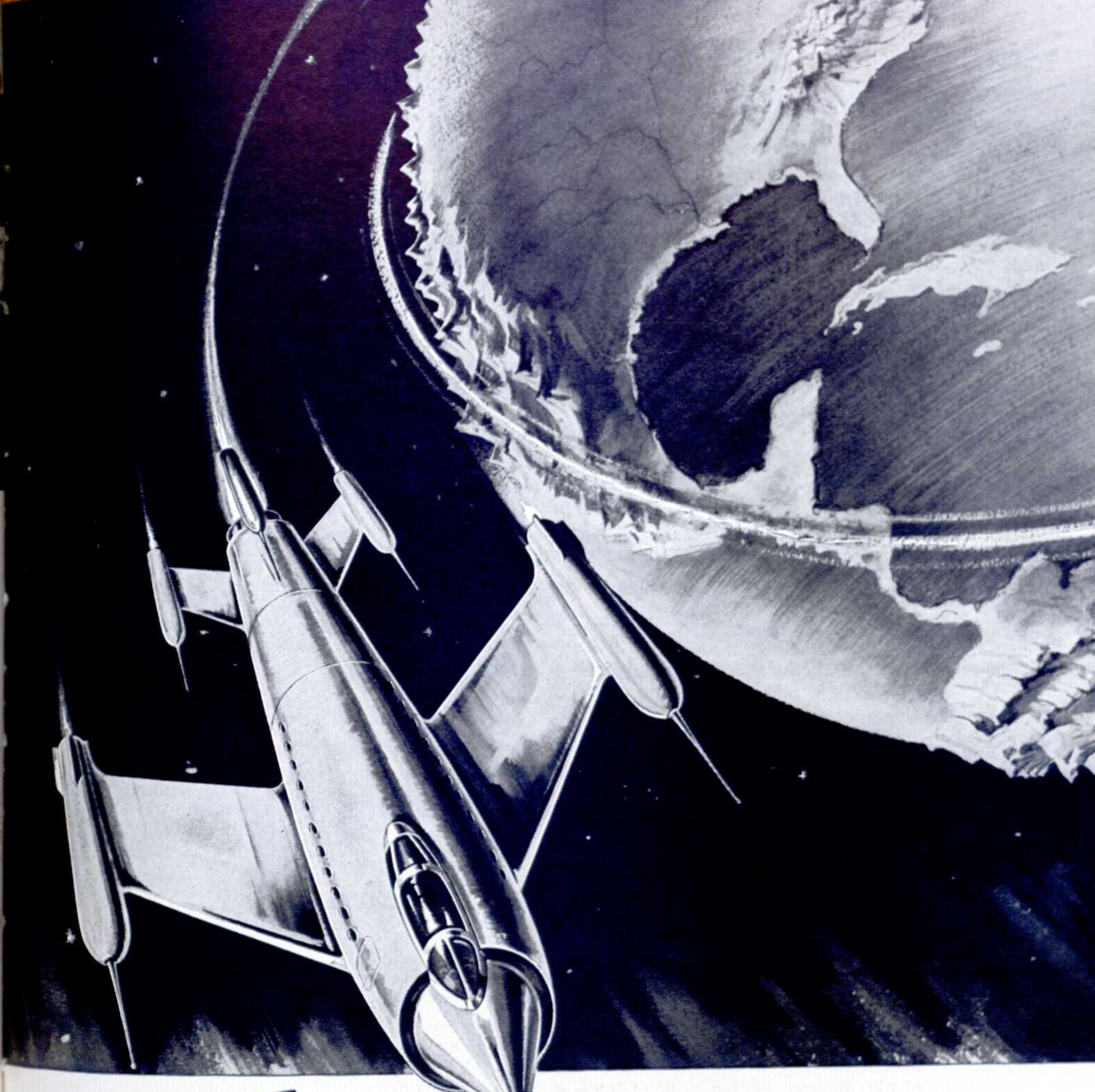

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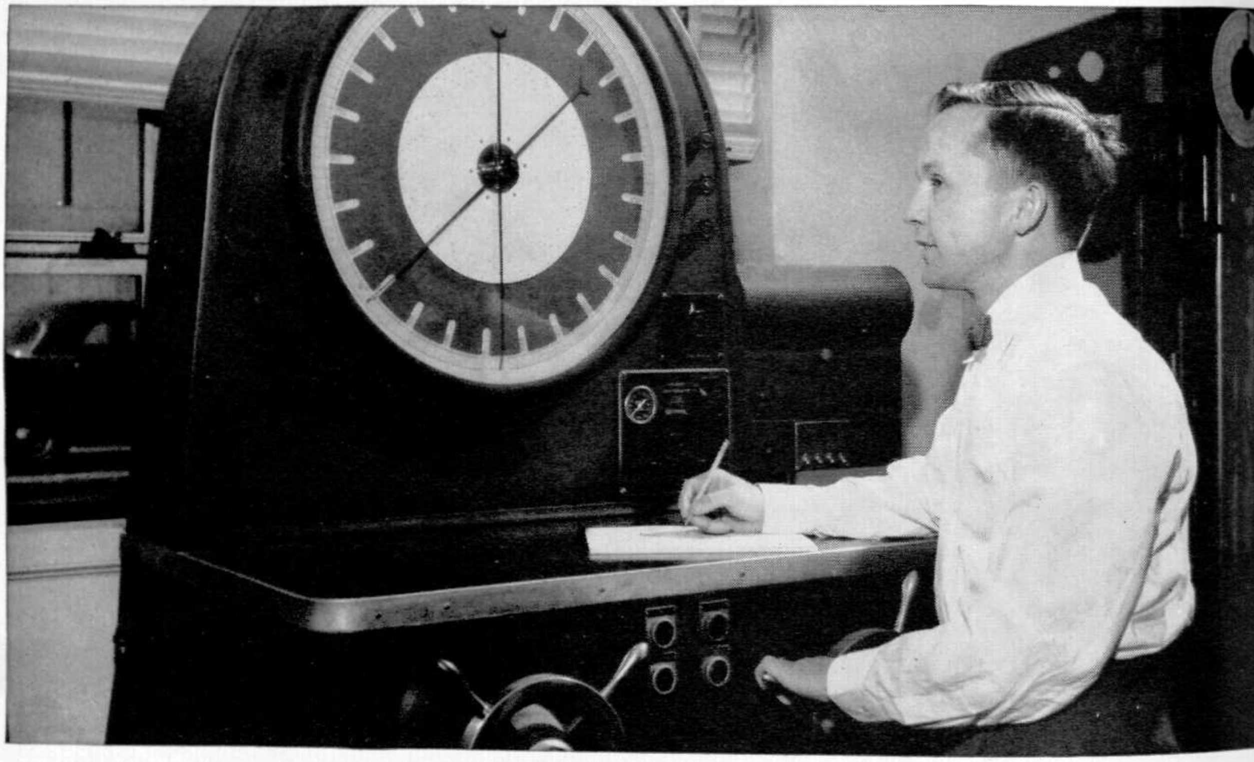

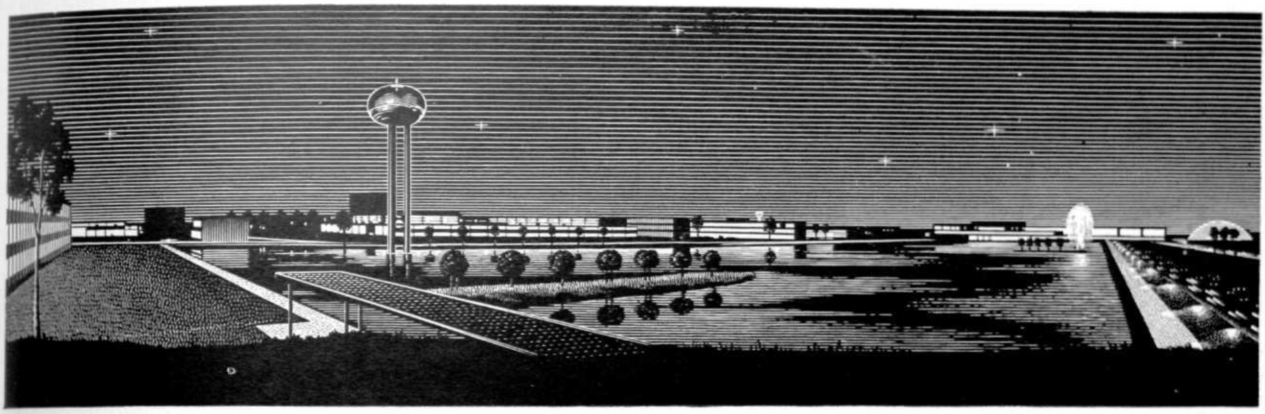

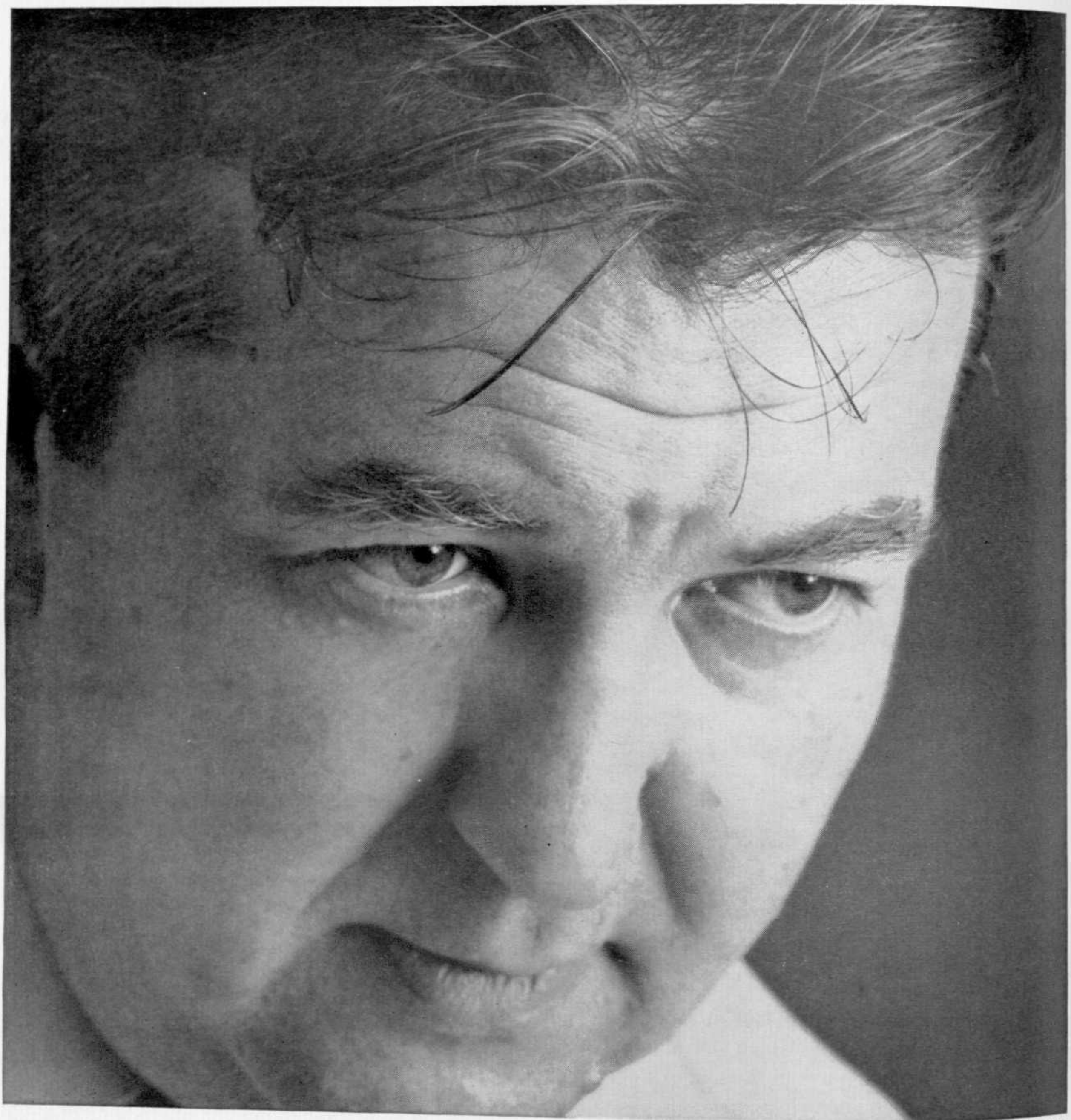

YAVNO

...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

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Spartan Engineer

of michigan state university

VOLUME 10 NO. 3 MARCH, 1957

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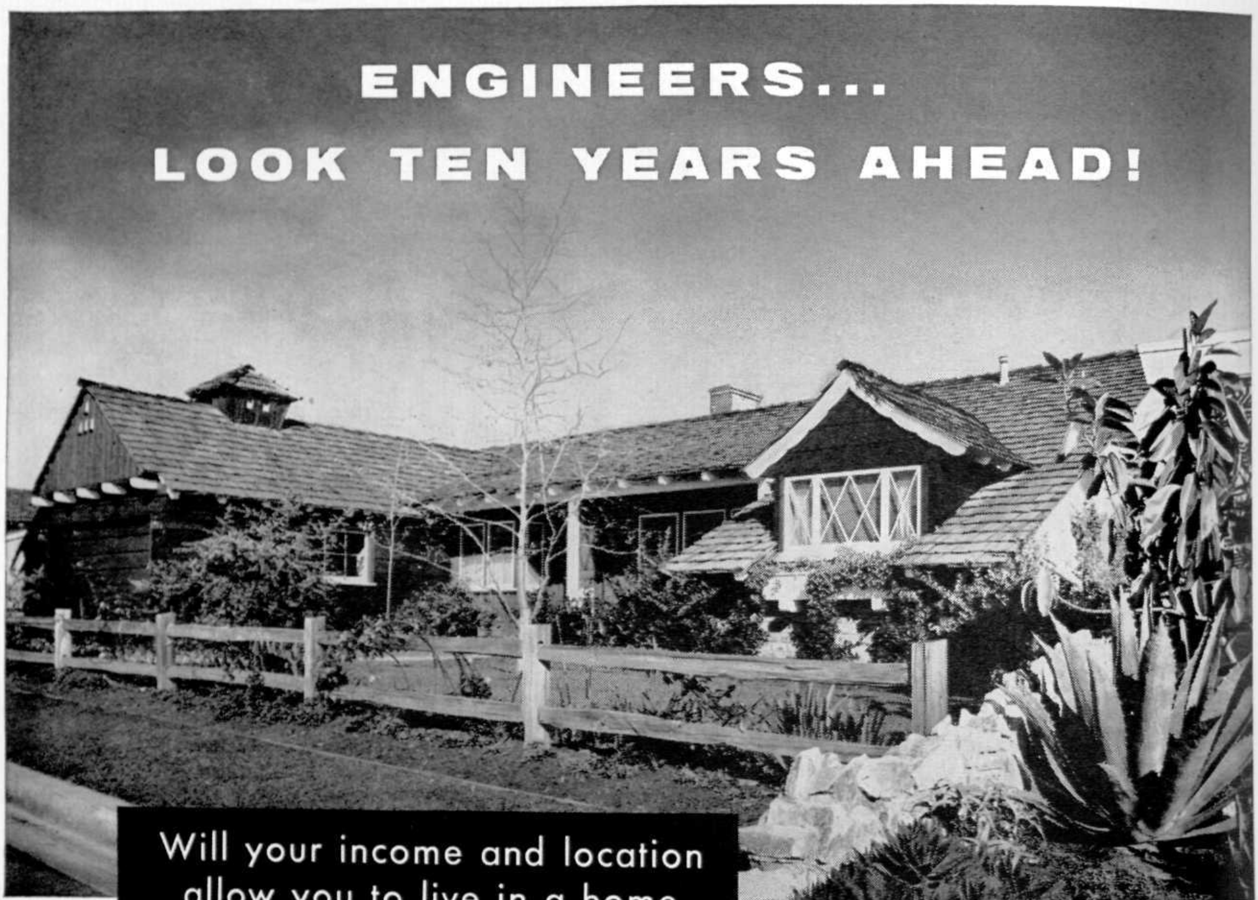

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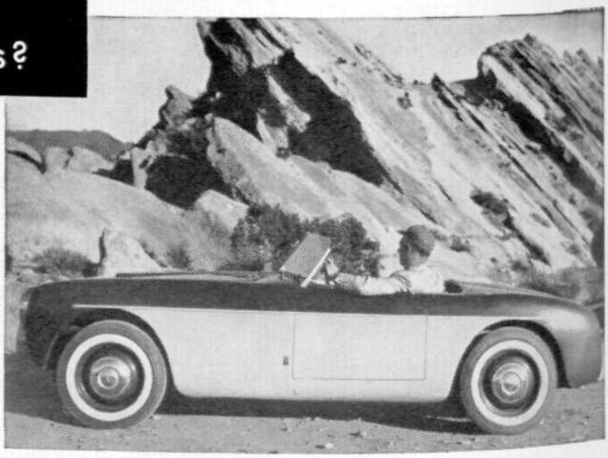

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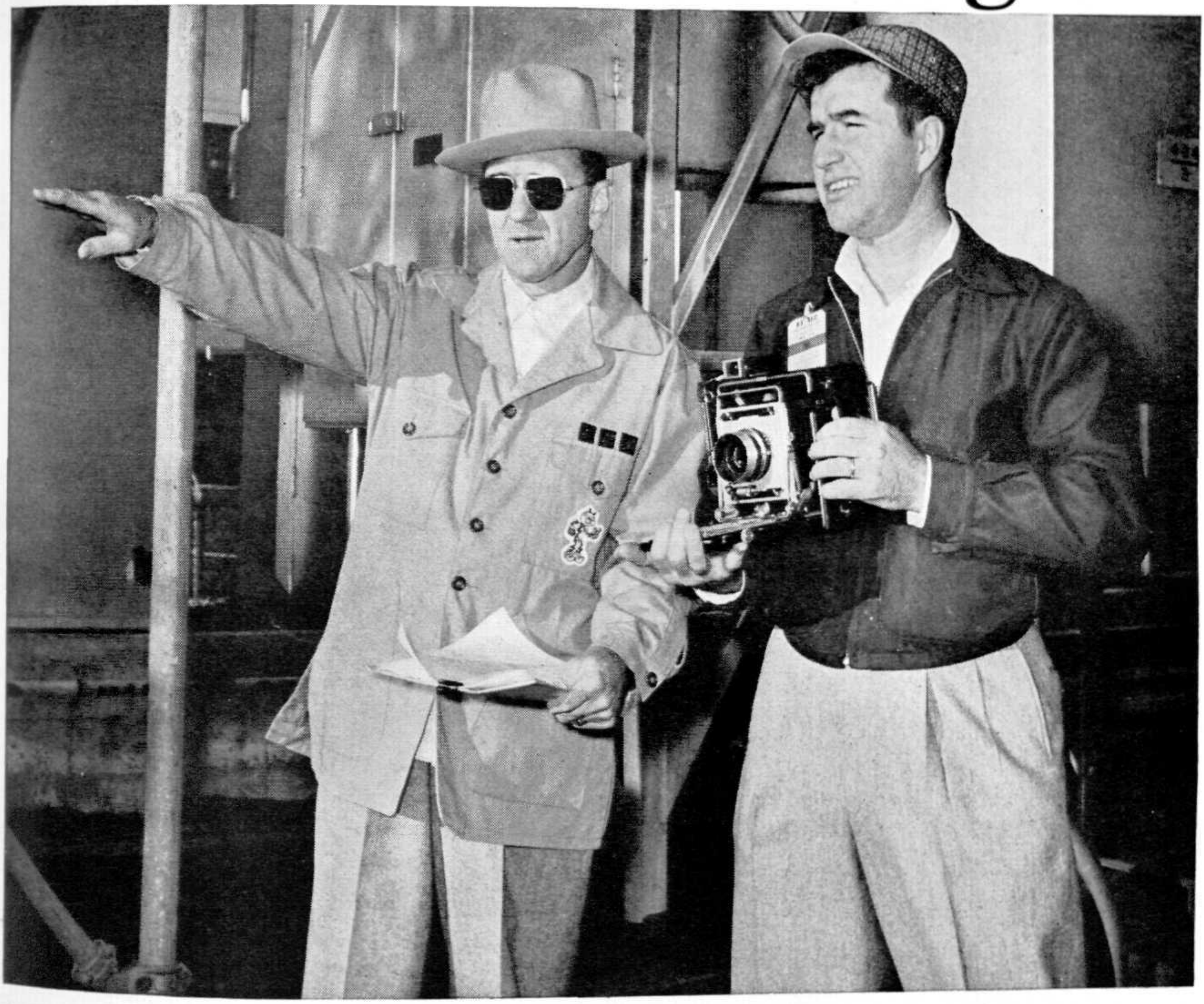
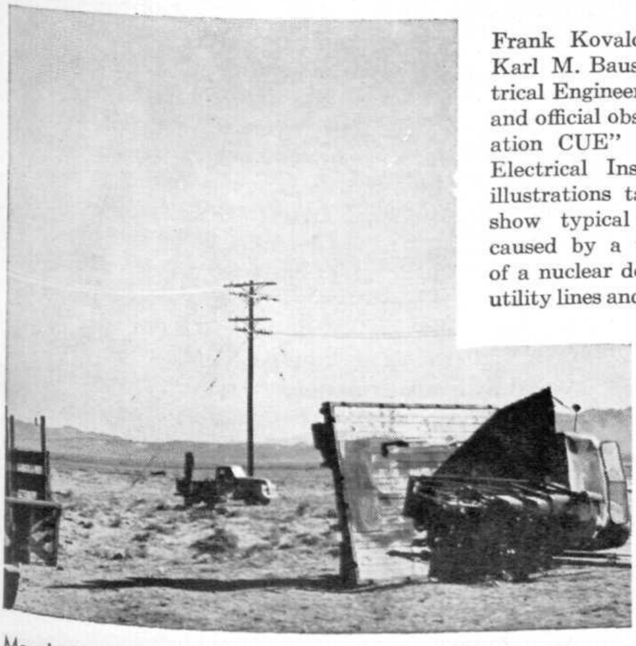
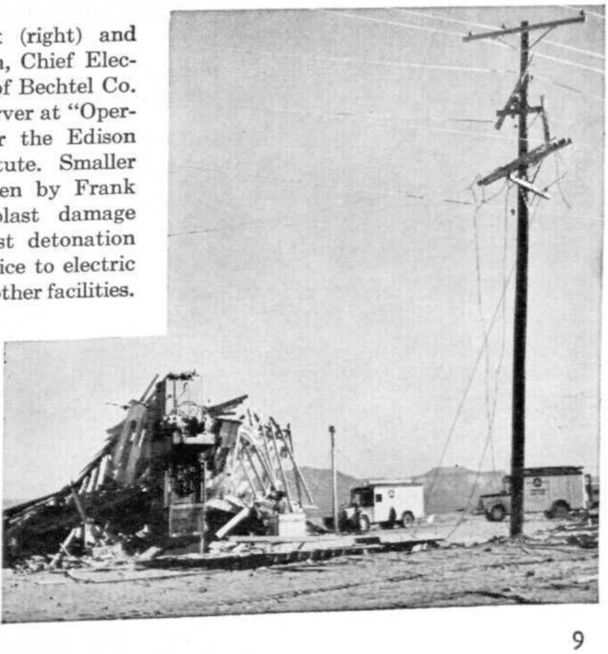
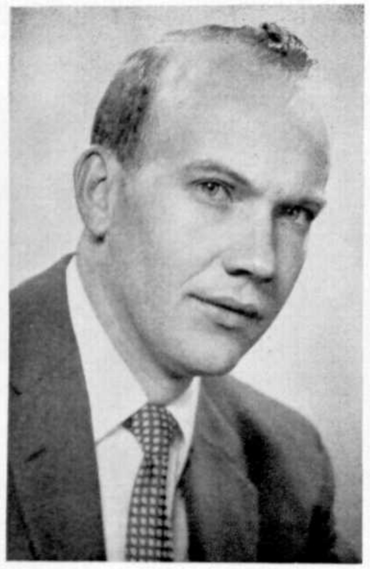




Frank Kovalcik (right) and Karl M. Bausch, Chief Electrical Engineer of Bechtel Co. and official observer at "Operation CUE" for the Edison Electrical Institute. Smaller illustrations taken by Frank show typical blast damage caused by a test detonation of a nuclear device to electric utility lines and other facilities.





