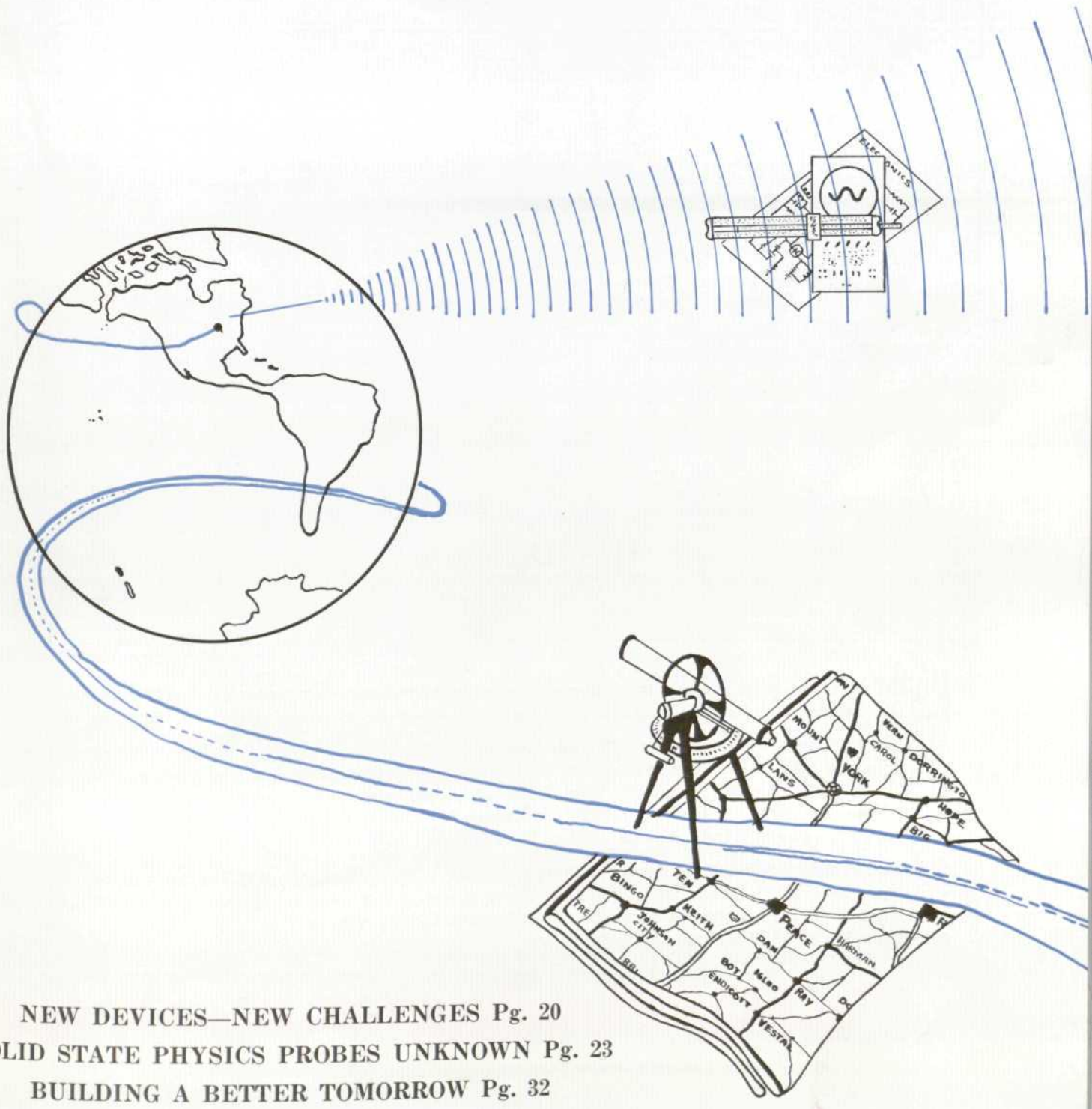
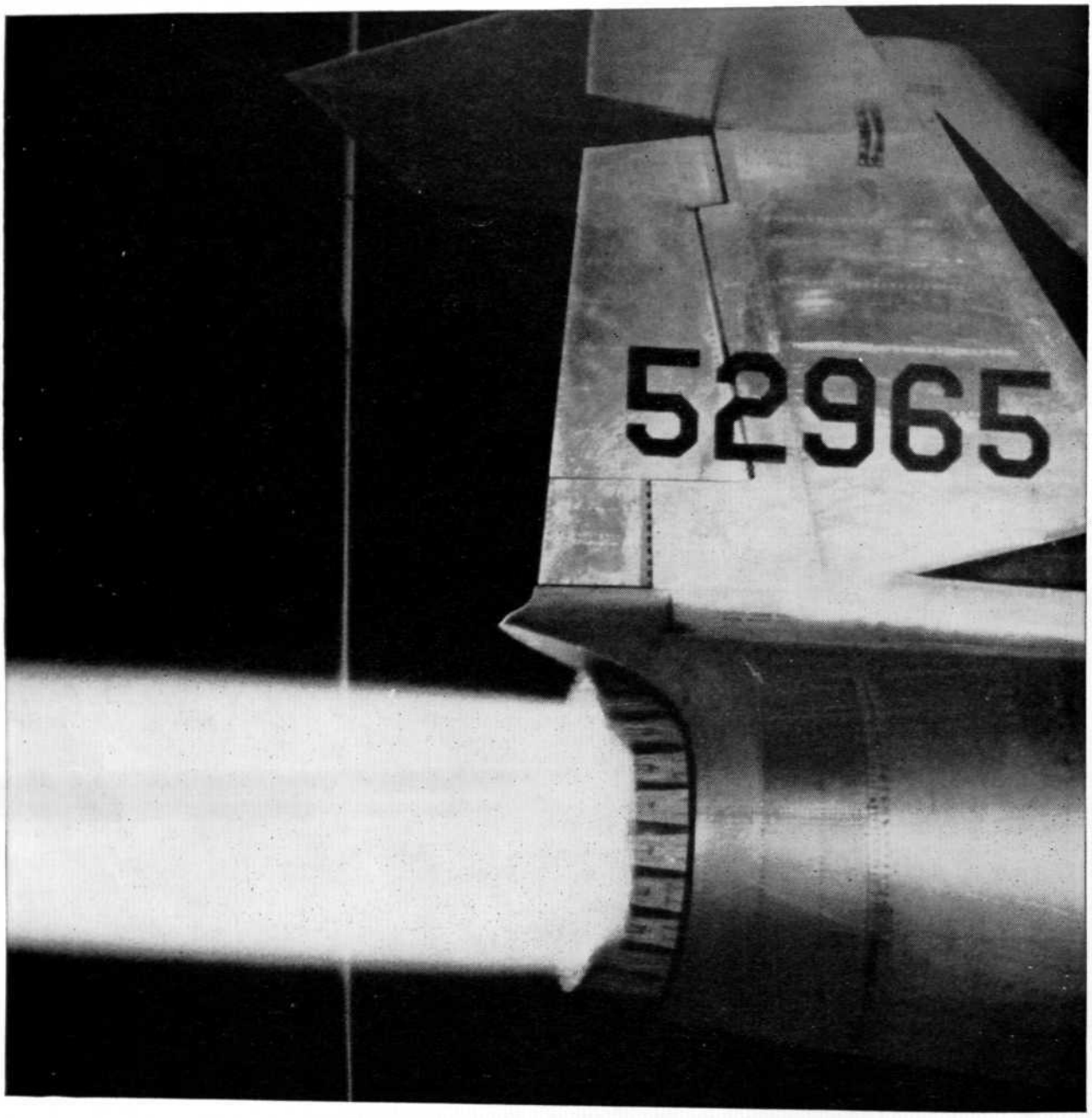
SPARTAN Engineer

PRICE 25¢

NOVEMBER, 1959



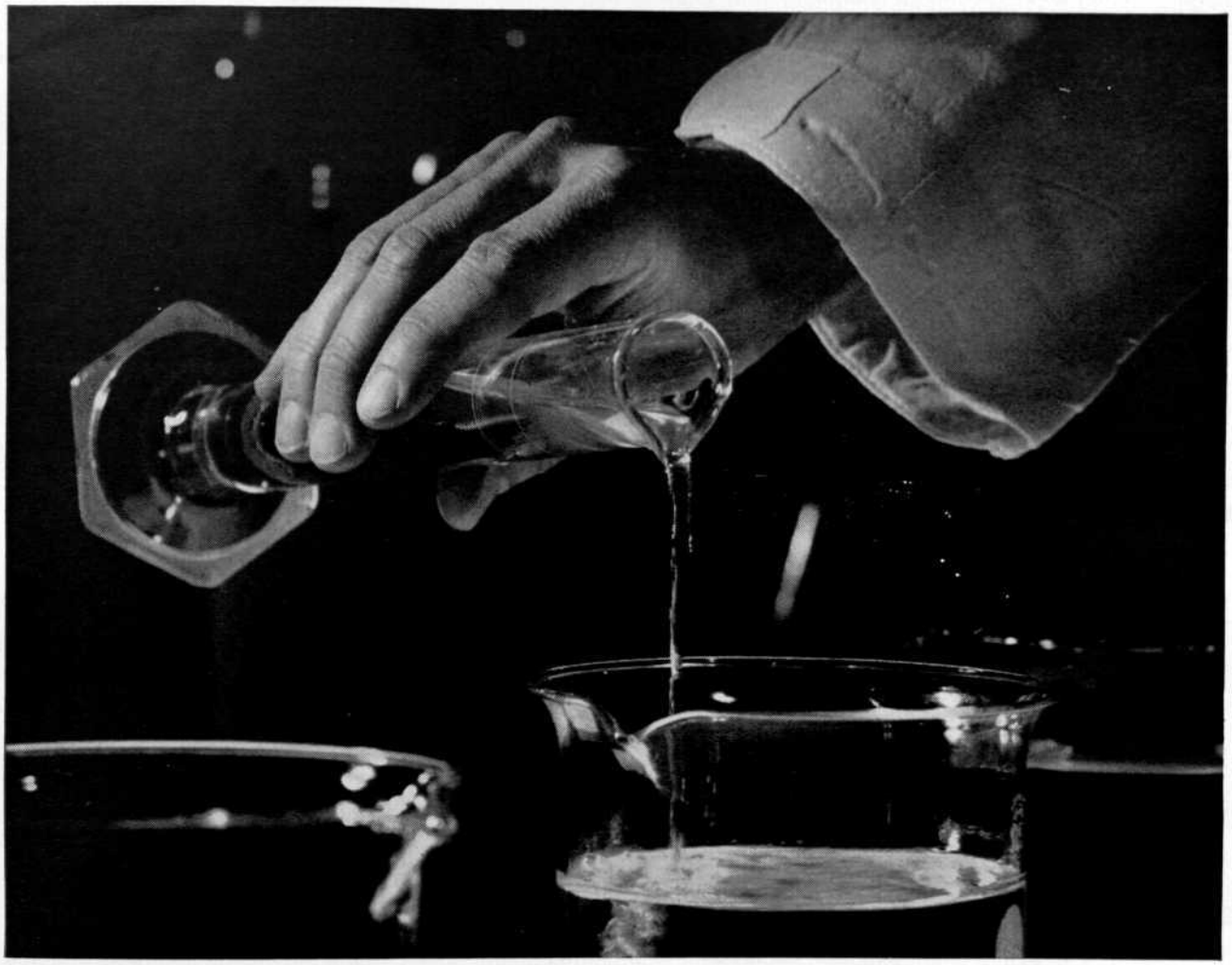


UNDER FIRE the performance of men and machines depends on what they are made of. United States Steel makes the materials for the machines, whether it's a very tough armor plate, or heat-resistant alloy, or Stainless Steels.

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

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

USS United States Steel



DOW is tomorrow-minded **people...**

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

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

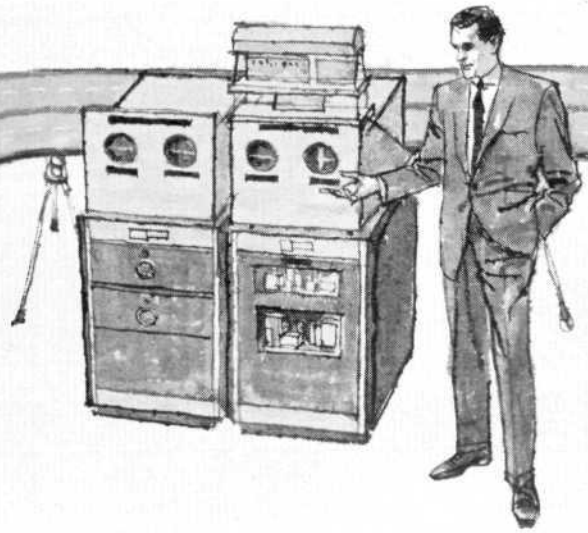
This broader view makes him plan well—for his family as well as for his job. As the phrase goes, he is "a good provider." He owns his own car. Chances are he owns his own home. Along with some 80,000 others he has invested in Dow stock because he believes in his company and wants to back up that belief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

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

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

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

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN DOW



Thinking far up the road

. . . in electronics

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

GM positions now available in these fields for men holding Bachelor's, Master's and Doctor's degrees:

Mechanical Engineering
Electrical Engineering
Industrial Engineering
Metallurgical Engineering
Chemical Engineering
Aeronautical Engineering
Ceramic Engineering
Mathematics
Industrial Design
Physics • Chemistry
Engineering Mechanics
Business Administration
and Related Fields

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

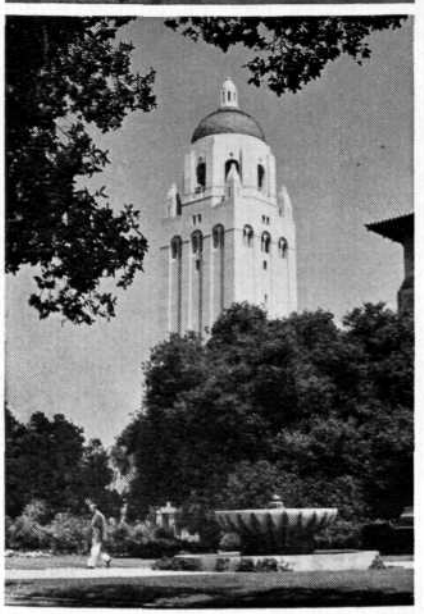
Among many available fields and products in which GM engineers and scientists work are: electronics, rocket propulsion, automotive, solar energy, astronautics, diesel engines and household appliances.

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

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

GENERAL MOTORS

An Announcement of Importance to Engineering and Physical Science Majors



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

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

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

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

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

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

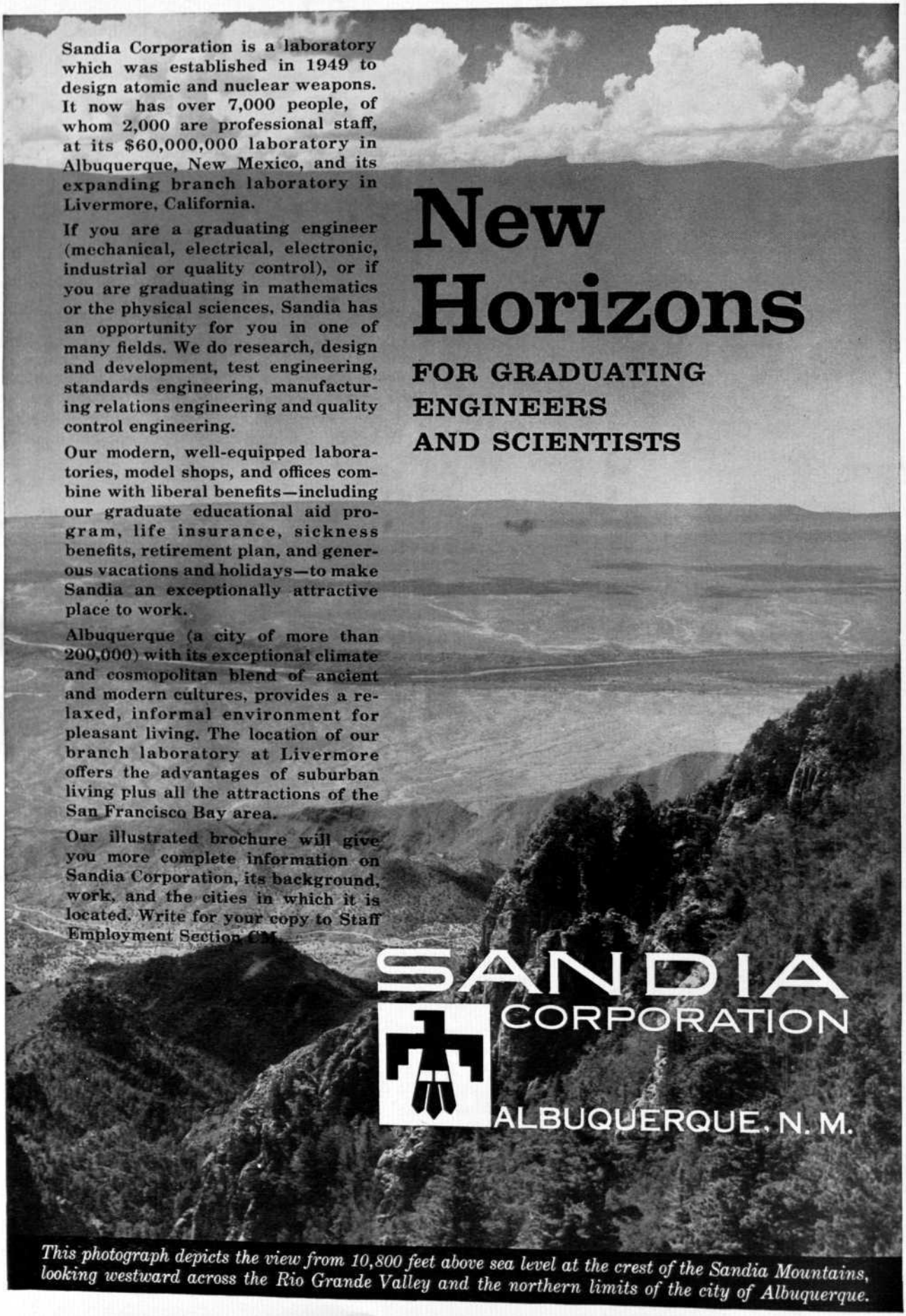
The Tuition Reimbursement Plan remits fifty per cent of the tuition for approved evening courses for salaried employees who are working full time.

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

Lockheed / **MISSILES AND SPACE DIVISION**

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

CAPE CANAVERAL, FLORIDA • ALAMOGORDO, NEW MEXICO • HAWAII



Sandia Corporation is a laboratory which was established in 1949 to design atomic and nuclear weapons. It now has over 7,000 people, of whom 2,000 are professional staff, at its $60,000,000 laboratory in Albuquerque, New Mexico, and its expanding branch laboratory in Livermore, California.

If you are a graduating engineer (mechanical, electrical, electronic, industrial or quality control), or if you are graduating in mathematics or the physical sciences, Sandia has an opportunity for you in one of many fields. We do research, design and development, test engineering, standards engineering, manufacturing relations engineering and quality control engineering.

Our modern, well-equipped laboratories, model shops, and offices combine with liberal benefits—including our graduate educational aid program, life insurance, sickness benefits, retirement plan, and generous vacations and holidays—to make Sandia an exceptionally attractive place to work.

Albuquerque (a city of more than 200,000) with its exceptional climate and cosmopolitan blend of ancient and modern cultures, provides a relaxed, informal environment for pleasant living. The location of our branch laboratory at Livermore offers the advantages of suburban living plus all the attractions of the San Francisco Bay area.

Our illustrated brochure will give you more complete information on Sandia Corporation, its background, work, and the cities in which it is located. Write for your copy to Staff Employment Section CM.

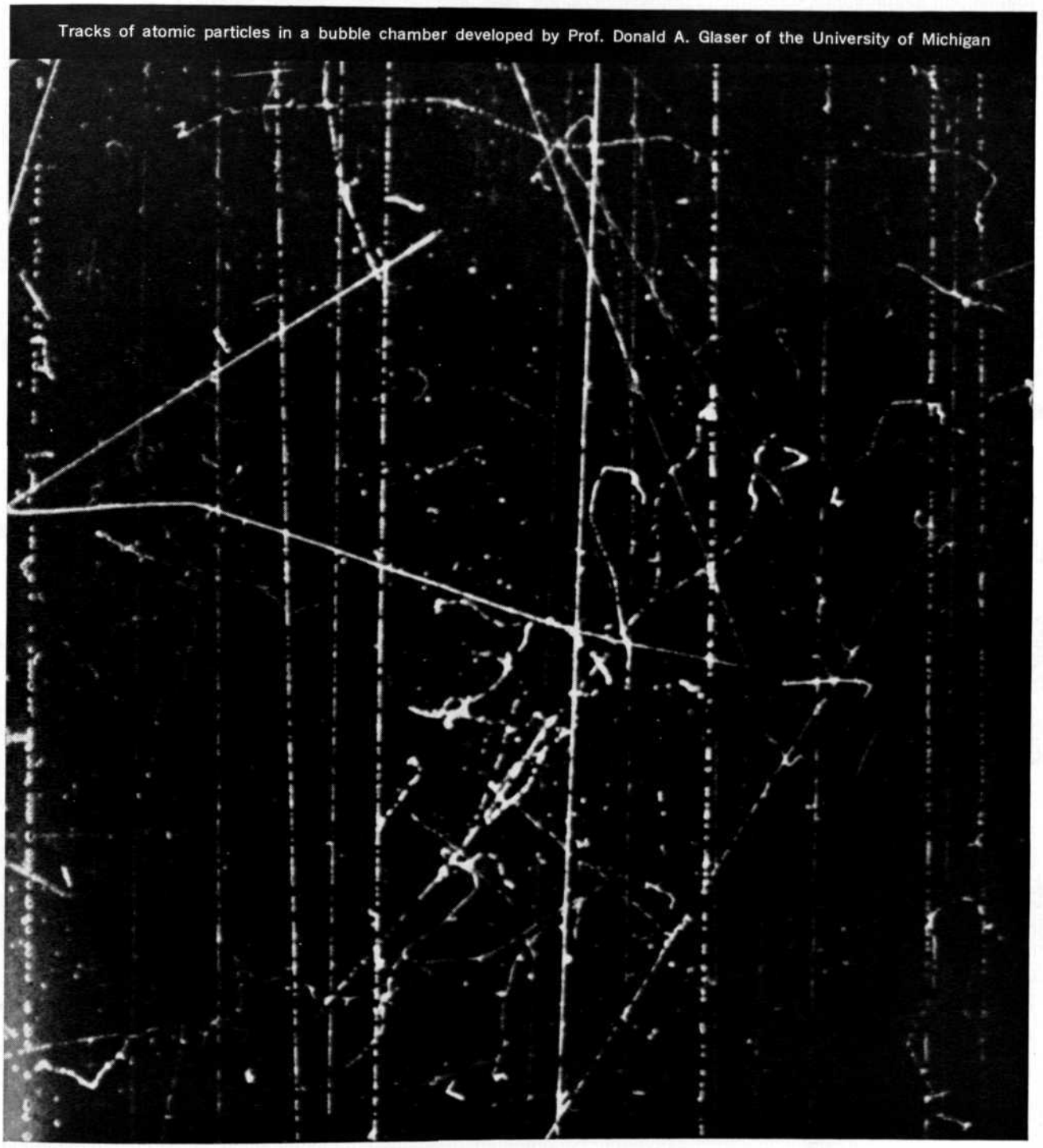
New Horizons

FOR GRADUATING ENGINEERS AND SCIENTISTS

SANDIA CORPORATION

ALBUQUERQUE, N. M.

This photograph depicts the view from 10,800 feet above sea level at the crest of the Sandia Mountains, looking westward across the Rio Grande Valley and the northern limits of the city of Albuquerque.



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

ATOMIC POWER and DETROIT EDISON

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

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

THE DETROIT EDISON COMPANY

Detroit 26, Michigan

Dean's Letter

You have all certainly perused the curriculum leading to a degree in your chosen major. Perhaps only a few of you have given it real thought as freshmen or sophomores. In those years you are busy with mathematics, physics, chemistry, or are looking ahead at the junior or senior years when you will get into those "real" engineering courses; the curriculum is only delaying you. Certainly not too many of you have realized that a curriculum is only a Table of Contents, that as a planned program of engineering education it is not complete.

The real education lies in the subject matter of the courses themselves and in learning how to think logically from point to point. These are the contributions of the faculty to your education. There is another fraction of your education that is not even listed in this Table of Contents, and must be added by you as an individual. This portion of your education is obtained through participation in extra-curricular campus activities; the University provides an opportunity for this, but you must participate to gain the benefits—and benefits there are. Our curriculum does not include courses in "Parliamentary Law" or "How to Influence People and Others," nor do we find "Conduct on Committees," "Impromptu Politics," or "Selling the Boss," yet such courses are available every day on this campus in the many activities of the student organizations. Their meetings and promotional activities offer opportunity for laboratory experience in human relations, personal conduct, speaking, and organization—all on an informal, unrecorded basis. If you fail in your first attempt to "Sell the Boss," no record is made or grade recorded. This takes much of the pressure off this portion of the learning process, and makes it fun as well as practice in the art of human relations.

There are many all-campus opportunities for this activity—here in Engineering we have the various Student Branches of our professional engineering societies in our departments, the Engineering Exposition, or work on the staff of this magazine, the "Spartan Engineer." Later on after having met the entrance criteria, there are the activities of the various engineering honor societies.

We wish to especially commend the work to be found with this magazine. Ability to write and to understand journalistic procedures is much sought after in industrial circles, and is also an area without much competition. The Spartan Engineer provides such experience and opportunity.

In fact, this whole unpublished topic in our curricular Table of Contents will be found worthwhile-without an experience here, you will not really have been to college. In fact, an employment interviewer might subtly tell you so.

J. D. Ryder, Dean

Spartan Engineer

of michigan state university

VOLUME 13 NO. 1 NOVEMBER, 1959

FEATURES

DEPARTMENTS

COVER: The cover for this month's Spartan Engineer was drawn by Herb Harman, a member of our staff. The cover portrays the world wide significance of the Electrical and Civil Engineering Professions. It's a salute to the excellent Electrical and Civil Engineering Departments at Michigan State University.

