SPARTAN Engineer

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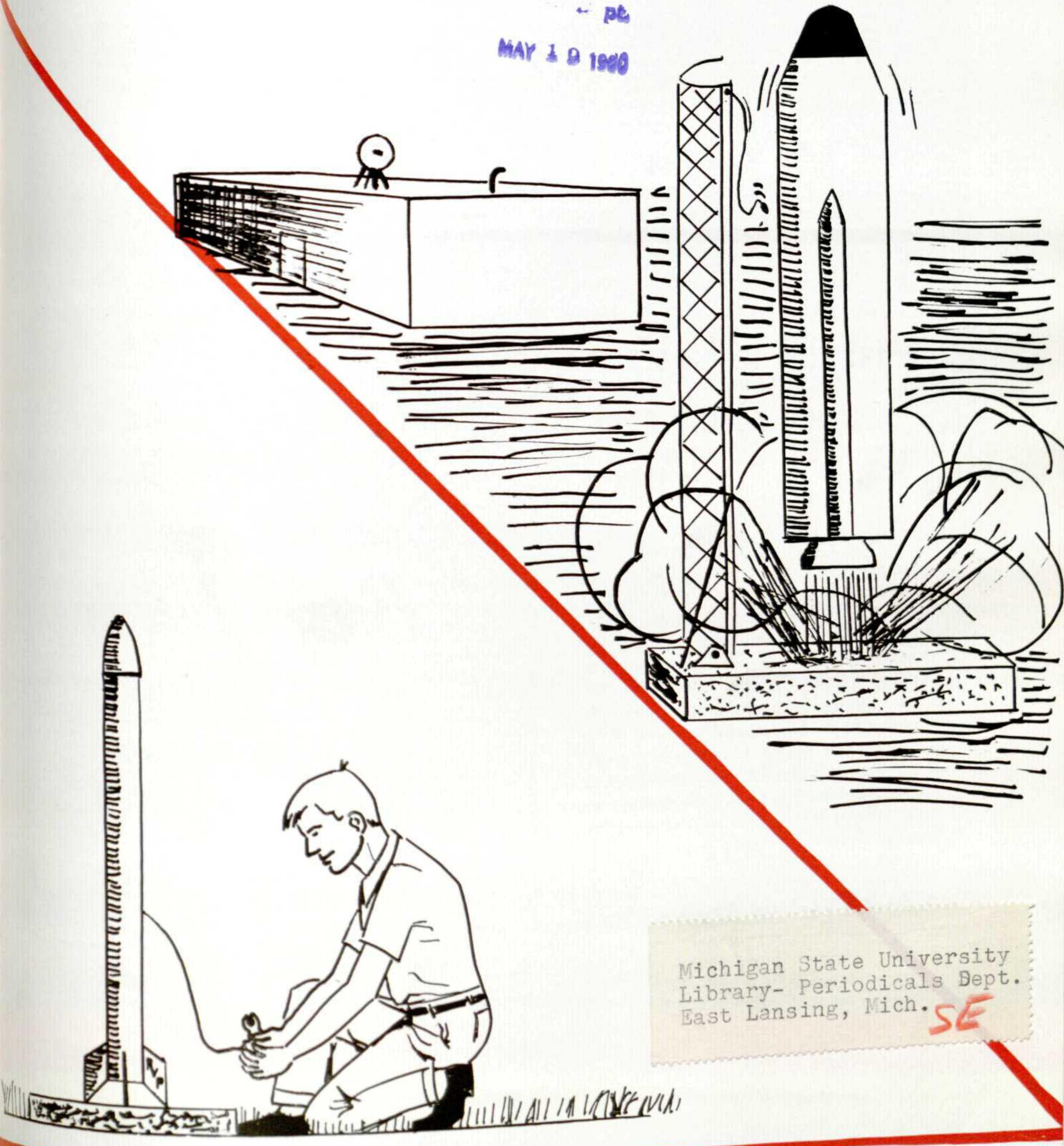
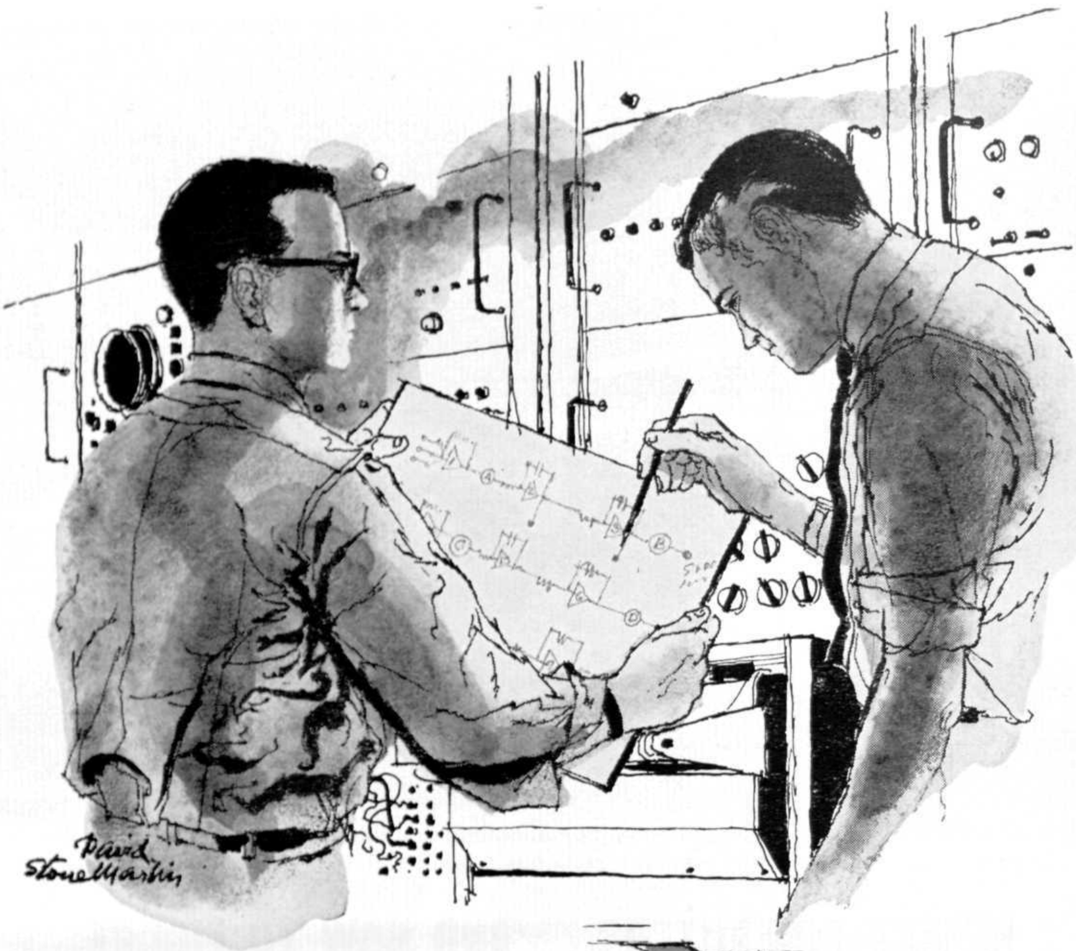
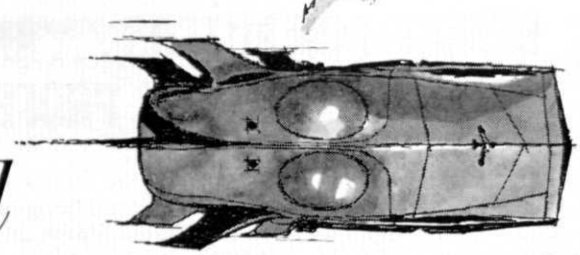
May, 1960



United Air Lines pilots review flight plan calculated by Bendix G-15 Computer at UAL's Operating Base, Denver, Colorado.



road testing the Firebird



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Dean's Letter

Inspection and quality control are operations employed by manufacturers to insure that their products are operable, and meet the standards of quality which they desire to maintain. The engineering colleges of the United States have their own form of quality control, to insure that the engineers graduated from these schools meet certain minimum standards appropriate to the engineering profession.

