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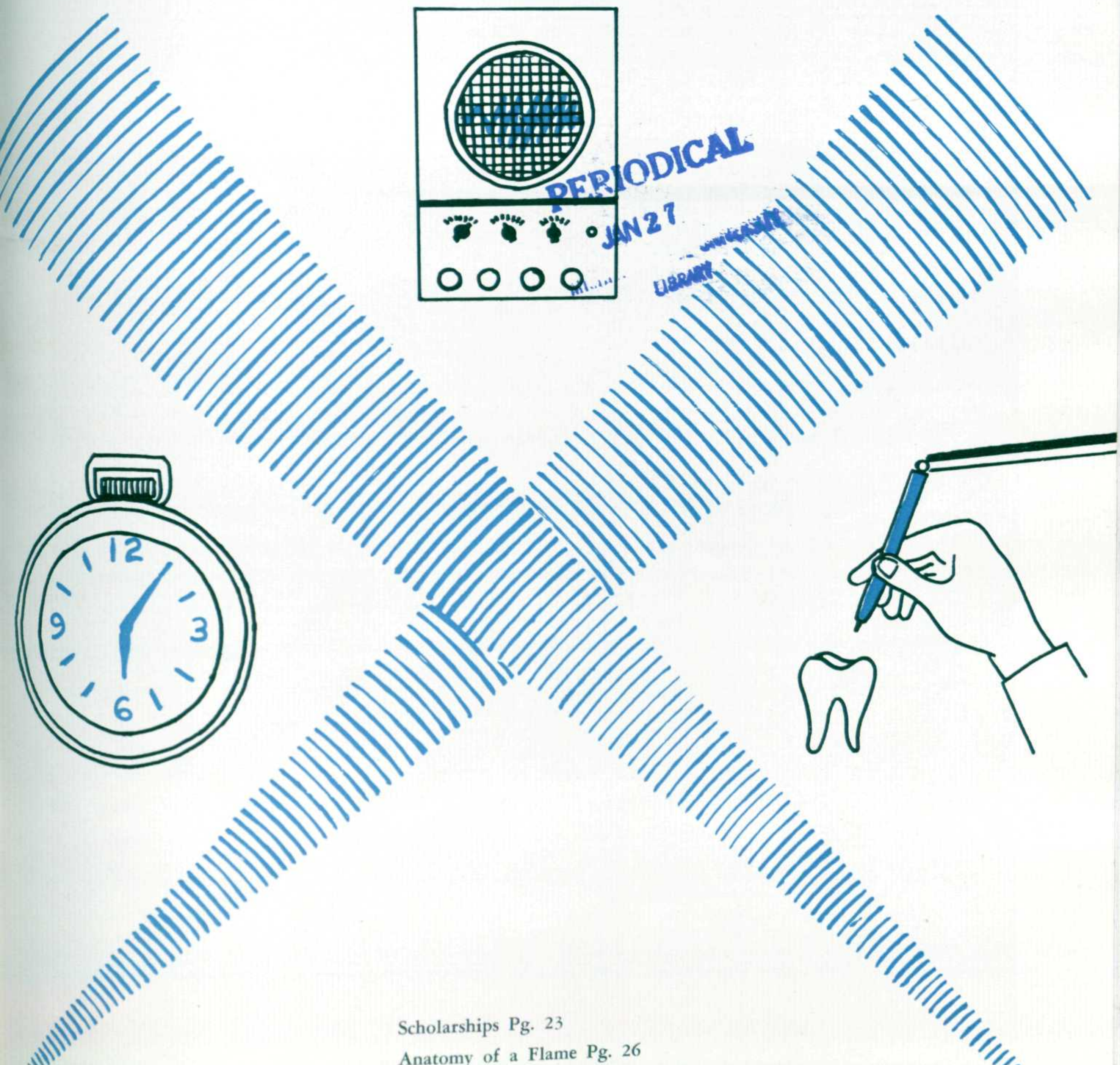
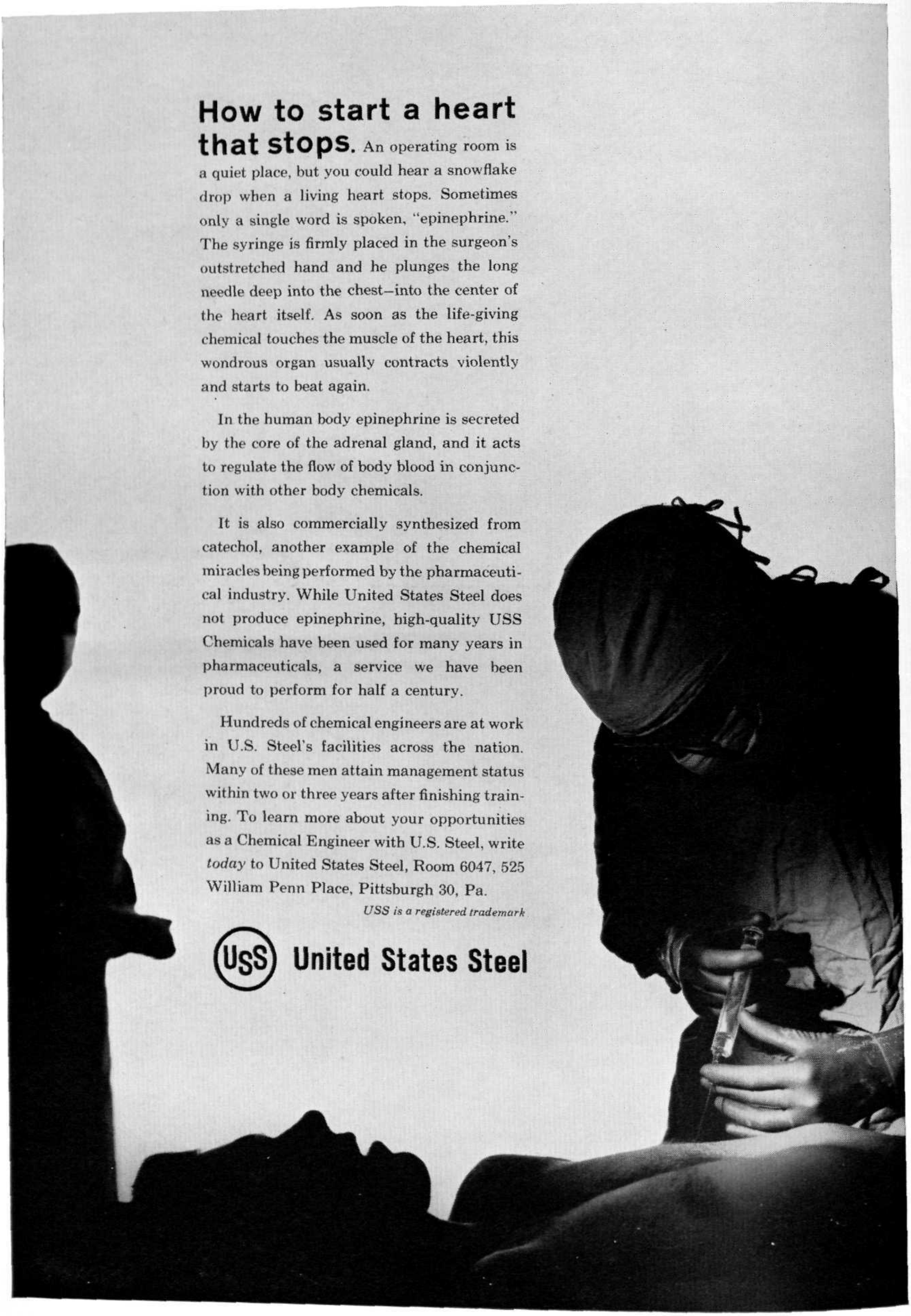
SPARTAN Engineer

Price 25c

January, 1960





How to start a heart that stops.

An operating room is a quiet place, but you could hear a snowflake drop when a living heart stops. Sometimes only a single word is spoken, "epinephrine." The syringe is firmly placed in the surgeon's outstretched hand and he plunges the long needle deep into the chest–into the center of the heart itself. As soon as the life-giving chemical touches the muscle of the heart, this wondrous organ usually contracts violently and starts to beat again.

In the human body epinephrine is secreted by the core of the adrenal gland, and it acts to regulate the flow of body blood in conjunction with other body chemicals.

It is also commercially synthesized from catechol, another example of the chemical miracles being performed by the pharmaceutical industry. While United States Steel does not produce epinephrine, high-quality USS Chemicals have been used for many years in pharmaceuticals, a service we have been proud to perform for half a century.

Hundreds of chemical engineers are at work in U.S. Steel's facilities across the nation. Many of these men attain management status within two or three years after finishing training. To learn more about your opportunities as a Chemical Engineer with U.S. Steel, write *today* to United States Steel, Room 6047, 525 William Penn Place, Pittsburgh 30, Pa.

USS is a registered trademark

USS **United States Steel**

The device about to be submerged is an "underwater sound source". It transmits sound waves beneath the sea and is part of the research equipment developed by Bendix Research Laboratories Division for use in the Bendix program of undersea acoustics research.

Bendix, America's most diversified engineering organization, offers challenging job opportunities in every area of man's scientific and engineering accomplishment—under the sea, on land, in the air and in outer space!

Take, for example, the urgent problem of defense against enemy submarines. Bendix—pioneer in sonar research development, and supplier of this equipment to our government for many years—was selected to develop new techniques to increase sonar capabilities.

Another important Bendix anti-submarine device is "dunked" sonar, lowered from helicopter into the sea to detect enemy submarines.

The spectacular "TV eye", which enabled the crew of the nuclear-powered submarine "Skate" to observe the underside of the Polar ice pack and locate areas for safe surfacing, was likewise a Bendix development.

The real "depth" of job opportunities at Bendix can best be measured by the many and diverse scientific fields in which Bendix is engaged.

For example—career opportunities are available in such fields as electronics, electromechanics, ultrasonics, computers, automation, radar, nucleonics, combustion, air navigation, hydraulics, instrumentation, propulsion, metallurgy, communications, carburetion, solid state physics, aerophysics and structures.

At Bendix there is truly *Opportunity in Depth* for outstanding young engineers and scientists. See your placement director for information about campus interview dates, or write to Director of University and Scientific Relations, Bendix Aviation Corporation, 1108 Fisher Building, Detroit 2, Michigan.

A thousand products **Bendix** AVIATION CORPORATION Fisher Bldg., Detroit 2, Mich. *a million ideas*


ILLINOIS

DOW is tomorrow-minded

plant...

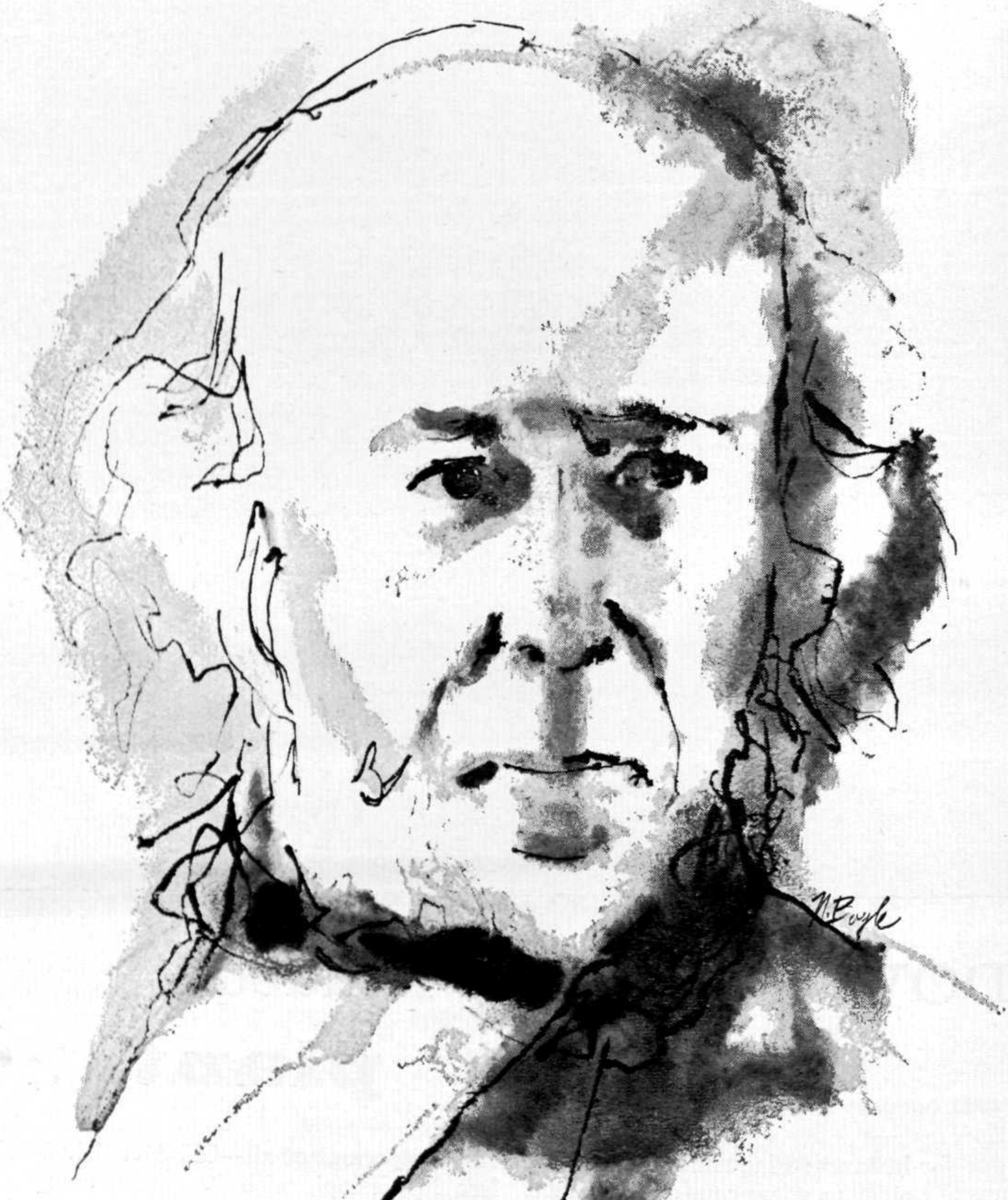
Take just one for-instance: Plaquemine. Some five hundred acres of Louisiana sugar cane country once. Stately oaks and magnolias. Today they're still there. But growing harmoniously with them are the vivid contemporary colors of the new plant—the Dow reds and greens, gleaming whites, Confederate gray, businesslike black. They blend in with the oaks and magnolias to provide one of America's most modern and distinctive plant vistas. Along with the forward-looking products and the people who produce them, this tomorrow-minded Dow plant is a part of the new face of the new South.

Plaquemine is located in one of the nation's fastest-growing concentrations of chemical manufacture. This now bustling Evangeline country offers abundant natural resources, an excellent network of transportation, good accessibility to great and developing markets and communities. And, perhaps most important of all—Old Man River—the limitless Mississippi, with its never-ending source of fresh water and its gate to the ocean-going trade routes of the world.

Today's Plaquemine is a symbol of Dow's tomorrow-minded growth—at one of the fastest rates in the industry. To keep pace with its output of products, new and old, Dow plants are building nationwide. Says the Chairman of the Board of Directors: "We build in boom times to keep up with the demand; we build in slump times for the future." And Dow continues to build its plants, products and people always with tomorrow in mind.

If you would like to know more about the Dow opportunity, please write: Director of College Relations, Dept. 2425FW, THE DOW CHEMICAL COMPANY, Midland, Michigan.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN DOW


N. Boyle

Dean's Letter

At a point near the end of four or more years of college work, many of you are reluctant to think of more of the same. However, those of you who can qualify from the point-average viewpoint owe it to yourselves to give serious thought to continuing with one or more years of graduate work.

Engineering of today is so demanding in terms of technical level that a man without graduate training who goes into research, development, or design, may ultimately find himself handicapped. Some day a door will shut ahead of him—a door behind which lays rewarding opportunity. Possession of a graduate degree will open such doors to broadened opportunity and responsibility, and all the other attributes of advancement.

Graduate education is usually open to those who stand in the upper half of their graduating classes. On our campus this means those with point averages above 2.7, and to all such we extend an invitation to give serious thought to more education—to open those doors in the future. Last year there were about 38,000 B.S. graduates in Engineering in the U. S., and about 6,000 graduate degrees were granted. The graduate degree immediately places one in a less competitive area, and its possession indicates to a prospective employer you have one of the big factors he is looking for—a willingness to continue learning.

If you are interested in a ten percent return on an investment, and this economics is easily proven, then talk with your Department Head or with me. We think we have a convincing story.

—J. D. Ryder, Dean

Spartan Engineer

of michigan state university

VOLUME 13 NO. 2 JANUARY, 1960

FEATURES

DEPARTMENTS

COVER: The cover for this month's Spartan Engineer was drawn by Reg Pilarski, a member of our staff. Portrayed are some interesting applications of the relatively new science of ultrasonics.

MEMBER, ENGINEERING COLLEGE MAGAZINES ASSOCIATED

* * *

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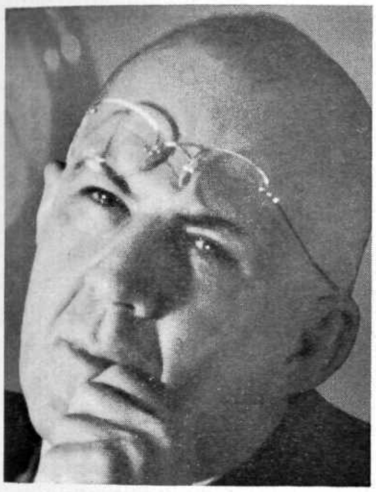
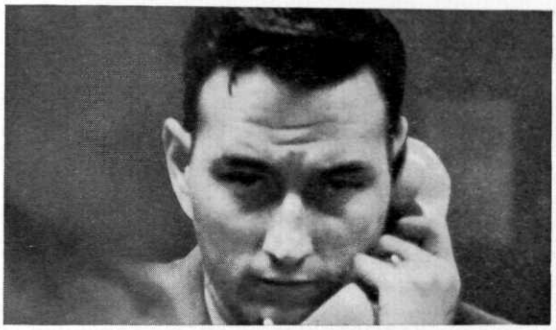
THESE MEN HAVE ONE THING IN COMMON ...BESIDES SUCCESS



KENT R. VAN HORN, Director of Research, Ph.D., Yale University



HARRY SUMNER, Sales Engineer, B.S. in Business Administration, University of South Carolina

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THOMAS R. GAUTHIER, Cleveland Works, Chief Metallurgist, B.S. in Chemical Engineering, Iowa State University

GUSTAV O. HOGLUND, Division Chief of Alcoa Process Development Laboratories, B.S. in Aeronautical Engineering, University of Michigan

These men have a faith. An abiding faith. It's in the future of a metal. Aluminum.

They all are department heads at Aluminum Company of America. They all started with Alcoa as young men fresh out of college. They all have prospered as Alcoa has prospered.

They all have received their promotions on merit . . . the same merit which has contributed signally to Alcoa's status as the Twentieth Century's outstanding corporate success story.

Today, the prospects for a new employee at Alcoa are even brighter, even more challenging than they were when these men first went to work. This is because the prospects for Alcoa and for aluminum are brighter.

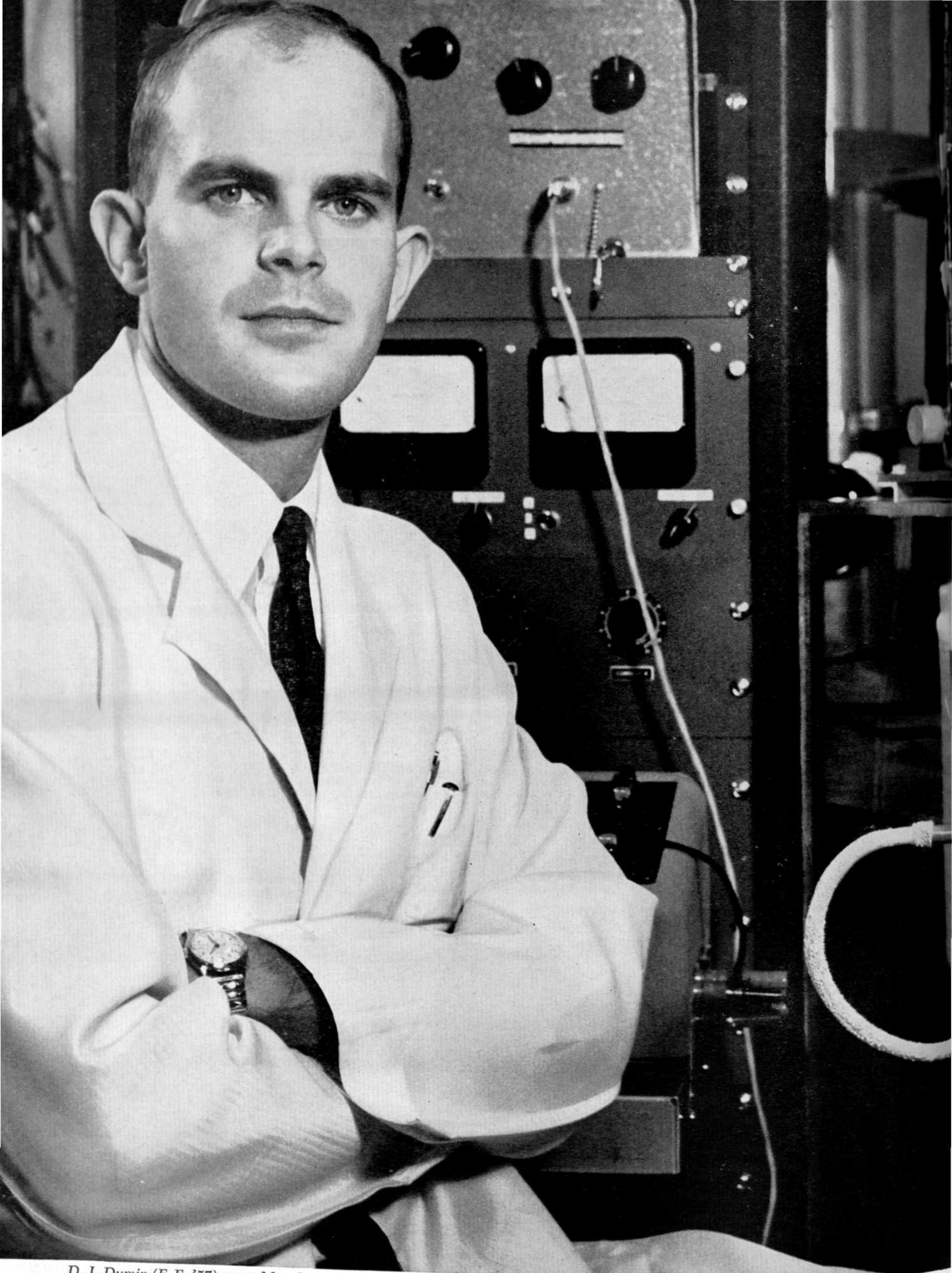
If a dynamic future in this kind of corporate environment interests you, contact your placement officer to arrange an interview. For more details, write for our free booklet, *A Career For You With Alcoa.* Write Aluminum Company of America, 810 Alcoa Building, Pittsburgh 19, Pa.