MEMBER, ENGINEERING COLLEGE MAGAZINES ASSOCIATED

* * *

Chairman: Professor Stanley Stynes
Wayne State University
Detroit, Michigan

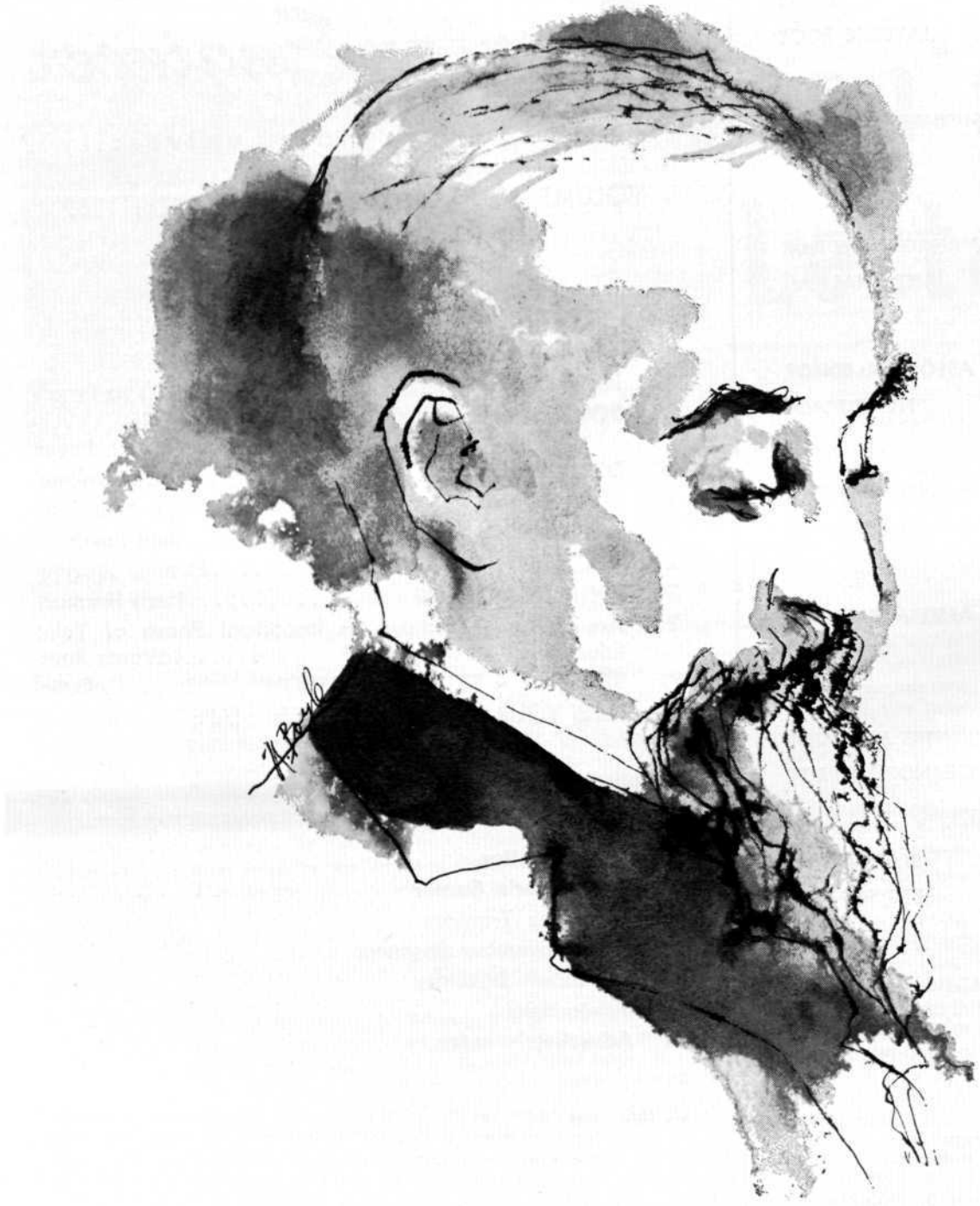
Publisher's Rep.: Littell-Murray-Barnhill, Inc.
369 Lexington Ave., New York 17
737 N. Michigan Ave.,
Chicago

* * *

Published four times yearly by the students of the COLLEGE OF ENGINEERING, MICHIGAN STATE UNIVERSITY, East Lansing, Michigan. The office is on the third floor of the Student Services Bldg., Phone ED 2-1511, Ext. 2614. Second class postage paid in E. Lansing, Michigan, under the act of March 3, 1879.

* * *

Subscription rate by mail $1.00 per year. Single copies 25 cents.



Vilfredo Pareto...on the lifetime of theories

"The logico-experimental sciences are made up of a sum of theories which, like living creatures, are born, live, and die, the young replacing the old, the group alone enduring. As with living beings, the lifetimes of theories vary in length and it is not always the long-lived ones that contribute most to the advancement of knowledge. Faith and metaphysics aspire to an ultimate, eternal resting-place. Science knows that it can attain only provisional, transitory states. Each theory fulfils its function, and there is nothing more to ask of it."

—Traile de Sociologie Generale, 1919

YOUR TASK FOR THE FUTURE

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

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

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

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

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

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

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

jpl

CALIFORNIA INSTITUTE OF TECHNOLOGY

JET PROPULSION LABORATORY

A Research Facility operated for the National Aeronautics and Space Administration

PASADENA, CALIFORNIA

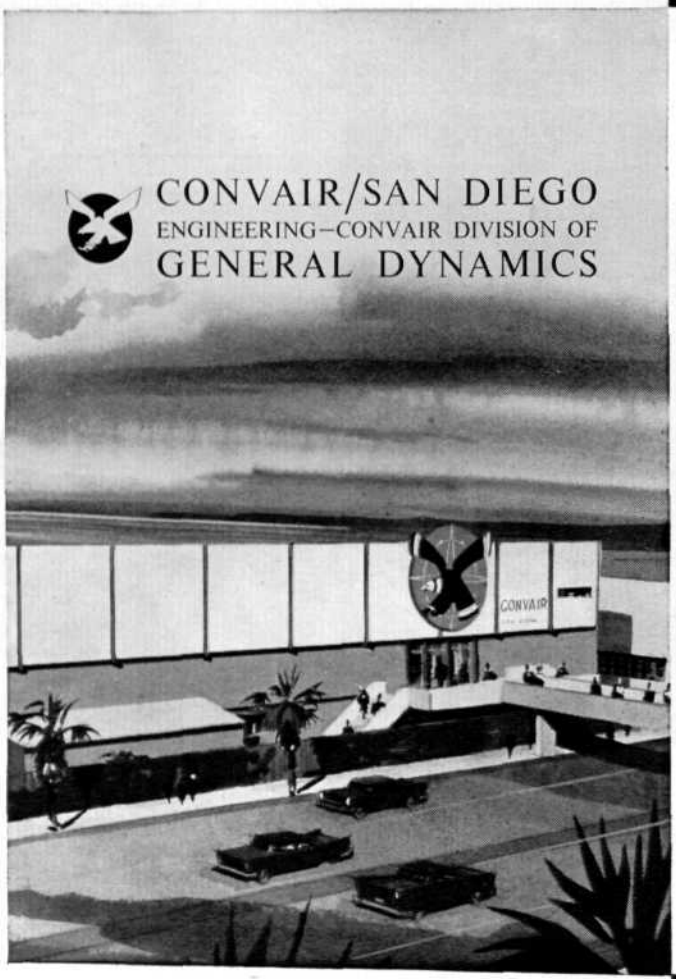
Employment opportunities for Engineers and Scientists interested in basic and applied research in these fields:

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

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

TOMORROW BEGINS TODAY AT CONVAIR SAN/DIEGO

FOR YOUNG ENGINEERS AND SCIENTISTS



As an engineering, mathematics or physics major, you will soon be called upon to make one of the most important decisions of your life: *Choice of Association.*

In making that decision, we hope you will choose the aerospace industry and Convair/San Diego. But whatever your choice, the selection of association must be made with meticulous care and keen awareness of what that decision will mean, not only immediately, but in years to come.

To arrive at such an important decision, you will need all the information available to you. That is why Convair/San Diego is suggesting that you carefully read a new booklet prepared for the express purpose of helping you make this vital decision.

Within the twenty-four pages of this brochure, you will find detailed information about Convair, the General Dynamics Corporation, and the work of each group within the Convair/San Diego engineering Department.

Whether or not you decide to discuss your career with us in more detail, we sincerely believe you will be better equipped to make your decision after reading this brochure.

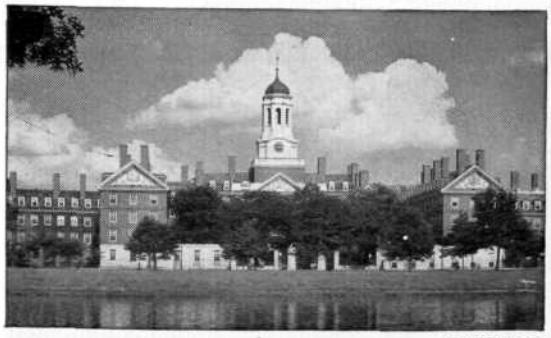
If your placement office does not have a copy, we will be pleased to mail you one. Simply write to Mr. M. C. Curtis, Industrial Relations Administrator, Engineering,

CONVAIR/SAN DIEGO CONVAIR IS A DIVISION OF GENERAL DYNAMICS

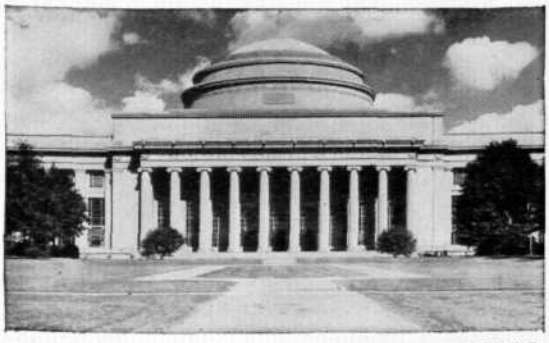
3302 PACIFIC HIGHWAY, SAN DIEGO, CALIFORNIA

Raytheon Graduate Program

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



HARVARD



MASSACHUSETTS INSTITUTE OF TECHNOLOGY

CALIFORNIA INSTITUTE OF TECHNOLOGY

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

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

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

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

RAYTHEON COMPANY, Waltham 54, Mass.

Excellence in Electronics RAYTHEON

The Editor's Corner

Are you a social hermit, or even worse, are you socially objectionable? As an engineering student, you may find yourself placed in one of these categories by those students outside of engineering.

Why do these students feel that engineers are a bunch of "squares"? Is it because engineering students are willing to put in those extra hours studying? Or is it because engineering students and their organizations make such a poor showing in all-university activities? Perhaps the answer is that engineering students are a bunch of "squares"!

In general the standards of the College of Engineering are as high or higher than any other school at Michigan State University. And since all engineers are not geniuses, they must spend a few extra hours at the books, but this still leaves some spare time for other activities.

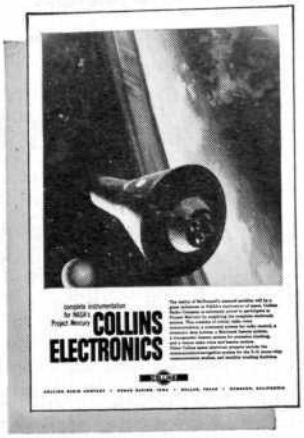
How do you spend this time? If you are a typical engineer, I can tell you some of the things you do **not** do. You do **not** support your professional organization, your engineering council, or any of the other activities sponsored by the engineering organizations. An even smaller number of you take part in all-university activities. Perhaps you question the value of these activities and prefer to spend these extra hours watching "Howdy Doodie."

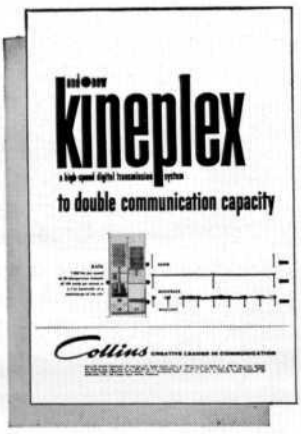
During the open smokers this fall, one engineering fraternity found it necessary to reject over half of the engineering rushees because they were literally in "deep left field."

Looking through the membership lists of the various activities in which engineering students participate, one finds many do not belong to a single organization. Of the 270 graduating seniors in engineering last June some 45 did not take part in any activity, while some 100 joined one activity during their senior year for the expressed purpose of having it on their records at the placement bureau. The active students represented less then 10$ of the graduating class. The Knights of Saint Patrick, an engineering service honorary, recognized even fewer as being worthy of recognition for participation in student activities.

Are you planning to work as a draftsman or technician for the rest of your life; or are you aiming for something more? If you spend four years doing only what is required for an engineering degree, you may find yourself continuing in this pattern after you leave college. Now is the time to gain some practice in doing more than is required.

Regardless of your interest, you will find an organization of other students with the same interests.' **Active** participation will not show on your records, but it will improve your job performance after you leave this campus.





COLLINS ELECTRONICS– diversification

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

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

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

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

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

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

FREE

C-1

Professional Placement,
Collins Radio Company,
Cedar Rapids, Iowa

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

Name _____

Address _____

City _____ State _____

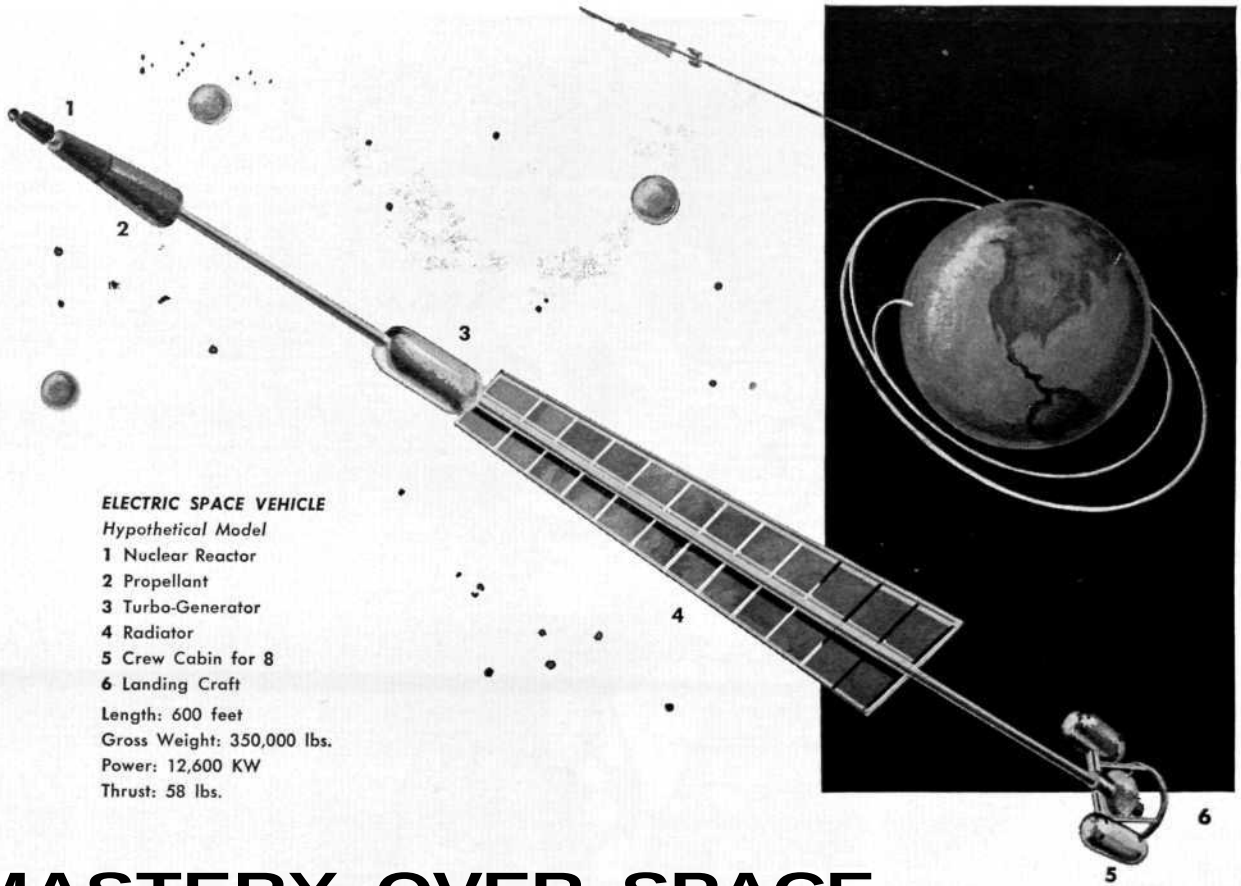
College or University _____

Major degree _____ Minor _____

Graduation date _____

COLLINS

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



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

MASTERY OVER SPACE

NASA's space efforts are directed toward two specific objectives. First, to make it possible for man to achieve the same mastery over space he has already secured in every other region he has attempted to make his own ... on the surface of the earth, under it, or in the air above it.
Second, to free man from one additional element of intellectual bondage—that is, to gain for all mankind additional knowledge about the cosmos.
To accomplish these objectives NASA's broadly conceived programs encompass intensive work in the following areas:

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

Research and development of spacecraft, missiles and aircraft.

Meteorological and communications satellite systems.

Space operations technology — Project Mercury and space rendezvous techniques.

Space propulsion research, including solid propellant rockets, high energy propellant rockets, l 1/2-million-pound-thrust single-chamber rocket engine, nuclear and electric rocket engines.

Orbiting space laboratories.

Scientists and Engineers:

Career opportunities for graduates at NASA are as unlimited as the scope of our organization.

Please address your inquiry to the Personnel Director of any of the following NASA research centers:

- **Langley Research Center Hampton, Virginia**
- **Ames Research Center Mountain View, California**
- **Lewis Research Center Cleveland, Ohio**
- **High-Speed Flight Station Edwards, California**
- **Goddard Space Flight Center 4555 Overlook Avenue, S.W. Washington 25, D. C.**

NASA National Aeronautics and Space Administration

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

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

YOU...

An Editor of a Top Engineering Publication ?

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

Are Jack Carroll's shoes your size?

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

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

*Wrote **in** College*

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

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

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

McGraw-Hill Tuition Refund Plan

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

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

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

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

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

McGraw-Hill

PUBLICATIONS

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42nd STREET, NEW YORK 36, N.Y.

IT'S LITERALLY ALL AROUND YOU!

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

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

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

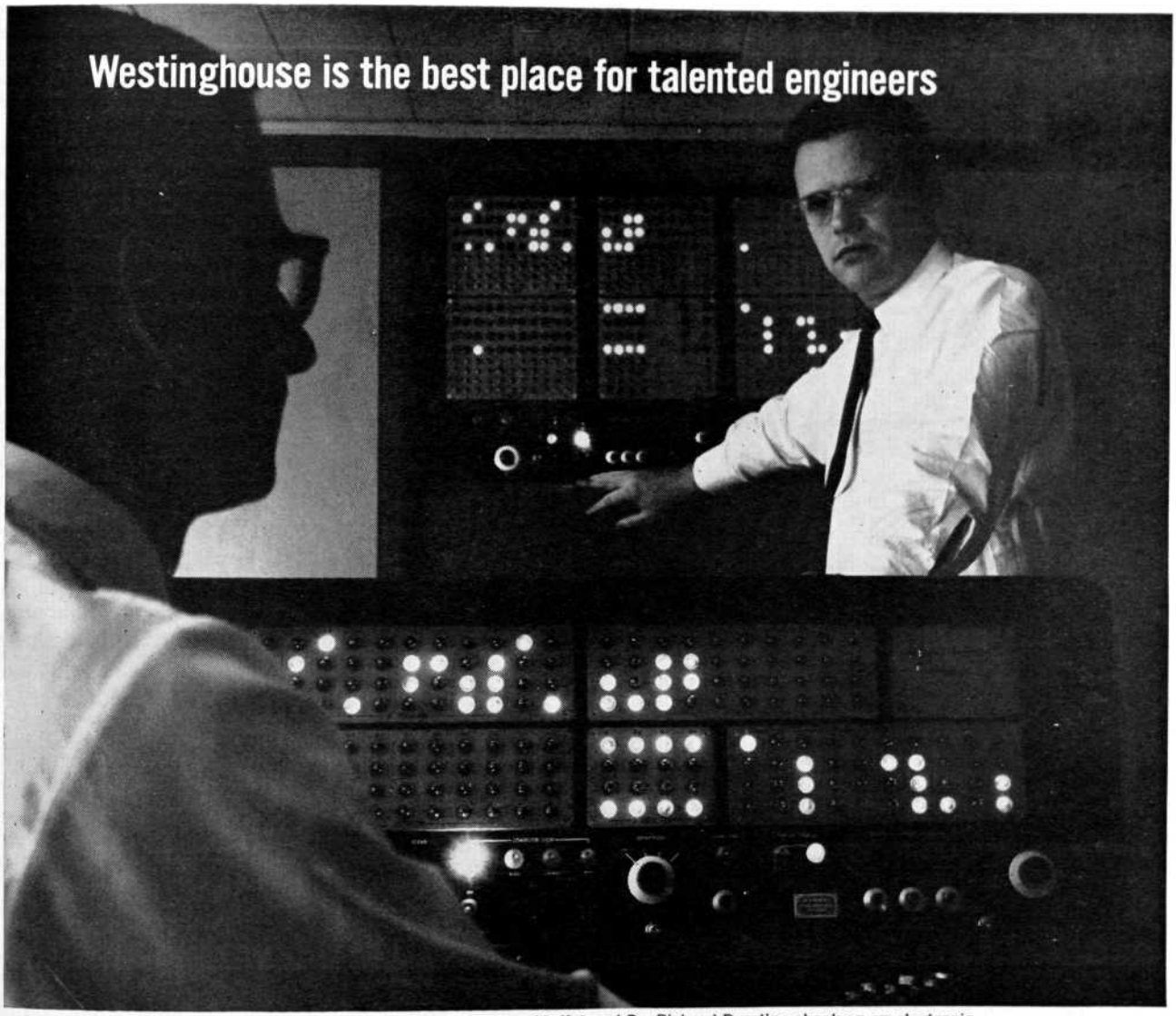
Here, then, is a space age challenge to be met with the finest and most practical engineering talent. Here, perhaps, is the kind of challenge *you* can meet.

SIKORSKY AIRCRAFT

One of the Divisions of United Aircraft Corporation

STRATFORD, CONNECTICUT

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



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

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

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

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

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

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

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

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

YOU CAN BE SURE...IF IT'S

Westinghouse

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

NEW DEVICES
NEW CHALLENGES

For the Electrical Engineer

by Dr. L. Von Tersch, Head of Electrical Engineering Department

One of the most persistent and common questions arising in any group of potential Electrical Engineering students is this—"What am I going to do when I graduate?" No **question** could be more difficult to answer. An investigation into the work now being conducted by the Electrical Engineering graduating class of June, 1959, reveals that approximately 35% are now engaged in duties that distinctly did not exist when they entered Michigan State University as freshmen in the Fall of 1955. What are some of these new activities in which Electrical Engineers are now participating?

Solid State Electronics

One area that is developing an importance second to none is that of solid state electronics. Prior to 1948 the term "electronics" primarily meant a study of vacuum tubes of many diverse characteristics, all depending upon a hot cathode as a source of electrons. During the next few years the transistor became relatively common and found its way into many commercial products. Now the transistor, with the name used in its original sense, may have to take a secondary position with respect to the myriads of solid state devices now appearing and now being hinted at in the technical literature. What does this mean to the Electrical Engineer? It means that he is going to have to be a very adaptable individual in order to accommodate himself to the world in which he must work. It means that his technical education must continually be improved in order to give him the best chance for this adaptation. It means that he cannot, in his college work, be taught very many specific things about this kind of a vacuum tube circuit or that kind of a transistor circuit but that he must gain an appreciation for the general analysis of non-linear circuits regardless of the components from which they be formed. It means that in order that he may best use these devices in systems that suit his purposes he must also learn a great deal about the devices themselves. In this he may be learning about things which were once the exclusive province of the metallurgist or the solid state physicist.

For example, one of the most impressive solid state devices of current discussion is the tunnel diode. This diode as with all other solid state diodes and transistors depends upon the transfer of charge across a "p-n" junction. A p-n junction is the junction between a p-type semiconductor, containing mobile positive charges in the form of vacant electron spots (holes) in the atoms of a crystal and an n-type semiconductor, containing mobile negative electrons. Normally the application of a suitable voltage causes charges to obtain an energy sufficiently great to exceed any potential barriers and pass through the junction. However the laws of quantum mechanics allow another possibility. Regardless of the relative energies involved, an electron has a small but finite probability of going from one side of a potential barrier to the other. The effect is as if the electron "tunneled" under the barrier. It is possible to arrange p and n type materials such that this condition is enhanced, giving rise to a completely new set of solid state devices. The "tunneling" time is very fast allowing very fast switching in pulse circuits and very high frequencies in oscillators or amplifiers.

A related field in which there was essentially no work whatsoever a few years ago is that of cryogenic devices. Many materials, primarily including the semiconductors and thin films of many metallic compounds, offer a variety of operating characteristics at low temperatures in the neighborhood of 4°K. Some of these devices show great promise in the search for new computer components.