DR. HERMAN E. KOENIG

Two M S U Professors discover that . . .

Kirchhoffs "Laws" Not Laws At All

by MYRIL B. REED and HERMAN E. KOENIG
Professors in Electrical Engineering at
Michigan State University

DR. MYRIL B. REED

Editor's note:

In recent developments in Electrical Engineering at Michigan State University it has been discovered that Kirchhoffs "Laws" are not laws at all, but rather they are a special case of a much more general rule. Here at M.S.U. the Kirchhoff equations are being expanded to apply to all fields of Engineering. This is the first time these developments have appeared in any publication.

A little practice at examining the fundamentals of Engineering leads to the guiding formula: examine what is done, not what is said. If Kirchhoff "laws", as used by Electrical Engineers, are examined in this light, what do we see? In the laboratories and field, two measuring instruments are used—one connected across and one in-line with a prescribed pair of points. These "measuring" instruments are basically *parts* of the physical system being studied and are so constructed that they affect the system as little as possible whereas the system, aside from the "measuring parts," affects the "measuring part" as much as possible. These two instruments are identical except that one of them is usually desensitized relative to the other. The instruments are calibrated so that numbers obtained from these measuring parts, when substituted into some specific equations, satisfy the equations, i.e., produce numerical equalities.

What do professional people say about this "measuring process"? Consider the following quotes or near quotes: the volts pump amperes through the wire; the voltage drives the current; the emf forces electrons along the conductor. Based on what is done, these notions seem a little naive even now. To the next generation, what we do will certainly seem adequate and even perhaps clever, but what we say is going to surely bring a condescending grin. Do we not treat our ancestors so? How do we react to the EARTH, AIR, FIRE, AND WATER of the Greeks; or CALORIC; or PHLOGISTON; or LUMINIFEROUS ETHER; or DEMONS IN THE ROCKS.

Back to what is done. The process can be stated generally in a simple way. The goal is to make measuring parts or instruments which can be associated with components of physical systems. These components in electrical systems have points of contact with each other and the simplest or fundamental component has two points of contact. With but two points of contact how can an instrument be connected but across and in-line? Not very complex is it? There is no problem since there is no choice. The problem arises in making instruments which can be so connected and which satisfy some simple and solvable mathematical pattern. In electrical engineering, the two "measuring parts" are available by merely changing the sensitivity of a basic construction. Part of the problem of matching a mathematical pattern is taken care of by the fact that there is only one mathematical pattern which can be handled in any "large sense," i.e., many equations. This mathematical pattern is the linear system of equations—linear algebraic equations or constant coefficient, ordinary, linear differential equations or combinations of these two kinds of equations. It is of prime importance to recognize the existence of such a drastic restriction and thereby to reach the conclusion: either the physical system is molded (regularized) toward fitting such a system of equations or the study of these systems is largely restricted to the laboratories or field. Even the partial differential equations, which, to many seem more fundamental, are usually reduced to linear equations with constant coefficients by altering this and omitting that.

With the admission of this mathematical block (which we can at least hope the mathematicians will do something about) one of the problems of engineering is somewhat simplified. The effort must be directed toward correlating observations in the physical realm with linear equations by regularizing the systems used and by inventing instruments which further this correlation.

Viewing Kirchhoff laws, in the light of the foregoing, indicates that their application depends on the success of electrical engineers in devising instruments and regularizing their physical systems so that the almost one and only mathematical pattern can be correlated with the numbers observed on the instruments. Viewed from this broad base, these so-called laws of Kirchhoff can hardly be called laws in anything like the absolute sense they are customarily viewed. Indeed, one of the Kirchhoff laws has been essentially superseded in the developments in electrical engineering at MSU, not at a loss but rather at an important gain.

Almost at once, from the view that Kirchhoff laws exist because physical systems can be regularized to correlate with linear equations, the idea occurs that perhaps these Kirchhoff laws are not unique with electrical engineering. And indeed they are not! But what are these Kirchhoff equations? They are linear, algebraic, homogeneous equations in terms of mathematical functions associated with the across and the in-line "measuring parts" or meters. In order to apply these equations to any physical system, it is necessary to invent instruments such that the oriented pattern of in-line observations at a junction fit a homogeneous algebraic equation and that the oriented pattern of across observations around a closed path fit a homogeneous algebraic equation. In addition, the functions associated with the across and the in-line observations must be related by a differential equation (constant-coefficient, linear, ordinary and usually not of higher than second order). A classical example of a Kirchhoff equation in other than an electrical system is the system of "force equations" associated with the junctions of the supporting members of static structures. These equations are certainly an exhibit of one of the laws of Kirchhoff. What about a structure in motion, say, a pendulum? Both of Kirchhoff laws apply here—the force equations and the displacement equations. Even such an unlikely thing as a gear box, or a refrigeration system can be correlated with these two laws as associated with the junctions and the circuits (closed paths) in the system. It is not necessary that either the junctions or the circuits be evident in the physical system. For example, in electrical engineering, electron tubes, transistors, crystals, even coils of wire do not contain some of the junctions and/or circuits assigned to them in their "equivalent network." The effect of this view is to open up a whole new endeavor, namely, that of dealing in an important and extraordinary way with electrical, mechanical, acoustical, thermal systems alone or in combination in an effective manner and under the guidance of a unified procedure.

Iggy, Choggy, and the Golden Balls

by A. D. Emerich

Like men, organizations often become as well known by their initials or nicknames as by their unwieldy proper names, as in the case of NATO and UNESCO. By this process, the unlikely-sounding words "iggy" and "choggy" are being heard increasingly in scientific and engineering circles. "Iggy" is I.G.Y., the International Geophysical Year, and "choggy" is a Slavicised pronunciation of C.S.A.G.I. (Comite Special de l'Annee Geophysique Internationale), coordinating body for the Year's research program.

The word "choggy" illustrates one notable feature of the Geophysical Year – an American nickname for an international committee with a French name, pronounced in the Slavic manner. IGY is the greatest *international* scientific project in history. Planning began in 1951, when the International Council of Scientific Unions created CSAGI, to draw up a world-wide program. The committee chose the period between July 1, 1957, and December 31, 1958, partly because during that time, the Sun will be in a phase of maximum activity, when this activity can be efficiently correlated with the Earth's magnetism, aurorae, and other Solar effects.

Next, CSAGI called upon interested nations to form national committees. Plenary sessions have been held periodically since that time, with 55 nations represented in November, 1956, each responsible for its own program within the broad outline proposed by CSAGI. A total of 5000 scientists and engineers will participate.

The Geophysical Year program will encompass a wide range of phenomena, but will center on twelve main points. Studies of the Earth's core and crust include seismology and geomagnetism. All major land and sea masses will be observed in investigations of glaciology, gravity, longitudinal and latitudinal variation, and oceanography. Atmospheric research will relate to aurora and airglow, ionosphere physics, meteorology, and the upper atmosphere. A final portion of the program is devoted to cosmic rays and solar activity.

Most nations technologically capable of systematic research, will participate, including not only "Western" nations, but such "Iron Curtain" states as Hungary, Yugoslavia, East Germany, Communist China, and the Soviet Union. However, the United States program will be the most extensive and will probably draw most attention, because of upper atmospheric exploration by US rockets and Earth satellites.

About the size of beach balls, these gold-plated spheres will be 20 inches in diameter, weigh about 21½ pounds, filled with instruments transmitting data on cosmic rays, Solar radiation, and temperature change. The manner in which the satellites slow down will indicate atmospheric density at high altitudes. A dozen or more satellites will be launched at Patrick Air Force Base in east Florida, carried 300 miles high by a 72 feet long, three-stage rocket, and released in their orbits. Each will travel at about 18,000 mph., going completely around the Earth in an hour and a half. The satellites will stay up for some time, will be tracked continuously both optically and by radio, to determine their precise orbits, as information is received from the moving globes.

Although IGY is the most inclusive and extensive project of its type ever planned, it is not the first. In 1882-3, and 50 years later in 1932-3, International Polar Years were held.

The first of these included establishment of stations in the Arctic, to study weather, aurora and magnetism. These observations showed that maximum auroral activity occurred in a band about 23 degrees wide,

(Continued on page 66)

No blue sky...just black and white facts

to back up our belief that

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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.

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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.
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Collins Radio Co.	Collins Radio Co.	Collins Radio Co.
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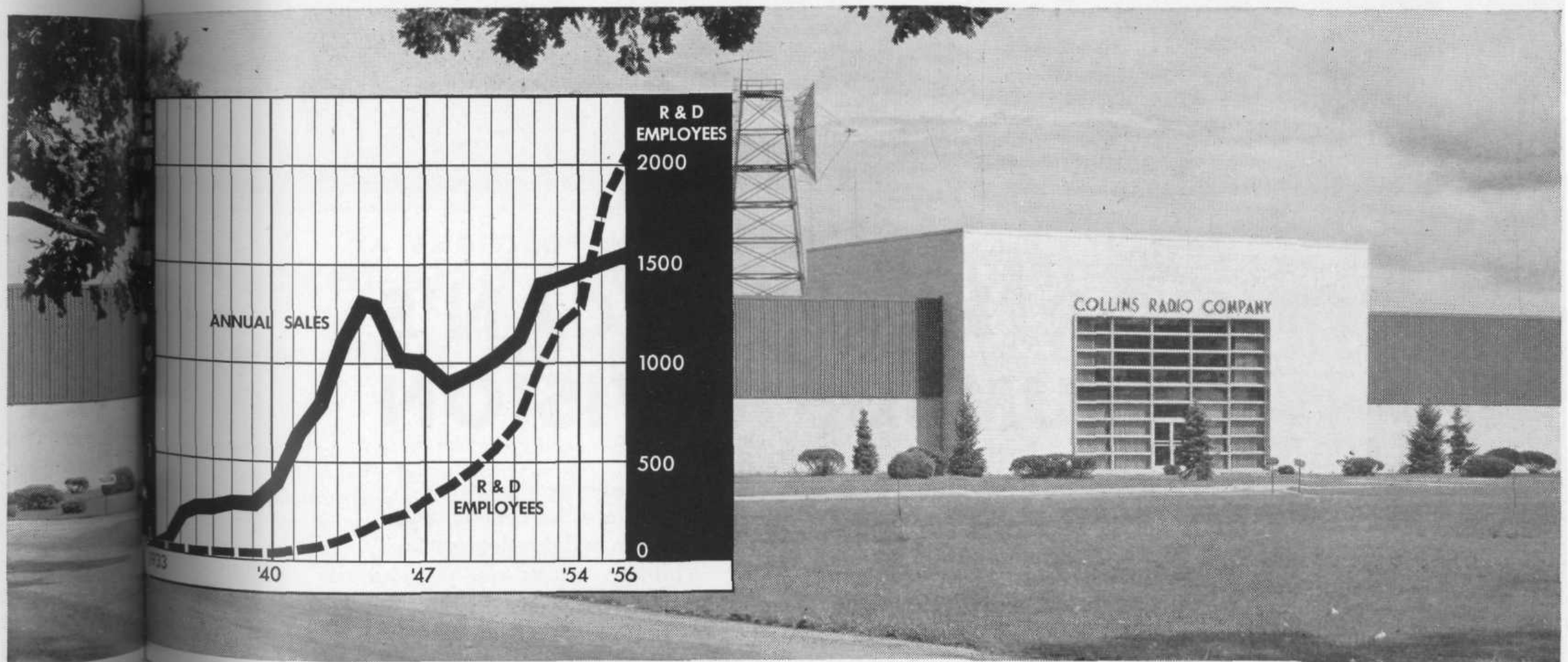

This graph shows the relationship between sales and employment of engineering personnel at Collins. Notice the steady increase in research and development employment despite sales fluctuations.

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

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First, Earth was all,
then the Sun, and then our Galaxy
of 100,000 million suns,
"like sand... flung down by handfuls
and both hands at once".
Now, we know our galaxy
is but one among a billion galaxies
where suns and earths
and atoms are ceaselessly created
by a Universe without
beginning and without end.
Political corollary: If nations may
forsake wars of aggression and deterrence
for a cooperative deployment
of earth's resources to explorations
in space and time, the new science of
astronautics may lead us soon
to the infinite plenty of the planets
and the stars.

worlds without end

Atoms in Industry

by Dr. James Stokley

As citizens of a world undergoing accelerating changes, it behooves us to understand these changes to the extent of our abilities. This comprehension comes easier when the guidance is expert. Here an able writer on science shows some of the things ahead for industry in the realm of the atom.

With the opening of the atomic age there have been a variety of reactions to this new force. Many think, with fear and terror, of the atomic bomb and its vast potentialities for destruction. On the other hand, the United Nations Conference on the Peaceful Uses of Atomic Energy, held at Geneva, Switzerland, in 1955, showed clearly that it can bring great benefits, particularly as a new source of power. With the shortage of conventional fuels a present problem in some parts of the world, and a threat for the future in others, the atomic nucleus offers a welcome new supply of energy. It seems to eliminate any fear that the advance of our economy may have to be curtailed during the next century or so, as supplies of coal and oil approach exhaustion.

It is in the atomic reactor that the splitting uranium nucleus releases a little of its store of energy in a controlled chain reaction (unlike the atomic bomb, where the reaction is allowed to go out of control). While the radiations emitted by this reaction impose some special problems not encountered in burning coal or oil, it is—like ordinary combustion—primarily a source of heat. Such heat may be used to turn water into steam, which is then fed into turbo-generators producing electricity.

If desired, instead, the heat may be utilized directly. Except in a few cases where atomically-produced heat, which might otherwise be wasted, can be applied as a by-product, it seems to have limited applications for heating buildings. However, it may prove a valuable source of "process heat." This is heat used directly in making many materials, such as rubber, cement, glass, paper, chemicals, metals, and petroleum. Since about a tenth of the nation's total energy consumption is now used in this way, it might prove a good market for heat from nuclear sources, even though some processes require temperatures as high as 3,000° F., well beyond the capability of any present reactor. By 1980, according to an estimate by the AEC, atomic sources might be able to supply as much as 10 per cent of the process heat used by American industry.

The Search for Uses

The Department of the Interior, with the Atomic Energy Commission, has made a preliminary study of the possibilities of using atomic heat for distillation of salt water, to provide fresh water for irrigation, or for municipal and industrial purposes. However, while this might provide an application for waste heat from a nuclear power plant, if it happened to be in a suitable location, it does not seem that atomic energy would have any significant advantages.

Another AEC study, with the collaboration of the United States Bureau of Mines, has been concerned with the gasification of coal. In the process contemplated, steam heated to temperatures of between 2,000° and 3,000° F. would be made to react with the coal right at the mines, producing gas that could be used in much the same way as natural gas. This would eliminate the need for expensive transportation of solid fuel, since the gas could be carried through pipelines.

Other possible applications, in which some interest was expressed by various groups when the McKinney Panel made inquiries, are in the extraction of nitrogen from the air, to make fertilizers, nitric acid, and other essential chemicals; in making acetylene and in the smelting of iron and copper.

But heat is not the only form of energy given off by atomic reactors and their products. The nuclear

*Dr. Stokley is Associate Professor of Journalism at MSU, holding the only post of its kind in any institution in the country; his field is scientific writing. The present article is taken from the author's forthcoming book, *The New World of the Atom,* published by Ives Washburn, Inc.

*DR. JAMES STOKLEY

radiations which are also emitted open up broad new fields of technology. The report to the Joint Congressional Committee on Atomic Energy by their Panel on the Impact of Peaceful Uses of Atomic Energy (headed by Robert McKinney) stated:

"Radiation energy cannot be thought of in the same terms as heat energy. For example, while an ordinary one-watt light bulb produces a barely perceptible amount of light or heat, a one-watt source of gamma radiation could kill a man in less than one hour. Research at Commission and industrial laboratories has demonstrated that radiation can be used to supply energy to initiate some chain chemical reactions and to supply all the energy required in basic chemical reactions. Radiation energy can also accomplish changes in the structure of materials and even create new materials which are difficult or impossible to produce by other known methods. . . .

"The future of atomic radiation is . . . speculative since little is known concerning the effects of massive quantities of radiation on various industrial processes and materials. Yet the prospect of substituting radiation energy for heat energy appears to offer real prospects in the food processing and chemical industries and may conceivably indicate a new direction from which future supplies for a different kind of energy than that now commonly used may come. Remembering our comparison of a one-watt light bulb and a one-watt gamma radiation source, it is apparent that a small amount of energy in the form of atomic radiation can be substituted for a relatively large amount of heat or electric energy in some industrial processes."

In some cases the radiation may have a trigger effect, starting a chemical chain reaction that is carried along the rest of the way by chemical energy. This occurs in the process of polymerization, by which plastics are made. The molecules of these materials are long chains, the same links being repeated hundreds of thousands of times. The unit is called a monomer and in this form it may be liquid. Then, when the necessary catalyst is added, these monomers link themselves together to form the long-chain polymers, and so the material solidifies.

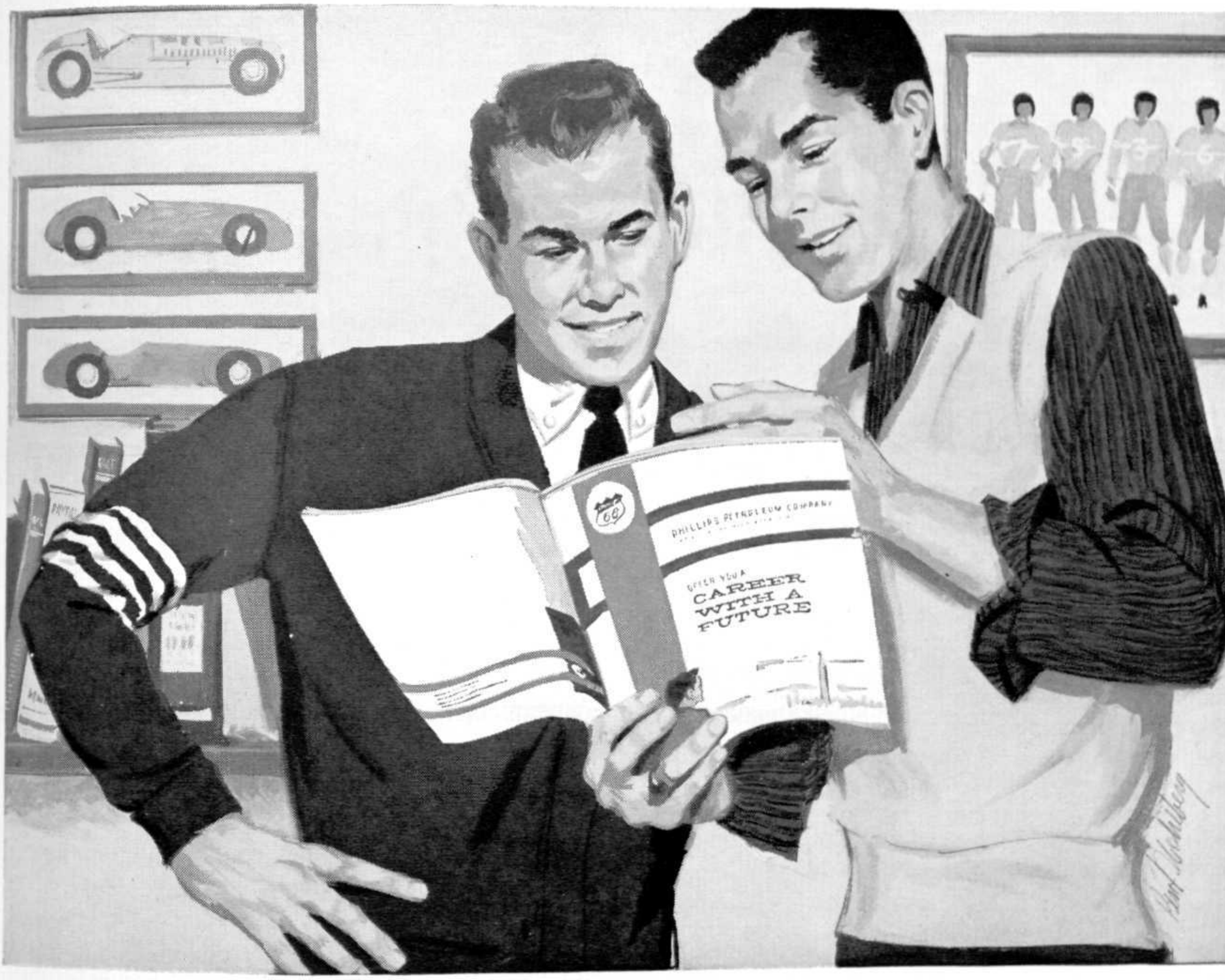
Butyl rubber, polymethyl methacrylate (used where glasslike transparency is wanted), polystyrene (an important electrical insulator), polyethylene (of which "squeeze" bottles are made), and many other plastics that are now used in large quantities are of this type; and in them all the polymerization process —the linking together of the individual units—can be initiated by radiation.

Whether radiation would be justified in their manufacture may be questionable, for only relatively small quantities of catalyst are needed to start the process by present techniques. The reaction vessels in which it is carried out are not expensive, while radiation equipment may be quite complicated. However, if it will simplify the operating conditions in any way, or permit some other advantages, a change might be justified.

The process of "grafting" is a familiar one in horticulture; for example, a dwarf apple or pear tree may be produced by growing these fruits on a quince tree. The process of "graft copolymerization" applies an analogous technique to chemistry. The ordinary polymer consists of the same unit repeated over and over. A copolymer is one of two different kinds of links, randomly distributed, while a graft copolymer is one with a chain of one polymer, upon which chains of another are grafted at certain intervals. Just as with the apple and quince, desirable properties of two different substances may thus be combined in one.

Although silicone rubber is resilient over a considerable range of temperature it is not as resistant to

(Continued on page 69)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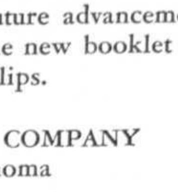
CAREER
WITH A
FUTURE

Technical Writing

By Harold K. Mintz

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Technical writing is the fastest growing branch of the profession. Its rapid development was triggered by World War II, stimulated by the Korean conflict and nourished by America's postwar prosperity. Today there is probably less competition in technical writing than in any other area of the writing profession.

Job opportunities are plentiful, especially in the 5.5 billion-dollar electronics industry, where the term technical writing originated. The Federal Government is the biggest purchaser of electronic equipment in the world, and roughly 4 per cent of the cost of this equipment arises from instruction handbooks—technical writing. And 4 per cent of billions is big business.

Positions that pay $5000-$10,000 are multiplying in the automotive, chemical, and aeronautical industries, in research organizations and in the Federal Civil Service. And prospects in the fast-growing nuclear power field look promising indeed.

What is technical writing? What is its importance and background and what are some of its underlying principles?

Science and engineering are the subjects of technical writing. Since most scientists and engineers do not have the time to write or do not write well, the need for technical writers becomes obvious.

Technical writing is impartial, factual, accurate, stimulating. It is designed for a specific purpose—to describe a technical device or process for engineers, management, customers, maintenance technicians, operators of complex equipment, and readers of professional journals, popular magazines or newspapers.

Technical writing is also extremely flexible and appears in various forms: research reports, manuals for installation, operation and overhaul, contract proposals, parts catalogs, progress reports, news releases, instruction leaflets for some home appliances, and do-it-yourself kits.