Your Guide to the Best in Aluminum Value

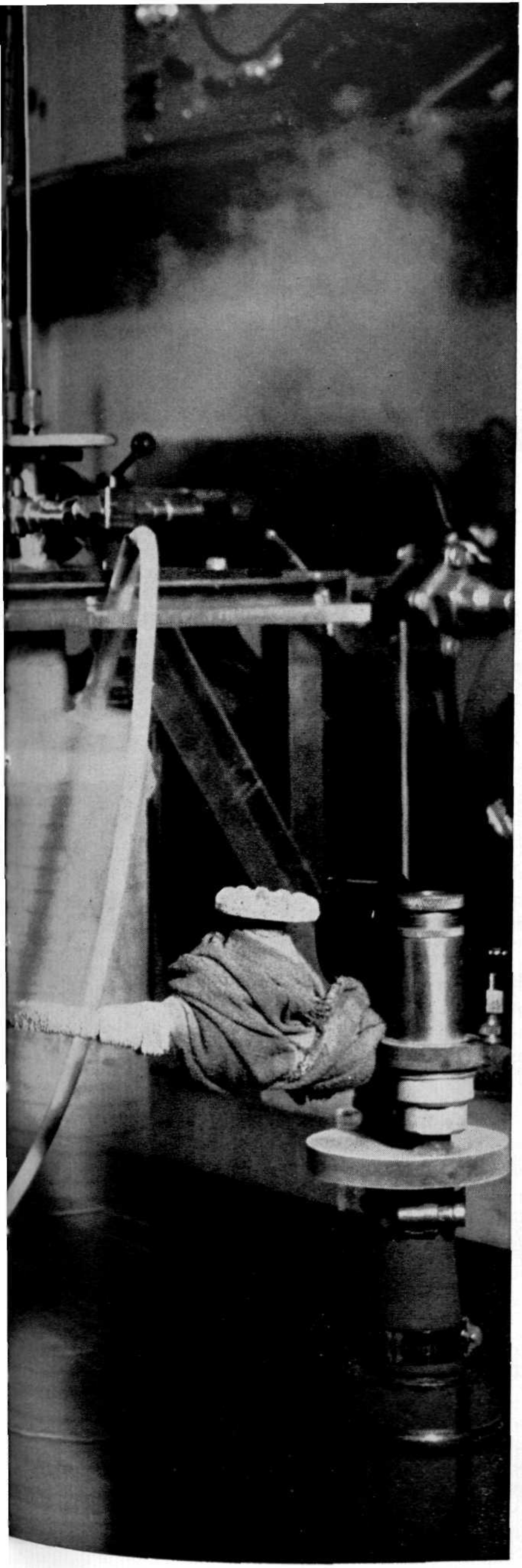
For exciting drama watch "Alcoa Presents" every Tuesday, ABC-TV, and the Emmy Award winning "Alcoa Theatre" alternate Mondays, NBC-TV

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA



D. J. Dumin (E.E. '57) earned his degree at Johns Hopkins. An Associate Engineer at IBM, he is doing original work in the design and testing of thin film circuits. Two of his ideas in this field have been filed upon for patents.



Editor's Corner

Are you interviewing for employment after graduation or for a summer engineering job? Would you like a certain job or is there a special company where you would like to work?

Whether you are looking for a permanent position or for a summer job, proper preparation for your campus interview will enhance your chances of getting that job.

Phase one of your preparation starts several years prior to the interview. Every company which hires engineers is looking for well-rounded technically competent people. Therefore, phase one consists of a well planned college education.

Every good university offers a curriculum which allows the student to develop technical competence, but the student must supply the desire to learn. Your grades are an indication of your technical competence. Therefore, you should plan to graduate with the highest possible grades.

A well planned college career should also include one or more extra-curricular activities. In choosing these activities, you should decide how much time you want to spend in the activity, what your interests are, and what you feel you will get from participating in the activity. Realizing that active participation benefits the individual more than just belonging to an organization, a student should choose those activities which best contribute to the goals of his education.

Phase two of your preparation starts when you start interviewing. At this time you will have completed most of the work required for your degree, and, then must decide where to apply what you have learned. Therefore, phase two consists of defining the career you plan to follow.

In considering one's career a person should evaluate a number of factors. Some of these are: is the job appropriate and interesting, will the company help or hinder your career, and what facilities will be necessary for the level of professional development desired?

A number of personal factors which should also be considered are: your family ties, geographical location desired, size of the city in which you would like to live, and the interests of your wife or fiancee. On the basis of these factors you will be able to select those companies in which you feel that the majority of these criteria will be satisfied.

Phase three of your preparation includes becoming acquainted with the companies you plan to interview, filling out pre-interview applications, arriving at the interview on time, and being neat and well groomed.

The editor wishes each of you the best of luck in interviewing, and I hope that the above comments (also see page 26) along with the tabulated information gathered from contacts with more than 40 companies will help you get that certain job.

Items which were mentioned as being of primary importance in judging candidates by at least ten companies.

	Primary Importance	Secondary	Not Mentioned
Grades	30	8	4
Interest in Company	30	7	5
Interviewer's Opinion	25	7	10
Personality	23	12	7
Extra Curricular Activities	21	12	9
Appearance	20	10	12
Work Experience	18	10	14
Ability to Communicate	17	2	23
Long Range Plans	15	7	20
Faculty Ratings	10	11	21

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 off-shore 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

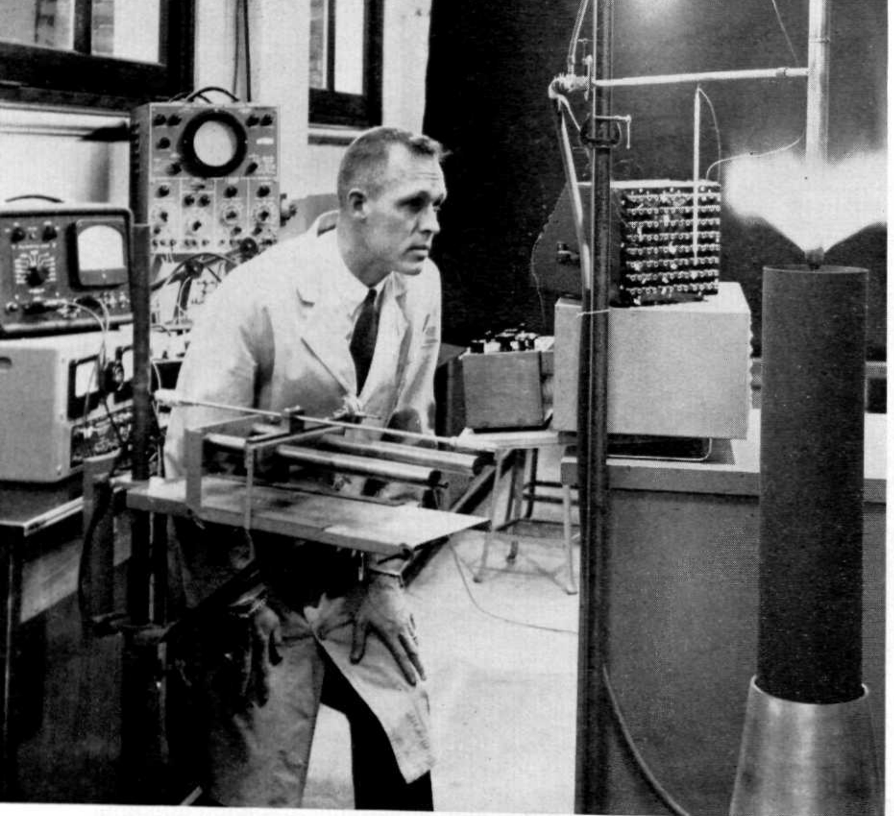
STRATFORD, CONNECTICUT

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

Anatomy of a Flame . . .

Unique research project in Mechanical Engineering Department seeks a more complete knowledge of the properties of a flame.

by NEWT BLACK,
Tech. Writing '60



Staff Instructor Robert J. Heinsohn controls apparatus designed to simulate heat effects of the high speed passage of an object through a gaseous medium. His Problem: Find out as much as is possible concerning the peculiar BOUNDARY behavior of the sheet of intense heat and flame threatening the foreward portions of the object.

EVERYDAY you see fire. You are constantly using it. But do you understand the fundamental nature of a flame?

Even though man has known and used fire for almost as long as he has existed on earth, much is unknown about its nature and characteristics.

Ancient man classed fire as one of the four elements. The other three were air, earth, and water. Today we use fire as a major source of power in our industries, and almost the exclusive source of power for our transportation.

Two men in the Mechanical Engineering Department have made a device with which they can isolate a flame and study its basic characteristics. In June, 1958, they began the experiment with their major purpose to isolate a flame, and thus allow its study with no interference from extraneous factors.

Robert Heinsohn, instructor, and Dr. Joachim Lay, professor, are conducting the experiment. Their apparatus consists of a long, hollow, copper rod pointed down at the center of a six-inch duct. From the duct flows a regulated mixture of propane and air.

As the fuel and air flow upward, the part of the stream closest to the surface of the rod is slowed. This **boundary layer,** as it is called, fans out forming a cone shape as the stream continues up the rod.

What is the boundary layer?

In order to understand why the boundary layer is important, one must first know two principles of a flame. A flame will progress or burn a fuel at a certain finite rate. As an example, if you ignite a long, thin piece of wood, the flame will move along the wood at a certain rate as it burns the wood. This rate may be called the **flame velocity.**

Secondly, for a flame to be stationary, the combustible material has to move into the flame at the same rate.

In Heinsohn's experiment, the velocity of the air-fuel mixture varies as it flows around the rod. For an infinitely small distance from the rod it approaches zero. But within limits, the greater the distance from the rod, the greater the velocity.

The velocity of the **main stream** (that region of the fuel and air mixture farthest from the rod) is much larger than the flame velocity, and hence, by itself, cannot support a flame since in that position the flame would be blown away. But, somewhere between the main stream and the surface of the rod there exists a series of points where the velocity of the flow is equal to the flame velocity. The line connecting these points is called the **locus of equal velocities.** Thus, along the line of these points a stationary flame can exist when lighted.

At the same time the region next to the surface of the rod is too close to the rod to support a flame. The heat of the flame would be absorbed by the rod so that the flame could not maintain enough heat to exist. This space is called the **dead space.**

With reference to figure I it is apparent that for a given fuel-air composition and stream velocity, there exists between the locus of equal velocities and the dead space a region where a flame can propagate. This propagation will drive the flame forward until at the intersection of these two lines (point of the **anchor**) further propagation is halted and the flame is stabilized.

If for a moment, a stable flame were to exist at a position downstream of that shown in figure II, the flow of fuel-air into the flame would be less than the flame velocity, and thus the flame would move upstream to the anchor point.

On the other hand, if a flame were to exist at a position upstream of that shown in figure II, the fuel-air flow would have a velocity larger than the flame velocity, and consequently the flame would be driven back to the position shown. Such a situation is considered to exist for flames which appear to hunt—seek an equilibrium position.

The boundary layer then can be defined as that region of low velocity flow between the main stream and the solid surface.

Two major factors control the shape of the boundary layer. The first is the shape of the object in the velocity flow. This is apparent since the air-fuel mixture will flow around a blunt rod with a different contour than it would flow around a pointed rod.

The second is the velocity of the mixture. If the velocity of the fuel-air mixture is increased, the boundary layer will become thinner.

Heinsohn's apparatus differs from others in that with it he can isolate a flame more thoroughly than any previous experimenter.

There is no outside enclosure which encloses the flame. And inside of the rod, around which the flame forms, are tubes through which water flows at a rate of almost one gallon a minute. This keeps the temperature of the rod below 100° F. at the warmest point. Therefore, as heating the rod would in its self keep the flame lit, keeping the rod cool removes this extraneous factor.

By varying the velocity stream and the percentage of propane to air, Heinsohn can by the use of delicate instruments measure velocities and temperatures at specific points in relation to the rod. He can also study the stability of the flame under different conditions.

Heinsohn believes that this experiment and other studies of flames may give clues to solve problems in the design of jet airplanes and missile nose cones.

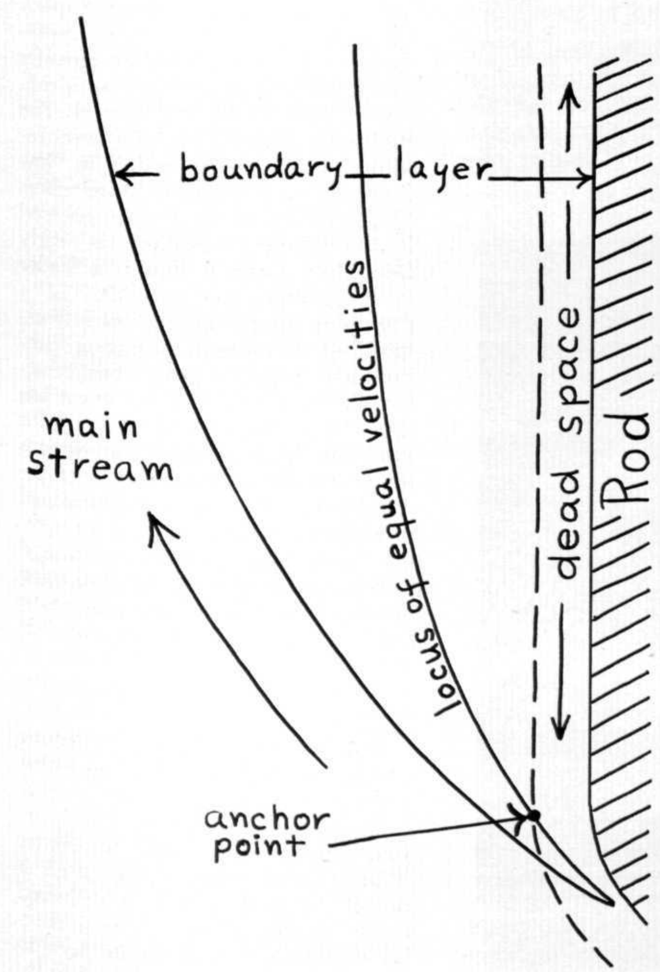


Figure I

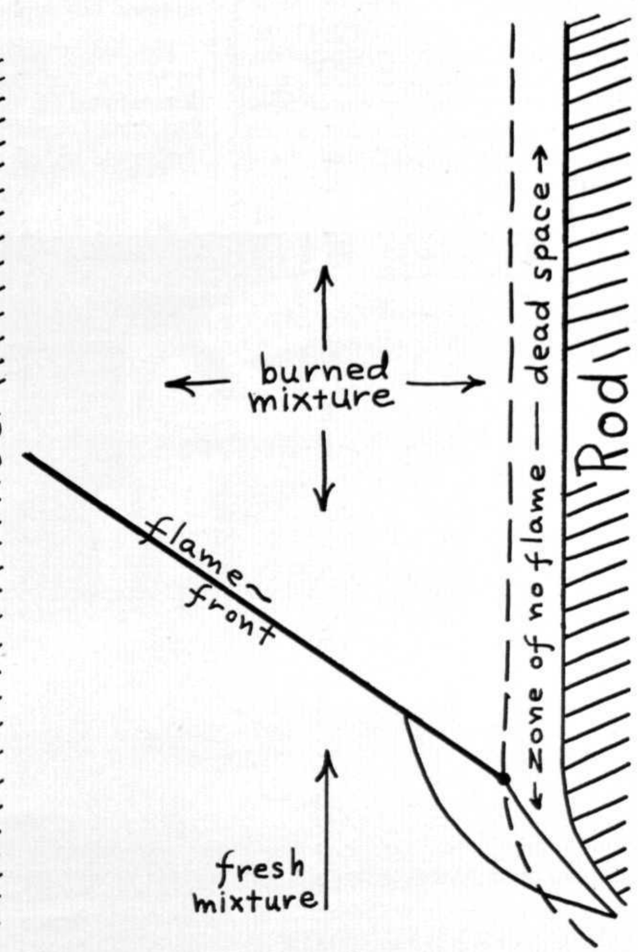


Figure II

PACKAGING:

A seldom heard of profession vies for its "place in the sun."

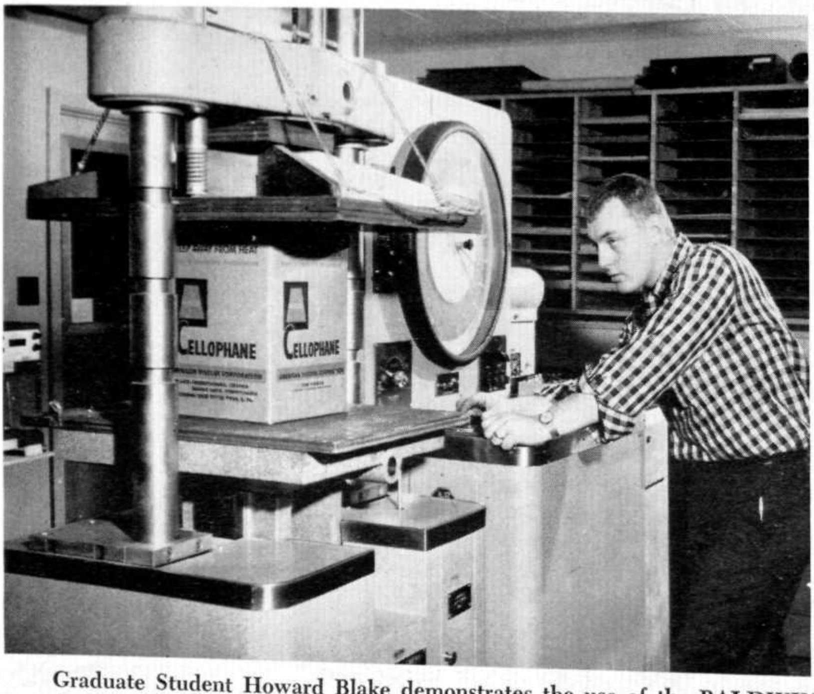
(Photos by Al Royce)

WE are "the School of Packaging." Our present classification is College of Agriculture, phylum—Forest Products, sub-phylum—Packaging. We've only been at Michigan State University since 1952, but we promise to be around for many years to come. Packaging is here to stay but it is relatively new and like anything new it will take time to become assimilated into the conscious thinking of those who are not directly connected with its operation.

In contrast to the popular opinion that graduates of the School of Packaging are little more than gift-wrapping specialists with college educations, a closer look at our functions and purposes may serve to erradicate such erroneous concepts.

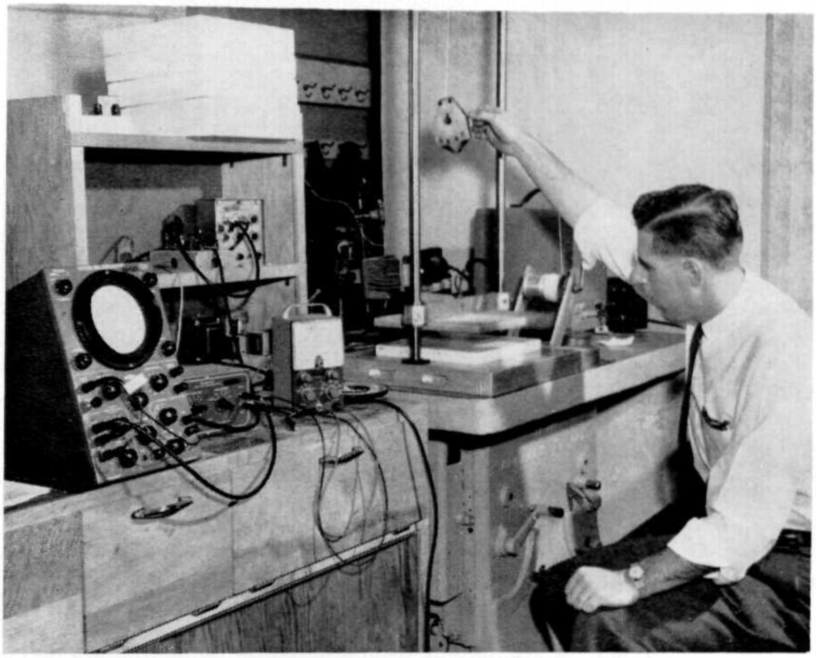
Ninety graduate and undergraduate students are presently enrolled in packaging. Out of one hundred and fifty-six men who have graduated from the curriculum, only two have gone into jobs unrelated to packaging. We are involved in a course which utilizes the basic concepts of business, management, and engineering programs. Familiarity with accounting, business law, speech and the applied sciences are required, and we have more than thirty credits of free electives on which to plan our class schedules. Prior to graduation, each student must compile a minimum of twelve weeks summer employment in some phase of packaging, a job each must obtain for himself. As a member of an industry still in its infancy, the packaging engineer may be expected to assume the role of technician, engineer, purchasing agent or manager. This illustrates the necessity for having such a diverse background. Transfer students from other departments on campus are required to have a 2.75 all-college average before entering the School of Packaging though probationary acceptance has applied in some cases.

The industrial recognition of the importance of packaging is best demonstrated in the work of the Packaging Foundation. This organization, made up solely of leading men in various manufacturing fields, has been responsible for much of the equipment donated to the school as well as for direct financial aid. Under their leadership, a program for constructing a $2,000,000 home for the School of Packaging is presently under way. Recent surveys have indicated that over 80% of the factory labor force is involved in packaging processes. At an American Management Association Packaging Exposition in Chicago's International Amphitheater last spring, 600 companies from 16 different countries were represented along with MSU's entry. The Packaging Material Manufacturers Institute show last November in New York was well attended by members of the school whose booth appeared in the Union Concourse in early December. General Foods, a leader in recognizing the potentials of a packaging education, has recently established the office of Packaging Vice-President in their organizational structure. Even the U. S. Government has gotten into the act and a few of our graduates have received commissions in the special material branch of the Air Force. These men are stationed at various aircraft companies throughout the country, maintaining the rigid standards of government packaging specifications. These examples prove that outside groups are interested in our work, now let's analyze the internal operations of the packaging school.



Graduate Student Howard Blake demonstrates the use of the BALDWIN-EMERY UNIVERSAL TESTING MACHINE, here determining the compression resistance of a cardboard container.

Look around you. Find something that has arrived in its present setting without first being packaged—a chair, a house, this magazine, the lawn, your lunch or your car? No matter what it is or where it is raised it cannot be used until it is delivered to the consumer. Our job as packaging engineers is to determine how to get the product there safely, how to



(Above) Alumnus Al Sasanko finds application for a drop-testing device, in observing the shock absorbing characteristics of materials.

by RICHARD SCOVEL,
Packaging '60

pack it for convenient use and how to make its container appealing to the public. Our materials are wood, paper, paperboard, glass, metal, and plastic. We seal these containers with adhesives and tapes, we identify them with labels and colors and we protect their contents with cushions. Our lab equipment, consisting of presses, tensile testers, dynamic cushion testers, etc., represents methods of material analysis duplicated by few other organizations in the country. The Product Development Division of the Koppers Company of Manaca, Pennsylvania, recently sent one of our alumni to use our equipment to run tests on a new cushioning discovery. Our school represents one of the latest phases in a process that started when the first caveman bundled his belongings in an animal hide in order to move to new hunting grounds. This simple container has been designed, developed and expanded into a Pandora's Box enclosing the problems of a 16 billion dollar a year industry.

The Packaging Society and Packaging Wives are two of our active clubs and we have our own honorary, Pi Kappa Gamma. Our headquarters are in building A-2 on south campus and the five rooms which comprise our office and laboratory are open for your inspection. Drop in and look around. Maybe you will begin to understand why we think that a packaging degree from Michigan State University is a pretty fancy package in itself.

(Right) The KARL-FISHER titration apparatus depicted here is being put to skilled use by students Dick Scovel and Judy Pilgrim in an experiment concerning moisture penetration of package materials.

Missile Launching Submarines . . .

Nuclear power and missiles combine to give United States potent striking weapon.

by JOHN THORNTON, E.E. '62

STRIVING to keep abreast of the Communist countries in military development, the U. S. Navy has revealed a potent striking instrument, the nuclear powered, missile-launching submarine. A highly mobile force of such subs is a deterrent of war as well as a weapon.

These subs can go for months without surfacing, touching a land base, or revealing their positions. Their underwater speed permits them to move rapidly from one location to another undetected.

Just the presence of such a fleet will be a deterrent to war. In turn it will have a great impact on our military tactics. And if war does come, these subs can surface, discharge their missiles in a few minutes and submerge. The damage from their missiles will seriously cripple any nation. There are very few methods that can stop either the sub or its missiles.

How did these submarines develop and how will they affect you?

In the early 1940's, the Germans realized the importance of striking the great industrial centers of the U. S. Their idea was to tow a V-2 rocket container behind one of their long range submarines, surface 100 miles off the east coast of the U. S. and fire their missile at one of our cities. Fortunately for us, the war ended before the German scientists could perfect their weapon. The whole project, including several U-boats and missiles, fell into Russian hands in 1945.

The first attempt to launch a missile from a U. S. sub was made in the Pacific in 1949. The Loon, a modified version of the German V-1, or "buzz bomb," was fired 80 miles out to sea from the U.S.S. Carbonero. Although it was fired directly over a task force, anti-aircraft guns and fighter planes were unable to bring it down. The submarine launched missile had proven itself.

Today, several conventional submarines are equipped with missiles such as the Chance Vought Regulus. But according to the U. S. Navy, nuclear subs armed with the Polaris IRBM will soon be patroling the seas.

