SPARTAN ENGINEER

JANUARY 1961

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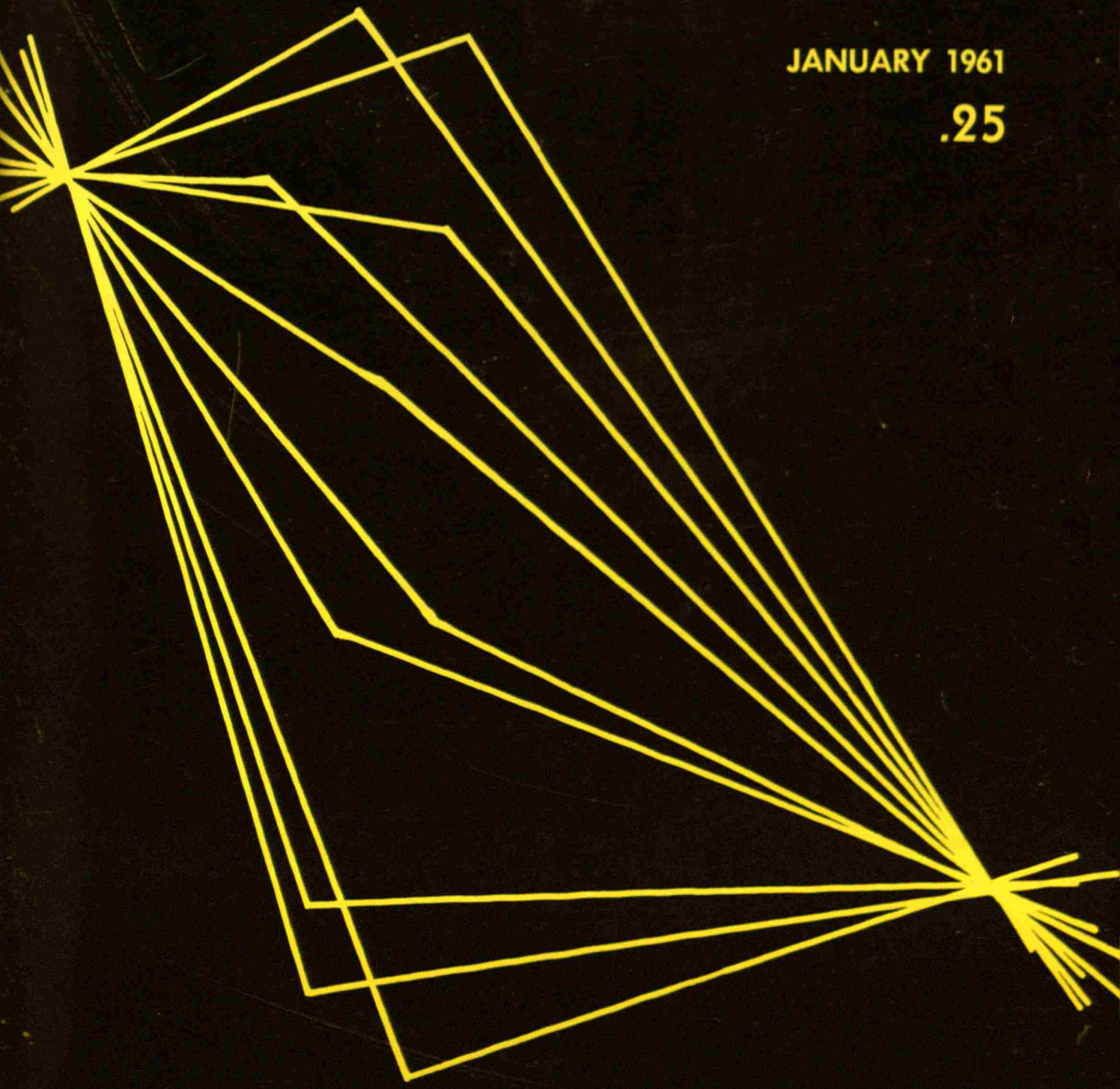

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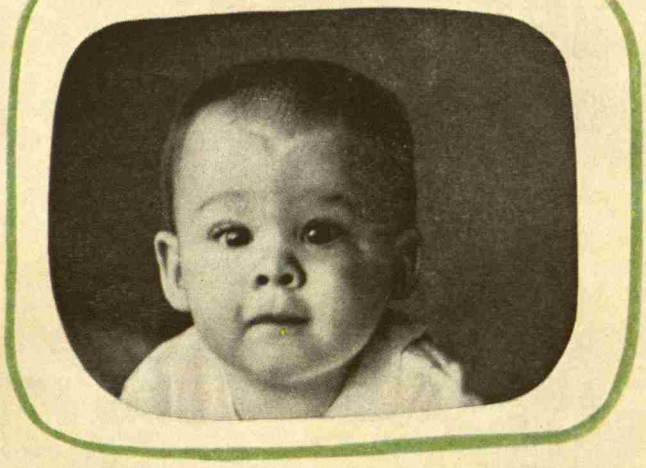

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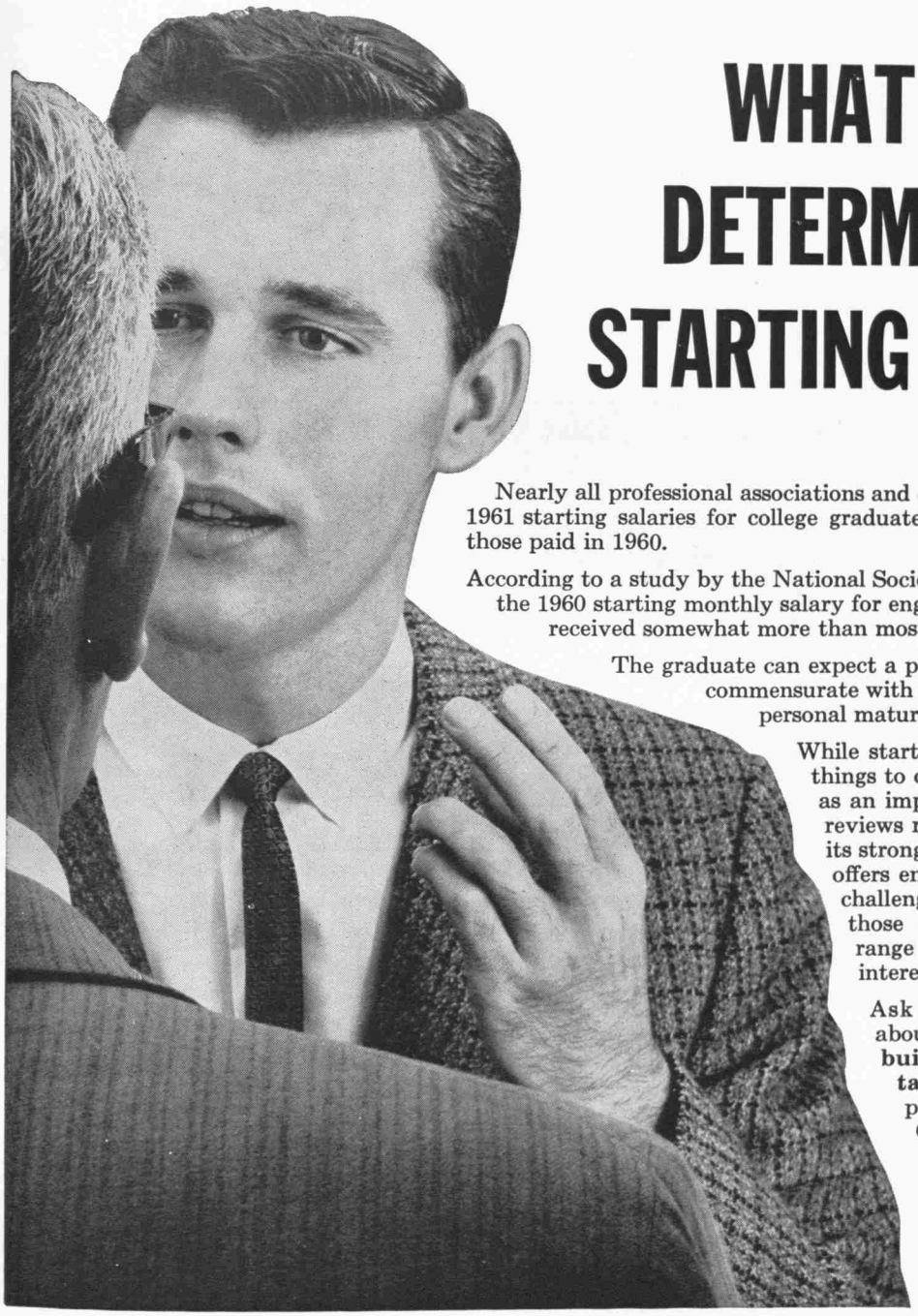

WHAT WILL DETERMINE MY STARTING SALARY?

Nearly all professional associations and employers are predicting that 1961 starting salaries for college graduates will be about the same as those paid in 1960.

According to a study by the National Society of Professional Engineers, the 1960 starting monthly salary for engineers averaged $530. E. E.'s received somewhat more than most other majors.

The graduate can expect a position—and compensation—commensurate with his previous work experience, personal maturity, and academic record.

While starting salary is only one of the things to consider, Bendix recognizes it as an important one, and continually reviews rates and trends to maintain its strong position. In addition, Bendix offers engineers and scientists superb challenges in such dynamic fields as those listed below, with a wide range of freedom to pursue special interests.

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Dean's Letter

You may often have heard that you are a student in the world's first Land-Grant College. You may also know that Michigan State, founded in 1855 to serve agriculture, was used as the model institution around which the Morrill Land-Grant Act was written and passed by Congress in 1862—but do you know what "Land-Grant" means in the field of education?

Michigan and her sister states were given grants of federal land, the sale of which was to provide funds for establishment of institutions to be primarily concerned with the teaching of agriculture, the *mechanic arts* and the *applied sciences.* The term "Land-Grant," historically referring to the method of establishment and initial financing, today has a much deeper significance as indicative of a philosophy of education peculiarly suited to a civilization almost wholly dependent on the products of the mechanic arts, or engineering in the modern sense.

Prior to 1850, a classic university was one which educated the sons, and a few daughters, of the rich in the arts of gentle living, and in the knowledge required by the professions of law, medicine, and the ministry.

The land-grant schools were created because of a recognition that the benefits of education should be available to the able of all classes, without regard to parental wealth, and that through formal education all classes and occupations in our country could be advanced. Thus the emphasis on agriculture, the mechanic arts, and the applications of science became the first great contribution of the land-grant idea.

It was soon recognized by these pioneer schools that not all those worthy of such education could come to remote campuses, yet all could benefit by being provided with new knowledge concerning their vocations. Thus was born the idea of extension education, or the philosophy of taking education to the people wherever they were, and this was the second great contribution of the land-grant institutions.

Michigan State has long been a leader in this practice of taking education to the people needing it in the state of Michigan. After World War II, with the development of new civilizations, it became apparent to President Hannah and others that the land-grant philosophy, which served so well for this nation in its period of development from agrarian life to industrial might, could also be directly applicable to these new nations. As a result, Michigan State is now well known for its part in taking a form of education appropriate to the world in which we live, into many developing countries, from Brazil and Colombia, to Okinawa, Vietnam, Pakistan, and Nigeria.

For its part the College of Engineering has Frank Roop of the Mechanical Engineering Department aiding the University of the Ryukyus in Naha, Okinawa, to develop an engineering program, and is shortly to send its first representatives to Poona College of Engineering, Poona, and Guindy College of Engineering, Madras, both in Southern India. There they will aid these long respected engineering institutions in improvement of teaching methods, and in furthering graduate work. In addition, we currently have in our graduate program twelve professors from a number of engineering colleges in India. Thus we carry *mechanic arts* and *applied sciences* beyond our borders, with the hope that education, brought to all people in all walks of life, may lead other countries of the world to political and cultural stability, as it has for us.

J. D. RYDER

Spartan Engineer

VOLUME 14 NO. 2 JANUARY 1961

COVER:
Designed by Roberta Huffmaster. It is her abstract impression of stereo.

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Alfred J. Carah, Chief Design Engineer, discusses the ground installation requirements for a series of THOR-boosted space probes with Donald W. Douglas, Jr., President of DOUGLAS

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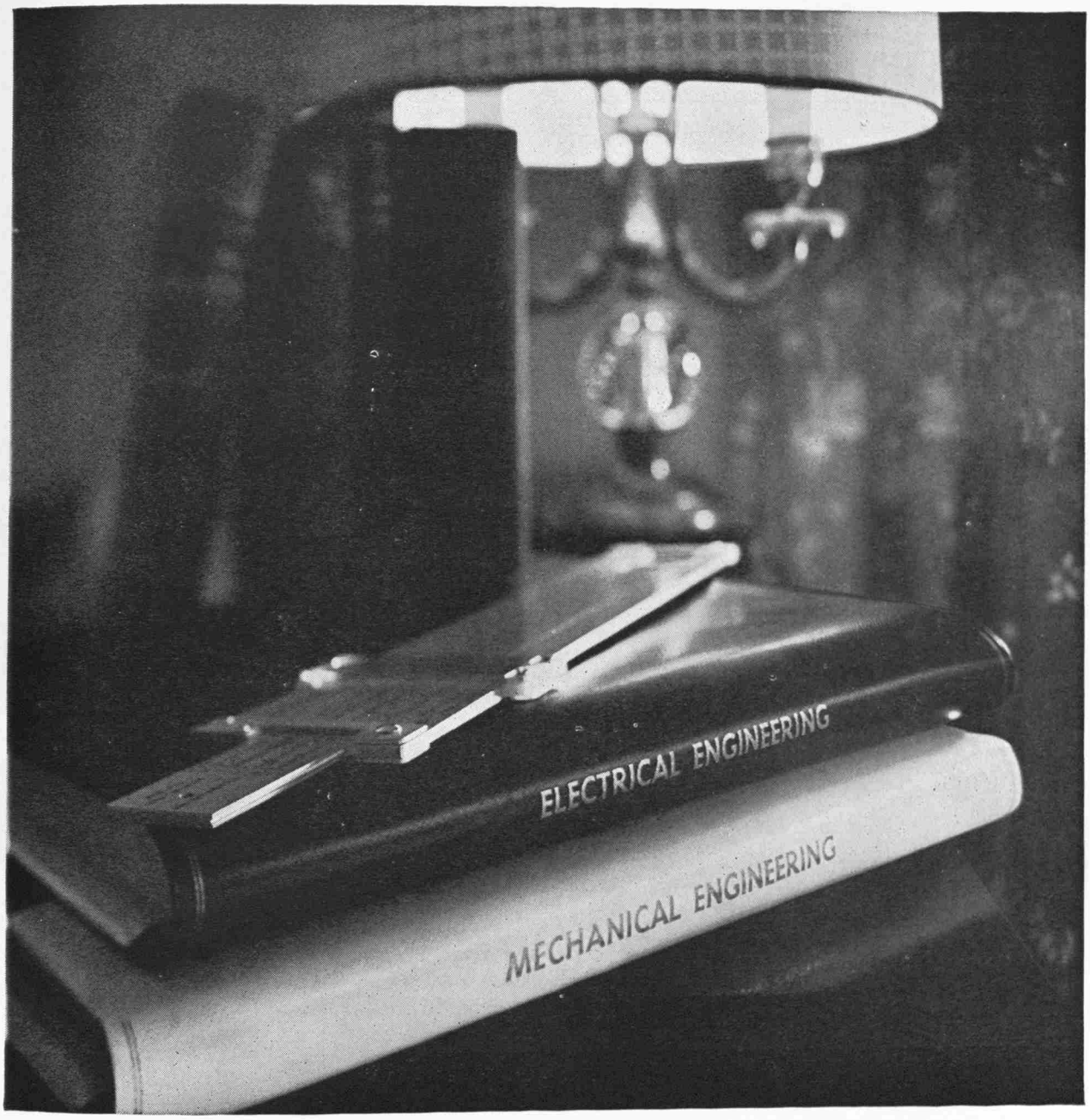

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May we discuss these with you as we visit your campus this year? You can arrange for this visit with your Placement Director; or write Professional Employment Manager, EM-2, Monsanto Chemical Company, St. Louis 66, Missouri.

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Editor's Corner

QUESTION: "In which area of management do you foresee the greatest difficulty in finding executive replacements?"

ANSWER: "Engineering management presents the greatest problem."

The Information Counselors' Survey takes periodic corporation surveys and, among other questions, the one stated above is always asked. And during the two years that I have been reviewing the results of these surveys, the area of major difficulty has always been in engineering management.

I think it is safe to conclude from this that there just aren't enough engineers who are more than just highly trained technical people.

Let's face facts: Already there is about four and a half years work being crammed into the four year program leading to a bachelor's degree in engineering. This gives one very little time to learn anything other than the technical aspects of engineering.

However, since the demand for engineers exceeds the supply, the average engineering graduate has no worry about getting a job. This is very nice and it looks like the engineer "has it made" from the start. . . .or does he?

The bachelor's degree merely permits the just out of college engineer to be placed in "the proving ground." From then on, success depends upon the attitude of the individual.