High Speed Computers

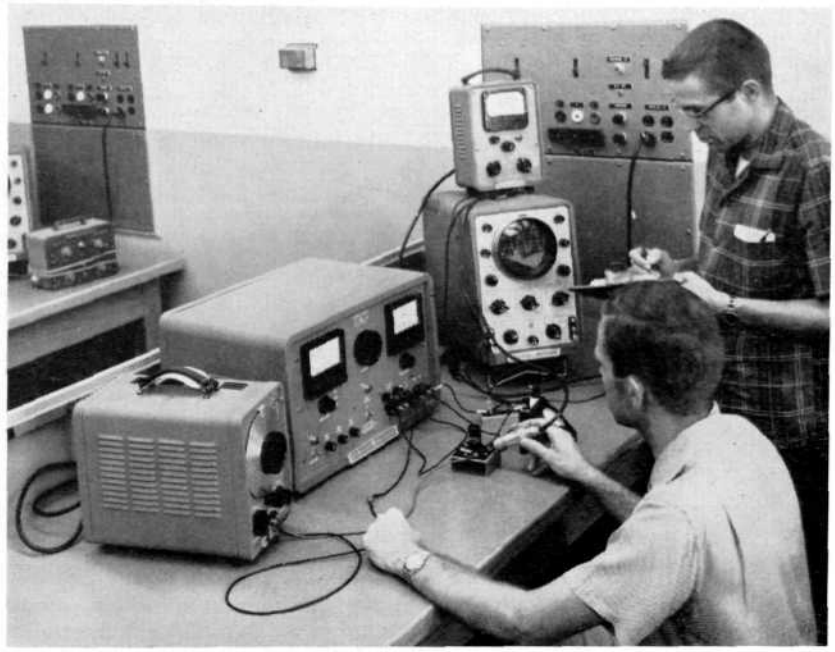
A second area which is having a profound effect on the activities of the Electrical Engineer is that of the high speed digital computer. At first glance it might seem that the interest of the Electrical Engineer is primarily that of circuit design. Modern high speed computers embody all current knowledge with respect to electronic circuit design and the most elegant and subtle circuits and components appear in these machines in an attempt to achieve greater speed and reliability. However the greatest effect on the Electrical Engineer and perhaps on all engineers is the significance of the computer as a tool in much of his work. The slide rule as a symbol of the engineer is now past and the new engineer is far more concerned with the principles of programming and numerical analysis.

As an example of the use of the computer in Electrical Engineering take the problem of optimum design of computer circuits. If the problem involves the construction of a half-adder concerning a few transistors and a few resistors it is of no difficulty to put together a circuit in the laboratory which will work in a suitable manner. In fact it is usually of no great difficulty to construct hundreds of similar circuits all of which are slightly different in component values and all of which appear to be satisfactory. However these circuits are all different and they will all behave differently for variations in temperature, supply voltages, and input signals. Which of the great **number** of possibilities offers the greatest reliability in operation if variation in all parameters is considered, realiz-

ing that the parameter of cost may also be another variable in the system? Although an optimum circuit may be extremely difficult to find in the laboratory the computer may be programmed to investigate these many possibilities and supply a solution. This circuit may even go into use in the computer which did the analysis, usually engendering many philosophic comments upon computer design.

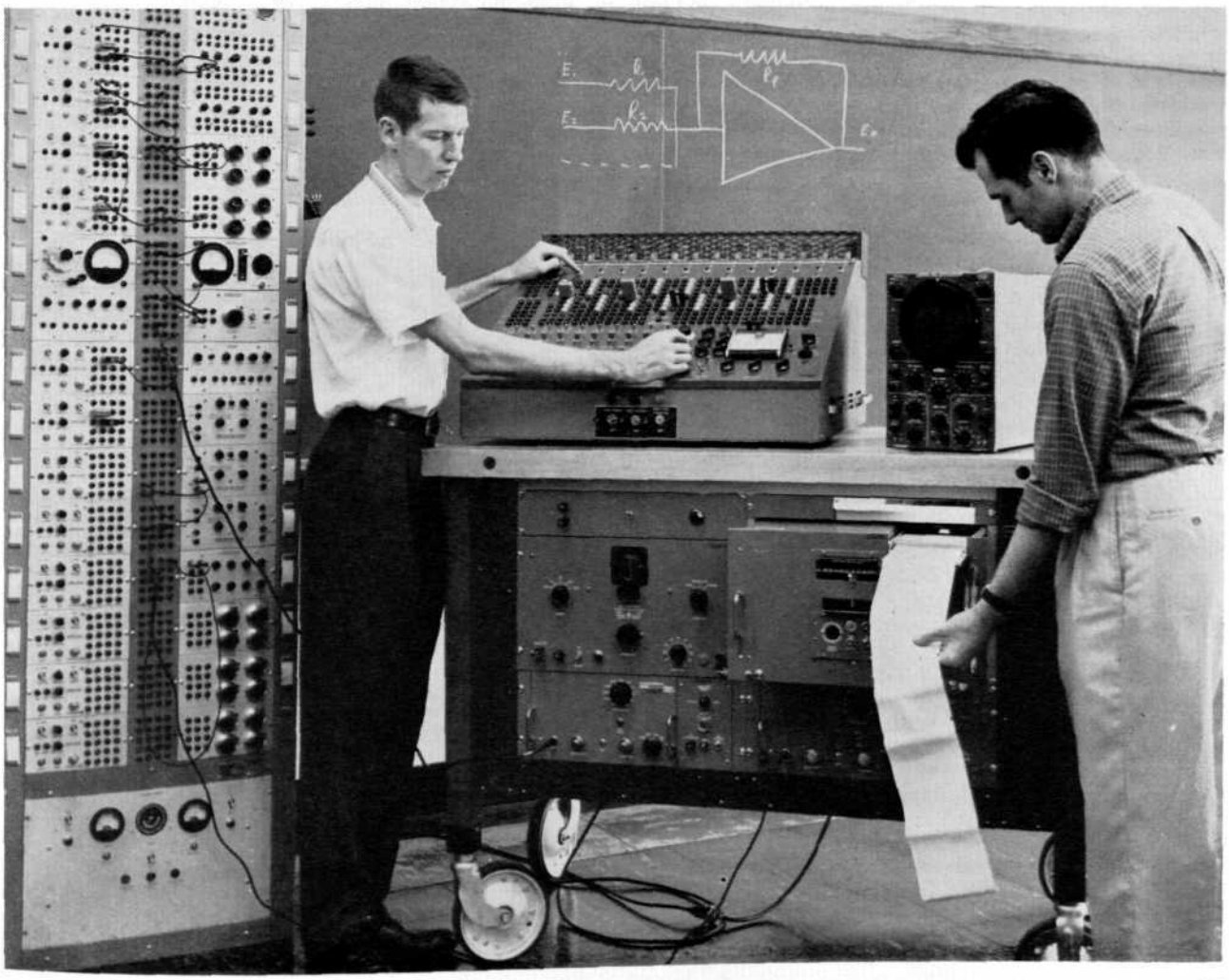
A New Approach

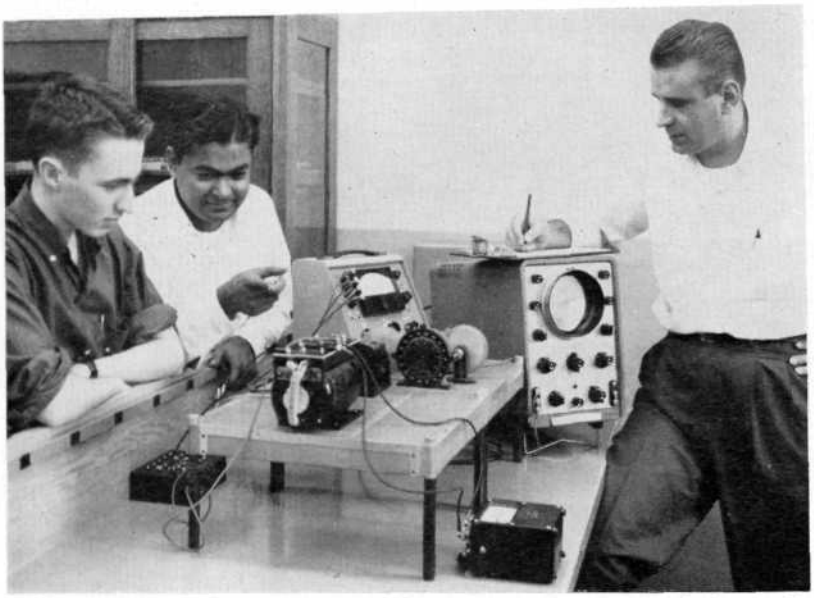
By inclination and education most engineers tend to avoid the problems which are liable to lead to "dog-work." They have in the past unconsciously classified the problems which lead to concise analytical solutions as the elegant problems in their field and have dismissed many of the long, tedious, numerical problems as being not worthy of their attention. However, new circuits and new control systems, many of them highly non-linear in nature, have forced an appraisal of the situation. The computer has made possible the solution



(Above) **Mr. J. Kately and Mr. D. Feirthe shown checking the operating characteristics of a laboratory amplifier.**

(Below) **Mr. L. Peltier and Mr. J. Richardson preparing to set up a problem on a Heathkit analog computer. Shown at left is a Boeing analog computer.**





Mr. J. Lang demonstrating a laboratory experiment in which coupling coefficient between the rotor and the stator of an A. C. machine is determined. Watching are Mr. H. Kesaran and Mr. J. Idson.

of many of those problems by the use of numerical techniques and much new knowledge has been created. This does not mean that the high speed digital computer is a solution for all such problems. Every solution of a complex, non-linear servomechanism contributes to the education of its designer and he immediately embarks on a bigger, more complicated, and more accurate system. He now finds that his computer is too slow, that the processes which solved his first problem now take far too much time for his new problem to be practical. What happens? He either alters his views on what is economically practical or he seeks a new and faster computer. There seems to be some evidence that whereas a small increase of speed merely allows one to do his problem a little faster, an increase in speed of the order of one magnitude can bring forth a completely new and different approach to the problem.

The engineer who has the opportunity to do considerable computer work also begins to get disturbed about a facet of his education. He begins to realize that the numerical techniques which have solved his non-linear differential equations would also have solved the linear equations that could sometimes be made to provide the concise analytical solutions. It seems quite possible that he would have been far better off in many respects to use his limited time to learn about the general numerical solution of all differential equations instead of the solution of a few easy special cases.

Electronic circuits for many other miscellaneous applications have greatly increased in complexity in a very small time. Parametric amplifiers, in which amplification is achieved by a periodic change in a parameter of the circuit, offers many exciting possibilities for low noise and high gain amplifiers. Circuits which store information by virtue of the fact that they have two or more stable phase positions have merit for possible computer memories.

The subject of batteries is usually considered to be somewhat prosaic but a comparison of currently available units would show a great number of departures from the batteries of a few years ago. Even the most common dry cells evidence astounding properties due to the availability of new materials. Fuel cells, which differ from dry batteries in that chemicals are fed in at a rate proportional to that at which electric energy is withdrawn, offer many appealing possibilities. Nuclear cells, which merely collect charged carriers from a radioactive source to create a voltage, have a large use in applications where current drain can be very small. Thermojunctions, although not batteries in the normal sense, offer greatly increased efficiencies and have many practical applications.

The Changing Technical Panorama

Some of the previous examples have indicated the rapidly changing technical panorama in which the Electrical Engineer finds himself. One wonders sometimes if it is possible for the graduate with a bachelor's degree to take his place in this scene. The answer is most definitely yes, provided the graduate realizes his true situation. He is in general little qualified to immediately do creative work in the area of his employer's specialization. However, he is immensely qualified to learn the specifics of his job for his undergraduate work will have provided him with the basic tools and background.

Of all the statistical information available which pertains to postwar education in Electrical Engineering, one of the most striking is that of the growth of graduate study. Graduate study allows the Electrical Engineer to obtain more of the basic tools, and in addition competence in some field of specialization. Experience indicates that again the basic tools are of far greater long-time value than specific training since a negligible number of individuals work indefinitely in the field of their graduate specialization.

Mr. B. Rose determining the square wave characteristics of a laboratory amplifier.

PROBES UNKNOWN

by Joe Poyer, Science Writing '61

Are you interested in a material of the future? The development and use of Lithium is a direct result of the nuclear age and may well become one of the most important materials to be used by science and industry in the future.

Research into the physical properties of the Lithium isotopes 6 and 7 is being conducted by Dr. D. J. Montgomery and Mr. Nguyen Tu Ban in the Physics-Astronomy department of Michigan State University. Mr. Ban is currently in charge of the project while Dr. Montgomery is on leave in France.

The possibilities for the application of Lithium in science and industry are many and varied: from the use of its compounds such as Lithium Hydroxide to prolong battery life, to the use of its isotopes in nuclear research as coolant materials and fusion materials.

In the photograph Mr. Ban is shown working with the specially designed apparatus used to measure the viscosity of the Lithium isotopes 6 and 7 in their liquid state.

The isotope to be tested is contained in a special stainless steel alloy sphere designed to resist the extremely corrosive nature of the liquid Lithium. The sphere is suspended in a vacuum of $5x10^{-5}$ to $5x10^{-6}$ mm. of mercury, at a temperature of 300°C. The melting temperature of Lithium is only 179°C. and so the isotope is constantly in a molten state.

The sphere is oscillated in such a manner that it spins on its longitudinal axis. This movement allows the liquid metal to move with and inside of the sphere. This movement of the Lithium inside the sphere creates friction which over a period of time will slow the oscillation of the sphere and eventually bring it to a halt. By measuring the amount of time required to slow the sphere using each of the isotopes, Mr. Ban is able to determine and compare the viscosity of each.

To make the comparisons as accurate as possible each of the isotopes is tested many times. The oscillation of the sphere is measured by a special instrument that estimates the amount and time for each series of oscillation.

The actual experimental work on isotope 6 started in the summer of 1959 and still has another month to run. Preliminary studies of the two isotopes indicate that they may be put to extensive use in the field of nuclear research. Lithium 6 absorbs neutrons readily and could conceivably be used in thermonuclear reactions. Lithium 7 has a low neutron

(Continued on Page 52)

(photo by Al Royce)

Mr. N. T. Ban looking at the setup used in checking viscosity of liquid Lithium.

Automotive Industry Looks to . . .

DISC BRAKES

. . . For Solution to Braking Problems

by Fred Sternkopf, Dairy Production '60

Everyday improvements are being made in the automotive industry, among these comes the development of a new type of brake to meet our modern needs. Before we make mention of these new brakes let us make a brief study of what a brake is and how it functions.

A car brake is a device for converting kinetic energy into heat, and dissipating it to the surrounding air. Modern performance, however, generates extra heat in the brakes, and modern car design makes it difficult to disperse the heat. The energy to be dissipated rises in proportion to the weight of the car and as the **square** of the speed. Thus the modern car, faster and often heavier than its pre-war equivalent, may need three times as much braking effort to stop it from maximum speed. Modern coachwork shields the drums from the direct air flow, and the use of the broadbased tires on wide drums forces the designers to put the brakes within the wheel, where they are shielded from the air flow. As the brakes get hot the drums expand away from the shoes and the pedal travel increases. The friction coefficient of the hot linings drops and finally the brakes fade.

The trend to smaller wheels prevents any increase in brake diameter, so designers have increased the drum width. There is a limit to what can be done, as a wide drum tends to become bell-shaped under heat and pressure. Radial fins help by producing a turbo-cooling effect. Lining manufacturers have played their part by producing anti-fade linings, but these require increased pedal pressure because of their lower friction coefficient. Another attempt to beat fade is the two-trailing shoe brake. It needs servo assistance, but it is much less liable to fade than brakes such as the two leading shoe type which depend heavily on a self-servo effect for their efficiency.

Today, many European manufacturers are looking to the disc brake to meet the needs of the future. The interest is the greatest on the other side of the Atlantic, because European conditions demand sustained braking capabilities higher than those current in the United States, especially on sportscars. Disc brakes have been proved in several years of competition. They are also used on nearly all American racing cars at Indianapolis.

The disc solves the most pressing current problems. It has a large rubbing area, both sides are exposed to direct air flow for heat dissipation. When hot, the disc expands towards the friction pads and not away from them, while water or dirt are quickly thrown off by centrifugal force. Finally, the disc has no self-servo effect, so it gives a stable and consistent action free from fade, whether hot or cold. It will go on working even when the disc is glowing red with heat.

Types of Disc Brakes

There are three main variations on the modern disc brake: Most popular is the fixed disc with fixed caliper and separate pistons on each side to press the pads against **the** disc. Another type uses a fixed disc and pivoted caliper, so that a fixed friction pad can be used on one side and a piston on the other without putting a side load on the disc.

The third type uses a fixed double caliper with two pistons and a sliding disc carried on splines. This type requires a large and heavy caliper, as two diametrically-opposed pistons are needed to avoid generating a side thrust which would jam the disc on the splines.

A fourth type has been tried experimentally on the General Motors Firebird II turbine car. A hollow-center disc is suspended from links on the wheel rim and is gripped by a caliper surrounding the wheel hub. It transfers the braking effort direct to the wheel, but there are numerous pivots on the links holding the disc which could develop wear. Two or more cylinders seem to be required to ensure symmetrical braking effort on the disc.

During racing, a variety of troubles have been met and overcome. One experimental metallic lining simply melted and fused itself to the disc, locking the wheels. Another problem was cracking or thermal distortion of the disc. Then heat passing from the friction pad into the piston caused the hydraulic fluid to boil and put the brakes out of action. This has been cured by providing an air space between pad and piston, and having a small ball-jointed plug to make the connection between the two. Much work has also gone into the design of calipers which are rigid without

excessive weight, as any flexibility in the caliper would nullify the advantage obtained from the rigidity of the disc.

Careful design has been necessary to avoid excessive heating of the wheel bearings. A disc with a recessed center like a top hat seems to have an advantage over the flat disc in this respect. Suspending the disc from the wheel rim as in the General Motors turbine car design would help to keep the bearings cool, but might transfer heat into the tire instead.

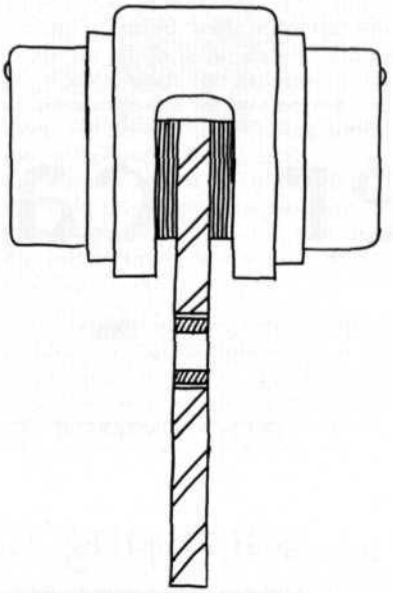
Some Important Advantages

A disc brake has about one third of the friction lining area of a drum brake, but it works at a higher pressure, and has a greater exposed area of metal to dissipate the heat. Pressure may be as much as 4,000 lbs. on each side of the disc. It is quite a problem to generate this kind of force without calling for excessive effort from the driver. One way would be to use large hydraulic cylinders on the brakes, but space, weight and cost all prevent this. Fortunately, the disc brake is very rigid, and has less "slack" or lost motion in the operating system than the drum brake. The calipers are very stiff, and automatic adjusters keep the pads close to the surface of the disc. The designer can therefore use a high pedal travel to produce a piston movement in the wheel cylinders. He cannot do the same on a drum brake, as he must keep some pedal travel in reserve to "follow up" the expanding drum and keep the shoes in contact during an emergency stop.

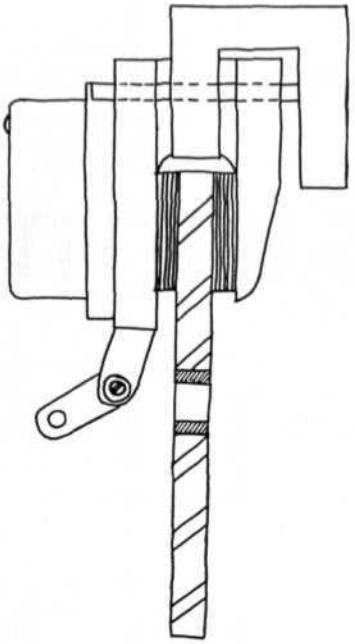
In most cases linings are visible, and the amount of wear can be measured at any time. Automatic pad adjusters provide constant clearance between pad and disc, and constant pedal travel. There is thus no need for any brake adjustment during the life of the linings, and these are said to last as long as those on ordinary drum brakes. When they are worn out, new pads can be fitted very quickly, without breaking any hydraulic connections.

All the current production models have solid discs, which are cheap, light and compact and meet requirements adequately. By drilling radial cooling passages in the disc the heat dissipation capacity can be increased by up to 50% which provides a useful reserve for fast cars. A more extreme example of induced airflow is the disc brake used on the Bugatti Grand Prix car. The disc here is really a bulky but carefully shaped centrifugal air impeller, with curved inter-

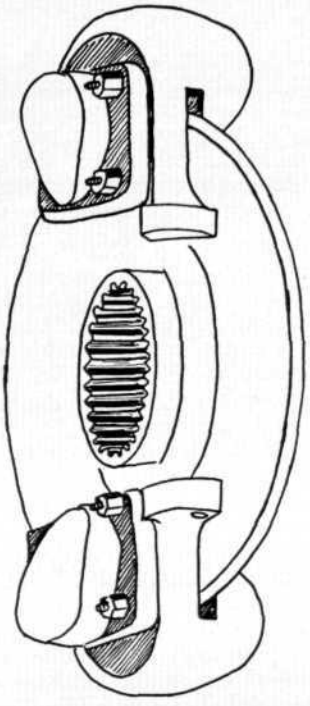
(Continued on Page 52)



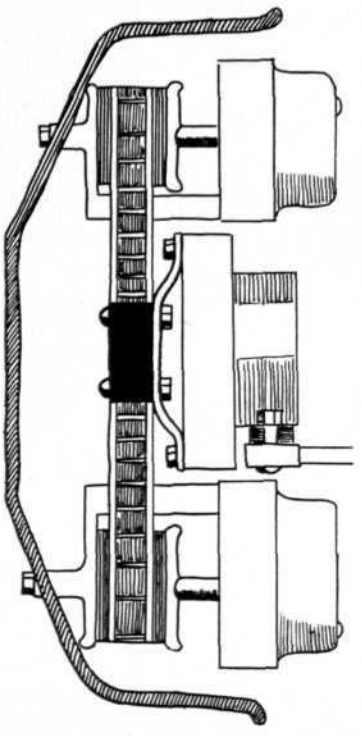
TYPE I



TYPE II



TYPE III



TYPE IV

summer camp

engineers relax and learn surveying fundamentals in upper peninsula

by Allen Nicholson, C.E. '60

This summer, as in the past, engineering students worked and relaxed at MSU's wilderness engineering camp in Michigan's upper peninsula. There in the solitude of the pines and running streams the students enlarged their engineering background, and had a very pleasant summer vacation.

Dunbar Forest Experiment Station is a branch of Michigan State University located approximately seventeen miles south of Sault Ste. Marie where the Charlotte River flows into the west branch of the St. Mary's River. It is administered by the Department of Forestry of the College of Agriculture. The forest is named in memory of the late Harris T. Dunbar who acquired part of the land now in the forest in 1902. In 1910 he donated most of the land to Chippewa County for an agricultural school. The brick school building and several of the service buildings were constructed at that time. The Dunbar Agricultural School was deeded to Michigan State University by Chippewa County in 1925. The original area of 577 acres has increased over the years to the present area of 5704 acres.

The surveying course was begun in 1953 under the direction of Professor Leo V. Nothstine. The eight week basic course was designed to utilize lectures, study periods, and field surveys in a balance which will efficiently train a student in the fundamentals of surveying. The students receive instruction and field practice in land surveys, cross-sections, U. S. land systems, topography, contours, earthwork, simple horizontal and vertical curves, hydrographic surveying, astronomical observations, and aerial photogrammetry. Lectures are given in the morning, and the afternoons are devoted to field work. Usually the field problems are the practical applications of the morning lectures. Highlights of the course are the planned trips to the Soo Locks and Kincheloe (Kinross) Air Force Base thru the cooperation of the Army Corp of Engineers.

The first few days the students receive orientation, meet the staff, are divided into parties of three men,

and are issued equipment. This summer the staff consisted of Professors Leo V. Nothstine and Alfred H. Leigh; Instructor, Bill Sack; and Field Assistants, Allen Davis and Allen Nicholson.

One of the frequent comments made by students is "How was a large brick school building constructed here?" When they are told that the extensive pit in front of the dining hall provided the material from which the bricks were made, they are even more astonished!

During the recent summer the weather was exceptionally fair enabling the students to spend a maximum amount of time in the field. As compared to past summer camps, there was very little rainfall; probably much to the chagrin of some of the students. Generally, however, precipitation has very little effect on fieldwork as there are several drawings that students must prepare along with the benefits they receive from a number of films that supplements the surveying course.

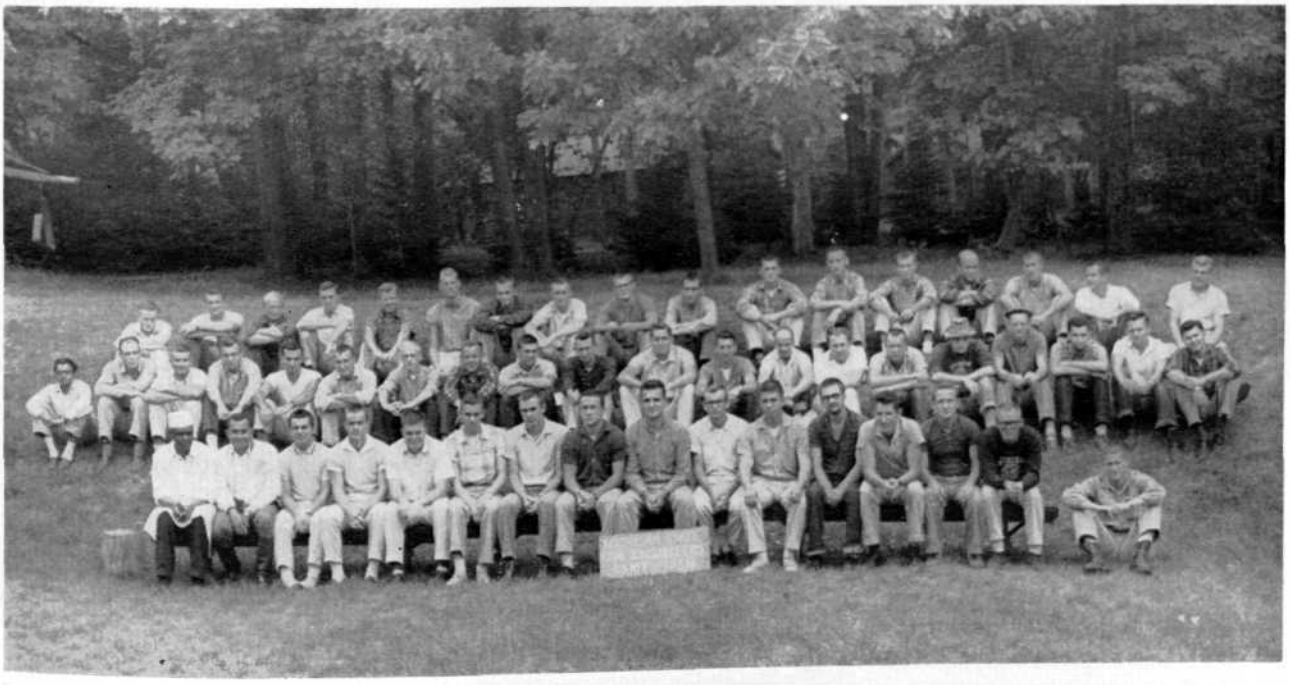
The students stay in cabins that are located L-shaped around the health center, dining hall, and bathhouse. Usually six men are assigned to each cabin. The cabins are furnished with bunkbeds, closets, writing tables, and bookshelves. The health center is staffed with a doctor who is always available in case of illness. As we approach the last few weeks of summer camp many students contract **a** disease, called "cabin fever," that is beyond the skill of the doctor. Words are useless in **attempting to** describe this dangerous malady! All that can be said here is that it is highly contagious and somewhat akin to "buck fever."