Early in March four of our departments were visited by a team of inspectors from the Engineers Council for Professional Development, the group designated to undertake the quality control function for the profession. These inspectors were renowned engineering educators, each an authority in his field of education, from other major universities of the East and Midwest. By discussion with the Provost, the department heads and individual faculty, survey of laboratories and equipment, and perusal of problems, test papers, and laboratory reports as actual student products, these men appraised our curriculums, our courses, our staff, and our research, and compared them with certain minimum criteria and with the academic level of the other 150 engineering colleges of the United States. While a final report will not be received until October, I feel confident that its contents will be favorable to our operation, with approval of the courses and curriculums available to you as students. In other words, I believe we passed!

Having just returned from a trip as a member of similar ECPD inspection teams at a far Midwest school and an Eastern college, I can vouch for the thoroughness of the survey, and the seriousness of purpose with which these inspecting teams approach their jobs. Two days of burrowing into a school from all angles, plus midnight discussions of findings, the fitting of information supplied by faculty members with other bits of information gleaned from administrative offices, budget, library, or research lab, lead to accurate appraisals of the strong and weak points of a college of engineering — the better to guarantee a quality professional education to you.

As a member of such inspection teams one also has the opportunity to glean new ideas, ascertain trends, and to learn of the outcome of educational experiments. Perhaps some of this information may also be of use in improving our work in your behalf at M.S.U. Engineering education is indeed a planned process to insure proper and appropriate education for a great profession.

J. D. Ryder

Spartan Engineer

of michigan state university

VOLUME 13 NO. 4 MAY, 1960

FEATURES:

DEPARTMENTS:

COVER: The cover for this month's *Spartan Engineer* was designed by Reg Pilarski, a member of our staff. Portrayed is the importance of rocket societies and clubs to further knowledge in the field of rocketry.

MEMBER, ENGINEERING COLLEGE MAGAZINES ASSOCIATED

* * *

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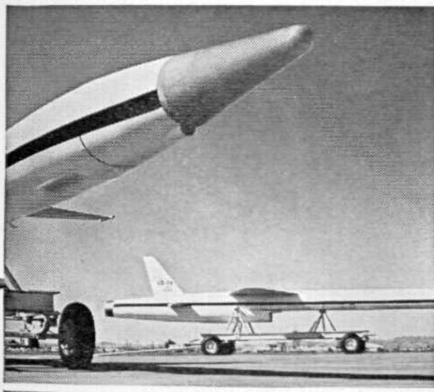
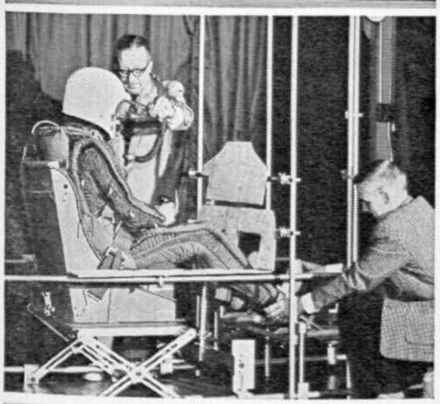
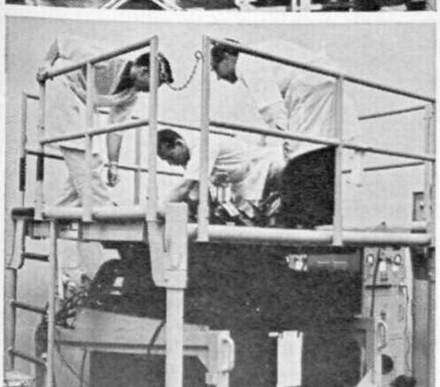
...NEWS IS HAPPENING AT NORTHROP

Take this 3-Minute Quiz to help you determine your future



1. *What part of the country has the best future for your type of work?*
2. *What part of the country offers an outstanding opportunity to enjoy your leisure?*
3. *Where can you work and still earn advanced degrees?*
4. *How important to you is the challenge of opportunity — and salary that matches your achievements?*
5. *Where can you work with outstanding men in your field?*





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Editor's Corner

Congratulations to those engineering seniors who will be graduating soon. You can look upon your studies in engineering with a sense of accomplishment. It represents a large investment of time and money, but more than this it represents an intellectual experience. With graduation, you are about to complete another step in your pursuit of knowledge.

Whether your long range goal is to be the head of a department in one of the various engineering firms or to be the vice-president in a large company, you will find that your degree in engineering will furnish a firm foundation from which to work toward your goal.

Building a career can be compared to erecting a large building. A good foundation is a necessary part of the building, but one must also make a wise selection of the materials used in completing the building. Integration of the materials into a well planned program of construction produces a building which one can be proud of.

Likewise, one's career starts with a good foundation represented by formal schooling in engineering at a university. Next one must select the materials and an overall plan in order to complete the structure.

One's long range goals represent the master plan. As in laying out the plans for a large building where one uses all of the skill and information available, one should also give serious consideration to his long range goals. Once you have decided on your goals, you are ready to select the proper materials for your plan. Some of the available materials are: experience gained on your job, graduate study, employer sponsored training, self study, professional activities and other activities such as civic work. Each of these materials has a place in building your career.

As an engineer each of you realizes it would be impractical to construct a large building using only one material. Would it be any more rational or practical to build a career from one material? Each of you must therefore decide what materials you will use in order to build the career you desire. A well balanced selection of materials will allow you to build a career which will mark you as a member of the engineering profession rather than just another high caliber technician.

The "Simple" Hilsch Tube...

Discovered more than 20 years ago, yet engineers cannot explain its unusual properties at the present time.

Man has accomplished many complicated feats such as hitting the moon and orbiting the sun, but to date he can't explain the effects of the simple Hilsch tube.

The Hilsch (or vortex, or Ranque) tube as it is sometimes called, is a very simple device which has no moving parts. It merely consists of a straight length of tubing intersected perpendicularly by another section of tubing with a tangential entry as shown in Fig. 1.

The diameter of one side of the straight tube is slightly smaller than the diameter of the other side.