Employers are, of course, looking for qualified engineers, but at the same time they are looking for their future leaders and executives. In other words, the well rounded individual is the sought after one.

This is why you may be asked questions by your interviewer such as, "How many books (not textbooks or required reading) have you read in the past year?" or "What were your extracurricular activities and what offices did you hold?"

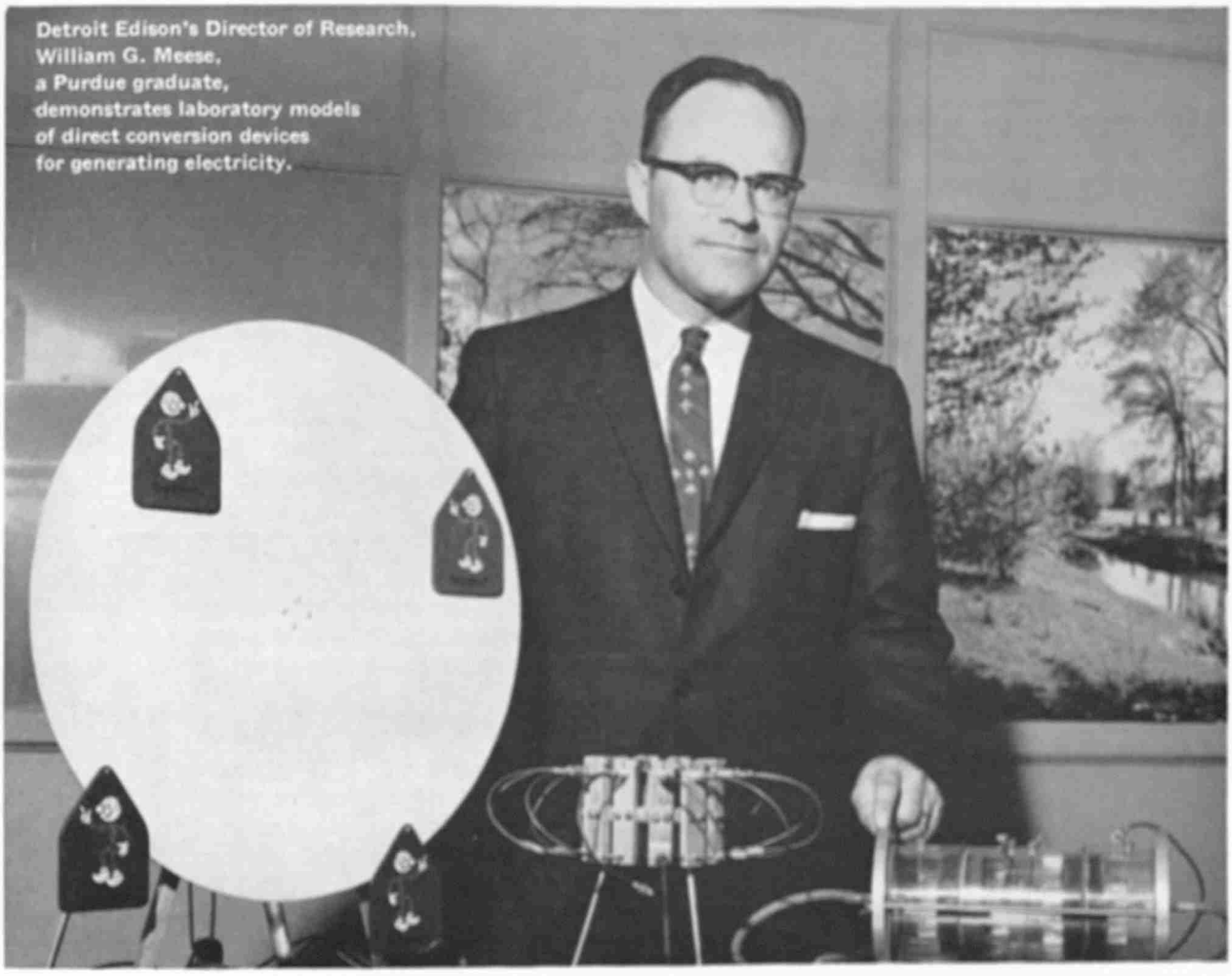
The majority of engineering students realize that they should do outside reading and participate in activities but for some reason don't bother to do so until they are near graduation. They then panic and frantically join organizations and "haunt" the library digging up book reviews.

Large corporations which publish engineering journals and the like often bring forth the matter of being a well rounded individual; they stress extra-professional reading and training. However, it seems that the majority of engineers do not take heed.

I'm sure most of you who are future engineers hope to become executives someday. However, the bachelor's degree you will receive certainly won't insure it.

When you get that long awaited degree, don't let it be the end of your learning. . . . It should be just the beginning.

R. V. P.



Detroit Edison's Director of Research, William G. Meese, a Purdue graduate, demonstrates laboratory models of direct conversion devices for generating electricity.

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FOR EIGHTY YEARS, America's electric power industry has been advancing the science of upgrading energy resources into the most usable, flexible and economical of all the forms of energy—electricity. The progress of our abundant industrial society has depended very largely on the refinement of "crude" energy —either in the form of heat from fossil fuels like coal, or in the form of falling water—into infinitely versatile electric power. ☐ Today the development of atomic electric power offers another means for even more efficient upgrading of our energy sources. In the near future this new development may lead to large scale *direct conversion* machines—enabling us to produce electricity directly from heat without steam generators and turbines. ☐ At Detroit Edison, research and development of new power sources through *fission, fuel cells, thermoelectric* and *thermionic generation* is being continuously appraised. Applications of this research for energy upgrading offer a challenge to young engineers coming into the electric power industry. ☐ You might like to find out more about us. Drop us a note and we will send you a copy of Detroit Edison Engineering—it tells about the challenges and opportunities you can expect. Write to Detroit Edison Employment Department, Detroit 26, Michigan or check with our representative when he visits your campus.

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IDEALS. People may occasionally speak disparagingly of someone as "a dreamer and an idealist." But these are exactly the qualities of all the men who seek to make something great out of something commonplace. When Herbert H. Dow turned an insignificant brine well into a vast chemical empire, he established the Dow philosophy that "everything must be good for something, and we will *make* it work." The rest remained for one other factor.

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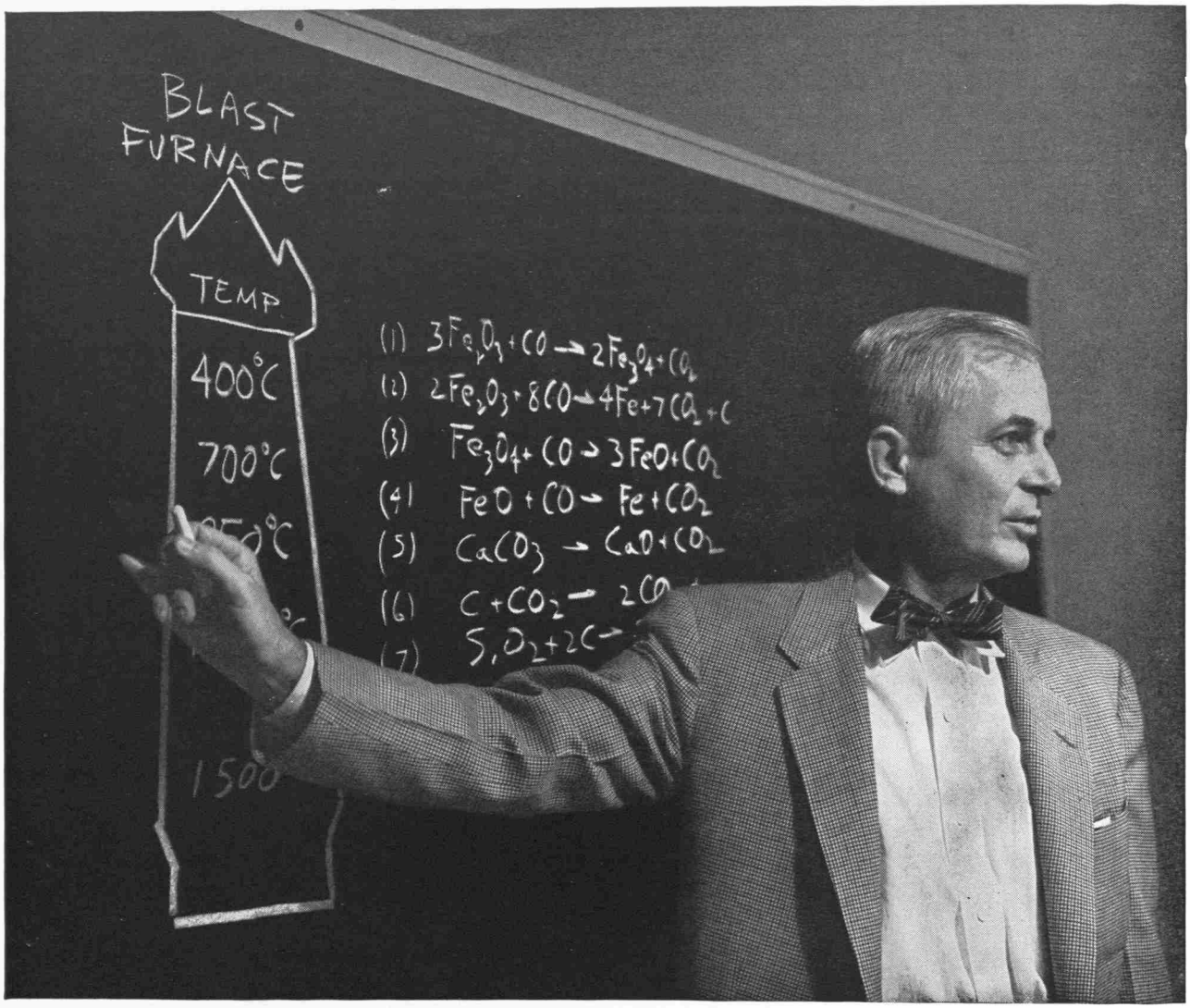

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DIMENSIONAL SOUND

An analysis of stereophonic reproduction

by *JEANNETTE McCLEES, E.E.*

THE accomplishment of stereophonic sound has brought a great deal of "liveness" and three-dimensionality into our auditory world today. Those who have heard the stereo illusion in all its purity will agree that it is a long step forward from yesterday's monophonic sound.

Fundamentally, stereophonic sound means solid sound. It is the attempt to achieve realism by presenting reproduced sound as it would be heard in real life; dimensionally, by both ears.

Stereo has been widely discussed and written about, but it is still widely misunderstood. This article presents an analysis of basic stereophonic reproduction.

Although other characteristics of stereo sound are important, directionality is its major attribute.

Directionality refers to depth, height and lateral spacing of sound. It depends on the ability of the ear to assign a position in space to a source of sound.

Several factors account for this ability:

First, the fast-acting nature of the ear enables a listener to detect a difference in arrival time of as little as six millionths of a second. If a sound reaches a listener's right ear six millionths of a second before it reaches his left, the tiny difference in time causes the mind to conclude that the sound is coming from the right.

This is known as the precedence effect. You can see that the ear is capable of sensing time with great fidelity, at least with sufficient fidelity to provide an accurate sense of direction on the basis of arrival time of the stimulus at both ears.

Second, because the ears are separated by the width of the head, a sound reaches one ear at a lower level of loudness. There is also an increase in air pressure on the ear nearest the sound source and a decrease on the ear furthest away.

The higher the frequency, the greater is the pressure difference. This accounts for a listener's ability to identify the direction of sounds of high frequencies more readily than those having low frequencies.

These intensity differences are more important than differences in arrival time in producing a sense of directionality. The ear is very sensitive to intensity differences, and for this reason, balance between channels and speakers is important in the quality stereo unit.

In an experiment, the difference between sound level at each ear was kept constant. When listeners wearing earphones were asked to state the direction of a sound source, each listener assigned the same angular location to the source. From this experiment, it is is believed that the mind assigns a given difference in a sound level at each ear to a given angular placement of the sound source.

Third, differences in the wave form at each ear help account for the sense of direction. The stereophonic effect is partially produced by a difference in high frequency or harmonic content, created by head and external ear shadowing, of the sound signal reaching the inner ear.

In other words, if a sound were coming from the right, the right ear would receive *all* the frequencies of the sound, while the frequencies reaching the left ear would be lacking in harmonic content. The lower frequencies tend to bend around the head so that a lower note reaches the further ear.

Fourth, the ears receive sound directly from the source and also from reflections from room surfaces. The sound seems to come from the source with the most natural or closest sound.

In reproducing sound, directionality can be achieved by keeping reverberation out of one of the speakers so that the source appears to be in the locality of the speaker with the least reverberation. The ratio of direct to reverberated sound enables the listener to locate the source, and creates an illusion of depth.

Spaciousness is as important as directionality in the stereo illusion. The objective of spaciousness is to create the illusion of a life-sized sound source rather than one the size of the speaker. It also creates the illusion that the performance is taking place in a large hall rather than in a typical living room.

This may be achieved by using a lateral speaker arrangement, and by reverberation. It was stated earlier that

(Continued on page 46)

THE COURIER

NEW SATELLITE IS A FORERUNNER FOR WORLD-WIDE RADIO COMMUNICATION

by *JOHN THORNTON, E.E.*

RECENTLY, a new type of satellite, the Courier, designed especially for global communications, was developed by Philco Western Development Laboratories. Acting as a miniature space station, Courier enables messages to be relayed by microwaves, either on a real-time or a delayed-time basis. The real-time communication system provides a direct contact between ground stations. The purpose of the delay system is to record the data on magnetic tape and later retransmit the data to another ground station. Either teletype or voice channels are available.

Basically the satellite has four main subsystems; a microwave system, a telemetry system, a command system and a power system.

The purpose of the microwave subsystem is to provide a communications link between ground stations and to store data for retransmission. Using four transmitters, four receivers, a receiver baseband combiner and five magnetic tape recorders, the microwave system provides for years of reliable service. The extra components in the system provide auxiliary circuits in case of failure, thereby enabling reliable reception and transmission of data.

The four FM receivers are transistorized and each one weighs about six and a half pounds. Each consumes about 3.3 watts of power. The four receivers operate in pairs, at the same time. Each pair of receivers is linked to a microwave antenna on the outer skin of the satellite and to a baseboard combiner which acts as a switching component. Under normal operations, the combiner measures the signal-to-noise ratio of each receiver and combines their outputs proportionally to these ratios. In case of failure of one of the receivers, the other receiver of the pair will still operate, providing normal communications.

The four FM transmitters are specially designed and, except for the power amplifier tube, are completely transistorized. Since frequency stability might be affected by the extreme temperatures, a crystal controlled oscillator circuit is used to operate an electromechanical frequency control system.

The transmitters also operate in pairs. But only one pair functions while the others act as spares.

Once data has been received, it is stored in one of five tape recorders. Four of the recorders store teletype digital communications while the remaining recorder is used exclusively for voice or analog information.

Each individual recording unit is hermetically sealed and of specialized design in order to reduce weight. The transistorized electronic components and ultra-light mechanical parts give maximum stability, simplicity and compactness. Although the units are approximately the size of a seven inch cube, and weigh less than eight pounds each, they have a five minute continuous recording and reproducing capacity.

Another subsystem equally as important as the microwave system is the telemetry system, whose main purpose is to analyze the performance and environmental conditions of Courier and to provide a way for commands to be sent to the satellite.

Epoxy fiberglass shells are mounted on dummy structure to check fit of parts. Wooden mock ups are used to determine exact location of the 38 "black boxes" making up the Courier payload.

The telemetry system handles up to 35 system parameters, such as power outputs, operating temperatures and conditions in space. This information will not only provide data necessary for global communications, but also data for the design of more efficient satellites.

Each piece of information to be telemetered is coded by a special generator. The coded data modulates six subcarries which then modulate the transmitter. A seventh subcarrier is used as a timing signal.

The four transmitters are connected to four whip antennas on Courier's outer skin. A diplexing unit enables simultaneous VHF transmission and reception.