The Nuclear Sub

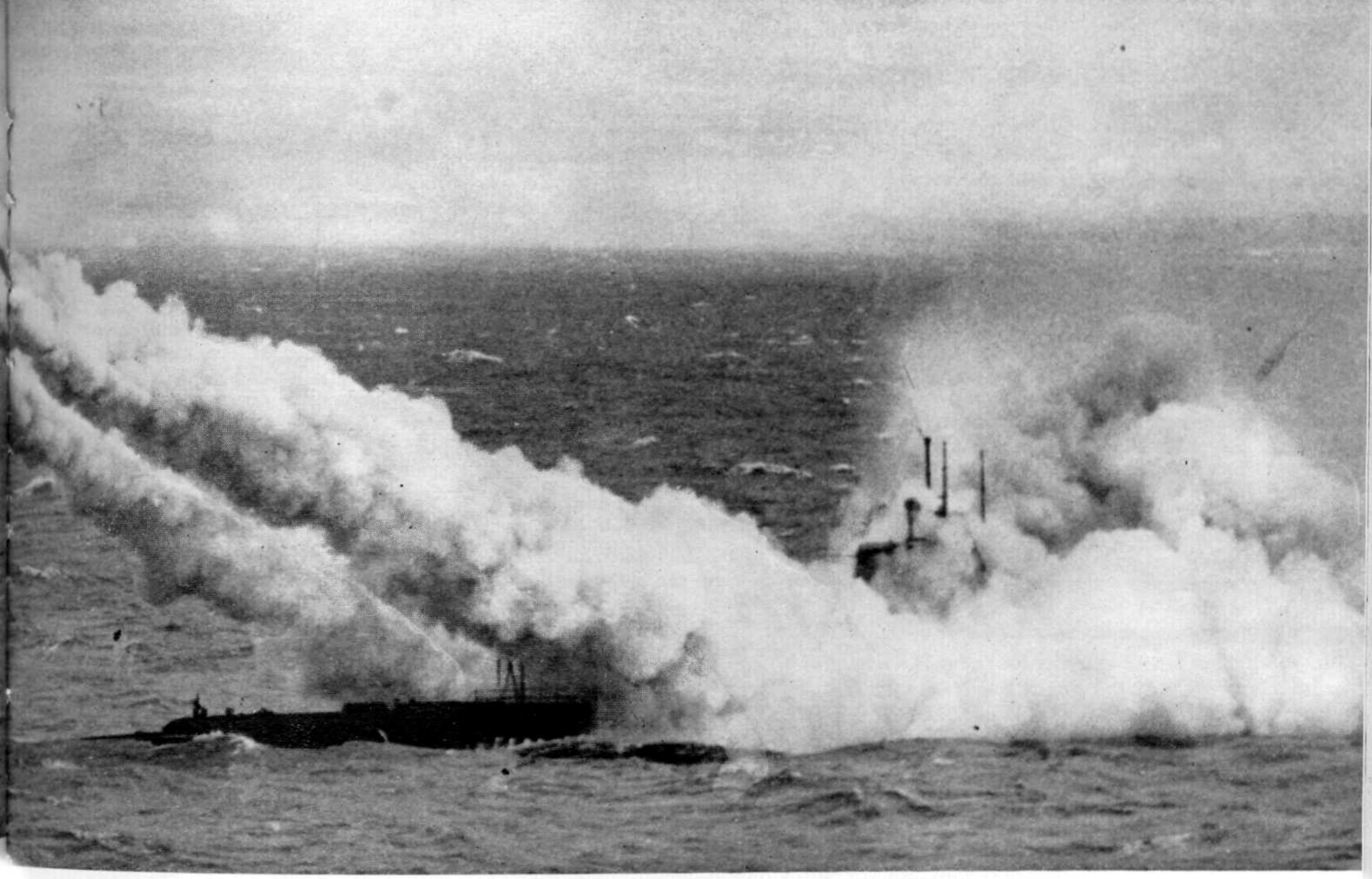
The new nuclear subs are advanced developments of the Skate and Nautilus. Combining the streamline teardrop shape of the nuclear sub Skipjack with the new Westinghouse SW5 reactor, these subs surpass any others in regard to speed, maneuverability and depth of operation.

There are two types or classes of missile launching subs. Submarines of the George Washington class are 380 feet long and displaces 5,600 tons. Each is capable of carrying and launching sixteen Polaris IRBM's while running submerged. At a depth of 1000 feet, they will have a top speed of 40 knots or more. This is about twice as fast as a World War II sub could run on the surface. The average cost of each sub is about 100 million dollars.

The Ethan Allen class is slightly larger. The first keel has just been laid. The length was increased to 410 feet to include some advanced electronic guidance equipment. Although this brings the displacement up to 5,900 tons, it does not impair speed. They are reported to be able to submerge to 3000 feet.

Both classes of submarines are designed for almost unlimited endurance. They can remain submerged for weeks at a time. The heart of their propulsion system is the SW5 reactor, which is the first mass produced reactor in history. It is the prototype reactor for future subs and some surface ships of the U.S. Navy. Although it occupies only twenty feet of a sub's length, it is capable of giving the sub a range of 90,000-100,000 miles at full speed without refueling.

The new subs are so complicated that they will have two complete



Navy submarine USS Tunny launches Chance Vought guided missile, Regulus I, with the aid of twin jet-assist units somewhere in the Pacific (Official U.S. Navy photo)

crews (Blue and Gold) consisting of forty-five men and five officers each. They will be changed at sea to allow the sub to remain on duty for the maximum time possible. In addition to standard air supplies, there will be chemical oxygen generators to increase the time they can remain submerged.

The "brains" of the sub is the Sperry Gyroscope Company's inertial navigation system called "SINS" (Ship Inertial Navigation System). Originally developed to guide missiles, it was adapted for use by submarine. With it, they may pinpoint their position while submerged.

Although designed to launch missiles, the new subs may be used as anti-submarine weapons. They will be armed with the Subroc, a guided torpedo. Fired from a torpedo tube, the Subroc will climb to the surface where its rocket engine will start. Traveling as far as fifty miles, it will locate its target, dive into the water track it with sonar, close in and destroy the enemy sub with its nuclear warhead.

Main Weapon

However, the main weapon of the subs will be the Polaris IRBM. Full scale tests have taken place and the missile will be operational when the George Washington is commissioned this year.

Polaris is a two stage, solid propellent rocket capable of carrying a thermonuclear warhead a distance of 1500 nautical miles. Weighing 14 tons at launching, the Polaris reaches a final velocity of 6000 miles per hour. It carries a nuclear warhead of 100 megatons of power.

Sixteen Polaris missiles will be mounted in vertical tubes in the deck of each sub. When the sub launches one, compressed air will shoot the missile to the surface where the rocket engine will ignite. The missile can be launched while the sub is submerged.

The Polaris is designed to be used against fixed targets such as military bases. It packs enough power to reach any part of the Soviet Union.

(*Continued on Page 38*)

MISSILE LAUNCHING SUBMARINES OF THE U.S. NAVY

NAME	TYPE	DATE COMPLETED	COST	MISSILE
Tunny	Conventional	Active duty	—	Regulus I
Barbero	Conventional	Active duty	—	Regulus I
Grayback	Conventional	Active duty	—	Regulus I, II
Growler	Conventional	1958	na	Regulus I, II
Halibut*	Nuclear	Dec. 1959	$ 54,000,000	Regulus I, II
George Washington	Nuclear	Dec. 1959	$100,000,000	FMB Polaris
Patrick Henry	Nuclear	March 1960	$100,000,000	FMB Polaris
Theodore Roosevelt	Nuclear	June 1960	$100,000,000	FMB Polaris
Robert E. Lee	Nuclear	Sept. 1960	$100,000,000	FMB Polaris
Abraham Lincoln	Nuclear	Dec. 1960	$100,000,000	FMB Polaris
Ethan Allen	Nuclear	June 1961	$105,000,000	FMB Polaris
—	Nuclear	na	$105,000,000	FMB Polaris
—	Nuclear	na	$105,000,000	FMB Polaris
—	Nuclear	na	$105,000,000	FMB Polaris

* Several more subs of the Halibut class were originally intended as missile launchers, but were converted to attack type subs upon cancellation of the Regulus program. Otherwise, all submarines listed above are in actual service or being built as missile launchers.

YOUR GUIDE TO EMPLOYMENT

COLLEGE RECRUITMENT HOLDS CERTAIN RESPONSIBILITIES FOR THE STUDENT AS WELL AS THE COMPANY.

Certain recruitment practices have developed from time to time, in the stress of competition for engineering graduates, which have not been consistent with professional standards. In 1948 a committee appointed by ASEE first studied this problem and published "Ethics of Interviewing Procedures" in 1949.

In 1956, accelerated competition for engineering graduates again occasioned some shortsighted recruitment practices. The ASEE Committee on Ethics decided to revise the 1949 publication. The Midwest College Placement Association also appointed a committee to study the problem, and as a majority of its membership was also affiliated with the ASEE, arrangements were made to review the MCPA committee recommendations.

The Committee on Ethics then published a revision titled "Recruiting Practices and Procedures" in April, 1957. Several months later, the College Placement Council, Inc., and the Chamber of Commerce of the United States jointly issued a statement on "Principles and Practices of College Recruiting."

In September, 1958, a "task force" representing the ASEE Committee on Ethics and the College Placement Council, Inc., met to resolve the differences between the two "codes." The 1959 revision of "Recruiting Practices and Procedures" which follows represents the combined efforts of the "task force" with the exception of item 7 under "Employer Responsibilities." This item contains greater detail about conditions of employment that are most important to engineering students. The ASEE Committee on Ethics believes this detail is essential to the implementation of the "General Principles" expressed in the "code" and consistent with the best interests of the engineering profession.

This statement of "Recruiting Practices and Procedures" has been endorsed by the ECPD Ethics Committee and constitutes a supplement to the ECPD Canons of Ethics. Its purpose is to aid in the development and maintenance of high ethical standards in the procedures of college recruiting and in the relations between the employing organizations, college authorities, and college students who are engaged therein.

GENERAL PRINCIPLES

It is in the best interests of students, colleges and employers alike that the selection of careers be made in an objective atmosphere with complete understanding of all the facts.

Therefore, the recruiting of college students for employment by business, industry, government and education should be carried out by the employers, students and college authorities to serve best the following objectives:

1. To promote a wise and responsible choice of a career by the student for his own greatest satisfaction, minimum wasteful turnover and most fruitful long term investment of his talents for himself, for his employer and for society.

2. To strengthen in him a high standard of integrity and a concept of similar standards in the employing organizations of the country.

3. To develop in the student an attitude of personal responsibility for his own career and advancement in it, based on performance.

4. To minimize interference with the educational processes of the college and to encourage completion of the individual's plans for further education.

PRACTICES AND PROCEDURES

Responsibilities of the Employer

1. The employer should contact the Placement Office well in advance regarding desired interview dates, broad categories of employment expected to be available, college degrees and other pertinent requirements. He should advise promptly any change in his original request or subsequent arrangements with the Placement Office.

2. The employer should provide suitable literature to give students a true and factual picture of the employing organization. This material should be supplied in sufficient quantities and well in advance of the interviewing date.

3. When both the parent organization and subsidiary or affiliated organization conduct interviews in the same college, the respective interviewers should explain clearly their missions and the connections, both to the Placement Office and to the students.

4. Not more than two and preferably only one interviewer representing an employer should appear for each interview schedule. Arrangements for more than two interviewers should be made in advance, and only for reasons considered adequate by the Placement Office.

5. The Placement or other appropriate officer of the college should be advised in advance of any plans for campus visits by the representatives of an employer, including alumni of the college, to acquaint faculty members or students with company employment activities or opportunities. Such representative should exercise scrupulous care to avoid undue demands on the time of faculty or students.

6. An employer who desires to contact an individual student at the time of his interview visit should communicate with the individual well in advance, with a notice to the Placement Office.

7. The interviewer should clearly explain to the Placement Office and students any special requirements such as the passing of tests, physical examinations, signing of patent agreements, or if his job is affected by any union contract.

8. The interviewer should be punctual. He should tell the Placement Office when he will arrive as well as

(*Continued on Page 38*)

DID YOU KNOW? . . .

These scholarships are available to you!

by JOHN BOLT, Geology '62

Obtaining a scholarship is largely a matter of self-help: the student, himself, must investigate and make application for it. Finding information is not difficult, if one knows where to look, but many qualified people do not.

College students can use the following sources: **Scholarships, Fellowships, and Loans,** by **S. Norman Feingold,** a list of scholarships administered by private sources. The new **Financial Aids Handbook** contains a compilation of all scholarships offered through the University. It includes a large number of the independent scholarships, and is available for reference purposes in the Men's Division of Student Affairs. The dormitories also have copies. Exact instructions on how to apply for a particular scholarship are as a rule found in the description of it, along with its amount and eligibility requirements. The scholarships offered to college undergraduates are somewhat variable, and so only their names have been given in the Handbook. The list given here is an amplification of the Handbook list, correct for the fall of 1959, and probably will be substantially correct for the fall of 1960 as well. Application from engineering students for any of the scholarships in the list should be made to the Dean of Engineering.

High school students should begin by talking to their principal. Each high school in Michigan receives, in the fall, application blanks and a synopsis of available scholarships administered by M.S.U. Information about the great number of independent scholarships can be found in the above mentioned: Feingold and the Handbook. Students planning to enter engineering should address inquires about university administered entrance scholarships to: Dean of Engineering, Michigan State University, East Lansing, Michigan.

DONOR	AMOUNT	NUMBER	ELIGIBILITY
American Society For Metals	$500	1	Soph. Met. E.
Bates & Rogers Foundation	Soph. & Jr. $400/yr. Sr. $500/yr.	1 each year	Civil Engineering (Soph. Jr. or Sr.)
Bulldog Electric Products	$500	1 each year	E.E. Jr., Sr., or Grad. Student
Consumers Power	$750-total only Several grants may be made	1 each class	E.E. or M.E. (renewable 3 years)
	$2500	1 new each year	Fulltime Ph.D. preparing for engineering teaching. Maximum tenure three years.
Detroit Edison	$75 + Tuition	1	Resident of Mich.; Soph., Jr. or Sr. in E.E. or M.E.
Douglas Aircraft	$750	1	Sr. in M.E. of E.E.; (U.S. Citizen)
Dow Chemical	$1500	1	Chem. E. grad.
	$500	1	Chem. E. Undergrad.
Dow Corning	$500	1	Sr. in E.E.
Foundry Educational Foundation	$450	2	Jrs. & Srs. in M.E. & Met. (U.S. Citizens only)
International Nickel	$300 + Tuition	1	Met. E. Undergraduate (renewable 4 years)
Malron Foundation	$500/year	2	Soph., Jr. & Sr. in Met. E. or M.E.
Swillie Foundation	$500/year	1	Jr. or Soph. in M.E.
Solvay Process Co.	$1,000 per year	1	Chem. E. Undergraduate (renewable 4 years)
Square D. Co.	$500/year	1 Sr. 1 Jr.	Jr. in E.E. or M.E.
Universal Oil Products	$1,600	Variable	Srs. in Chem. E.
Western Electric	$1,400	1	Undergraduate (U.S. Citizen)
Westinghouse	$500	1	Sr. M.E. or E.E.
Whirlpool Corp.	$275 each	4	M.E. or E.E. Sr. or Jr.
Whirlpool-Geldfrof	$275/yr.	1 each 4th year	M.E. Freshman

BETTER LIVING Comes with Ultrasonics

by JOE POYER, Science Writing '61

Two of man's greatest scourges are about to be settled once and for all. How many times have you sat in a dentist's chair, waiting in agonized anticipation for the dentist's drill? Or, how many times have you stood over a sink full of dirty dishes and sworn to yourself that in the future you would eat from paper plates? Now through the miracle of modern science, you may never have to worry about either again.

Sounds like a TV commercial doesn't it? But it's not. Ultrasonic drills, now being used by dentists, are completely painless and Westinghouse Electric Company has developed an ultrasonic dishwasher.

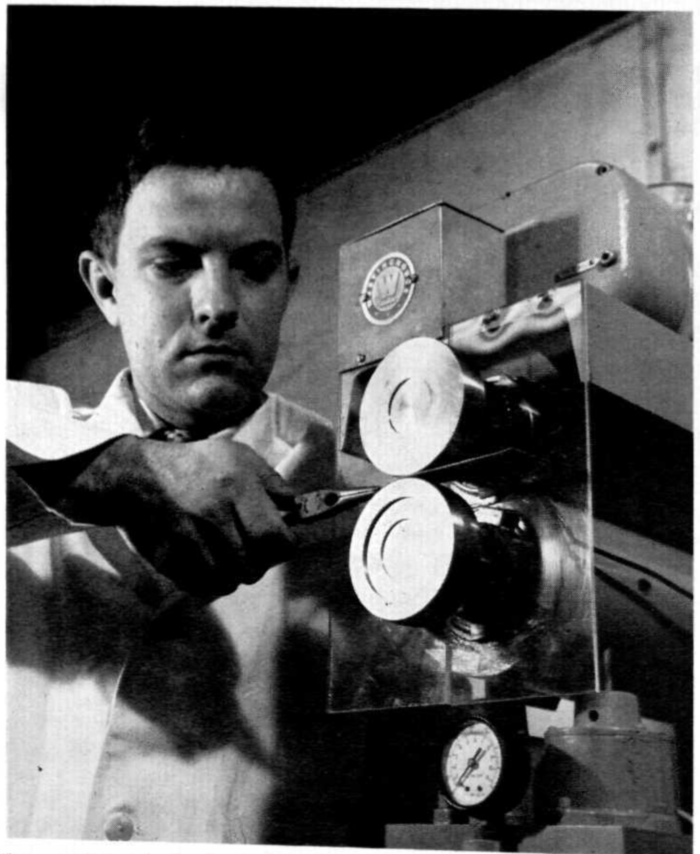
The Theory of Ultrasonic Sound

The division between sonic and ultrasonic sound occurs at about 17,000 cycles per second. A cycle is the wave-like motion that a sound describes while traveling through any physical medium, be it a solid, a liquid, or a gas.

Essentially, a sound wave is the deformation of the physical medium in which it is traveling. It consists of an alternate compression and rarefraction or decompression of the physical medium. This compression and decompression can be compared to the action of a bellows. As you push the two handles together, you force air out of the bag by compressing it. When you pull the handles apart, you decompress the bag and allow the air to rush in.

When a sound wave travels through a medium, the molecules are forced from their places in the molecular structure and the medium is compressed. After the wave front passes, the molecules resume their places in the structure until the next wave front reaches them. This alternate compression and decompression of the medium is vibration and sound waves are composed of vibrations.

Ultrasonics are readily transmitted in solids. In fact solids are the best conductors of ultrasonics of the three physical mediums. The closely packed molecular structure of the solids allows a "tighter" vibration. By this, is meant the solid does not allow a wide area of deformation and dissipation of the energy of the sound wave.



This model of the Westinghouse developed ultrasonic seam welder is shown completing a weld between two 10-mil-thick aluminum straps. This weld is performed by passing the aluminum sheets between the two wheels which vibrate at 20 kilocycles per second. The periphery of these wheels press against the metals and break up the oxide coating on the metal's surface. By a kneeding action the metal lattices on the surfaces weld themselves.

In liquids, there is no real molecular structure, but the molecular attraction between the molecules of the liquid restricts the area of deformation and dissipation enough to make liquids good conductors of ultrasonic sound waves.

In gases, the dispersement of the molecules allows the ultrasonic wave energy to be dissipated quickly and within a very short distance from the source. It is therefore readily apparent that solids make the best conductors of ultrasonic waves.

Walter G. Mayer, asst. professor of physics and astronomy at Michigan State University, is conducting research on the basic properties of wave propagation.

The research is being done on methods to make visible for more detailed study, the propagation of sound waves in a liquid medium.

As a sound wave crosses a beam of monochromatic light, it acts as a diffraction grating and breaks the light beam up into its component colors, thereby causing a diffraction pattern or as it is more commonly known, a rainbow. The sound wave takes the place of a raindrop or any other prism. When a beam of light is passed through the prism it is broken down into its component colors thereby causing a rainbow effect. This rainbow effect is called a diffraction pattern. From the spacing of the lines of color in the pattern it is possible to investigate the characteristics of the velocity of light.

This diffraction phenomenon is called the *Debye-Sears Sound Diffraction Action.* This phenomenon depends on the fact that ultrasonic waves actually consist of an alternate compression and expansion of the medium through which the sound wave is passing.

The application of this phenomenon is useful in tracing the course of ultrasonic waves and investigating the action of light passage through lenses and crystals.

Applications of Ultrasonic Energy

Several promising applications of ultrasonic energy are being investigated. The most important, and perhaps, the most fascinating, is the use of ultrasonics in cleaning. The cleaning is accomplished by a phenomenon called **cavitation.** The object to be cleaned is immersed in a liquid solvent. Ultrasonic sound waves are then beamed into the liquid. As the power level is increased, the molecules of the solvent undergo intense accelerations within the lattice structure. When a certain power level is reached, the lattice is ripped apart wherever impurities are present, usually at the interface, or surface, of the liquid and the object being cleaned. The points of rupture will become cavities because the high frequency vibrations will have vaporized the molecules of the solvent. As the cycle passes, these points of strain will collapse, producing tremendous pressures locally (around 1,000 atmospheres or 15,000 pounds per square inch and temperatures of nearly 1,000 degrees F.).

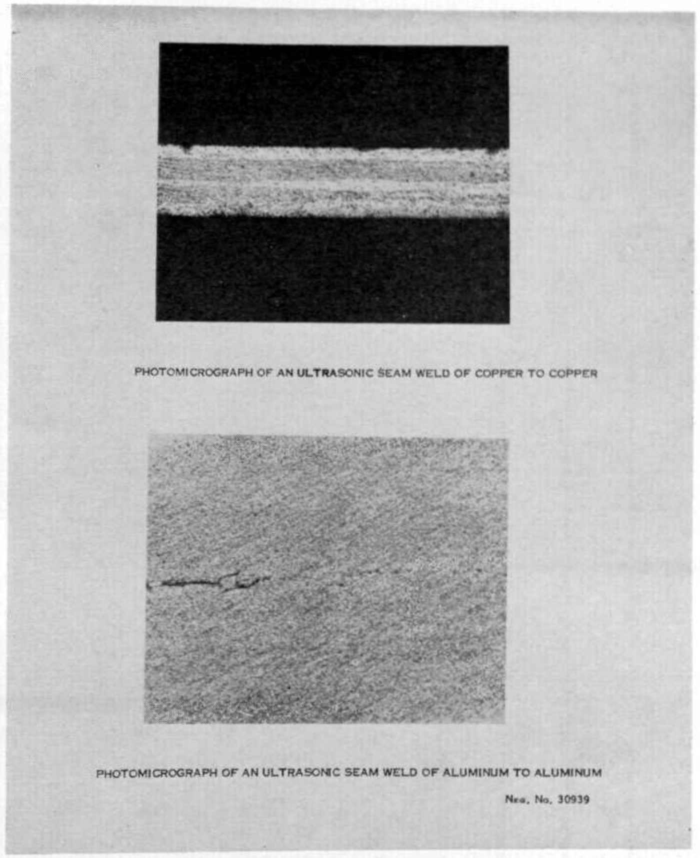
The result is that the dirt is literally blasted off the object being cleaned. This cleaning technique is ten to twenty times faster than the ordinary methods, and it allows fully assembled pieces of appartus to be cleaned, thus removing completely the time needed for disassembling the equipment.

As mentioned earlier, Westinghouse has developed an ultrasonic dishwasher that will wash dishes faster, cleaner and without scrapping in both hot and cold water. It is also possible to sterilize them at the same time by using the cavitation principle to decontaminate radio-active materials.

The phenomenon of cavitation has also been used to detect gas bubble flaws in molten metal and eliminate them by destroying the gas bubbles.

Cut a star shapped hole in a piece of high tensile strength steel! Impossible by ordinary drilling and cutting methods. But by using a newly developed method for cutting and drilling holes in just about anything, including teeth, it is possible to apply ultrasonic energy to do the job.

By using a transducer, a device for producing or receiving ultrasonic waves, to vibrate a tool at about 30 kilocycles and allowing a slurry of abrasive particles to run over the article to be drilled, a neat, perfectly cut hole can be drilled or cut by the action of the vibrating tool on the abrasive particles which chip away the material. By this method oddly shapped holes have been cut in ceramics, metals, and even the most brittle glasses.



Magnified 100 times, the copper-to-copper seam weld (top) shows no line of demarcation in the weld. This seam weld shows a pronounced cold work structure and there is no indication of a cast structure as might be obtained with fusion welds. The photomicrograph at the bottom shows one edge of a seam weld. The unwelded area at the left was not part of the weld but was included to show the difference between welded and unwelded sections.