The spectacular effect of the apparatus is that when compressed air at room temperature is fed through it, the entering stream of air separates into two streams of different temperatures; the hot stream leaving through the large end and the cold stream leaving through the small end. But, even though the Hilsch tube is simple, there is presently no general agreement as to the theory of its operation.

So far, analyses have been based on very little systematic experimentation because of the difficulties involved in gathering data. And the analysis of the phenomenon involves three fields: gas dynamics, thermodynamics, and heat transfer. The problem is also complicated mathematically. Nevertheless, since 1946 when it was brought to the United States from Germany, scientists of widely different backgrounds have been interested in the phenomenon.

(Photos by Eric Lundberg)

by NEWT BLACK, Tech. Writing '60

The history of the Hilsch tube dates back to 1931 when it was first reported by G. Ranque, a metallurgist at a steel works in France. Ranque noticed the vortex cooling effect at his work in cyclone separators. Soon afterward he constructed a device to duplicate the effect, and applied for a French patent in December, 1931. He thought it might be used in refrigerators.

Subsequent developments, however, brought the disappointing realization that the Hilsch tube was inefficient as a refrigerator, so nothing more was heard of it until 1946 when R. Hilsch from Germany published a paper on the device.

In 1947 at the end of the war in Europe, an army occupation group of scientists went through Germany and came back with many German scientific discoveries – one of these was a simple tube whereby you could blow into it and get hot and cold air from it at the same time.

At about the same date a Johns Hopkins University professor also brought back a model and a thesis by Hilsch. The thesis provided performance data and optimum dimensions for the vortex tubes. The data showed that the maximum effect would send −60°F. air from the small end and +400°F. air from the large end.

Widespread American interest has been given to the Hilsch tube ever since. The extreme simplicity of the device and the spectacular separation of hot and cold air streams suggested that it might replace some of the more complicated refrigerator designs.

However, subsequent investigation showed that the power required to operate the vortex tube was many times that required by a conventional refrigerator. But, other applications are suggested for the device, especially regarding jet-aircraft cooling. Thus, interest in the phenomenon continues.

At Michigan State University two men, Dr. J. E. Lay, associate professor of mechanical engineering; and Bung Chung Lee, a doctoral candidate, were awarded an army contract in 1958. The objective of this project is to obtain basic knowledge of the velocity, pressure, and temperature distributions in the vortex tube.

(Fig. 1) Newt Black, left, of the Spartan Engineer consults with Dr. Joachim Lay and Bung Chung Lee. Dr. Lay's left hand is on the large tube (warm air exit) and his right hand is pointing at the small tube (cold air exit). Probe is shown near center of tube.

Lee and Dr. Lay felt that, even though the effect diminishes as the size of the device is enlarged, they could obtain more accurate data with a large Hilsch tube.

Hence, they designed a plexiglas tube which was large enough to permit velocity, temperature, and pressure measurements to be taken without causing major disturbances in the flow field.

The inherent limitations to the study of the tube, until recently, kept concise investigation of the Hilsch tube from progressing very far.

Both Ranque's and Hilsch's original models were of very small diameters (4 to 18 mm tubes) where impressive effects were obtained with low or moderate air supply pressures. "Such small models, however, are not suitable to the basic study of the vortex phenomenon," said Dr. Lay, "because they do not lend themselves to velocity, pressure, or temperature traverses."

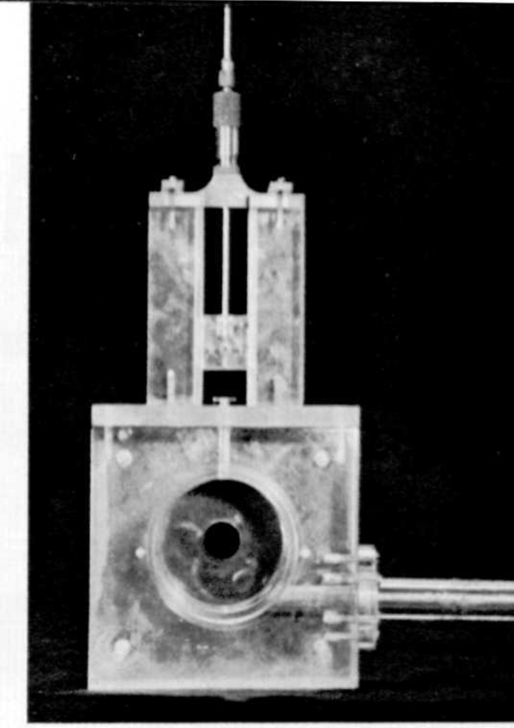
To perform these measurements, Lee and Dr. Lay designed considerably larger models; this in turn requires high flow rates of air. Also the vortex effect is lessened; thus, instead of getting the tremendous temperature differences, the MSU researchers get a high temperature of 100°F. and a low of 40°F., Fig. 2.

Their model is a 2 in. diameter vortex tube made of lucite. Dr. Lay points out that lucite also permits flow-visualization studies. Their model is adaptable to many kinds of measurement at different points along the length of the tube.

Compressed air at room temperature is fed tangentially into a center block, Fig. 3, from which it spirals along the axis of the vortex tube, and out the ends of the tube.

Stagnation temperature, stagnation pressure, static pressure, and velocity traverses are taken at stations along the tube as shown in Fig. 4. The exit end of the tube is fitted with a cone-shaped valve which is movable in and out to regulate the flow in the hot tube.

Dr. Lay's vortex tube is so designed that a number of sections can be fitted together to form a tube of any desired length.



(Fig. 3) Center block with probe mounted on top. Also shown is air entry on right.

The key feature of Dr. Lay's design is that a probe assembly can be inserted at different stations (1/10 in. apart) along the length of the Hilsch tube, and the probes (in the form of hypodermic needles) may be raised, lowered, or revolved within the flow field; thus measuring the velocity of the air flow. "Care must be taken, however," said Dr. Lay, "not to disturb the flow pattern."

The big drawback to the experiment is the tremendous job of gathering data. Each run requires 360 different readings, and the probes