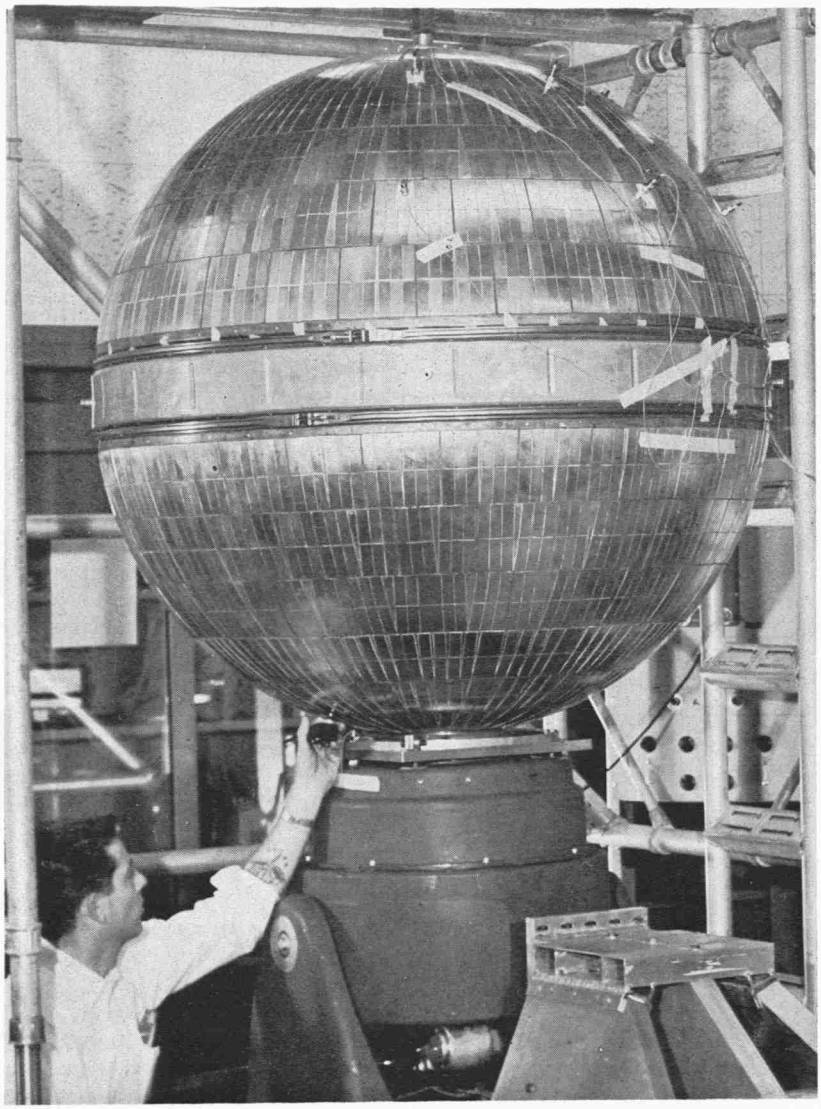
Both the telemetery and microwave systems are in turn controlled by a third system: the command system. The command system acts as a switchboard for telemetry and microwave communications, providing syncronization for the various complex switching operations. Another function of the command subsystem is to switch equipment in case of failure of a component.

The main components of this subsystem are a command decoder and spare receivers. The command decoder, which resembles a small digital computer, checks incoming commands for correct coding. Signals from the ground are picked up by two small, crystal-controlled FM command receivers which in turn feed the data to the decoder.

Also included in this system is a small, 50 mw. beacon transmitter. The signal from this transmitter enables the satellite to be tracked from the ground and also indicates when it is within range of the ground stations.

In order to supply power for the various circuits, an ingenious power-pack was devised. Approximately 70% of the outer surface of the satellite's skin is covered with 19,152 small, rectangular solar cells arranged in groups. When fully exposed to sunlight, they furnish 70 watts of power. Each solar cell is a thin, diffused-junction, silicon wafer which is covered with a thin, glass radiation filter. Seven cells are connected in series to form "shingles" which in turn are put in series to form 84 cell groups. These groups form two independent arrays.

Each array charges a nickel-cadmium battery, permitting greater power loads to be supplied to the equipment. When illuminated, the cells charge the batteries at a rate of 1.8 amps. The storage batteries permit Courier to operate while it is in the earth's shadow. Because of this type of power supply, Courier will be able to operate indefinitely.



The balanced and weighted model of the Courier is mounted on the vibration table to test its performance under the conditions which are encountered as the Thor-Able-Star accelerates the payload into orbit around the earth.

The following describes a typical pass of the Courier over ground station: At the ground station the receiving antenna points in the direction from which the satellite will appear. As the satellite appears on the horizon, the signal of the beacon transmitter is picked up. A coded command from the station causes the satellite's equipment to come to an active state. The beacon transmitter switches off and the telemetry transmitter begins to forward data to the station where it is recorded. Then the ground antenna switches to microwave frequency. When the microwave signal is picked up, instruments on the ground automatically begin to track the satellite.

Data relay or exchange is accomplished during the fifteen minute period before the satellite disappears over the horizon. The relaying equipment in Courier then switches off.

When Courier was launched on October 4, 1960, it was a major accomplishment in space communications. With its advanced equipment, it is a forerunner for world-wide radio communication.

RUSSIAN EDUCATION

A challenge to American education and freedom

DURING the last year the Russian educational system graduated 108,000 engineers; the U. S. graduated 38,000. American technical schools trained 15,000 technicians while the Soviet *technicums* were producing 250,000 graduates.

This great disparity in numbers of engineers and technicians, as well as recent Soviet advances in space exploration, may have wide ramifications in the cold war. Does it mean that we will have to change our educational system or even our political and economic system to survive? It certainly justifies a closer look at Red reading, writing, and 'rithmetic.

Every Russian boy and girl must attend a minimum of seven years of school, roughly equivalent to nine years of American schooling. Within a few yeras the entire ten years, equivalent to our twelve years, will be made compulsory.

The Russian education is completed in fewer years by using a six day week with six hours of lecture each day for ten months each year and by carrying heavy loads. For example, the universal Russian curriculum for seventh grade students includes Russian language and literature, mathematics, history, U.S.S.R. Constitution, physics, biology, chemistry, geography, foreign language, drafting, and physical education.

Despite the constant over-working and the many uninteresting compulsory courses, academic standards are generally higher than in the U. S. because of the fierce competition and the great incentives. In order to gain admission directly to a university a student must have a high A average. Low A and high B students can enroll in night or correspondence courses, enter a *technicum,* or enter the university after working two years.

Strong incentives are provided to encourage the superior students to continue their education, especially in engineering. Students and graduate engineers are exempt from the draft. They are provided with ample housing even in badly crowded cities.

Contrary to the communist ideal, large wage differentials exist in the U.S.S.R. The common laborer receives about 350 rubles per month, a truck driver about 740, a school teacher about 1,000, an engineer about 2,500, a full professor about 5,000, a department head 6,000, and a member of the U.S.S.R. Academy of Sciences about 10,000 rubles per month.

Engineers and teachers also have very high prestige in Russia because the people realize that they have been instrumental in changing Russia from a peasant country to a rapidly advancing industrial nation.

No tuition is charged in any Soviet school; in fact, most of the students in the universities receive scholarships or living allowances. The grants for engineers vary from 300 rubles a month the first year to 500 the fifth year. Grants are lower or nonexistent for students in less essential majors.

Scholastic competition is encouraged by giving 25% increases to students who got all A's in the preceding quarter. Students must keep a B average to keep their scholarships, but authorities are more lenient with engineers. In addition to the regular scholarships, there are about 7,000 personal scholarships ranging from 500 to 1,000 rubles per month for outstanding students in nearly every field.

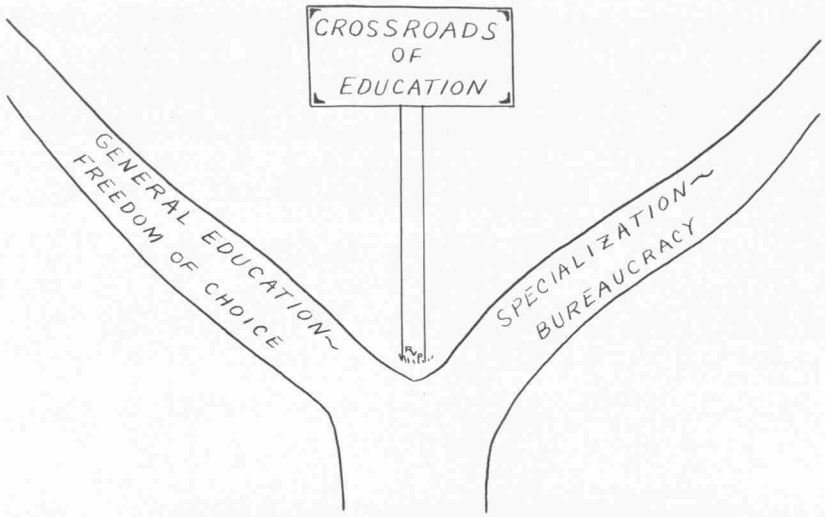
In return for this preferential treatment, the Soviets expect their engineering students to work hard. For example, a first term freshman in mechanical engineering at Moscow Higher Technical Institute is required to take 4 hours of Marxism-Leninism, 2 hours of a foreign language, 8 hours of math, 4 hours of chemistry, 5 hours of descriptive geometry, 2 hours of technology of metals, 5 hours of drafting, 4 hours of shop training, 2 hours of physical education, and 3 hours of military training each week. Attendance is mandatory.

Russian engineering students spend one year and four months in on-the-job training sessions in industry. Many of the students work two years in industry before entering the university. As a result the classroom education is more theoretical and mathematical than in the U.S.

Engineering curriculums in Russia are much more specialized. The Soviets do not produce mechanical engineers, they produce cold metal working engineers, thermal processing equipment engineers, etc. Each of the 835 majors and specializations has a set curriculum of five years.

The Russian engineering curriculums are highly technical; the only nontechnical courses are a propaganda sequence in Marxism-Leninism and political economy. A few electives are offered but they are all technical and must be taken in addition to the regular schedule.

Another big difference between the American and Russian engineering students is that 30% of the Russian en-



by PAUL BUTLER, M.E.

gineering students are women. Russian women have equal opportunity to get any job from ditch-digging to engineering; they form an important reservoir of talent.

One reason for the high number of Russian graduates is the low drop-out rate. Of the resident students only about 16% drop out, compared to a figure of 41% for the U.S. The figures are, of course, higher for evening and correspondence students.

An important link in the Soviet educational system is the *technicum* or specialized secondary school. Students may transfer to the *technicum* after 7 years in the elementary school, but most students graduate first and enter the *technicum* if they are denied admission to the university.

Last year the *technicums* graduated 250,000 technicians for industry. These technicians are in the same fields as the engineers but they are more narrowly specialized and their education is practical rather than theoretical.

Not only are the Soviets graduating more engineers and technicians than the U.S., but they are increasing their enrollments every year at a substantial rate. In contrast, U.S. engineering enrollment has fallen 7% during the last two years.

However, the Russian system has many faults and drawbacks from the American point of view. One is the extreme specialization. The Soviets are not interested in educating men, they are interested in producing workers. American education teaches men how to think; Russian education teaches them not to think.

The propaganda courses in Communist doctrine are just that; propaganda. The students dislike the course but attendance is mandatory and failing the course means automatic expulsion.

The rigid admission requirements are a handicap. Students can apply to only one school a year. To avoid missing a year students frequently apply to inferior schools and offer to accept admission in any major.

Even if they do not like their major there is little chance of changing it unless the planners decide that a shortage exists in some field and ask for transfer volunteers. If there are no volunteers students are transferred against their will. Engineering students cannot transfer to science or science majors to engineering because the two fields are taught at different schools.

Because of the rigid curriculum schedules, students must take many courses which they find unnecessary or uninteresting. The lack of non-technical electives discourages many students with more than one interest.

Most of the new enrollments consist of students in night and correspondence courses. These students must work full time and study long hours, which puts a great burden on them. For this reason the drop-out rate is high and the average student takes many years to complete the program.

Only 3% of Russian university graduates go on to graduate school. However, because of the heavy course load, the shorter vacations, the practical training, and the five year program, the Russian degree is considered to be equivalent to a master's degree in the U.S.

The great majority of the graduates are arbitrarily assigned jobs in any part of the country in which they are needed. Recently the Russian government decreed that married couples must be assigned jobs in the same county, an important policy change.

Russian graduates are guaranteed a job but they must always remain engineers in their specialty unless the government asks them to change. The U.S. loses many engineers each year to management, sales, etc.

Although the Soviet system produces engineers efficiently, it should be obvious that their methods could not be adopted in this country because of our different political, economic, and philisophic systems. Their educational methods would conflict with the American way of life.

American industry does not need the large numbers of engineers the Soviets are producing. However, the demand is much higher than the present supply, and the decrease in engineering enrollment definitely calls for some remedial action.

Some of the Russian methods could be easily applied to American education; for example, government engineering scholarships and coeducational engineering. Technical schools could be set up to train technicians. Giving graduate engineers exemption from the draft would be a cheap and very effective way of getting more engineers.

The United States can produce enough engineers without changing to a totalitarian educational system, but we cannot afford to be complacent; we must act to meet the challenge.

BE PREPARED

POINTS TO REMEMBER WHEN BEING INTERVIEWED

by ROBERTA HUFFMASTER, MATH & PHYS. SCI.

THERE is a big demand for engineers in industry, and there will continue to be one in the years to come. This, however, doesn't automatically eliminate the need to sell yourself to a prospective employer. In fact, since salaries are high for starting engineers, the company has a vested interest in finding the best.

In order to make the best impression on the representative, and also make a wise choice in terms of a career, we feel that you should be made aware of some important tips that can help you when you go into an interview. Jack Kinney, Director of the Placement Bureau, was very helpful in suggesting ways to sell yourself effectively.

When being interviewed, you should adopt the Boy Scout motto, "Be Prepared." This may seem trivial and practically intuitive, but these two words cover a wide variety of things to do or not do.

Personal appearance is of great importance. Since the interviewer sees you before ever hearing you, the impression you make can depend to a large extent on how you are dressed. This means neatness in all particulars; suit, tie, shoes, etc.

If there is no time to change from school clothes into a suit before a scheduled interview, a few words of explanation and a neat appearance will correct the situation. Polite consideration is important. Don't smoke unless invited to, don't chew gum, sprawl over the chair, mumble answers, or take notes while talking to the recruiter. Write down the important points right after the interview.

There are just as many "do's" as "don't's" in being prepared. Do be early for the appointment. If there is an emergency, and it becomes impossible to keep a scheduled appointment, a telephone call to the Placement Bureau is absolutely necessary. A person who doesn't show up is denied the privilege of using the bureau again.

Do use the library facilities provided to read up on the particular company you are interested in. The material in the racks can be studied and kept. The vocational library is also a good place to learn about a particular organization. If you know something about the company's benefits, training program, etc., you can ask intelligent questions and the recruiter won't have to repeat information in the brochures.

During the interview, the representative is bound to ask questions that require some thought before answering; such as "Why would you want to work for this organization?" or "What do you have to offer my company?" Here again it is much easier to cope with the probing questions if you are prepared beforehand by serious thought about your aims and motives. You should have a definite area in engineering that interests you, such as research, production, design, or sales engineering.

Other questions asked in order to search out the applicant's sincerity,

An interview in progress. This is one of the twenty-one 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.

ability, personality and habits are: "What did you like to do most in college?", "Why did you choose engineering?", "Where did you spend your summers?", "What organizations did you belong to and what offices did you hold?" (they're interested in active leaders, not joiners), and "Did you participate in athletics?" Although these may seem a little irrelevant to being an engineer, they help the recruiter see past your grade record to you as an individual.

Besides this type of interview, in which the representative asks the questions and expects you to listen to him part of the time, there is another approach to the matter, and that is for the recruiter to say, "Tell me about yourself." What he is looking for is your capacity to think quickly, to be factual, and to stick to a subject.

Through the use of the interview, references, and records, a recruiter tries to evaluate you as a prospective employee. He is generally looking for:

1. grades (he would find nothing wrong with an average of 3.5 or better);
2. extra-curricular activities (preferably as an office holder);
3. work experience in or out of your major field;
4. personality, adjustment, and ability to get along with others.

You should look the company over with at least as much interest and thoroughness as the company does you. Some students forget that their opportunity is not just another job, but possibly a permanent career. Because this is a major step, you should look for definite characteristics in the company. Some of these are:

1. reputation and rating of the company;
2. type of product made or service rendered;
3. kind of work opportunities available;
4. location;
5. type of people that make up the company.

After the interview, you may be asked to fill out some form. This should be done immediately and neatly, and either returned to the recruiter or mailed directly to the company as instructed. If you are very interested in the company, a letter thanking the interviewer for his time is in order.

If you are invited to visit the organization, a thank-you letter is almost mandatory. A word about the expense account given you when you do visit a company—Always be honest and accurate. Their bookkeeping department won't be fooled by a $9.00 cab fare and you are jeopardizing a possible job opportunity.

Two major stumbling blocks faced by senior students are discouragement and a romantic view of a career. There is no reason to feel that you are a failure when, after 3 or 4 interviews, you haven't received a job offer. The students who used the Placement Bureau last year averaged 11 interviews (3,279 interviews for 300 engineering students). Each succeeding interview gives you more confidence in your ability to handle the situation and make a good impression.