In charge of the preparation of meals in camp is John Russell acknowledged by all as the "most important man in camp." The culinary skill of this man is amazing and his versatility in the kitchen would be the envy of many wives and mothers. Then, too, I'm sure that anyone that has dined at Camp Dunbar would remember John's "cinnamon rolls."

There are many opportunities for recreation at Dunbar. Hiking, fishing, swimming, and canoeing are encouraged. There is also recreational equipment available for those that are interested in horseshoes, volleyball, **basketball, ping-pong, baseball,** and softball. Then again, many fellows take advantage ol the opportunity to take pictures ol the area. Some are **attracted** to **observing** ship **traffic** on the St. Mary's River. One ol the more distinguished ships that passed up the St. Mary's **River** this summer was Queen **Elizabeth's royal ship,** the Brittania.

At the mouth of the Charlotte River is a point of land known as Dunbar Park that is very popular during the summer months. This area is open to the public as well as to students at Dunbar. It has outdoor fireplaces, a picnic shelter, and bathing facilities. It also provides an excellent view of the ships passing up and down the St. Mary's River.

Despite all the hard work and play, the students leave camp with happy memories. The fellowship, new friendships, working and living together are but a small part of the intangible values a student receives along with the satisfaction of a job "well done."



The happy faces in the picture above are the Civil Engineering students that spent the first eight weeks of the summer at Camp Dunbar. From left to right in the back row we have: J. Gruner, R. Farino, G. Werner, C. Swenson, Dr. Reid, J. Gilbert, J. Lowden, R. Haan, J. Welton, A. McCallum, R. Brohl, C. Lehto, B. Griner, R. Schluter, G. Johnson, J. Nemec, Prof. A. H. Leigh. In the middle row: S. K. Poddar, Mr. Day, (Camp Manager) A. Davis, A. Nicholson, G. Cleere, D. Williams, R. Force, R. Hills, J. Gilg, J. McPherson, J. Shackelford, P. Miller, N. Overbeek, J. Bowles, J. Copley, R. Fosmoen, H. White, R. Chelemedos, N. Simkins, Mr. Wm. Sack, (Instructor) and in the front row: John Russell, (Cook) E. Samaniego, W. Wells, A. Egres, R. Kershner, D. Saltysiak, L. Ketchum, C. Patterson H. Posse, C. O'Hara, H. Hammond, J. Johnson, G. DeHenau, R. Shull, A. Bekmanis, B. King. Taking the picture is Prof. L. V. Nothstine.

"A WOMAN'S TOUCH"

the fairer sex invades engineering

by Beth Buschlen, M.E. '60

Femalea in engineering? You're **probably** not **as surprised** as **a** professor in (lie **late L880's** who started **dan** with **"Gentlemen—er—and** lady?" He was probably **the first** professor to **encounter a** girl studying engineering. **Today** over seventy years later, as the first day of classes arrived tin's or similar **openings** were **Indubitably echoed in a few** of our **college classrooms. If you're one** of **those** men of **engineering** slowly be-**Ing infiltrated** by **the** fairer sex, upon **hearing** tin's opening, **you** may not be surprised **but** are **probably** puzzled to know **why.** Yes, why would a girl **choose** engineering as a career? So this is **the question** I asked the girls **enrolled in this program** here at M.S.U.

The girls were quite eager to explain hoping this may relieve the barrage of "whys" they so frequently encounter. The reasons they gave were many and varied but invariably th?re were these three present: interest, desire and need. First, a deep seated interest in the sciences especially mathematics. Second, a desire to know the how of things, the principles involved, and then how to employ these principles in practice. Finally the most important, a personal need to be faced with **a** challenge.

The first two reasons are essentials for an engineer and are self explanatory but let's examine the challenges. First there is a difficult curriculum to be mastered. Girls face, as all engineers, a field of study which is one of the most exciting and challenging offered for our technological minded world of today. She also has to face the challenge presented by our archaic tradition which somehow has it that it is quite unfeminine for a girl to use any of her mechanical and mental aptitudes for science There is a constant challenge of retaining ones femininity and despite of it, being accepted into this trandi-tionally masculine field. We want to add that the girls find the atmosphere at [illegible] greatly alleviates this prob-

at M.S.U greatly alleviates this problem of acceptance. Thirdly, she as all scientific personnel face the even broader challenge of today's world. For our natioa to get behind in the scientific race could be disasterous. Yet in 1958 the United STates graduated only 133 women engineers while Russia graduates every year thousands more than we have graduated in our hisstory. This in itself should be challenge enough for any American especially the female half. Barb Jackson, an Ag. engineering sophomore, sums it up very well for all the girls with, "Engineering somehow seems to offer a challenge to me that no other field quite surpasses." [illegible]

Far greater in number, the intangible rewards are various enough to accommodate and satisfy many different people. Thus is indicated in at least one sense, the scope of engineering. It is a flexible profession in which one may choose a career specifically in engineering, from a research project down to working with household gadgets, or may diverge into a great variety of related jobs. Engineering, in a general sense, seems to be the "liberal arts" of the sciences. This is quite important especially to a girl because if employment becomes scarce she still has the technological knowledge from her engineering courses to do a large variety of things. Although it's a field whose personnel design assembly lines, it doesn't appeal to the stagnant assembly line type mind. This is at least in part due to the fact that it is still a relatively new field, one that is constantly changing, and bound to continue expanding in the decades ahead. Despite its constant growth engineering subject matter is still a logical, ordered system, on the whole being practical but not monotonous or trivial. All these attributes appeal to the girls.

Individual differences determine the reasons any one engineer would give for his choice of profession but we have attempted to summarize the reasons our girls gave for their choice. It all seems to boil down to the simple fact that they just plain like it better than any other field. Any engineer will tell you that they wouldn't last very long if they didn't really like it.

VERSATILITY PLUS!

. . . DR. OTTO ASSUMES HEAD OF M.S. DEPARTMENT

by Eleanor Warren, Math '60

"My, what big hands you have!" This might be your first impression of Dr. Louis L. Otto, who has been selected as the new head of the Mechanical Engineering Department at Michigan State. The large hands are only a small part of Dr. Otto's physique. You may readily observe that he is over six feet tall and weighs over two hundred pounds.

The large build was partially responsible for helping him become an expert oarsman while he was a student at Cornell University. After receiving his Bachelor's degree with high honors, Dr. Otto also completed work on a Master's degree in Automotive Engineering at Cornell.

His ability to handle boats has carried over from his college days to his present hobbies. An avid sailing fan, Dr. Otto may often be found on his boat with his favorite companions, his children. They are Carol, age 18; Elaine, age 15; and Robert who is almost 14. If you were to ask him where his favorite sailing place is, he would probably reply, "I like to explore new places and to start out on trips with no definite destination in mind." This is typical of the Otto sailing crew. They enjoy taking their time and investigating new and fascinating areas. The sailing enthusiasts are cheered on by Dr. Otto's wife, Dorothy.

The new department head also actively engages in the sport of bowling and is considered to be very good in that field. He bowls not only for Michigan State but is a member of the local Airlift Corporation Bowling Team. Golf, also, figures into his very busy schedule.

Dr. Otto is an ardent football fan and almost never misses a game. He takes special pride in his choice of seats and is usually seen sitting on the forty-nine and a half yard line or better.

The Lecture-Concert Series at the University often finds the Ottos in attendance. They, also, frequently attend the World Travel Series. Sometimes they pattern their own trips after those seen in the Travel Series.

Everyone who meets Dr. Otto likes him immediately. This is probably due to his pleasing personality which is complemented by his ability to talk in a smooth and graceful manner and by being able to add meaningful and informative statements to a conversation on almost any topic from recreation to the most highly scientific subjects.

Students are attracted immediately by this great display of personality. They respect him first for the position that he represents but second and equally important, they consider him to be a friend. Yes, Dr. Otto is a real friend to the students; he radiates confidence and most important of all he is able to reach the students. This he does by devoting endless hours of effort to the student and his academic endeavors and extra-curricular activities. As an example, you may recall the unlimited hours that he devoted to the supervision of the construction of the midget autos for the annual Engineering Exposition.

In a less direct way, Dr. Otto has devoted many hours to the welfare of his students. He has served as Chairman of the Scholarship Committee for the Engineering College. In this position, he was responsible for selecting, after careful investigation, the candidates for various scholarships.

Dr. Louis Otto is not a newcomer to Michigan State. He has been a member of the staff since 1949 when he served as a graduate assistant while doing doctorate work. Prior to this, he taught at Cornell University and worked as an engineer in industry. He received his Ph.D. in 1951 and since then has been a member of the staff at Michigan State University.

In addition to serving as a Full Professor, he has been Acting Head of the Engineering Drawing Section (1954-5) and Acting Head of the Mechanical Engineering Department (1955).

Those of you who remember the excellent rehabilitation program in the Automotive Laboratory in 1956 have Dr. Otto to thank. He was chiefly responsible for the planning and construction of special laboratory demonstrations for the Automotive Engineering classes. To speak in more scientific terms, among others he was responsible for providing a demonstration of Crankshaft-Torsional-Vibration in an Operating Machine by means of a Dual-Beam Oscilloscope.

As a member of eight or more Professional Societies, he receives excellent opportunities to learn of the new developments in his field. Included in these societies are: Tau Beta Pi, Pi Tau Sigma, Society of Automotive Engineers, American Society for En-

(Continued on Page 60)

Unique Organization Provides . . .

UNLIMITED FUTURE...

For Progressive Engineers

by Herb Harman, E.E. '60

A massive structure, brilliantly illuminated against the evening light, stands as a symbol of a community striving to create a better place in which to live. This structure with its foundations embedded forty feet into the earth, houses turbines as large as modern ranch style homes, and boiler systems which climb six stories creating steam to generate power and heat. This tremendous power plant is familiar to many in the Lansing area for it is owned by the city and operated by the Board of Water and Light. This is the Ottawa Street Power Plant, a segment of the municipally owned public utility.

A municipal public utility is a **unique** organization with its principal objective, not being profit for its stockholders, but efficiency and service for its customers. A continuous effort is made by its engineers to insure that service, whether it be light, heat, power, or water, always be kept at maximum output, at minimum cost.

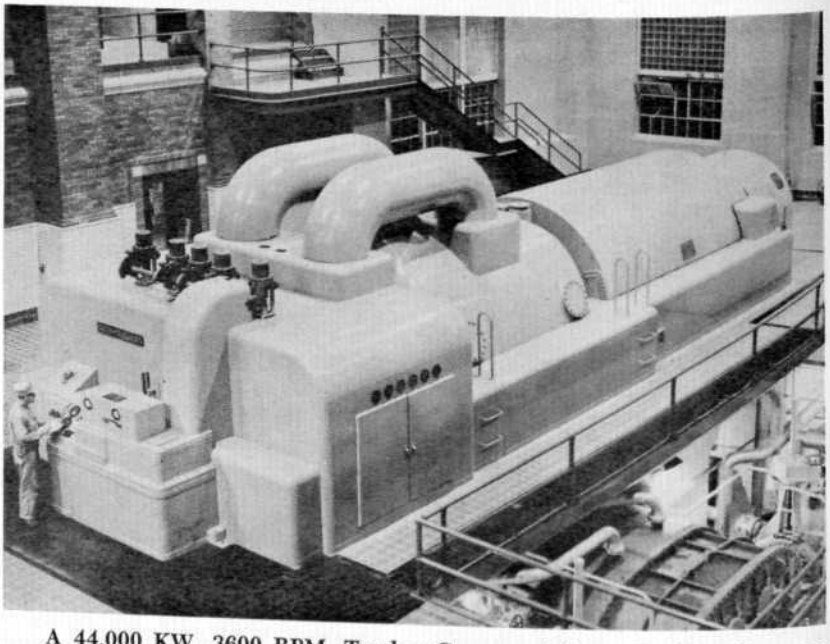
This is truly a challenge in today's engineering world where many technical advances are being made at the expense of the taxpayer. A public utility, whether privately owned or municipally owned, must combine all of the modern achievements in its particular fields, and transmit these to its many demanding customers.

Necessary For Existence?

Taken for granted, the utility is just another added expense to the common public. The conveniences supplied are of unlimited value and a necessity. Where would you be if you had to generate your own electricity? How would everyone provide their own continuous supply of purified water?

The Board of Water and Light has provided many services for approximately 75 years. Originally it was founded as a private corporation in 1883. In 1885 the city constructed its first well, and in 1892 took over possession of the electric light plant. Each succeeding year the facilities expanded as did the populated areas of the city. The year 1906 found another private utility competing for electric power and steam heating business in the Lansing area. Competition in these fields by the private firm, the Michigan Power Company, proved to be futile. Its service undependable, its maintenance poor, and its rates high, the company met disaster, and sold to the City of Lansing in 1919. At this time the engineers were in the middle of an intensive program to expand its facilities to provide more comprehensive and more adequate services. Foresight became a tradition, as careful plan-

(Continued on Page 70)



A 44,000 KW, 3600 RPM, Tandem-Compound Steam Turbine Generator Unit.

are you neglecting an important phase of your educational development?

by LaVerne Root, Applied Mechanics (M.S.) '60

What do you know about the Engineering Council? Are you aware of the services and activities sponsored by the Engineering Council, available to you as an engineering student? Will you receive the maximum return on your investment in your college education?

Many engineering graduates have found that participation in extra-curricular activities has paid off in dollars and cents in the form of higher starting salaries. In fact many companies place the ability to get along with people (indicated by participation in extra-curricular activities) second only to good grades. Most extra-curricular activities may be enjoyed free or at a small cost to the student. One of the most important activities for engineering students is the Engineering Council. This group is made up of students and operates in much the same manner as the All University Student Government. The Engineering Council consists of representatives of the various students organizations in egineering. According to its constitution, it is to coordinate the activities of the student organizations and promote the best interests of the engineering student and the College of Engineering. In the past, the council has only partially fulfilled its purpose. A talk with Ed Daniels, President of the Engineerrag Council indicates this will be changed this year.

Editor: Why hasn't the council achieved its purpose in the past?

Daniels: In any governing or advisory group, such as the Engineering Council, the efforts and achievements of the group are only as good as those of the individual members. Although we have a number of hard working People on the council, the organizations represented in many cases might as well exist on paper only.

Editor: Could you clarify what you mean?

Daniels: Most of the engineering organization at M.S.U. have a very real and important function they should be performing for their members. Instead we find many of these organizations holding one meeting a term with only a token attendance. Of course everyone blames the old campus bugaboo "student apathy." Perhaps if the students have no interest in these organizations, they should be abolished along with the Engineering Council. If this were to happen, the student would awaken to the fact that membership and participation in the various student activities is an important part of a college education. In the long run it is up to the officers and indirectly the student to correct this situation.

Editor: What do you suggest?

Daniels: I think that the officers have a responsibility and duty, and should consider their position as something more than a mere honor. Considering the officers duties in relation to the council, I feel that the officers should see that their representatives to the council are informed on the interests of the organization. Although in all cases, the interests of the university and the engineering college are of primary importance, the representative should also know where his organization stands so that he will not be forced to guess at how the members of his organization feel. The officers also should encourage the representative to keep the members informed on the activities of the council. This would allow the organization to cooperate better with the council and it would reduce much of the friction present in previous years.

Editor: Why should the individual student be interested in the council, since in most cases he will not be a representative?

Daniels: If the student has an understanding of the aims and purposes of the council, he will be prepared to judge how well his organization is cooperating with the council and whether his organization and indirectly the individual member is receiving the maximum benefit from the activities of the council. He will also be able to see ways in which his organization may help the council to support the endeavor to make the M.S.U. College of Engineering a better place to obtain an education.

Editor: What about the student, who has an interest in the council, but is not a representative? Is there anything he can do?

Daniels: Every Engineering Council meeting is open to all members of the College of Engineering as well as anyone interested in the activities of the engineering students. I will personally guarantee that anyone visiting a council meeting, having an idea or gripe to express, will have an opportunity to be heard. The council normally meets every other Wednesday during fall and winter terms and every Wednesday during spring term. Meetings are held in the reading room in Olds Hall. Announcements of meetings will be placed in the State News and will be posted in Olds Hall.

Editor: What about the student who has some spare time and would like to work on some of the Engineering Council activities?

Daniels: Perhaps I should indicate some of the activities of the council before I answer your question. The largest activity is the annual engineering exposition held spring term.

(Continued on Page 60)

engineering's oldest profession

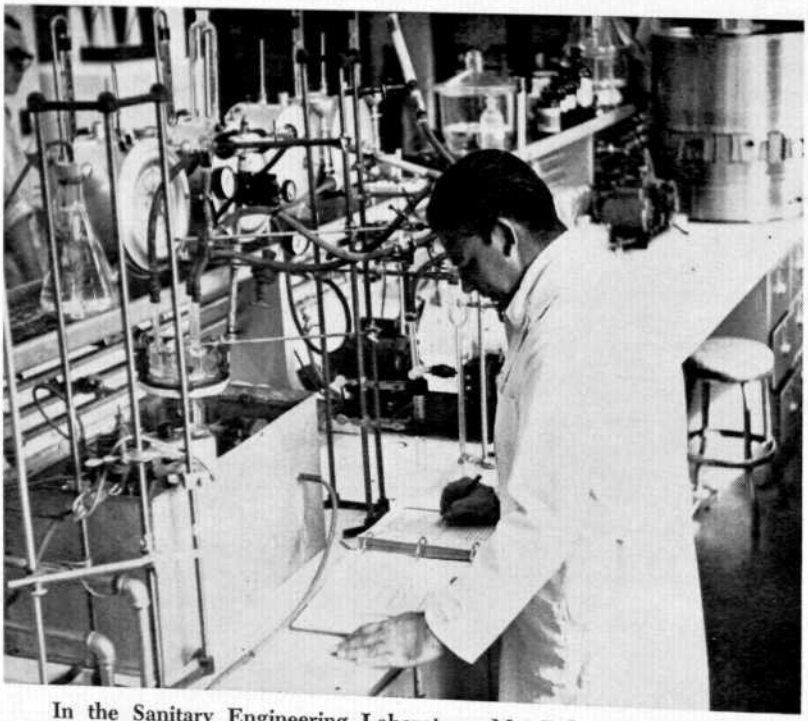
"BUILDING A BETTER TOMORROW"

by Dr. C. Cutts, Head of Civil Engineering Department

(photos by Ron Murray)

Each year Civil Engineers are called upon to analyze, design and construct a **number** of **unusual** structures. These may be nuclear reactors like the one under construction at Monroe, Michigan, or missile launching structures at Cape Canaveral, Florida. The 160 ft. diameter radio astronomy telescope at Green Banks, West Virginia and the underground **reinforced** concrete NIKE launching bases surrounding many of our large cities are other examples. These demands upon the Civil Engineer are not unusual, since he is called upon each year to meet the demands of our growing civilization and its national security.

In some of these activities he teams up with architects, contractors, mathematicians, scientists, business leaders, and other engineers. What are the shielding capabilities of the concrete walls of a nuclear reactor made with metal aggregate? What thickness of wall is required to reduce radiation to a given level? What is the effect of high temperature on missile and aircraft structures as well as the after burners of jet planes on airport runways? What are the stresses due to wind pressure in the Navy's new radio astronomy paraboloid dish, which is expected to be 600 ft. in diameter? These are some of the technical questions posed as Civil Engineers face the frontiers of expanding knowledge in science and engineering.



In the Sanitary Engineering Laboratory, Mr. Robert S. Lipe, Graduate Assistant, takes data on his continuous flow apparatus for determining the relationship between substrate concentration, growth and respiration rates in microorganisms.

While many new technical problems confront the Civil Engineer, there are also the challenges of working in many parts of the country and in foreign lands. The Civil Engineer may find himself locating oil pipelines in Saudia Arabia or constructing radar warning towers in the permafrost country of the North. He may be designing a water supply or sewage disposal plant for a community in South America or it may be a highway system in his own state or local community.

The young engineer has the choice of many geographical locations. Whether his choice be the small town in the Midwest, the industrial areas of the East or the assignment abroad, he will find many opportunities for travel and meeting new faces. He will also find that many engineering projects call for inside or outside work as well as the combination of both.

There are many facets to Civil Engineering. These are designated as Highway Engineering, Sanitary Engineering, Hydraulic Engineering, Construction Engineering, Structural En-

gineering, Traffic Engineering, Soils Engineering and Surveying. First and above all the Civil Engineer is a builder. He builds bridges, highways, airports, buildings, dams, tunnels, harbors, water supply systems and sewage disposal systems and facilities. In all of these enterprises the Civil Engineer follows a step by step procedure from initial analysis stage to the final design. By applying mathematics and the physical science relationships he develops an optimum design at minimum cost. Economy must be continually dealt with from the analysis and design of minimum weight aircraft to the utilization of land for an expanding highway system. One of the things that distinguishes the engineer from his fellow men is his ability to come up with a workable solution in a short period of time. In addition to being interested in long term fundamental research, he must be able to solve the everyday conventional engineering problem which characterizes the professional practitioner. The next time you visit the Upper Peninsula via the Mackinac Straits Suspension Bridge or ride into Detroit on the James Couzens or Ford Freeway or look at the sky-scrapers on the Detroit skyline—think of the Civil Engineer-designer and builder of monumental structures.

The Common Pattern

All fields of engineering have a common functional pattern and whether he be a Civil or Mechanical, Electrical or Chemical, the engineer will find his duties and assignments are characterized in one of these categories:

1. Administration
2. Planning and Design
3. Research and Development
4. Production and Operation
5. Construction and Installation
6. Consulting
7. Sales
8. Teaching

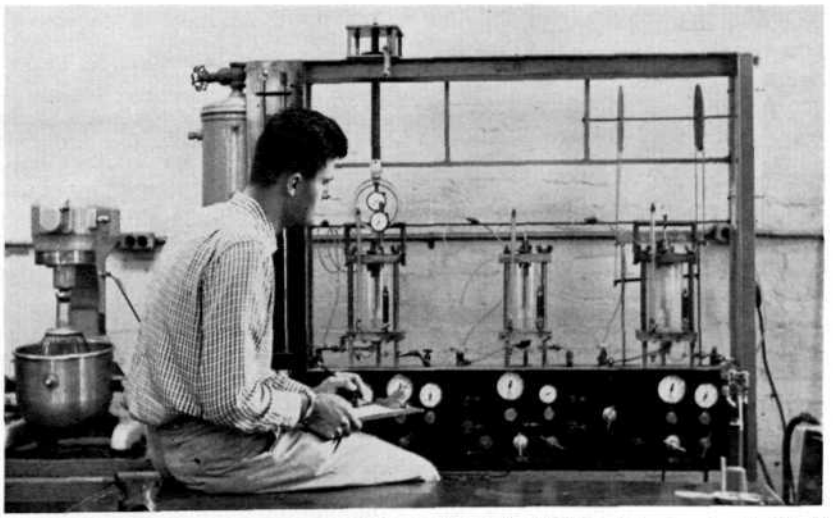
Thirty-four percent of all engineers are engaged in administration and twenty percent do planning and design work. Eighteen percent of all engineers are engaged in research and development activities.

M. S. U. Curriculum

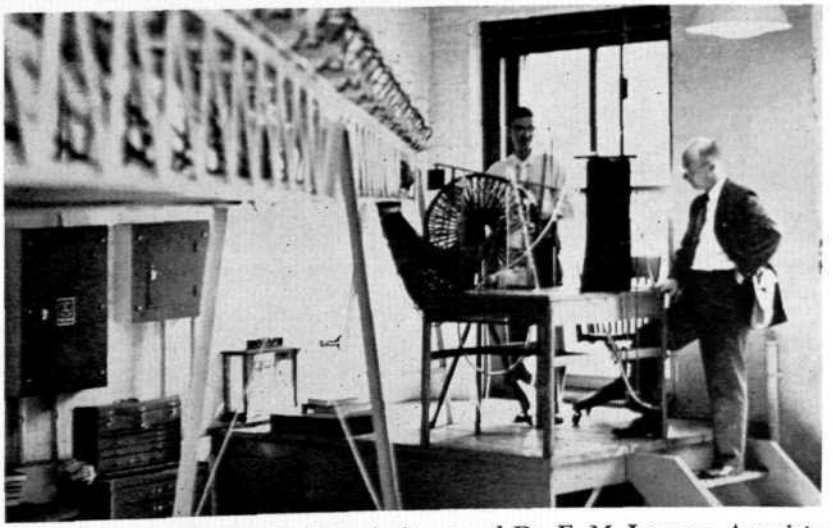
The curriculum in Civil Engineering at Michigan State University has several distinguishing characteristics. First of all, it gives emphasis to chemistry, physics, mathematics and mechanics and second it provides a strong fundamental base for the many specialized fields. Having completed the sequences in mathematics and Physical sciences in the Sophomore year, the Civil Engineering student moves into several sequences of engineering course work. Starting with engineering materials he follows with analysis work in **determinate** and statically indeterminate structures and then studies design in structural stool, reinforced concrete and other materials. With geology and soil mechanics, he combines his structural background to learn how loads are transmitted to soil through footings-foundation analysis and design. Another sequence is the transportation series. With **a** knowledge of traffic demands, land values, and route layout, he studies the design of rigid and flexible pavement and highway geometry. Thus, the structural engineer and the highway engineer both develop their specialized (iolds from the same fundamental base of soil mechanics and materials.