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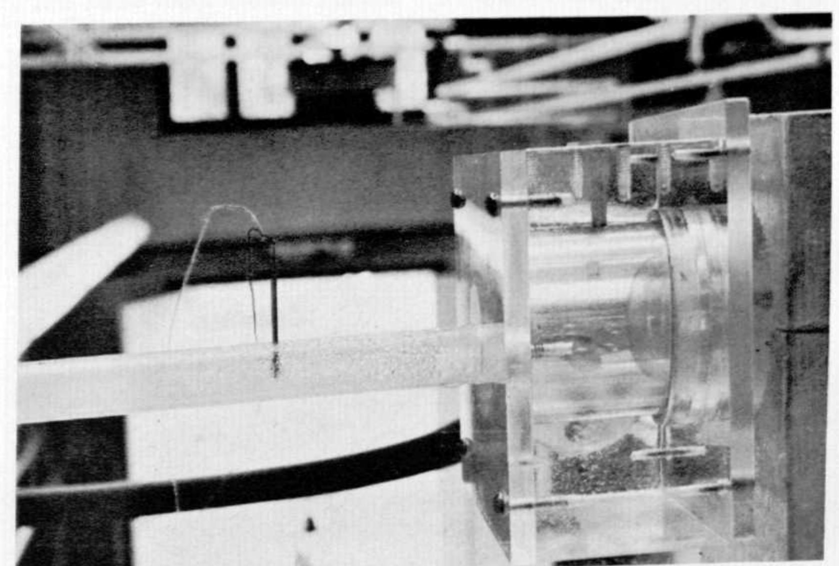
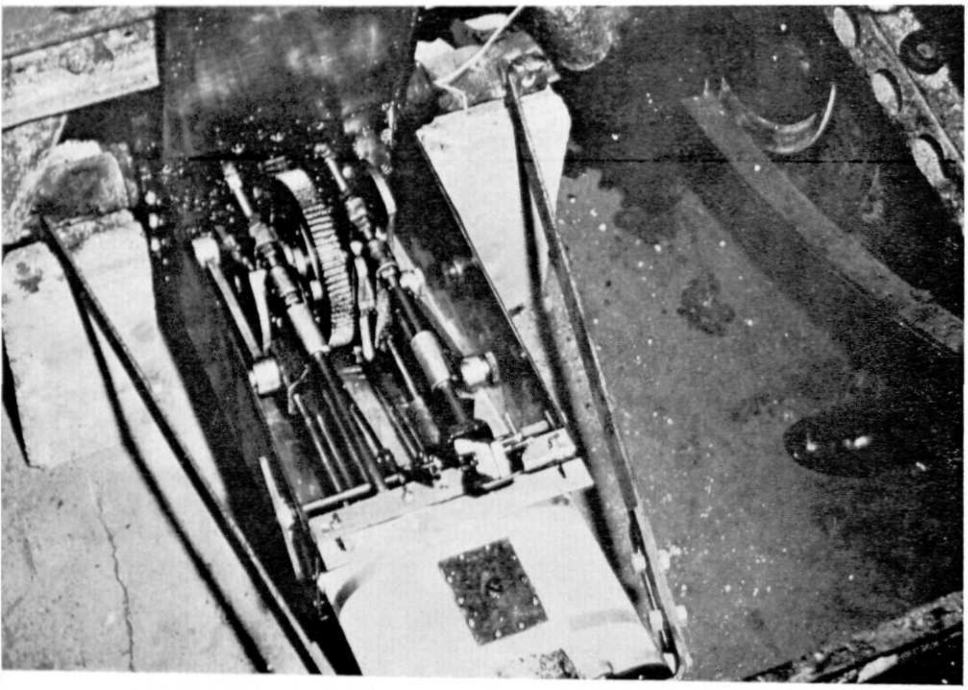


(Fig. 2) Small tube showing condensation due to the passage of cold air.

STEAM CARS

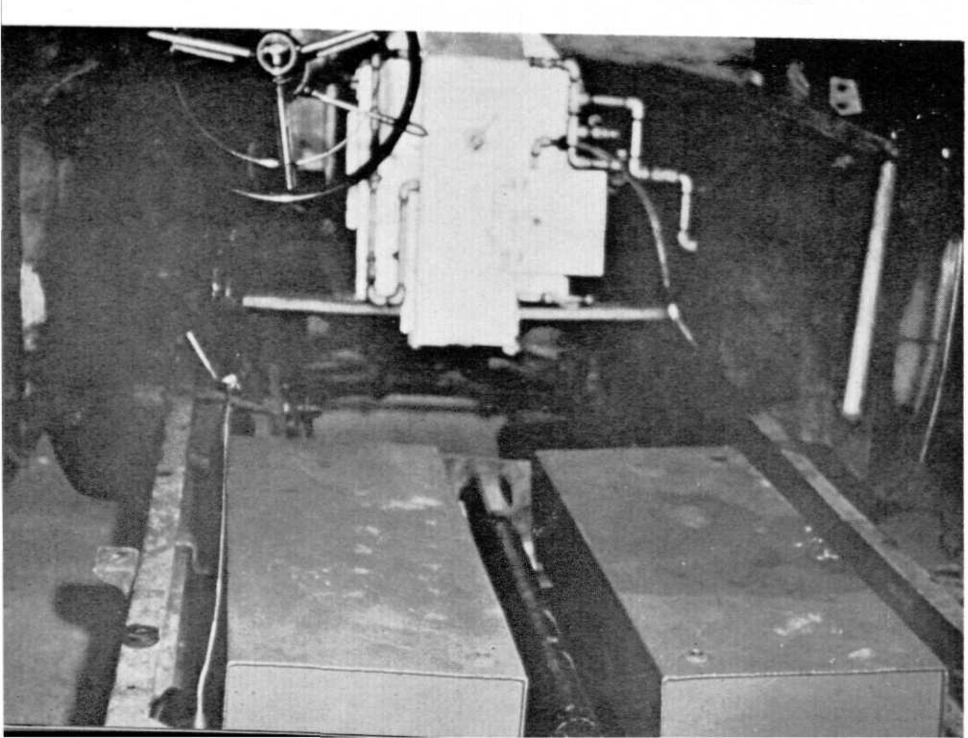
offer simplicity and high efficiency

by DAN FERGUSON, M.E. '61



(Above) Rear view of the differential of a 1951 Lincoln. The engine is an integral part of the differential.

(Below) Fuel oil tanks in center of car help to distribute weight. Boiler is under hood in front.



How would you like to have a car that accelerates from 0 to 60 mph in less than 5 seconds, runs on #2 fuel oil, and has a two cylinder engine that makes the same number of revolutions per mile regardless of car speed? These advantages and many more can be realized by the use of steam as a source of power in the automobile.

As far as we know, the first vehicle driven by its own engine was propelled by steam. It was built in 1770 by a Frenchman, Nicholas Cugnot. This vehicle had three wheels; power was applied to the front wheel only.

In spite of this early start, it wasn't until the late 1800's that the gasoline engine, electric motor, and the steam engine were widely used as sources of power for self-propelled vehicles.

The two main components of a steam power plant are the boiler and the engine. The system may contain a condenser. The boiler may be of many types: the pot boiler, flash boiler, or the multitube boiler. The engine may be of two, three or four cylinders and either single or double acting. Because the steam engine can be connected directly to the ring gear in the differential, the transmission, drive shaft, universal joints, clutch, flywheel, and gear shift are unnecessary.

Early pioneers in steam car development in the United States were the Stanley Brothers. They built their first car in 1898 and made continuous improvements. They used a pot boiler and a double-acting two cylinder engine. In 1906 a Stanley racer established many records, among them the speed of 127.66 miles per hour. One of the Stanley Brothers was killed in an accident in 1917, and in 1924 the company went out of business.

A few of the other 125 makes of steam cars that have been on the market since 1900 are the Mobile, the Locomobile, Lane, Clark, Eclipse, White, Gearless, Coats, Doble, Brooks, and the Delling. The Delling Steam Car Company was the last company to go out of business in 1934. R. E. Olds, founder of Oldsmobile Division of General Motors, even built a steam car. This was in 1887 but it was never offered for sale.

The gasoline engine is basically a constant speed and constant load machine which is quite suitable for boats or airplanes. But in the propulsion of an automobile, both speed and power must be varied. This is done by the clutch, transmission, carburetor, etc.