(Continued on page 50)

AIRBORNE

Edited by *JEANETTE McCLEES, E.E.*

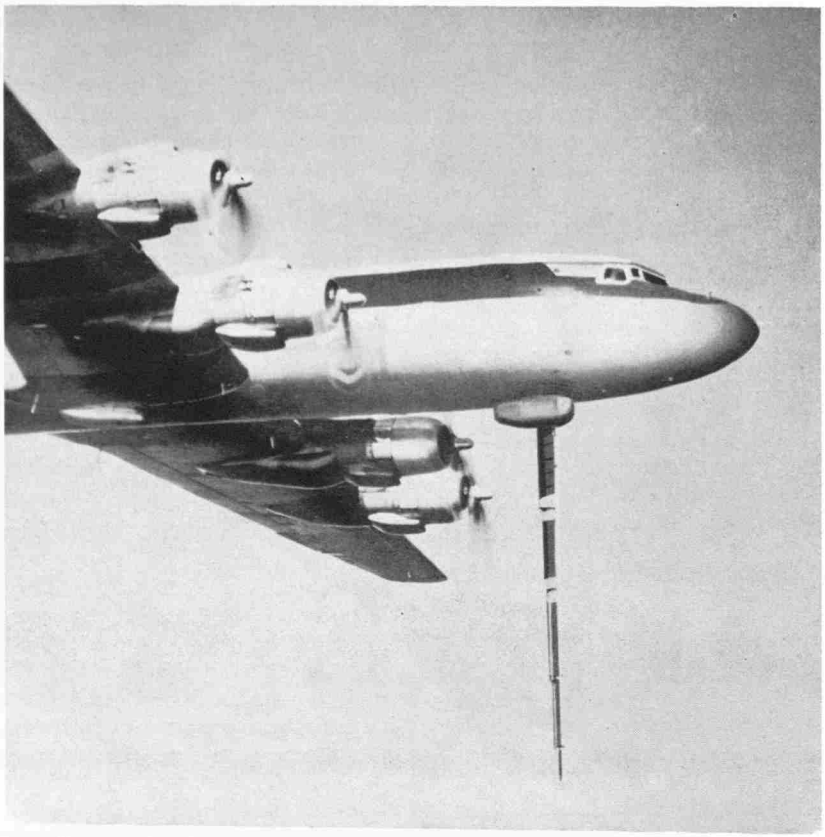
TV instruction in the classroom is a new, regional exploration in education. The MIDWEST PROGRAM ON AIRBORNE TELEVISION INSTRUCTION will offer a variety of subjects to all or parts of six states, at various grade levels, beginning January 30, 1961. The programs will originate from an airplane orbiting over Montpelier, Ind.

MPATI's aim is to harness television to bring the highest quality of education to millions of students, in large and small communities alike, more quickly and at less cost than by any other means available.

Television is a powerful new tool which can help schools and colleges increase instructional effectiveness and improve the relevance and quality of the curriculum. It gives far more students access to unusally talented teachers and rich learning experiences, such as scientific demonstrations, that cannot possibly be provided in ordinary classrooms.

Two DC-6AB aircraft (one to serve as a steandby) will be used for transmitting study courses to the schools. Based at Purdue University Airport, West Lafayette, Indiana, each plane will be equipped with two TV transmitted and external 30-foot sending antenna, permitting telecasting of two courses of instruction simultaneously.

The transmitting aircraft will orbit in a circle of 10 miles radius at an assigned altitude of 23,000 feet over north central Indiana, with the community of Montpelier as the approximate center. The Federal Aviation Agency has assisted in the selection of this airspace to insure uninterrupted operation of the planes.



Four-engine DC6AB aircraft used in Midwest Program on Airborne Television Instruction employs 24-foot-long sending antenna which retracts for take-offs and landings.

The Federal Communications Commission has granted limited experimental authorization, subject to stated conditions, to use the needed telecasting channels, both for the air-to-ground transmission and a ground-to-air link. The latter will not be used at the outset, but may be activated later to beam "live" courses via the aircraft from studios at Purdue University some 85 miles to the west.

Air-to-ground transmission will be on standard-band, ultra high frequency channels. MPATI also will experiment with narrow-band (3 megacycle instead of 6 megacycle) UHF transmission which ultimately could permit a doubling of the number of programs transmitted.

Over-all responsibility for engineering the airborne telecasting system is being carried by Westinghouse Electric Corporation, and responsibility for the narrow-band aspects of the program by CBS Laboratories Incorporated.

In addition to school systems which will be receiving the courses directly, local educational television stations in major cities in the area will be encouraged to pick them up for re-telecasting to "fringe" areas of reception or video tape them for telecasting to schools or homes at hours different from the airborne telecast schedule.

Purdue University and the Purdue Research Foundation are providing the legal, fiscal and physical facilities for the development of the program during its first stages.

Total project costs of $7 million are being met by a $4½ million appropriation from the Ford Foundation and contributions by private industry.

Schools and colleges in all or parts of Wisconsin, Illinois, Indiana, Kentucky, Ohio and Michigan will be

CLASSROOM

Flying television transmitter spreads learning across six midwestern states

reached by this program. Within this area there are more than five million students in over 13,000 separate locations. These schools can be served by the transmitting aircraft except where terrain and similar obstacles cause reception "blindspots," especially on the outer edges of the circle.

Recent engineering studies have laid the basis for the MIDWEST PROGRAM to telecast over two channels, and the eventual possibility of as many as six simultaneously from one aircraft. Such a system will permit the telecasting of courses over most of the territory within a radius of 150-200 miles. A stand-by aircraft will assure high reliability of operation regardless of weather conditions and equipment breakdown.

MPATI will service the participating schools in two phases:

1. February through May, 1961: This will be a period of demonstration telecasts, permitting schools to observe the program and to check the quality of signals received. During this period the aircraft will transmit on two VHF channels simultaneously, four hours per day and four days per week.
2. September 1961 through May 1962: This phase will constitute the first full academic year of airborne telecast instruction. During this period present plans call for the aircraft to transmit six hours a day, four days a week.

During both phases of telecasting, interested schools will be provided with assistance on both the technical and educational aspects of the program.

MPATI has conducted an extensive "teacher talent search" to find the most outstanding teachers from classrooms throughout the United States. The final selection of the TV teachers will be from among 50 of the best screened.

These teachers gathered at workshops at Purdue University during the summer of 1960 to prepare the courses for airborne TV. On completion of course preparation, the TV teachers will go to production centers such as local educational TV stations, for the actual recording work.

Participating schools and colleges will receive teaching guides and supplementary materials for the MPATI courses in December, 1960.

MICHIGAN COOPERATING INSTITUTIONS

Michigan State University, East Lansing
James L. Page, Area Coordinator

Western Michigan University, Kalamazoo
Martin Cohen, Area Coordinator

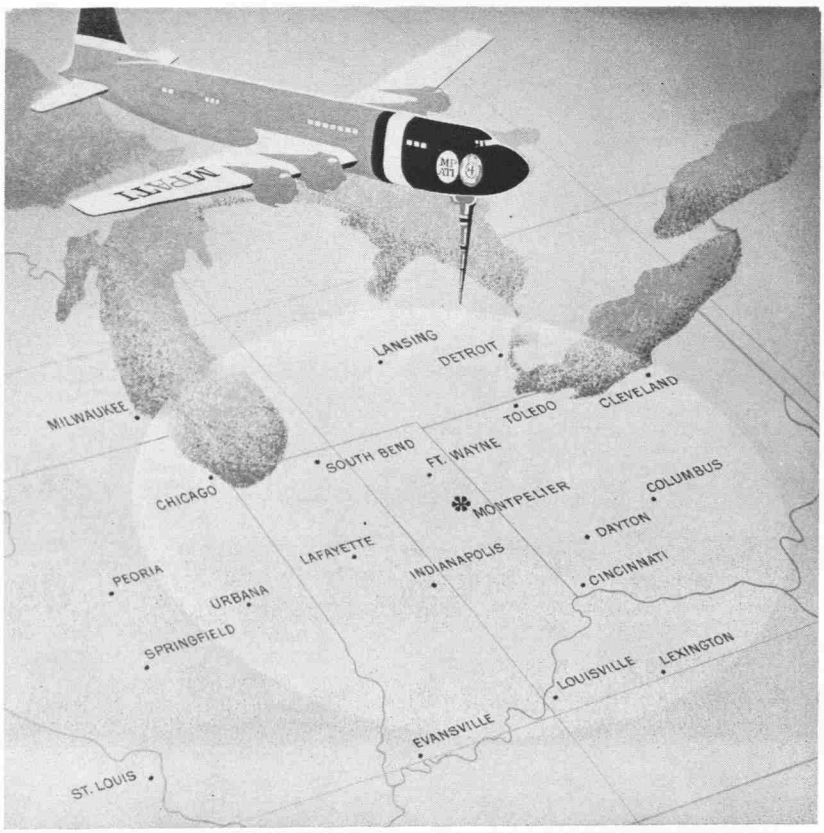
Wayne State University, Detroit
John Barson, Area Coordinator

University of Michigan, Ann Arbor
Edward Stasheff, Administrator, Instructional Television Project

The above persons are available upon request to all schools for consultation and help in all aspects of the MIDWEST AIRBORNE TELEVISION project from in-service training to public information.

James L. Page, Assistant Director, Audio-Visual Center, MSU, and MPATI Area Coordinator has received information that 230 teachers and 7,910 students will be interested participants in the Michigan State area.

WMSB-TV, Michigan State University's educational station, is preparing to receive the MPATI test pattern with its UHF equipment and will have a monitoring facility for the MPATI program.



Map showing the area of six mid-western states reached by educational television programs relayed from plane circling Montpelier, Indiana.

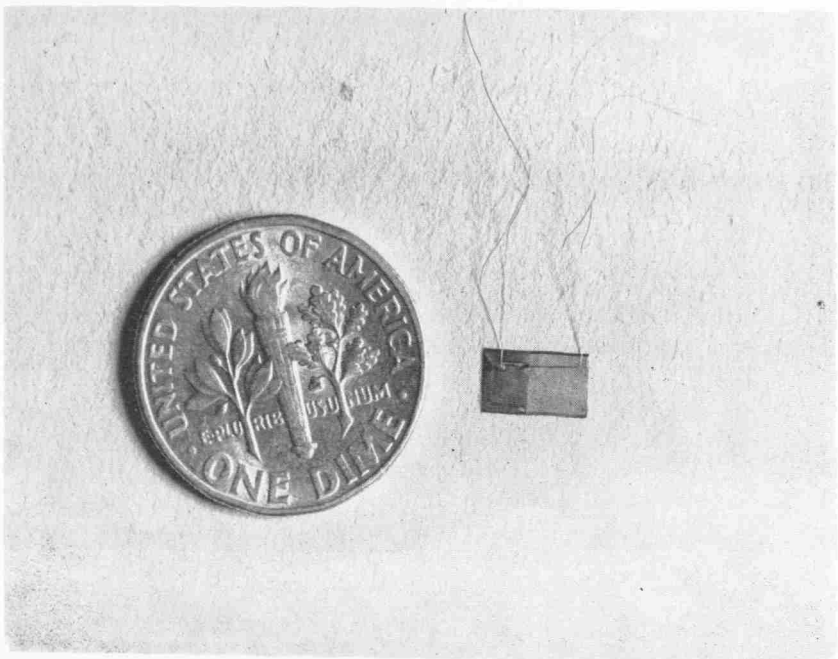
MOLECULAR ELECTRONICS

NEW CONCEPT OF MINIATURIZED FUNCTIONAL BLOCK SHRINKS ELECTRONIC WORLD

by KENNETH L. LESLEY, E.E.

THE PRESENT-DAY, extensive application of electronic equipment to military use places upon the constituent components the most rigorous requirements ever to be specified. The trend of the greater part of these applications is toward miniaturization. For a man carrying a portable transmitter, miniaturization is a blessing; for a satellite it is a necessity. This miniaturized electronic gear, in addition to being lightweight and compact, must be operable in motion. Also it must be rugged with regard to varied environments because military utilization may carry the gear to many parts of the universe. Equipment installed in a modern long-range missile will run the temperature gauntlet as it leaves a hot desert launching pad and is propelled to freezing high altitudes. Clearly, this electronic gear must be capable of reliability in meeting the most strenuous environments without failure. Thus, miniaturization and reliability are the goals in the field of microsystem electronics.

Microsystem electronics suggests itself to division into three levels of application; application may be undertaken on the device, circuit, or system level. Molecular electronics is concerned with the circuit and system levels. This field, occasionally termed "molecular engineering," is concerned with the design of appropriate materials in conjunction with appropriate electrodes to result in an integrated structure giving a desired electronic effect. Realization of this "functional block" by the miniaturization of a system or circuit into a microsystem helps to solve the problem of size but, unfortunately, does not yield maximum reliability.



A molecular electronic two-stage video amplifier shown beside a dime.

The importance of reliability cannot be overstressed; in a unit such as a satellite in orbit, repair or replacement is out of the question. Therefore, reliability and longevity are a must. In an effort to solve the problem of reliability, multipath or redundant circuits are used.

In the Nike Hercules missile, it is imperative that the warhead not explode near the launching site where human lives would be endangered. Within the missile there are circuits designed to prevent complete arming of the missile until it is sufficiently out-of-range of the launching site. In this disarming safety circuit, component failure could mean a circuit failure with disastrous results. To insure against such failures making the missile unsafe, a redundant circuit is used to bypass the failure but still allow the missile to complete its mission in the normal way. Ironically, in order to

insure reliability by building in extra circuits, emphasis falls upon miniaturization to allow more circuits per unit volume. This type of systems reliability is a substitutional answer to the question for it does not solve the problem of reliability within the functional block.

At this stage of development in molecular electronics, complete reliability has not been attained; it is still a goal to be achieved. Manufacturers and research engineers studying this problem feel that it can be partially solved through standardization. Any experimental field or infant industry is bound to be plagued by a lack of common terminology and nomenclature. Beyond this rather basic but vastly important problem, there is the question of standardization in manufacture. A means toward the end of uniform reliability is the use of standard designs, materials, processing techniques, and testing methods. At present such a system of standardization is coming of age in the transistor industry.

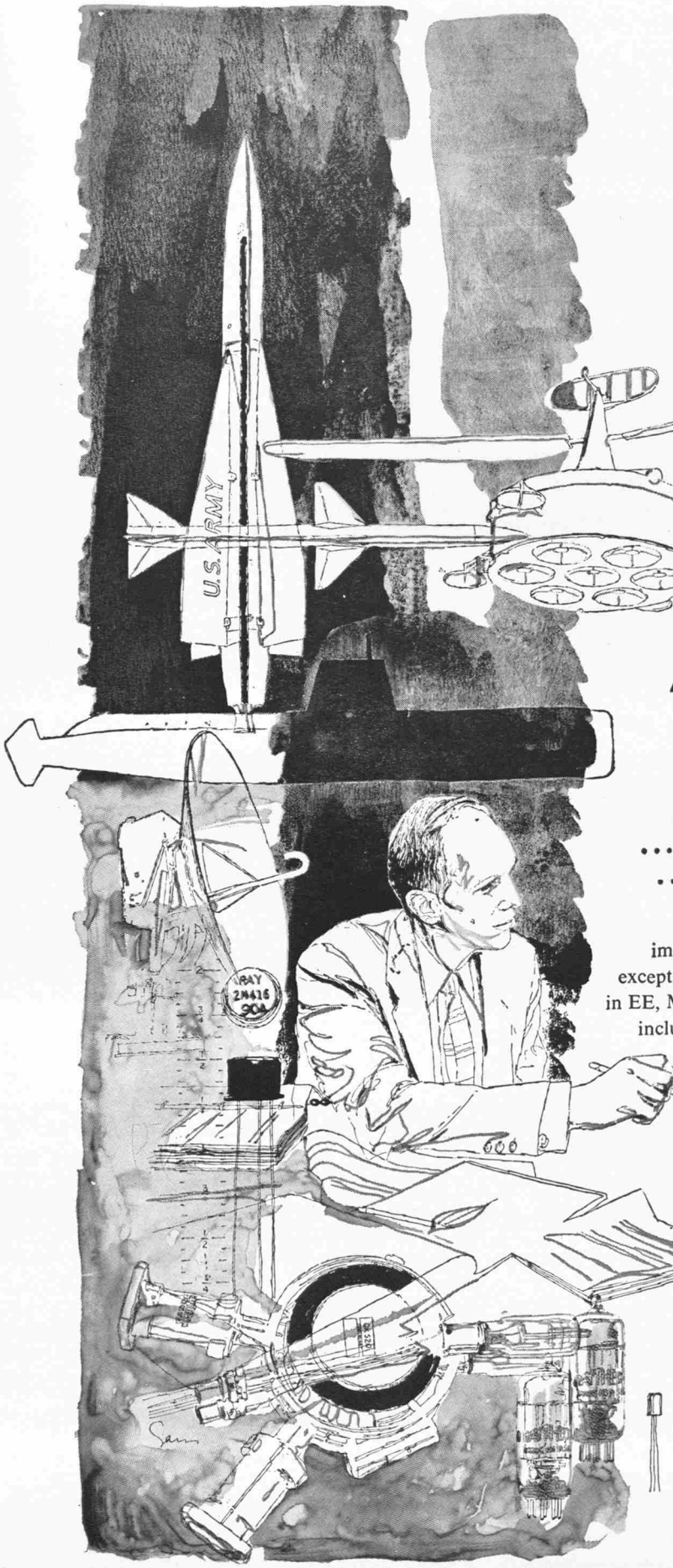
Transistors, in a relatively short period of twelve years, have been developed to such a point that they can effectively compete performance-wise and cost-wise with their forty-four year old rival, the vacuum tube. Being of a miniaturized nature, the transistor encountered much the same type of problems as confront the microsystem. Manufacturing processes constitute a major problem in the transistor industry. Prior to the development of the relatively new dendrite method of manufacture, it was necessary to resort to highly-sophisticated methods of growth and alloying processes. This is not to say that these methods are now obsolete nor is it meant to forecast future obsolesence. It is merely to say that the dendrite method of drawing crystal ribbons from a molten mass appears to have much promise when compared to the conventional method of X-ray or crystallographic inspection followed by precision sawing, etching, and polishing of crystals to obtain a satisfactory working surface. Such manufacturing problems and their preceding surface study problems are also inherent in microsystems.