Importance of Technical Writing

How important is technical writing in our industrial society? Eminently well qualified to answer that question is Dr. Vannevar Bush, formerly president of Carnegie Institute, author, educator, and wartime director of the Office of Scientific Research and Development. This is what Dr. Bush says:

> Had I invented a new dynamite and reaped a fortune from it, I should be inclined to establish a Nobel Prize for the interpreter of science, who can in these days often serve his fellows far more than the individual who merely adds one morsel to the accumulated factual knowledge.

In the same vein, Charles F. Kettering, retired director of General Motors Research Laboratories, says that scientific research is completed only when its results have been reported to others. Research without publication, he emphasizes, is unproductive.

Background of Technical Writing

Technical writing is not a new art form; it did not spring up, full blown, in the 20th century. The first textbook on it appeared in 1908; from then to 1940 there was just a trickle of literature. From 1940 to 1950 the trickle broadened into a stream, and since 1950 the stream has developed into a river.

Technical writing of a classic stature dates back to the 1st century A.D. to a Roman author, Vitruvius, who produced a ten-volume work on city planning and architecture. About the same era, Frontinus, a water commissioner of Rome, wrote a celebrated report on the aquaducts of the Eternal City. In the 16th century, Georg Agricola (born Georg Bauer), a German physician and scientist and the father of mineralogy, authored his masterpiece, *De re metallica*. Some 350 years later, it was translated into English by an American mining engineer (and his wife), who later became President of the United States, Herbert Hoover.

From the days of Rome to the 19th century, science progressed slowly and writers kept pace with it. However, since 1900, science has marched forward in seven-league boots, pushing back undreamed of frontiers of knowledge. Information has accumulated at a rate far outdistancing our ability to publish, distribute, and assimilate. This unbalanced condition drives home with sledgehammer force the crying need today for interpreters of science and technology—in short, technical writers.

In the past centuries, engineers and scientists were the elite, the few highly educated people of their times. They worked alone or in small groups, in sharp contrast to the current practice. Engineers and scientists today pool their specialized knowledge and pull together as members of project teams in research, development, design, and production. Their success hinges on two factors: technical proficiency and skill in communicating ideas with one another and with the outside world.

Before World War II, technical writing did not exist as a recognized profession and few companies employed full-time technical writers. Engineers and scientists did their own writing of reports, very often their second most important duty. But when war came, the pressure of accelerated industrial research and production programs forced scientists to relinquish most of their writing activities to specialists. The Armed Forces needed mountains of equipment and instruction manuals. How else could soldiers and sailors operate and maintain tanks, planes, and battleships at peak performance?

When the war ended, an increasingly wide segment of industry realized the importance and value of technical writing. More and more companies began to employ writers, more books and articles started to appear, and more colleges began to give courses in engineering writing.

Agencies Promoting Technical Writing

One of the more aggressive agencies in advancing the profession of technical writing is the Society of Technical Writers, founded in Boston (a beehive of electronics) in 1953. This society now consists of 14 chapters throughout the United States and represents over 450 members in this country, Canada, South America, and Europe.

The Society of Technical Writers defines a technical writer as one who:

"A. as his principal function

(1) secures, organizes, and presents scientific or engineering information; or

(2) edits, reorganizes, and rewrites such information; or

"B. (1) teaches the principles and practices of technical writing, and

(2) has had practical experience in technical writing or editing."

The society, which issues a quarterly entitled *Technical Writing Review*, was organized to promote four objectives:

1. Developing and establishing standards. A project is now underway that will result in a glossary of terms and abbreviations common to the technical writing profession.
2. Stimulating an exchange of information in technical writing and allied fields such as technical publishing and illustrating.
3. Encouraging the development of technical writers.
4. Acquainting others with the profession.

Other agencies aiding the cause of technical writing are: the National Association of Science Writers, and the Society of Technical Writers and Editors (both in New York City); Science Service and American Documentation Institute (both in Washington, D. C.); and the Technical Publishing Society in Los Angeles.

Many colleges and universities offer courses in technical writing, including the United States Military and Naval Academies. However, the school that has captured all honors is Rensselaer Polytechnic Institute. R. P. I. offers a one-year graduate program, available also in the evening division, leading to a degree of master of science in technical writing. To be eligible for this program, students must hold degrees in science or engineering, and once enrolled, must continue with science studies. A plan is now being drawn up for giving parts of this graduate course, under short-term periods, to industrial writers.

Since June 1953, Rensselaer has sponsored a Technical Writers' Institute that includes lectures, discussions, writing exercises, and personal consultations with authorities. This annual one-week conference is open to representatives of industry and government.

In addition to the stimulus afforded by colleges and societies, the technical writing profession is also benefiting from a new phenomenon mushrooming on the business horizon – technical writing organizations. There are about 100 such firms in the country with a business volume estimated at around $75 million. New York City alone has about 40 such agencies and one of them employs more than 1000 people.

Many manufacturers of complicated apparatus prefer to hire such agencies on a part-time basis rather than try to train their own full-time writers. This condition prevails, especially if the writing must conform to government specifications, a painstaking task.

Handbooks written to the specifications of the Armed Forces must be engineered as precisely as the equipment they explain. Because so much skilled effort goes into those manuals, it is estimated they cost more than $100 a page before printing.

Advertising agencies, of course, grind out reams of technical copy, but it differs in one major respect—it aims to sell, not to inform. Nevertheless, much of their writing ranks high in content and style, and deserves study.

Qualifications of a Technical Writer

If you write for a living and monthly bills plague you, technical writing may be the answer. It provides you with a regular income and with research experience, both of which help smooth the way for your part-time creative writing projects.

(Continued on page 29)

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

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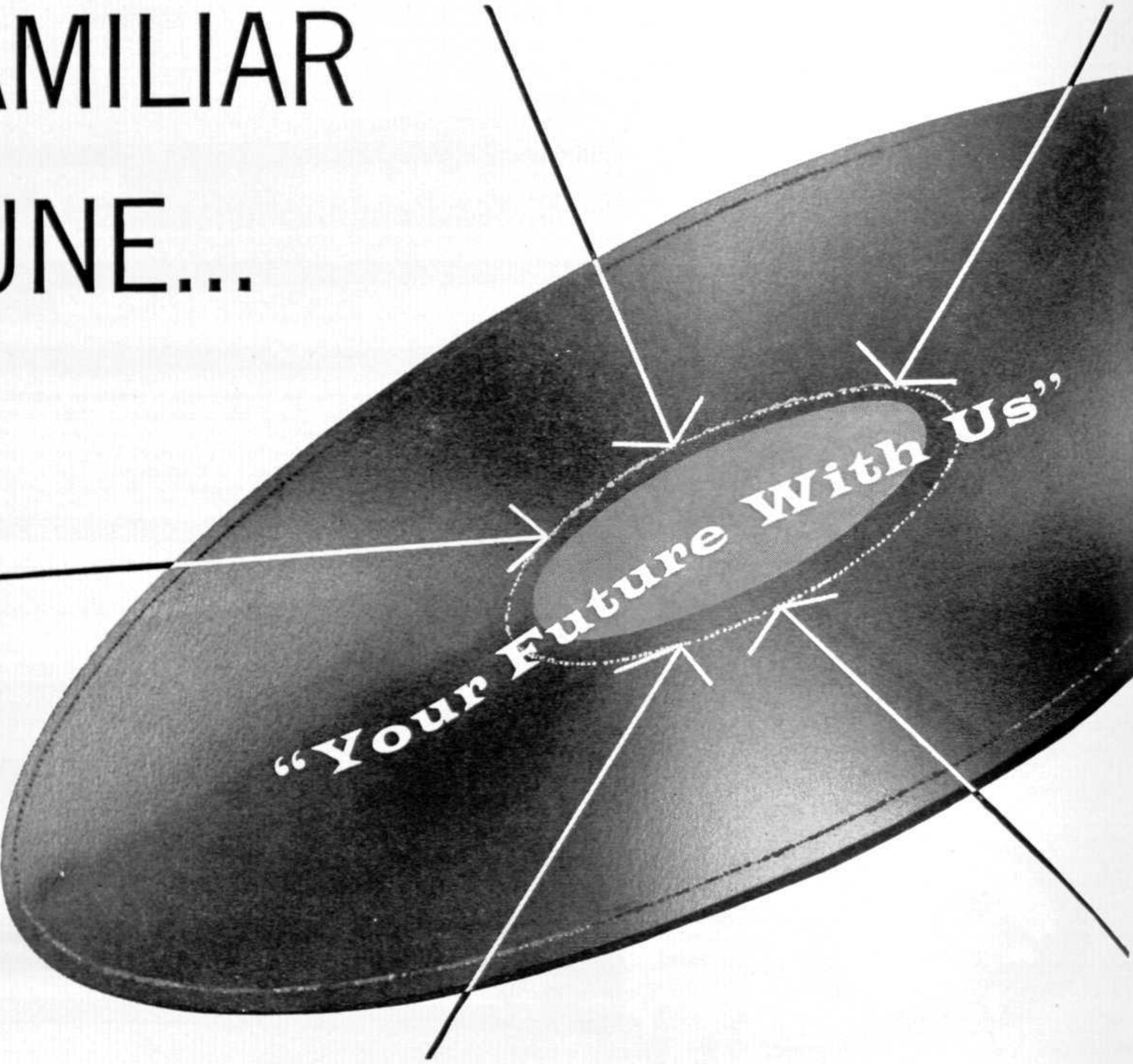

with a

BRIGHT NEW BEAT!

One company after another plays "Your Future With Us", hoping to make a hit. The reason is obvious: today there are more openings for engineers and skilled technicians than there are capable young men to pick up the pay checks.

We play the tune, too, but we like to think ours has a new twist, a bright new beat. Since we are a young company in a new and different field, our fresh approach comes naturally. Even though we pioneered the modern helicopter, our baby was probably born *after you were!*

While making no attempt to deny our youth, neither do we attempt to reject the plaudits earned in our few short years. Helicopters are acclaimed everywhere as the world's most versatile *aircraft*. We look to your generation to help Sikorsky helicopters become the world's most versatile means of *transportation*. And we offer you the kind of career that naturally follows such a challenging assignment.

Getting acquainted, of course, is a give-and-take proposition. You can start the ball rolling with a letter to Mr. Richard Auten at our Bridgeport Personnel Department.

SIKORSKY AIRCRAFT

BRIDGEPORT-STRATFORD, CONNECTICUT

One of the divisions of United Aircraft Corporation

TECHNICAL WRITING—

(Continued from page 25)

Should you decide to become a technical writer (also known as engineering writer, specifications writer, or publications engineer), you will need five major qualifications:

1. The first qualification is a general knowledge of science, particularly physics, mathematics, and chemistry, since one or the other enters all science news today. If you are familiar with a branch of engineering, your horizons will be that much broader and deeper.

2. Besides this general background, you will have to specialize. For example, if physics is your field, you should decide on what area in the physical world you will devote yourself to—nuclear power applications, electronics, electricity, mechanics, heat, light, or sound. Any one of those subgroups will occupy you for a lifetime of study.

3. However, knowledge by itself is not enough; it must be backed up by acute observation, thorough analysis, mature judgement. You should be able to evaluate what a scientist tells you or what he does in a laboratory or plant. You need not be able to perform experiments or other techniques of the scientist, but asking intelligent questions about them and understanding the answers—those tasks are yours.

Practical experience as an engineer, technician, or even as a hobbyist sharpens your ability to analyze and sift data. You should not accept as gospel all statements of scientists; they make mistakes too and your experience helps you detect them.

4. The next trait of a technical writer—understanding of the reader—is one of the obstacles that trips up scientists when they take pen in hand. Jargon is their technical language and they tend to think that everybody understands it. Scientists usually write as they speak—technically, leaving the readers on their own to mine the ore. And very few readers have the capability or inclination to do so.

In order to hold your readers, you should put yourself in their place. Remember, they are always asking —how? why? what? An old axiom points the way: Never underestimate your readers' intelligence or overestimate their knowledge.

If you tend to say "conflagration" for "fire," "prognostication" for "prediction," or "illumination" for "light," then you should burn into your mind a few astonishing statistics from the Department of Defense. Do you know that 45 per cent of enlisted military personnel now in the Armed Forces have not graduated from high school? And that only about 3½ per cent have graduated from college? These statistics probably typify our entire population, which brings us to the final major requirement of a technical writer:

5. Writing ability. You may be blessed with an abundance of the other qualifications; but if you lack the art of writing simply and clearly, you had better learn it.

Technical Editor

The technical editor, usually an experienced technical writer, supervises the writing activities of many people in many departments of an organization. He knows how to work with scientific personnel and how to direct photographers, illustrators, typists, and printers in producing a finished book. His value to the company depends largely on how fast he grasps the over-all technical picture.

In addition, an editor should be somewhat versed in copy layout, printing processes, photography, art, copyright law, trade organs in his industry, and government "specs" (if his company sells to the government). Above all, a successful editor must be a diplomat, for in rewriting and checking accuracy and English usage, three of his chief functions, he may be treading on someone's toes. And the poorest writers are often the most sensitive and belligerent about their literary aptitude.

There are, of course, other minor skills that editors and writers would do well to cultivate. A flair for the spoken word proves an asset in interviewing, in conferences, perhaps for an occasional speech, and also for tape-recording of technical data—a distinct possibility in the near future. A well-rounded editor and writer should be able to check advertising copy and contribute ideas to it, to snap a photograph, to sketch passably well.

Opportunities for technical editors are not nearly so legion as for technical writers but they are increasing, especially in large industrials.

Guideposts in Technical Writing

Basically, the principles of good technical writing parallel the principles of any other form of good writing. Yet there are some techniques worth mentioning:

1. Before starting to write, you should gather your information, study equipment and processes, form an outline with heads and subheads, and plan illustrations. These steps will consume at least half your time but they will minimize your rewriting task, save you much waste motion and help get you off to a running start—a traditional stumbling block.

2. Brevity is highly desirable and hard to achieve, but don't attain it at the expense of clarity. Because technical writing is so often packed with intricate ideas, physics formulas, and calculus equations, clarity of expression assumes crucial importance, almost on a par with accuracy.

To insure reader understanding, use diagrams and charts, tables and photographs freely. Such visual aids should be captioned and numbered, placed in the text where they are most pertinent and specifically mentioned in the text. Other means of needling your readers' attention are the "you" approach and news-peg tie-ins.

3. Words are the essential tool in writing and the way you use them can make or break you. To paint

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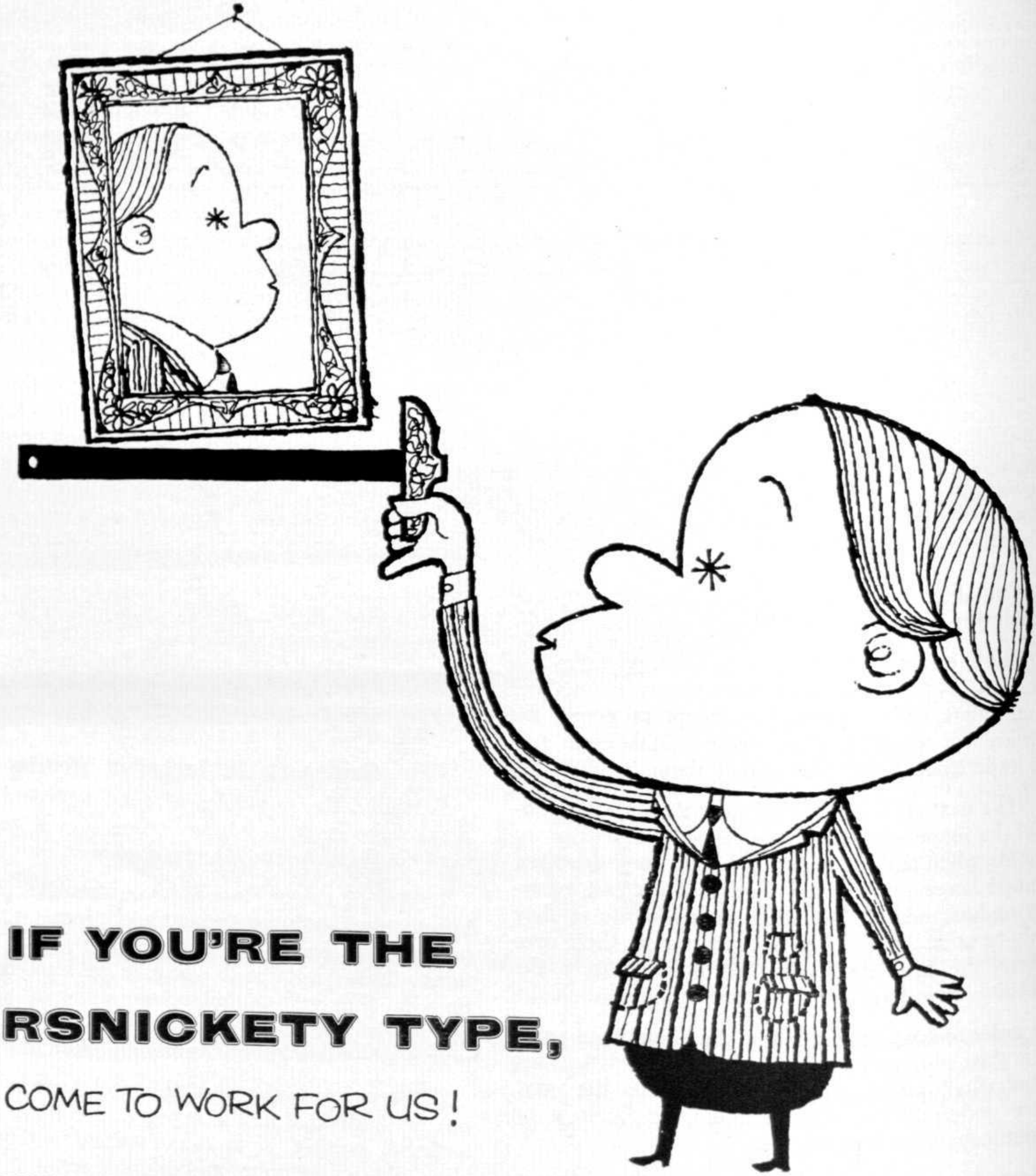

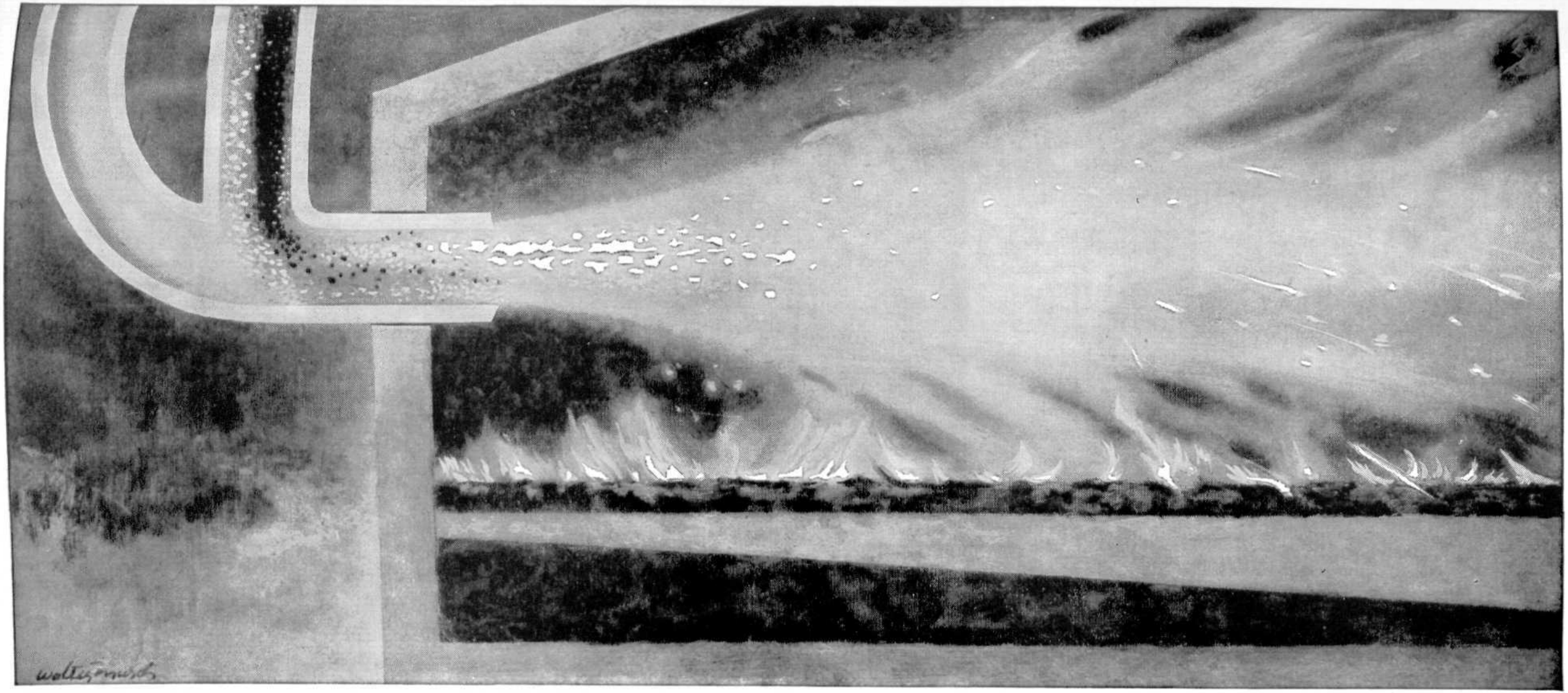

An artist's inside look at 1000-ton-a-day oxygen flash smelting furnace of Inco-Canada at Copper Cliff, Canada.

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:

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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.

NO ACHILLES HEEL

The final test of most products for industry is their ability to withstand—*completely*—the corrosive effects of long periods of time. In cables this is especially true, since no part of any cable is more serviceable than its weakest point. Fortunately—but not accidentally—no Achilles heel limits Kerite insulation. Kerite cable in perfect working condition after 40, 50, and more years of difficult service is the rule, rather than the exception.

The value and service life of a product can be no greater than the integrity and craftsmanship of its maker.

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NEW DEVELOPMENTS

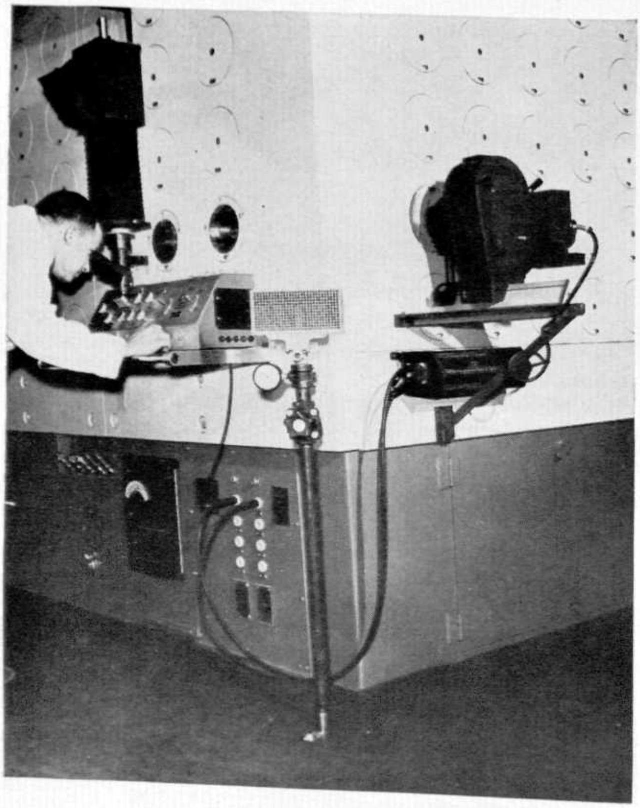
Edited by Richard Thompson

Dangerous Peep Show

A new remote-controlled microscope developed at the Hanford plutonium plant inspects materials emitting radiation so intense that its optics eventually go "blind."