(Continued on Page 24)

Engineering Alumni

receive another service from MSU through the new Engineering Alumni Association.

by GEORGE FOLEY, Pre-Law '62

Another **First** for the Engineers! This time the breakthrough is not in the electrical, mechanical or chemical realm, but in the field of Alumni relations. The College of Engineering is the first College of Michigan State University to establish a separate alumni association of its own.

For some time it has been felt that the M.S.U. College of Engineering and its Alumni would both benefit by a closer working relationship. It was felt that an Engineering Alumni Association which was designed specifically to meet the needs of Engineers would be desirable. The University Alumni Office also sanctioned theis proposal and in September of 1959 the ground work was laid for the organization. Forty members of the M.S.U. Engineering alumni representing various graduating classes were contacted and this group along with Dean Ryder did the actual planning of the Association.

The Engineering Alumni Association does not limit its membership to Engineering graduates exclusively and any former student of the Engineering College who is interested in M.S.U. is eligible to join. Members of the Engineering faculty and friends of the College may also take part in the organization.

The purpose of the Engineering Alumni Association according to its by-laws is "to provide a medium whereby the Alumni may cooperate with the College of Engineering for the improvement not only of the College of Engineering but also the Michigan State University in its entirety." Also, "It shall provide a means of helpful advisory service to the engineering administration on one hand and where needed a helpful service to engineering alumni either as individuals or as a group."

Although the organization is still in its infancy much work has already been started towards achieving these goals. The Association has appointed three standing committees: the committees for Annual Reunion, Public Relations and for Alumni Contacts and Surveys.

Mr. Earl Kelly, chairman of the Alumni Reunion Committee, has announced that the College of Engineering Alumni Association will hold its 1960 reunion September 30th and October 1st. All Engineering graduates, former students and their families are invited to attend.

The Contacts and Surveys Committee headed by Mr. Robert Alpers has also been very active. Cards have been sent to the engineering alumni in an attempt to bring the alumni files up to date. Other surveys are also being planned by this committee. One example of how this type of survey might mutually benefit M.S.U. and the alumni is that this information is the kind used by listings such as Who's Who's in Engineering. Michigan State University has many outstanding graduates whose names do not appear in publications of this nature because information about them is not available.

The Public Relations Committee, with Claud Erickson as chairman, has also been very active. Among the Committee's primary objectives is that of promoting interest in engineering in local school and local communities. The stimulation of general interest in the field of Engineering will be of mutual benefit both to M.S.U. and to the Alumni.

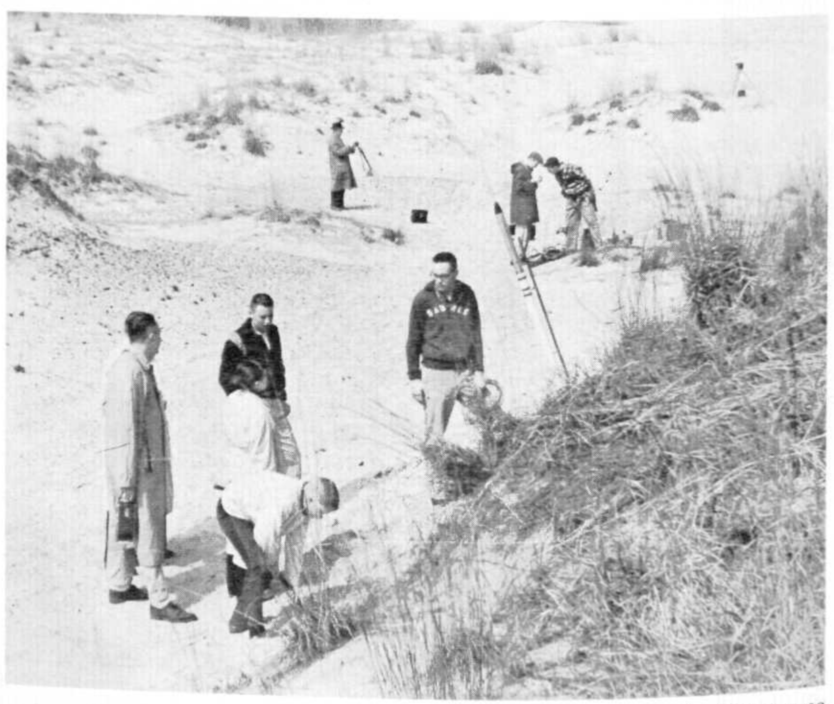
The officers for the first year as elected by the 32 members of the Board of Directors are: Chairman, Major Albert Sobey, '09, Flint; 1st Vice-Chairman, C. Earl Webb, '12, Okemos; 2nd Vice-Chairman, Claud R. Erickson, '22, Lansing; Secretary-Treasurer, Miss Agnes McCann, East Lansing.

Amateur Rocketry

A young science looks for recognition through a program of safety and dedicated study

Editor's note: Scientists and engineers use many tools in their quest for knowledge of our physical universe. Many of these tools, such as atomic energy and rockets are potentially dangerous if misused. The amateur scientist should follow the example of the scientists, in working with these tools. He should first become familiar with his area of interest so that he can recognize the potential hazards. Next, he must find out what safety precautions should be taken. In all experiments he must adhere to all safety precautions to reduce the danger to himself and others.

The following article illustrates how a group in amateur rocketry in adhering to the proper safety procedures averted injury to themselves as well as to others. Compare their procedures with those groups or individuals that have made the newspaper by blowing up a rocket in a residential neighborhood or any of the other types of such accidents caused by carelessness. The cooperation of a qualified advisor is also important in the undertaking of a hazardous scientific study.



(Left) The X7-A, a rocket of an earlier series than the X9-A. It was fired in November 1957 and it reached an altitude of 600 feet.

(Above) Shown is the firing area during preparations for a flight test of the X9-A. Present in the picture are several members of Morgan Park Rocket Society and their advisors.

by JOHN THORNTON, E.E. '62

MOST people, when they hear the word amateur rocketry, immediately think of a group of unsupervised youngsters building rockets of plumbing pipe and matchheads. Unfortunately there are such instances, but these cases should not be confused with a relatively large group of college and high school students who devote a great deal of time, research, and money in making amateur rocketry as safe as possible. These students, working closely with qualified adult supervision, approach amateur rocketry as a scientific undertaking.

This group has built sophisticated rockets with a high degree of efficiency, capable of carrying payloads to respectable altitudes. The payloads vary from multi-channel telemetering systems, complete with parachute recovery, to more simple equipment such as smoke and vapor generators. Various experiments have ranged from mail rockets, as fired by the Reaction Research Society, to sending animals aloft to expose them to cosmic rays. Besides experimenting with conventional solid and liquid fueled powerplants, amateurs have built and tested plasma and ion propulsion systems.

The Morgan Park Rocket Society, a small group to which the author belongs, fired over fifty flight missiles from 1955 to 1958 without any serious injuries, except maybe a smashed thumb where some over-zealous member missed a nail with a hammer. Careful procedures and strict rules were responsible for this safety record. Another group, the Reaction Research Society, has fired over three hundred rockets in fifteen years, but has not had a serious accident resulting from a rocket test. Many other groups have similar records.