The concept of microsystems is based upon the crystalline behavior of domains and interfaces within a functional block with regard to the control of energy flow. The design of the system and consequental development begins in the hands of a designer who establishes the function of the block by a study of the requirements of the system. From there the system goes to a topologist who determines the mathematical design of the block through the domain and interface relations that are to control the energy flow within the system. It is the work of the materials engineers to produce a system with the desired physical effects, generally using germanium and silicon as the basic semiconductor materials. It is these materials engineers who are faced with the realization problems of material behavior, physical strength, and other results of processing behavior. The result of their successful work is a microsystem functional block having the required characteristics to fulfill the job need and the reliability to make it practical.

A molecular electronic function block used as an amplifier in conjunction with a conventional preamplifier and speaker.

Although the microsystem today is not the prevalent thing, it is a matter of up-and-coming importance. If we keep an ear tuned to the professional journals, we will hear the whisper of progress. Closely following the professional journals' articles, the trade magazines and the newspapers will begin proclaiming the wonders of microsystems. Within five years, it is not unlikely that we will see the application of molecular electronics in such important fields as telemetering, fire-control guidance, communications, counter-weapons, and flight-control systems. Such application will indicate more than the culmination of years of study and research; it will indicate the beginning of a new concept of electronics.

Information and photos courtesy of Westinghouse Electric.



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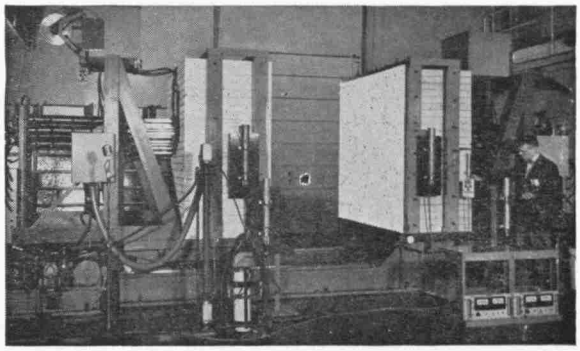
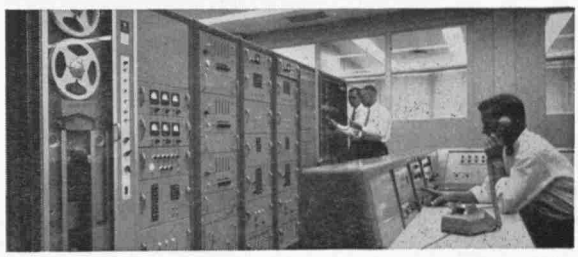
Specifically, what would *you* do?—*your own engineering talent* provides the best answer. And Pratt & Whitney Aircraft provides the atmosphere in which that talent can flourish.

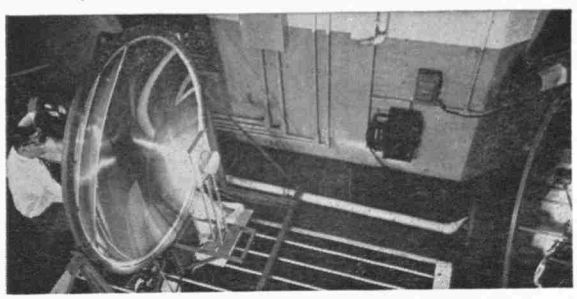
For further information regarding an engineering career at Pratt & Whitney Aircraft, consult your college placement officer or write to Mr. R. P. Azinger, Engineering Department, Pratt & Whitney Aircraft, East Hartford 8, Connecticut.



At P&WA's Connecticut Aircraft Nuclear Engine Laboratory (CANEL) many technical talents are focused on the development of nuclear propulsion systems for future air and space vehicles. With this live mock-up of a reactor, nuclear scientists and engineers can determine critical mass, material reactivity coefficients, control effectiveness and other reactor parameters.



Representative of electronic aids functioning for P&WA engineers is this on-site data recording center which can provide automatically recorded and computed data simultaneously with the testing of an engine. This equipment is capable of recording 1,200 different values per second.



Studies of solar energy collection and liquid and vapor power cycles typify P&WA's research in advanced space auxiliary power systems. Analytical and Experimental Engineers work together in such programs to establish and test basic concepts.

PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

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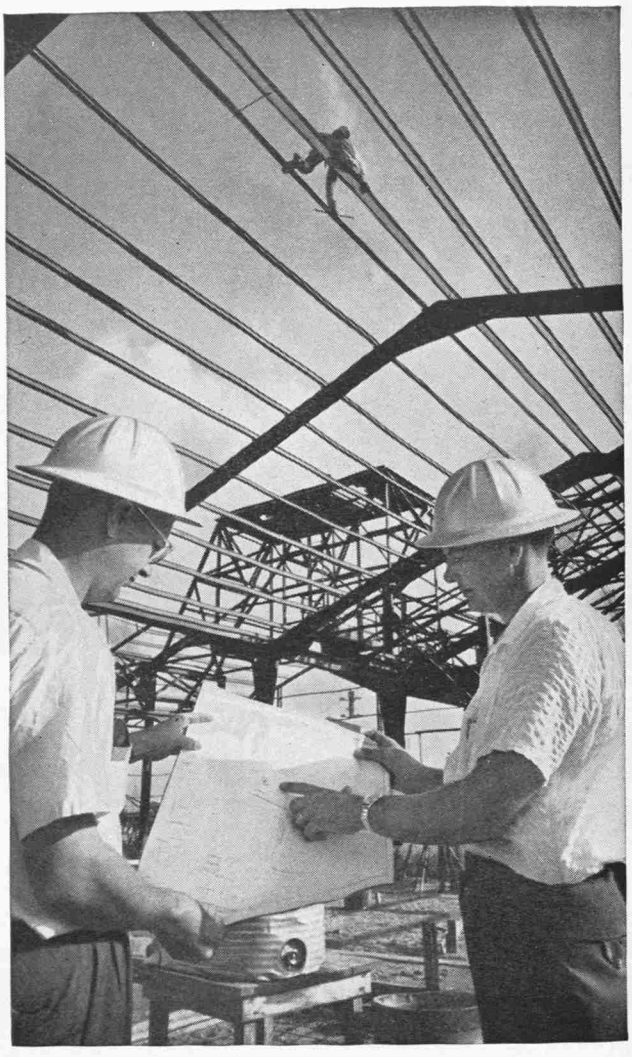

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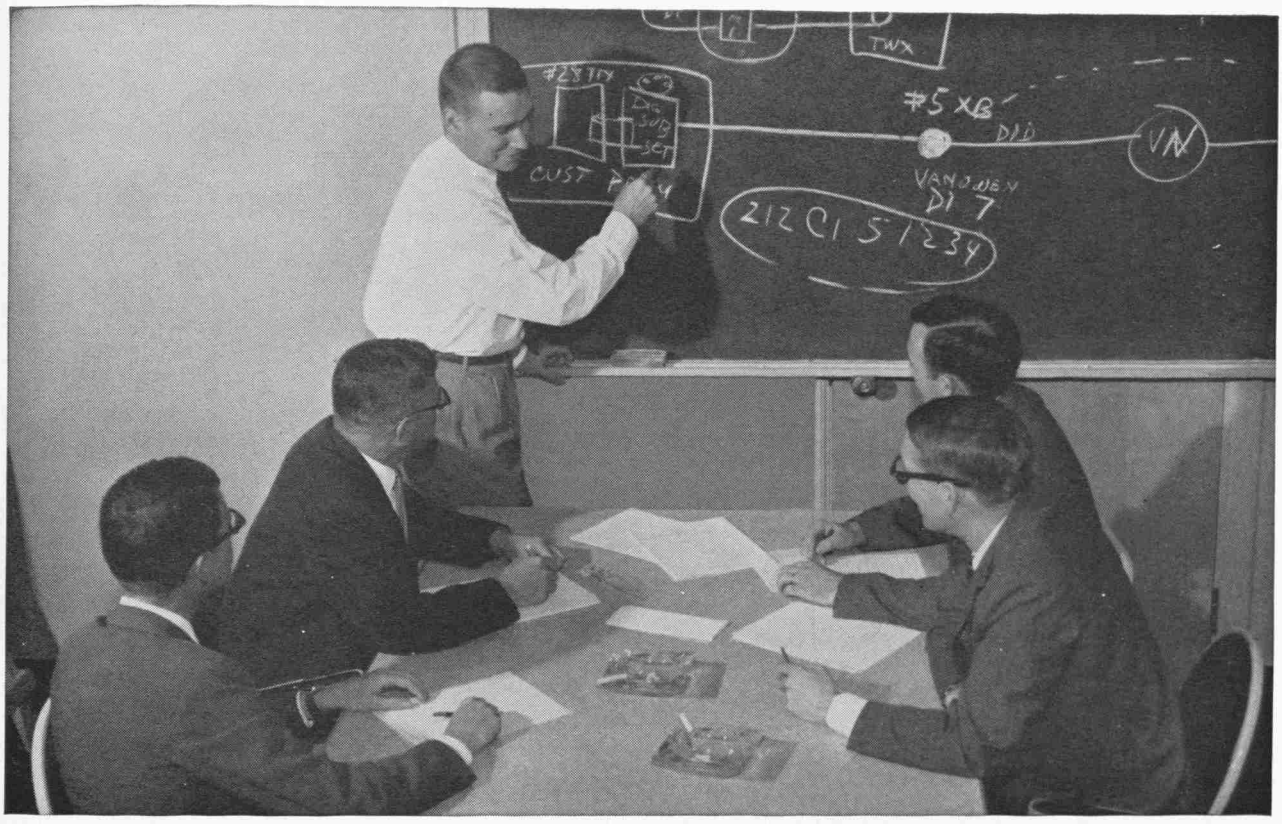

STU'S EXPLAINING HOW MACHINES WILL SOME DAY "OUTTALK" PEOPLE

"Stu" Smith graduated from Southern Cal with a powerful yen for excitement. His kind of excitement—Engineering.

He got what he bargained for (and a little more) when he joined Pacific Telephone. One of Stu's early assignments was to find out how existing Long Distance networks could be used to pipeline high speed "conversations" between computers in distant cities.

The fact that he did a fine job did not go unnoticed.

Today, four years after starting his telephone career, Senior Engineer Stuart Smith heads a staff of people responsible for telegraph and data transmission engineering in the huge Los Angeles area. As a pioneer in this new data transmission field Stu predicts data processing machines will some day do more Long Distance "talking" than people.

Stu contacted 12 other companies before joining Pacific Telephone. "I don't think there's any limit to where a man can go in the telephone business today. Of course, this isn't the place for a guy looking for a soft touch. A man gets all the opportunity he can handle right from the start. He's limited only by how well and how fast he can cut it."

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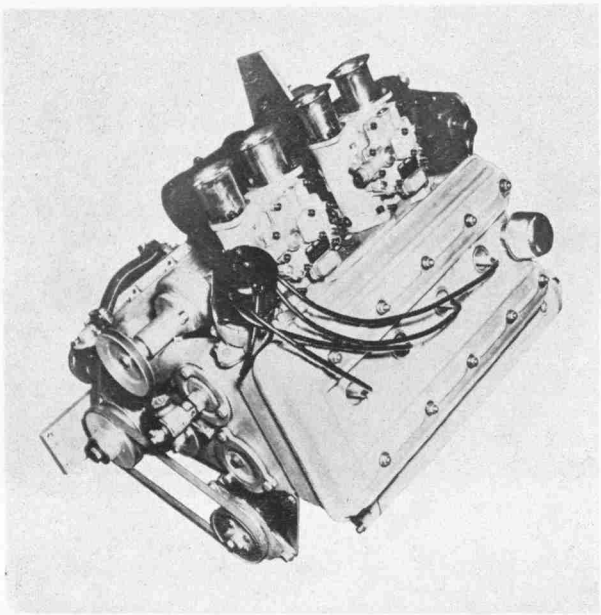
BELL TELEPHONE COMPANIES

WHAT'S NEW



STAINLESS STEEL ENGINE

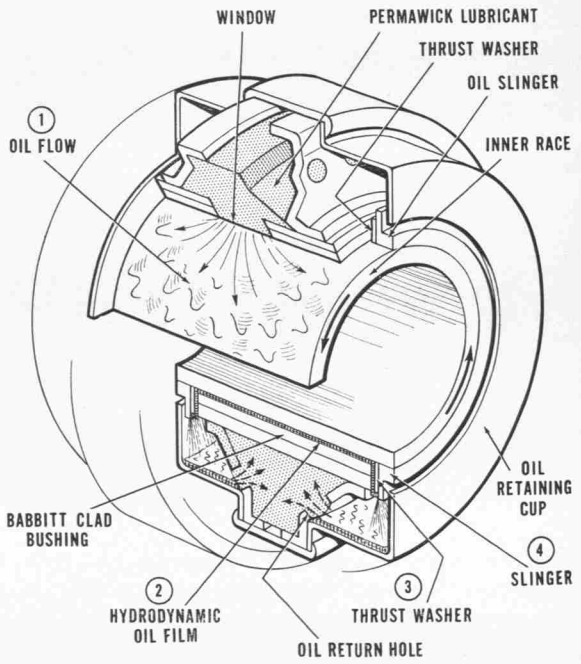
Auto designers and engineers are taking their first look at a remarkable new engine which features a block made of a thin, stainless steel sheet.

Designed by Lloyd Taylor, and produced by Tyce Engineering Corporation of Chula Vista, California, the four-cylinder engine is sparking discussion among auto experts by its unique combination of high power, lightness, and durability. For instance, one model of the Tyce/Taylor engine delivers 175 hp, yet weighs only 175 lbs., or one horsepower per pound.

The main reason for the new engine's amazing performance is its use of brazed, thin stainless steel sheet for the block assembly, including combustion chambers, cylinders, water jacket, intake and exhaust ports, upper block pan, and spark plug tubes.

Tyce Engineering specified a grade of stainless steel known to the metal trade as Type 302. This is a familiar stainless composition employed in everything from pots and pans, to rocket support stands, and building fronts. Besides contributing to the lightness, strength and durability of the Tyce/Taylor Four, the stainless steel construction of the block does away with corrosion worries. Moreover, the thin stainless steel stampings—(in some sections only the thickness of a penny)—dissipate heat several times faster than a cast block. As a bonus, the uniform wall thickness eliminates the troublesome "hot spots" which cause pinging in conventional engines.

The new engine, which is available in four displacement sizes (91, 105, 120, and 135 cubic inches), can be converted from one size to another simply by replacing the crankshaft to change the stroke. All sizes have the same 3.50-in. bore, all develop maximum power at 6500 rpm.



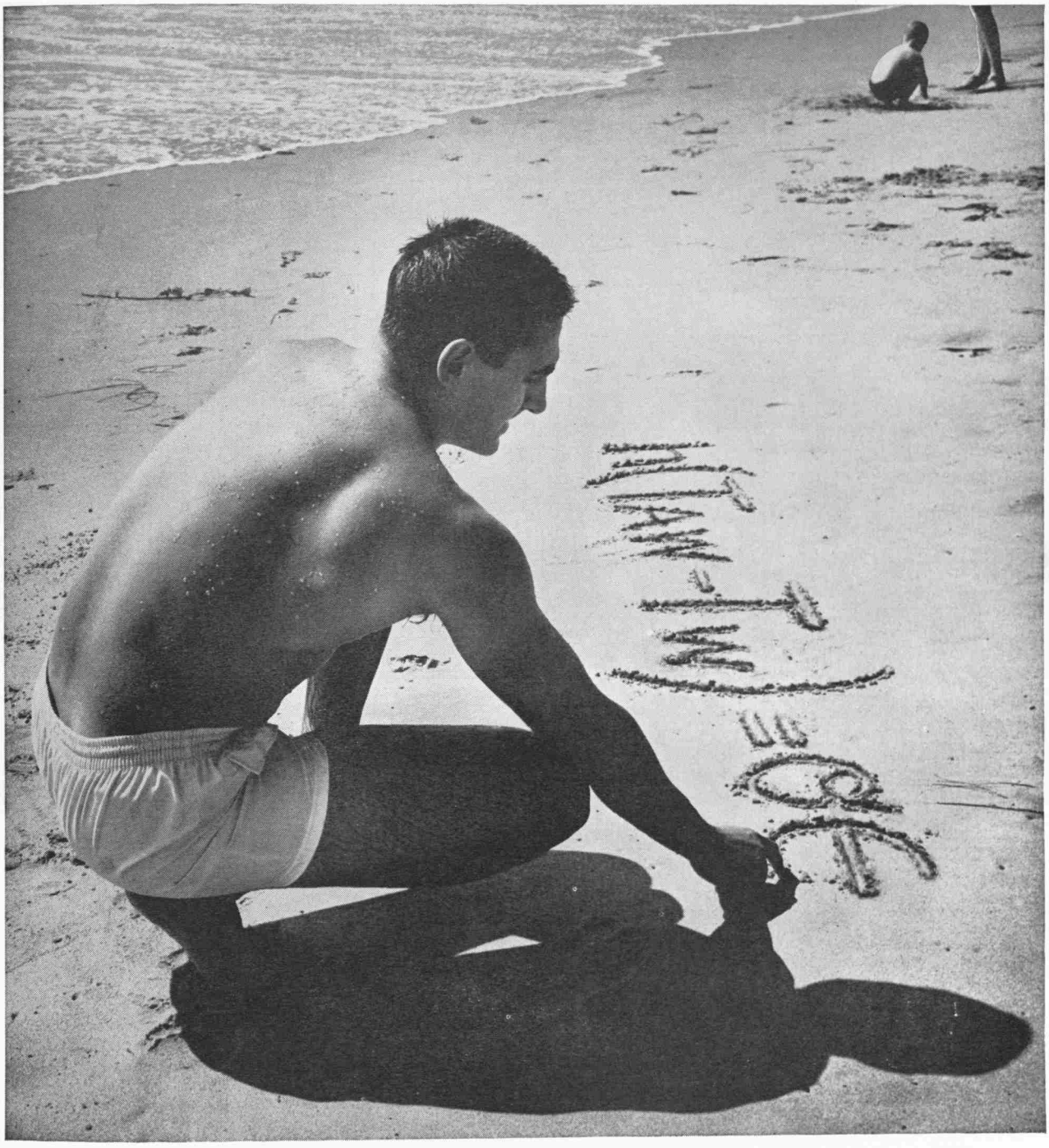
REVOLUTIONARY BEARING

A revolutionary new family of bearings, which combine the design advantages of sleeve and ball bearings, has entered production by the Tann Bearings Company, Detroit.