Another important facet of Civil Engineering deals with fluids. This is the sequence of courses in hydraulics, hydrology, water supply, sewerage and sewage treatment and is the realm of interest of the Hydraulic and Sanitary Engineer. Added to these areas of study are contracts and construction, plus the field of nuclear energy. The curriculum provides nine hours of elective course work in the senior year permitting

(Continued on Page 52)



In the Soils Laboratory, Mr. William A. Sack, Assistant Instructor in Civil Engineering conducts a triaxial loading measurement on a clay soil sample.



Mr. John R. Adams, Graduate Assistant and Dr. E. M. Laursen, Associate Professor of Civil Engineering are making pressure measurements of air flow over dune shaped roughness elements.

MEET YOUR SPARTAN ENGINEER STAFF....

(*photos by Norm Hines and Tom Armstrong*)

As the first issue of the 1959-1960 Spartan **Engineer** arrives, you discover that the stall is composed of many new members.

Not only is the staff new, but it is larger. This is for a reason. Your engineering magazine, like the entire field of engineering, is dynamic. This means it is constantly expanding and progressing.

Last year the Spartan Engineer averaged 52 pages. This issue contains 72. Last year we had 9 members on the staff; this year we have 21.

The increase is not entirely due to the larger magazine, however. More people are becoming interested in scientific writing, or technical writing as it is sometimes called. Rightly so—what is more important to a man's career than the tools of his trade?

And for the engineer one tool is language. An engineer has three important parts to his written language. One is mathematics, the next is mechanical drawing, and the third is the often neglected ability to write clearly and concisely.

Enough of why they are here, let's meet the staff members.

EDITOR-LaVerne Root became editor of the Spartan Engineer by appointment of The Board of Publications last spring term. He edited the spring issue in 1959, and worked last summer on this issue.

The first staff meeting of the 1959-60 Spartan Engineer Staff.

He holds a BS in mechanical engineering, and now is working toward a MS in applied mechanics. Vern

is in charge of the entire magazine, and everyone is responsible to him.

He is a member of ASME, Pi Tau Sigma, Knights of St. Patrick, and says his main interest is reading scientific books and magazines, and listening to classical music.

MANAGING EDITOR-An electrical engineering senior, Herb Harman is responsible for magazine layout, Pictures, and headlines. He designed the cover for this issue.

Herb has been in many campus activities including: Election's Commissioner and Administrative Vice President of the executive branch of student government, editor of Helot Publication, and director of research on AUSG history project, concerning student governing body relations.

He is also a charter member and first President of the Omicron Chapter of Sigma Phi Delta, a professional engineering fraternity.

Herb is interested in the writing aspect of engineering, and plans his career in technical writing, technical recruiting, and management.

ASSISTANT EDITOR-Joe Poyer has the job of coordinating and advising staff members who want to write for the various JETS publications. JETS is a high school organization founded in 1950 by the MSU Engineering College. Since then it has spread to include 40 states and Puerto Rico.

Joe is the Spartan Engineer correspondent for the JETS. He is former editor-in-chief of the Battle Creek Junior College paper, Triad, and is a junior in journalism, major in science writing.

He was President of the Student Affairs Committee at Battle Creek Junior College, and is now a pledge of Alpha Gamma Rho.

ASSOCIATE EDITOR-Newton Black has the job of assigning and editing articles.

Newt completed his military service last year, and returned to MSU to continue his major of technical writing. A senior, he was formerly police reporter for the Michigan State News, and presently reports on engineering and science for the paper.

His interests center on science, writing, and sports. A former MSU baseball player, he is now table tennis champion of the university. In high school football he set a national

(Continued on Page 38)

engineers

and what they do at Pratt & Whitney Aircraft...

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

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

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

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

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

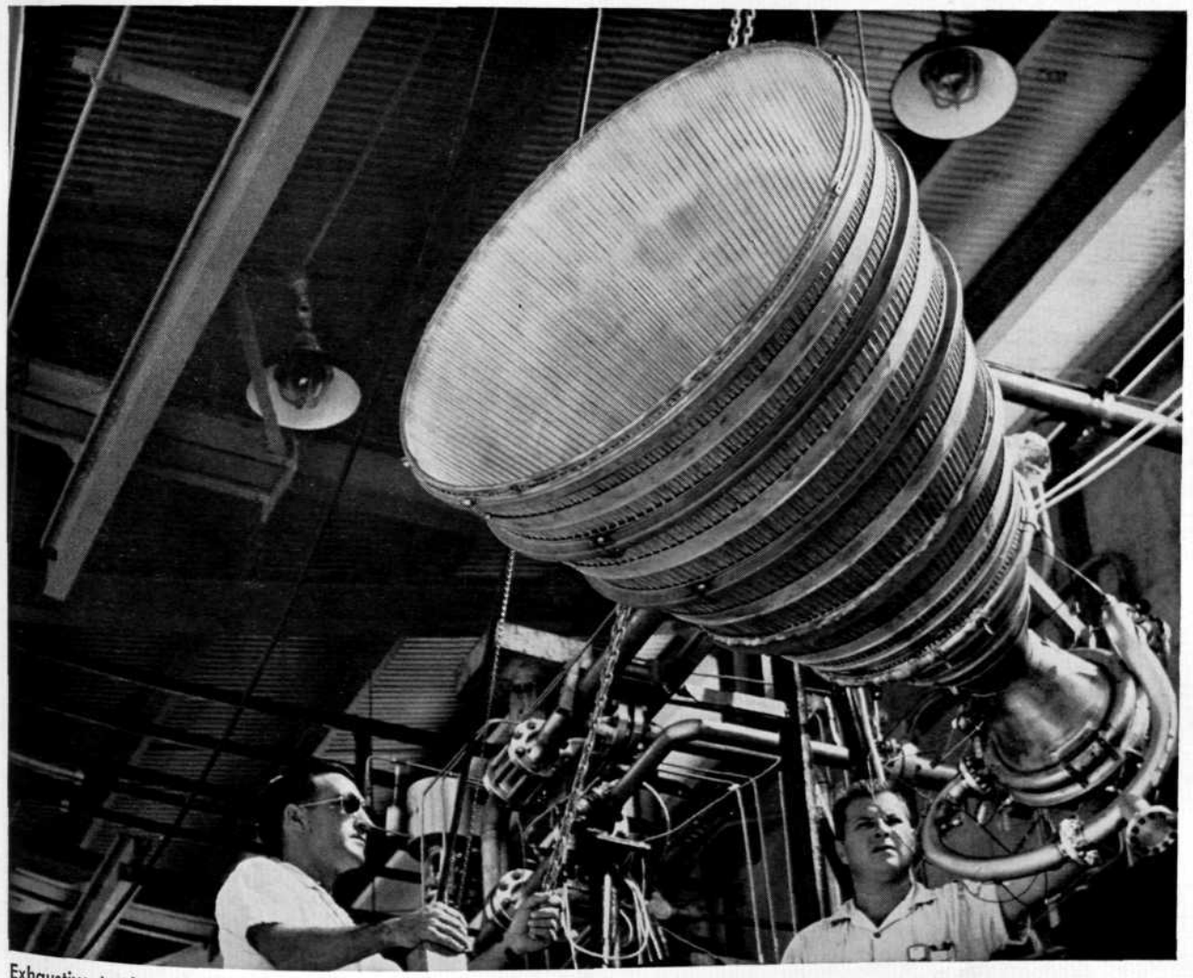
Included in a wide range of engineering activities open to technically trained graduates at all levels are these four basic fields:

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

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

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

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



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

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

PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

CONNECTICUT OPERATIONS — East Hartford

FLORIDA RESEARCH AND DEVELOPMENT CENTER — Palm Beach County, Florida

STAFF

(Continued from Page 35)

record for the longest field goal—45 **yards.**

ASSISTANT EDITOR-A Lansing **boy,** Keith **Harris,** is **a** junior in me**chanica] engineering.** His duties are to gather **information,** and rewrite articles. This is his second year as assistant editor.

Keith is **a** busy man. He is married and works twenty hours a week as a bookkeeper for a Lansing company.

Two years ago, while going to school, he worked as a mechanic for a Chevrolet dealer, and last year he managed a gas station. When he finds free time he turns to his hobbies of golf and photography.

BUSINESS MANAGER-This position is in responsible hands—at least in the opinion of the editor. For she is his fiancee.

Hester Ray, a sophmore in elementary education, handles national

advertising and payroll. Her hobbies are sports and listening to classical music. She also was appointed to this position by The Board of Publications last spring.

ASSISTANT BUSINESS MANAGER—Eleanor Warren, the second girl on the staff, is a senior majoring in math. She is from Ovid, Michigan, and helps the staff by typing, filing, and mailing magazines to subscription holders.

She is Vice President of MSU Young Republicans, on the steering committee for Kappa Phi Methodist Woman's Organization, and on the executive council for Block-S.

Eleanor is interested in music and cooking, and she plays the saxophone for a dance band. After getting her masters degree in math, she would like to become an industrial mathematician.

PROMOTION MANAGER-This Lansing student, **a** junior in electrical engineering, is in charge of publicity. Don Anderson makes posters, places notices, and will head the Engineering Exposition Committee.

He has Sigma Phi Delta fraternity behind him in these projects. Don is from **Bridgman,** Michigan, and spends his free time working on electronics and tinkering on his car.

Working with the office holders are 13 other staff members. They write articles and do various other jobs connected with publishing a magazine. Their names are:

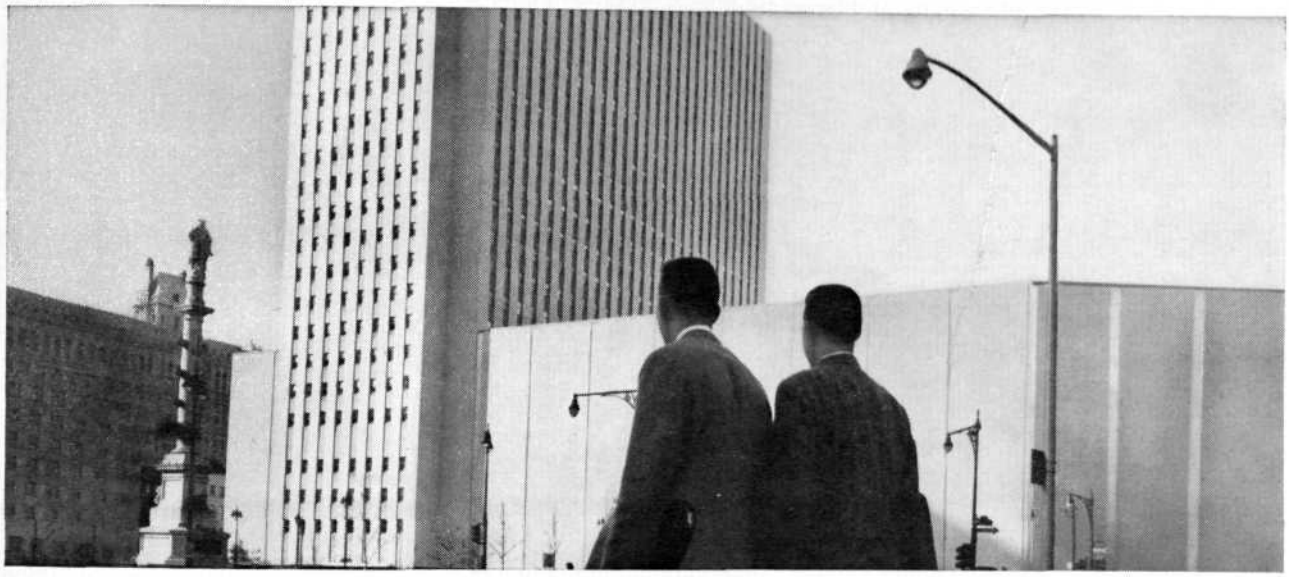
Dean White
Richard Scovel
George Foley
Chandravadan Amin
Shrikumar Poddar
Reg Pilarski
Raul Lepage
Norm Fishel
John Bolt
Erwin Anderson
Conrad Ryden
John Thornton
Fred Bigio

These are your staff members. Most of them are studying engineering, but some are from the other schools at MSU. They are all here for one reason—to become familiar with writing and publishing a magazine.

Few of them have had previous experience on a magazine, but they all agree that when they graduate this experience will be a valuable part of their education.

Won't you join them and add to your education?

New "post-grad" program helps engineers move ahead at Western Electric



MANHATTAN'S COLISEUM TOWER building houses Western Electric's New York training center. Here, as in Chicago and Winston-Salem, N.C., Western Electric engineers participate in a training program that closely resembles a university graduate school.

Careers get off to a fast start—and keep on growing—at Western Electric.

One big help is our new Graduate Engineering Training Program. This unique full-time, off-the-job study program starts soon after you join Western Electric... continues throughout your career. Students are offered courses in various fields including semiconductors, computers, feedback control systems, and problem solving techniques. What's more, they study methods for improving skills in communicating technical information and the art of getting ideas across.

You'll find the work at Western Electric stimulating, too. As manufacturing and supply unit of the Bell System, we pioneered in the production of the transistor, repeatered submarine cable, and the provision of microwave telephone and television facilities spanning the country. Engineering skills can't help developing—careers can't help prospering — in the lively, exciting technical climate at Western Electric.

Western Electric technical fields include mechanical, electrical, chemical, civil and industrial engineering, plus the physical sciences. For more information pick up a copy of "Consider a Career at Western Electric" from your Placement Officer. Or write College Relations, Room 2000, Western Electric Company, 195 Broadway, New York 7, N. Y. And sign up for a Western Electric interview when the Bell System Interviewing Team visits your campus.

Western Electric

MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

CLASSROOM SESSION at one of the centers takes up the first part of the three-phase program, Introduction to Western Electric Engineering. During this initial nine-week training period, new engineers are provided with a better understanding of Western Electric engineering methods and technical practices.

TECHNICAL TALK often continues after class. The free and easy informality of the new Western Electric training program offers plenty of opportunity for the stimulating exchange of ideas.

Western Electric Graduate Engineering Training Centers located at Chicago, Winston-Salem, N. C., and New York. Principal manufacturing locations at Chicago, Ill.; Kearny, N. J.; Baltimore, Md.; Indianapolis, Ind.; Allentown and Laureldale, Pa.; Burlington, Greensboro and Winston-Salem, N. C.; Buffalo, N. Y.; North Andover, Mass.; Lincoln and Omaha, Neb.; Kansas City, Mo.; Columbus, Ohio; Oklahoma City, Okla.; Teletype Corporation, Chicago, Ill. and Little Rock, Ark. Also Western Electric Distribution Centers in 32 cities and installation headquarters in 16 cities. General headquarters: 195 Broadway, New York 7, New York

ENGINEERS • SCIENTISTS

THE MITRE CORPORATION

Invites Candidates for Baccalaureate and Graduate Degrees to Investigate the Career Opportunities Available in Large-Scale System Engineering

Accelerating programs in the growing technological field of large-scale system engineering at **MITRE** afford young engineers and scientists unique career opportunity because:

• MITRE, a systems engineering and development organization, formed under the sponsorship of the Massachusetts Institute of Technology, has the unusual assignment of providing engineering solutions to the varied and complex problems inherent in large-scale air defense systems.

• The complexities involved in the design and development of the world's largest real-time control systems provide an opportunity to apply professional skills across a broad scientific spectrum. Included within this long-range work program is the design, development, evaluation and integration of the diverse components, equipments and subsystems from which total systems are evolved. This is a continuing assignment because the MITRE system approach takes cognizance of the immediate and long-term threat, the total defense technology—both present and projected—and the complex logistics of air defense that insures the best possible defense system, at minimum cost, for any given time period.

• Working directly with the men who designed and developed the SAGE System, professional growth is stimulated in a multi-disciplined environment where there is freedom of choice to apply individual skills in areas which best fit professional talents. Assignments range from system design through prototype development to advanced operations research.

• Openings are available at MITRE's modern locations in suburban Boston, Massachusetts — Fort Walton Beach, Florida — and Montgomery, Alabama.

We invite you to discuss with us how your academic training can be effectively utilized in the following areas:

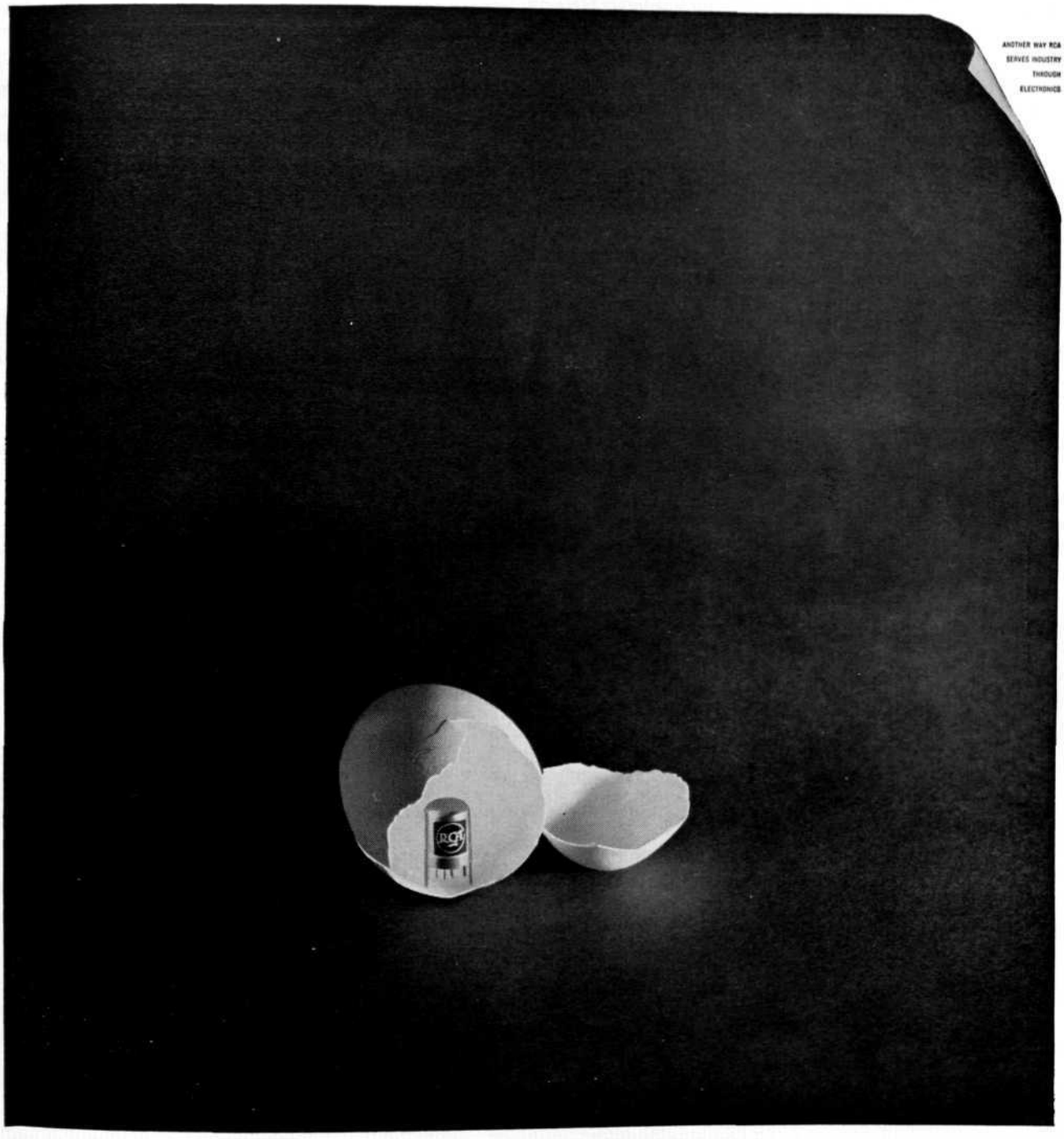
- COMMUNICATIONS SYSTEMS
- RADAR SYSTEM DEVELOPMENT
- REAL-TIME COMPUTER CONTROL SYSTEMS
- ENVIRONMENTAL TESTING AND EVALUATION
- SYSTEM RESEARCH AND DESIGN
- COMPONENT DEVELOPMENT
- ELECTRONIC RECONNAISSANCE AND COUNTERMEASURE SYSTEMS
- BASIC ELECTRONIC RESEARCH

Please contact your Placement Director to arrange interview on campus

THE MITRE CORPORATION

244 Wood Street — Lexington 73, Massachusetts

A brochure more fully describing MITRE and its activities is available on request.



RCA Electronics introduces the tube of tomorrow

Called the Nuvistor, this thimble-size electron tube is likely to start a revolution in electronics. RCA engineers scrapped old ideas—took a fresh look at tube design. The result will be tubes that are far smaller, perform more efficiently, use less power, can take more punishment, are more reliable. Developmental models now being tried out by designers will have a profound effect on the size, appearance, and performance of electronic equipment for entertainment, communications, defense, and industry in the future. It is another example of the way RCA is constantly advancing in electronics.

RCA RADIO CORPORATION OF AMERICA

Hughes Fellowship Programs

HUGHES MASTERS FELLOWSHIPS. The Hughes Masters Fellowship Program offers unusual opportunities for academic training leading to a master's degree ... and, in addition, provides each fellow with practical experience in the professional field of his choice.

Approximately one hundred new awards will be made by Hughes in 1960 to qualified applicants who possess a bachelor's degree in science or engineering. Additional awards are open to qualified applicants interested in business administration and education.

Hughes conducts extensive research and development in the scientific and engineering fields. While working for Hughes, fellows may be assigned to such areas of Research & Development as: microwave devices, parametric amplifiers, masers, infrared search and track systems, microminiaturization, antenna arrays, simulation methods, propagation, data handling, human factor analysis——and to **a** variety of engineering areas such as guided missiles, weapons control systems and systems analysis.

A selected group of award winners will be offered a **FULL STUDY PROGRAM.** Participants in this program will receive fellowships that permit them to attend an outstanding university on **a** full time basis during the regular academic year with a substantial stipend.

Other award winners will be assigned to the **WORK STUDY** PROGRAM and will attend a university sufficiently near a facility of the Hughes Aircraft Company to permit them to obtain practical experience in **a** professional field of their choice, by working at the company part time each week. An appropriate stipend will also be awarded.

After completion of the Master's Program, fellows are eligible to apply for HUGHES STAFF DOCTORAL FELLOWSHIPS.

The classified nature of work at Hughes makes eligibility for security clearance a requirement.

Closing date for applications: January 15, 1960.

How to apply: Write Dr. C. N. Warfield, Scientific Education, Hughes Aircraft Company, Culver City, California.

HOWARD HUGHES DOCTORAL FELLOWSHIPS. If you are interested in studies leading to a doctor's degree in physics or engineering, you are invited to apply for one of approximately 10 new awards in the 1960 Howard Hughes Doctoral Fellowship Program.

This unique program offers the doctoral candidate the optimum combination of high-level study at an outstanding institution plus practical industrial experience in the Hughes laboratories.

Each Howard Hughes Doctoral Fellowship provides approximately $8,000 annually. Of this amount $1,800 is for tuition, books, fees, thesis and research expenses. The remainder is the award of a cash stipend and salary earned by the fellow.

Hughes conducts extensive research and development in the scientific and engineering fields. Typical programs include: network analysis and synthesis, semiconductor materials, plasma electronics, communications, computing...and solid state physics, atomic and nuclear physics, tests of the general theory of relativity, chemistry, physical chemistry and metallurgy, information theory, mechanics of structures, electro-mechanical propulsion systems, and systems analysis.

Howard Hughes Doctoral Fellowships are open to outstanding students qualified for admission to graduate standing. A master's degree, or equivalent graduate work, is considered very desirable before beginning the Fellowship Program.

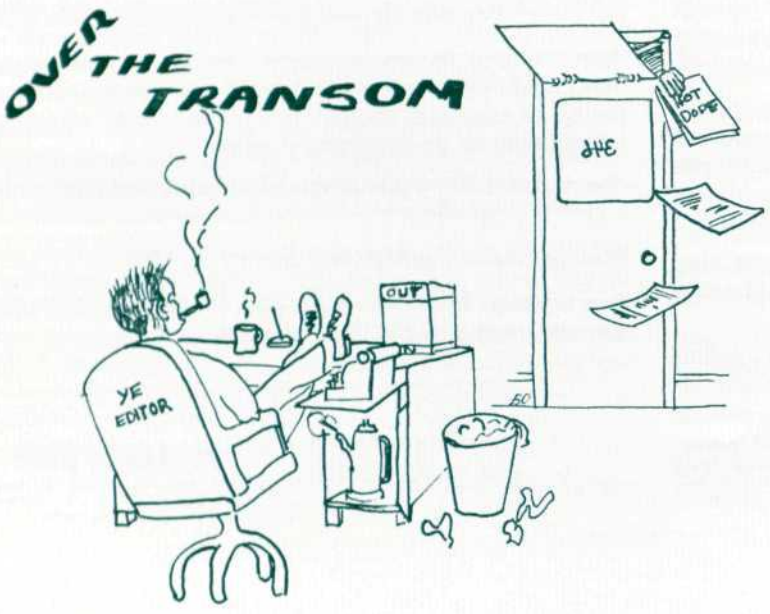
The classified nature of work at Hughes makes eligibility for security clearance a requirement.

Closing date for applications: January 15, 1960.

How to apply: Write Dr. C. N. Warfield, Scientific Education, Hughes Aircraft Company, Culver City, California.

Creating a new world with ELECTRONICS

HUGHES



Scientists and engineers in American industry are anything but happy with their lot, Opinion Research **Corporation** reported today.

At the root of the problem, an ORC study disclosed, is a fundamental, and unresolved, conflict between the scientific mind and the management mind.

The study involved interviews with 622 scientists and engineers and 105 managers in six major companies deeply engaged in scientific research. The companies are in the aircraft, chemical, drug, electrical and electronic **equipment,** petroleum, and rubber industries.