Scientists use the instrument to study changes that occur in the microstructure of metals exposed to chain-reaction bombardment. The information they gain is used to develop alloys and fabrication methods that will make atomic structures withstand increased radiation exposure.

Pieces examined in this work have been deformed by radiation and in the process have become ray emitters. As a result, the Hanford microscope is eventually damaged by these rays.



A new remote controlled microscope used to inspect materials emitting radiation.

All work is done remotely inside the 38-ton steel cell which houses the radioactive sample. First, the sample is placed in the cell by means of mechanical "hands" powered by electric motors.

Such a "hand" removes the sample from a lead container and positions it against grinding and polishing wheels. Then, electrical etching equipment removes the top layer of metal which has been made into a "non-typical microstructure" by the heat of the grinding.

Mechanical "fingers" place the radioactive sample on the microscope stage, and the scientist manipulates sensitive controls to bring into focus one of three compound objective lenses.

Light beamed through a wall port is focused to a bright pin point, illuminating the polished sample of metal inside the cell. Reflected light from a circular dot of metal, sometimes as small as five one-thousandths of an inch in diameter, is collected by a compound lens and projected through another wall opening to an external eyepiece. There, it is transformed into a vastly enlarged image of the circular area.

The instrument can optically separate two elements of grain structure one one-thousandths of an inch apart. In effect, it places the observer's eye within one two-hundred and fiftieth of an inch of the "hot" surface and still permits the eye to focus.

Up Phosphors

As with all such advancements in the apparatus of man's living, beginning with rush lights in the caves, the development starts off with great inefficiency and high cost, in one way or another. When Destriau made his first observation of the new light source, it was necessary to allow the eye to adjust for several minutes in the dark in order to see the faint spectral glow produced. Nearly all the great discoveries of our time are based on the observation of just such tiny, imperceptible effects or phenomena. It was 1947, with war intervening, before Destriau raised the glow sufficiently to publish the first comprehensive paper on electroluminescence. Following this, industrial laboratories, led in this country by Westinghouse, launched a basic investigation into the production of light in solids, which began to get off the ground only in 1954.

World's First Electric Watch

A new era in timekeeping was ushered in with the introduction of the world's first electric wrist watch, perfected after ten years of research, development and testing.

No larger than a conventional wrist watch, it incorporates the first basic change in watch construction in almost five centuries.

Unveiled at a New York press luncheon, the watch will be available to consumers some time this month.

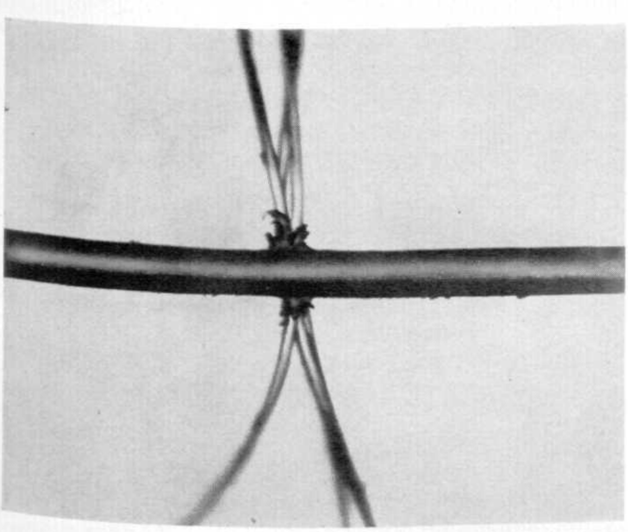
The radical structure of the electric watch completely eliminates the mainspring, an integral part of portable timekeeping devices since it was invented in 1480 by Peter Henlein of Nuernberg, Germany. The new watch is the only one in existence which runs without winding or without periodic agitation.

The watch movement is so exquisitely engineered that a tiny energizer the size of a small shirt button will run it for a minimum of twelve months. In fact, the electric watch would run for more than 20 years on energy that would operate a 100-watt bulb for no longer than one minute.

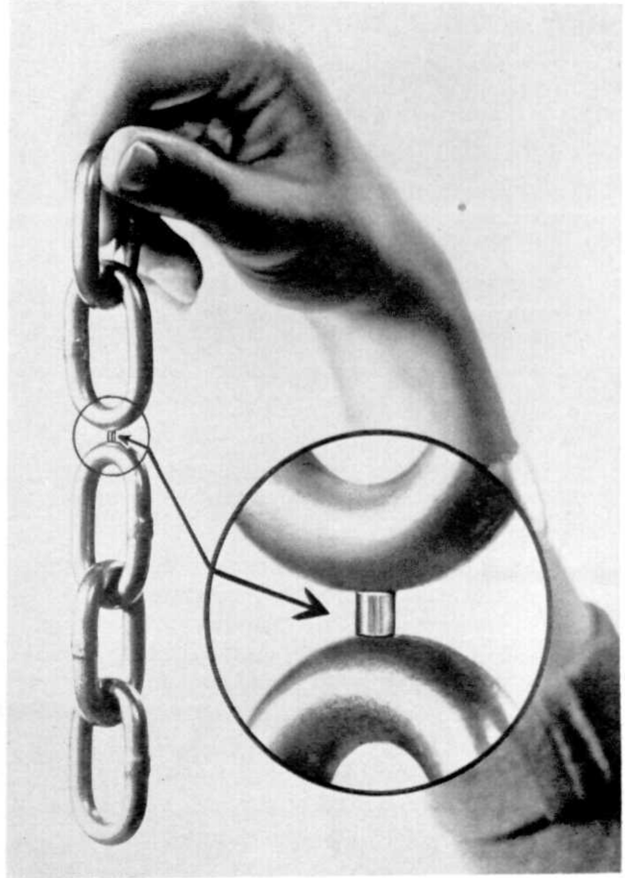
The electric watch also has profound implications for our national defense, with miniature timing devices so vital to modern weapons of war.

The electric watch operates on chemical energy stored in a tiny energizer. This energy is converted into electrical power as it releases a stream of electrons through a coil of fine wire fixed on a balance wheel. The electrical energy through interaction with permanent magnetic fields causes the balance wheel to oscillate. This oscillation is the mechanical energy which runs the watch.

The over-all result is a precise miniature power plant built into the balance wheel, which in turn powers the gears and moves the hands of the watch.



Shown are three strands of the wire, six ten-thousandths (.0006) of an inch in diameter, strung through a hole bored in a human hair. Picture is magnified 300 times.



This tiny permanent magnet (see arrows) weighs only fifty-six ten thousandths of an ounce but is so powerful that it is shown supporting a chain 215 times its own weight.

In the past, the balance wheel only controlled the power furnished by a mainspring. In the electric watch it furnishes its own power as well as controls it.

The essential difference between this motor and the conventional electric motor is that the power plant, combined with a balance wheel, permits the flow of energy to be strictly controlled and the speed of the hands to be held to an accuracy of more than 99.995 per cent.

The coil is made of wire only one fifth the thickness of human hair. Enough of this wire for 1000 watches would weigh only two ounces but would stretch from Dover all the way across the English Channel and well into France.

The tiny magnets used in the electrical system are of platinum alloy and have the highest energy content of any magnet in the world today.

The gold-plated energizer is designed for long life and low power. It is 400 times more efficient, in terms of space, than the mechanical energy stored in a mainspring, and does an incredible amount of work for its size.

(Continued on page 36)

NEW DEVELOPMENTS—

(Continued from page 35)

Vulcan Gun

A rapid-firing 20 millimeter weapon, one of the first specifically designed for present supersonic jet aircraft, was recently unveiled at Aberdeen Proving Ground, Maryland.

Named after Vulcan, ancient Roman god of fire, the new weapon was developed by electrical engineering company's aeronautic and ordnance department under the sponsorship of U. S. Army Ordnance and with technical supervision from the Springfield, Massachusetts, Armory.

Development of the new 20 millimeter cannon was prompted by the tremendous increase in speed of modern jet aircraft.

Until the development of Vulcan, armament fire power rates had lagged behind the speeds of jet aircraft. Vulcan now fulfills the requirement of a weapon capable of firing at an extraordinarily high rate in the short time available to shoot at fast moving targets.

The new 20 millimeter cannon has "borrowed" two design features from the original Gatling gun, patented in 1862. Both guns have a rotating multi-barreled cluster, and both are externally driven. External power for the Gatling gun came from human energy as the operator turned the crank. The Vulcan gun is externally powered by either electricity or hydraulic fluid.

Engineers and Army Ordnance officers made a study of every machine gun mechanism patented in the United States. The Gatling gun design was selected because its rotating cluster of barrels offered the necessary characteristics for an extremely high rate of fire.

According to its designers, the Vulcan gun is simple to operate and maintain, and can be field stripped and reassembled in less than 30 minutes.

Ashes to Ashes

A small black box may soon outmode household dusting. Called a power pack, it is being built for use with a special electrostatic filter in room air conditioners.

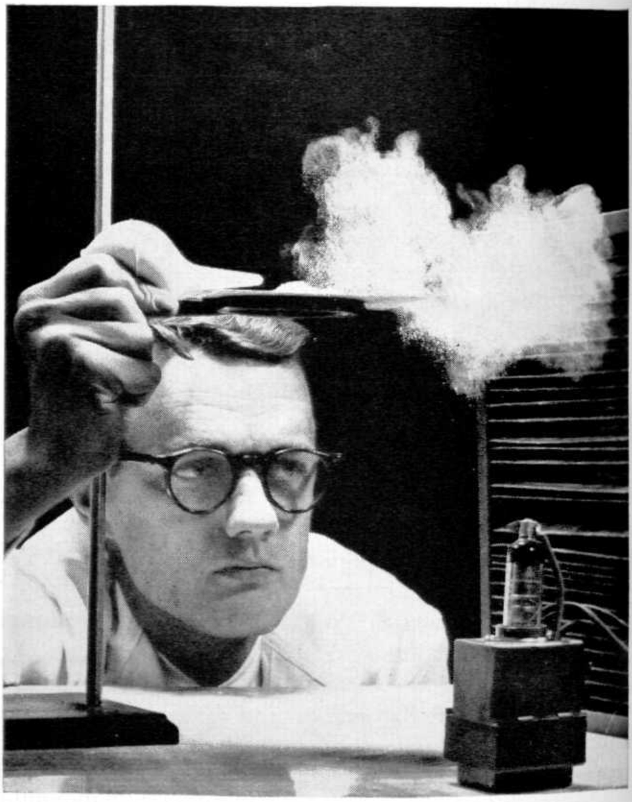
Providing the nearest approach to dust-free air yet attainable in the average home, the filter-power pack combination is designed to remove dust, grime, soot, smoke, lint, and pollen from the air before it is circulated through the house. The system is designed to give nearly 100 per cent pollen protection and better than 95 per cent effectiveness in filtering out dirt which causes discoloration.

First built for room air conditioners, the power pack uses less current than three Christmas tree lamps, or about ten watts, according to engineers.

Over 300 per cent more effective than ordinary mechanical filters, the electrostatic system filters out particles so small that 400 such tiny bits packed closely together would be only barely visible to the naked eye, the engineers said.

An electrostatic air filter uses the power pack to do its housecleaning by building up an electric charge on the filter. This charge captures dust the same way bits of iron and steel are drawn to a magnet.

The power pack operates on regular household circuits, 115 or 230 volts, 60 cycles.



New power pack used with special filter may soon eliminate household dusting.

New Nose Is Good News

In the intercontinental ballistic missile race, the development of a nose cone which can withstand flight conditions similar to that of a meteor is one of the most challenging problems facing engineers today.

The nose cone is the extremely forward part of the missile which carries within control equipment and the missile warhead.

The flight of the ballistic nose cone is similar to that of a meteor in that it must descend from extreme altitudes at hypersonic velocities and must re-enter the dense layer of air surrounding the earth.

However, unlike a meteor, missile nose cones must not break or burn up but must remain intact and functional. In a sense, engineers and scientists are designing better meteors.

The tremendous magnitude of this task is emphasized by the fact that the relatively little knowledge

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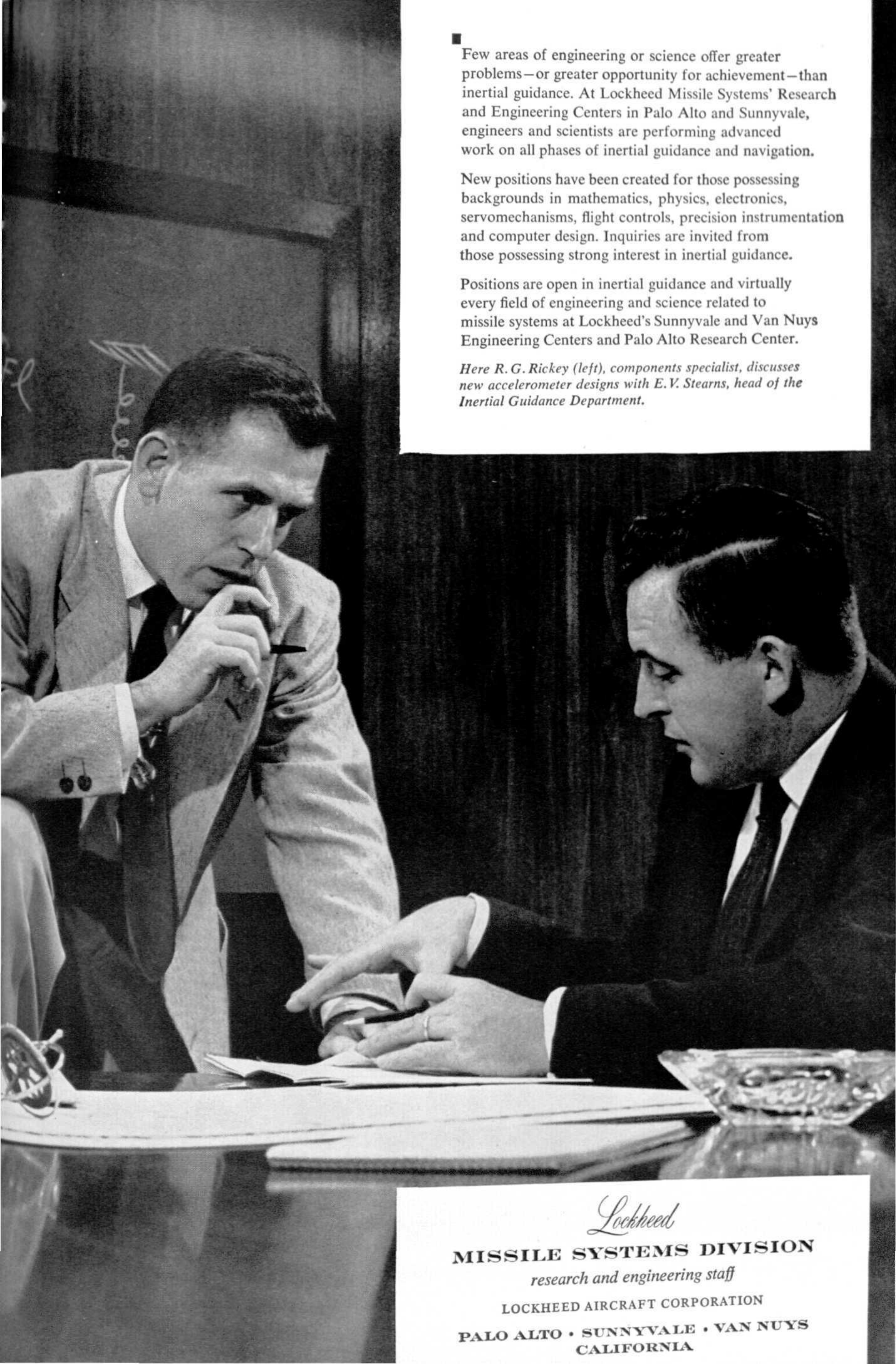

Few areas of engineering or science offer greater problems—or greater opportunity for achievement—than inertial guidance. At Lockheed Missile Systems' Research and Engineering Centers in Palo Alto and Sunnyvale, engineers and scientists are performing advanced work on all phases of inertial guidance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

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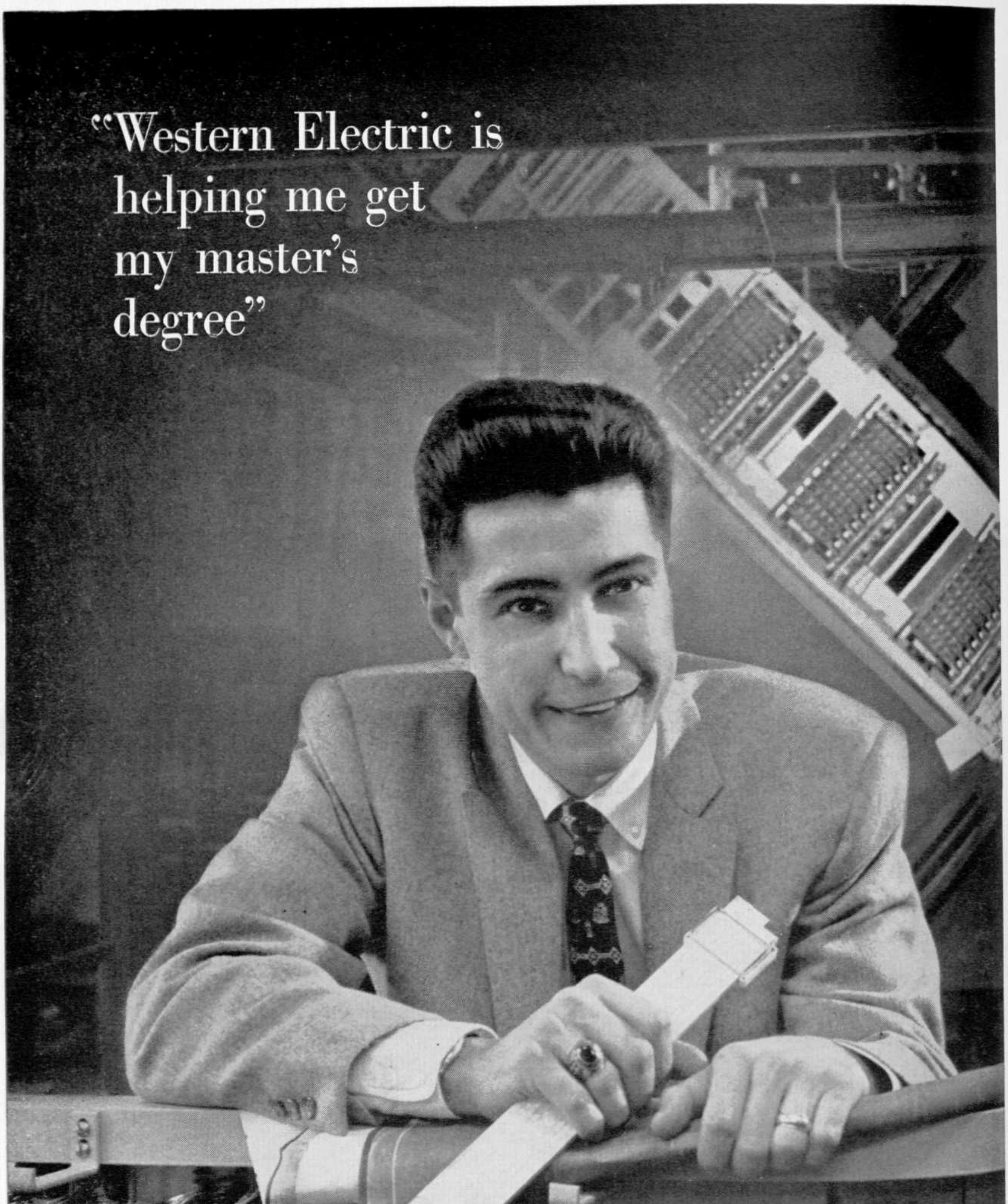


JOHN MORAN, who joined Western Electric's engineering staff at the Kearny Works recently, is now studying for his M.S.M.E. under the new Tuition Refund Plan. Western Electric expects to refund the tuition for John's graduate study at the Newark College of Engineering this year.

Western Electric's new TUITION REFUND PLAN can help you continue your studies while launching an exciting career

Under the new plan, Western Electric will refund tuition costs for after-hours study at graduate or undergraduate level, up to a maximum of $250 for each school year.

Say, for example, that you decide on a career at Western Electric in one of many rewarding phases of telephony—electronics, development engineering, design, manufacturing production, plant engineering, or some other. You may be eligible for financial assistance to help defray the cost of graduate or other study from the very first day. Choose engineering, science or any course that is appropriate to your job or that adds to your ability to accept greater responsibility, and the Company will refund to you up to $250 a year for tuition. (You'll note from the map on this page that Western Electric's work locations are well situated in terms of major population areas. That means that many of the nation's best schools are close by.)

Plus values, like the new Tuition Refund Plan, give Western Electric engineers many opportunities that others never have. There's specialized training both in the classroom and on the job . . . a formal program of advanced engineering study that includes full-time, off-job courses of up to 10 weeks' duration . . . a retirement and benefit program that's one of the best known and most liberal in industry . . . low-cost life insurance that would appeal to any man with his eye on the future. And of paramount importance is the chance to work alongside top men in the field of communications.

There's a good deal more for which there isn't space here. Why not write us or contact your placement office to schedule an interview when Bell System representatives visit your campus.

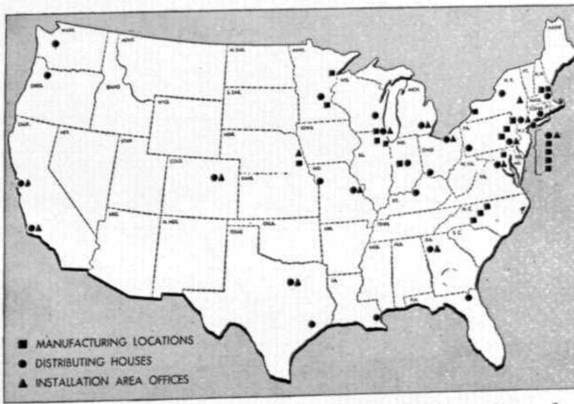
As one of us, you'd help engineer the manufacture, distribution or installation of the equipment needed for the nation-wide communications network of 49 million Bell telephones.

Here—where transistors were first developed for production; where repeaters for the new transatlantic telephone cable were tailor-made—there's a constant need for new products and new processes. Two-thirds of the equipment we make today for the Bell telephone companies is of types developed since World War II.

Besides telephone work, Western Electric—over the years—has been responsible for a continuous flow of defense jobs for the government such as the Nike guided missile system and the DEW Line.

There's plenty of room for advancement . . . whatever your field of specialization. So—whether you'd be helping with our telephone job, or working on a major defense project like guided missile systems—with Western Electric you can expect to grow!

For our College Tuition Refund Plan booklet and additional information about Western Electric write: College Relations, Room 1030, Western Electric Company, 195 Broadway, New York 7, N. Y.



Western Electric has major manufacturing plants located at Chicago, Ill., Kearny, N. J., Baltimore, Md., Indianapolis, Ind., Allentown, Pa., Winston-Salem, N. C., Buffalo, N. Y., North Andover, Mass. Distribution Centers in 30 cities. Installation headquarters in 16 cities. General headquarters: 195 Broadway, New York, N.Y. Also Teletype Corporation, Chicago 14, Illinois

Western Electric

MANUFACTURING AND SUPPLY — UNIT OF THE BELL SYSTEM

Walls Converted Into Paper-thin Light Fixture . . .

Electroluminescent Lighting

Reprint from Architectural Forum
January 1957

In 1936 the French physicist Professor Georges Destriau and a small band of co-workers discovered an entirely new method for obtaining light. It consisted simply of a thin layer of phosphors, such as the coating on a television tube, between two thin conductive plates. When an alternating current of high enough voltage was applied between the plates, the excited phosphors emitted a faint light. This differed from the fluorescent lamp, then in development, which employed invisible ultraviolet light from a mercury-glow discharge to excite phosphors into emitting visible light. And it differed from all other means of phosphorescent emission, which included X-rays, as in fluoroscope tubes, and cathode rays, as in television. The new method, in which the two thin plates acted as condensers to create an electromagnetic field, became known as electroluminescence.