Unique features of the new bearing include a base life of 20,000 hours, a lifetime recirculatory oiling system, and a hydrodynamic oil film between inner race and bushing which supports the weight of the shaft. There is no metal-to-metal contact at any point.

The above diagram illustrates the operation of hydrodynamic oil film.

(Continued on page 34)



Some ideas just won't wait

With over 70 advanced projects in the works, the Northrop atmosphere is so stimulating that ideas often refuse to wait — they compel attention wherever the inspiration strikes. Missile guidance, rendezvous and maneuverability in space, bioastronautics, universal checkout systems, laminar flow control for aircraft present insistent, gratifying challenges. If you have sharp creative abilities in these lines, investigate the intellectually invigorating environment and rewards offered by Northrop's current and future programs.

We seek exceptional engineers, physicists, and mathematicians to join our thinkers and doers. Send us a card today with your name, address, and area of special interest.

Northrop

Northrop Corporation, Box 1525, Beverly Hills, California

Engineers who qualify to fill these chairs...

are on the road to filling responsible jobs with a growing company in a growing industry

● American Air Filter Company is one of the world's pioneers in the field of "better air." Starting 30 years ago as a manufacturer of air filtration equipment only, it has, through a planned program of product development, attained the unique position of being the one company in its industry that can take the complete over-all approach to the customer's air problems. In brief, this means supplying and coordinating all the proper products to filter, cool, heat, clean (control process dust), move, exhaust, humidify and dehumidify air.

"Better Air", while a big business today, is still in its infancy. Name any industry, any building type, and you have a present or potential user of AAF equipment. Other well-known trade names in the AAF family are Herman Nelson, Kennard and Illinois Engineering. At present, AAF operates ten plants in Louisville, Moline, Ill., St. Louis, Chicago and Montreal, Canada.

THIS KIND OF ENGINEERING DEGREE . . .	. . . QUALIFIES YOU FOR THIS KIND OF JOB
Mechanical	*— Engineering, Sales or Manufacturing*
Electrical	*— Engineering or Sales*
Industrial	*— Manufacturing or Sales*
Civil	*— Sales*

FORMAL FIVE-MONTH TRAINING COURSE

Your first job at AAF will be to complete a full five-month course in its technical training school. This is a complete and carefully planned course covering every phase of this business of better air and is under the direction of Mr. James W. May, a recognized authority on air handling problems and presently a member of the board of directors of ASHRAE. Classes, held in special, air conditioned quarters, are supplemented by field trips to visit AAF plants and observe on-the-job applications of equipment.

YOUR FUTURE IS ALL-IMPORTANT TO AAF

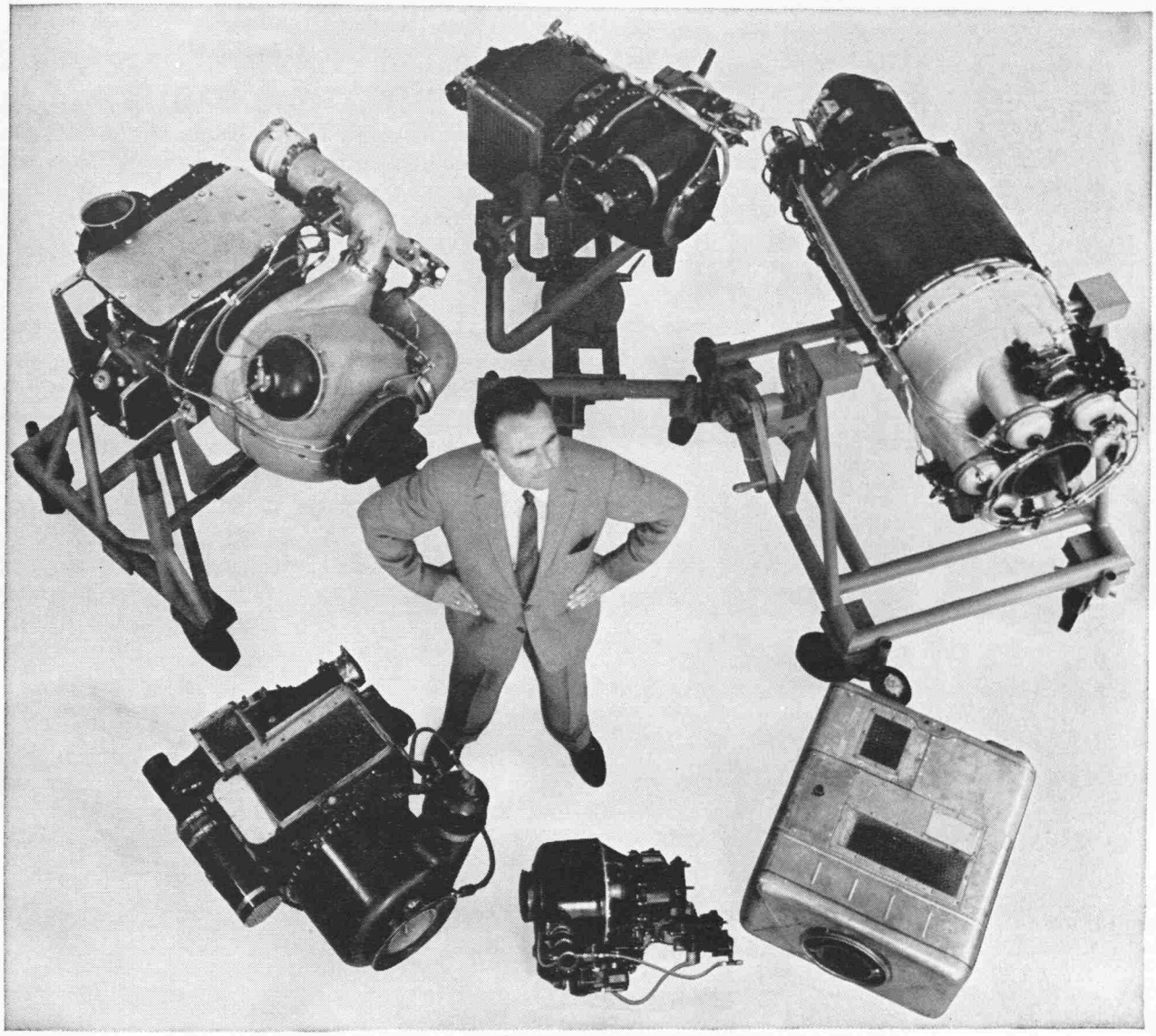
AAF prides itself on attempting to match the man to the job. During your training period you will have contacts with key company personnel. Your personal desires as to type and location of job are given every consideration. AAF is big enough to provide opportunities galore—small enough to never lose sight of the personal touch that adds satisfaction along with success.

A representative of AAF will be on your campus soon to interview students interested in learning more about the opportunities with this company. Consult your Placement Office for exact date.

AAF **American Air Filter**

BETTER AIR IS OUR BUSINESS

Auxiliary Gas Turbines becoming a prime power source for industry



Helmut Schelp, chief engineer, AiResearch Manufacturing Division of Arizona, Phoenix, surrounded by typical gas turbines now in production ranging in size from 30 to 850 hp. Clockwise from the top: GTC 85-28 GTCP 105 · GTP 70-6 · GTP 30-1 · GTP 70-10 · GTU 85-2.

AiResearch Gas Turbine Engines, the most widely used power source for the starting, air conditioning, cooling and heating of jet aircraft, now are becoming a prime power source for industry.

Easier to maintain because of few moving parts, these lightweight gas turbine engines develop more horsepower per pound and inch than any other engine. Most efficient at maximum speeds, they run on almost any fuel and start immediately in any weather.

Future prime power applications of AiResearch gas turbines for industry include: earthmoving equipment; small independent generator plants; marine use; helicopters and small conventional aircraft; emergency power plants; air conditioning, heating, refrigeration; atomic energy (closed cycle gas turbine with atomic energy heat source).

The foregoing and other diverse, highly interesting Garrett programs provide outstanding opportunities for engineers.

An orientation program lasting a period of months is available, in which new graduates work on assignments with experienced engineers in laboratory, preliminary design and development projects. Should you be interested in a career with The Garrett Corporation, write to Mr. G. D. Bradley in Los Angeles.

THE GARRETT CORPORATION

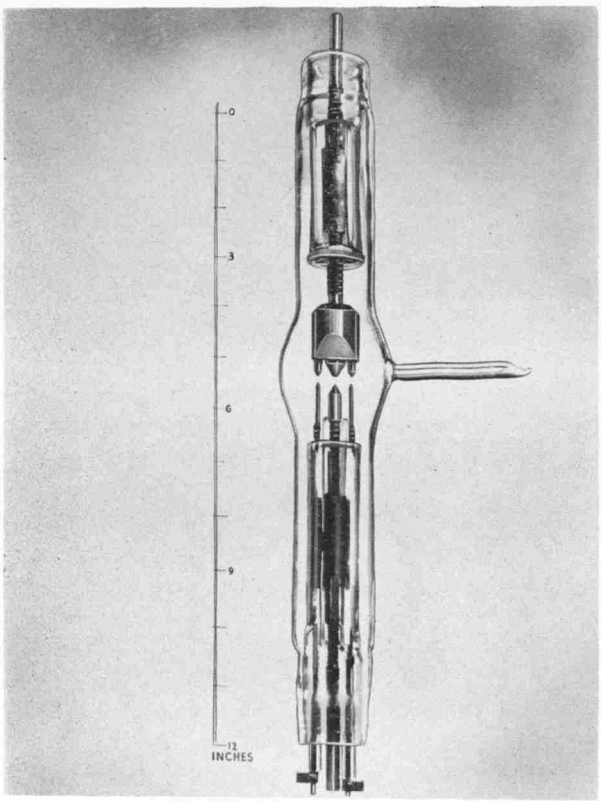
AiResearch Manufacturing Divisions

LOS ANGELES 45, CALIFORNIA • PHOENIX, ARIZONA

OTHER DIVISIONS AND SUBSIDIARIES: AIRSUPPLY-AERO ENGINEERING • AIRESEARCH AVIATION SERVICE • GARRETT SUPPLY • AIR CRUISERS AIRESEARCH INDUSTRIAL • GARRETT MANUFACTURING LIMITED • MARWEDEL • GARRETT INTERNATIONAL S.A. • GARRETT (JAPAN) LIMITED

(Continued from page 30)

1. Oil is drawn from reservoir of Permawick lubricant through bearing window.
2. Rotation of inner race under load generates hydrodynamic oil film, supporting inner race without metal-to-metal contact.
3. Oil forced to bearing ends by film pressure lubricates thrust washer.
4. On leaving washer, oil is picked up by slinger and slung to oil retaining cup, from which it is reabsorbed by Permawick in oil return hole.



XENON BULB

Xenon high pressure, high brightness bulbs are a new type of powerful lamp for military use, searchlights, projectors and space applications. The rays of the xenon lamp can be projected for a distance of 50 miles.

In one "envelope," the bulb has three brilliant arc discharges spaced approximately one-quarter of an inch from the other, differing in this way from one-arc conventional lamps. The availability of the three closely spaced arcs, which can be switched and regulated independently, makes the lamp particularly useful for military and space applications, as well as commercially.

The shells of xenon bulbs must be made of fused quartz, the only suitable transparent material with a softening point as high as 3500°F. These highly heat-resistant bulbs are filled with more than 10 times atmospheric pressure of xenon (more than 140 lbs. per sq. inch). Thus, xenon lamps are the most advanced and intricate products of the electric lamp industry to date.

"CURRENT CONTENTS OF SPACE AND PHYSICAL SCIENCES"

A comprehensive weekly listing of the 110,000 articles reported in the space and physical sciences each year was announced by the Institute for Scientific Information. Inaugural issue will appear in January 1961.

This new service is specially designed to help individual scientists keep abreast of the avalanche of research reports emanating from thousands of research laboratories throughout the world. CURRENT CONTENTS OF SPACE AND PHYSICAL SCIENCES enables scientists to locate essential reading in minutes in such fields as missiles and rockets, computers, mathematics, physics, chemistry, instrumentation, atomic energy and all other subject areas in the space and physical sciences.

For further information and a specimen copy of CURRENT CONTENTS OF SPACE AND PHYSICAL SCIENCES contact the Institute for Scientific Information, 1122 Spring Garden Street, Philadelphia 23, Pa.

IBM FORMS SPECIALIST GROUP

The creation of new technical and professional force to lead the way into the next computer era was announced by International Business Machines Corporation.

The force, initially numbering more than 1,000, is expected to grow to several thousand within the next few years.

Mathematicians, machine experts and industry specialists compose the new data processing systems engineering organization. The objective of the group is to assure the best systems for all IBM machine users and to develop breakthroughs along a wide front in the solution of advanced management and scientific problems.

"Just as the computer has mastered separate, routine accounting functions during the past decade the 1960's will see it involved in the scientific management of entire businesses and industrial complexes," predicted Gilbert E. Jones, president of IBM's Data Processing Division.

In addition to the new group, IBM also announced a supporting educational program offering systems training in depth. Advanced formal courses will be given to systems engineers working in special fields. The recently-opened IBM Systems Research Institute provides graduate-level studies. The Institute, the first of its kind, will soon graduate its initial class.

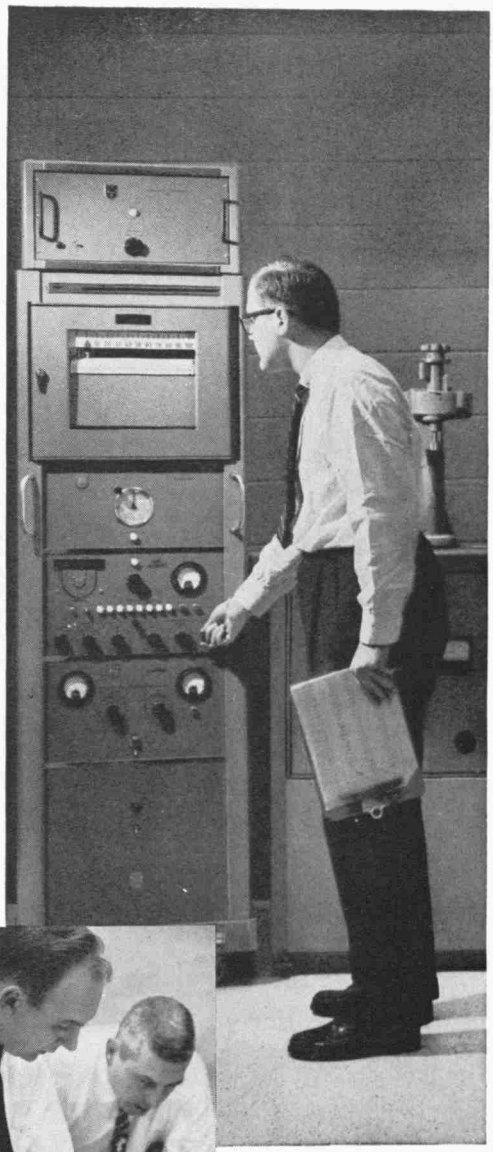
Facts about chemical industry growth that can be important to your future career

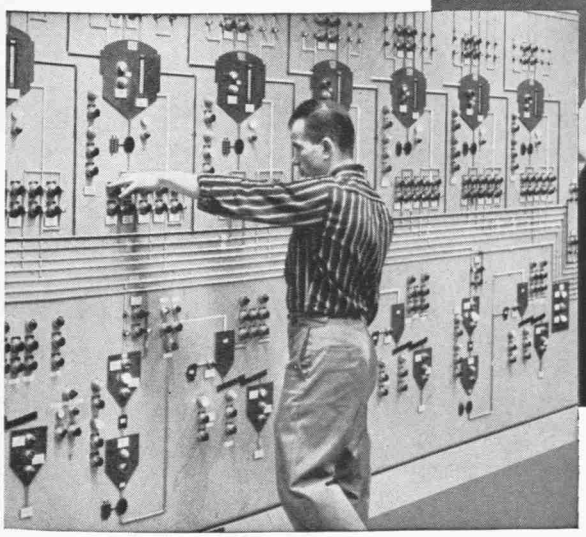
Did you know that the chemical industry has grown at a rate of about 10% per year since 1929, as compared with only 3% for the economy as a whole? It's a fact! And there's every reason to believe that this favorable growth rate will continue.