Seam Welding

An ultransonic seam welder works like this. Sheets of metal to be welded together are passed between two wheels that are vibrating at 20 kilocycles. These wheels press on the metals from opposite sides thus breaking up the oxides that form on the surface. By producing a kneeding action the crystal structures on the surfaces of the metal are welded together.

No electric current is passed through the metals although the weld has the appearance of an electric weld. This new process will allow dissimilar metals, that are not readily weldable with present techniques, to be welded. The only other process for welding dissimilar metals is the cold welding process. The great disadvantage of cold welding is that it

(*Continued on Page 56*)

a LOOK inside your placement bureau

by NEWT BLACK,
Tech. Writing '60

WITHIN the next few years you probably will be sitting in one of the 21 interview rooms in the Placement Bureau. Across from you will be a representative from a large company—an executive engineer. "Why would you like to work for our company?" he will ask.

This is the climax of your college career; the goal for which you have spent four years of your life. Your future rests on the impression that you make upon this man.

But you, as a student at MSU, have an advantage over students in other universities. Your Placement Bureau is one of the most modern employment facilities offered by an American university.

Located on the first floor of the Student Services Building, the bureau offers a centralized point for you to meet representatives from companies across the United States. More than 1,000 employing organizations will make use of the facilities of the bureau this year. Four full-time men and 13 secretaries operate the largest campus placement system in the country.

What are the funtions of the bureau, and how do they apply to you?

Jack Kinney, director of the Placement Bureau, said, "Our objective is

An interview in progress. This is one of the 21 such rooms used for interviewing at the Placement Bureau.

The main lobby of the Placement Bureau. Many people will be seen in the lobby during days when interviews are being conducted. *(Photos by Norm Hines)*

to get more employers to come to this campus, and more students to interview." Kinney, an all-American baseball player at MSU in 1950, seems to be reaching this goal. Since the bureau moved from Morrill Hall to the Student Services Building in 1957, the number of interviews has jumped from less than 5,000 to an expected 15,000 this year.

"We are not only concerned about getting a graduating senior a job," said Kinney, "but we also want him to get the right job. And we want to make the process pleasant and easy for both the students and employers."

From the standpoint of the employer, the function of the interview is to find out whether a student is a possibility for the interviewer's company. If the interviewer desires a certain student, he will either make a direct offer to him, or invite the prospective employee on a tour of the company's facilities.

But this procedure usually takes a month or more. When the interviewer leaves the campus, he takes a copy of the student's records back to his company. Other company executives look over the qualifications of the student and decide whether they want him in their organization.

If they do, they will probably invite the graduating senior to the company so that more company officials can meet him. At the same time the student will get an opportunity to view the organization from within. Thus, both the company and the prospective employee are better able to evaluate each other.

After this tour is over, and if the employer wants the student, he will make an offer to him. Since this procedure takes a long time, especially if a student makes two or more trips to see different companies, it is usually best to start interviewing early in the senior year.

A successful job interview is a major step toward fulfillment of your ambitions. The 20 or 30 minutes you spend with the interviewer may determine the entire future of your life.

You have spent a sixteen-year period in academic preparation for a job, and you sell yourself to an employer in just thirty minutes or less of interview time—that is, if you are prepared for the interview. If not, you may still be looking for a job.

The Placement Bureau has two books that are especially helpful to the prospective interviewee. One is **Your Job Interview,** and the other, **College Placement Annual.** Copies of these helpful books are free.

What is a good procedure to follow in preparing for an interview?

First, the Placement Bureau posts a "green sheet," listing the companies that will be interviewing during the following week. You must sign up for an interview one week in advance. This is a pleasant task. Two helpful secretaries, Mrs. Shirley Gecowets and Mrs. Sally Herr, receptionists at the bureau, will tell you the openings that are available for an interview with the company in which you are interested.

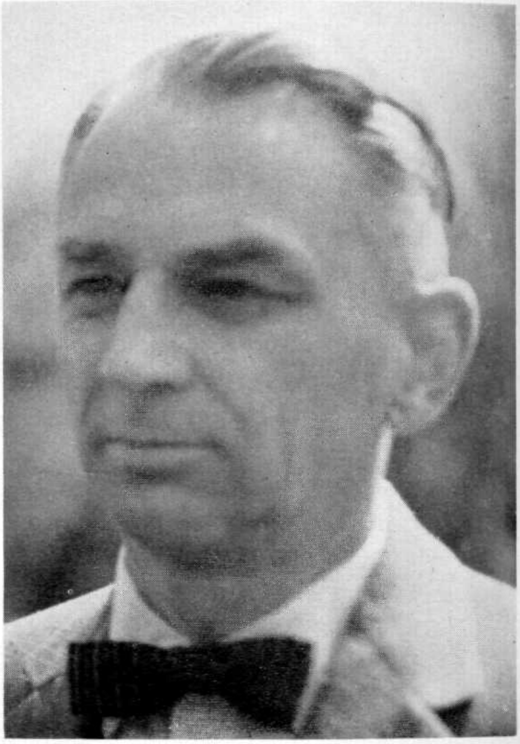
After you sign up, the next step will be to become familiar with the company so that you can talk intelligently with its representative. The bureau library is for this purpose. It has brochures and catalogs from every company which will interview during the year.

Your next step is to arrive for the interview about 15 minutes early. At

(Continued on Page 56)

SERVICE!

B. K. Osborn devoted to electrical engineering at M. S. U.



by GEORGE FOLEY, Pre-Law '62

IF one word could be used to describe B. K. Osborn's career at Michigan State University it would be service. Mr. Osborn, with 36 years as a member of Engineering faculty, is familiar to the majority of the Electrical Engineering graduates at MSU.

Mr. Osborn, a graduate of the University of Michigan, received his degree in Electrical Engineering in 1918. He was employed at Michigan Bell Telephone Company and Adams X-ray for several years. He received an appointment to Michigan State's Engineering staff as an instructor in 1924, and has seen Michigan State grow from a relatively small agricultural college to its present status as a Big Ten University.

Mr. Osborn has played an important part in this growth. He provided the basis for much of Michigan State's recent expansion in Electrical Engineering, by developing the electronics and communications laboratory practically from scratch in 1924 to where it was on a par with other schools of comparable size. He has kept pace with the almost daily new developments in the Electrical Engineering field. Perhaps the reason for this is his keen interest in the world around him. According to his wife, Evelyn, he never leaves any stones unturned in his interest in engineering.

High on the list of his many activities are his hobbies. They include photography, sailing, listening to music, and part-time gardening. At the present time, he is concentrating primarily on photography. He doesn't have any special subjects which he photographs, but one can be sure that among his favorites are his three sons; David, a graduate of the University of Michigan; Stephen, a graduate of Michigan State; and Kenneth, who is presently enrolled at Michigan State as a junior. No doubt his two grandchildren will also claim a prize place in his album.

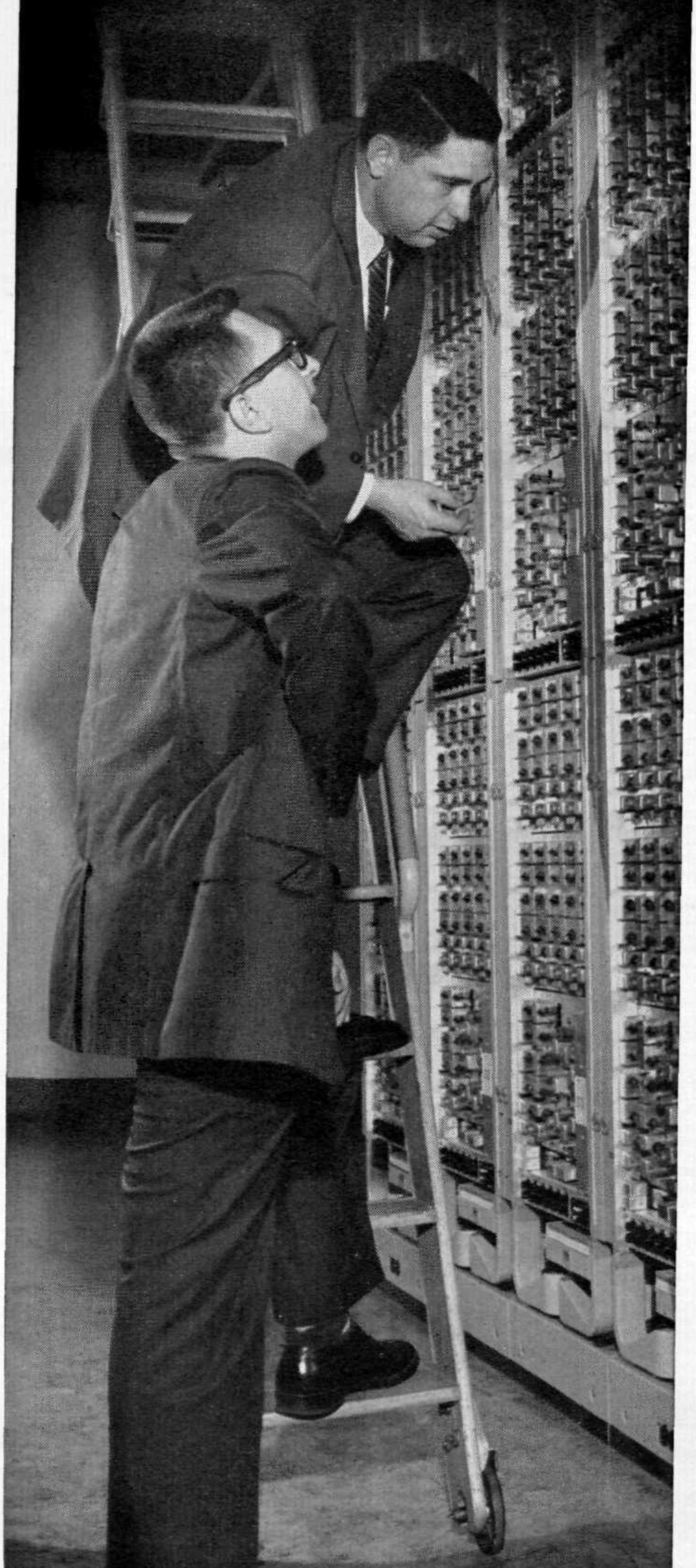
Mr. Osborn was born near Lake Michigan in the town of Springport. This might account for his interest in sailing. The Osborn's have a canoe which they put a sail on. This provides enjoyable recreation for the whole family.

It was almost inevitable that Mr. Osborn, being very apt in laboratory work, should become an amateur radio operator. He owned a ham set for a number of years and during that time was a member of the American Radio Relay League. In connection with his laboratory work he has had articles which have appeared in various trade magazines and professional journals.

Mr. Osborn's professional affiliations include membership in the A.I.E.E. and the I.R.E. He has occupied a prominent position in "Who's Who in Engineering" for a number of years.

Over the past 36 years Mr. Osborn has given invaluable contributions to the growth and development of this university. Everyone at Michigan State can certainly be proud of the fine work that he has done.

MEET BURNELL RICHARDSON AND DICK MASLOWSKI



They're transmission engineers with Michigan Bell Telephone Company in Detroit. Burnell graduated from Western Michigan in 1951 with a B.S. in Physics, spent four years in the Navy, then joined the telephone company. His present work is with carrier systems, as they relate to Direct Distance Dialing facilities.

Dick got his B.S.E.E. degree from Michigan in 1956 and came straight to Michigan Bell. He is currently engineering and administering a program to utilize new, transistorized repeater (amplifier) equipment.

Both men are well qualified to answer a question you might well be asking yourself: "What's in telephone company engineering for *me?*"

SAYS DICK:

"There's an interesting day's work for you *every* day. You really have to use your engineering training and you're always working with new developments. Every time Bell Laboratories designs a new and more efficient piece of equipment, you are *challenged to incorporate it in our system effectively and economically.* For example, I have been working on projects utilizing a newly developed voice frequency amplifier. It's a plug-in type—transistorized—and consumes only two watts, so it has lots of advantages. But I have to figure out where and how it can be used in our sprawling network to provide new and improved service. Technological developments like this really put spice in the job."

SAYS BURNELL:

"*Training* helps, too—and you get the best. Through an interdepartmental training program, you learn how company-wide operations dovetail. You also get a broad background by rotation of assignments. I'm now working with carrier systems, but previously worked on repeater (amplifier) projects as Dick is doing now. Most important, I think you always learn 'practical engineering.' You constantly search for the solution that will be most economical in the long run."

There's more, of course—but you can get the whole story from the Bell interviewer. He'll be visiting your campus before long. Be sure to sit down and talk with him.

BELL TELEPHONE COMPANIES

Fudge Factors

MULTIPLY	BY	TO OBTAIN
Abamperes	10	amperes.
Abamperes	3×10^{10}	statamperes.
abamperes per sq. cm.	64.52	amperes per sq. inch.
abampere-turns	10	ampere-turns
abampere-turns	12.57	gilberts
abampere-turns per cm.	25.40	ampere-turns per inch
abcoulombs	10	coulombs.
abcoulombs	3×10^{10}	statcoulombs
abcoulombs per sq. cm.	64.52	coulombs per sq. inch.
abfarads	10^{9}	farads
abfarads	10^{15}	microfarads.
abfarads	9×10^{20}	statfarads.
abhenries	10^{-9}	henries
abhenries	10^{-6}	millihenries.
abhenries	$1/9 \times 10^{-20}$	stathenries.
abmhos per cm. cube	1.662×10^{2}	mhos per mil foot.
abmhos per cm. cube	10^{3}	megmhos per cm. cube.
abohms	10^{-15}	megohms
abohms	10^{-3}	microhoms.
abohms	10^{-9}	ohms.
abohms	$1/9 \times 10^{-20}$	statohms.
abohms per cm. cube	10^{-3}	microhms per cm. cube.
abohms per cm. cube	6.015×10^{-3}	ohms per mil foot.
abvolts	$1/3 \times 10^{-10}$	statvolts.
abvolts	10^{-8}	volts.
acres	43,560	square feet.
acres	4047	square meters.
acres	1.562×10^{-3}	square miles.
acres	5645.38	square varas.
acres	4840	square yards.
acre-feet	43,560	cubic-feet.
acre-feet	3.259×10^{5}	gallons.
amperes	1/10	abamperes.
amperes	3×10^{9}	statamperes.
amperes per sq. cm.	6.452	amperes per sq. inch.
amperes per sq inch	0.01550	abamperes per sq. cm.
amperes per sq inch	0.1550	amperes per sq. cm.
amperes per sq inch	4.650×10^{8}	statamperes per sq. cm.
ampere-turns	1/10	abampere-turns.
ampere-turns	1.257	gilberts.
ampere-turns per cm.	2.540	ampere-turns per in.
ampere-turns per inch	0.03937	abampere-turns per cm.
ampere-turns per inch	0.3937	ampere-turns per cm.
ampere-turns per inch	0.4950	gilberts per cm.
areas	0.02471	acres.
areas	100	square meters.
atmospheres	76.0	cms. of mercury.
atmospheres	29.92	inches of mercury.
atmospheres	33.90	feet of water.
atmospheres	10,333	kgs. per sq. meter.
atmospheres	14.70	pounds per sq. inch.
atmospheres	1.058	tons per sq. foot.
Bars	9.870×10^{-7}	atmospheres.
Bars	1	dynes per sq. cm.
Bars	0.01020	kgs. per square meter
Bars	2.089×10^{-3}	pounds per sq. foot.
Bars	1.450×10^{-5}	pounds per sq. inch.
board-feet	144 sq. in.x1 in.	cubic inches.
British thermal units	0.2530	kilogram-calories.
British thermal units	777.5	foot-pounds.
British thermal units	3.927×10^{-4}	horse-power-hours.
British thermal units	1054	joules.
British thermal units	107.5	kilogram-meters.
British thermal units	2.928×10^{-4}	kilowatt-hours.
B.t.u. per min	12.96	foot-pounds per sec.
B.t.u. per min	0.02356	horse-power.
B.t.u. per min	0.01757	kilowatts.
B.t.u. per min	17.57	watts.
B.t.u. per sq. ft. per min	0.1220	watts per square inch.
bushels	1.244	cubic feet.
bushels	2150	cubic inches.
bushels	0.03524	cubic meters.
bushels	4	pecks.
bushels	64	pints (dry).
bushels	32	quarts (dry)
Centares	1	square meters.
centigrams	0.01	grams.
centiliters	0.01	liters.
centimeters	0.3937	inches.
centimeters	0.01	meters.
centimeters	393.7	mils.
centimeters	10	millimeters.
centimeter-dynes	1.020×10^{-3}	centimeter-grams.
centimeter-dynes	1.020×10^{-8}	meter-kilograms.
centimeter-dynes	7.376×10^{-8}	pound-feet.

MULTIPLY	BY	TO OBTAIN
centimeter-grams	980.7	centimeter-dynes.
centimeter-grams	10^{-5}	meter-kilograms.
centimeter-grams	7.233×10^{-5}	pound-feet.
centimeters of mercury	0.01316	atmospheres.
centimeters of mercury	0.4461	feet of water.
centimeters of mercury	136.0	kgs. per square meter.
centimeters of mercury	27.85	pounds per sq. foot.
centimeters of mercury	0.1934	pounds per sq. inch.
centimeters per second	1.969	feet per minute.
centimeters per second	0.03281	feet per second.
centimeters per second	0.036	kilometers per hour.
centimeters per second	0.6	meters per minute.
centimeters per second	0.02237	miles per hour.
centimeters per second	3.728×10^{-4}	miles per minute.
cms. per sec. per sec.	0.03281	feet per sec. per sec.
cms. per sec. per sec.	0.036	kms. per hour per sec
cms. per sec. per sec.	0.02237	miles per hour per sec
circular mils	5.067×10^{-6}	square centimeters.
circular mils	7.854×10^{-7}	square inches.
circular mils	0.7854	square mils.
cord-feet	4 ft.x4 ft.x1 ft.	cubic feet.
cords	8 ft.x4 ft.x4 ft.	cubic feet.
coulombs	1/10	abcoulombs.
coulombs	3×10^{9}	statcoulombs.
coulombs per sq. inch	0.01550	abcoulombs per sq. cm
coulombs per sq inch	0.1550	coulombs per sq. cm.
coulombs per sq. inch	4.650×10^{8}	statcouls. per sq. cm.
cubic centimeters	3.531×10^{-5}	cubic feet.
cubic centimeters	6.102×10^{-2}	cubic inches.
cubic centimeters	10^{-6}	cubic meters.
cubic centimeters	1.308×10^{-6}	cubic yards.
cubic centimeters	2.642×10^{-4}	gallons.
cubic centimeters	10^{-3}	liters.
cubic centimeters	2.113×10^{-3}	pints (liq.).
cubic centimeters	1.057×10^{-3}	quarts (liq.).
cubic feet	2.832×10^{4}	cubic cms.
cubic feet	1728	cubic inches.
cubic feet	0.02832	oubic meters.
cubic feet	0.03704	cubic yards.
cubic feet	7.481	gallons.
cubic feet	28.32	liters.
cubic feet	59.84	pints (liq.).
cubic feet	29.92	quarts (liq.).
cubic feet per minute	472.0	cubic cms. per sec.
cubic feet per minute	0.1247	gallons per sec.
cubic feet per minute	0.4720	liters per second
cubic feet per minute	62.4	lbs. of water per min.
cubic inches	16.39	cubic centimeters.
cubic inches	5.787×10^{-4}	cubic feet.
cubic inches	1.639×10^{-5}	cubic meters.
cubic inches	2.143×10^{-5}	cubic yards.
cubic inches	4.329×10^{-3}	gallons.
cubic inches	1.639×10^{-2}	liters.
cubic inches	0.03463	pints (liq.).
cubic inches	0.01732	quarts (liq.).
cubic meters	10^{6}	cubic centimeters
cubic meters	35.31	cubic feet.
cubic meters	61,023	cubic inches.
cubic meters	1.308	cubic yards.
cubic meters	264.2	gallons.
cubic meters	10^{3}	liters.
cubic meters	2113	pints (liq.).
cubic meters.	1057	quarts (liq.).
cubic yards	7.646×10^{5}	cubic centimeters.
cubic yards	27	cubic feet.
cubic yards	46,656	cubic inches.
cubic yards	0.7646	cubic meters.
cubic yards	202.0	gallons.
cubic yards	764.6	liters.
cubic yards	1616	pints (liq.).
cubic yards	807.9	quarts (liq.).
cubic yards per minute	0.45	cubic feet per second.
cubic yards per minute	3.367	gallons per second.
cubic yards per minute	12.74	liters per second.
Days	24	hours.
Days	1440	minutes.
Days	86,400	seconds.
decigrams	0.1	grams.
deciliters	0.1	liters.
decimeters	0.1	meters.
degrees (angle)	60	minutes.
degrees (angle)	0.01745	radians.
degrees (angle)	3600	seconds.
degrees per second	0.01745	radians per second.
degrees per second	0.1667	revolutions per min.
degrees per second	0.002778	revolutions per sec.
dekagrams	10	grams.
dekaliters	10	liters.
dekameters	10	meters.
dollars (U.S.)	5.182	francs (French).
dollars (U.S.)	4.20	marks (German).
dollars (U.S.)	0.2055	pounds sterling (Brit.)
dollars (U.S.)	4.11	shillings (British)
drams	1.772	grams.
drams	0.0625	ounces.
dynes	1.020×10^{-3}	grams.
dynes	7.233×10^{-5}	poundals.

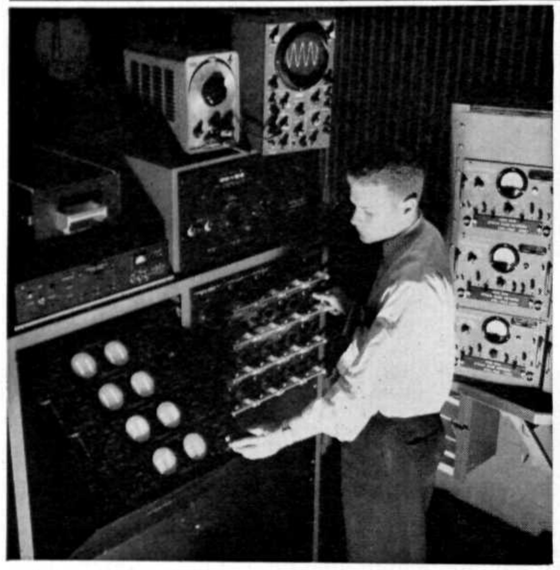
MULTIPLY	BY	TO OBTAIN
dynes	2.248×10^{-6}	pounds.
dynes per square cm.	1	bars.
Ergs	9.486×10^{-11}	British thermal units.
Ergs	1	dyne-centimeters.
Ergs	7.376×10^{-8}	foot-pounds.
Ergs	1.020×10^{-3}	gram-centimeters.
Ergs	10^{-7}	joules.
Ergs	2.390×10^{-11}	kilogram-calories.
Ergs	1.020×10^{-8}	kilogram-meters.
ergs per second	5.692×10^{-9}	B.t. units per minute.
ergs per second	4.426×10^{-6}	foot-pounds per min.
ergs per second	7.376×10^{-8}	foot-pounds per sec.
ergs per second	1.341×10^{-10}	horse-power.
ergs per second	1.434×10^{-9}	kg.-calories per min.
ergs per second	10^{-10}	kilowatts.
Farads	10^{-9}	abfarads.
Farads	10^{6}	microfarads.
Farads	9×10^{-11}	statfarads.
fathoms	6	feet.
feet	30.48	centimeters.
feet	12	inches.
feet	0.3048	meters.
feet	.36	varas.
feet	1/3	yards.
feet of water	0.02950	atmospheres.
feet of water	0.8826	inches of mercury.
feet of water	304.8	kgs. per square meter.
feet of water	62.43	pounds per sq. ft.
feet of water	0.4335	pounds per sq. inch.
feet per minute	0.5080	centimeters per sec.
feet per minute	0.01667	feet per sec.
feet per minute	0.01829	kilometers per hour.
feet per minute	0.3048	meters per minute.
feet per minute	0.01136	miles per hour.
feet per second	30.48	centimeters per sec.
feet per second	1.097	kilometers per hour.
feet per second	0.5921	knots per hour.
feet per second	18.29	meters per minute.
feet per second	0.6818	miles per hour.
feet per second	0.01136	miles per minute.
feet per 100 feet	1	per cent grade.
feet per sec. per sec.	30.48	cms. per sec. per sec.
feet per sec. per sec.	1.097	kms. per hr. per sec.
feet per sec. per sec.	0.3048	meters per sec. per sec.
feet per sec. per sec.	0.6818	miles per hr. per sec.
foot-pounds	1.286×10^{-3}	British thermal units.
foot-pounds	1.356×10^{7}	ergs.
foot-pounds	5.050×10^{-7}	horse-power-hours.
foot-pounds	1.356	joules.
foot-pounds	3.241×10^{-4}	kilogram-calories.
foot-pounds	0.1383	kilogram-meters
foot-pounds	3.766×10^{-7}	kilowatt-hours.
foot-pounds per minute	1.286×10^{-3}	B.t. units per minute.
foot-pounds per minute	0.01667	foot-pounds per sec.
foot-pounds per minute	3.300×10^{-5}	horse-power.
foot-pounds per minute	3.241×10^{-4}	kg.-calories per minute.
foot-pounds per minute	2.260×10^{-5}	kilowatts.
foot-pounds per second	7.717×10^{-2}	B.t. units per minute.
foot-pounds per second	1.818×10^{-3}	horse-power.
foot-pounds per second	1.945×10^{-2}	kg.-calories per min.
foot-pounds per second	1.356×10^{-3}	kilowatts.
francs (French)	0.193	dollars (U.S.).
francs (French)	0.811	marks (German).
francs (French)	0.03865	pounds sterling (Brit.).
furlongs	40	rods.
Gallons	3785	cubic centimeters.
Gallons	0.1337	cubic feet.
Gallons	231	cubic inches.
Gallons	3.785×10^{-3}	cubic meters.
Gallons	4.951×10^{-3}	cubic yards.
Gallons	3.785	liters.
Gallons	8	pints (liq.).
Gallons	4	quarts (liq.).
gallons per minute	2.228×10^{-3}	cubic feet per second.
gallons per minute	0.06308	liters per second.
gausses	6.452	lines per square inch.
gilberts	0.07958	abampere-turns.
gilberts	0.7958	ampere-turns.
gilberts per centimeter	2.021	ampere-turns per inch.
gills	0.1183	liters.
gills	0.25	pints (liq.).
grains (troy)	1	grains (av.).
grains (troy)	0.06480	grams.
grains (troy)	0.04167	pennyweights (troy).
grams	980.7	dynes.
grams	15.43	grains (troy).
grams	10^{-3}	kilograms.
grams	10^{3}	milligrams.
grams	0.03527	ounces.
grams	0.03215	ounces (troy).
grams	0.07093	poundals.
grams	2.205×10^{-3}	pounds.
gram-calories	3.968×10^{-3}	British thermal units.
gram-centimeters	9.302×10^{-8}	British thermal units.
gram-centimeters	980.7	ergs.
gram-centimeters	7.233×10^{-5}	foot-pounds.