Today electroluminescence is in exciting development by nearly all the larger electric and electronic industrial laboratories, headed by Westinghouse, which was quick to take on Destriau as consultant, and by Sylvania Electric. As a practical light source, electroluminescence is not yet efficient enough for wide use, but it is moving up with great speed. And it holds not only the physical potential of outdistancing all other light sources in efficiency but also the potential of providing the first truly architectural use of light. For, like so many developments crowding in, electroluminescence lends itself, with great economy of means and elimination of clumsy apparatus, to panel fabricaton. It is, in fact, a sandwich panel of light.

The reason that the development has moved so fast since 1954 is that converging streams of knowledge have come together to give it a great push. The rise of solid-state physics, producing many exciting new developments in electronics, is widening the understanding of energy states in solids. The development of television is bringing forth many new phosphors. And the ability of chemistry to go beyond natural substances to create by molecular alchemy not only greatly improved synthetic phosphors but also many other new materials swells the tide upon which electroluminescence is riding. When Westinghouse turned in 1954 to develop synthetic phosphors to the specific needs of this form of luminescence, the results were almost immediate and spectacular. A typical electroluminescent panel now consists of a plate of glass on which is put down first a thin, transparent conductive coating (developed by Corning Glass), then a thin layer of zinc sulfide phosphors embodied in a polyvinyl chloride plastic film, then a layer of aluminum

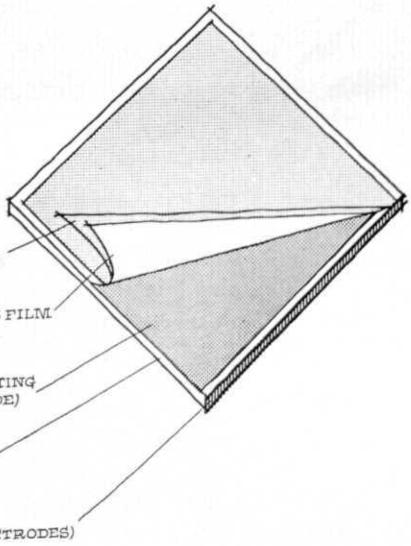
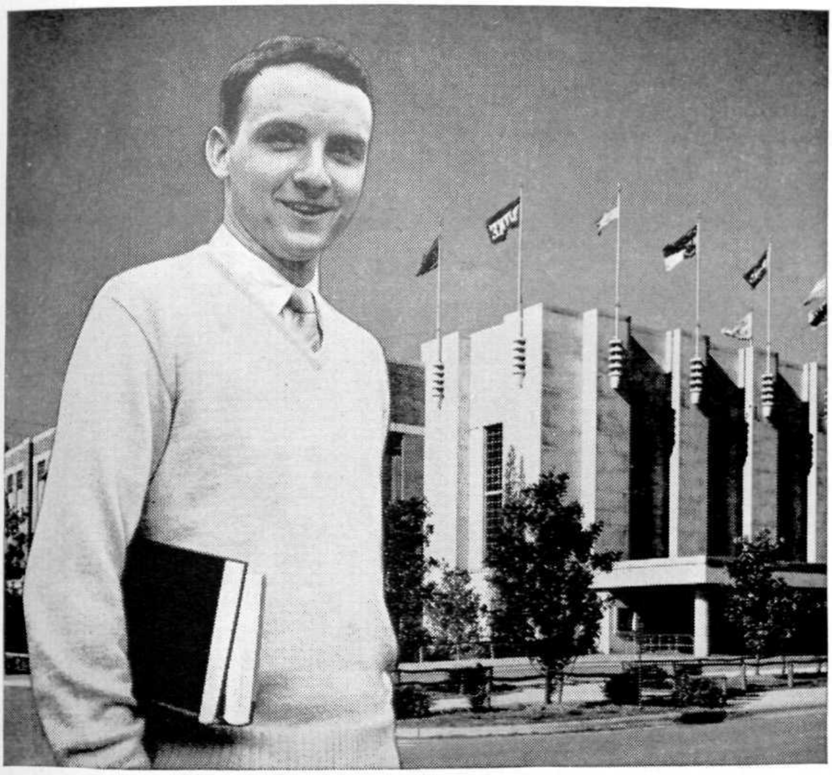


Diagram showing a typical sandwich panel of electroluminescent light.

foil to act as the second plate or electrode—the whole sandwich being little more than ⅛" thick.

The main areas in which improvements in efficiency are due to come are in phosphors and the dielectric plastic in which they are embedded. New phosphors of great variety are arising almost monthly. Late

(Continued on page 75)



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
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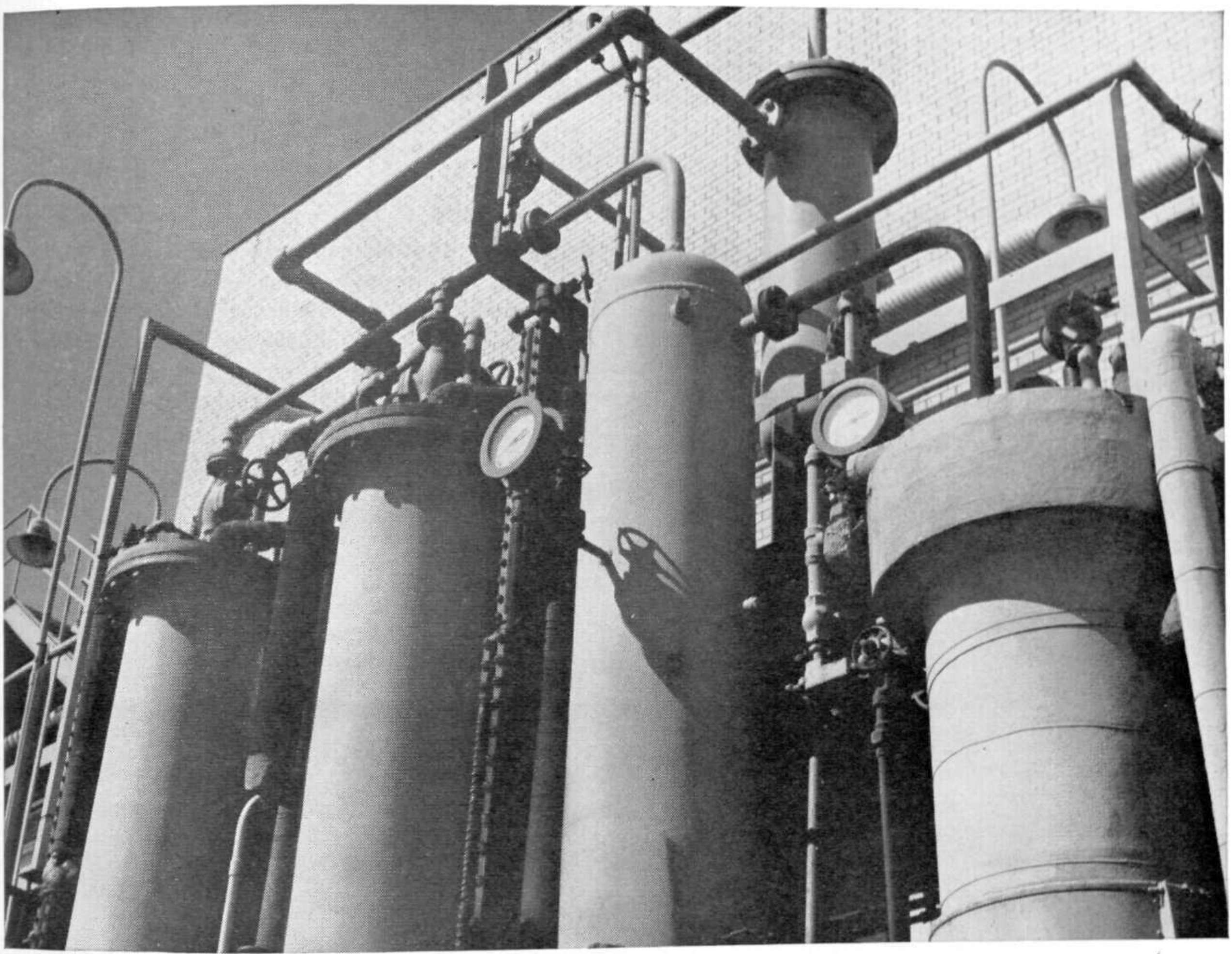
BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

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.



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.

CLUBS AND SOCIETIES

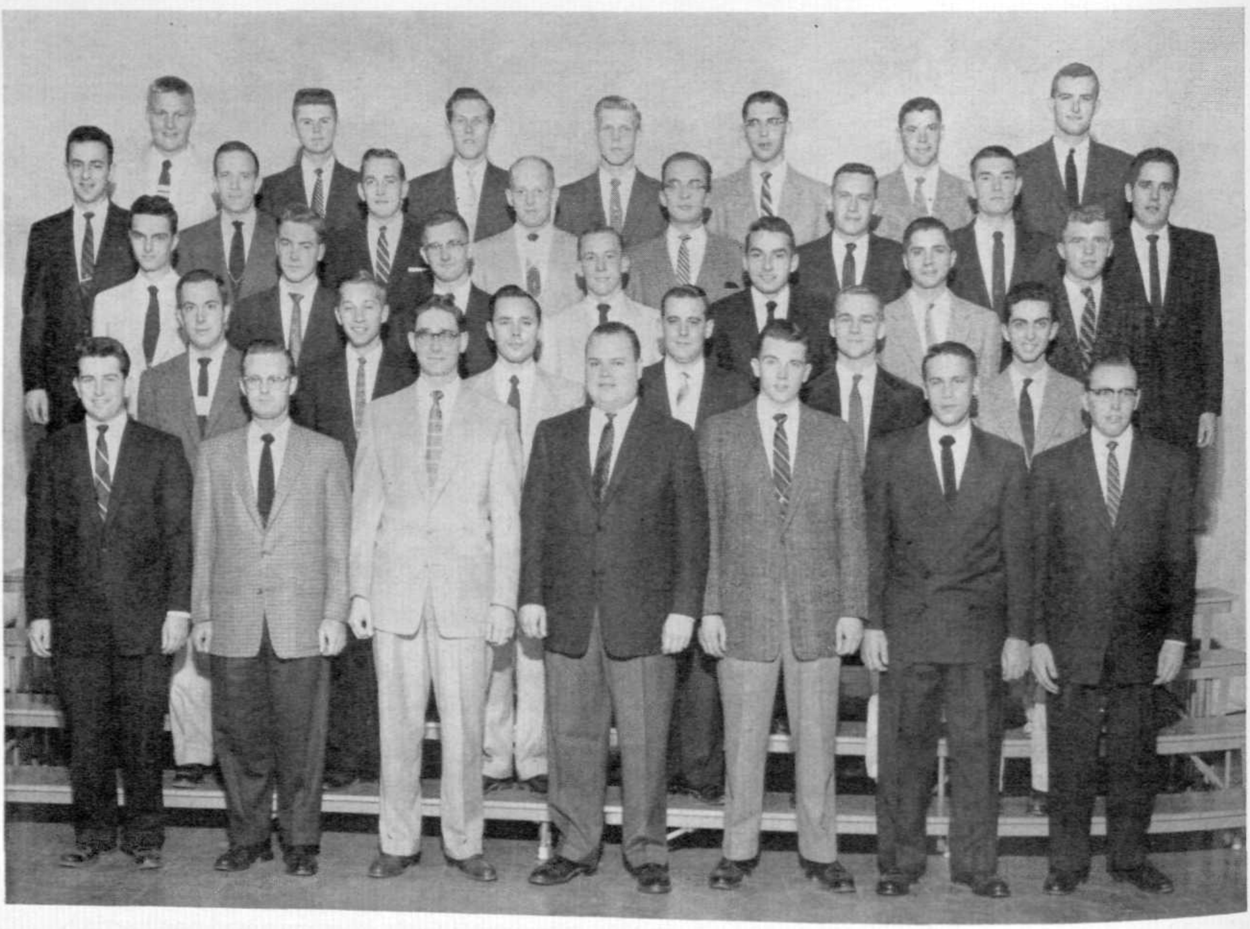
PI TAU SIGMA

Pi Tau Sigma is a national honorary fraternity for Mechanical Engineers. The fraternity was established in 1915, first at the University of Illinois, then Wisconsin, and later at other leading universities and colleges. At the present there are 60 chapters. The MSU Chapter was installed in 1950.

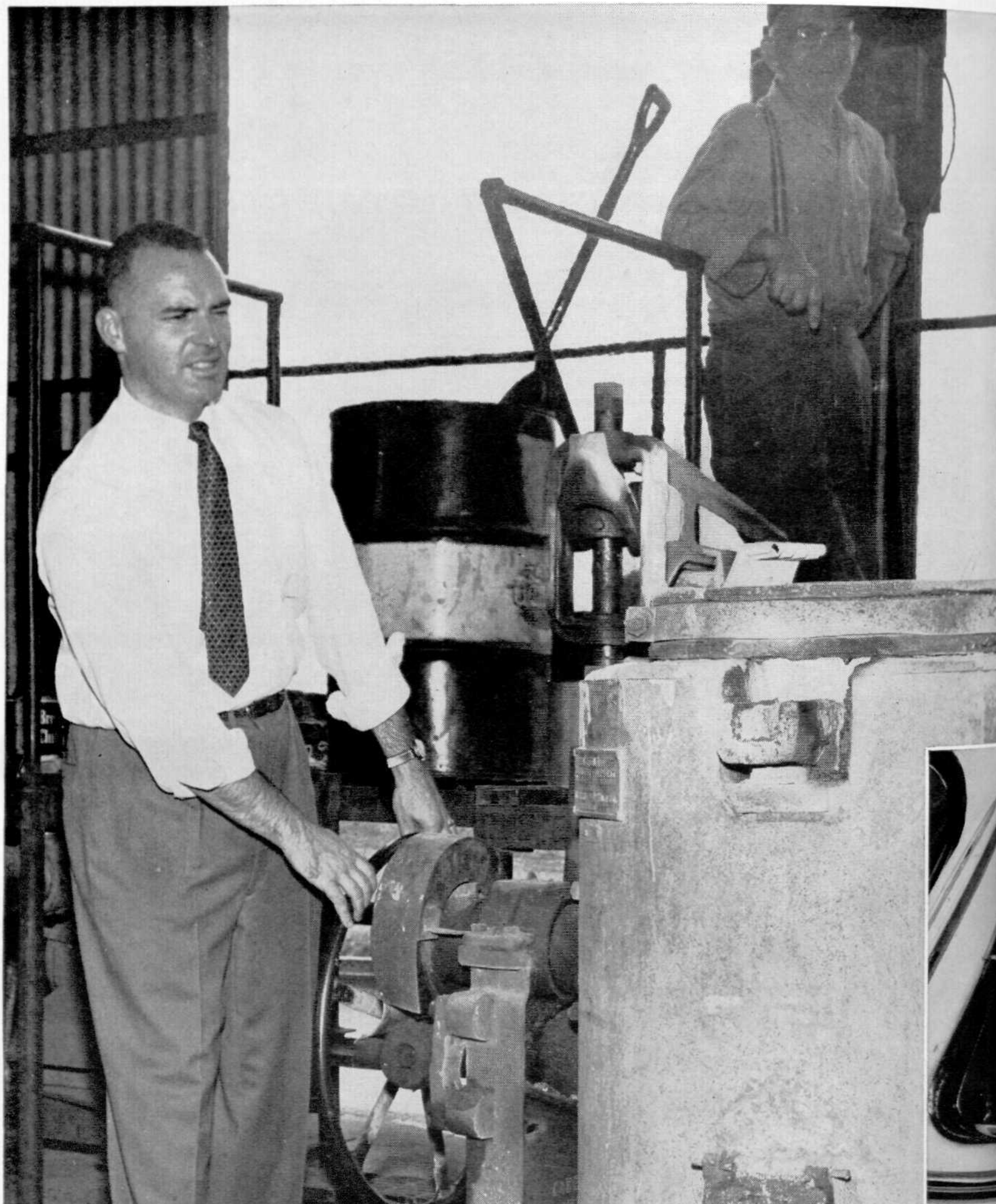
The fraternity was established to promote a bond of fellowship for those in the study and in the profession of Mechanical Engineering, who demonstrate by their academic or practical achievements a real interest or distinct ability in Mechanical Engineering.

Membership consists of three classes: Honorary, Active, and Graduate. Four Honorary members were selected in 1956, three of whom are on the Mechanical Engineering Department Staff, Professor Rotty, Mr. Ditsworth, and Professor Morse. The fourth Honorary member selected was Mr. Herman Bickel, Chief Engineer of Wickes Boiler Co., Saginaw. Other Honorary members include J. F. Wolfram, General Manager of Oldsmobile and Claud R. Erickson, Head Engineer for Board of Water, Light, and Electric Commission, Lansing. There are presently 42 Active members and 28 Honorary and Graduate members. Active members are selected from the Junior and Senior class. A good academic record is needed to make a student eligible for Pi Tau Sigma, but this is not the only prerequisite

(Continued on page 52)



FRONT ROW—(left to right) Dick Higgenbottom, Jim McKinley, Joe Daugherty, Bill Plant, Horace Prindle, Hugh Niven, Karl Kerns.
SECOND ROW—Dick Cornell, Dennis Kuzma, Wayne Sebrell, Dick Willyoung, Dick Coleman, Joe Colucci.
THIRD ROW—Dave Morse, Warren Kleis, Ralph Furtney, Tom Slattery, Jim Fent, Walter Eckhart, Jim Peterson.
FOURTH ROW—Frank Paganini, John Brown, Dick Burke, Chuck Fowler, Stacey Halkides, Dean Cooper, Keith Salisbury, Dick Herrick.
TOP ROW—Carl Diener, Bill Trecka, Doug Steury, Jim Ruotanen, Dean Bluman, Dick McCormick, Charles Kirchhoff.



More graduate engineers moving up in the GAS industry ...the nation's sixth largest

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

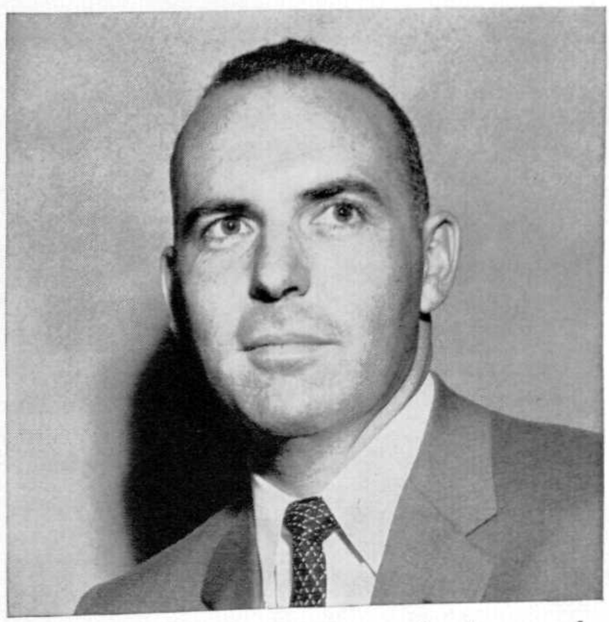
There are many opportunities for you in the Gas industry. The industry needs engineers, and does not overhire. You won't be regimented. There's always room for advancement. With utility companies and with manufacturers of Gas equipment, there's a future for you as an engineer. Call your nearest Gas Utility.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

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

fter completing the company's Student Engineering Training Pro-ram, Joe spent one year in the Gas and Steam Testing Laboratory. le was then promoted through various levels of engineering and upervisory assignments, to his present job of Assistant Superin-endent on April 1, 1956. This department has over 450 employees nd is responsible for the installation and servicing of industrial, ommercial and domestic gas appliances on customers' property, and he installation and servicing of gas and steam metering and pressure ecording 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.

CLUBS AND SOCIETIES—

(Continued from page 48)

for membership. Some other qualities are leadership, personality, industry, dependability, and probable future success in Mechanical Engineering.

The present officers are Joe Colucci, President; Keith Salisbury, Vice-President; Dick McCormick, Treasurer; Chuck Kirchhoff, Recording Secretary; Wayne Sebrell, Corresponding Secretary.

Pi Tau Sigma has taken an active part in the annual Engineering Exposition, constructing exhibits, acting as guides, and putting up signs. The fraternity also has a bulletin board for a "Know Your Faculty" program. Each month a picture and a brief history of a faculty member is displayed so that students can become better acquainted with instructors.

Each year there is a National Convention of Pi Tau Sigma. Horace Prindle represented MSU at the convention held at State College of Pennsylvania last year. It is hoped that the 1958 convention can be held here, after the new Mechanical Engineering building is completed.

The American Foundrymen's Society

The Student chapter of the American Foundrymen's Society at MSU was first organized in 1948. Its purpose is to familiarize the interested student with the opportunities available in the foundry industry, the nation's fifth largest.

The foundry industry earnestly supports the many student chapters of the AFS and its close relationship has a uniqueness among university organizations. MSU's Student AFS chapter is no exception, having as its industrial advisors: Richard Dobbins, Plant Engineer at Albion's Malleable and Ken Priestly, President of Vassar Electrolay Products. Both of these men are graduates of MSU.

Officers of the chapter for the year 1956-57 are:

Chairman, Dwaine Pozen, East Lansing Senior

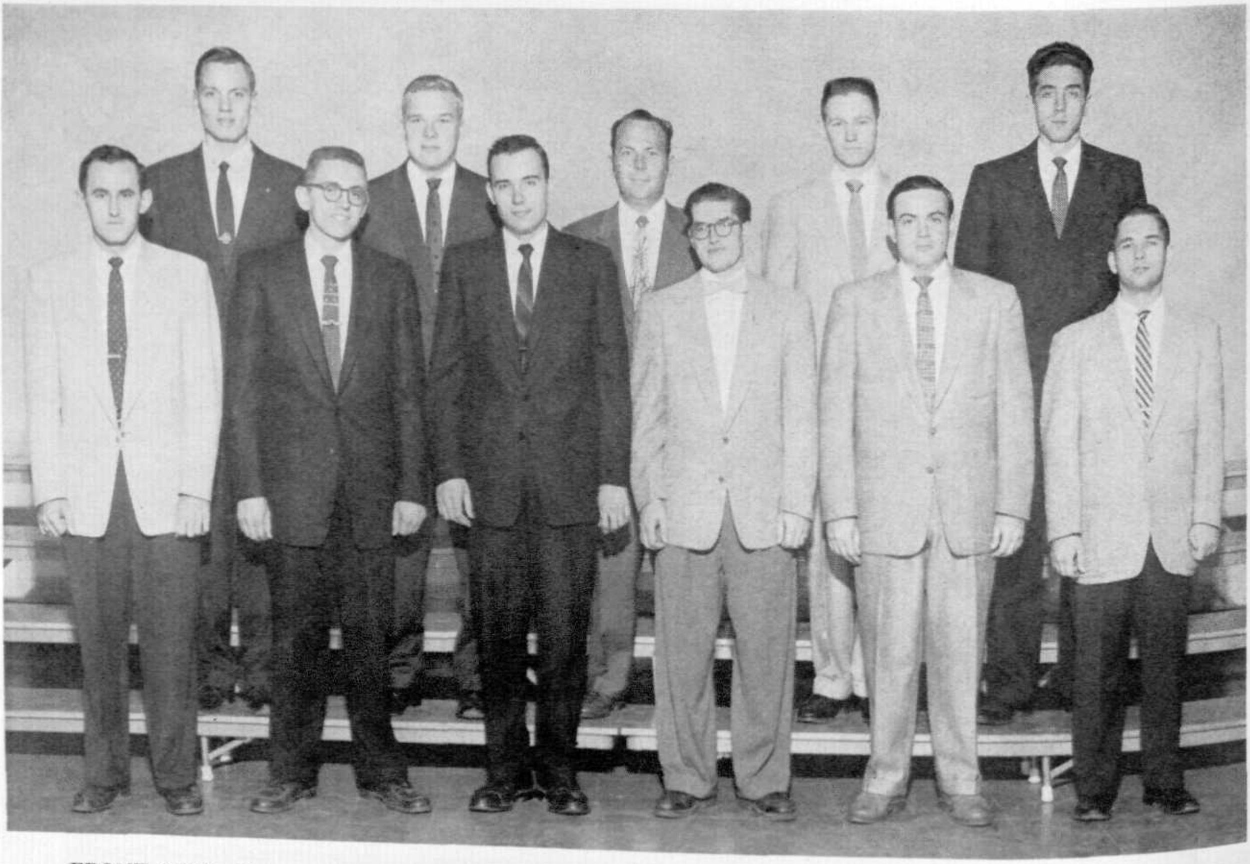
Vice-Chairman, Richard Willyoung, East Lansing Senior

Secretary-Treasurer, Clarence Chambers, Spring Arbor Senior

Corresponding Secretary, Rodger Wood, East Lansing Senior

(Continued on page 82)

ETA KAPPA NU — ELECTRICAL ENGINEERING HONORARY



FRONT ROW—Bernard Potwardowski, Fred Brewer, Jack Wirth, Ernie Lapensee, Jack Greene, Rex Morin.
BACK ROW—Ron Hileman, Bernard Bartos, Melvin Anderson, William Wallschlager, Conrad Roth.