For the graduating chemist or chemical engineer, this spells opportunity. Opportunity to grow with a growing industry.

Allied Chemical, for example, now produces more than 3,000 diversified chemicals at over 100 plants throughout the country. Many of these products are basic—used in volume by almost every industry. Allied is at the heart of the nation's economy and looks forward to continued growth and stability.

Ask our interviewer about career opportunities at Allied when he next visits your campus. Your placement office can give you the date and supply you with a copy of "Your Future in Allied Chemical." Allied Chemical Corporation, Department 161-R1, 61 Broadway, New York 6, New York.



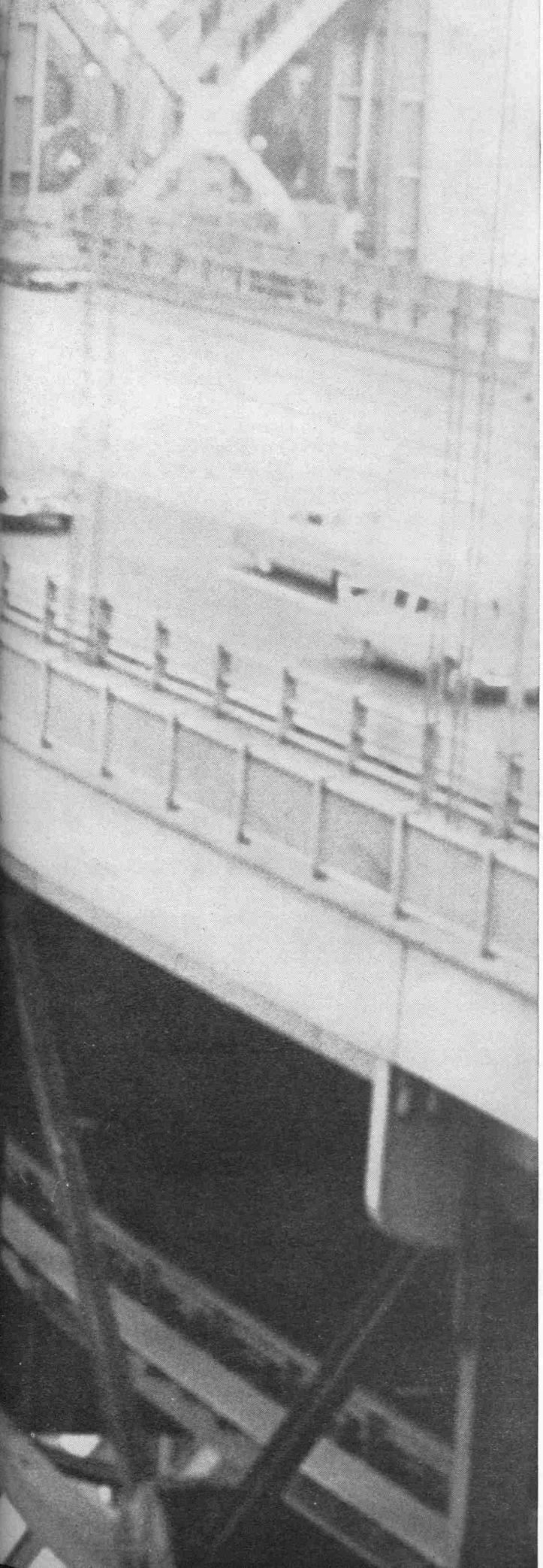


DIVISIONS:

BARRETT • GENERAL CHEMICAL
INTERNATIONAL • NATIONAL ANILINE
NITROGEN • PLASTICS AND
COAL CHEMICALS • SEMET-SOLVAY
SOLVAY PROCESS

Allied Chemical

BASIC TO AMERICA'S PROGRESS



Thomas O'Connell (B.S. in M.E., Notre Dame, '54; M.B.A., New York University, '60). Recently, as part of his job in marketing at IBM, he found himself assisting the customer technicians with the design problems of one of the world's busiest bridges.

WHAT'S AN IBM MAN GOT TO DO WITH REDESIGNING A BRIDGE?

Tom O'Connell is an engineer working in marketing areas as an IBM Data Processing Representative. His job is to introduce management to the advantages of electronic data processing. Once they have acquired an IBM system, he acts as a consultant on new uses for the system.

A Spectacular Engineering Achievement. How is he helping to redesign a bridge? One of his clients is the agency which constructs and operates transportation facilities in the New York-New Jersey area. Recently, they began to add a lower deck to the George Washington Bridge. It has been a spectacular engineering achievement. Sections were brought up the Hudson River on barges and hoisted hundreds of feet into position. All this while heavy traffic continued in both directions.

This double-decking of one of the world's busiest bridges took complex planning. An IBM system materially aided in the verification of bridge design calculations and in suspension bridge truss analysis under various loading conditions. Tom O'Connell supplied many of the computer programs that were used in conjunction with other programs developed by the customer. Tom now knows a lot more about the problems of bridge design.

A Job That Makes News. One of the exciting aspects of Data Processing Marketing at IBM is this wide diversity of systems application. Using the knowledge a man has gained in college, and backed by the comprehensive training he receives at IBM, he moves into many kinds of application areas. The areas are always interesting, sometimes newsworthy. In fact, almost every day newspapers carry stories about new applications of computer systems in important areas of business, industry, science and government.

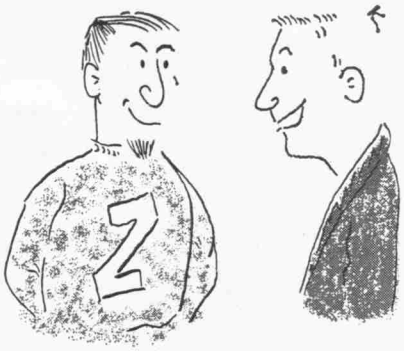
If you would like to find out in more detail about the many kinds of marketing opportunities at IBM, our representative will be visiting your campus soon. He'll be glad to sit down with you and discuss the reasons why marketing is a career with a virtually unlimited future. Your placement office can make an appointment. Or you may write, outlining briefly your background, to:

Harley A. Thronson
IBM Corporation
618 S. Michigan Ave.
Chicago 5, Ill.

IBM®

You naturally have a better chance to grow with a growth company.

WHAT HO, WRATISLAW! I UNDERSTAND THAT YOU HAVE ACCEPTED AN ENGINEERING POSITION.



YES, ROGER, THE COMPANY I'M JOINING IS A LEADER IN MANY DIVERSIFIED FIELDS OF ELECTRONICS.

FOR EXAMPLE, THEY ARE THE LEADERS IN CREATING AND PRODUCING AIRBORNE NAVIGATION, COMMUNICATION, INSTRUMENTATION, AND CONTROL SYSTEMS.

THEY ARE ALSO VERY BIG IN THE GROUND COMMUNICATIONS DEPARTMENT. . . PIONEERING AND PRODUCING SINGLE SIDEBAND, TRANSHORIZON AND MICROWAVE SYSTEMS.

THE MOST, TO SAY THE LEAST, HUH, BUDDY?

PEOPLE INVOLVED IN BROADCAST AND AMATEUR RADIO TELL ME THAT THIS COMPANY MAKES EQUIPMENT THAT'S . . . UH . . .

LIKE, ON THE BALL, IF YOU'LL PARDON THE PUN.

THEY ARE ALSO LEADERS IN MISSILE ELECTRONICS AND SPACE EXPLORATION. THEY WERE FIRST TO BOUNCE VOICES, TELETYPE, WIREPHOTOS, AND I DON'T KNOW WHAT ALL, OFF THE ECHO SATELLITE.

SO THESE ARE THE REASONS, WRATISLAW, THAT YOU ARE JOINING COLLINS?

YES, ROGER, THESE AND THE FACT THAT MY GREAT-AUNT LEFT ME A 10-ROOM RANCH HOUSE NEAR ONE OF THE COLLINS R & D LABS.

There are many sound reasons why engineers go to work for Collins. One of the nation's leading growth companies, Collins offers the young engineer an exceptional opportunity to advance within the company. Salaries and benefits are tops in the industry. What's more, you choose the area of the country in which you would like to work. Research, development and manufacturing facilities are located in Cedar Rapids, Dallas and Burbank.

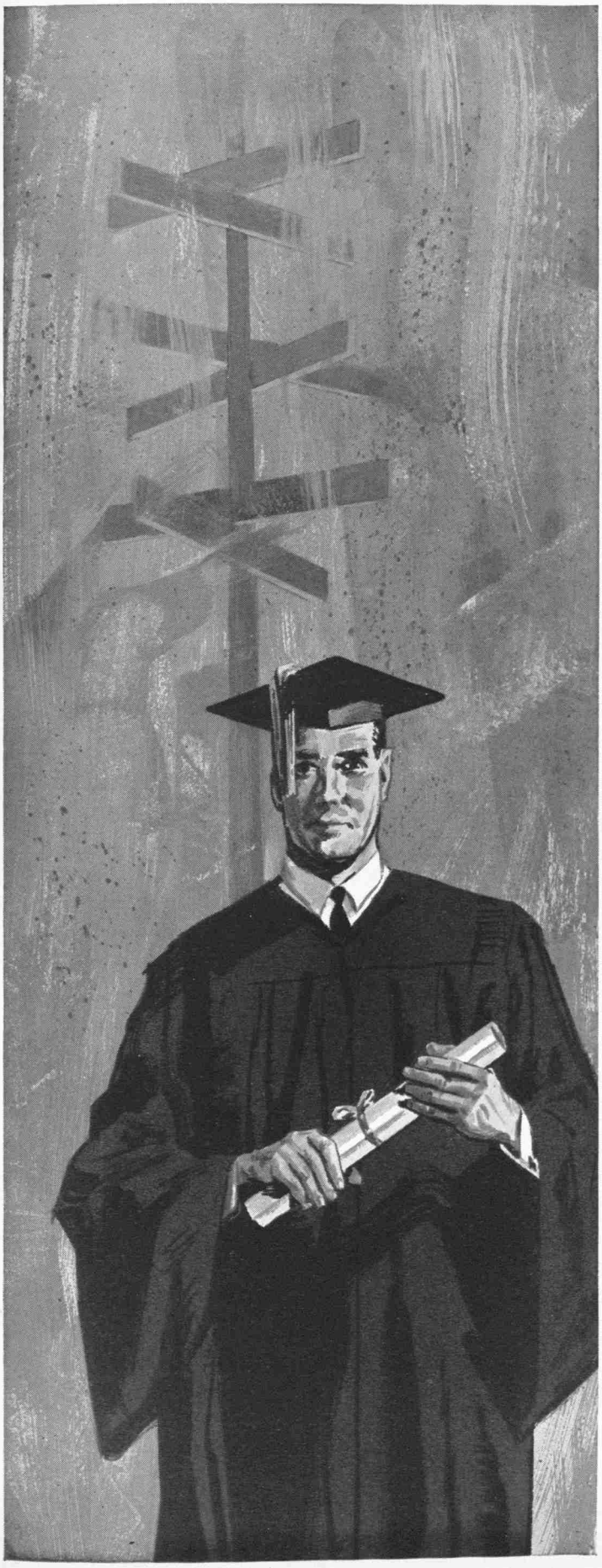
Collins likes engineers . . . 20% of its 15,000 employees are engineers. Collins is in the business, basically, of selling the products of their imaginative thinking.

Collins would like to discuss your future with you. Write for the free booklet "A Career with Collins" and ask your placement Counselor when the Collins representative will be on campus.

COLLINS

COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA • DALLAS, TEXAS • BURBANK, CALIFORNIA



For the man who likes to make his own career decisions

The Allis-Chalmers Graduate Training Course is based on freedom of opportunity. You will have up to two years of practical training to find the right spot for yourself. At the same time, you enjoy a steady income. You can accept a permanent position at any time — whenever you can show you are ready.

You help plan your own program, working with experienced engineers, many of them graduates of the program. Your choice of fields is as broad as industry itself — for Allis-Chalmers supplies equipment serving numerous growth industries.

A unique aspect of the course is its flexibility. You may start out with a specific field in mind, then discover that your interests and talents lie in another direction. You have the freedom to change your plans at any time while on the course.

Types of jobs: Research • Design • Development • Manufacturing • Application • Sales • Service.

Industries: Agriculture • Cement • Chemical • Construction • Electric Power • Nuclear Power • Paper • Petroleum • Steel.

Equipment: Steam Turbines • Hydraulic Turbines • Switchgear • Transformers • Electronics • Reactors • Kilns • Crushers • Tractors • Earth Movers • Motors • Control • Pumps • Engines: Diesel, Gas.

Freedom of Opportunity opens the doors to challenging and interesting careers. Among them is our Nuclear Power Division, with an engineering staff in Washington, D. C., a new research and development center in Greendale, Wis., and an important research effort at Princeton University involving power from the hydrogen atom. For details on the opportunities available, write to Allis-Chalmers, Graduate Training Section, Milwaukee 1, Wisconsin.

A-1192

ALLIS-CHALMERS

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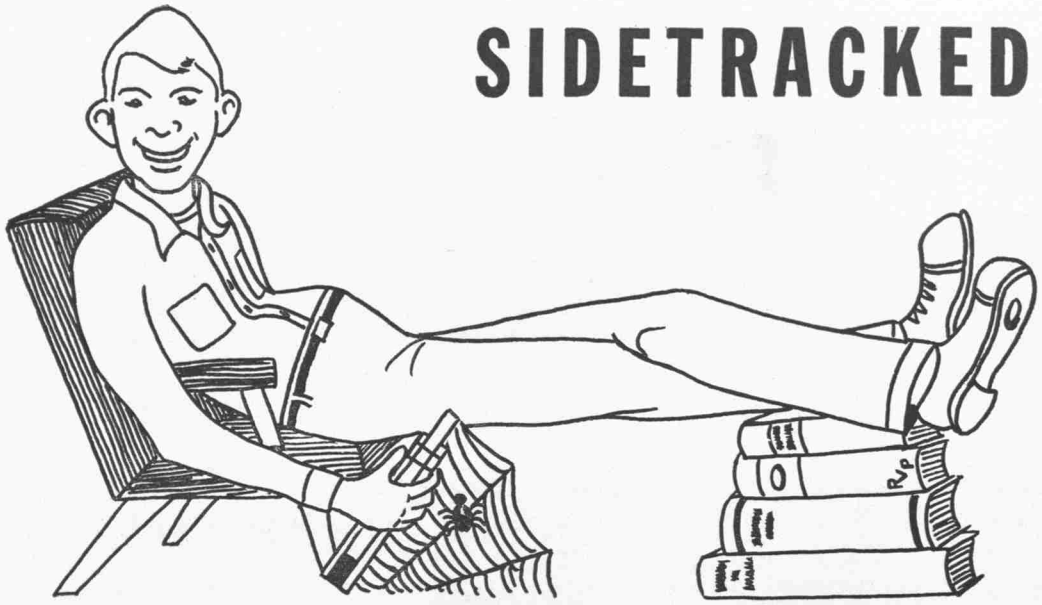

The math professor was notorious for piling on home work. Finally one harassed student went to him and complained that it was absolutely impossible to do all the assigned problems.

"Here's what you do," suggested the instructor. "Just do half the problems."

The student's face brightened.

"Then," continued the prof, "next year, when you're repeating this course, you can do the other half."

* * * *

Rules for handling women electrically:

If she talks too long—Interrupter.
If she wants to be an angle—Transformer.
If she meets you half way—Receiver.
If she gets too excited—Controller.
If she gets up in the air—Condenser.
If she is hungry—Feeder.
If she sings inharmoniously—Tuner.
If she is wrong—Rectifier.
If she is too fat—Reducer.
If she gossips too much—Regulator.
If she wants to get married—Resistor.

* * * *

There are only two kinds of parking left on campus—illegal and no.

C.E.: "Was her father surprised when you said you wanted to marry his daughter?"

Aero.E.: "Was he surprised? Why the gun fell right out of his hands."

* * * *

The teacher was explaining to the grammar school students the merits of owning a yearbook and having one's picture in it.