Of the scientists and engineers interviewed, 72 per cent complained that management misuses their talents, 71 per cent maintained that their companies force them to overspecialize, and 67 per cent contended that getting ahead in management is more a matter of politics than knowledge.

One of the most sought-after professional groups in industry, 80 per cent of the scientists and engineers complained they were underpaid, when compared with others with similar training and responsibilities.

The study revealed a conflict between management's need to sell its products and make a profit and a basic quest for knowledge by the technical men. While 74 per cent of scientists and engineers interviewed listed sales and profits as primary goals of their companies, fewer than half said they shared these goals.

In addition, 75 per cent complained that corporate pressures did not permit them the freedom "to work in their own way." They cited as obstacles demands for immediate results, schedules, budgetary considerations and pressure to conform to established methods of problem-solving. One of the managers declared that "the place for such freedom is in academic institutions, not competitive industry."

The study singled out several factors that appear to breed conflict between a company's management and its scientific personnel.

It was found that scientists and engineers have a desire for status and freedom which is difficult to meet in a corporation and is more appropriate to private, professional practice or university life.

It also was shown that technical men often fail to understand techniques and approaches used by management, such as managerial decision-making and the nature of risk taking.

In addition, the study disclosed a lack of mutual respect on the part of management and technical groups, with each group tending to evaluate the other's accomplishments and rewards by its own standards.

ORC's research suggested several constructive steps to deal with the management-scientist relationship. These include a need for managers to place greater emphasis on interpreting their everyday decisions to the technical man and a need for more realism during college training and recruiting so that the future scientist or engineer may know what to expect of corporate life.

Congratulations to the following spring and fall term four-pointers in engineering:

SENIORS

Charles Anderson
Robert Harger
James Eagan
Ernest Kollar
James Resh
Hal Smith
Gordon Bandermolen
Brice Boesch
Carl Ferrar
Donald Byde
Milton Lutchansky
Thomas Sanford
Aldred Stevens
Paul Woodruff

JUNIORS

Robert Dunn
Edward Scharmer
Willard Matheison

BASIC COLLEGE

James Anderson
John Frsyth
Larry Kirkby
Gary Ballman
Richard Freeman
Larry Osterink

NEW YORK, October 1-Herbert Hoover, representing 300,000 members of 18 major engineering societies, today broke ground for the 18-story United Engineering Center at United Nations Plaza. Mr. Hoover was assisted by a freshman engineering student from Hawaii, Jerry Fujimoto, representing the engineers of the future.

In remarks just before he turned the first shovel-full of earth at the site of the new Center, Mr. Hoover called the occasion "an event of national importance. The engineering societies in our country comprise a great army of over 250,000 creative minds covering almost every branch of the profession."

The United Engineering Center, scheduled for completion in mid-1961, will house the headquarters of major engineering societies and joint engineering groups. The Center has been made possible by contributions from industry and from thousands of individual engineers. Plans for the Center have been eight years in the making. To date, more than 500 companies have contributed nearly $5 million, and some 56,000 engineers have added another $3 million.

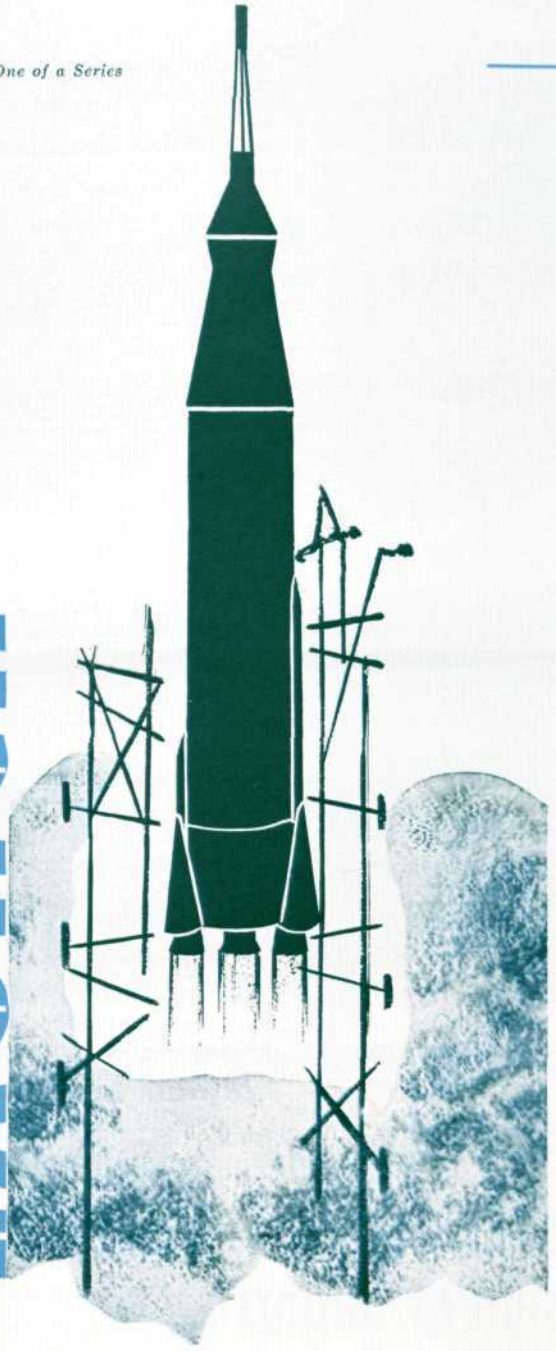
Located at First Avenue between 47th and 48th Streets, the Center will be part of the complex of new buildings located on United Nations Plaza that are "dedicated to the service of mankind and of world society."

Number One of a Series

ENGINEERING GRADUATES—YOUR

STEPPING STONES TO SPACE

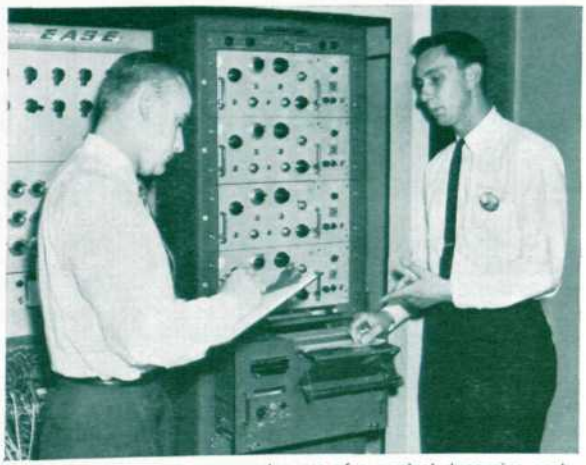
LAUNCH



Your career, like a missile, must first get off the ground. You need more than just momentum. Remember—the "DESTRUCT" button has been pushed on many a missile because of poor guidance. In selecting the position which best suits your interests and abilities, seek competent guidance from your Professors and Placement Officers.

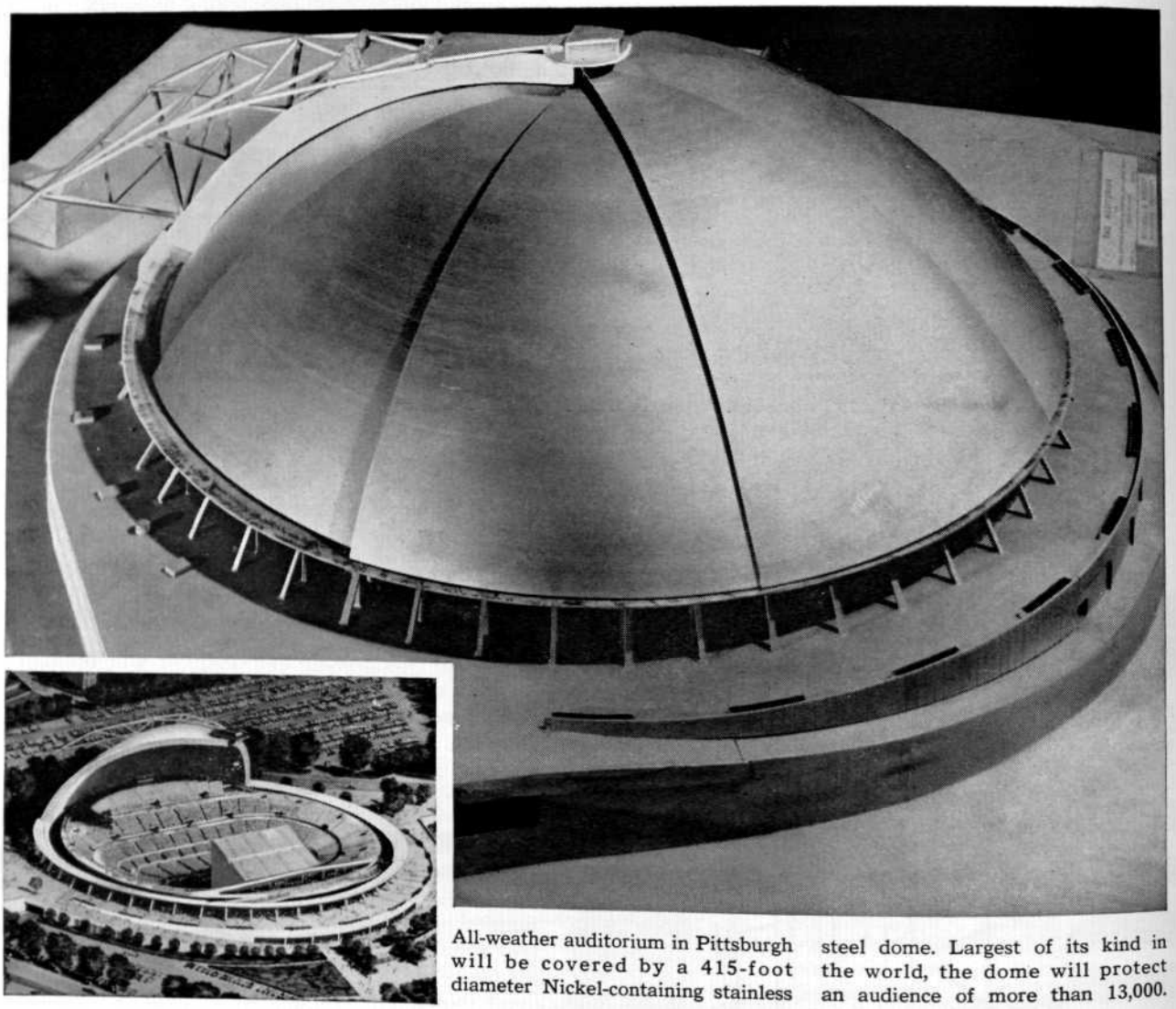
At McDonnell—young engineers have a wide choice of interesting assignments covering the entire spectrum of aero-space endeavor—airplanes, helicopters, convertiplanes, missiles, and spacecraft.

Learn more about our company and community by seeing our Engineering Representative when he visits your campus, or, if you prefer, write a brief note to: Raymond F. Kaletta
Engineering Employment Supervisor
P.O. Box 516, St. Louis 66, Missouri



Seen here discussing a computer run of a control dynamics problem are young Project Mercury staff members, Joseph J. Voda, MSAE, U. of Illinois, '58, on the left, and Lawrence D. Perlmutter, M.S. Instrumentation, U. of Michigan, '59.

McDONNELL Aircraft



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

For Pittsburgh's new auditorium...

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

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

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

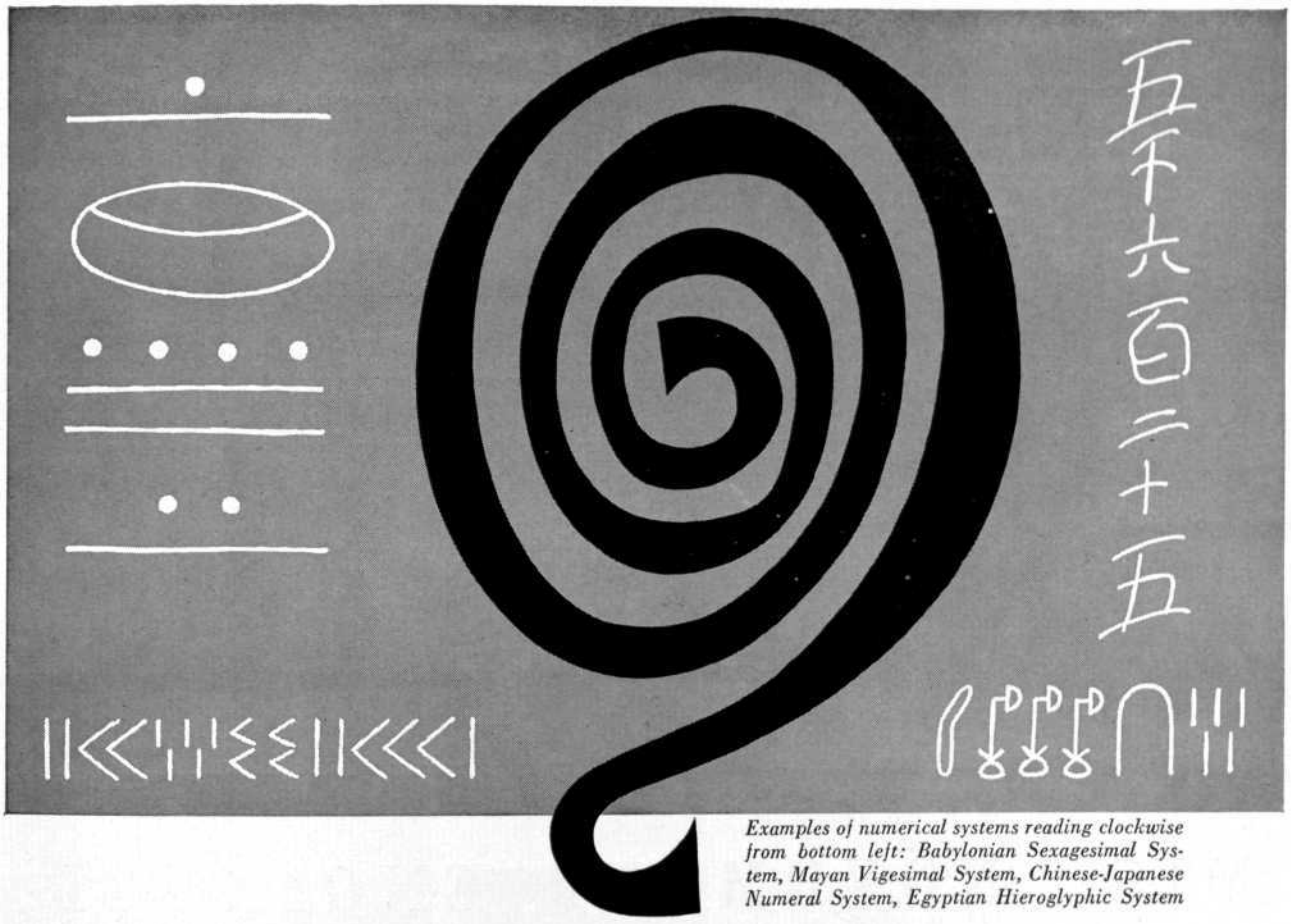
In Pittsburgh's new all-weather auditorium, the push-button umbrella roof can be closed at the first sign of bad weather without disturbing the show. In private homes, a roof design like this could bring the beauty of nature right into the home.

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

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

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

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



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

undetermined X multipliers

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

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

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

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

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

SYLVANIA

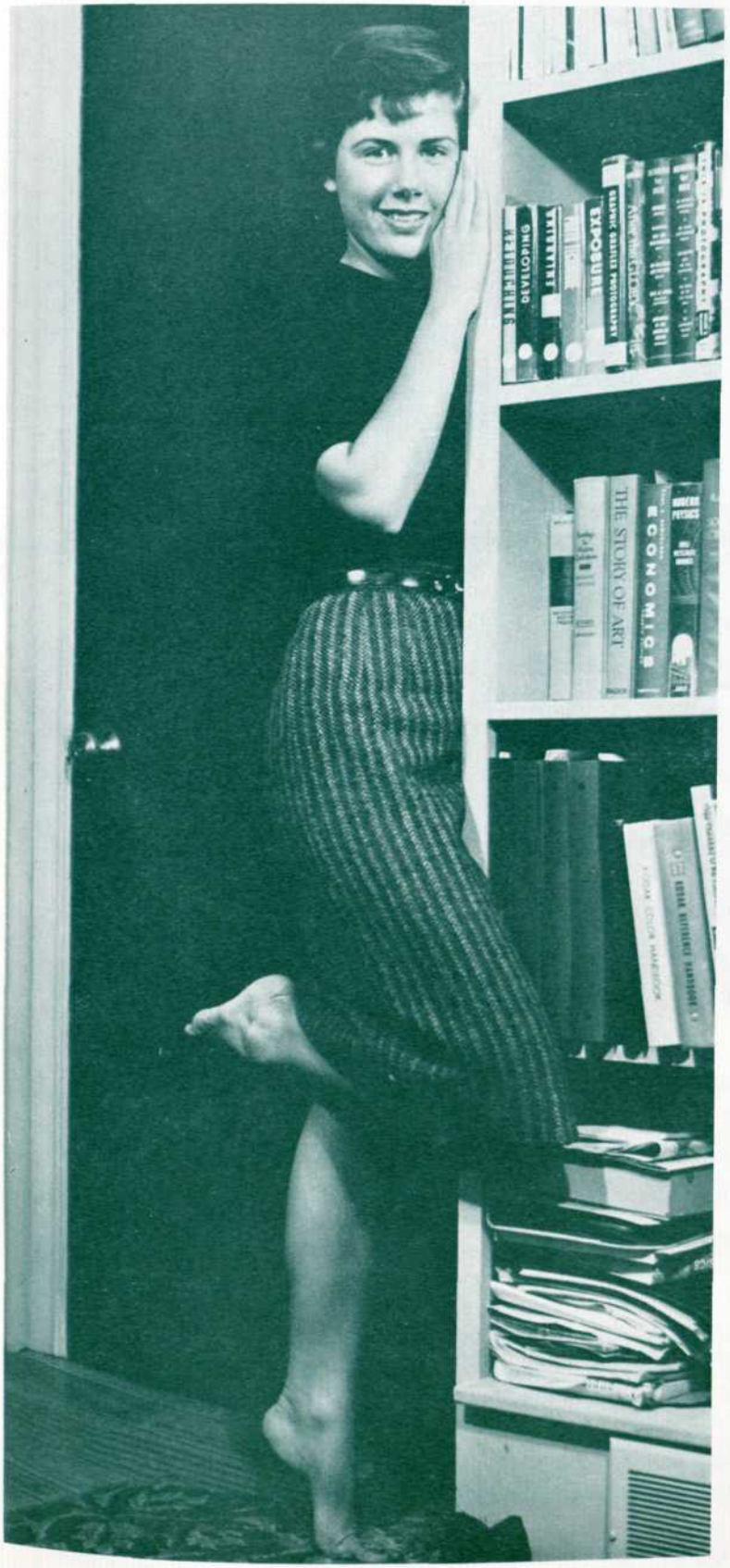
Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

730 Third Avenue — New York 17, N. Y.

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

MISS NOVEMBER ENGINEER

(Photos by Norm Hines)



Janice Kay De Meester

Home Town: Grand **Rapids**

Age: 20

Sorority: Delta **Gamma**

Specs: **5' 4 1/2'**
Brown Hair
Brown Eyes
33-23-33

Major: **Journalism**

IHobbies: Water **Skiing**
Sewing

FOLLOW THE LEADER IS NO game

with Delco. Long a leader in automotive radio engineering and production, Delco Radio Division of General Motors has charted a similar path in the missile and allied electronic fields. Especially, we are conducting aggressive programs in semiconductor material research, and device development to further expand facilities and leadership in these areas. Frankly, the applications we see for semiconductors are staggering, as are those for other Space Age Devices: Computors . . . Static Inverters . . . Thermoelectric Generators . . . Power Supplies.

However, leadership is not self-sustaining. It requires periodic infusions of new ideas and new talent—aggressive new talent. We invite you to follow the leader—DELCO—to an exciting, profitable future.

If you're interested in becoming a part of this challenging DELCO, GM team, write to Mr. Carl Longshore, Supervisor-Salaried Employment, for additional information—or talk to our representative when he visits your campus.

DELCO RADIO DIVISION OF GENERAL MOTORS

KOKOMO, INDIANA

Air brake for a spaceliner

The earth's atmosphere, one of the biggest obstacles to getting into outer space, can be one of our biggest assets coming back. At Douglas we are investigating how we can use its braking effects on rockets returning from deep space trips at far faster than ICBM speeds. Success will allow us to increase payloads by reducing the weight of soft landing systems. This technique also will aid us in pinpointing landing areas. Current reports show real progress. Douglas is engaged in intensive research on every aspect of space planning, from environmental conditions on other planets to the destroyer-sized space ships necessary to get there. We invite qualified engineers and scientists to join us. Write to C. C. LaVene.Box 600-X, Douglas Aircraft Company, Santa Monica, California.

Arthur Shef, Chief, Advanced Design Section, Missiles and Space Systems, irons out a problem with Arthur E. Raymond, Senior Engineering Vice President of **DOUGLAS**

MISSILE SYSTEMS ■ SPACE SYSTEMS ■ MILITARY AIRCRAFT ■ JETLINERS ■ CARGO TRANSPORTS ■ AIRCOMB ■ GROUND-HANDLING EQUIPMENT

OLDEST PROFESSION

(Continued from Page 33)

the student to pursue further specialization in his technical field or he may broaden his course of study by taking any or all of these courses outside the College of Engineering. Elective course work in the College of Business and Public Service has been quite popular.

One of the activities which the Civil Engineering Department is most proud is its research program. During the past year research grants have been received from both private industry and governmental agencies. These grants have varied in amount from $10,000 to $39,000. The most recent sponsor of research has been the Dow Corning Corporation. Other sponsors are the U. S. Bureau of Public Roads, Michigan State Highway Department, National Institutes of Health and the National Science Foundation. Dr. E. M. Laursen in the hydraulics area is studying the shear and pressure distribution on dune-shaped roughness. Dr. R. F. McCauley is concerned with the corrosion of water pipes in Michigan and is studying the effect of various types of coatings in the reduction of corrosion. Dr. K. L. Schulze is actively engaged in developing a better understanding of the aerobic decomposition process. Dr. T. H. Wu in our soil mechanics area has been assisted by a number of graduate students in the study of porewater pressure in clay soils. Dr. R. K. L. Wen has recently initiated a study on dynamic effects in cantilever highway bridges. Opportunities exist for graduate students to assist on these projects and inquiries should be directed to the principal investigators of the various projects.

Civil Engineering is truly a dynamic field which challenges the minds of many in seeking a better world to live in.

DISC BRAKES

(Continued from Page 25)

ior vanes. It is completely enclosed in a small-shell casing. It makes a rather bulky construction and sacrifices one of the main advantages of the open disc-direct airflow over the working surfaces.

On large cars, disc brakes show a saving in unsprung weight of 45 to 50 lbs., which is an important extra advantage. The weight saving declines with the size of the car, and on the smallest there would be little if any difference between drums and discs.

Wear of friction pads rises rapidly beyond a certain critical temperature, but materials have been developed which will work at 1,000 degrees F without excessive wear. Patents have been obtained for brakes which have the pads mounted on swinging arms and so obtain a self-servo effect similar to the self-wrapping action of the leading shoe on a drum brake, but this is not favored at present as it would sacrifice the great advantage of consistent behavior, hot or cold.

At present the ratio of friction pad to disc area is about one to six but the optimum ratio between friction pad area and disc surface has probably not yet been established. Little is known of the durability of discs in sandy countries or in severe winter conditions where there is a lot of salt on the roads. It is clear that the design of the disc brake is far from finality, but brakes already in production are giving good results. Therefore it looks as if disc brakes, offering greater safety are here to stay.

SOLID STATE

(Continued from Page 23)

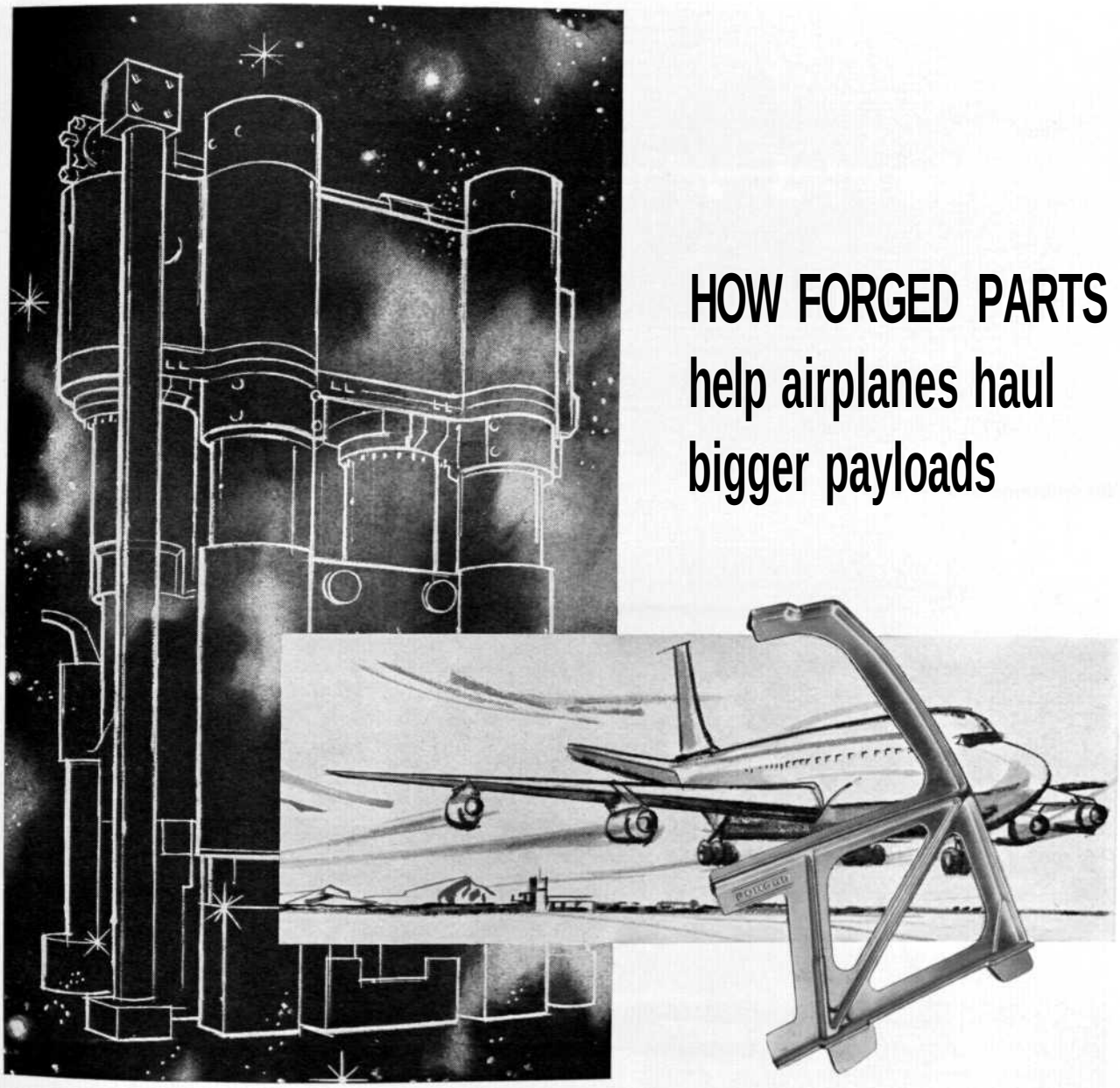
cross section and shows promise as an atomic pile coolant or heat exchanger in light-weight nuclear reactors.