MULTIPLY	BY	TO OBTAIN
gram-centimeters	9.807×10^{-5}	joules.
gram-centimeters	2.344×10^{-8}	kilogram-calories.
gram-centimeters	10^{-5}	kilogram-meters.
grams per cm.	5.600×10^{-3}	pounds per inch.
grams per cu. cm.	62.43	pounds per cubic foot.
grams per cu. cm.	0.03613	pounds per cubic inch.
grams per cu. cm.	3.405×10^{-7}	pounds per mil-foot.
Hectares	2.471	acres.
Hectares	1.076×10^{5}	square feet.
hectograms	100	grams.
hectoliters	100	liters.
hectometers	100	meters.
hectowatts	100	watts.
hemispheres (sol. angle)	0.5	sphere.
hemispheres (sol. angle)	4	spherical right angles.
hemispheres (sol. angle)	6.283	steradians.
henries	10^{9}	abhenries.
henries	10^{3}	millihenries.
henries	$1/9 \times 10^{-11}$	stathenries.
horse-power	42.44	B.t. units per min.
horse-power	33,000	foot-pounds per min.
horse-power	550	foot-pounds per sec.
horse-power	1.014	horse-power (metric)
horse-power	10.70	kg.-calories per min.
horse-power	0.7457	kilowatts.
horse-power	745.7	watts.
horse-power (boiler)	33,520	B.t.u. per hour.
horse-power (boiler)	9.804	kilowatts.
horse-power-hours	2547	British thermal units.
horse-power-hours	1.98×10^{6}	foot-pounds.
horse-power-hours	2.684×10^{6}	joules.
horse-power-hours	641.7	kilogram-calories.
horse-power-hours	2.737×10^{5}	kilogram-meters.
horse-power-hours	0.7457	kilowatt-hours.
hours	60	minutes.
hours	3600	seconds.
Inches	2.540	centimeters.
Inches	10^{3}	mils.
Inches	.03	varas.
Inches of mercury	0.03342	atmospheres.
Inches of mercury	1.133	feet of water.
Inches of mercury	345.3	kgs. per square meter.
Inches of mercury	70.73	pounds per square ft.
Inches of mercury	0.4912	pounds per square in.
Inches of water	0.002458	atmospheres.
Inches of water	0.07355	inches of mercury.
Inches of water	25.40	kgs. per square meter.
Inches of water	0.5781	ounces per square in.
Inches of water	5.204	pounds per square ft.
Inches of water	0.03613	pounds per square in.
Joules	9.486×10^{-4}	British thermal units.
Joules	10^{7}	ergs.
Joules	0.7376	foot-pounds.
Joules	2.390×10^{-4}	kilogram-calories.
Joules	0.1020	kilogram-meters
Joules	2.778×10^{-4}	watt-hours.
Kilograms	980.665	dynes.
Kilograms	10^{3}	grams.
Kilograms	70.93	poundals.
Kilograms	2.2046	pounds.
Kilograms	1.102×10^{-3}	tons (short).
kilogram-calories	3.968	British thermal units.
kilogram-calories	3086	foot-pounds.
kilogram-calories	1.558×10^{-3}	horse-power-hours.
kilogram-calories	4183	joules.
kilogram-calories	426.6	kilogram meters.
kilogram-calories	1.162×10^{-3}	kilowatt-hours.
kg.-calories per min.	51.43	foot-pounds per sec.
kg.-calories per min.	0.09351	horse-power.
kg.-calories per min.	0.06972	kilowatts.
kgs.-cms. squared	2.373×10^{-3}	pounds-feet squared.
kgs.-cms. squared	0.3417	pounds-inches squared.
kilogram-meters	9.302×10^{-3}	British thermal units.
kilogram-meters	9.807×10^{7}	ergs.
kilogram-meters	7.233	foot-pounds.
kilogram-meters	9.807	joules.
kilogram-meters	2.344×10^{-3}	kilogram-calories.
kilogram-meters	2.724×10^{-6}	kilowatt-hours.
kgs. per cubic meter	10^{-3}	grams per cubic cm.
kgs. per cubic meter	0.06243	pounds per cubic foot.
kgs. per cubic meter	3.613×10^{-5}	pounds per cubic inch.
kgs. per cubic meter	3.405×10^{-10}	pounds per mil. foot.
kgs. per meter	0.6720	pounds per foot.
kgs. per square meter	9.678×10^{-5}	atmospheres.
kgs. per square meter	98.07	bars.
kgs. per square meter	3.281×10^{-3}	feet of water.
kgs. per square meter	2.896×10^{-3}	inches of mercury.
kgs. per square meter	0.2048	pounds per square ft.
kgs. per square meter	1.422×10^{-3}	pounds per square in.
kgs. per sq. millimeter	10^{6}	kgs. per square meter.
kilolines	10^{3}	maxwells.
kiloliters	10^{3}	liters.
kilometers	10^{5}	centimeters.
kilometers	3281	feet.
kilometers	10^{3}	meters.

(Continued on Page 34)

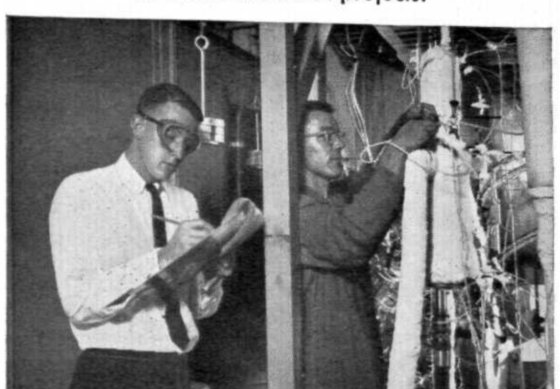
engineers

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.

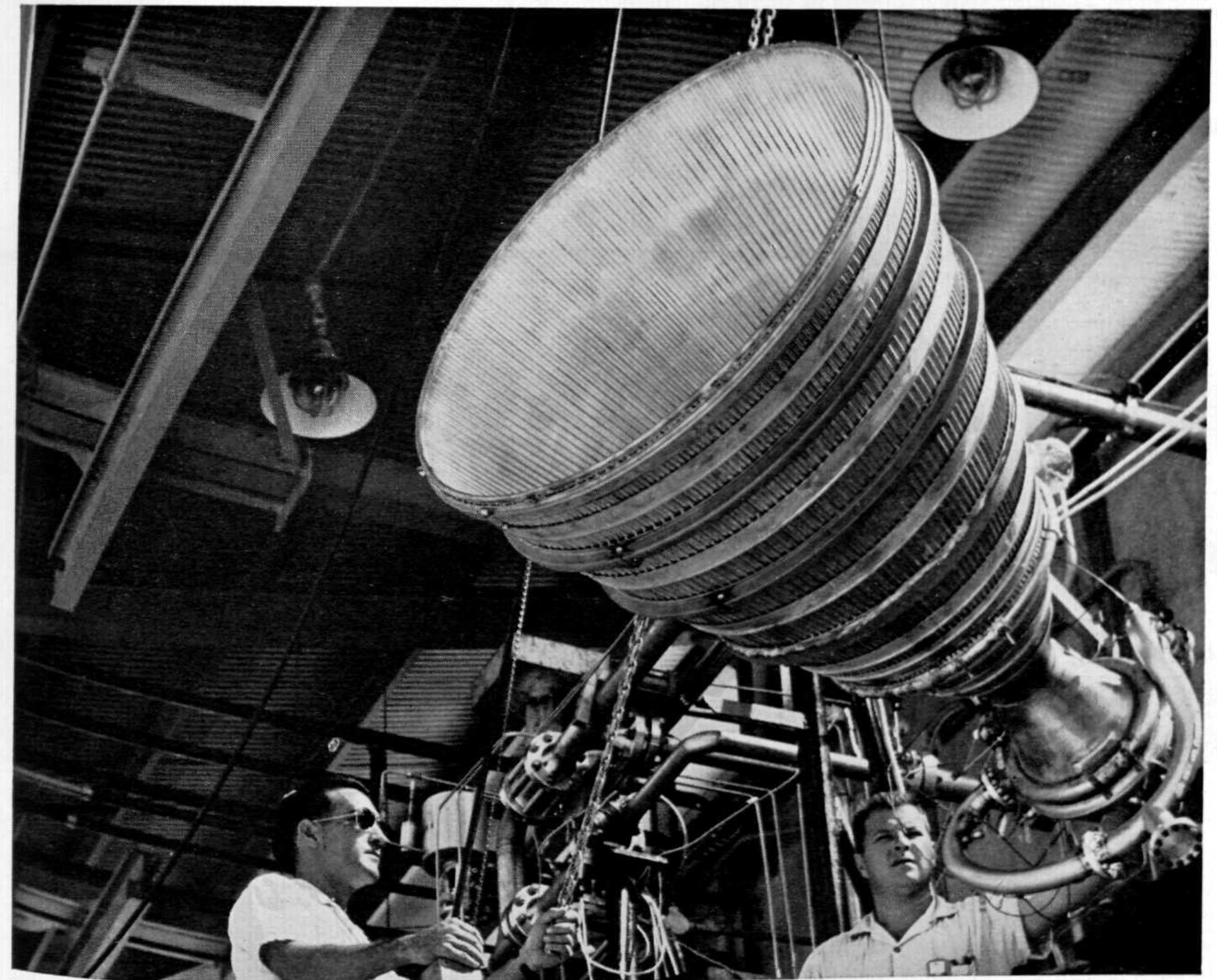
Included in a wide range of engineering activities open to technically trained graduates at all levels are these four basic fields:

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

FUDGE FACTORS

(*Continued from Page 31*)

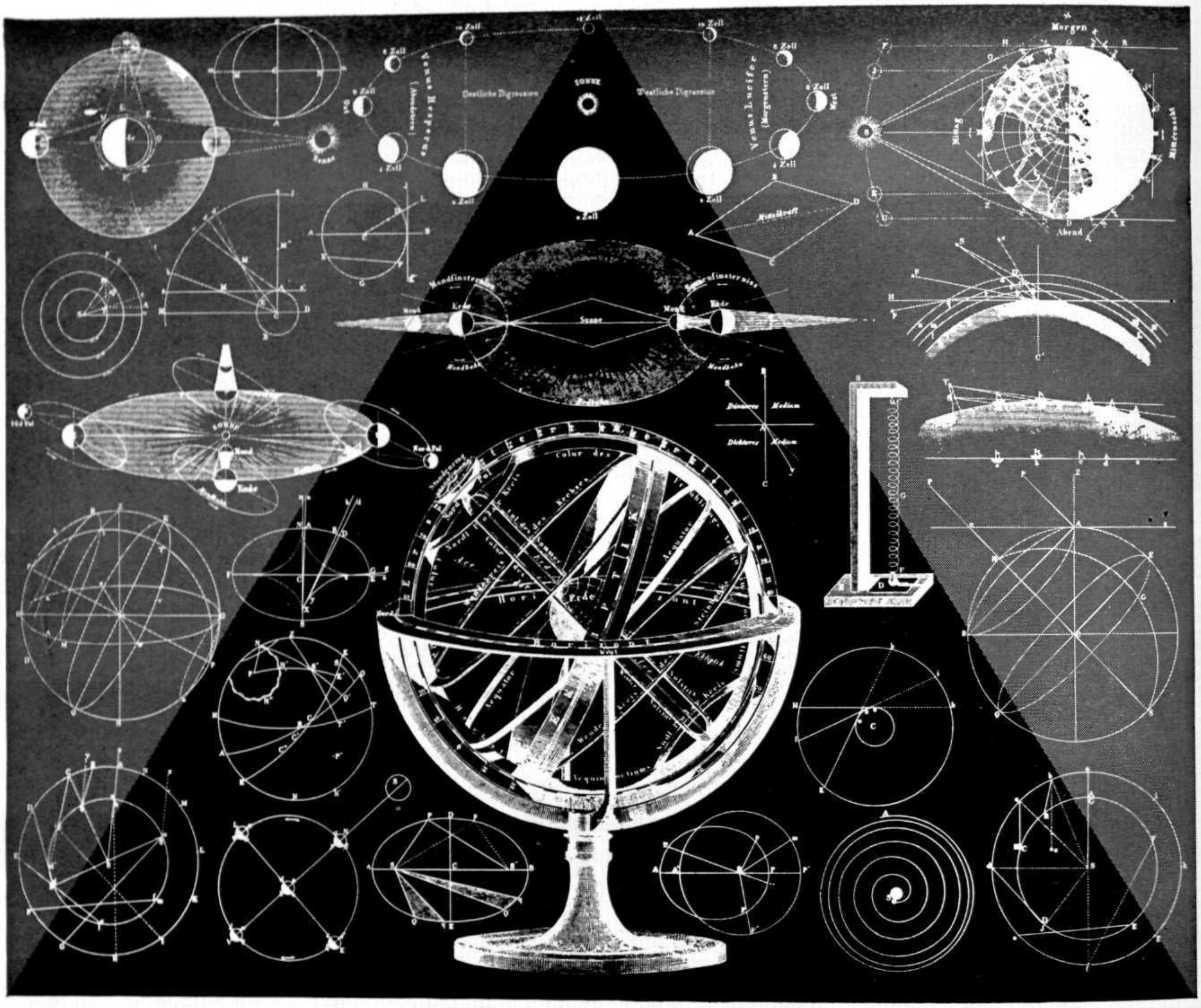
MULTIPLY	BY	TO OBTAIN
kilometers	0.6214	miles.
kilometers	1093.6	yards.
kilometers per hour	27.78	centimeters per sec.
kilometers per hour	54.68	feet per minute.
kilometers per hour	0.9113	feet per second.
kilometers per hour	0.5396	knots per hour.
kilometers per hour	16.67	meters per minute.
kilometers per hour	0.6214	miles per hour.
kms. per hour per sec.	27.78	cms. per sec. per sec.
kms. per hour per sec.	0.9113	ft. per sec. per sec.
kms. per hour per sec.	0.2778	meters per sec. per sec.
kms. per hour per sec.	0.6214	miles per hr. per sec.
kilometers per min.	60	kilometers per hour.
kilowatts	56.92	B.t.u. units per min.
kilowatts	4.425×10^{4}	foot-pounds per min.
kilowatts	737.6	foot-pounds per sec.
kilowatts	1.341	horse-power.
kilowatts	14.34	kg.-calories per min.
kilowatts	10^{3}	watts.
kilowatt-hours	3415	British thermal units.
kilowatt-hours	2.655×10^{6}	foot-pounds.
kilowatt-hours	1.341	horse-power-hours.
kilowatt-hours	3.6×10^{6}	joules.
kilowatt-hours	860.5	kilogram-calories.
kilowatt-hours	3.671×10^{5}	kilogram-meters.
knots	6080	feet.
knots	1.853	kilometers.
knots	1.152	miles.
knots	2027	yards.
knots per hour	51.48	centimeters per sec.
knots per hour	1.689	feet per sec.
knots per hour	1.853	kilometers per hour.
knots per hour	1.152	miles per hour.
Lines per square cm.	1	gausses.
lines per square inch	0.1550	gausses.
links (engineer's)	12	inches.
links (suveyor's)	7.92	inches.
liters	10^{3}	cubic centimeters.
liters	0.03531	cubic feet.
liters	61.02	cubic inches.
liters	10^{-3}	cubic meters.
liters	1.308×10^{-3}	cubic yards.
liters	0.2642	gallons
liters	2.113	pints (liq.).
liters	1.057	quarts (liq.).
liters per minute	5.855×10^{-4}	cubic feet per second.
liters per minute	4.403×10^{-3}	gallons per second.
$\log_{10} N$	2.303	$\log_{10} N$ or $\ln N$.
$\log_{10} N$ or $\ln N$	0.4343	$\log_{10} N$.
lumens per sq. ft.	1	foot-candles.
Marks (German)	0.238	dollars (U.S.).
Marks (German)	1.233	francs (French).
Marks (German)	0.04890	pounds sterling (Brit.).
maxwells	10^{-3}	kilolines.
megalines	10^{6}	maxwells.
megmhos per cm. cube	10^{-3}	abmhos per cm. cube.
megmhos per cm. cube	2.540	megmhos per in. cube.
megmhos per cm. cube	0.1662	mhos per mil foot.
megmhos per inch cube	0.3937	megmhos per cm. cube.
megohms	10^{6}	ohms.
meters	100	centimeters.
meters	3.2808	feet.
meters	39.37	inches.
meters	10^{-3}	kilometers.
meters	10^{3}	millimeters.
meters	1.0936	yards.
meter-kilograms	9.807×10^{7}	centimeter-dynes.
meter-kilograms	10^{5}	centimeter-grams.
meter-kilograms	7.233	pound-feet.
meters per minute	1.667	centimeters per sec.
meters per minute	3.281	feet per minute.
meters per minute	0.05468	feet per second.
meters per minute	0.03	kilometers per hour.
meters per minute	0.03728	miles per hour.
meters per second	1968	feet per minute.
meters per second	3.284	feet per second.
meters per second	3.0	kilometers per hour.
meters per second	0.06	kilometers per min.
meters per second	2.237	miles per hour.
meters per second	0.03728	miles per minute.
meters per sec. per sec.	3.281	feet per sec. per sec.
meters per sec. per sec.	3.6	kms. per hour per sec.
meters per sec. per sec.	2.237	miles per hour per sec.
mhos per mil foot	6.015×10^{-3}	abmhos per cm. cube.
mhos per mil foot	6.015	megmhos per cm. cube.
mhos per mil foot	15.28	megmhos per in. cube.
microfarads	10^{-15}	abfarads.
microfarads	10^{-6}	farads.
microfarads	9×10^{5}	statfarads.
micrograms	10^{-6}	grams.
microliters	10^{-6}	liters.
microhms	10^{3}	abohms.
microhms	10^{-12}	megohms.
microhms	10^{-6}	ohms.
microhms	$1/9 \times 10^{-17}$	statohms.
microhms per cm. cube	10^{3}	abohms per cm. cube.
microhms per cm. cube	0.3937	microhms p. in. cube.

MULTIPLY	BY	TO OBTAIN
microhms per cm. cube	6.015	ohms per mil foot.
microhms per inch cube	2.540	microhoms p. cm. cube.
microns	10^{-6}	meters.
miles	1.609×10^{5}	centimeters.
miles	5280	feet.
miles	1.6093	kilometers.
miles	1760	yards.
miles	1900.8	varas.
miles per hour	44.70	centimeters per sec.
miles per hour	88	feet per minute.
miles per hour	1.467	feet per second.
miles per hour	1.6093	kilometers per hour.
miles per hour	0.8684	knots per hour.
miles per hour	26.82	meters per minute.
miles per hour per sec.	44.70	cms. per sec. per sec.
miles per hour per sec.	1.467	feet per sec. per sec.
miles per hour per sec.	1.6093	kms. per hour per sec.
miles per hour per sec.	0.4470	M. per sec. per sec.
miles per minute	2682	centimeters per sec.
miles per minute	88	feet per second.
miles per minute	1.6093	kilometers per min.
miles per minute	0.8684	knots per minute.
miles per minute	60	miles per hour.
milligrams	10^{-3}	grams.
millihenries	10^{6}	abhenries.
millihenries	10^{-3}	henries.
millihenries	$1/9 \times 10^{-14}$	stathenries.
milliliters	10^{-3}	liters.
millimeters	0.1	centimeters.
millimeters	0.03937	inches.
millimeters	39.37	mils.
mils	0.002540	centimeters.
mils	10^{-3}	inches.
miner's inches	1.5	cubic feet per min.
minutes (angle)	2.909×10^{-4}	radians.
minutes (angle)	60	seconds (angle).
months	30.42	days.
months	730	hours.
months	43,800	minutes.
months	2.628×10^{6}	seconds.
myriagrams	10	kilograms.
myriameters	10	kilometers.
myriawatts	10	kilowatts.
Ohms	10^{9}	abohms.
Ohms	10^{-6}	megohms.
Ohms	10^{6}	microhms.
Ohms	$1/9 \times 10^{-11}$	statohms.
ohms per mil foot	166.2	abohms per cm. cube.
ohms per mil foot	0.1662	microhms per cm. cube.
ohms per mil foot	0.06524	microhms per in. cube.
ounces	8	drams.
ounces	437.5	grains.
ounces	28.35	grams.
ounces	0.0625	pounds.
ounces (fluid)	1.805	cubic inches.
ounces (fluid)	0.02957	liters.
ounces (troy)	480	grains (troy).
ounces (troy)	31.10	grams.
ounces (troy)	20	pennyweights (troy).
ounces (troy)	0.08333	pounds (troy).
ounces per square inch	0.0625	pounds per sq. inch.
Pennyweights (troy)	24	grains (troy).
Pennyweights (troy)	1.555	grams.
Pennyweights (troy)	0.05	ounces (troy).
perches (masonry)	24.75	cubic feet.
pints (dry)	33.60	cubic inches.
pints (liquid)	28.87	cubic inches.
poundals	13,826	dynes.
poundals	14.10	grams.
poundals	0.03108	pounds.
pounds	444,823	dynes.
pounds	7000	grains.
pounds	453.6	grams.
pounds	16	ounces.
pounds	32.17	poundals.
pounds (troy)	0.8229	pounds (av.).
pound-feet	1.356×10^{7}	centimeter-dynes.
pound-feet	13,825	centimeter-grams.
pound-feet	0.1383	meter-kilograms.
pounds-feet squared	421.3	kgs.-cms. squared.
pounds-feet squared	144	pounds-ins. squared.
pounds-inches squared	2.926	kgs.-cms. squared.
pounds-inches squared	6.945×10^{-3}	pounds-feet squared.
pounds of water	0.01602	cubic feet.
pounds of water	27.68	cubic inches.
pounds of water	0.1198	gallons.
pounds of water per min.	2669×10^{-4}	cubic feet per sec.
pounds per cubic foot	0.01602	grams per cubic cm.
pounds per cubic foot	16.02	kgs. per cubic meter.
pounds per cubic foot	5.787×10^{-4}	pounds per cubic inch.
pounds per cubic foot	5.456×10^{-9}	pounds per mil foot.
pounds per cubic inch	27.68	grams per cubic cm.
pounds per cubic inch	2.768×10^{4}	kgs. per cubic meter.
pounds per cubic inch	1728	pounds per cubic foot.
pounds per cubic inch	9.425×10^{-6}	pounds per mil foot.
pounds per foot	1.488	kgs. per meter.
pounds per inch	178.6	grams per cm.