HOW WOULD YOU LIKE TO WORK WITH GENERAL MOTORS IN THE FIELD OF ELECTRONICS? ... WITH MEN WHO ARE ENGINEERING AND MANUFACTURING INDUSTRY'S HIGHEST POWERED GERMANIUM TRANSISTORS AND OTHER ELECTRONIC COMPONENTS AND PRODUCTS?
... men who have the ability to solve problems that stand in the way of progress ... men who give a qualified college graduate a running start on success. They're Delco Radio men—and our most prized asset. You can work with them—become one of them. They have perfected the new high-powered germanium transistors, the beginning of an expanded program of research, development, and production at Delco Radio. This revolutionary transistor is already filling a vital need, and its potential use is incalculable! To keep this program moving and to develop equally big, new ideas in the field of electronics, Delco Radio needs men like yourself—graduates with degrees (BS, MS and PhD) in electrical engineering, mechanical engineering, metallurgy, physical chemistry, physics, and production engineering. If you are interested in permanent work in the field of semiconductor devices, applications, production, and related engineering jobs, contact us today. You'll find Delco Radio's policies regarding salaries, promotions, and benefits as advanced as the transistor itself.
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GM GENERAL MOTORS
Delco Radio
DIVISION OF
GENERAL MOTORS
KOKOMO, INDIANA

NEW DEVELOPMENTS—

(Continued from page 36)

existing at present in the new fields of aerothermodynamics, aeroballistics, hypersonic and other fields must be extrapolated into unknown technology.

This means that the frontiers of science in physics, chemistry, metallurgy, electronics and other basic sciences must be expanded and new research tools must be developed to enable scientists to work in technical areas never before explored.

At present designs for unique shock tunnels and ballistic firing ranges to simulate conditions which will be encountered by the nose cone in its flight, as well as many other test equipment and processes still highly classified, are being made.

Vanguard Pusher

A powerful new rocket engine, designated the X405, will deliver a thrust of over 27,000 pounds when it launches the 11-ton VANGUARD rocket during the International Geophysical year.

The X405, the main power boost for VANGUARD will operate for about 150 seconds to accelerate the earth satellite vehicle through its initial 36 miles of flight toward outer space.

Burning a hydrocarbon fuel and liquid oxygen, the X405 rocket engine will have accelerated the VANGUARD rocket to a speed of 4,000 miles an hour, or more than a mile a second at burnout.

Advanced components, including a turbopump and thrust chamber, are credited with making possible the long-duration, high-altitude flight. The engine will be gimbal-mounted to permit changing thrust direction as much as 5 degrees for accurate flight path control.

X-ray Machine Traces Atomic Charges in Metals

Hitherto unknown changes in the atomic arrangement of iron-aluminum alloys have been discovered through the use of the world's most powerful crystallographic X-ray machine at electronic research laboratory.

Valuable for their superior magnetic properties, iron-aluminum alloys may find wide application throughout the electrical industry for such apparatus as generators, transformers, circuit breakers, and similar electrical equipment.

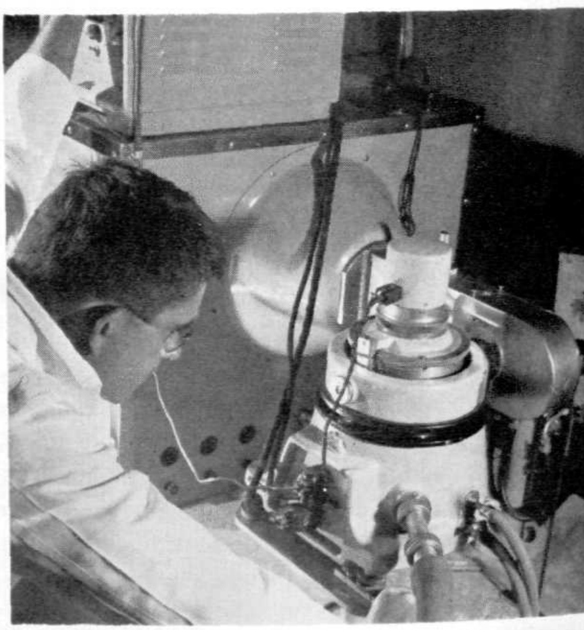
The designer of the super-power X-ray said new information on the previously puzzling behavior of iron-aluminum would give metallurgists greater insight into these metals.

Heretofore we were able to observe that at certain temperatures, iron-aluminum reacted in unexpected ways. We were aware of these changes but were unable to understand or explain them.

With the use of the new high intensity X-ray machine it is possible to take X-ray photographs of these alloys during the precise moments when, due to temperature changes, the magnetic arrangement of atoms in the metal is undergoing transformation.

Because the crystallographic X-ray machine is at least 15 times more powerful than any comparable device now in existence, X-ray time has been reduced sharply on iron-aluminum and other alloys under investigation. This unusually high power—and the fact that the X-ray beam can be concentrated on a focal spot less than half the normal size—makes it possible to obtain an X-ray source which is 15 times more brilliant. Thus, X-ray photographs can be taken in one-fifteenth of the usual time, collapsing hours of normal work into a few minutes.

Because of its unusually brilliant X-ray source, the super-powered machine makes possible metals research that previously was considered too costly or



Super-powered X-ray probes atomic structure of matter.

otherwise impracticable. Especially is this true in cases where metals must be tested at high or low temperatures. X-ray photos have been taken at temperatures as low as 300 degrees below zero Fahrenheit. This conceivably could be accomplished with less powerful equipment, but it would be difficult to maintain accurate temperature control, and because of the long exposure time which would be necessary, the cost of liquid helium—the cooling agent—would be prohibitive. By reducing exposure time to one-fifteenth of that formerly required, the cost of liquid helium needed for cooling is reduced proportionately.

In addition to conducting studies at low temperatures, it has been possible to photograph metals in a

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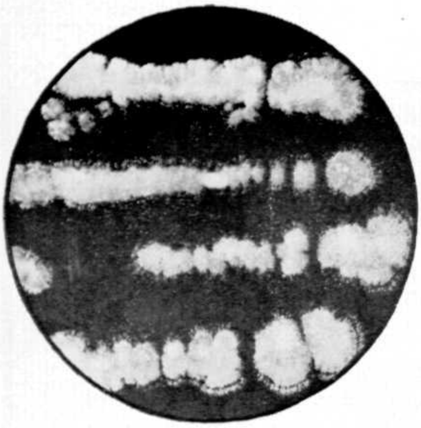
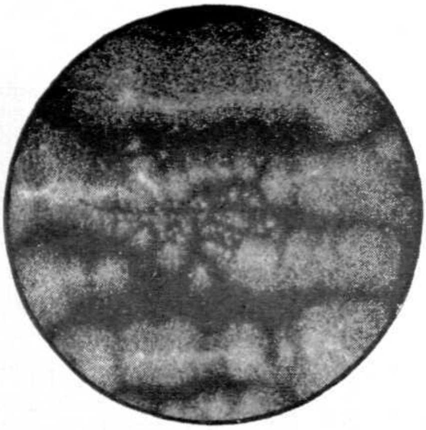
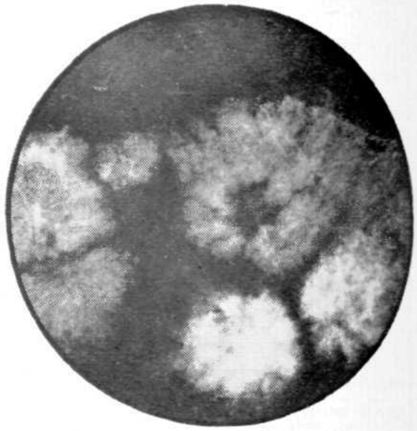


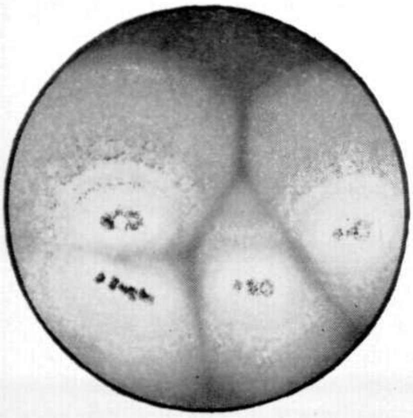
PENICILLIUM CITRINUM



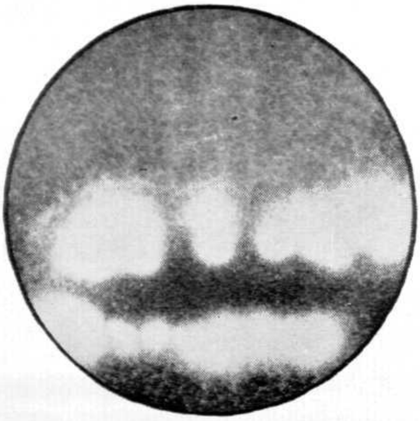
ASPERGILLUS TERREUS



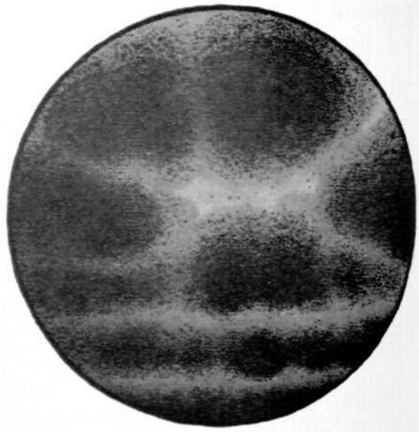
CHAETOMIUM GLOBOSUM



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.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NEW DEVELOPMENTS—

(Continued from page 56)

super-heated state. X-ray "snap shots" of metals as hot as 3000 degrees Fahrenheit have been taken, making it possible to study the characteristics of the metal before it vaporizes or undergoes some chemical change at the elevated temperature.

The machine is also equipped with an adapter which gives an X-ray beam only 400 millionths of an inch in diameter—about one-tenth the diameter of a human hair. This thin, intense beam approaches the dimensions of the tiny crystallites which make up the crystal of a metal, and permits the investigation of individual crystals with an exactness not possible with a beam of larger size.

X-ray Steel Analysis

"Point probe microanalysis," a new metallurgical research technique, permits analysis of steel-specimen areas 10,000 times smaller than is possible by any other method. The new technique was conceived in France about six years ago and is now being developed and refined by American scientists.

The point probe method of analysis involves the use of an electron microscope containing a focused electron beam to excite X-ray emission from a region as small as a few microns in diameter. The characteristic X-rays emitted are then analyzed by a crystal spectrometer.

This method has wide application in metallurgy for study of inter-granular corrosion, analysis of segregation of alloying elements among the metallic phases and along metallic grain boundaries, measurement of inter diffusion during welding and plating, and for determining the composition of fine precipitate particles.

The basic instrument being studied and modified is a vertical 7½-foot electron microscope with a 4-foot electron column.

The steel samples to be studied are placed in a specimen chamber through a door in the base of the column. A vacuum is then created by a standard oil-diffusion pump. An optical binocular microscope and mechanical stage motion permits the operator to make a visual adjustment of the specimen under the beam.

The beam is generated by an electron gun which accelerates electrons through approximately 30,000 volts. The beam is focused by three electrical lenses. The electron-beam cross-over point formed by the objective lens is focused by the repeater lens on the surface of the steel sample.

The focused beam strikes a selected area of the specimen's surface, causing X-ray emission. The X-ray beam is then analyzed to determine its component wave lengths by reflection from a lithium-fluoride crystal. Each chemical element in the sample emits an X-ray of characteristic wave length. The concentration of the element determines the intensity of that wave-length component. At present the instrument is able to detect all elements with atomic number equal to 22 (titanium) or higher.

The X-ray intensity at each wave length is measured by a geiger or proportional counter. The signal is amplified through a vacuum-tube arrangement to activate a pen on a graph. The X-axis of the graph indicates the wave length and the Y-axis charts intensity. The technician can analyze this data into a quantitative analysis.

Pocket-Size TV Camera

Pocket-size television camera, built around transistors and new RCA half-inch vidicon camera tube, has been developed by RCA for military airborne, mobile, and field closed-circuit TV applications. Ultra-miniature TV camera weighs less than a pound, measures only 1⅞ by 2⅜ by 4½ inches.

New Electronic Memory Unit Can Handle Millions of Items at Split-Second Speeds

A new memory device has been built that will enable electronic computers to store more than a million bits of information in a space little larger than a shoe box and to recall any or all of the items in a few millionths of a second.

The new memory consists basically of thin, printed plates of special magnetic material perforated with small holes.

A key point in the operation of all electronic computers is the information storage system in which vari-

(Continued on page 80)

every **airline** **in**

the **world** **using**

multi- **engine** **aircraft**

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

AERONAVES (Mexico) • AEROVIAS GUEST (Mexico) • AIR ALGERIE (Algeria) • AIR FRANCE (France) • AIR-INDIA (India) • AIR LINGUS (Ireland) • AIRWORK (England) • ALAS (Argentina) • ALASKA • ALITALIA (Italy) • ALLEGHENY • AMERICAN • ANSETT (Australia) • ANA (Australia) • AVENSA (Venezuela) • AVIANCA (Columbia) • BEA (England) • BOAC (England) • BRAATHENS (Norway) • BRANIFF • BRITISH WEST INDIES • BUTLER (Australia) • CAPITAL • CATHAY PACIFIC • CENTRAL AFRICAN • CMA (Mexico) • CONTINENTAL • CPA (Canada) • CRUZEIRO DO SUL (Brazil) • CUBANA (Cuba) • DELTA • EASTERN • EL-AL (Israel) • ETHIOPIAN • FINNAIR (Finland) • FLYING TIGERS • GARUDA (Indonesia) • HAWAIIAN • HORIZON • HUNTING-CLAN (England) • IAC (India) • IBERIA (Spain) • IRAQI AIRWAYS • JAL (Japan) • JAT (Yugoslavia) • KLM (Holland) • LAI (Italy) • LAN (Chile) • LAV (Venezuela) • LUFTHANSA (Germany) • MISRAIR (Egypt) • MOHAWK • NATIONAL • NEW ZEALAND NATIONAL • NORTHEAST • NORTHWEST • PACIFIC NORTHERN • PAKISTAN • PANAGRA • PANAIR (Brazil) • PAN AMERICAN • PHILIPPINE • QANTAS (Australia) • REAL-AEROVIAS (Brazil) • RESORT • RIDDLE • SABENA • SAUDI ARABIAN • SA (South Africa) • SAS (Scandinavia) • SEABOARD & WESTERN • SLICK • SOUTHWEST • SWISSAIR (Switzerland) • TAA (Australia) • TAE (Greece) • TAI (France) • TAP (Portugal) • TCA (Canada) • TEAL (New Zealand) • THAI (Thailand) • TRANSAIR (U. K.) • TRANSOCEAN • TWA • UAT (France) • UNITED • VARIG (Brazil) • VASP (Brazil) • WESTERN

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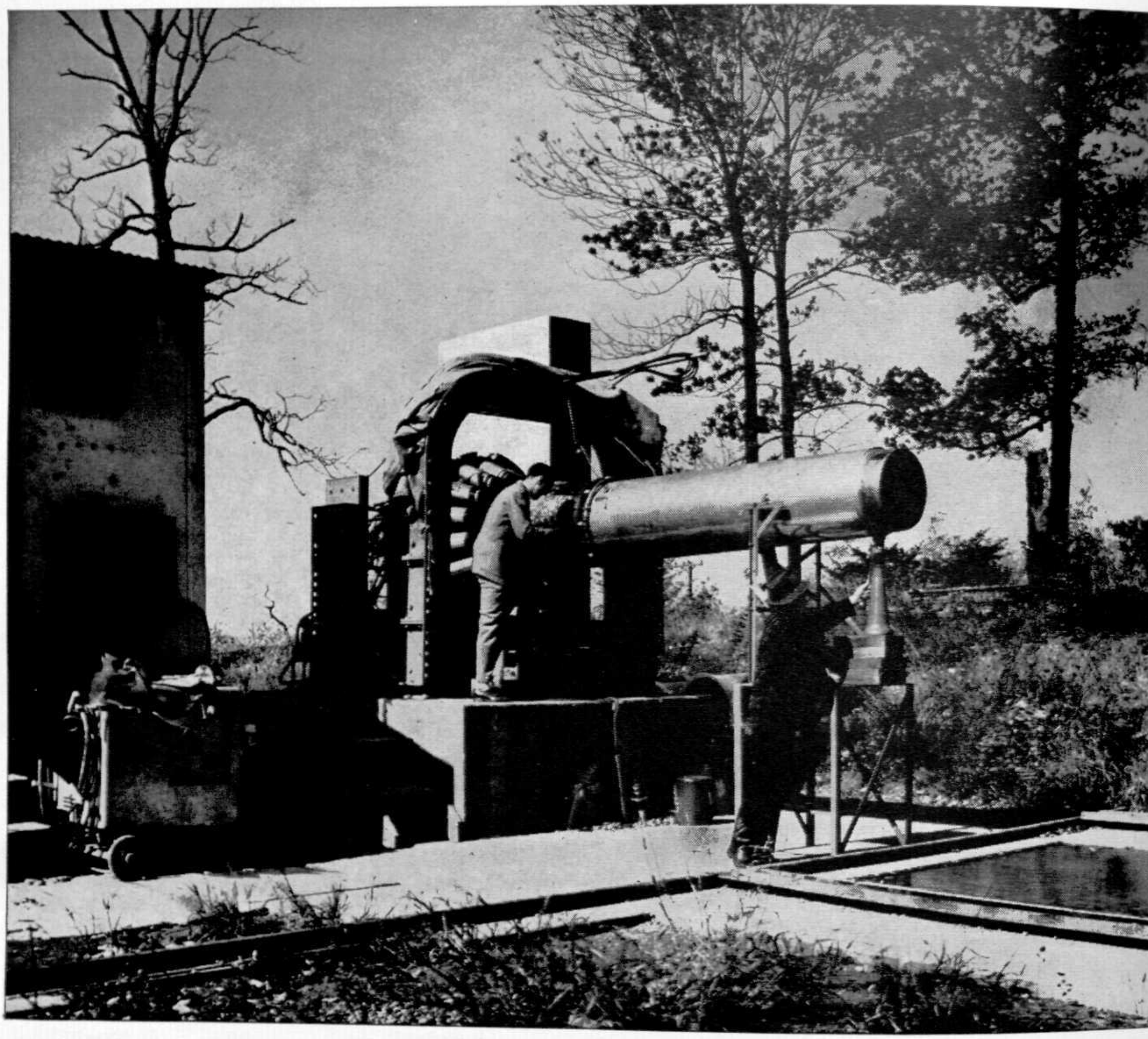


Progress and Diversification

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

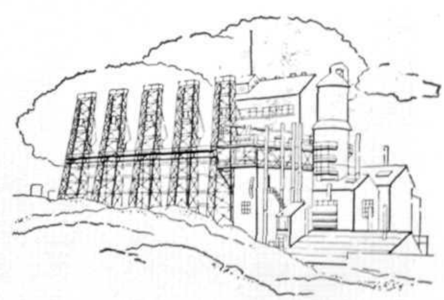
Many new products, including Duracron acrylic enamel were introduced in 1956 for both consumer and industrial use. Additional capacity is being planned in 1957 for Selectron Plastics, a series of versatile thermosetting resins.

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.

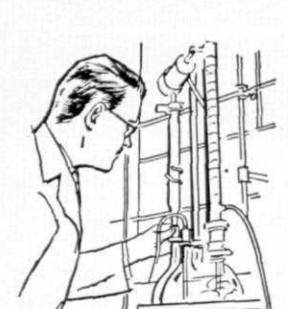
CHEMICALS

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.



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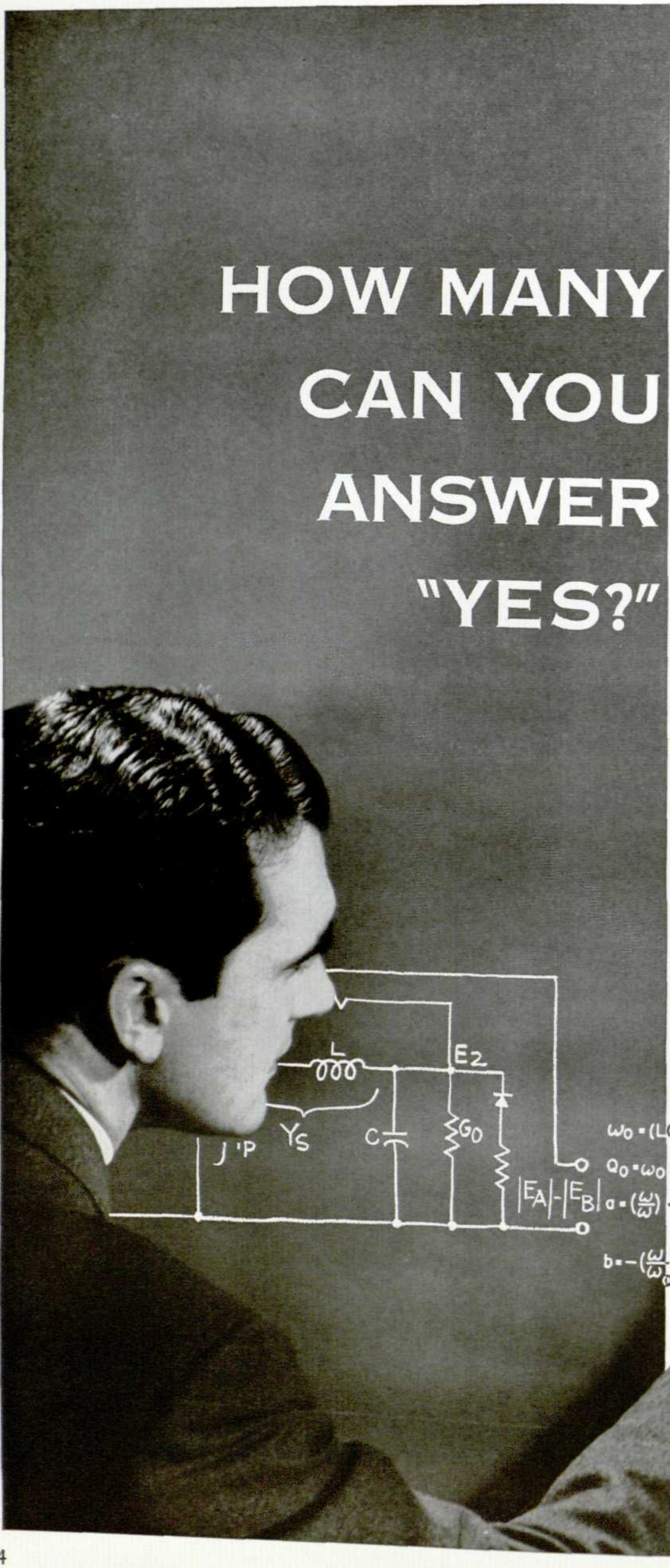
HOW MANY
CAN YOU
ANSWER
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L
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ω0 = (LC)^-1/2
Q0 = ω0 L/r

Radio Cooking

by J. L. Newcomer, Associate Professor in Restaurant and Hotel Management at MSU

Since man first discovered fire, food has been heated by placing it near or in contact with heat, but soon, Mrs. Housewife may be cooking by radio waves. In this method the heat is not applied to the food but is generated within it.