Nuclear reactors of the type used in the atomic powered submarines Nautilus and Seawolf may be made lighter and more compact through the use of Lithium 7 as a coolant.

The density of Lithium is 0.53 gm/cc; it will float on gasoline being only half as heavy as water. Its heat capacity, 1.0 cal/g/°c, is equal to that of water, three times that of sodium which is now used as the heat exchanger, and twenty-five times as high as lead. All this makes it the most promising coolant being developed today.

The only drawback to the use of Lithium in the liquid state is its extreme corrosiveness. This obstacle may be overcome through the use of the special stainless steel alloy used in the construction of the metal sphere in which it is being tested.

There is still much to be learned about the chemical and physical properties of Lithium and its component isotopes. The research being conducted in the Physics-Astronomy Department of Michigan State University by Dr. D. J. Montgomery and Mr. Nguyen Tu Ban is a very important part of this research.



HOW FORGED PARTS help airplanes haul bigger payloads

In an airliner, every pound of weight saved is worth hundreds of dollars ... in revenue-making payload. And in military aircraft, pounds saved mean added miles-per-hour ... or added load carried.

In commercial products ... trucks, cars, materials-handling equipment... the pounds of dead weight you eliminate by using forgings make money year-after-year for the operator. The forging process lets you put the metal exactly where you need it to carry the load, withstand shock or vibration, endure torsion. And with not a surplus ounce of non-working weight going along just for the ride.

Forged parts are the designer's friend... strong where strength is needed, lowest in weight, twice-worked by original rolling of the best metals *plus* the hammer blows or high pressures of the forging process.

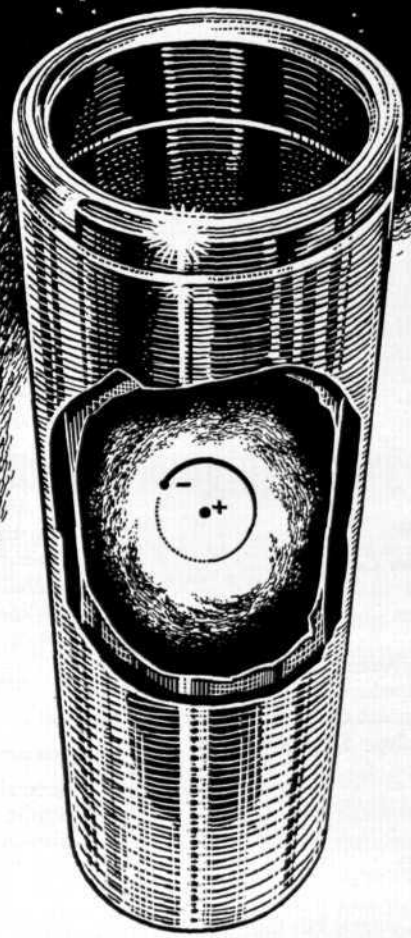
Write for literature to help you specify, design, and procure forged parts.

When it's a vital part, design it to be FORGED

Drop Forging Association • Cleveland 13, Ohio

Names of sponsoring companies on request to this magazine

what is entropy?



Heat lost except at absolute zero?

A measure of disorder?

A statistical probability of state?

The gradient of a scalar?

Macrocosmic phenomenon or microcosmic, too?

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

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

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

Energy conversion is our business

ALLISON
Division of General Motors,
Indianapolis, Indiana

PLACEMENT DIRECTORY

December 1

International Harvester
American Steel Foundries
Wettinghouse Electric
Nordberg Manufacturing Co.
Aetna Casualty & Surety
Continental Illinois Bank and Trust C<

December 2

Michigan Dell
Northtrop Corporation
Columbia Southern Chemical Corp.
dens Falls Insurance Co.
Continents] Casualty **Co.**
California State Personnel lioard
Radiation Incorporated

December 3

Michigan Hell
Burroughs Corporation
Owens-Corning Fiberglas
Prudrntial Insuranee Co.
Continental (Casualty Co.
American Standard Industrial Div.
Detroit **Public** Schools
Equitable Life Assurance Co.

December 4

Michigan Bell
American Standard Industrial Div.

December 7

U. S. Rubber Co.
Penick & Ford
Revco

December 8

Federal Aviation Agency

January 11

The Budd Co.
Airborne Instruments Lab

January 12

Public Service Electric & Gas
Sherwin-Williams Co.
Insurance Company of N. America
Rome Air Material Area - USAF
Socony Mobil Oil
Picatinny Arsenal
Metal & Thermit Corporation

January 13

Socony Mobil Oil
San Diego City School
Detroit Public Schools
Potomac River Naval Command
International Resistance Co.

January 14

Great Lakes Steel
Republic Steel Corporation
Pacific Semiconductors, Inc.
Universal Oil Co.
San Diego City Schools
Combustion Engineering

January 15

Great Lakes Steel
Automatic Electric Co.
Pratt & Whitney Aircraft
Ball Brothers Co.

January 18

The Mitre Corporation

January 19

Raytheon Manufacturing Co.
International Nickel
Swift & Co.
Anaconda Wire & Cable
Pittsburgh Plate Glass
McDonnell Aircraft
Goodman Manufacturing Co.
J. C. Penney

January 20

Sealed Power Co.
Swift & Co.
Hot Shoppes
Melpar
McDonnell Aircraft
Hercules Powder Co.
Ford Instrument Co.
General Railway Signal Co.

January 21

Linde Co.
Raymond Concrete Pile Co.
National Carbon Co.
Dow Chemical
General Electric-
Corning Glass
Magnaflux Corp.
Swift & Co.
Cadillac Motor Co.
H. J. Heinz
Burroughs
Pittsburg Mills Inc.
Champion Paper & Fibre Co.

January 22

Linle Co.
Swift & Co.
Olin Mathieson Chemistry Co.
Lie C. Moore Corp.
White Motor Co.
Wyandotte Chemicals
Dow Chemical
Michigan State Highway Department

January 25

General Motors
Michigan Bell
Armstrong Cork
Owens - Illinois
Devoe & Raynolds Co.

January 26

Armstrong Cork
Owens - Illinois
Convair-Astronautics, San Diego
Armour
Deere & Co.
General Motors
Magnavox
Michigan Bell
Blaw - Knox

January 27

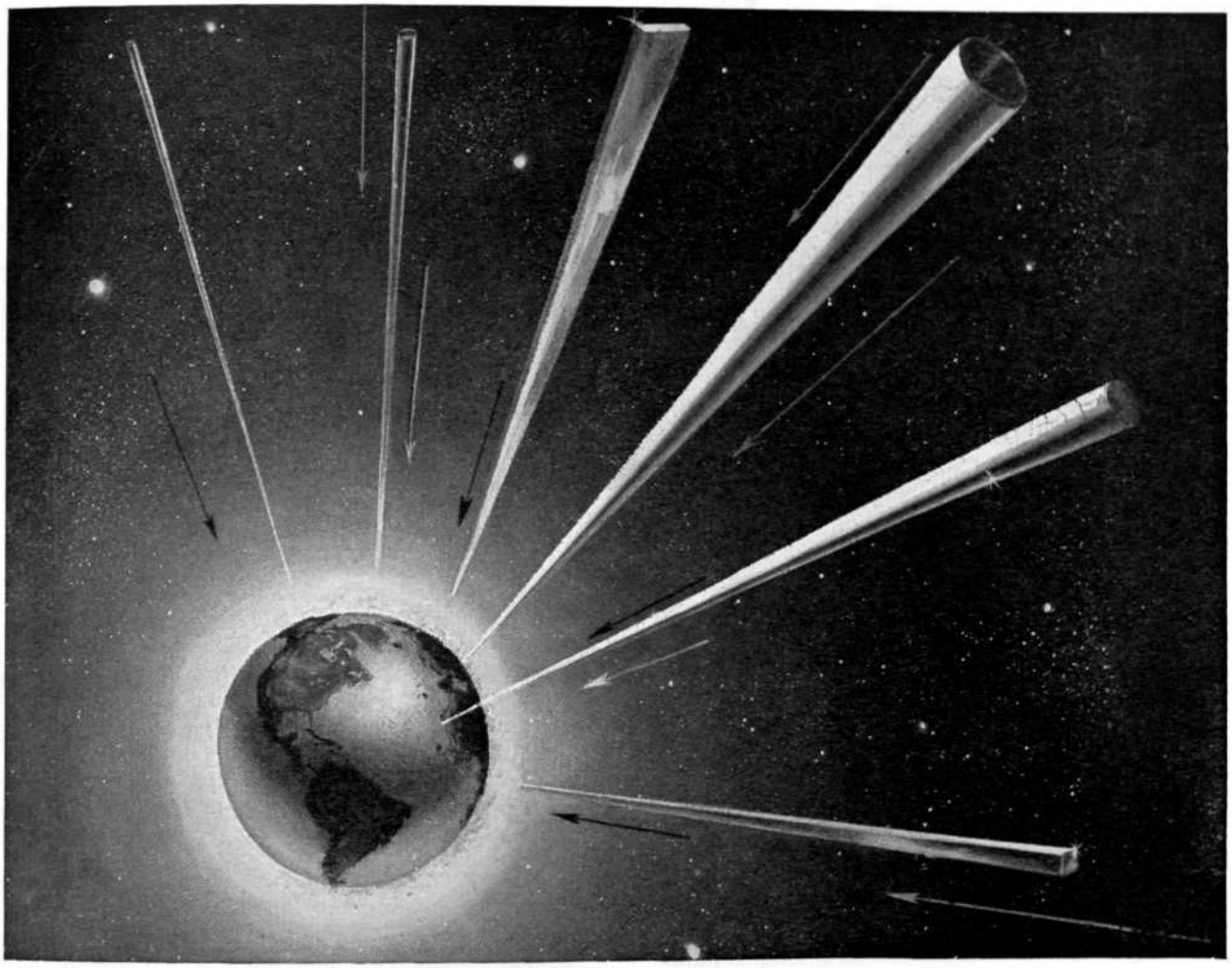
Armstrong Cork
U.S. Army Ordnance Missile Command
Convair-Astronautics, San Diego
Carnation Co.
General Motors
Kendall Co.
Michigan Bell
Chesapeake and Ohio R.R.

January 28

General Motors
Bendix Aviation
Lincoln National
Argonne National Lab
Union Carbide Nuclear
Air Reduction Co.
Michigan Bell
Carnation Co.

January 29

General Motors
Bendix Aviation
Michigan Bell
Union Carbide Nuclear
Herkner Frazier & Smits



METALS...the challenging heart of tomorrow's progress

Today the metals industry is poised at the threshold of its most exciting advances. New needs for metals yet undreamed of . . . revolutionary developments and production techniques . . . new modifications and applications of the basic metals . . . all spell opportunity for enterprising young metallurgists and engineers. Now is the ideal time to enter this challenging field, and lay the foundation for a richly rewarding career.

Bridgeport Brass Company offers a uniquely thorough and diversified grounding in all aspects of metals from A to Z . . . Aluminum to Zirconium. Here you will find a training program second to none in the industry, designed to give you a broad Company-wide perspective that will aid you materially in selecting your permanent assignment.

To maintain its leadership in metals technology, Bridgeport is embarking on a major program of expansion and product diversification that will provide practically unlimited opportunities for professional achievement and rewards. To learn what this can mean to your future, ask your placement director for a copy of "Careers in Metals with Bridgeport Brass", or write direct to Mr. F. J. Finsinger, 30 Grand Street, Bridgeport 2, Conn.

Bridgeport

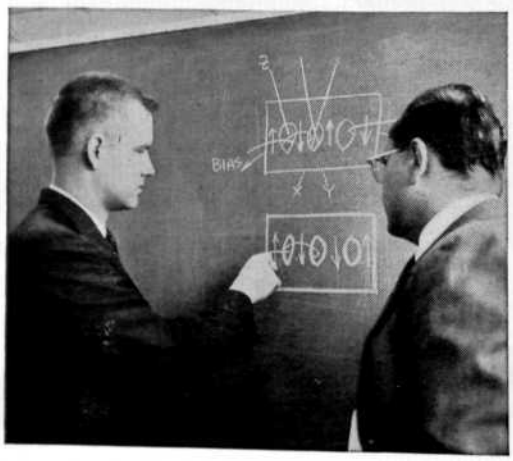
BRIDGEPORT BRASS COMPANY

Bridgeport 2, Conn. • Sales Offices in Principal Cities

Specialists in Metals from Aluminum to Zirconium

Product Development at IBM

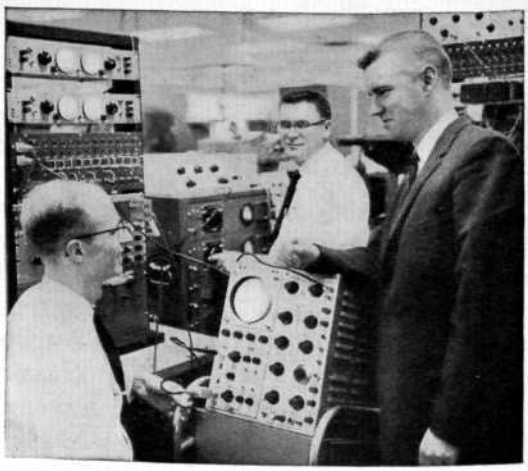
IBM Engineer Richard R. Booth explores electronic frontiers to develop new, faster and larger storage devices for tomorrow's computers.



Computing time cut from six months to one day

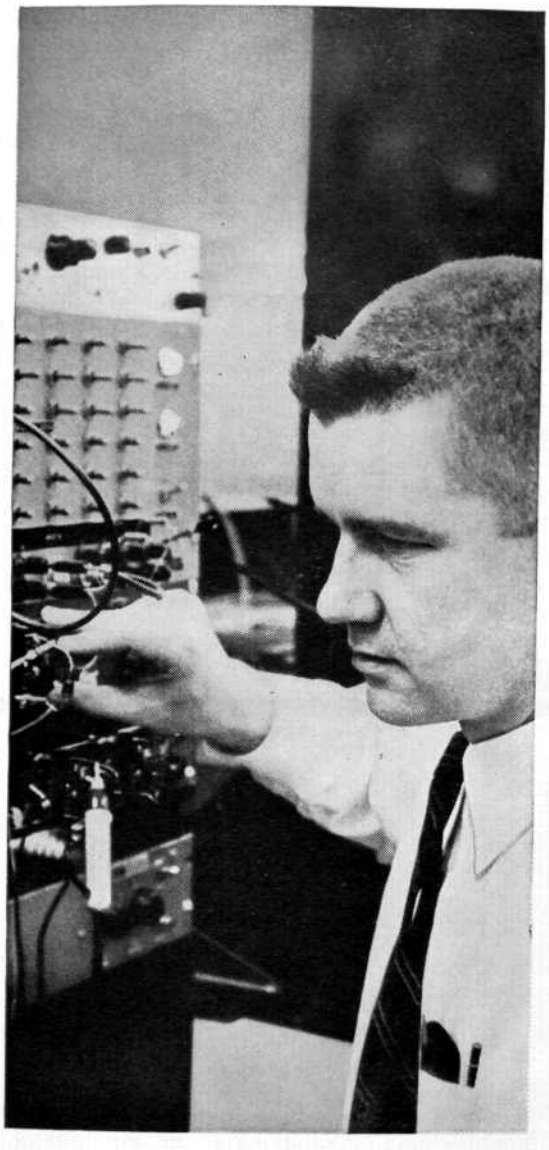
"My job is to design and develop new, high-speed storage devices for a powerful new computer that will perform, in one day, operations requiring six months on present equipment," said Dick Booth as he began a typical day recently. A product development engineer at the IBM Laboratories in Poughkeepsie,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

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



Increasing **responsibility**

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



Preparing for the future

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

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

A chance to contribute

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

* * *

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

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

IBM®

ENGINEERING COUNCIL

(Continued from Page 31)

Planning will start toward the end of fall term. This will require a number of committees handling publicity, exhibits, dance, race, coordination with the JETS, and other such activities. These committees consist of volunteers from the student body. In addition a number of activities such as the Professional Registration Exam Review are sponsored by the council. Each such activity is made possible through the support of the organizations and the individual who is willing to give a small amount of his time. Most of these individuals are from outside of the council.

Editor: Do you have any specific plans for the coming school year?

Daniels: We will of course coordinate the engineering exposition and will sponsor the extra activities such as the race and dance which have been a part of the exposition in the past. The council will assist in keeping the students and public informed on the activities of the College of Engineering and its students. A number of other activities are in the planning stage and will be presented for approval of the organizations at a later date.

Editor: I hope the student body will give you the support you need to carry out your many activities. I'm sure there are a number of students who can give you some or their spare time and that the entire student body will support your activities through attendance and participation.

DR. OTTO

(Continued from Page 29)

gineering Education and American Society of Mechanical Engineers.

Indeed, we may say versatility-plus when we speak of Dr. Louis Otto. He is not only a well known authority in his field but he is a man with many interests: his family, his students, and his unlimited hobbies.

It is with a great deal of pleasure that we say, "Welcome, Dr. Otto, we are glad to have you as the new head of our Mechanical Engineering Department."

He's an Allis-Chalmers Engineer

He has confidence born of knowing where he's going and how he's going to get there. The graduate training program at Allis-Chalmers helped him decide on a *specific* career — and he had a choice of many. He knows his future is bright because Allis-Chalmers serves the growth industries of the world . . . produces the widest range of industrial equipment. He is confident of success because he is following a successful pattern set by Allis-Chalmers management.

Here is a partial list of the unsurpassed variety of career opportunities at Allis-Chalmers:

Types of jobs

Research
Design
Development
Manufacturing
Application
Sales
Service

Industries

Agriculture
Cement
Chemical
Construction
Electric Power
Nuclear Power
Paper
Petroleum
Steel

ALLIS-CHALMERS

A-5882

American Airlines

Equipment

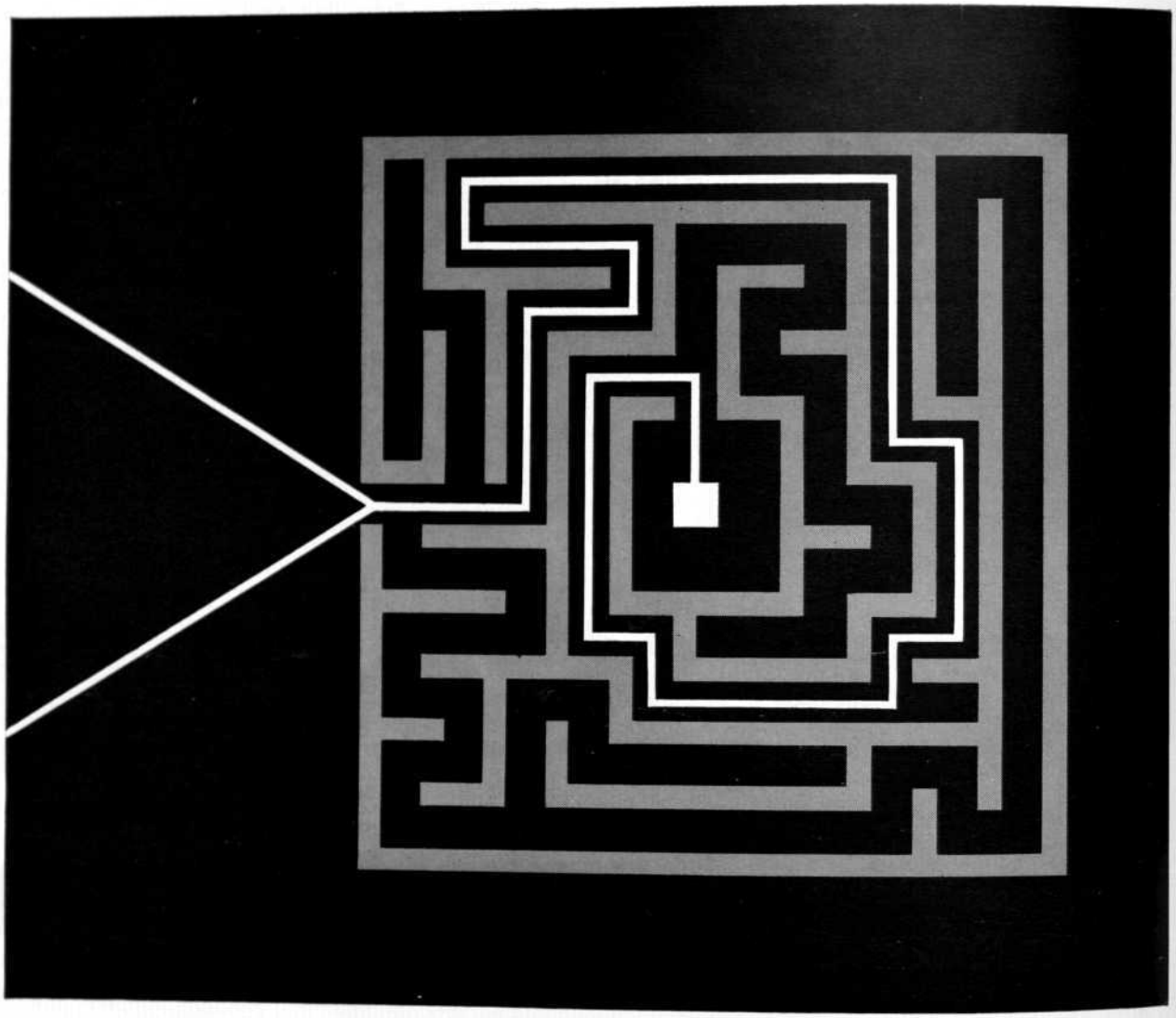
Steam Turbines
Hydraulic Turbines
Switchgear
Transformers
Electronics
Reactors
Kilns
Crushers
Tractors
Earth Movers
Motors
Control
Pumps
Engines
  Diesel
  Gas

Fields

Metallurgy
Stress Analysis
Process Engineering
Mechanical Design
High Voltage Phenomena
Nucleonics
Electronics
Hydraulics
Insulation, Electrical
Thermodynamics

from GTC to "VIP"

The graduate training course helps you decide on your "Very Important Position," by giving you up to two years of theoretical and practical training. This course has helped set the pattern of executive progress since 1904. For details write to Allis-Chalmers, Graduate Training Section, Milwaukee 1, Wisconsin.



A RESUME IS A TWO-PARTY AFFAIR

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

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

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

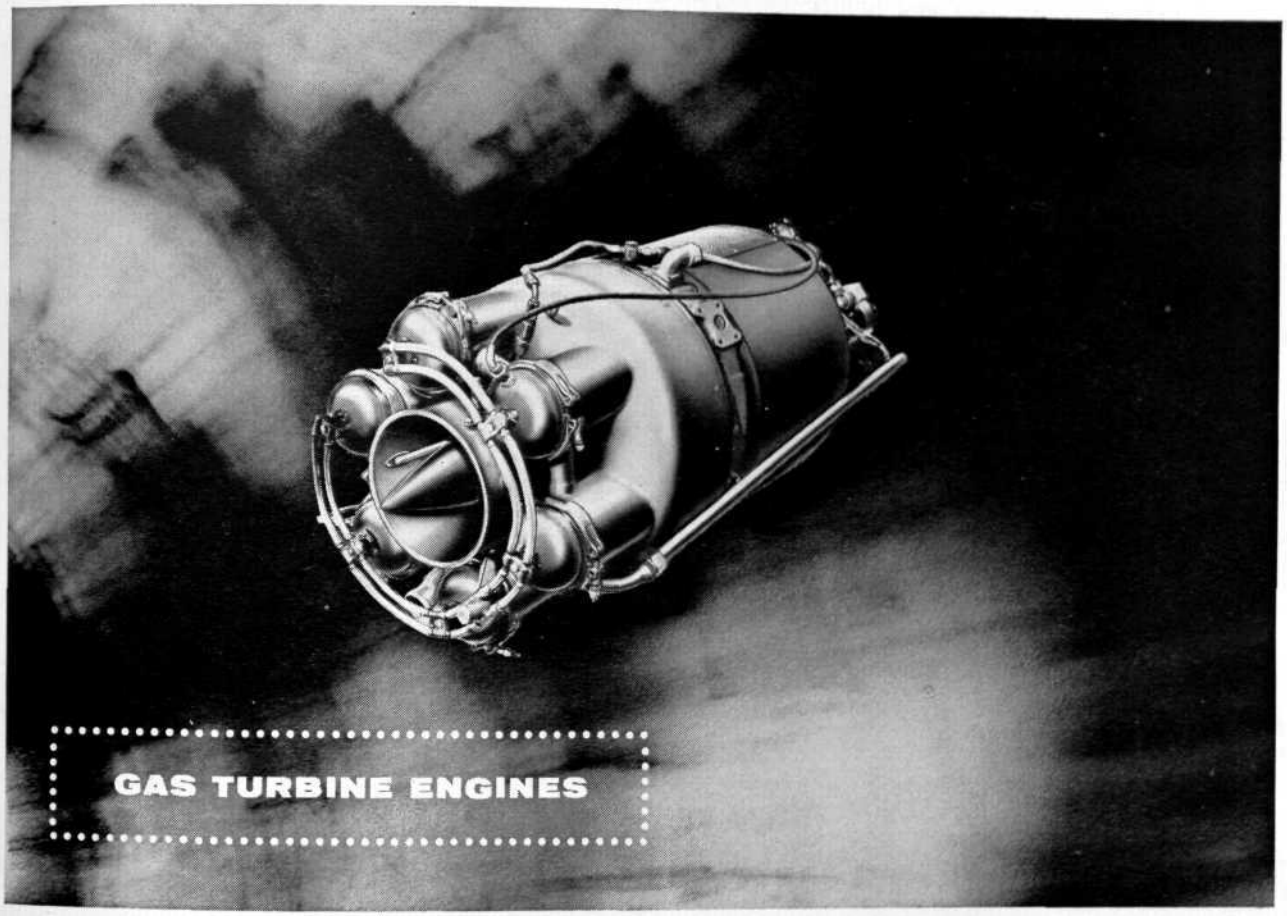
In addition to the opportunities for work and association with distinguished engineers and scientists, our graduate education tuition refund program encourages engineers to continue their formal training . . . and the facilities for graduate work near ITT locations are superior.