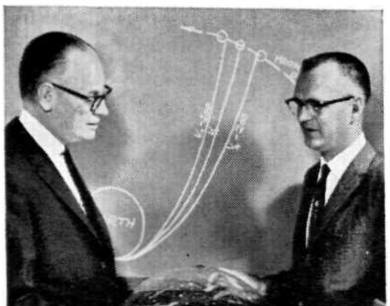
MULTIPLY	BY	TO OBTAIN
pounds per mil foot	2.306×10^{6}	grams per cubic cm.
pounds per square foot	0.01602	feet of water.
pounds per square foot	4.882	kgs. per square meter.
pounds per square foot	6.944×10^{-3}	pounds per sq. inch.
pounds per square inch	0.06804	atmospheres.
pounds per square inch	2.307	feet of water.
pounds per square inch	2.036	inches of mercury.
pounds per square inch	703.1	kgs. per square meter.
pounds per square inch	144	pounds per sq. foot.
Quadrants (angle)	90	degrees.
Quadrants (angle)	5400	minutes.
Quadrants (angle)	1.571	radians.
quarts (dry)	67.20	cubic inches.
quarts (liq.)	57.75	cubic inches.
quintals	100	pounds.
quires	25	sheets.
Radians	57.30	degrees.
Radians	3438	minutes.
Radians	0.637	quadrants.
radians per second	57.30	degrees per second.
radians per second	0.1592	revolutions per second.
radians per second	9.549	revolutions per min.
radians per sec. per sec.	573.0	revs. per min. per min.
radians per sec. per sec.	9.549	revs. per min. per sec.
radians per sec. per sec.	0.1592	revs. per sec. per sec.
reams	500	sheets.
revolutions	360	degrees.
revolutions	4	quadrants.
revolutions	6.283	radians.
revolutions per minute	6	degrees per second.
revolutions per minute	0.1047	radians per second.
revolutions per minute	0.01667	revolutions per sec.
revs. per min. per min.	1.745×10^{-3}	rads. per sec. per sec.
revs. per min. per min.	0.01667	revs. per min. per sec.
revs. per min. per min.	2.778×10^{-4}	revs. per sec. per sec.
revolutions per second	360	degrees per second.
revolutions per second	6.283	radians per second.
revolutions per second	60	revs. per min.
revs. per sec. per sec.	6.283	rads. per sec. per sec.
revs. per sec. per sec.	3600	revs. per min. per min.
revs. per sec. per sec.	60	revs. per min. per sec.
rods	16.5	feet.
Seconds (angle)	4.848×10^{-6}	radians.
spheres (solid angle)	12.57	steradians.
spherical right angles	0.25	hemispheres.
spherical right angles	0.125	spheres.
spherical right angles	1.571	steradians.
square centimeters	1.973×10^{5}	circular mils.
square centimeters	1.076×10^{-3}	square feet.
square centimeters	0.1550	square inches.
square centimeters	10^{-6}	square meters.
square centimeters	100	square millimeters.
sq. cms.-cms. sqd.	0.02402	sq. inches-inches sqd.
square feet	2.296×10^{-5}	acres.
square feet	929.0	square centimeters.
square feet	144	square inches.
square feet	0.09290	square meters.
square feet	3.587×10^{-8}	square miles.
square feet	.1296	square varas.
square feet	1/9	square yards.
sq. feet-feet sqd.	2.074×10^{4}	sq. inches-inches sqd.
square inches	1.273×10^{6}	circular mils.
square inches	6.452	square centimeters.
square inches	6.944×10^{-3}	square feet.
square inches	10^{6}	square mils.
square inches	645.2	square millimeters.
sq. inches-inches sqd.	41.62	sq. cms.-cms. sqd.
sq. inches-inches sqd.	4.823×10^{-5}	sq. ft.-feet sqd.
square kilometers	247.1	acres.
square kilometers	10.76×10^{6}	square feet.
square kilometers	10^{6}	square meters.
square kilometers	0.3861	square miles.
square kilometers	1.196×10^{6}	square yards.
square meters	2.471×10^{-4}	acres.
square meters	10.764	square feet.
square meters	3.861×10^{-7}	square miles.
square meters	1.196	square yards.
square miles	640	acres.
square miles	27.88×10^{6}	square feet.
square miles	2.590	square kilometers.
square miles	3,613,040.45	square varas.
square miles	3.098×10^{6}	square yards.
square millimeters	1.973×10^{3}	circular mils.

MULTIPLY	BY	TO OBTAIN
square millimeters	0.01	square centimeters.
square millimeters	1.550×10^{-3}	square inches.
square mils	1.273	circular mils.
square mils	6.452×10^{-6}	square centimeters.
square mils	10^{-6}	square inches.
square varas	.0001771	acres.
square varas	7.716049	square feet.
square varas	.0000002765	square miles.
square varas	.857339	square yards.
square yards	2.066×10^{-4}	acres.
square yards	9	square feet.
square yards	0.8361	square meters.
square yards	3.228×10^{-7}	square miles.
square yards	1.1664	square varas.
statamperes	$1/3 \times 10^{-10}$	abamperes.
statamperes	$1/3 \times 10^{-9}$	amperes.
statcoulombs	$1/3 \times 10^{-10}$	abcoulombs.
statcoulombs	$1/3 \times 10^{-9}$	coulombs.
statfarads	$1/9 \times 10^{-20}$	abfarads.
statfarads	$1/9 \times 10^{-11}$	farads.
statfarads	$1/9 \times 10^{-5}$	microfarads.
stathenries	9×10^{20}	abhenries.
stathenries	9×10^{11}	henries.
stathenries	9×10^{14}	millihenries.
statohms	9×10^{20}	abohms.
statohms	9×10^{5}	megohms.
statohms	9×10^{17}	microhms.
statohms	9×10^{11}	ohms.
statvolts	3×10^{10}	abvolts.
statvolts	300	volts.
steradians	0.1592	hemispheres.
steradians	0.07958	spheres.
steradians	0.6366	spherical right angles.
steres	10^{3}	liters.
Temp. (degs. C.) +273	1	abs. temp. (degs. C.).
Temp. (degs. C.) +17.8	1.8	temp. (degs Fahr.).
temp (degs. F.) +460	1	abs. temp. (degs. F.).
temp. (degs. F.) —32	5/9	temp. (degs. Cent.).
tons (long)	1016	kilograms.
tons (long)	2240	pounds.
tons (metric)	10^{3}	kilograms.
tons (metric)	2205	pounds.
tons (short)	907.2	kilograms.
tons (short)	2000	pounds.
tons (short) per sq. ft.	9765	kgs. per square meter.
tons (short) per sq. ft.	13.89	pounds per sq. inch.
tons (short) per sq. in.	1.406×10^{6}	kgs. per square meter.
tons (short) per sq. in.	2000	pounds per sq inch.
Varas	2.7777	feet.
Varas	33.3333	inches.
Varas	.000526	miles.
Varas	.9259	yards.
volts	10^{8}	abvolts.
volts	1/300	statvolts.
volts per inch	3.937×10^{7}	abvolts per cm.
volts per inch	1.312×10^{-3}	statvolts per cm.
Watts	0.05692	B.t.u. units per min.
Watts	10^{7}	ergs per second.
Watts	44.26	foot-pounds per min.
Watts	0.7376	foot-pounds per sec.
Watts	1.341×10^{-3}	horse-power.
Watts	0.01434	kg.-calories per min.
Watts	10^{-3}	kilowatts.
watt-hours	3.415	British thermal units.
watt-hours	2655	foot-pounds.
watt-hours	1.341×10^{-3}	horse-power-hours.
watt-hours	0.8605	kilogram-calories.
watt-hours	367.1	kilogram-meters.
watt-hours	10^{-3}	kilowatt-hours.
webers	10^{8}	maxwells.
weeks	168	hours.
weeks	10,080	minutes.
weeks	604,800	seconds.
Yards	91.44	centimeters.
Yards	3	feet.
Yards	36	inches.
Yards	0.9144	meters.
Yards	1.08	varas.
years (common)	365	days.
years (common)	8760	hours.
years (leap)	366	days.
years (leap)	8784	hours.

These conversion factors first appeared in the November '54 and January '55 issues of the CITY COLLEGE VECTOR.



Guided tour of the solar system



The new NASA Thor-boosted research rocket, DELTA, now being constructed by Douglas, will set up big signposts for further space explorations. Combining elements already proved in space projects with an advanced radio-inertial guidance system developed by the Bell Telephone Laboratories of Western Electric Company, DELTA will have the versatility and accuracy for a wide variety of satellite, lunar and solar missions. Douglas insistence on reliability will be riding with these 90 foot, three-stage rockets on every shoot. At Douglas we are seeking qualified engineers to join us on this and other equally stimulating projects. Write to C. C. LaVene, Box 600-X, Douglas Aircraft Company, Santa Monica, California.

Maxwell Hunter, Asst. Chief Engineer—Space Systems, goes over a proposed lunar trajectory with Arthur E. Raymond, Senior Engineering Vice President of DOUGLAS

MISSILE AND SPACE SYSTEMS ■ MILITARY AIRCRAFT ■ DC-8 JETLINERS ■ CARGO TRANSPORTS ■ AIRCOMB ■ GROUND SUPPORT EQUIPMENT

NUCLEAR SUBS

(*Continued from Page 21*)

Both stages are made of steel and the total length of the missile is forty-seven feet. The maximum diameter is almost ten feet.

Aerojet General Corp. is building the powerplants for both stages. Using a high energy propellent, it delivers 80,000-100,000 pounds thrust.

Thickol Corp. is assisting Aerojet in the development of the second or main stage. It consists of a three nozzle chamber with solid propellent. The performance is similar to the first stage.

Since the Polaris uses solid fuel, it is easier to maintain and launch than a liquid fuel rocket of equal power. No long tedious countdown is needed. Therefore, all sixteen missiles in one sub could be fired in a matter of minutes. The first of a new series of Polaris missiles designed for a 900 mile range flew successfully last month.

Tactics

But no matter how efficient the missile or submarine are, they must work together. This calls for new tactics developed to take advantage of the nuclear sub's characteristics.

Basically, the tactics consist of using a highly mobile launching platform, the submarine, to carry the missile within range of the target. The missile is responsible for the actual destruction of the target. This is over-simplified quite a bit.

Let's take an example. Country X's war staff decides to attack the U. S. Although the enemy bombers intended to launch a surprise attack, they are detected far out over the ocean by a radar picket ship. Instantly the call goes out to all military units as well as the Air Force.

Far away, cruising submerged in the North Atlantic, the nuclear sub Advenger picks up a signal. A few moments pass while the navigator feeds the sub's position into the computer. The captain has selected the target. He pushes the button. With a slight whoosh, the Polaris is on its way toward Country X. The sub can either launch more missiles or speed to another location.

Even if any of the enemy planes had managed to evade our missiles and interceptors, and started home, they would find very few of their bases left intact. Crowding in at the few remaining airfields, they will be good targets for either missiles or planes.

If there were ten subs patroling at sea, a maximum of 160 missiles could be launched at any one time. This is enough to destroy the major air bases, industrial centers and military installations of the enemy.

With this sort of retaliation facing them, the war staff of an enemy nation would be foolish to attack. They would receive as much damage as they could inflict on us. So the Fleet Ballistic Missile Submarine is a deterrent to war as well as an offensive weapon.

It is easy to see how nuclear subs affect the average person. The country who gets a monopoly on this type of weapon has an advantage. They could be used against the U. S. as easily as in defense of it.

Perhaps the potentialities of the nuclear sub were best described by Rear Admiral H. G. Rickover. "Nuclear powered submarines capable of launching IRBM's with nuclear warheads will become underwater satellites. They will be able to move anywhere at any time, completely submerged. The problem of locating and destroying them will be tremendous. The enemy would be in the position of a man trying to find a black cat on a vast and empty plain on a moonless and starless night."

GUIDE

(*Continued from Page 22*)

his expected departure time. Every effort should be made to avoid last minute cancellations.

9. The interviewer should very carefully follow the interview time schedule agreed upon with the Placement Office.

10. As soon as possible following an interview, the employer should communicate with the student and the Placement Office concerning the outcome of the interview.

11. The employer should give the student reasonable time to consider his offer, and in no case should the student be pressured into making a decision concerning employment.

12. If the employer invites a student to visit his premises for further discussion of employment, the visit should be arranged to interfere as little as possible with class schedules. He should explain what expenses will be paid, how and when. Invitations for this purpose should be made only on an individual basis and the employer should avoid elaborate entertaining or overselling.

13. The employer should not offer a student special payments, gifts, bonuses, or other inducements, nor should he compensate or favor a third party to prevail upon the student to accept an employment offer.

14. Employers should not raise offers already made except when such action can be clearly justified as sound industrial relations practice, such as, when an increase in hiring rate is required on an overall basis to reflect salary adjustments in the employing organization.

15. The employer should keep the Placement Office informed concerning his interest in particular students and his negotiations with them.

16. When a student has declined a job offer, the employer should accept that decision as final. If for any reason the employer wishes to re-establish contact with the student, he should do so only through the Placement Office.

17. The employer should engage each student who has accepted his offer except when failure to do so is the direct result of contingencies explained during the interview or unavoidable economic factors not foreseen when the offer was made.

Responsibilities of the College

1. As part of its general obligation for the development of the student, the college should accept responsibility for stimulation of his thinking about his career objectives and for assistance in overcoming handicaps which may hinder his progress toward objectives appropriate for him. Competent counseling services should be provided for this purpose, available to individual students.

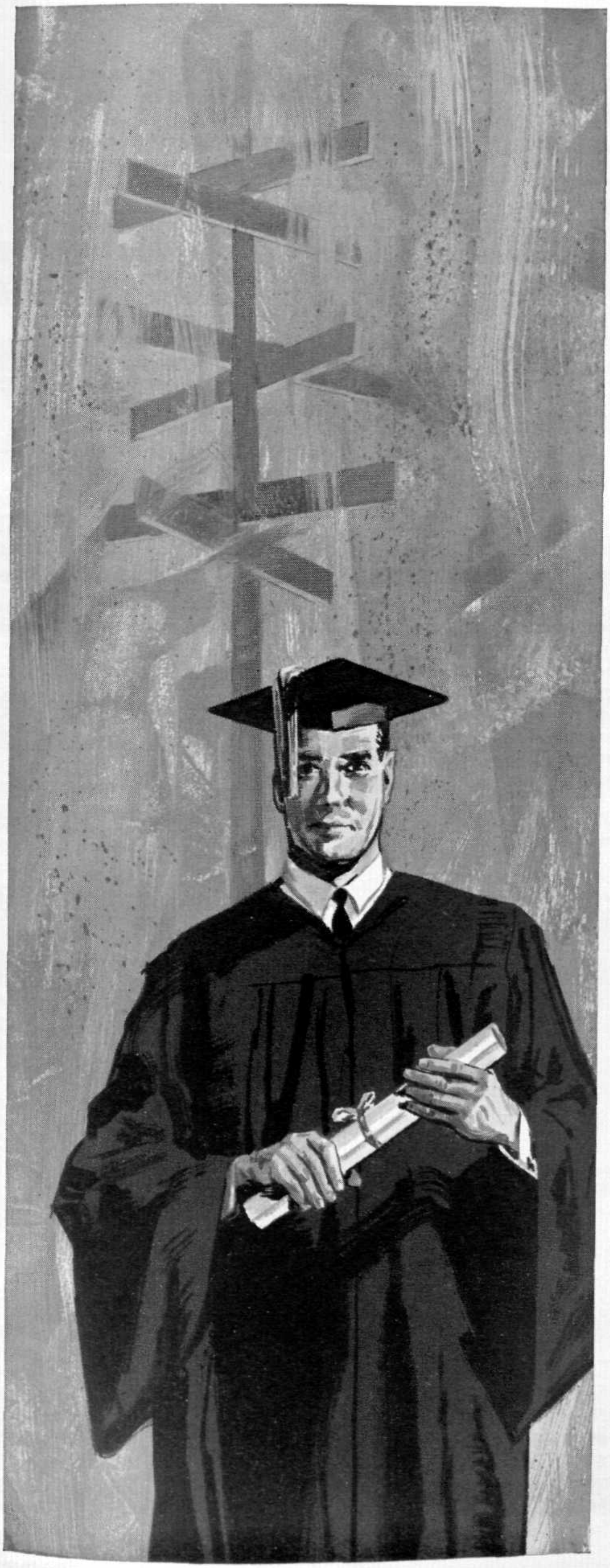
2. The Placement Office should inform employers concerning the number of students available for interview in the several curricula, and the dates of graduation. This information should be sent as soon as it is available.

3. The Placement Office should annuonce to students early in the school year which employers will interview students and when. The Placement Office should make revised announcements from time to time as may be necessary.

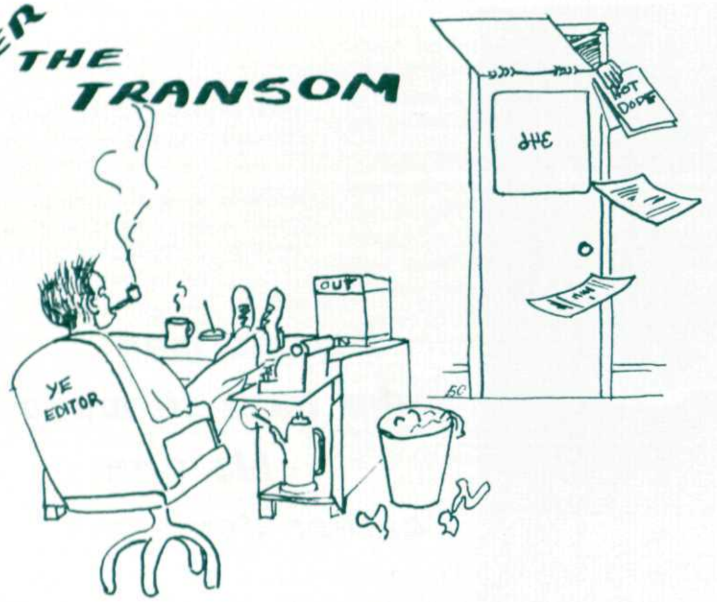
4. The Placement Office should make employment literature available to students and faculty.

5. When an employer is looking for graduates in several fields (e.g., engineering, psychology, physics) the Placement Office should issue an-

(*Continued on Page 50*)



OVER THE TRANSOM



Official 1959 figures are expected to be published by the U.S. Office of Education in the near future. The following are our estimates for 1959 and our forecast for 1960.

From Colleges With ECPD Accredited Curricula	1958 Actual	1959 Estimated	1960 Projected
Aeronautical	1188	1300	1285
Agricultural	359	360	350
Chemical	2920	3025	2975
Civil	4673	5050	4975
Electrical	8712	9500	9400
General	683	710	685
Industrial	1783	1875	1825
Mechanical	7859	8425	8350
Metallurgical	662	680	670
Mining	220	205	190
Petroleum	680	685	660
All Others	1477	1800	1750
Total	31216	33615	33115
From other Colleges	4116	4350	4300
Grand Total	35332	37965	37415

Data for 1959 and 1960 represent scaling down of earlier estimates because retention rates in recent years have decreased. The 1959 graduating class (close to 38,000) started in 1955 with 72,825 freshmen; although the freshman class in the following year (1956) was larger—77,738—it now appears likely that the number graduating (four years later) will be smaller. Within the past five or six years the trend in degrees by curricula distribution have shown; Electrical gaining steadily (now 27%); Civil dropping (now 15%) while Mechanical (25%); Chemical (10%) and Industrial (5%) have remained fairly constant.

The Critical Skills Program, with an off-and-on history since its inception in 1956, is again up for review. The Department of Defense would like to quietly drop the program, which in the last year has been limited to 2,000 positions.

The Commissions, as in the past, will insist on the continuation of the Program until legislative authority for service alternatives exist for engineers and scientists in essential activities—as they recommended to the Senate Armed Services Committee earlier this year.

New Appointments:

Donald Anderson, assistant professor of Chemical Engineering, March 15.

William D. Powrie, assistant professor of agriculture, October 31.

Sabbatical Leave of Absence:

James Anderson, professor of Mechanical Engineering, January 1 to July 31, study, travel and health.

Perhaps the four women who earned Doctor's degrees in engineering in 1958 were made of stern stuff, but they proved it could be done. More significantly, they demonstrated conclusively that there are places for women in science and engineering at every level of training.

Women have been entering the field of engineering in larger numbers, but even so they comprise less than 1% of the engineering enrollments in institutions of higher learning throughout the country. In the decade beginning in 1949 and ending in 1958, the number of young women working for engineering degrees increased from 763 to 1,718. The 1,718 were matching their wits against 288,000 men.

In the fields of science and mathematics the situation is somewhat better. In a recent survey it was found that 20% of the junior majors in science and mathematics are women, although the distribution varies drastically from field to field. For example, of the 11,274 included in the count, 4,739 were registered for majors in the biological sciences, and 3,357 were majoring in mathematics. In the physical sciences, on the other hand, where total enrollment was very nearly as large as in the biological sciences, the women majors numbered only 2,358. Chemistry claimed by far the largest number of this group—1,812. In physics they made solid gains but still comprised only 4.3% of the majors, and in geology they were thrown for a very bad loss. For the past two years the demand for geologists has been low, and in the competition for scarce jobs, too many women have lost out to men. Their experience was reflected in the sharp drop in junior majors last year.

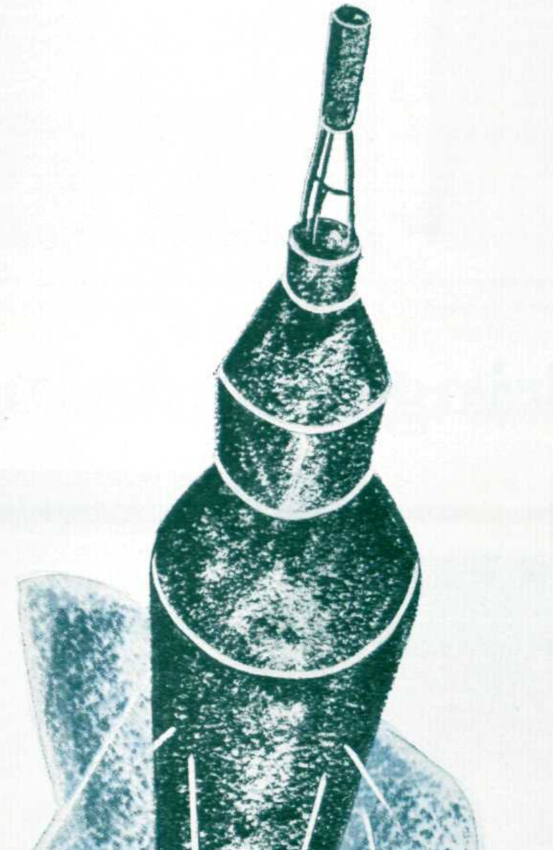
The earth sciences are an exception, for in all other fields of science and engineering the demand for trained personnel has increased, and in certain fields it has increased spectacularly. Industrial concerns, engineering schools, and government laboratories are scouring the country for electronics and electrical engineers. Shortages are acute in several specialties in mechanical engineering. Available jobs greatly outnumber available physicists, and even with the marked response to the demand for mathematicians, the 30% increase that has taken place in junior majors is not likely to exceed the growing demand.

The staff of the Spartan Engineer would like to introduce their faculty advisors. These gentlemen will advise the growing staff on ways to make the magazine more interesting.

Heading the group of advisors are John D. Ryder, Dean of Engineering and William McIlrath, Director of Student Publications. Denton McGrady of the Metallurgical Engineering Department will continue as our technical advisor. New to the group of advisors are; James Stokley, Journalism, who will advise on problems involved in writing; Thomas Farrell, Business Service, a former ECMA officer, who will act as local critic; and Harold Plumb, a Michigan State University engineering alumni, who will advise us on alumni relations.