Strange as it may seem, this method might be considered as an unexpected and unplanned outcome of the Second International Polar Year. During this event in 1932-3, scientists carried on a research program in the arctic. One of the studies concerned the ionosphere. To study this region of upper atmosphere they sent out short pulses of radio waves and measured the time for them to be reflected back to the transmitter. Results from this work became the forerunner of radar. Radar became an important means of detecting aircraft during the Second World War.

But what does radar have to do with cooking? To answer this we must turn to the early days of radio broadcasting. It was noticed that people working near the transmitters often became unduly fatigued. It was soon learned that they actually ran a few degrees of fever although they were evidently in good health. Dr. W. R. Whitney, Director of Research at the General Electric Company, performed some experiments and learned that stray waves near the transmitter caused the fever.

Other researchers then became interested and made further studies to see how this form of artificial fever might be used in a practical manner. They found that when substances were placed inside or near coils through which radio frequency waves were traveling the temperature of the material was raised several degrees. Further experimenting showed that the heating effect was greater for the shorter wave lengths. But the radio tubes used in those early days were not suitable for extremely short wave lengths.

However, when it was discovered that extremely short radio waves could be used to detect aircraft, considerable research was carried on to improve the method which later became known as radar.

Probably the most important single development which made radar possible was a special type of radio tube capable of generating extremely short waves. This tube is known as a magnetron.

Experimenters who had given up heating by radio waves now had a tube which would generate the short waves they needed. So in a way, we can think of the Second International Polar Year as being the grandparent of radio cooking, and radar in turn as being its parent.

Now how does this method of cooking work? We all know that when two sticks are rubbed together they become heated. Every Boy Scout knows this; he is taught how to use it to start a camp fire. The heating is due to friction between the two pieces when they are rubbed together. Now all matter is composed of molecules. These molecules are free to move around. Even though a substance may appear to be solid, nevertheless the molecules which make up the substance can and do move about. At low temperatures they vibrate slowly, while at high temperatures they vibrate much faster.

When a substance, say a piece of steak, is placed in or near a coil through which radio waves are traveling the alternating electric field around the coil causes the molecules in the steak to move about much faster. And thus the temperature is raised, since it is the speed at which molecules move that determines how hot a thing is.

When a steak is cooked on the stove the outside cooks first. The temperature on the inside gradually increases and finally the steak is done through. But with radar cooking there is no heat applied to the outside; the heat is generated within the steak and it cooks at the same speed throughout its thickness.

What are the advantages of radar cooking? To begin with some people say that foods cooked by this method taste better. It is claimed that the natural juices are retained. But there is a very practical benefit too. We now enjoy the benefits of home frozen-food cabinets, but we all know that first the food must be thawed before it can be put on the stove or in the oven. This is an inconvenience, especially when the unexpected guest arrives for dinner.

With radar cooking, thawing is not necessary. One simply takes a steak out of a zero degree deep-freeze,

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IGGY, CHOGGY—

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centered at the magnetic pole. Other data was obtained then which is still of value.

During the second Polar Year, Arctic geophysical studies resulted in new knowledge of the ionosphere (the region of upper atmosphere which reflects radio waves to ground level) by new radio sounding methods, sending short pulses of radio waves upward and measuring the amount of time taken for their return. Radar was developed on the basis of this study, which thus greatly advanced radio science as well as geophysics.

IGY was undertaken in recognition of the enormously valuable results produced by the Polar Years. Scientists hope that they may anticipate even greater accomplishments to grow from IGY, which may well be the forerunner of future international projects. The rockets and radio waves will be sent into space in 1957-8, explosion sound waves which will help technologists probe the interior of the Earth, measurement of ocean currents and tides, and study of the particles which are bombarding this planet from Outer Space – all this may help answer some critical questions. Is the Earth's climate changing? Are glaciers receding? Will melting Arctic ice eventually engulf coast low lands? What are cosmic rays and where do they come from? Just what causes the aurora? What do sunspots, and solar flares, have to do with long-range radio transmission on Earth?

The officers of the US Committee for IGY, Drs. Joseph Kaplan of UCLA, and A. H. Shapley of the National Bureau of Standards, indicated their own convictions in a report to the US Senate: "These and many other questions are the objectives of the IGY program. They are important to man's understanding of the Earth and the universe surrounding him. The answers will provide him not only new basic knowledge by applications in many fields of human activity –from the raising of crops and transpolar air travel to better radio communications and navigation. . . Through this joint effort of many nations, there is ample assurance that man will better learn the nature of his environment from the depths of the Earth to outer space."

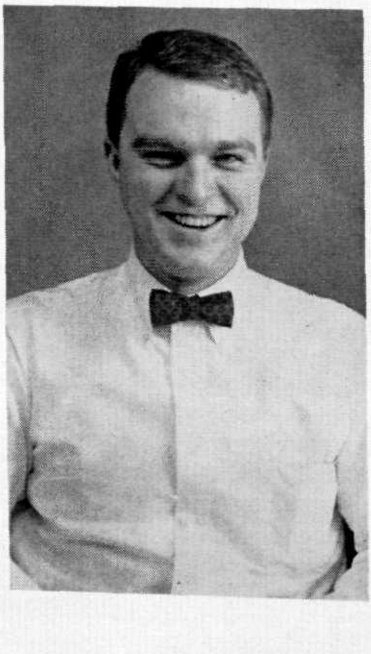
A fraternity had sent its window curtains to the cleaners and there was some delay in having them returned. One morning a note arrived from the girls' rooming house across the street. "Dear Sirs," it read, "may we suggest that you procure curtains for your windows. We do not care for a course in anatomy." The chap who left his shaving to answer the door and receive the note sent back the following answer: "Dear Ladies: This course is not compulsory."

* * *

Veteran of the South Seas: "While in the Marshalls I saw the screwiest bird. It lays square eggs and talks."

Prof.: "Oh yeah! What does it say?"

Vet. P.: "Ouch!"



Don Emerich, author of "Iggy Choggy and the Golden Balls" attended Columbia University where he was a reporter on the Columbia *Daily Spectator*, a member of Alpha Delta Phi social fraternity, and the Van Am Society, a service honorary. Currently he is technical editor for the Michigan State Highway Department Research Laboratory and a part-time journalism student.

The International Geophysical Year article was prepared as a class assignment for Journalism 318, Technical Writing for the lay public.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ATOMS IN INDUSTRY—

(Continued from page 21)

solvents as acrylonitrile. Perhaps a graft of acrylonitrile on silicone rubber might produce a new type, which would be both solvent-resistant and resilient. Although such work is now in its early stages, work at the Brookhaven National Laboratory, by Dr. Bernard Manowitz, indicates that radiation techniques may make such grafts possible.

Rubber is a polymer and, for most applications, is vulcanized by the process originally discovered by Charles Goodyear. This sets up cross-linkages from one Polymer chain to another, making the product much stronger. Studies by the Goodyear Tire and Rubber Company, and the Wright Air Development Center, have demonstrated that vulcanization of rubber may be accomplished by radiation.

Work at the General Electric Research Laboratory has shown that something similar may be done to polyethylene. The unbreakable squeeze bottles made of this plastic, in which many products are now marketed, have been limited in their application because they collapse into a shapeless mass when exposed to a temperature about that of boiling water. Thus, it has not been possible to sterilize them by steam or other heat, a process that would be necessary if they were to be used for medical applications.

The General Electric Company scientists, however, found that if such bottles are exposed to high-energy radiation they could be subjected to temperatures considerably above the boiling point of water, and still hold their shape. This process is now being applied to the production of a polyethylene tape for electrical insulation, which will stand much higher temperatures than standard tape.

In addition to these cases, where radiation triggers off a chain reaction and supplies only a small fraction of the total energy required, there are other chemical processes for which radiation can furnish all the energy needed. Experiments have been made which indicate that such chemicals as carbolic acid, hydrogen peroxide, glycols (one of which is used as a permanent anti-freeze in automobiles), and hydrazine are considered possibilities for such a mode of manufacture.

Hydrazine is particularly interesting. This is a compound of nitrogen and hydrogen (N_2H_4), similar to ammonia $(NH_3)_3$, which burns with a violet flame. It has great possibilities as a fuel for rockets or jet planes, but is made at present by a rather expensive process. Dr. Manowitz suggests that if a radiation process can be economically applied, every plant now making ammonia could turn out vast quantities of hydrazine.

Other Radiation Sources

Radiation for such application can come not only from a reactor, or from reactor products. The experiments on polyethylene, at the General Electric Research Laboratory, were done with a million-volt X-ray machine, modified to give cathode rays of similar energy. In other laboratories, electrostatic machines, of the Van de Graaff type, have been used to produce these radiations. Unlike radioactive isotopes, which gradually decay in intensity, the cathode ray generator gives a steady output. Morever, it emits radiation only as needed, while turned on. The radioactive materials emit it constantly, whether it is wanted or not, until they reach the end of their lives.

The reactor itself represents a source of radiation. With a homogeneous reactor, or one using liquid fuel, the radioactive gases produced by fission may be steadily drawn off and used on the spot for radiation. With solid fuel reactors there are several possible methods. The fuel elements that have seen service, and have become loaded with fission products, might serve as radiation sources before they are put through the reprocessing plant. The fission products themselves, after having been removed, can be used as sources. One of these is cesium 137, with a 37-year half-life, which emits both beta and gamma rays. Then again, cobalt may be placed in the reactor, in a place where otherwise the neutrons would not be utilized. By such means ordinary cobalt, of mass 59, is converted by neutron capture into cobalt 60, a beta and gamma emitter of 5.3 years half-life, which finds many uses as a source of radiation.

That ample radiation sources will be available in the future is indicated by an estimate that, by 1980, with 137 million kilowatts of power available from nuclear fuel, the fuel elements will yield about 100,000 kilowatts of radiation power per year, while 20,000 kilowatts from cobalt 60 and 3,000 kilowatts from cesium 137 will have accumulated by 1980.

Use in Thickness Gages

One of the most widely used applications of radiation is the beta-ray thickness gage. Sheet aluminum, as well as plastics and other products, may be made by passing the material between two heavy rolls, a fixed distance apart. To maintain proper thickness, it is necessary to check the product, and readjust the rolls if there is any variation. If this were to be accomplished with hand-operated calipers, it would be necessary to stop the process and take a measurement.

Measurement on the fly, however, is possible with beta rays. All that is needed is to place on one side of the sheet material a source of beta rays (such as strontium 90) of known intensity, and on the other a radiation detector that measures the amount that passes through. The thinner the sheet, the stronger is the transmitted beam, thus the gage may be calibrated to indicate directly—say in thousandths of an inch—the thickness of the metal, plastic, or other material, even as it moves along at high speed. Moreover a degree of automation may be introduced, by

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having some sort of automatic control of the space between the rolls, which, in turn, is regulated by the reading of the thickness gage.

In 1954, 350 companies were using these gages, and several large companies (rubber and abrasives) reported estimated savings of $100,000 per gage per year. Assuming three gages per company (the actual range was from one to twelve) an annual savings of from a minimum of $25,000 to a maximum of $100,000 per gage, the AEC estimated annual savings from a probable of $25 million to a high of $100 million.

While beta rays have rather low penetrating power, they can get through things like paper, plastics, and aluminum, if it is not too thick. Gamma rays, on the other hand, like X-rays, may penetrate even considerable thicknesses of iron and steel. Radium has been used in the past as a source of gamma rays to take radiographs of thick castings, and now such reactor-produced radioisotopes as cobalt 60, yttrium 88 (with a 100-day half-life), or tantalum 182 (113 days) can be used in the same way. In many large plants, X-ray generators of 1 or even 2 million volts energy are used for a similar purpose.

The radioisotopes, however, make a more compact and portable means of taking such radiographs. For example, the Ford Motor Company is well equipped with high-voltage X-ray equipment, but in one case the company purchased nine huge steel pots, each to hold 100 tons of slag from their steel mill operations. Some external defects appeared which were questioned by the inspectors. As the pots weighed 30 tons each, it would have been difficult to move them to the X-ray laboratory and cobalt 60 radiographs were made, inspecting them where they stood. The radioactive isotope was placed inside the overturned pot and X-ray films were placed on the outside surface, thus recording a shadow picture of the internal parts of the metal.

In another case, a three-story office building was erected at the Ford plant, using floors constructed of prepoured concrete. These were raised and held in position by plates welded to the roof support beams. It was necessary to test these welds, since the outer appearance was not sufficient to show their quality. Here again cobalt 60 was used to produce the gamma rays with which radiographs were made, showing that the welds were safe.

Such tests can produce a real saving in costs of construction, since the boiler code of the American Society of Mechanical Engineers permits pressure vessels to be made of 12 per cent thinner boiler plate if the structure is completely radiographed. This not only allows a 12 per cent saving in the amount of steel used, but also the welders' time is saved, since they are welding thinner pieces. On one Hortonsphere fifty feet in diameter, used to store gases under high pressure, the net savings were figured at about $6,000. Several thousand such spheres are in use.

Further Radioisotope Uses

Radioisotopes are also finding countless industrial uses as tracers, where their radioactivity permits some particular substance to be followed, even through an intricate process. One such use is in sending oil through pipelines that may be thousands of miles in length. These pipes are used to carry various kinds of petroleum products. After one kind of oil has gone through, another will be sent along immediately following, and there is very little mixing at the interface.

However, at the receiving end it is necessary to know accurately when this interface arrives. Then a quick shift is made in the valves, so as to feed the new arrival into a different tank. If it is necessary to wait until the second product actually starts pouring out at the end of this pipe, the previous product may be seriously contaminated. Therefore at the refinery, just as the new kind of oil starts, a radioisotope is injected and is carried along with the flowing oil. At the other end a workman waits with a Geiger counter against the pipe; when the interface arrives there is an outburst of clicks that tells him the time has come to shift to another tank. With the switch made at the right time, there is very little mixing.

This also has produced important savings. As of 1954, an AEC statement reported, at least three oil companies were using this method and others were expected soon to follow. These companies reported that every time the method was used they saved about $500. Since it may be used an average of three times daily the year round, annual savings have reached perhaps $2 million.

Antimony 124 is the isotope generally used. Since it emits gamma rays as well as beta, it can easily be detected through the pipe. With a half-life of 60 days, it lasts long enough to travel the distance, and as it decays it turns into a stable isotope of tellurium; therefore, no long-lived radioactivity remains in the oil.

One oil company made use of radioisotopes to study problems of wear and lubrication in gasoline and diesel engines, and to find the effects of various lubricants. This involved a determination of wear on the piston rings, as they slide up and down inside the cylinder. To run the engine long enough for worn metal actually to appear on the cylinder walls might take many months, but radioactivity gives the answer in hours.

A new piston ring is inserted in a reactor, where the action of neutrons makes it radioactive. Then this ring is placed on the piston of an engine, which is operated in the usual way. The oil employed is not originally radioactive, but it soon becomes so, from a minute amount of material worn off from the ring, and by measuring this activity accurately, the exact amount of wear is determined. Also, it is possible to place a photographic film against the cylinder wall,

(Continued on page 72)

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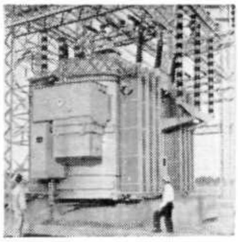
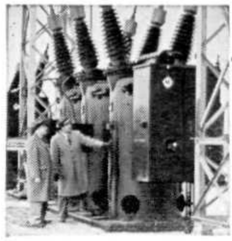

Transformers of all Types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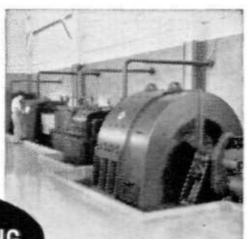
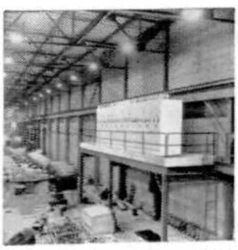

Motors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ATOMS IN INDUSTRY—

(Continued from page 70)

after the engine has been running. This makes a radioautograph, for, where the surface is radioactive, the film is exposed, while other parts are unaffected. Thus, when developed, there is a picture of the radioactive areas, the density indicating the strength of the activity and the amount of material worn off the ring.

Atomic radiations ionize air and make it electrically conductive, so that a charged body will be discharged if some radioactive materials are near by. This effect is utilized in the dosimeter, worn like a fountain pen by workers in atomic plants to show the amount of radiation they are receiving. At the beginning of a period of work the device is charged to a known level, and at the end its charge is again measured. From the amount that is lost, it is possible to tell how much exposure to radiation the worker has experienced.

This same principle is utilized in the printing industry, where sheets of paper coming from a press may acquire a charge of static electricity. This causes one sheet to repel another, and it is hard to stack them. Formerly, it was often the practice to have a gas flame arranged so that the sheets would pass over it quickly as they left the press. The flame also ionizes the air and lets the charge leak away. Ordinarily, the paper moves so rapidly that it does not ignite, but there may be some fire hazard. A bar containing polonium, which occurs naturally and emits alpha rays, or some similar isotope, produced in a reactor, may now be placed near the sheet, thereby discharging it.

Although the thickness gage is perhaps the most important radioisotopic application in process and quality control, there are many others. In separating a mixture of compounds, such as the different hydrocarbons present in petroleum, an extraction column may be used. This is a vertical tube, packed with a material that has selective absorption for the different liquids passing through it. Some will go more rapidly than others, and it is necessary to know when one has gone through, or another started. This can be done by introducing into the mixture a sample of one of the compounds present, prepared with a radioactive isotope of carbon or another element that it contains. This will behave just like the nonradioactive compound, and go through the column with it, but a detector at the bottom will show when the tagged atoms arrive. Similarly in other chemical processes the same methods may be employed.

One is in the catalytic cracking of petroleum to make gasoline and other types of oil, the introduction of radioisotopes permitting the process to be followed closely. The AEC has reported that, by such means, one oil company saved an estimated $100,000 by avoiding a week's shutdown and the loss of gasoline production that would have been suffered. This tracer technique for cracking control is now a standard part of the company's operation and other companies have been licensed to use it. The AEC estimates that an annual saving of between $1 and $5 million has resulted.

In testing the wear of tires a rubber company added a radioactive compound to the tread when they were made. A car could be equipped with one of these tires, and driven around. Then, as wear occurred, the radioactivity of the tread would be reduced. This could be measured even while the automobile was moving, with a radiation detector close to the tire.

Similarly, in testing effects of detergents and their efficiency as cleaning agents, samples of cotton were treated with radioactive dirt. The radioactivity, measured before and after washing, gave a very accurate index of how effectively the dirt had been removed.

In an assembly line where production parts are dipped successively into a coating material, and some automatic means is desired to stop the process when a certain thickness has been reached, a small amount of radioisotope may be added to the coating solution. Then, as the product passes down the line, it may pass a series of Geiger counters, which indicate the degree of radioactivity and hence the thickness, which could thus be kept uniform.

In making steel by the open-hearth process, it may be desirable to keep a continuous check on the distribution of phosphorus between the slag and the metal. If a small amount of radiophosphorus were added to the molten bath, it would go into the slag, along with the normal phosphorus. By measuring the radioactivity of samples removed periodically the percentage of the element in the slag can be determined. The same thing can be done with sulfur.

To measure pollution in a stream, some radioactive material may be added to the stuff being dumped. Then a sample of the water may be taken downstream, and its radioactivity measured. If there is none, it would generally mean that there is no pollution. Something similar may be done to measure the flow of a liquid. A bit of radioactive tracer may be injected, so as to be carried along. Then, by measuring the time it takes to pass two Geiger counters, a known distance apart, the rate of flow can be found.

Pneumatic tube systems are often used in large plants to carry orders and other messages, but sometimes the carrier gets jammed and the failure is hard to locate. In this case, a small and harmless quantity of a radioisotope may be applied permanently to the carrier. If it becomes stuck, all one has to do is to check the length of the pneumatic tube, from the outside, with the Geiger counter, and radioactivity will be encountered when the jammed carrier is reached.

A radioisotope may also serve as a leak detector. For example, one factory had a radiant heating system, of pipes embedded in the concrete floor and

(Continued on page 74)

INDUSTRIES THAT MAKE AMERICA GREAT

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The textile industry—through its variety of processes and products—plays one of the most significant roles in the everyday lives and activities of all Americans. Today, efficient men, methods and machines produce yarns and fabrics for an almost endless list of products of which clothing, carpets, drapes, tires, belting, shoes and furniture are but a sample. With heartening regularity, textile manufacturing advances are being made, new fibers and blends created, and new applications developed.

Pacing textile industry progress is an intensive research program. Synthetics now are as familiar and serviceable as cotton, wool and other natural fibers, and have freed us from any dependence upon imports such as silk. Concentrated development of the industry's manufacturing processes has brought new techniques and methods to improve and speed up the transformation of raw fiber into finished material.

But not content with the dynamic progress already made, the textile industry is continuing to reinvest earnings to insure further advances. It is enlisted—with its suppliers and processors—in a never-ending effort to improve machines and methods.

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(Continued from page 72)

through which hot water was circulated. When a leak developed at some unknown point in the system, it seemed as if the piping would have to be dug up until the leak was located.

Instead, a salt containing sodium 24, which emits gamma rays, was dissolved in the water. A technician went all over the floor with a Geiger counter until he found a place from which there was considerable radiation. Here the radioactive salt had leaked out and accumulated, and it was possible to pinpoint the leak and take up the floor at the right place. Since the half-life of sodium 24 is only 15 hours, after a few days its activity had dropped practically to zero. Thus, there was no long-remaining activity to constitute a hazard to workers.

Future Goals

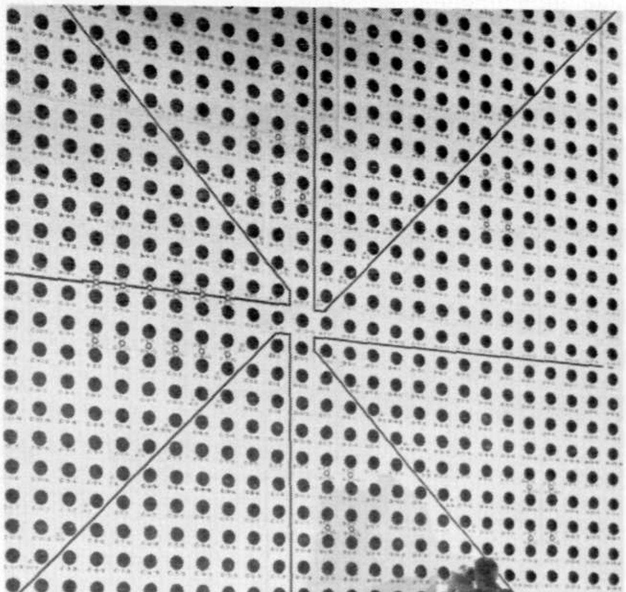
Summarizing these various industrial uses of atomic energy products, the report of the McKinney Panel said:

"The one million dollars worth of radioisotopes now being sold annually by the Commission in industry are making possible savings through process and quality controls estimated at $100 million annually. This important business is growing larger with every new idea. It contrasts sharply with atomic power from which few, if any, have so far made money.