Let's take a look at the design, construction and testing of a typical rocket built by the Morgan Park Rocket Society. Usually the idea comes from a desire to perform a certain experiment or to test a new method. A preliminary design with rough specifications is drawn up. The main effort at this stage is to design the rocket as a system instead of individual parts. From these initial plans, detailed drawings are made. Each part is considered individually and then is fitted into place. Every fault eliminated on the drawing board means a better performing rocket. When this stage is completed, construction begins.

A typical rocket, the X9-A, was constructed in two sections, the thrust chamber assembly and the instrument section. The X9-A, the last rocket fired by our group, was designed specifically to carry a two pound payload to an altitude of 4000 feet. The thrust chamber or motor was made of a four foot section of S.A.E. 1020 seamless steel tubing, with an outside diameter of two inches and a wall thickness of one-sixteenth inch. This was quite sufficient to withstand the pressure of a low energy propellent burning at 1200 degrees F. A safety factor of 4 was always used in chamber construction, in case internal pressures rose higher than normal. The nozzle, held by eight machine screws, was machined from aluminum, which withstands thermal erosion better. Also, the density of aluminum being about one-third that of steel, the total weight of the motor was reduced. The nozzle, being a critical part, was given an extremely smooth finish. The forward bulkhead, which separated the thrust chamber and instrument section, was also aluminum.

The instrument housing consisted of a two inch aluminum tube into

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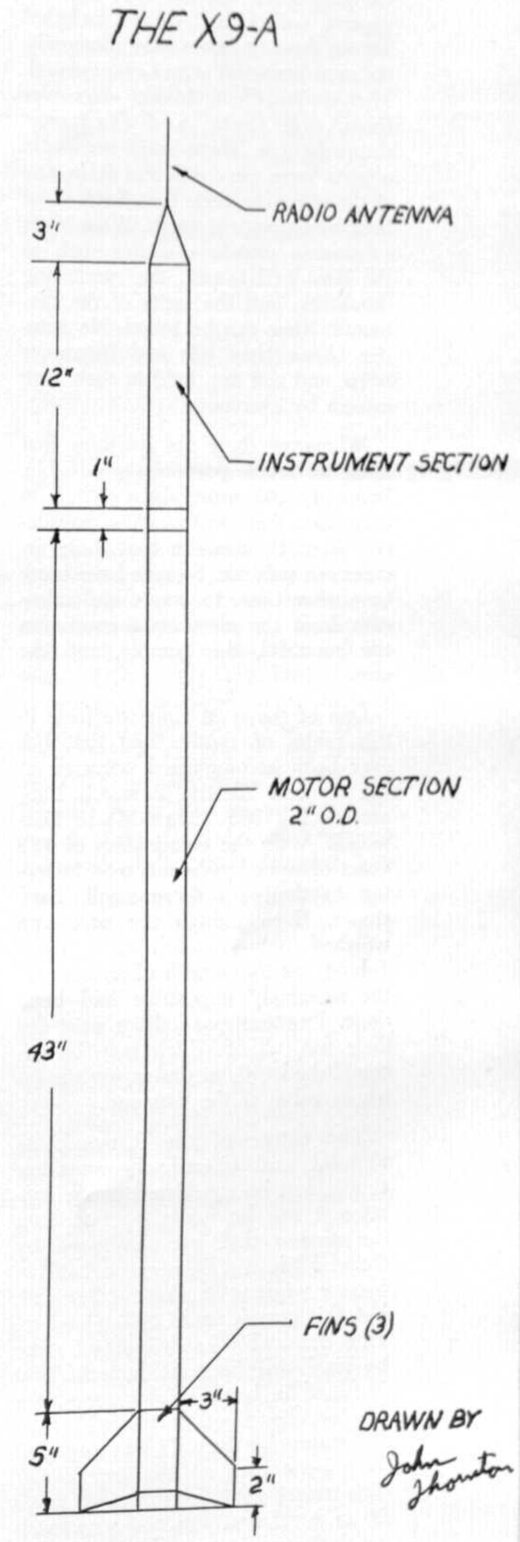


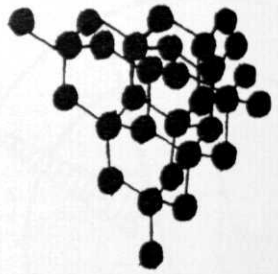
The diagram shows the basic layout of the X9-A. Dimensions give an indication of the overall size of the rocket.

MAN MADE GEMS

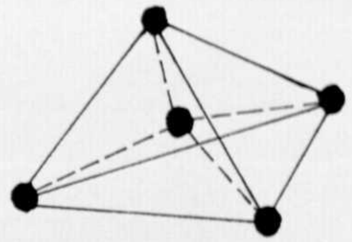
Man duplicates nature in producing diamonds of an industrial grade

(Photos courtesy of General Electric)

by WILLIAM HAHN, Ch.E. '61



Lattice structure of diamond molecule.



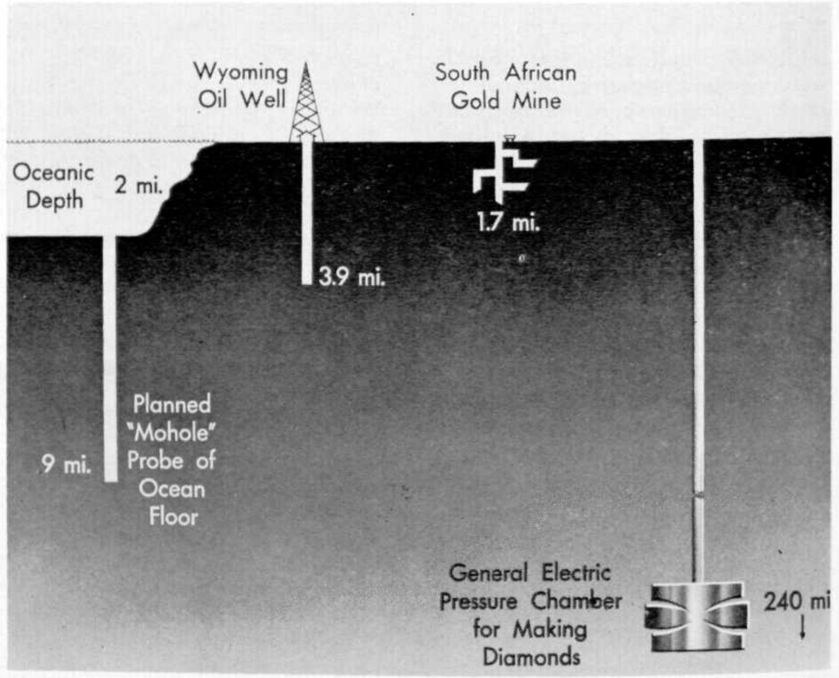
Diamond crystal structure of interlocking tetrahedrons.

Throughout recorded history man has always had the tendency to acquire treasures. King Tut, Solomon, Genghis Khan all had vast and expensive collections. Always included among these treasures were diamonds, the most beautiful stones ever created. Men studied them, fought wars over them, stole them, and even worshipped them. These small inanimate objects were very different from any of the other creations that Nature had bestowed upon the earth. What other substances possess qualities such as the fiery brilliance, the everlasting durability, and the rarity of the diamond? None can be found. No wonder these tiny bits and fragments were, and still are, held in such high esteem by everyone.