"Just think," she said, "thirty years from now you can look in this annual and say, 'There's Willie Jones; he's a judge now. And there's Sally White; she's a nurse. And there's . . . ' "

"And there's teacher," came a voice from the back of the room. "She's dead."

* * * *

Employer: "Are you looking for work, young man?"

Engineering Student: "No, but I would like a job."

* * * *

Blonde: "Wouldn't you call it mental telepathy if we were both thinking the same thing?"

Engineer: "No, just plain luck."

* * * *

E. E. Prof.: "Now watch the blackboard while I run through it once more."

E.E.: "Thought you were going to visit that blonde in her apartment."

C.E.: "I did."

E.E.: "How come you're home so early?"

C.E.: — "Well we sat and chatted awhile. Then suddenly she turned out the lights. I can take a hint."

* * * *

Statistics reveal that the average American foot is getting bigger. The target is now so large, that even an amateur, practicing the fast draw, can shoot off a couple of his own toes.

* * * *

Coed: The nimblest man on campus is the one who can shift gears in a Volkswagon without getting his face slapped.

* * * *

She: "Have you heard about the new college game?"

He: "No, what is it?"

She: "Button, Button, here comes the housemother."

* * * *

Finals, finals everywhere
with drops and drops of ink,
And never a prof who'll leave the room
And leave a guy to think.

Illustration courtesy of Grad, Urbahn & Seelye.

Inco Nickel helps give engineers the solution to metal problems in new radio telescope

How do you design a precision instrument that will "see" 38 billion light years into space? This problem was answered by the engineers working on this revolutionary, new radio telescope.

But these engineers faced another challenging problem—*How do you actually build it?* How do you build a telescope as tall as a 66-story building with a reflector so big it could hold six football fields?

How do you build a rotating mechanism that can swing this giant up or down, or sideways, to aim at any spot in the Universe with pin-point accuracy? Just the tiniest amount of wear or distortion in this mechanism could throw the telescope millions of miles off target in the far reaches of space!

Where could they get construction materials tough and strong enough? Nickel gave them the answer! Nickel in steel gave these engineers a material tough enough to maintain precision in the rotating mechanism even under the anticipated 20,000-ton load. And Nickel, to be used in the steel members, gave them the high strength at minimum weight needed to support the giant reflector.

The radio telescope is one of the many developments in which Nickel has solved important problems. Most probably you, yourself, in the near future, will be faced with problems just as difficult. When you are, you can count on Nickel—and the cooperation of Inco—to help get the job done . . . and done right!

If you'd like to get acquainted with Nickel steels, write us for a copy of, "Nickel Alloy Steels and Other Nickel Alloys in Engineering Construction Machinery." Educational Services, The International Nickel Company, Inc., New York 5, N. Y.

INCO TRADE MARK

International Nickel

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

"Where The Boys Aren't"

Engineering "Dropouts" Cause Concern Among U. S. Educators

Almost half of the students who start programs in engineering fail to complete them, the American Association for the Advancement of Science was told.

The high casualty rate is one of the principal concerns of engineering educators, reported Richard T. Fallon of Michigan State University's College of Engineering.

Fallon, who participated in a panel discussion before the engineering section of the association, is director of the Junior Engineering Technical Society (JETS), which has 742 chapters in high schools and junior colleges in all 50 states and several foreign countries.

"Engineering enrollments have been meeting the bare needs of the economy during the past six years," Fallon said.

He added that such enrollments could be sufficient "if the students who started in engineering remained in the field and graduated with degrees." However, he reported that about half (48 per cent) of the engineering students are lost along the way for various reasons.

Engineering "drop outs" appear to fall into three groups, Fallon noted.

One group, comprising about 17 per cent of engineering students, "have the capabilities, talents and interests in engineering," he said, "but they have not been properly prepared or oriented in high school toward engineering. Such students are not informed about what is required in engineering training and what engineers do on the job."

Fallon said these students are victims of "poor teaching in high school, lack of responsibility on the part of guidance persons and lack of sympathy on the part of high schools for the engineering story."

"These are not the so-called gifted students for whom everything is being done these days," he said, citing some science programs which accept only students with IQ's of 135 and over.

Fallon referred to the large segment of students "just under the cream of the crop" and a group from which, he said, "we must draw our skilled engineers and technicians." He stressed that this is the area where such programs as JETS are most effective in encouraging better scholarship and setting the necessary predisposition towards engineering.

Fallon said there is another 12 per cent segment of engineering students who fail to make the grade but "who should have been steered out of engineering in the first place, either in junior or senior high schools."

"This group just does not have the proficiencies in the basic sciences to handle engineering courses," he explained. This could be remedied in part, he believes, by better aptitude testing and by giving the students experience through junior engineering programs.

A third group of students who drop out of engineering, about 17 or 18 per cent, "are victims of new pressures and delusions that every one who studies science is going to be a scientist," Fallon noted.

Such students, Fallon explained, "soon defect to other fields when they find that engineering does not offer the glamour they sought or it does not offer them a chance to pursue majors in the disciplines where they built up their proficiencies, such as mathematics, physics and chemistry."

Fallon called for "more imagination on the part of engineering educators" to allow engineering students to have the option of a major in mathematics, physics or chemistry along with their engineering courses.

He also stressed the need for a more realistic evaluation in secondary schools as to what engineering requires. For example, he pointed out that sending a satellite up by way of a rocket is 95 per cent engineering, designing, building, and operating the hardware, rather than theoretical science.

The high rate of attrition, concluded Fallon, has caused the national government, industry and university officials to support such programs as JETS, which present a realistic picture of engineering and technology.

We wish you the best of everything in this new year

The Staff - "Spartan Engineer"

MINUTE BIOGRAPHY

Leo V. Nothstine, Associate Professor, Civil and Sanitary Engineering

Mr. Nothstine graduated from Mancelona High School, Mancelona, Michigan in 1934. He attended MSU and graduated in 1938 with a C.E. degree. After working a year in construction, he attended Kansas State with a research assistantship, graduating with a Master's degree in C.E., then taught two years at Texas Tech.

Nothstine worked for a year as a stress analyst for the Glenn L. Martin Co., then for three years, starting in 1942, for the Ford Motor Company at Willow Run. While there he worked on the B-24 bomber, as a liaison between production and engineering, in flight research and instrumentation. He helped develop and perfect the American version of the BI buzz bomb, taking part in launchings in the Gulf of Mexico.

After the war, he worked in automotive research. In September of 1945 he joined the firm of Gould Enigneering in Flint, Michigan, designing municipal works, and one year later joined the MSU staff as an assistant professor.

Very active in student affairs, Nothstine is advisor to one fourth of all civil egineers, advisor to the civil engineers honor society, Chi Epsilon, and faculty advisor to Phi Lambda Tau, the all engineering honor society. He is also a member of many professional societies and is a registered C.E. and land surveyor.

Mr. and Mrs. Nothstine and their four sons reside in Okemos. His favorite hobbies are hunting and fishing, which would be expected with four boys in the family.

While he is not doing any research at present, he encourages his students to do so. In his teaching he strives to put the matter across to his students without sacrificing any necessary material and he is always looking for better teaching methods. Professor Nothstine expects to remain indefinitely at MSU.

(Continued from page 13)

a large ratio of reverberated sound to direct sound reduces the ear's ability to locate the source. Therefore, reverberation reduces the impression that the sound originates in a restricted area.

In a concert hall, the sound reaching a listener has been reverberated several times from the surfaces of the room. The mind associates the ratio of direct to reverberated sound and the time interval between the direct and reverberated sound with a given size of room or hall.

Stereophonic sound also deepens upon differences in multiple representations of sound. These may differ in time of arrival at the ears, wave form and intensity. The multiplicity effect can be achieved by one channel serving as the sound source and altering the sound's characteristics as it is reproduced through a second speaker system.

In producing the stereo illusion, two microphones, left and right, pick up the musical impulses from the source and feed them into two sound tracks on tape. These sound tracks are then pressed both laterally and vertically into grooves on a record. A needle was developed which is capable of moving laterally and up and down simultaneously to pick up both channels of sound.

The two sound channels are unscrambled by the stereo cartridge in the tone arm. This miniaturized electric generator, translates the sound channels into electrical impulses and directs them into separate amplifier circuits. Here they are magnified and fed into two separate loudspeakers which translate these impulses into sound which your ears hear stereophonically.

When your left ear receives an impression from one speaker on the left, and your right ear one from the right, your brain combines both impressions into one total impression.

The stereo illusion is a three-dimensional image which is characterized by the sensations of directionality, spaciousness and solidity. A whole new world of listening pleasure has been opened since its introduction. Future research will undoubtedly make even further progress so that our sense of hearing can be exploited to its fullest capability.

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BE PREPARED

(Continued from page 19)

The second block is the idea that from out of nowhere will come the only right job with the only right company. This is false. Any one of 5 or 6 organizations should be able to provide the opportunities you are looking for. The job then becomes one of narrowing the field down. Once you make your choice, however, don't look back and wish. It gives a bad name both to the school and to you if you suddenly decide that the company's offer doesn't really take into consideration all that you are worth.

The Placement Bureau was established to be a middle ground between industry and students; by doing your part to make it run smoothly, you not only help the companies find the best employees, but help yourself in finding the right job.

From the National Bureau of Standards

Symbol: WO. Atomic weight: 120. Occurrences: Found wherever a man is found, seldom in a free state.

Physical properties: Generally rounded in form. Boils at nothing and may freeze at any minute. Melts when treated properly. Very bitter if not used well.

Chemical properties: Very active. Possesses great affinity for gold, silver, platinum, and precious stones. Violent reactions when left alone. Able to absorb great amounts of food. Turns green when placed beside a better-looking specimen. Ages rapidly.

Uses: Highly ornamental. Useful as a tonic in acceleration of low spirits, etc. Equalizes the distribution of wealth. Is probably the most powerful income-reducing agent known.

Caution: Highly explosive when in inexperienced hands.

Preparation of this tongue-in-cheek reference file card on women was a project of the Standards Bureau Laboratories at Boulder, Colorado.

REMINDER!

On the average, man is a 0.25 megohm, 1 watt resistor; at 1 milliampere, shock is perceptible. At 10 mils, you can't let go, 100 mils is generally fatal, and electrical engineers are already in short supply.

Don't make an ash of yourself!

ADVERTISER'S INDEX

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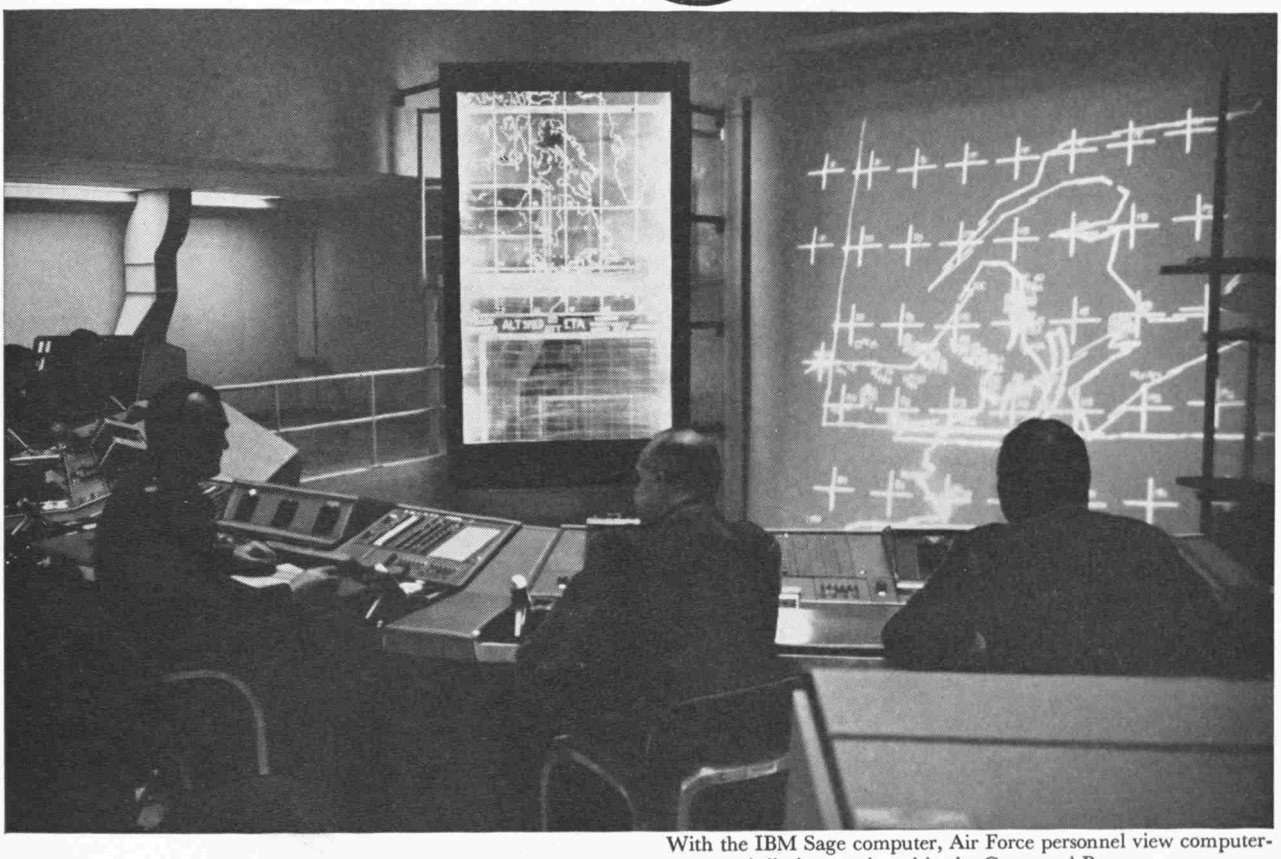

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TRADEMARK

One of a series

Interview with
General Electric's Earl G. Abbott,
Manager—Sales Training

Technical Training Programs at General Electric

Q. Why does your company have training programs, Mr. Abbott?

A. Tomorrow's many positions of major responsibility will necessarily be filled by young men who have developed their potentials early in their careers. General Electric training programs simply help speed up this development process.

In addition, training programs provide graduates with the blocks of broad experience on which later success in a specialization can be built.

Furthermore, career opportunities and interests are brought into sharp focus after intensive working exposures to several fields. General Electric then gains the valuable contributions of men who have made early, well-considered decisions on career goals and who are confidently working toward those objectives.

Q. What kinds of technical training programs does your company conduct?

A. General Electric conducts a number of training programs. The G-E programs which attract the great majority of engineering graduates are Engineering and Science, Manufacturing, and Technical Marketing.

Q. How long does the Engineering and Science Program last?

A. That depends on which of several avenues you decide to take. Many graduates complete the training program during their first year with General Electric. Each Program member has three or four responsible work assignments at one or more of 61 different plant locations.

Some graduates elect to take the Advanced Engineering Program, supplementing their work assignments with challenging Company-conducted study courses which cover the application of engineering, science, and mathematics to industrial problems. If the Program member has an analytical bent coupled with a deep interest in mathematics and physics, he may continue through a second and third year of the Advanced Engineering Program.

Then there is the two-year Creative Engineering Program for those graduates who have completed their first-year assignments and who are interested in learning creative techniques for solving engineering problems.

Another avenue of training for the qualified graduate is the Honors Program, which enables a man to earn his Master's degree within three or four semesters at selected colleges and universities. The Company pays for his tuition and books, and his work schedule allows him to earn 75 percent of full salary while he is going to school. This program is similar to a research assistantship at a college or university.

Q. Just how will the Manufacturing Training Program help prepare me for a career in manufacturing?

A. The three-year Manufacturing Program consists of three orientation assignments and three development assignments in the areas of manufacturing engineering, quality control, materials management, plant engineering, and manufacturing operations. These assignments provide you with broad, fundamental manufacturing knowledge and with specialized knowledge in your particular field of interest.

The practical, on-the-job experience offered by this rotational program is supplemented by participation in a manufacturing studies curriculum covering all phases of manufacturing.

Q. What kind of training would I get on your Technical Marketing Program?

A. The one-year Technical Marketing Program is conducted for those graduates who want to use their engineering knowledge in dealing with customers. After completing orientation assignments in engineering, manufacturing, and marketing, the Program member may specialize in one of the four marketing areas: application engineering, headquarters marketing, sales engineering, or installation and service engineering.

In addition to on-the-job assignments, related courses of study help the Program member prepare for early assumption of major responsibility.

Q. How can I decide which training program I would like best, Mr. Abbott?

A. Well, selecting a training program is a decision which you alone can make. You made a similar decision when you selected your college major, and now you are focusing your interests only a little more sharply. The beauty of training programs is that they enable you to keep your career selection relatively broad until you have examined at first hand a number of specializations.

Furthermore, transfers from one General Electric training program to another are possible for the Program member whose interests clearly develop in one of the other fields.

Personalized Career Planning is General Electric's term for the selection, placement, and professional development of engineers and scientists. If you would like a Personalized Career Planning folder which describes in more detail the Company's training programs for technical graduates, write to Mr. Abbott at Section 959-13, General Electric Company, Schenectady 5, N. Y.

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