"Produced as byproducts of nuclear reactors, these radioisotopes provide industry with small sources of radiation and tracers. These atomic tools are so cheap, require so little investment, permit such prompt returns, and are so free from information control restrictions that their use is expanding rapidly.

"Radioisotopes are being used in industry, but greater significance may lie in future utilization of atomic heat and radiation. Process heat and radiation in such industrial fields as food preservation and industrial chemical production hold important promise. Many other major areas undoubtedly exist for both atomic heat and radiation.

"These goals for industrial research and development could make real contributions to our economy. They are within the competence of existing industrial research strengths."



SOUTH FACE OF BROOKHAVEN REACTOR
Through these holes in the Brookhaven reactor are introduced tons of pure uranium metal. Once in the graphite moderator of the reactor proper, uranium atoms fission, or split, in a chain reaction. The reaction releases atomic particles, known as neutrons, for use in experiments and for production of radioisotopes.

RADIO COOKING—

(Continued from page 65)

places it in the radar unit and within 5 minutes the steak is sizzling done. It is reported that a 15 pound frozen turkey can be roasted in 1½ hours; rolls baked in 1½ minutes. A chocolate cake bakes in 4 minutes and potatoes bake in 4 to 5 minutes. When Bill or Mary come home from school they will be pleased to learn that "hot-dogs" cook in 30 seconds.

This unique food preparation method has been used in several restaurants throughout the country for five or six years. Restaurant operators have found it especially well suited for preparing baked lobster. They say that it takes only 5 to 6 minutes to prepare a frozen lobster and that no other method so well preserves the delicate flavor of this popular sea food. Another reason for its popularity in specialty restaurants is the fact that the unit can be located in the dining areas and because of its phenomenal performance attracts patrons' attention. In this respect, it promotes the sale of certain special dishes in much the same manner as infra-red broiling, charcoal cooking and rotisserie barbecuing. It reminds one of the days when a chef with his tall hat flipped pancakes in the front window.

The housewife may want to know the size of the appliance, how much it costs and how expensive it is to use. At present, radar cooking units are made in only one size; about the same dimensions as the ordinary built-in-the-wall type conventional oven. Two or three years ago they sold for about $1200.00 but the manufacturer now predicts that they will soon sell for near $800.00 and eventually they hope to compete in price with ordinary cooking units. It is reported that the cost of operation is the same as for any ordinary gas or electric oven.

Pass the radar-burgers, please.

TECHNICAL WRITING—

(Continued from page 29)

word-pictures, it is better to use two-syllable words (Anglo-Saxon preferred) than five-syllable words, plain words than technical ones, concrete words than abstract ones. Try to avoid weak, colorless verbs, and use adjectives and adverbs sparingly for they carry little weight in technical writing.

Science is constantly enlarging its vocabulary, largely from Latin and Greek. And nothing causes more grief for readers than strange-looking words they don't understand. But how many writers commit that blunder! They forget that as writers, they are primarily teachers and the aim of teaching is to inform, not to befog.

4. When introducing a scientific term, you should define it immediately. For example: When an electron, a very tiny particle of negative electricity, strikes a . . . .

On the other hand, a physicist may explain a calorie as "the amount of heat required to raise the temperature of one gram of water one degree centigrade." Such a description would leave your readers cold. It would be much more compelling to say: "A man digging ditches burns 160 calories an hour, or a pat of butter equals 100 calories." By explaining the unknown in terms of the known, your message breaks through the knowledge barrier.

However, it is easy to overwork definitions and to clutter up an article with them. Too many definitions bog down the reader and cause his interest to lag.

5. Another difficulty may arise in dramatizing scientific achievements. If you write, for instance, that the latest jet plane streaks through space at Mach II, many of your readers will be unimpressed. You therefore point out that Mach II is twice the speed of sound and the speed of sound is about 740 miles an hour. But you don't stop there. You explain to your readers that when they zip along at 60—breaking the law, naturally—they cover one mile while the jet sweeps through 24 miles!

6. As you remember, your sole purpose as a technical writer is to describe a technical device or process for your particular class of readers. To produce a live, readable report, you should get as close to your project as possible, even if you only tighten nuts and bolts. It's this "in-the-field" and "on-the-spot" coverage—not shuffling papers in an ivory tower—that will best equip you with an understanding of the practical aspects and theory of the whole picture.

If you have a general science background and a science specialty, keen powers of analysis and judgment, understanding of your readers, and a knack for clear, concise writing—there are challenging and well-paying positions for you in technical writing.

As a technical writer your key objective is not to record facts on paper; it is to slant the right information to the right people at the right time in such a way that they can grasp it with the least difficulty.

An old adage buttons up the introduction, body, and conclusion in a neat package: Tell your readers what you're going to tell them, then tell them and finally tell them what you've told them.

ELECTROLUMINESCENT—

(Continued from page 41)

last year Westinghouse put on a public demonstration in which it showed how in five separate panels different phosphors produce green, blue, yellow and red light, while a mixture of the first three produces white; how, using different phosphors on a single panel, green light may be changed to blue or white or pink simply by raising the frequency of the current from 60 to 10,000 cycles; and how, by stacking four different transparent color-emission panels together, frequency changes can produce in turn all the primary colors of the rainbow. A demonstration room paneled with 112 panels, each a foot square, operating on 350-v alternating current at 3,000 cycles, produced a greenish light with a brightness of about 100 foot-lamberts (50 foot-candles at working surfaces) or an efficiency of 3 lumens per watt. This is about 1/10th the efficiency of a translucent-screened fluorescent ceiling.

Brightness is still obtained at the expense of efficiency. A brightness of over 2,000 foot-lamberts has been achieved experimentally in the laboratory, well over that of the fluorescent lamp, but at the expense of 600-v, 20,000 cycle current. At ordinary 110-v, 60 cycle house current, the panel light is considerably dimmer than a television screen. Progress on low-voltage phosphors has been made by both Sylvania and Westinghouse, though the probability is that the system will always require for best results higher than ordinary voltages and frequencies, which means circuitry to convert to these. At the present stage, on a comparable basis, electroluminescence at its best has reached an efficiency of about 10 lumens per watt against 16 for the 100-watt incandescent lamp and 60-70 for the 40-watt fluorescent tube.

But electroluminescence has climbed to this efficiency from a low of only 0.5 lumen per watt three years ago. And, whereas the incandescent lamp and fluorescent tube have about reached the practical limits of their efficiency, the phosphor sandwich is only at the beginning. Theoretically, due to the simplicity and physical nature of the system, its likely maximum efficiency is estimated to be about 240, which would be about four times the efficiency of the present very efficient flourescent light, with even less heat produced than by that notably cool light source. Broadly, therefore, in its effect on power consumption and air-

(Continued on page 84)

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

"Yeah, I flunked, too."

* * *

Then there's the one about the moron who thought steel wool was the fleece from a hydraulic ram.

* * *

Newton's tenth law—the dimmer the porch light, the greater the scandal power.

* * *

Three engineering students looking at a beautiful girl:

"By golly!" cried the M. E.

"By gum!" cried the E.E.

"By tomorrow night," sighed the C. E.

* * *

Statistics show there are three classes of coeds – the intellectual, the beautiful, and the majority.

* * *

"I simply gotta divorce this woman," the disconsolate man told the court. "She insists on keeping a goat in our bedroom and the smell is so bad I can't stand it."

"That sounds bad," said the judge, "but couldn't you open a window?"

"What, and let all my pigeons get out?"

* * *

"It's quite simple," explained one of the C.E.'s in E.E. 330, "to hook up an electric power circuit. We merely fasten leads to the terminals and pull the switch. If the motor runs, we take our reading. If it smokes, we sneak back and get another one."

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ODE TO A LAB REPORT

When I grow old and even older,
I'll never forget that manila folder,
Bane of existence, object of hate
And never less than three weeks late.
Title, object, method, theory –
The clock strikes one, my eyes are bleary.
If I could have my preference
I'd never write a reference,
Never compute efficiency
For reading numbering eighty-three,
But many like that have I done,
At least infinity plus one,
Many to tell the dullest dullard
That graphs are labeled and curves are colored.
Engineers Arise – storm the fort;
And abolish forever the lab report.

– Unanimous

° ° °

Date: "You remind me of the ocean."

Agri: "You mean I'm wild, romantic and restless?"

Date: "No, you make me sick."

° ° °

A Chinese visitor was heard to observe: "Funny people you Americans. You take a glass and put sugar in it to make it sweet, and lemon to make it sour. Then you pour whiskey in it to make it hot and ice to make it cold. And then you say, 'Here's to you' and then you drink it yourself."

° ° °

Father: "What do you mean by bringing my daughter home at this hour of the morning?"

Engineer: "Have to be in class by 7:30."

° ° °

Since we call professors "profs," it's easy to figure out what we ought to call assistants.

° ° °

Dear Pop:

Everything fine at school. I'm getting lots of sleep and am studying hard. Incidentally, I'm enclosing my fraternity bill.

Your son, Pudge.

Dear Pudge:

Don't buy any more fraternities.

Your Pop.

NEW DEVELOPMENTS—

(*Continued from page 60*)

ous elements of a computing problem are stored electronically and recalled instantly as they are needed. The development of the magnetic core system several years ago brought substantial gains in speed and efficiency by providing for the first time a means for storing thousands of bits of information and recalling them instantly in any desired order, combination, or quantity.

The new apertured plate now carries this development several steps further, providing a means for handling millions rather than thousands of bits of information, and at the same time offering far greater compactness and operating simplicity than could be achieved with the earlier system.

This development should permit the design and construction of larger and more versatile electronic computers and data processing systems, and it will at the same time provide a compact and economical type of memory for relatively small computing equipment.

Information Is Stored in Magnetic Form

The operation principles, like those of the magnetic core system, are based on the fact that computer language consists only of "0" and "1," used in various combinations to represent any words, numbers or symbols.

Since any desired information can be formulated in terms of 0 and 1, it is possible to employ a storage or memory system in which each of the memory elements can be switched electrically to represent one or the other of these two values.

The new aperture plate memory stores this information in the form of magnetic fields. One of the two values is represented by a flow of magnetism, or magnetic flux, in one direction around a hole in the plate, while the other value is represented by a magnetic flux in the opposite direction.

The small plates used in the new system are made of a special ferromagnetic material, a ceramic-like substance that can be molded in any desired size or shape, and hardened by heating. The experimental units are less than an inch square and contain 256 holes, permitting the storage of 256 bits of information in each plate.

Production of the presently-used magnetic core memory system involved a complex assembly operation, since it was necessary to thread wires in two directions through tiny ferromagnetic cores, and then to link all of the cores in a system with two more windings. The row and column windings in the core system served to address each individual core, while the other windings provided the means for storing and reading out information.

With the new plate system, the plates themselves are insulators and the holes can be joined by conduc-

(*Continued on page 84*)

"Sam, the baby has swallowed the matches. What will I do?"

"Use your cigarette lighter."

° ° °

MEN

What can she do?

Literary: What does she read?

Society: Who are her parents?

Religious: What church does she go to?

Engineer: Where is she?

° ° °

The bright student looked long and thoughtfully at the second examination question, which read: "State the number of tons of coal shipped out of the United States in any given year." Then his brow cleared and he wrote:

"1492 – none."

° ° °

Then there was the engineer who suddenly decided to live a strictly moral life. First, he cut out smoking. Then he cut out liquor. Then he cut out swearing. Then he cut out women.

Now he's cutting out paper dolls.

Parable of an Engineer

(Reprinted from the American Engineer)

One day three men: a lawyer, a doctor and an engineer, appeared before St. Peter as he stood guarding the Pearly Gates.

The first man to step forward was the lawyer. With confidence and assurance, he proceeded to deliver an eloquent address which left St. Peter dazed and bewildered. Before the venerable Saint could recover, the lawyer quickly handed him a writ of Mandamus, pushed him aside and strode through the open portals.

Next came the doctor. With impressive, dignified bearing, he introduced himself: "I am Doctor Brown." St. Peter received him cordially. "I feel I know you, Dr. Brown. Many who preceded you said you sent them here. Welcome to our city."

The engineer, modest and diffident, had been standing in the background. He now stepped forward. "I am looking for a job," he said. St. Peter wearily shook his hand. "I am sorry," he replied; "We have no work here for you. If you want a job, you can go to Hell." This response sounded familiar to the engineer and made him feel more at home. "Very well," he said, "I have had Hell all my life and I guess I can stand it better than the others." St. Peter was puzzled. "Look here, young man, what are you?" "I am an engineer," was the reply. "Oh yes," said St. Peter, "Do you belong to the Locomotive Brotherhood?" "No, I am sorry," the engineer responded apologetically, "I am a different kind of engineer." "I do not understand," said St. Peter, "What on earth do you do?" The engineer recalled a definition and calmly replied, "I apply mathematical principles to the control of natural forces." This sounded meaningless to St. Peter and his temper got the best of him. "Young man," he said, "You can go to Hell with your mathematical principles and try your hand on some of the natural forces there." "That suits me," responded the engineer, "I am always glad to go where there is a tough job to tackle." Whereupon, he departed for the Nether Regions.

And it came to pass that strange reports began to reach St. Peter. The Celestial denizens, who had amused themselves in the past by looking down upon the less fortunate creatures in the Inferno, commenced asking for transfers to that other domain. The sounds of agony and suffering were stilled. Many new arrivals, after seeing both places, selected the Nether Region for their permanent abode. Puzzled St. Peter sent messengers to visit the other domain and to report back to him. They returned all excited and reported to St. Peter: "That engineer you sent down there," said the messengers, "has completely transformed the place so that you would not know it now. He has harnessed the Fiery Furnaces for light and power. He has cooled the entire place with artificial refrigeration. He has drained the lakes of brimstone and has filled the air with cool perfumed breezes. He has flung bridges across the Bottomless Abyss and has bored tunnels through the obsidian cliffs. He has created paved streets, gardens, parks and playgrounds, lakes and rivers and beautiful waterfalls. That engineer you sent down there has gone through Hell and has made of it a realm of happiness, peace and industry."

CLUBS AND SOCIETIES—

(Continued from page 52)

Professor Charles C. Sigerfoos of the Mechanical Engineering Department is the faculty-advisor of the chapter and has unselfishly served in this capacity since 1948.

At present there are about 30 members in the chapter and there is room for many more. Interest in the foundry field and yearly dues of $4.00 constitute the only requirements of membership. A student membership in the AFS entitles one to a year's subscription to "Modern Castings," reduced prices on technical books, and reduced rates on field trips. It also provides the opportunity for contracts which may prove valuable upon graduation.

As an added uniqueness of AFS, the parent organization returns the membership fee to the student chapter to help finance its projects. Among these projects at MSU, are: Field trips to a representative foundry each term, participation in the career carnival, a student-industry banquet at the end of the Spring term, and co-sponsorship of the Michigan Regional Foundry Conference.

Everyone is cordially welcome to attend these affairs. Those who join the student chapter will find that the letters AFS also stand for "A Friendly Society."

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NEW DEVELOPMENTS—

(Continued from page 80)

tors using the highly efficient printed circuit technique in place of the complex storage and readout windings of the previous core system.

The development of these aperture plates has now reached a stage which opens possibilities of memories of very large capacities—millions of bits. Because this arrangement requires much less driving power than previous systems, it promises also to reduce and simplify the associated electronic circuits.

ELECTROLUMINESCENT—

(Continued from page 75)

conditioning load, the development of electroluminescence has high promise and significance.

The Shaping of Light

Architecturally, electroluminescence opens even more exciting prospects. These do not lie simply in the direction of simplifying the luminous ceiling, growing in beauty and complexity, from its present one-foot of fixtures, ballasts, reflectors and screening to a panel less than an inch in depth. They lie even more in shaping a new, soft, glareless, shadowless and seemingly sourceless light to architectural structure, for there are no foreseeable limits to the size or shape such panels may take. They may be curved to fit completely luminous shell domes or other free-form structures that are now rising. They may be molded into luminous balustrades, stair wells or stair risers and to other useful and decorative interior or exterior effects. They free lighting from the point source or fixture.

Moreover, electroluminescence introduces some quite new concepts into room lighting. Lighting may now move away from the ceiling toward extensive wall friezes of light to promote the psychologically warmer, more intimate effects of lighting at shoulder or head height. Two knobs would control such lighting, one for brightness, the other for color. Brightness would be adjustable to the level of outdoor light and to the interior task and need. Color would be adjustable to the mood. Panel light could be turned toward the warm red end of the spectrum for gray, drab, cold days, toward cool blue in hot summer weather. The dramatic possibilities for commercial buildings are, of course, almost limitless.

It may be some time before this new lighting is feasible on any large scale, though a period well within five years seems practical for some uses. It will probably appear first in large buildings and industrial plants, where the prospect of completely lighted interior structures holds promise for increased efficiency in specialized operations. But panel lighting is a development that architects and engineers must take into account for the future in the full range of their art.

INDEX TO ADVERTISERS

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**Inside back cover
***Back cover

Left to right: Dan Palmer, Texas A&M, '54; Ted Webb, Caltech, '55; Bob Stancil, Georgia Tech, '54; Chuck Herndon, Illinois, '50.

SIDETRACKED

STOLEN BY FRANK W. BRUTT

The Russian school teacher asked a pupil who the first humans were.

"Adam and Eve," the kid replied.

"And what nationality were they?"

"Russian, of course," said the kid.

"And how do you know," asked the teacher.

"Easy," the kid replied. "They had no roof over their heads, no clothes to wear, and only one apple between the two of them – and they called it Paradise!"

° ° °

It's amazing what some women get away with, and still keep their amateur standing.

° ° °

Did you hear about the I.E. who was a big gun in industry; he had been fired seven times.

Nurse: "Doctor Jones, I believe that engineering student has passed his crisis."

Doctor: "How can you tell?"

Nurse: "Well, when I left him he was trying to blow the foam off his medicine."

° ° °

The government has perfected a simplified tax form for next year. Here it is:

1. What was your income last year?
2. What were your expenses?
3. How much have you left?
4. Send it in!

° ° °

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

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

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

° ° °

Prof.: "What is an engineer?"

Student: "A person who passes as an exacting expert on the basis of being able to turn out with prolific fortitude innate strings of incomprehensible formulae calculated with micromatic precision from vague assumptions which are based on debatable figures taken from inconclusive experiments carried out with instruments of problematical accuracy by persons of doubtful reliability and questionable mentality for the avowed purpose of annoying and confounding a hopeless chimerical group of fanatics referred to all too frequently as Engineers."

Quo Vadis Engineer

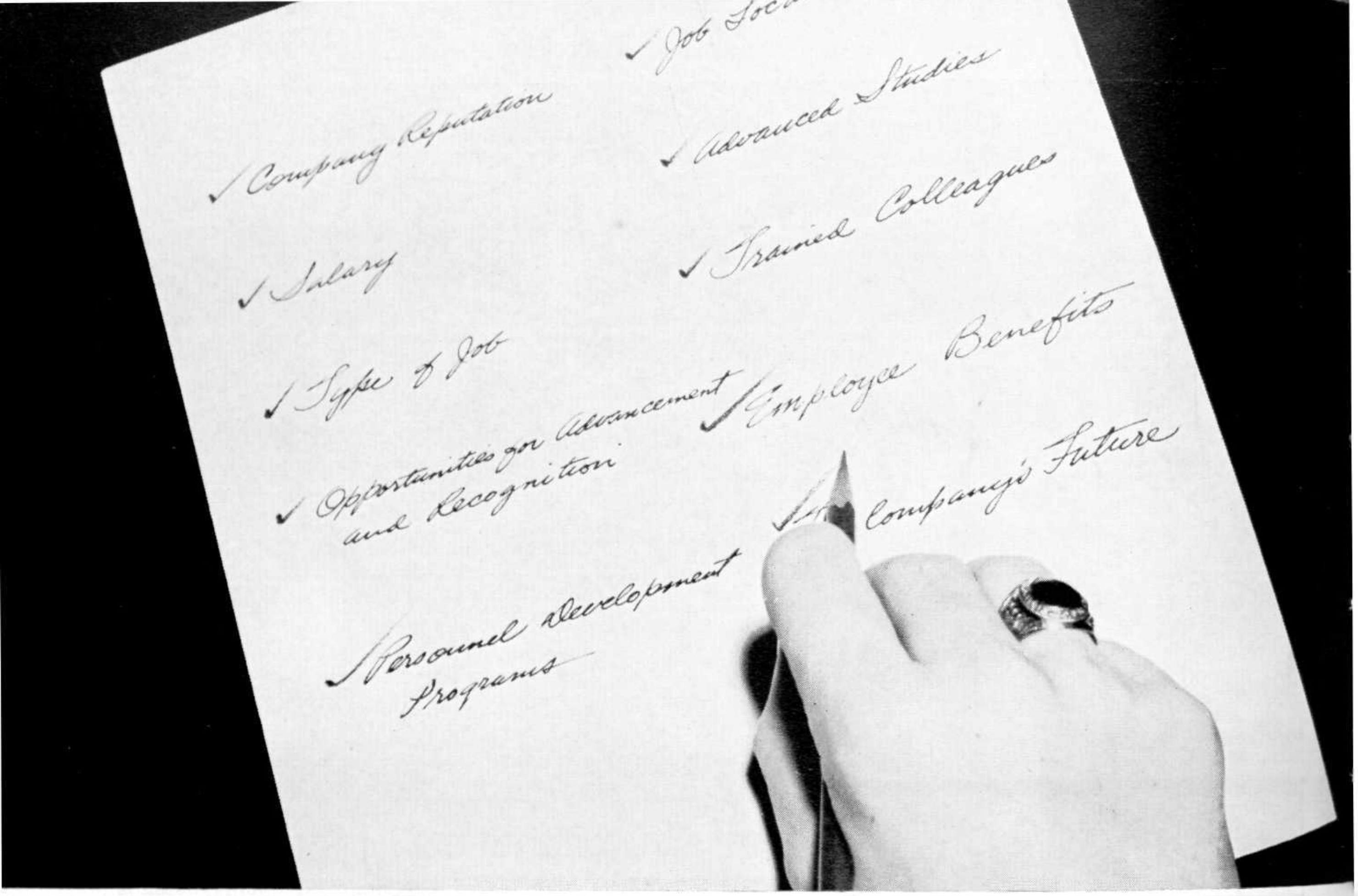
"Where goest thou, Engineer?" Out to work in an industry crying for technically trained men. The situation is such that there are simply not enough Engineers to go around. Each year the number of Graduating Engineers falls short of the number demanded by industry. As is the case with supply and demand, when the demand is greater than the supply, the asking price goes up. In the past two or three years the starting salary for Engineers has increased about $30 a month each year until now the average starting salary is around $470 to $480 a month.

The average Engineering graduate has pretty much of a choice concerning where he wants to work and for whom he wants to work. At the Michigan State University placement bureau there are usually ten or more companies every day interviewing Engineers – it wasn't always so. Here is what the Engineering graduate of 1950 was faced with.

In 1950 four companies came during the year to interview Engineers. One company said they would speak to the top 5% and no others need apply. They hired nobody. Two other companies made no such restrictions as to who could be interviewed but they didn't hire anybody either. The fourth company hired 5 men – one Mechanical Engineer and four Electrical Engineers. Of the 520 Engineers who graduated that year approximately 25 had jobs to go to when they graduated. The starting salary was in the neighborhood of $250 a month. Roy Genaw, the man who furnished this information, was president of Tau Beta Pi in 1950 and one of the top men in his class. He had to hitch hike around the country after graduation looking for a job.

The Engineer has finally come into his own. In this age of increasing technology the Engineer is becoming more and more necessary – but it wasn't always that way.

E.R.L.



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• **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.

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