ENGINEERING GRADUATES—YOUR

ACCELERATION



STEPPING STONES TO SPACE

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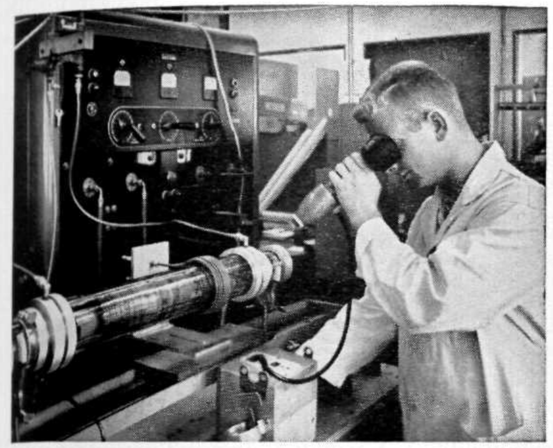
Engineering Employment Supervisor
P.O. Box 516, St. Louis 66, Missouri

Monitoring a thermal-stress test in the Transient Heat Facility are Project Mercury staff members, True E. Cousins, BSAE, U. of Kansas, '58, on the left, and Eugene G. Shifrin, BSME, U. of Iowa, '55.

McDONNELL *Aircraft*



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

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

Checking Einstein with an atomic clock in orbit

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

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

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

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

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

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CAMPUS INTERVIEWS

FEBRUARY 29, 1960

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Tucson, Arizona

Wendy Linn Mouw

Home Town: Birmingham, Michigan

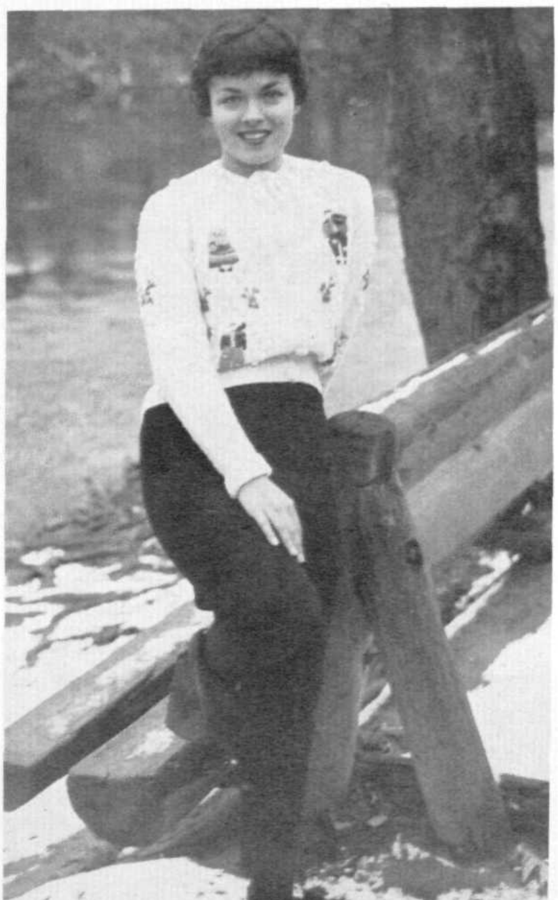
Age: 20

Specs: 5′ 2″
Brown Hair
Green Eyes
34-24-34

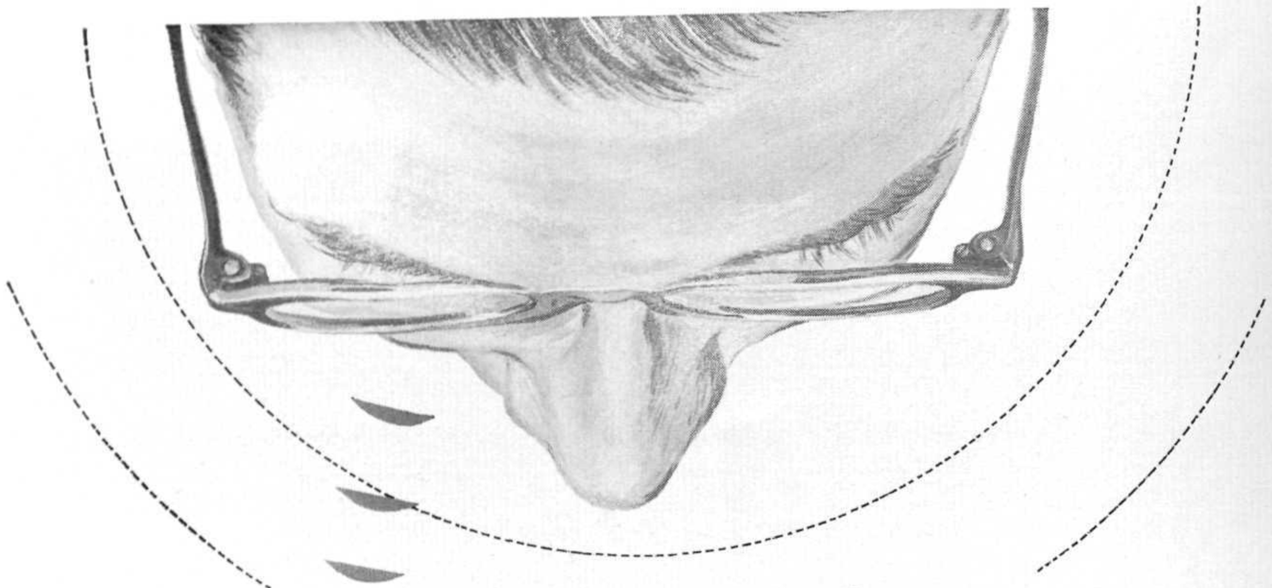
Major: Business & Secretarial

Hobbies: Golf
Swimming

MISS JANUARY ENGINEER



(Photos by Norm Hines)



Look beyond the obvious . . .

. . . as you consider your first professional job. At Melpar, we believe that all young engineers and scientists should develop the habit of looking beyond the obvious.

First, what is the obvious? It's obvious that you're in demand. You don't have to worry about getting your material wants satisfied. And you don't have to worry about getting opportunities for professional growth. Since you are in demand, you can expect to get the things you want from any number of potential employers.

But, if you look beyond the obvious, you'll realize now that you're going to want something more than "want satisfaction" out of your career. You're going to want *pride*—pride in your personal, individual contribution.

At Melpar, where we are now working on 120 advanced defense and space exploration projects, we are interested *only* in young men who realize that pride is a reward that extends much beyond the obvious. Because Melpar is a proud Company. We're proud of our IMAGINEERING approach to the solution of electronic problems; we're proud of our uninterrupted growth and controlled expansion; we're proud of the communities that surround our laboratories and plants in Northern Virginia and Boston, and we're proud of our creation, design, and production of electronic products destined for universal application.

If you want an opportunity to be proud of your contribution and your Company, we're interested in hearing from you. Tell us about yourself. Either ask your college's Placement Director to arrange a personal interview with the Melpar representative who will be visiting your campus, or write to our Professional Employment Supervisor. Tell him if you would like to hear from one of your college's graduates who is now progressing at Melpar.

MELPAR INC

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In Historic Fairfax County
(10 miles from Washington, D. C.)

February 8

Standard Oil of Calif.
Lockheed Missiles
Square D.
Int'l Tel. & Tel.
Arthur Anderson
U.S. Graphite
Simons Co.
Harshaw Chemical Co.
Royal Oak Pub. Schools
Detroit Controls Dev.-Amer. Std.

February 9

Lockheed Missiles
Square D.
Hess & Clark
Hamilton-Standard
Int'l Tel. & Tel.
Harvischfeger Corp.
Richards-Wilcox Co.
I.B.M.
Frankford Arsenal
Convair-San Diego

February 10

K.V.P.
Hess & Clark
Hamilton-Standard
Int'l Tel. & Tel.
Texas Instrument, Inc.
I.B.M.
Firestone Tire & Rubber Co.
Convair-San Diego
Grand Rapids Public Schools

February 11

U. S. Steel Co.
U.S. Steel Co. (Hagen)
Ford Motor Co.
Allied Chemical
B.F. Goodrich
Dow Corning
Dept. of the Navy
Ralston Purina
American Nat'l Bank & Trust Co.
National Carbon
Pomona Unified School District
San Jose Unified School District
Kern County Union High School

February 12

Ford Motor Co.
B. & O. Railroad
General Mills
Ralston Purina
National Carbon
Pomona Unified School District
Ohio Fuel Gas Co.
U.S. Dept. of Commerce-Patent Office
Ricke Kumler Co.
Link Belt Co.
J. L. Hudson
Los Angeles State College
Grosse Pointe Public Schools

February 15

Douglas Aircraft
Kaiser Aluminum & Chemical
Firestone Tires & Rubber Co.
Diamond Alkali
Wright Air Development Div.
Chas. Pfizer & Co.
Continental Can
The Trane Co.
Surface Combustion Corp.
Control Data Corporation
Kordite Co.
Esso Std. Oil Co.
Chev. Gear & Axle

February 16

Libbey-Owens-Ford
Standard Oil of Ohio
Douglas Aircraft
Columbia-Southern Chem.
Anchor Hocking Glass
Reilly Tar & Chemical
Commonwealth Edison
Minnesota Mining & Mfg.
Firestone Tire & Rubber Co.
Upjohn Co.
Alcoa
Stewart Warner
The Trane Co.
Leland Public Schools

February 17

Union Carbide Chemicals
Libbey-Owens-Ford
Continental Oil Co.
American Air Filter
Anchor Hocking Glass
Bureau of Ships
General Foods Corp.
California Texas Oil Corp.
Minnesota Mining & Mfg.
Institute of Paper Chemistry
Babcock & Wilcox
Warthington Corp.
Indiana & Michigan Elect. Co.
Michigan Bell
General Elect.

February 18

Borg Warner
Caterpillar Tractor
Ingersoll-Rand Co.
Inland Steel
Bridgeport Brass
Michigan Bell
Lubrizol Corp.
General Electric
Prudential Ins.
Baker Perkens
Battle Creek Public Schools

February 19

Visking Co.
Caterpillar Tractor
Michigan Bell
Strongberg-Carlson
Prudential Ins.
Shillitos
Allis-Chalmers
Warren Consolidated Schs.
Packaging Corp. of America
Sinclair

February 22

Procter & Gamble
North American Aviation
Lockheed Aircraft Corp.
Eastman Kodak
Minneapolis-Honeywell
Dupont
Los Angeles Civil Service
J. Walter Thompson Co.
Standard Oil

February 23

Procter & Gamble
Martin
North American Aviation
Lockheed Aircraft
Rogers Public School
Eastman Kodak
Reynolds Metals
Dupont
Pacific Finance

February 24

Reynolds Metals
Industrial Nucleonics
Martin
North American Aviation
El Monte School District
Sundstrand
Eastman Kodak
Paul E. Williams
Pacific Finance

February 25

Kaiser Steel
Kroger
Martin
National Security Agency
Dewey & Almy Chem.
Div. W. R. Grace & Co.
Avco Mfg.-Crosle Div.
Chain Belt Co.
Kroger (McCaffery)
New York Life Ins. Co.
Rohm & Haas Co.
Chevrolet-Flint Mfg.
Michigan Bell
Wood Conversion

February 26

Grandville Public Schools
National Security Agency
Pittsburgh Des-Moines Steel
Simmons Co.
Kroger
Kroger (McCaffery)
General Elect.
Cargill Inc.
Wood Conversion
Kaiser Steel
Ladish Co.
McGraw Hill
Pure Oil
Plainwell Comm. Schs.

February 29

Shell Chemical Corp.
General Electric
Motorola Inc.
Parke Davis & Co.
Johnson Service Co.
Lilton Industries
Dana Corp.
Manufacturers Nat'l Bank of Detroit
Naval Air Development Ctr.
Detroit Travelers Inc. Co.
Wyandotte Public Schools
Portage Township Schools

March 1

Shell Chemical Corp.
General Electric
Kawneer
Leeds & Northrop
Kearfott Co.
I.B.M.
Consumers Power
Kemper Ins.
Standard Oil Res. Lab.
Kimberly-Clark

March 2

Sangamao Electric
Kawneer
Shell Chemical (Summer)
U.S. Dept. of Interior-Bureau of Reclamation
Union Carbide Corp.
I.B.M.
Abbott Labs
Kimberly-Clark
Godwin Hts. Public Schools
Automatic Music

March 3

Hewlett-Packard Co.
City of Milwaukee
Civil Service
Union Carbide Corp.
Potomac River Naval Cmd.-Naval Res. Lab.
Sperry Gyroscope
Eastman Kodak
Spaulding Fibre Co. Inc.
Long Beach Unified School District
Nat'l Bank of Det.
Berkley Unified School District

GUIDE

(*Continued from Page 38*)

nouncements to all qualified students concerned, and, so far as practicable, should schedule interviews for those who express interest.

6. The Placement Office should not restrict the number of interviews per student, except as necessary to discourage indiscriminate "shopping."

7. The college should provide adequate space and facilities for quiet and private interviews.

8. The Placement Office should provide interviewers with available records of those students in whom they are interested.

9. The Placement Office should arrange for interviewers to meet faculty members who know students personally and can provide information about their work and qualifications.

10. The Placement officer and faculty members should counsel students but should not unduly influence them in the selection of jobs.

11. The Placement Office should make certain that students are acquainted with this statement of "Principles and Practices of College Recruiting."

Responsibilities of the Student

1. In seeking company interviews, the student should recognize his responsibility to analyze his interests and abilities and consider carefully his career objective and appropriate ways of meeting it. He should read available literature and consult other sources for information about the employer and organize his thoughts in order that he may intelligently ask and answer questions.

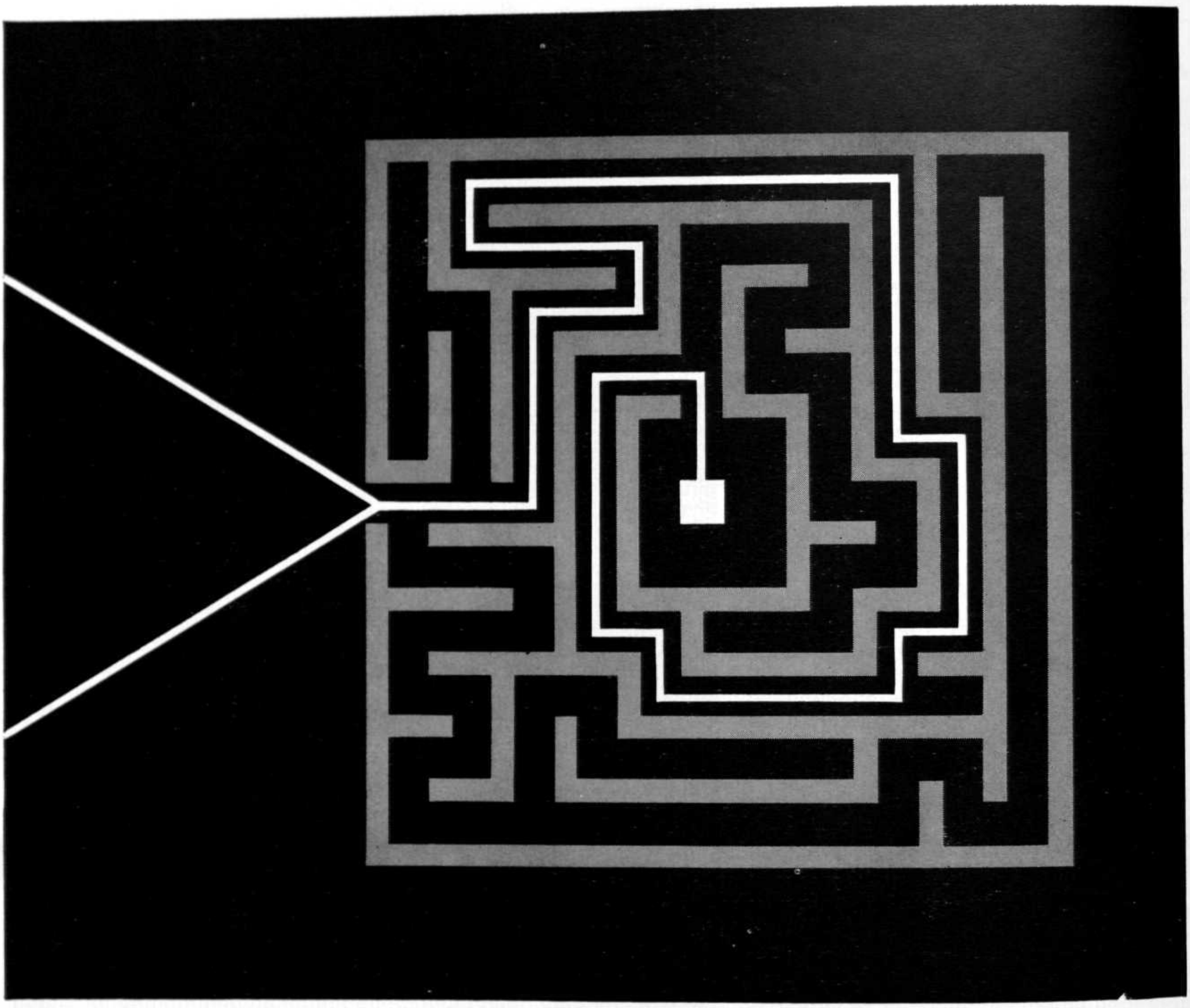
2. The student should contact the Placement Office well in advance regarding desired interviews or cancellations.

3. The student should use care in filling out such forms as may be requested in preparation for interviews.

4. In his interviews, the student should recognize that he is representing his college, as well as himself, and should be punctual and thoroughly businesslike in his conduct.

5. The student should promptly acknowledge an invitation to visit an employer's premises. He should accept an invitation only when he is sincerely interested in exploring employment with that employer.

(*Continued on Page 56*)

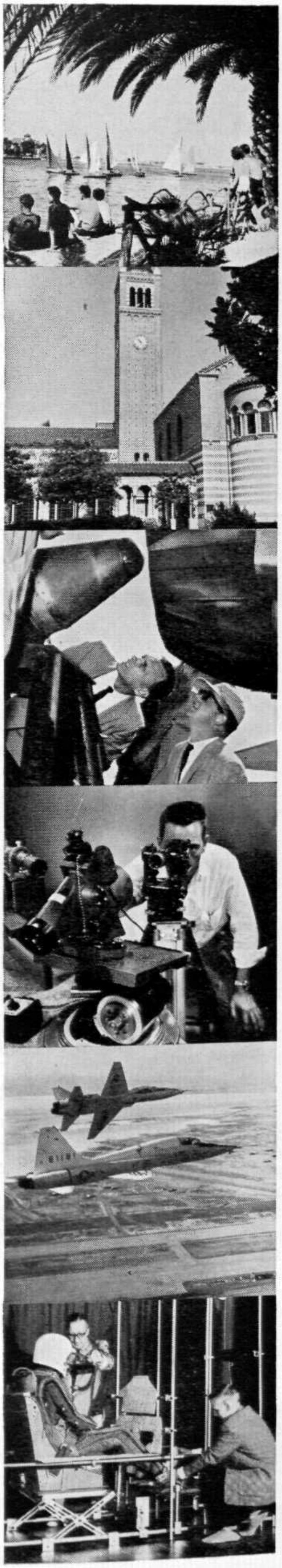


News is *<u>happening</u>* *at Northrop*

FIND OUT MORE *about the young engineers and scientists who are making the news <u>happen</u> at Northrop.*

WRITE TODAY *for information about Northrop and all of its Divisions.*

Engineering & Scientific Personnel Placement Office Northrop, P.O. Box 1525 Beverly Hills, California



Here's a 7-Question Quiz to help you decide on your future:

1 **Where Do You Want To Work?** If your interests lie in the fields of electronics or the aircraft/missile industries, you will want to join the outstanding scientists and engineers in Southern California–the electronic, aircraft/missile center of the world.

2 **Where Do You Want To Live?** If you work at Northrop you'll be able to spend your leisure at the Pacific beaches, in the mountains, on the desert. You'll enjoy an active life in Southern California's incomparable year-round climate.

3 **Want Top Salary?** Northrop's salary structure is unique in the industry. At Northrop you'll earn what you're worth. With this growing company you'll receive increases as often as you earn them. And these increases will be based on your own individual achievements. Northrop's vacation and fringe benefits are extra liberal.

4 **Want Advanced Degrees?** At Northrop you'll continue to learn while you earn with no-cost and low-cost education at leading Southern California institutions. You'll earn advanced degrees and keep current with latest advances in your own chosen field.

5 **Want To Work With Leaders?** Your Northrop colleagues are acknowledged leaders in their fields–men chosen for their capabilities and their skills in guiding and developing creative talents of younger men. These are men who delegate authority, assure you of fair share of credit for engineering triumphs.

6 **Want The Challenge Of Opportunity?** At Northrop you will apply your talents to the work you enjoy–in the fields best suited to your inclination and ability. You'll work with the newest, most-advanced research and test equipment. At Northrop and its Divisions you are offered a wide diversity of over 30 operational fields from which to choose.

7 **In Which Of These 3 Divisions Would You Like To Work?**

NORAIR DIVISION is the creator of the USAF Snark SM-62 missile now operational with SAC. Norair is currently active in programs of space research, flight-testing the USAF-Northrop T-38 Talon trainer and Northrop's N-156F Freedom Fighter.

RADIOPLANE DIVISION, creator of the world's first family of drones, produces and delivers unmanned aircraft for all the U.S. Armed Forces to train men, evaluate weapon systems, and fly surveillance missions. Today Radioplane is readying the recovery system for Project Mercury.

NORTRONICS DIVISION is a leader in inertial and astro-nertial guidance systems. At Hawthorne, Nortronics explores infra-red applications, airborne digital computers, and interplanetary navigation. At Anaheim, Nortronics develops ground support, optical and electromechanical equipment, and the most advanced data-processing devices.

NORTHROP CORPORATION Beverly Hills California

ALUMNI NOTES

William Frank Uhl, chairman of the board, Chas. T. Main, Inc., and senior partner, Uhl, Hall & Rich, Boston, Mass., is one of the foremost hydraulic engineers in the U.S. and is widely acknowledged in foreign countries. His professional career, principally in connection with hydroelectric power, has been marked by work with 34 new plants, 28 redevelopments, and he has acted as consultant on 52 others. He has been engaged on many projects in Africa, Turkey, South America, and Canada. Mr. Uhl joined Charles T. Main in 1909, became president of Chas. T. Main, Inc. in 1939, and in 1957 was made chairman of the board. At the present time, through Uhl, Hall & Rich, he is engaged in the design and supervision of construction of two large hydroelectric projects for the Power Authority of the State of New York—Barnhart Island on the St. Lawrence River and Lewiston on the Niagara River. Together the plants have a total normal capacity of 3-million kw in the U.S. Mr. Uhl is a member of the Tennessee Valley Authority Board of Consultants, and he formerly acted as special consultant on a number of U.S. Engineer flood-control projects. He has been a member of the Engineers Joint Council National Water Policy Panel; is a member of the New England Section for Hydraulic Power of the Edison Electric Institute; vice-chairman of the U.S. Committee of the International Commission on Large Dams. Mr. Uhl is the author of a number of papers on the subject of hydroelectric power, flood control, and other subjects. He is a member also of ASCE, AIEE, NSPE, The American Geophysical Union, the Newcomen Society, and is an Honorary Member of B.S.C.E. Tufts University and Michigan State University have each conferred upon him the honorary degree of doctor of engineering. He is a registered professional engineer in 33 states. In 1958, ASCE awarded him the James Rickey Medal and in 1955 he received the Alumni Award for Distinguished Service from his Alma Mater, Michigan State University.

° ° °

Robert Almquist (w'59) is now working in Marketing Management for the Standard Oil Company of Ohio. He is living at 2402 Elmwood, Westlake, Ohio.

° ° °

Benton Anderson ('59) is employed as an associate engineer and is working on circuit design for digital computers. His address is 3842 W. 11th St., Hawthorne, Calif.

° ° °

Charles Anderson ('59) is a research and development engineer for R.C.A. Charles resides at 169 Mansfield Blvd. N., Haddonfield, New Jersey.

° ° °

Charles Arnold ('59) is continuing his education at M.S.U. in the field of applied mechanics.

° ° °

Duane A. Barney ('59) is an electrical engineer for I.B.M. He is spending most of his time working on a large computer in the Data Processing Division. Duane's address is RFD 2 Box 251, Hopewell Junction, N.Y.

° ° °

Russell F. Barry ('59) is employed by R.C.A. as a research and development engineer. He is residing at 43-B Parkway Apts., Haddonfield, N.J.

° ° °

Olin Baughman ('59) is working for the Westinghouse Education center in Pittsburgh, Pa.

° ° °

Merwin Beckwith ('59) is working as a research engineer for the Ford Motor Company. He is primarily with the design and field test of farm tractors and implements.

° ° °

Richard Bell ('59) is employed as a production engineer for Lockheed Aircraft Corp., Marietta, Georgia. He is living at 105 Woodland Dr., Kennesaw, Ga.