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

INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

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

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



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

EXCITING FIELDS OF INTEREST FOR GRADUATE ENGINEERS

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

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

Other major fields of interest include:

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

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

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

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

THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

Los Angeles 45, California • Phoenix, Arizona

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

Faith of the Engineer

I AM AN **ENGINEER.** *In my profession I take deep pride,* ***but*** *without vainglory; to it I owe solemn obligations that I am eager to fulfill.*

As an Engineer, I will participate in none but honest enterprise. To him that has engaged my services, as employer or client, I will give the utmost of performance and fidelity.

When needed, my skill and knowledge shall be given without reservation for the public good. From special capacity springs the obligation to use it well in the service of humanity; and I accept the challenge that this implies.

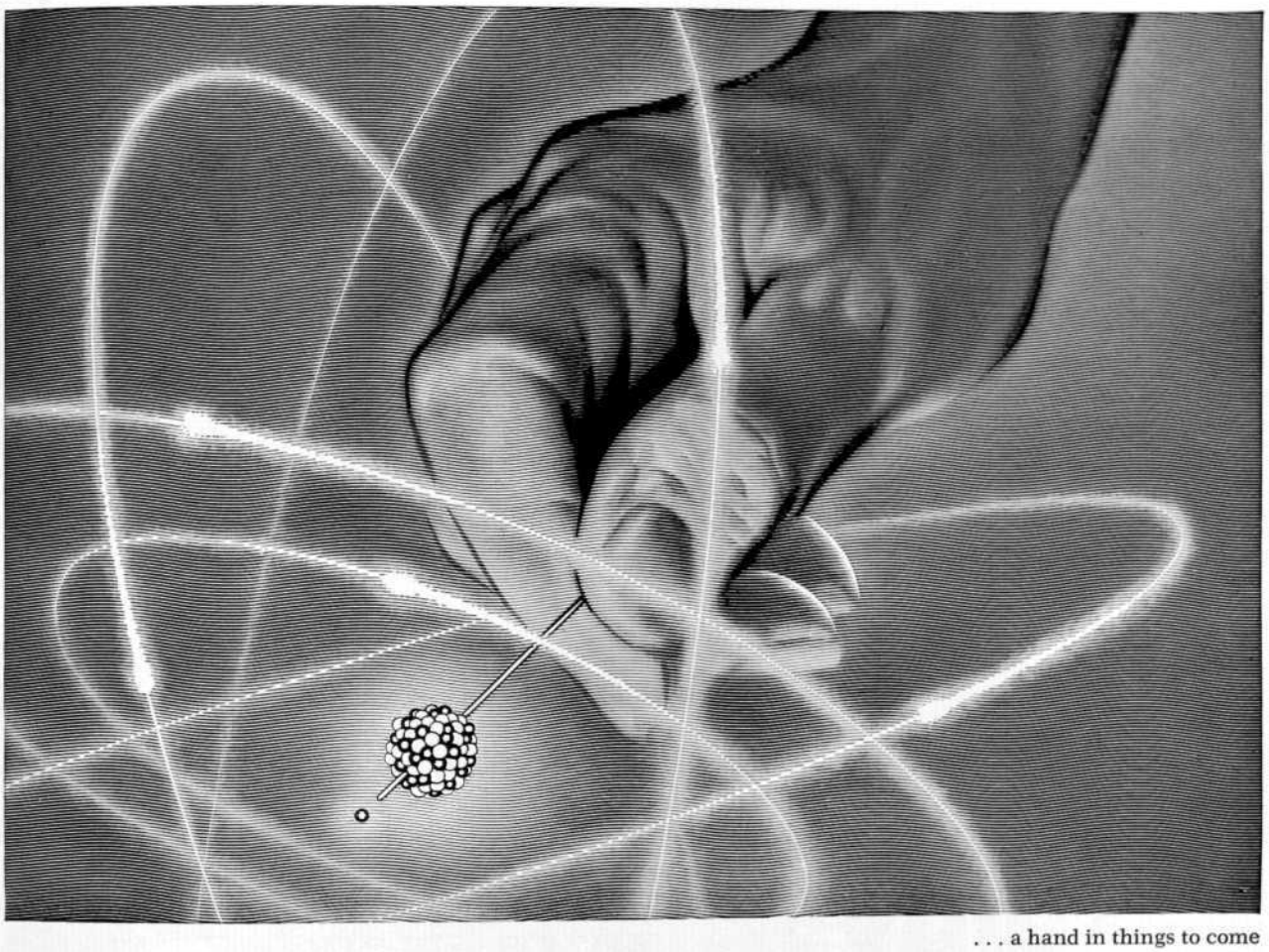
Jealous of the high repute of my calling, I ***will*** *strive to protect the interests and the good name of any engineer that I know to be deserving; but I will not shrink, should duty dictate, from disclosing the truth regarding anyone that, by unscrupulous act, has shown himself unworthy of the profession.*

Since the Age of Stone, human progress has been conditioned by the genius of my professional forbears. By them have been rendered usable to mankind Nature's vast resources of material and energy. By them have been vitalized and turned to practical account the principles of science and the revelations of technology. Except for this heritage of accumulated experience, my efforts would be feeble. I dedicate myself to the dissemination of engineering knowledge, and, especially, to the instruction of younger members of my profession in all its arts and traditions.

To my fellows I pledge, in the same full measure I ask of them, integrity and fair dealing, tolerance and respect, and devotion to the standards and the dignity of our profession; with the consciousness, always, that our special expertness carries with it the obligation to serve humanity with complete sincerity.

Published by

Engineers Council for Professional Development



. . . a hand in things to come

Probing the atom... for you

The boundless energy of the uranium atom means a brighter future

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

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

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

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

UNION CARBIDE

...a hand in things to come

The story of Standard Oil's contributions to oil progress through research is told to the public in advertisements like this during the year.

When a boy asks "WHY?" ...anything can happen!

This scene can be duplicated thousands of times throughout the country. And as long as it goes on, America can be sure of continued progress. Here Bob Hansen (left) and two friends explore the mechanical wonders of an engine (1933 model). The two other boys are Tony Riccardi (center) and Bill Hess. They are all students at Niles Township High School, Skokie, Illinois.

Ever since Bob Hansen was old enough to hold a wrench, he has been tinkering with machines. Next year his repair shop on his driveway at home will disappear because Bob, an honor student, is going to college to study engineering.

Bob is one of thousands of American boys with a restless curiosity about things mechanical. What makes a clock tick? What makes a bicycle brake hold? What makes a car run? From such curiosity comes the mechanical progress that has helped to make America great.

In Standard Oil's big automotive laboratory in the research center at Whiting, Indiana, engineers are going through a similar process every day—asking questions and finding answers. How do fuel additives affect combustion? How do they affect engine deposits? How do burning rates differ?

And the questions continue outdoors, too. In all kinds of weather—hot, cold, wet, dry, low barometer, high barometer—different blends of gasoline are tried to see what happens under what conditions. Fuels are designed in the laboratories for experimental engines that won't appear in an automobile for five years. Standard Oil products are under constant improvement to give the finest performance possible. You get years-ahead quality with Standard Oil products—and at a reasonable cost.

Where does progress start? Does it start on the private driveway of a boy's home or in a huge research laboratory? Progress starts whenever someone asks "Why?" and sets out to find an answer.

The efficiency of gasoline and lubricants is improved constantly in Standard Oil's huge automotive laboratory in Whiting, Indiana. Here fuels are designed, too, for automobiles that will not be on the street until five years from now. Robert W. Boydston, above, is working on a "fuels of the future" experiment.

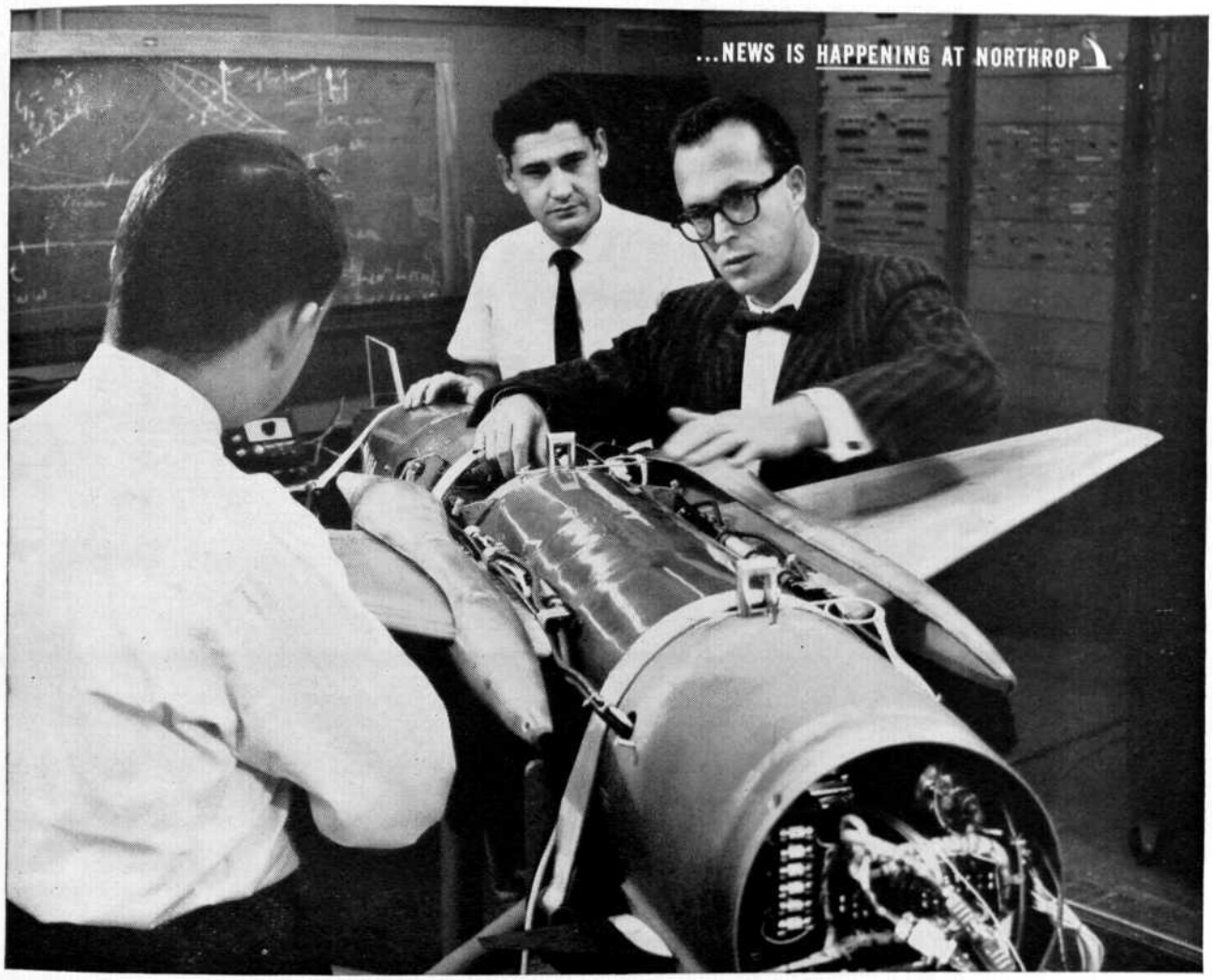
What makes a company a good citizen?

Perhaps even more than an individual, a company must have a healthy respect for the future. Many companies, like Standard Oil, have large families—tens of thousands of people who depend on Standard for their livelihood. Progress through research is one way of protecting the future of both employees and investors and of helping to assure economic stability for the communities in which they live and **work.**

STANDARD OIL COMPANY

STANDARD

THE SIGN OF PROGRESS... THROUGH RESEARCH



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

YOUNG ENGINEERS ARE NORTHROP'S NEWSMAKERS!

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

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

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

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

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

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

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

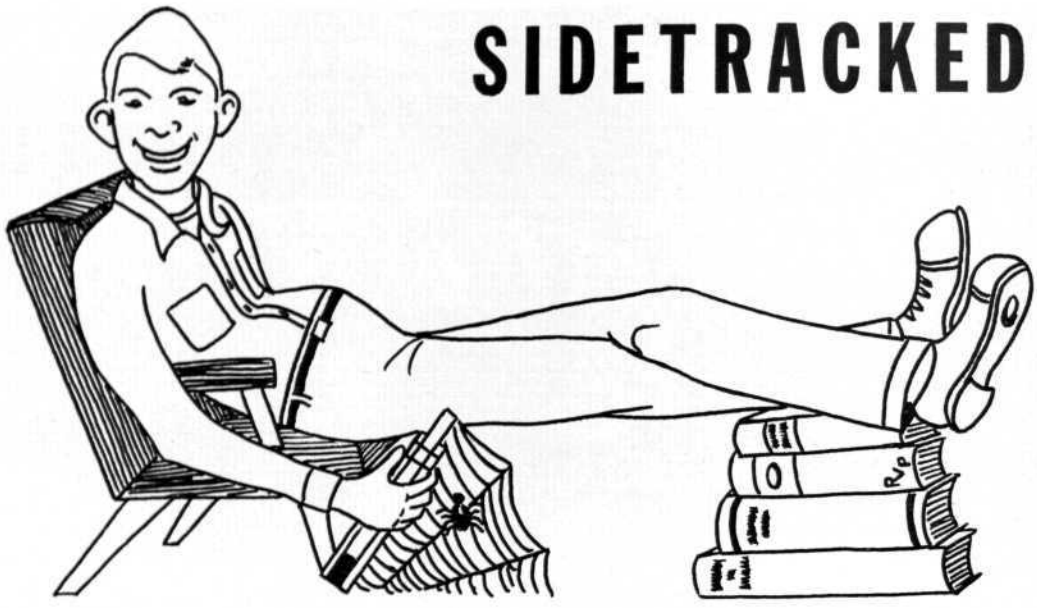
NORTRONICS DIVISION. Pioneer in celestial and inertial guidance. Currently exploring infrared applications, airborne digital computers and interplanetary navigation; developing ground support, optical and electro-mechanical, and data-processing equipment.

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

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

Divisions of NORTHROP CORPORATION

SIDETRACKED



A professor, who long suspected his class was drowsing off on him, decided to catch everyone off base. During the lecture he suddenly dropped into douhletalk.

"You then take the loose sections of fendered smolg and gwelg them —being careful not to overheat the brouglitabs. Then extract and wapf them gently for about a time and a half. Fwengle them each twice, then swiftly dip them in blinges, if handy. Otherwise discriminate the entire instrument in twetchels. Are there any **questions?"**

"Yes," came a sleepy voice from the rear. "What are twetchels?"

o o o

Social Worker: "Sir, would you be interested in contributing something to the old ladies home?"

Spendthrift: "Sure, I'll send my mother-in-law over tomorrow."

9 9 4

Late to bed
And early to rise
Keeps your roommate
From wearing your ties.

o a s

"How much are these cigars?" asked a customer.

"Two for a quarter," the girl behind the counter said.

"I'll take one."

"That will be fifteen cents."

The customer paid the money and left. A man who had overheard the transaction came up to the counter. "Here's a dime," he said. "Give me the other one."

The Engineer's Psalm

Professor Smith is my instructor; I shall not pass.

He maketh me to exhibit mine ignorance before the whole class.

He telleth me more than I can write,

He lowereth my grade.

Yea, though I walk through the corridors of knowledge, I do not learn.

He tries to teach me;

He writeth the equations before me in hopes that I will understand them.

He bombardeth my head with integrations, My sliderule freezeth up,

Surely enthalpies and entropies shall follow me all the days of my life,

And I shall dwell in the College of Engineering forever.

—Unanimous

e © o

A young C.E. was proudly showing the Governor his first project, a three million dollar dam. The Governor stared in amazement and exclaimed, "Migawd, the water—it's supposed to be on the other side."

a a o

With the successful launching of a satellite with a dog inside, Russian scientists are planning a second animal launching. Soviet geneticists are busy trying to develop a breed of cattle small enough to fit into a sputnik. This will be the herd shot round the world.

An inmate of the lunatic asylum was to be examined for dismissal. The first question he was asked was: "What are you going to do when you get out of here?"

The inmate replied: "I'm going to get me a slingshot and come back and break every window in this place."

After another six months in the padded cell, he was again examined and the same question was put to him.

"Well, I'm going to get a job," was the reply.

"Fine," said the examiner, "And then what?"

"Then I'm going to buy a big car."

"Good."

"And then I'm going to meet a beautiful blonde."

"Then I'm going to take her out driving on a lonely road."

"Yes."

"Then I'm going to grab her garter, make a slingshot, and come back here and break every window in this place."

« o «

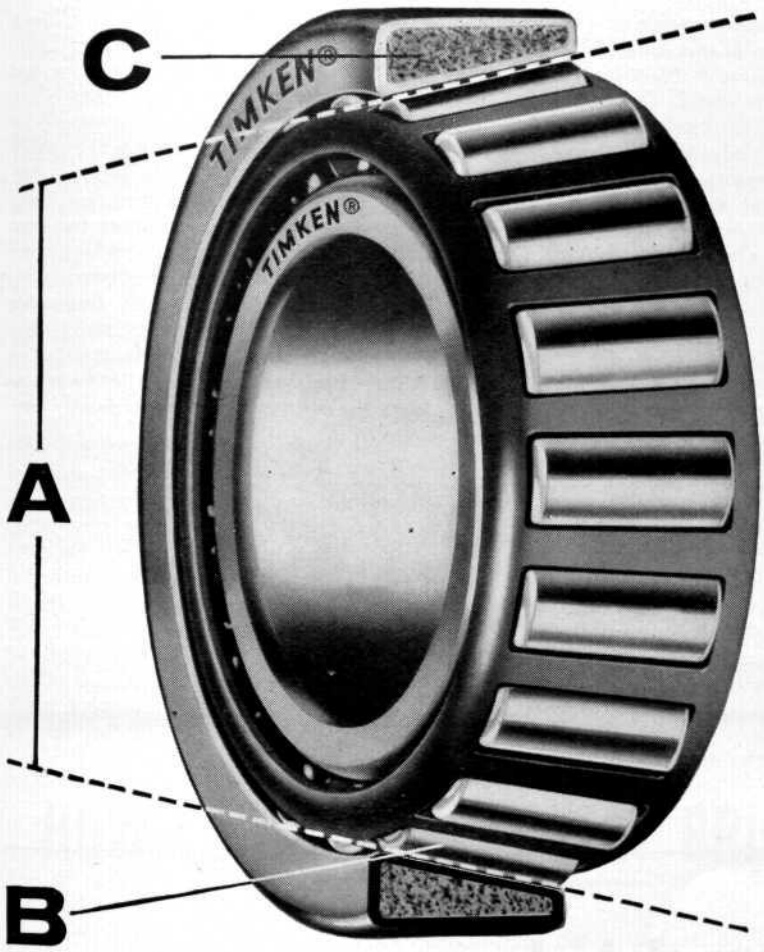
EE: "Lady, I've found the trouble with your car. You've got a short circuit in the wiring."

Lady: "Well, for goodness sake, lengthen it!"

• • •

Notice in want ads-

Young man transferring from engineering to art would like to trade one good study lamp for a comfortable bed.



What is a Timken® tapered roller bearing?

IT'S an anti-friction bearing that's geometrically designed to give true rolling motion—and precision-made to live up to that design. Here's how you, as an engineer, can benefit from Timken® bearings:

A *Tapered design* enables a Timken roller bearing to take any combination of both radial and thrust loads. You'll often find that one Timken bearing does the load-carrying job of two ball or straight roller bearings.

B *Full line contact* between rollers and races gives Timken bearings *extra* load-carrying capacity. This enables a design engineer to cram maximum capacity into minimum space. And Timken bearings can be pre-loaded for accurate gear or spindle alignment.

C *Case carburization* makes the steel of Timken bearing races and rollers hard on the outside to resist wear, tough on the inside to resist shock. This prolongs the life of Timken bearings. And the steel we start with is the best. It's nickel-rich for toughness.

What is Better-ness? it's our word for the result of the ceaseless American urge to make machines that do more, do better, do faster. Our engineers help make Better-ness possible. They've pioneered every major tapered roller bearing advance. And they work right at the drawing board with engineers of every major industry. It's exciting, rewarding work with a future.

If you would like to help create Better-ness on our engineering team, write Manager, College Relations, The Timken Roller Bearing Company, Canton 6, Ohio.

BETTER-NESS rolls on

TIMKEN®

tapered roller bearings

First in bearing value for 60 years

UNLIMITED FUTURE

(Continued from Page 30)

ning for future expansion lias always been well ahead of the expected requirements.

Continued Expansion

In 1884, there were 186 subscribers for electricity. Today there are over forty thousand customers **paying** less than five per cent per kilowatt hour of what was paid 75 years ago. In 1885, two and a half million gallons of water per clay was being supplied, as compared to the capability of conditioning 60 million gallons per day at the present time. The residents of the Lansing area are among few who can boast that their community is supplied with water from wells. It is projected that in 1985 Lansing will generate a half million kilowatts.

The engineering department at the Hoard of Water and Light is capably stalfed with conscientious and dedicated workers. Unlike the more glamorous industries hiring engineers today, this is one company where the rapid turnover of engineering talent cannot be found. The knowledge that there is security with a public utility can be affirmed here. Perhaps more important is the individual requirement which is noted only by the engineer himself, lacking in many other organizations—job satisfaction. Another fact, which is to the liking of many engineers today, is the lack of rigid specialization in their particular field of Engineering. An engineer with the Board has the opportunity to start a project and continue to the very end, watching it develop, expand, and produce according to his predictions. This is his project, with the responsibility and authority to see it through.

The City of Lansing has much to be proud of in its Board of Water and Light. Engineers in the Water Conditioning plant helped to make the Board one of the first in the world to reclaim lime from the water. At present the men responsible are among the most noted in the country, and continually working to achieve even greater results. The street lighting department ranks among the top ten in the nation in providing effective and comprehensive coverage for the city. Its administration is capable and efficient, constantly looking forward for greater progress in order to pass on to its customers the best in service from a municipally owned public utility. Plans are now being formulated to cope with increasing needs of the next twenty years—new buildings, new power plants, and an increased work force with twice as many engineers as are presently employed.

The future of the public utility is unlimited. Its requirements are dictated by the increase in population and the ever increasing need for more power and more water. Whether it be steam driven turbines or atomic reactors, the services provided will continue to increase just as rapidly as the engineer can put forth his efforts in solving the many complex problems which still exist in the field of public service.

HOW LONG WILL IT STAY BRIGHT AND SHINY?

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

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

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

What does all this have to do with you?

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

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

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

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

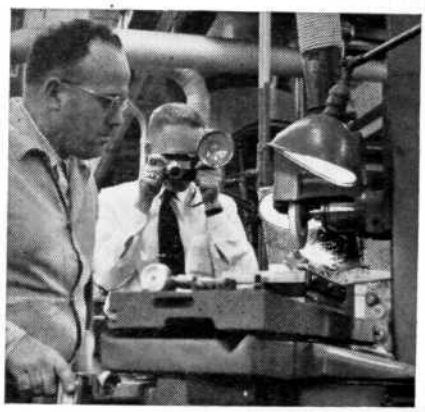
DU PONT
REG. U.S. PAT. OFF.

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

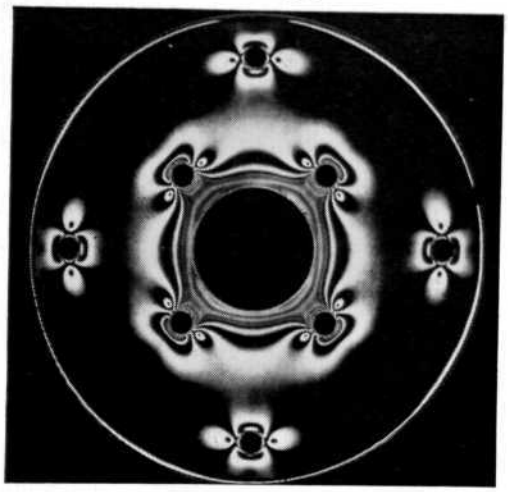
Freshmen, sophomores, and juniors are needed to fill vacancies in several editorial positions on the SPARTAN ENGINEER. Training in technical journalism is available to all interested engineering students who desire experience in the publication field. Come up and chat with us in Room 346, Student Services Bldg., any class day. Perhaps you, too, can reap the rewarding benefits of this extra-curricular activity.

ADVERTISERS' INDEX

From research to finished product–
Photography works with the engineer



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



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

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

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

Careers with Kodak

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

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

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

EASTMAN KODAK COMPANY
Rochester 4, N.Y.

Kodak
TRADE MARK

Interview with Genera
Charles F. Savage
Consultant—Engineering Professional Relations

How Professional Societies Help Develop Young Engineers

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

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

Q. How do these societies help young engineers?

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

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

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

Q. What contribution is the young engineer expected to moke as on active member of technical and professional societies?

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

Q. How do you go about joining professional groups?

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

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

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

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

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

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

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

GENERAL ELECTRIC