Whenever there are qualities that make an article particularly valuable, humanity has most always tried to reproduce them so that they may derive from the benefits that these articles can produce. So men have tried, time after time, to create and fabricate from the elements around him the beautiful, the durable, and the rare.

One of the most climactic feats in this realm of synthesizing that has ever been accomplished occurred at the General Electric Research Laboratory in 1955 "Man-Made Diamonds" were the culmination of 125 years of work by various men in trying to duplicate these small, hard stones. Even though the prototype weighed only a tenth of a carat (about one thousandth of an ounce), the seemingly impossible had been done. Limitless possibilities exist for their use, all of which may be accomplished without destroying the intrinsic value of the diamond.

The nature of the diamond, its physical and chemical properties, should first be considered before any attempt can be made in describing the process that was developed by General Electric. It may be hard to believe when you look at a diamond, but this gem is made out of carbon. How can such a lovely, elegant stone be made of the same material that is found in black chimney soot, the line made by a pencil, the coal burned in furnaces, or the solid lubricant used in various parts of the automobile? The secret as to why the diamond is so lucid and the other materials so drab and opaque, lies in the design or pattern that nature has assigned to the different crystalline forms of carbon.



Pressures as high as 1,800,000 pounds per square inch are achieved in the General Electric pressure chamber for making diamonds. Such pressures occur in nature at a depth of 240 miles below the earth's surface.

The discovery of the inner skeletal structure of both allotropic (same constituents but different arrangement) forms of carbon was made in the early 1900's with X-ray apparatus. The resulting pictures showed that the basic recurring unit of the diamond was a tetrahedron (4 planed pyramid) and a hexagon for graphite. The tetrahedral configuration of diamond can best be described by imagining the following picture. A lone carbon atom is placed in the geometrical center of the tetrahedron. In each of the four corners of the pyramid another carbon atom is placed. Between each of these carbon atoms and the central one a line is drawn to represent the bonding or attracting forces that hold the system together. If the atom at the center of this pyramid is imagined to be the peak of the next occurring unit, and this arrangement is carried on many billions of times, the resulting structure is the diamond. These interlocking tetrahedrons are the reason for the characteristics that diamonds possess.

Graphite has entirely different properties because of a different structure. By taking the hexagonal structure and placing a carbon atom in each of the six corners and then assuming that the lines, which define the hexagon, are the bonds or binding forces, the graphite pattern will take shape. If an uncalculable number of these hexagons are joined into a chicken wire pattern, a broad plane is formed. If several of these planes are placed one on top of each other in layers, the configuration of graphite is outlined. There are no connecting forces between the layers of the planes except extremely weak electrostatic forces (VanderWaals). This fact enables the planes to slide over each other and thus make graphite a good lubricant.

Why diamonds form tetrahedrons and graphite hexagons is another example of the control that Mother Nature has over natural elements. Graphite is the most common configuration found over the earth. Thermodynamically, it is the easiest to form and the most stable. Diamond, on the other hand, requires the most extreme and rare conditions for tetrahedral formation. Graphite is always preferred because it has a lower potential energy. Transition to the diamond will occur only when instances of extreme conditions arise.

Most of the diamond regions of the earth are places where volcanic activity once predominated. Ages ago in these areas, vast unsettled regions of activity were brewing beneath the surface of the earth. Masses of molten rock of a certain chemical composition (no quartz), which were at extremely high temperatures and pressures, were in motion. Conditions in this state were just right so that the carbon atoms that were present were crowded together into a very compact mass; thus started the tetrahedral alignment into definite patterns. Crystals grew in a relatively short time and diamonds separated out. Without such optimum surroundings, graphite would have been formed.

From the tremendous forces at work, from the expanded gases, and the liquefied rock, the fluids began to work their way up the faults and fissures in the overlying mantle. Finally, one of the cracks gave way with a cataclysmic eruption and the ensuing waves of molten lava formed a volcano. Time brought activity to a halt and then years of erosion by destructive elements leveled the cone. What was left was the pipe or the fissure extending deep inside the earth. Imbedded in it were the diamonds. Today these pipes are the richest source of the gems.

When the details of natural formation became known during the 1800's, some people wondered if it would be possible to duplicate such conditions in the laboratory and thus be able to artificially produce diamonds. Subsequent trials by various men all ended in failure, even though some claimed to have perfected it. The validity of such statements has since been disproved.

Progress was slow, and many people thought it was sheer folly to ever think that such a development was possible. A major break-through occurred in 1938 when F. D. Rossini and R. S. Jessep of the National Bureau of Standards published data showing the thermodynamic limits of graphite. These showed that if graphite is heated to 3000°F. and a force of 20,000 pounds per square inch was applied for a few minutes, no diamonds were formed; but a reverse transition of diamond to graphite was

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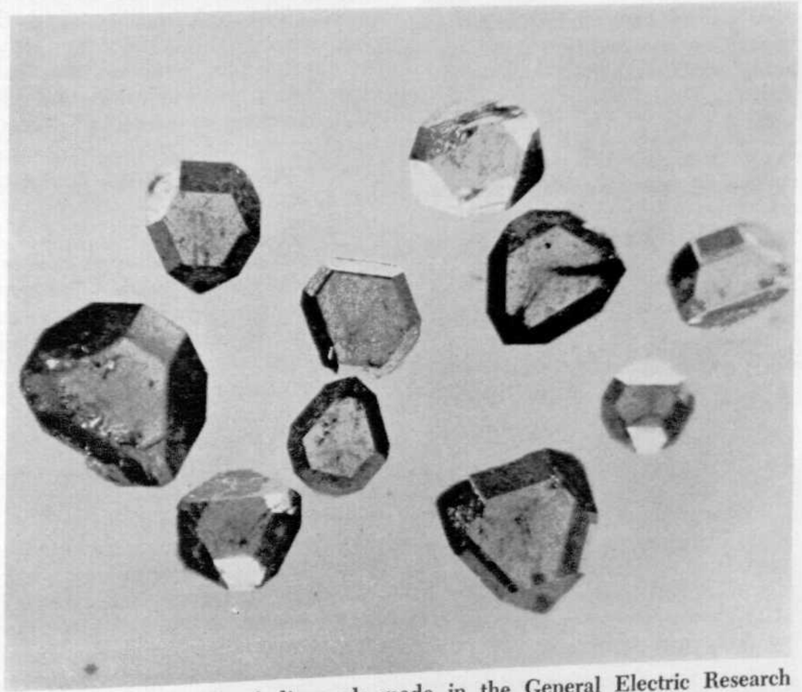

Photomicrograph of diamonds made in the General Electric Research Laboratory.

by ELEANOR WARREN, Math. '60

Our society must educate more and better scientists. Nearly five hundred high schools in forty-one states and Puerto Rico have taken the big step toward answering this call. They are active participants in the Junior Engineering Technical Society or JETS as the program is better known.