° ° °

Page Bellinger ('58) received his masters degree in agricultural engineering in December. He served as a graduate research assistant and was interested primarily in hay pelleting.

° ° °

Harold Bennett ('59) is working as a research engineer for the Institute Plant of Union Carbide. His address is 113 B South St., S. Charleston, W. Va.

° ° °

Lawrence Bokor ('59) is working with aircraft control and guidance systems for Kollsman Institute. His address is 338 Broadway, Monticello, New York.

° ° °

Albert Berg ('59) is now a graduate student in mining and metallurgy at the University of Wisconsin. He is residing at 7522 Woodhaven, Madison, Wisconsin.

° ° °

Harry Bodak ('59) is working for General Electric in the area of design of Micro-Wave equipment. His address is RD#5, c/o S. Furman, Amsterdam, N.Y.

° ° °

Brice Boesch (S'59) is employed by the Soil Conservation Service in Saginaw. His address is 1163 Ridge Rd., Sebewaing, Mich.

° ° °

Ted Benson ('58 F) is an engineer for Ryerson and Haynes, Inc. in Jackson. He is residing at 606 Garfield.

° ° °

Hugh Bond ('58) is employed by the Michigan State Highway Department as a Highway Design Engineer. He is living at 333 N. Fairview, Lansing, Mich.

° ° °

Gordon Bonney ('59) is an engineering trainee at Cooper-Bessemer Corp. He is residing at 5 South Park St., Mt. Vernon, Ohio.

° ° °

Donald Borchardt ('59) is an associate engineer for Martin-Denver Corporation. Donald is living at 80 West Kenyon, Englewood, Colorado.

° ° °

Paul Koopman ('38) and his wife Ilah (Carpenter), ('37) have moved to a new home in Grand Rapids. Their address is 900 Iroquois Dr., S.E., Grand Rapids 6, Mich.

° ° °

Ivan E. Parsons ('39) is chief engineer at Continental Motors in Muskegon. He and his wife Mary (Finley), (w'42) live at 435 W. Circle Dr., N. Muskegon, Michigan.

° ° °

John W. Leggat, Jr., ('40) is an engineer in the research laboratories at General Motors. His address is 2502 Woodland, Royal Oak.

° ° °

Robert T. Bogan ('42) is community relations manager of Monsanto Chemical Company's Springfield, Mass. plant. In addition to employee communications, Bogan handles community relations programs such as newspaper, radio and television publicity, plant tours, public speaking assignments and film showings.

° ° °

W. R. "Bill" Monroe ('43) lives at 408 N. Main, Three Rivers, Michigan.

° ° °

Bruce Wangen ('44) is a civil engineer in Detroit. He and his wife Janey (Humphreys) live at 8635 Becker, Allen Park, Mich.

(Continued on Page 56)

YOUR TASK FOR THE FUTURE

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

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

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

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

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

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

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

jpl

CALIFORNIA INSTITUTE OF TECHNOLOGY

JET PROPULSION LABORATORY

A Research Facility operated for the National Aeronautics and Space Administration

PASADENA, CALIFORNIA

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

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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.

GUIDE

(Continued from Page 50)

6. When a student is invited to visit an employer's premises at the employer's expense, he should include on his expense report only those costs which pertain to the trip. If he visits several employers on the same trip, costs should be prorated among them.

7. As soon as the student determines that he will not accept an offer, he should immediately notify the employer.

8. The student should not continue to present himself for interviews after he has accepted an employment offer.

9. Acceptance of an employment offer by the student should be made in good faith and with the sincere intention of honoring his employment commitment.

10. The student should keep the Placement Office advised concerning his employment negotiations in accordance with the policy of his Placement Office.

PLACEMENT

(Continued from Page 27)

this time you check in with Mrs. Gecowets, and she affirms your appointment. When the interviewer is ready for you, he will push a button which flashes a signal to Mrs. Gecowets. She will page you over a loud speaker. After you go up to her counter, she will tell you the name of your interviewer. Then it's up to you.

Engineers' average starting salaries are the highest of any graduate at MSU. Last year electrical engineering graduates averaged $537 a month to start. Next highest was mechanical, $513; metallurgical, $509; civil, $503; chemical, $483; and agricultural, $467.

These figures are the average starting salaries. The lowest was approximately $50 less than the average, and the highest was approximately $50 higher than the average. A master's degree holder averaged $75 a month more than a person with a bachelor's degree.

The 345 engineers who graduated during the 1958-59 year chose various companies after their interviews. The company that lured the greatest number was Bendix with 18. General Electric was second with 15. The rest of the graduates chose approximately 50 other companies, went to graduate school, or joined the military service.

The greatest number of graduates were in the electrical engineering group—109, mechanical—103, civil—56, agricultural—33, chemical—24, metallurgical—14, and applied mechanics—6.

Another service of the Placement Bureau is the Student Employment Division, which provides part-time jobs through the school year, and full-time summer employment. Last year over 2,500 part-time jobs were listed during the school year, and 90% of them were filled. More than 7,500 summer jobs were listed last summer.

MSU offers its graduating seniors an excellent opportunity to sell their wares. And since it (unlike many other university placement bureaus) does not limit the number of interviews that a senior may have, an engineer can benefit by proper use of its facilities.

ULTRASONICS

(Continued from Page 25)

requires a large deformation of the metals being welded. Ultrasonic seam welding requires no deformation.

A new era in ultrasonics is clearly on the way, both in the laboratory and on the production line. New developments such as the ultrasonic dishwasher and seam welder are just a beginning. These developments, not to mention the ultrasonic dentists' drill, will make life easier and more enjoyable in the years to come.

Ultrasonics are finding their place in the medical world. Ultrasonic waves are being used for knifeless surgery in destroying tumors and curing cancer. Ultrasonics have also been used for years by the Navy for underwater object location, or as it is better known, sonar.

The applications of ultrasonics are limited only by the boundaries of man's inventive genius.

ALUMNI NOTES

(Continued from Page 54)

Thomas H. Mitzelfeld ('47) is a section engineer at the General Motors Technical Center in Warren, Michigan.

° ° °

Col. Russell V. Perry ('18) is a retired Army officer. He lives in Ludington, Mich., at 509 Pere Marquette St.

° ° °

Emmet Greenwood ('23) retired last summer after 35 years as Jackson County engineer for Consumers Power Company. He is a past president of the Jackson County Alumni Club.

• Shown above is a freon refrigeration system for the Boeing 707. Through its unique design, a 10-ton cooling capacity is provided at one-tenth the weight of commercial equipment. The leading supplier of manned flight environmental control systems, Garrett designs and produces equipment for air-breathing aircraft as well as the latest space vehicles such as Project Mercury and North American's X-15.

DIVERSIFICATION IS THE KEY TO YOUR FUTURE

Company diversification is vital to the graduate engineer's early development and personal advancement in his profession. The extraordinarily varied experience and world-wide reputation of The Garrett Corporation and its AiResearch divisions is supported by the most extensive design, development and production facilities of their kind in the industry.

This diversification of product and broad engineering scope from abstract idea to mass production, coupled with the company's orientation program for new engineers on a rotating assignment plan, assures you the finest opportunity 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 missiles.
- **Gas Turbine Engines**—world's largest producer of small gas turbine engines, with more than 8,500 delivered ranging from 30 to 850 horsepower.

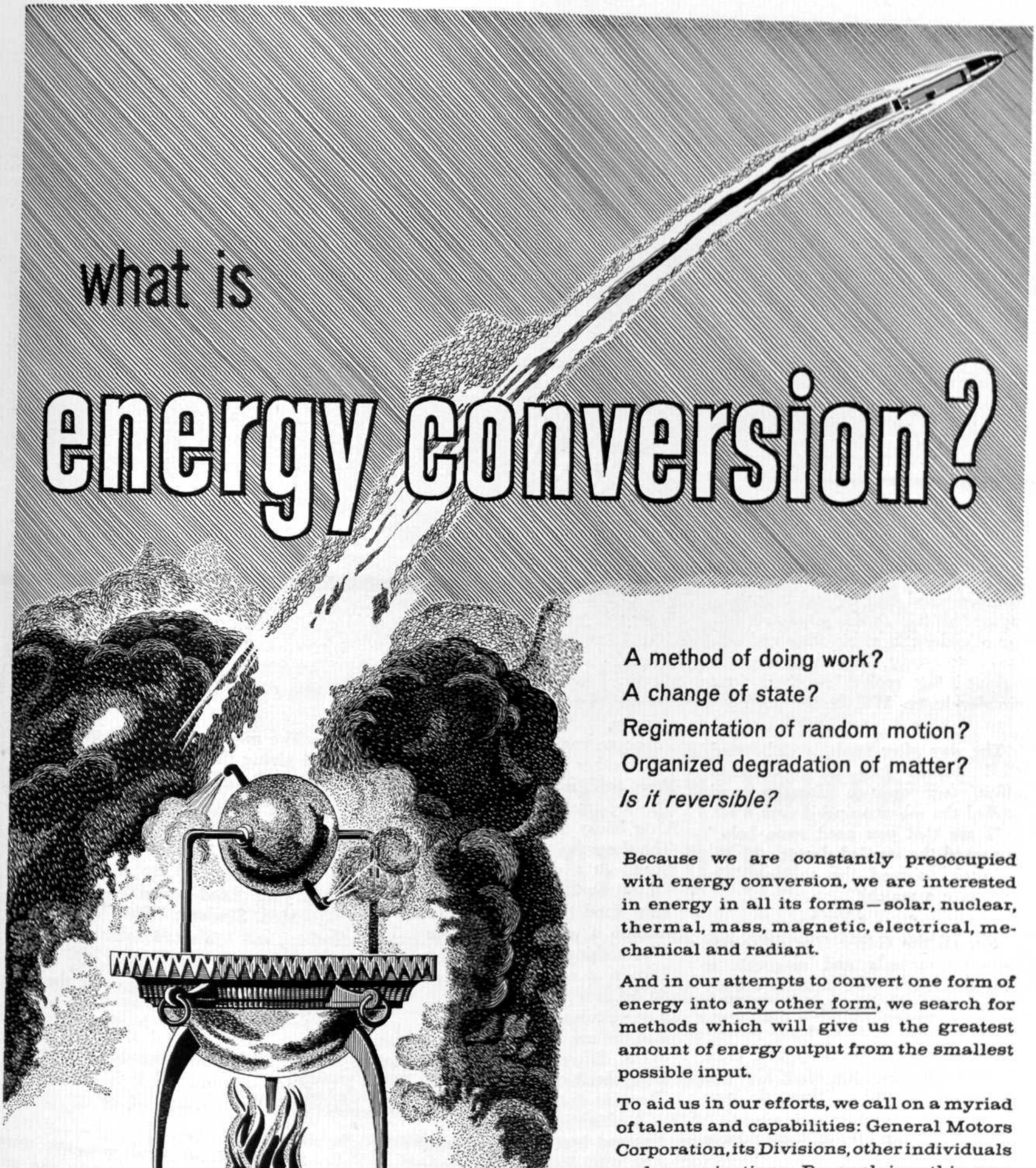
See the magazine, "The Garrett Corporation and Career Opportunities," at your college placement office. For further information write to Mr. Gerald D. Bradley in Los Angeles...

THE GARRETT CORPORATION

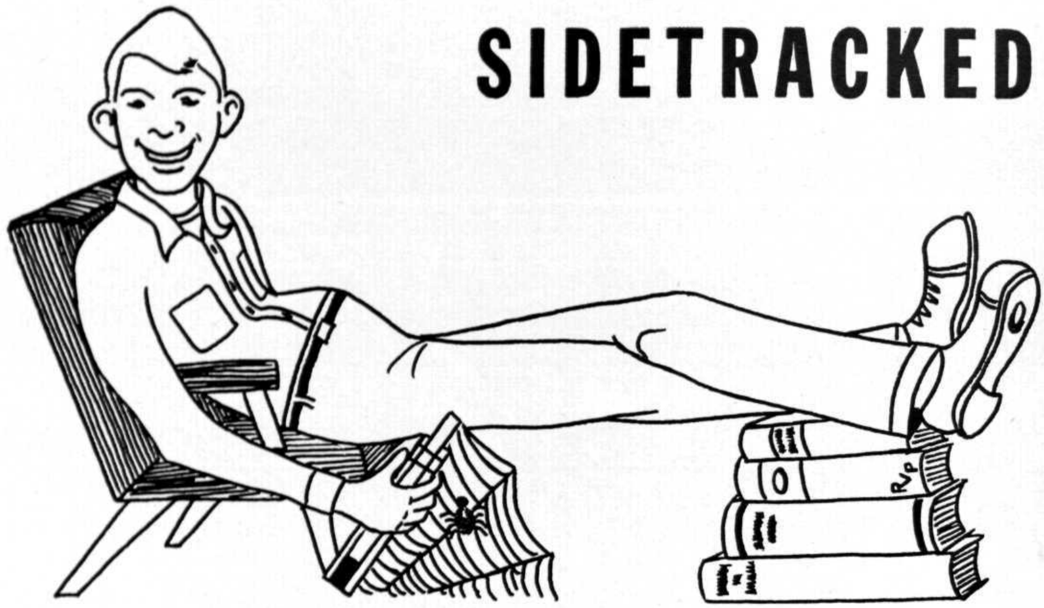
AiResearch Manufacturing Divisions

Los Angeles 45, California • Phoenix, Arizona

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


what is
energy conversion?

SIDETRACKED



A young man sent a letter to another young man pointing out that he understood that he had been taking out his fiancee. He requested that the offender call at his office and talk the matter over. Two days later he received this reply: "Received your circular letter. Will be at meeting."

° ° °

The day after finals, a disheveled ChE walked into a psychiatrist's office, tore open a cigarette, and stuffed the tobacco up his nose.

"I see that you need some help," remarked the startled doctor.

"Yeah," agreed the student. "Do you have a match?"

° ° °

For all the C.E.'s: The difference between amnesia and magnesia is that the fellow with amnesia doesn't know where he's going.

° ° °

First Drunk: "We're getting close to town."

Second Drunk: "How do you know?"

First Drunk: "We're hitting more people."

° ° °

God made a machine, the machine made men.
Doctors, Lawyers, Priests, and then,
The Devil got in and stripped the gears
And turned out the first bunch of engineers.

° ° °

Two junior EE's had just completed a stiff Mechanics exam and were discussing it.

First EE: How far were you from the right answer on the second problem?

Second EE: Two seats.

When I was but a little lad
Upon my mother's knee,
She used to ask me, "Son of mine—
What will you one day be?"
And I, with my slide rule in my hand—
the toy I loved so dear—
Would answer, "Mamma, you should know,
I'll be an engineer!"
While other little boys my age
Were reading fairy tales,
I'd bug my little eyes out
Over books of logs and scales.
The formulae they stuffed me with
Were not sweet mild and meal—
I'd eat equations X times Y—
How good they made me feel!
And so it was that pi to me
Was nothing that I ate;
I knew it equaled three one four
So I'd leave it on my plate.
The calculus and algebra
Became my bone and joint;
What difference did it really make
If my head came to a point?
Then, as it is in every life,
A kindred soul I spied—
I wooed her with exponents,
And with fractions she replied.
Her smile was quite symbolic,
Her figure hyperbolic;
Her lips were hysteresis loops,
Her smile was quite symbolic.
Our wedding was a joining
Of two mathematical wizards.
We knew all calculations
From alpha to the izzards.
Yet with all this wealth of knowledge
No matter how we try,
The operation we do best
Is just to multiply!

° ° °

He: "Whisper those three little words that will make me walk on air."

She: "Go hang yourself."

° ° °

Counselor: "How do you like this room as a whole?"

Freshman: "As a hole it is fine; as a room, not so good."

° ° °

The men in the nudist colony were all giving the eye to the shapely new entrant. One turned to the fellow next to him and said, "saayy! I bet she'd sure look good in a sweater!"

° ° °

Professor: "What are the bones in your hand called?"

Med. Student: "Dice."

° ° °

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

° ° °

EE: "What will you have to drink?"
Date: "I guess I'll have champaign."
EE: "Well, guess again."

° ° °

Professor: A fool can ask more questions than a wise man can answer:

Student: "No wonder so many students fail your exams."

° ° °

Soph.: "I failed my Physics exam."

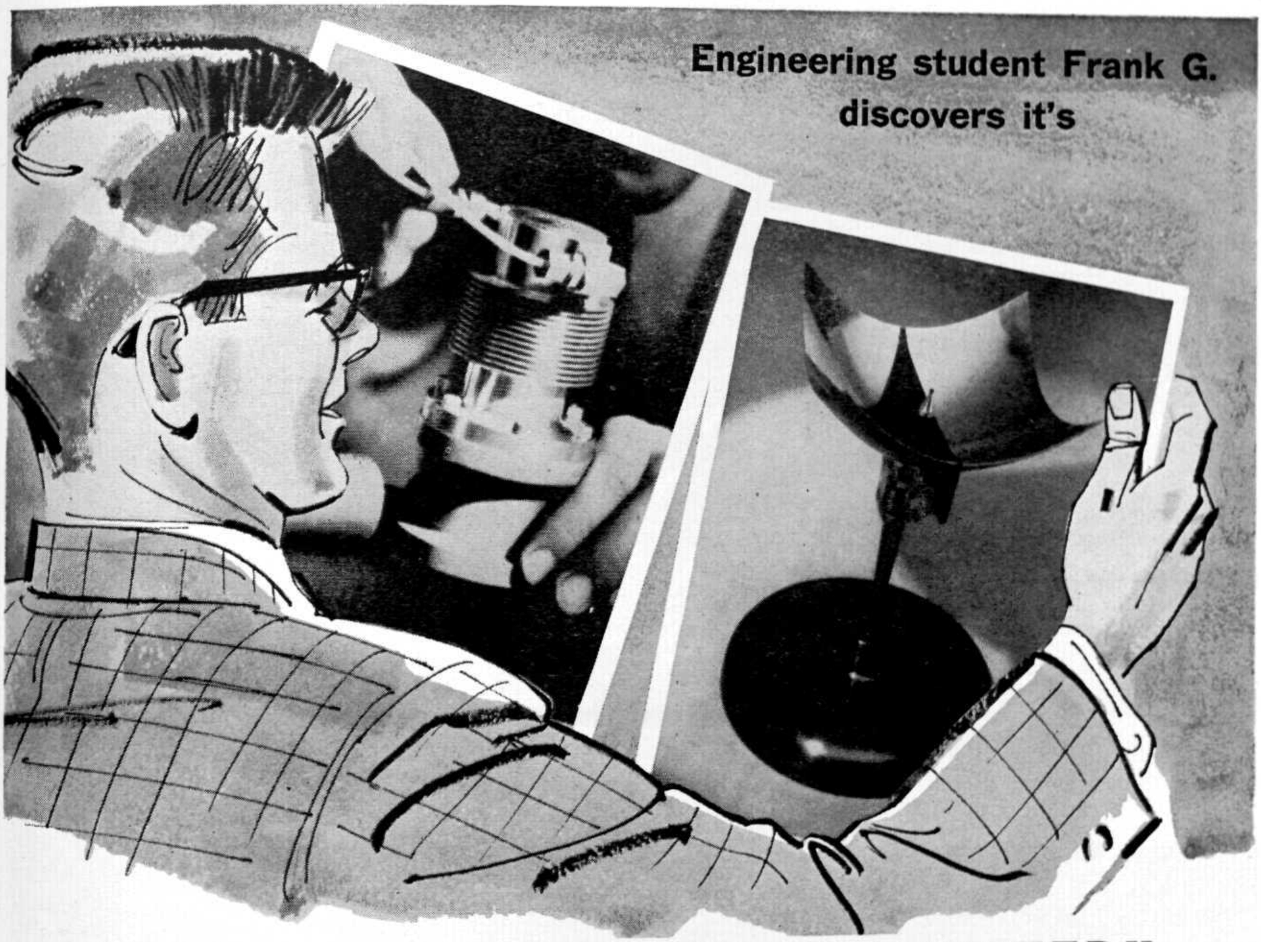
Jr.: "But I thought you had the answers written on your cuff."

Soph.: "Yeah, but by mistake I put on my calculus shirt."

° ° °

Doris: "I can't marry John, father. He's an atheist and doesn't believe there's a Hell."

Father: "Go ahead and marry him, Doris, you'll convince him."



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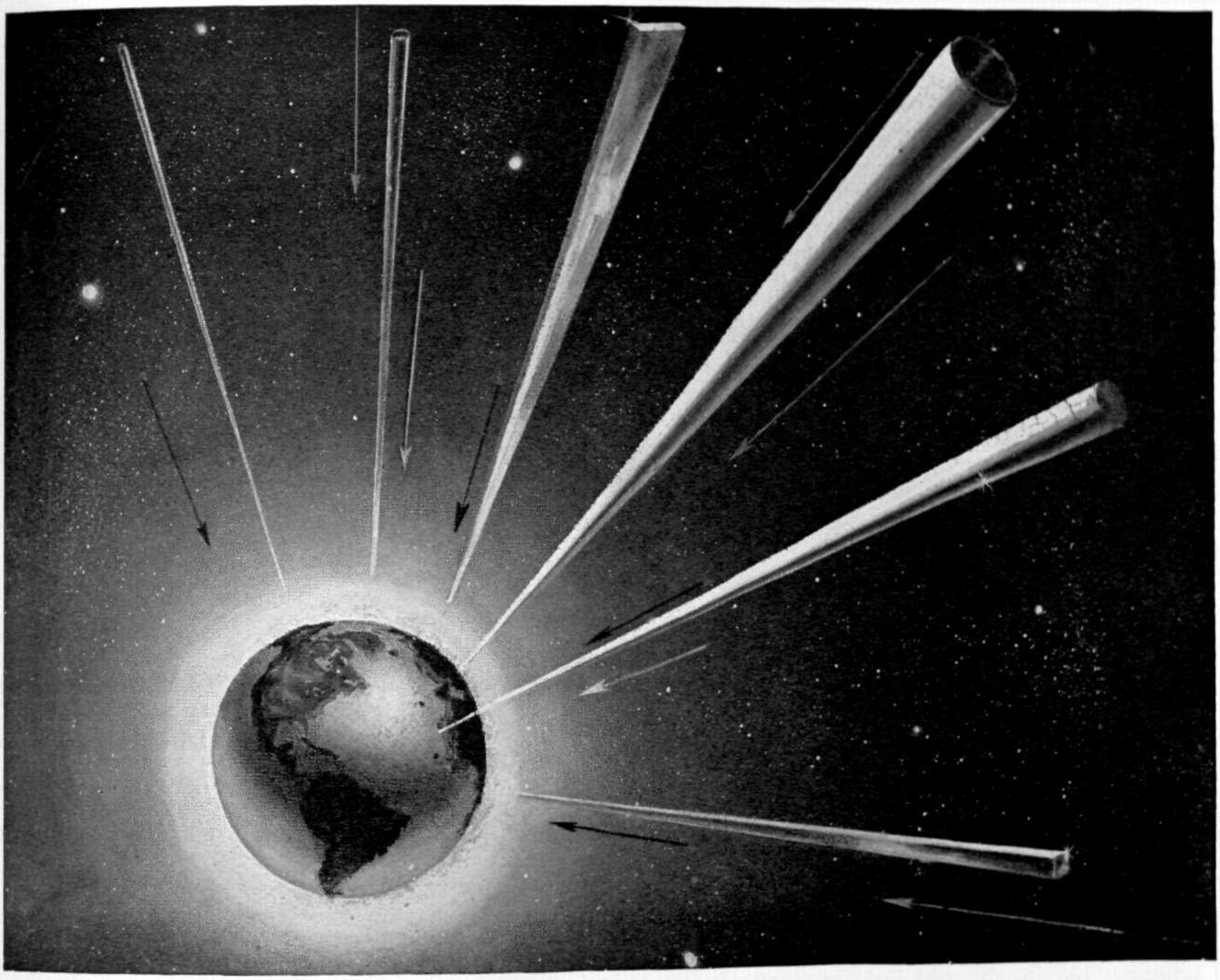

Freshmen, sophomores, and juniors are needed to fill vacancies in several editorial positions on the SPARTAN ENGINEER. Training in technical journalism is available to all interested engineering students who desire experience in the publication field. Come up and chat with us in Room 346, Student Services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

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Interview with General Electric's

Charles F. Savage

Consultant—Engineering Professional Relations

How Professional Societies Help Develop Young Engineers

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

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

Q. How do these societies help young engineers?

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

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

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

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

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

Q. How do you go about joining professional groups?

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

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

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

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

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

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

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

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