JETS was founded at Michigan State University just ten years ago, but rapidly spread to other areas. The National Headquarters for the organization remains on the Michigan State campus.

"Opportunities in Engineering and Science For Youth" is the goal of JETS. The group works with industry, engineering and scientific societies, and educational institutions to develop an outstanding science program for the American high school student.

What makes this science program so outstanding? It is not just another textbook course that stresses memorizing several hundred pages of formulas. First of all, JETS is an extra-curricular activity that may be selected by any junior or senior high school student provided a local chapter is available. This means that 99-100% of the students who belong have a great deal of interest or ability in the field of science. Secondly, JETS stresses learning by doing. Each member has an individual or group project that he works on during the entire year. Importance is placed on originality and creativity. Projects range from simple telescopes to complex electronic computers depending upon the experience and ability of the individual students.

The project ideas often spring from the **Academic Unit Plan.** Every two weeks a standard manual is sent to all of the participating students. This booklet has a new theme each time with subjects ranging from aeronautics to metallurgy and crystallography. The manuals are used as a study guide for the JETS meetings. Contained in the booklet is an outline for presentation and study, sample problems (ranging from easy to most difficult), pictures and diagrams, and an excellent bibliography for additional reading on the subject. From the general plan, each student is stimulated into his own area.

JETS activities are in no way limited to the use of the manual and and to the work on the individual project. Through reading of their publication, JETS-O-GRAM, you may see that chapter activities often include field trips to industries and exhibits, listening to scientific lectures, watching scientific movies, and conducting scientific or career programs for assemblies, other schools, or television.

The old saying, "All work and no play makes Jack a dull boy," is certainly believed by JETS members. Individual chapters sponsor social events, but even more important is the opportunity for each student to display his project at the annual Engineering Exposition. The event, held in May at Michigan State University, provides not only an excellent opportunity for "socializing" but gives the JETS member a chance to see what other students have been able to create. Certainly, many of the group will go home with an inspiration for next year's project. The exposition also allows the students to see the engineering and scientific facilities that are available on the campus and provides an opportunity for talking with professors and industrialists.

Unity among members is another aim of JETS. This is illustrated by the use of a standard manual and by the national publication and meetings. Each member of the organization also receives a JETS pin and has the opportunity to purchase an emblem jacket or official slide-rule tie clasp if he desires. These articles help to instill a sense of unity and enhance a feeling of belonging to an organization.

The local organization of the groups is quite fascinating. It is often thought of as an exploration group and the officers are given related names, e.g., Captain, First Officer, Navigator, and Communications Officer. In addition, there is the JET Pilot or advisor who is a science or mathematics teacher in the local school and there is an engineering advisor who is a local engineer or scientist. Each chapter is self-governing and may adopt its own constitution and amendments as the need arises. Financial assistance is granted through industry, universities, and scientific and engineering organizations.

JETS is primarily interested in adequately preparing a student to meet the scientific demands of the day. For this reason, they have set up a program called "The Big Brother Day." This is an opportunity for a JETS member to spend a day with an engineer or scientist in his own field of interest. The program provides excellent views of what is being done today and what is expected of our scientists.

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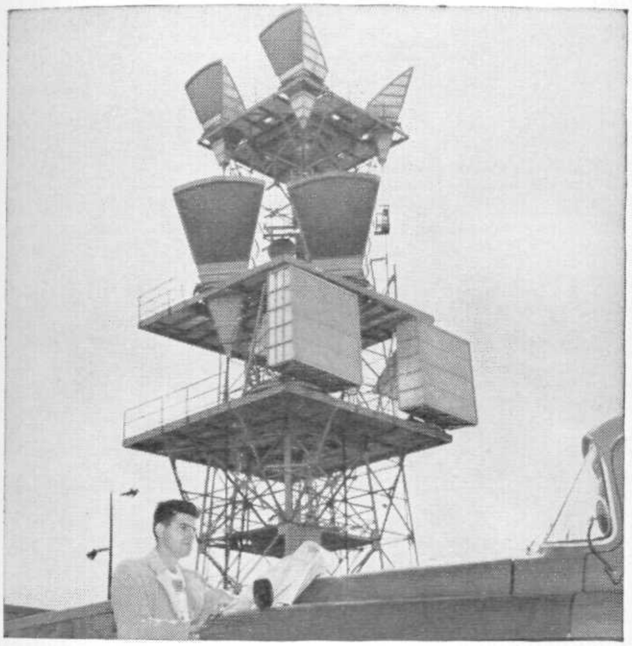
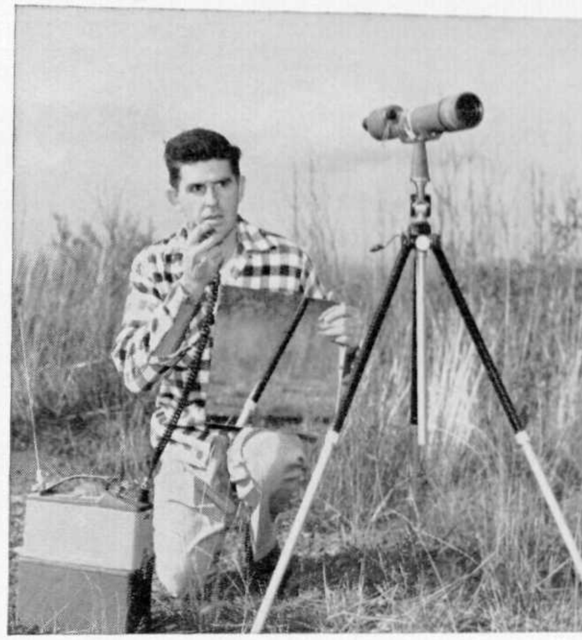


Dick Ernsdorff studies a microwave site-layout chart atop a mountain near Orting, in western Washington state. On assignments like this, he often carries $25,000 worth of equipment with him.



Here, Dick checks line-of-sight with a distant repeater station by mirror-flashing and confirms reception by portable radio. Using this technique, reflections of the sun's rays can be seen as far as 50 miles.

He wears two kinds of work togs

For engineer Richard A. Ernsdorff, the "uniform of the day" changes frequently. A Monday might find him in a checkered wool shirt on a Washington or Idaho mountain top. Wednesday could be a collar-and-tie day.

Dick is a transmission engineer with the Pacific Telephone and Telegraph Company in Seattle, Washington. He joined the company in June, 1956, after getting his B.S.E.E. degree from Washington State University. "I wanted to work in Washington," he says, "with an established, growing company where I could find a variety of engineering opportunities and could use some imagination in my work."

Dick spent 2½ years in rotational, on-the-job training, doing power and equipment engineering and "learning the business." Since April, 1959, he has worked with microwave radio relay systems in the Washington-Idaho area.

When Dick breaks out his checkered shirt, he's headed for the mountains. He makes field studies involving microwave systems and SAGE radars and trouble-shoots any problem that arises. He also engineers "radar remoting" facilities which provide a vital communications link between radar sites and Air Force Operations.

A current assignment is a new 11,000 mc radio route from central Washington into Canada, utilizing reflectors on mountains and repeaters (amplifiers) in valleys. It's a million-dollar-plus project.

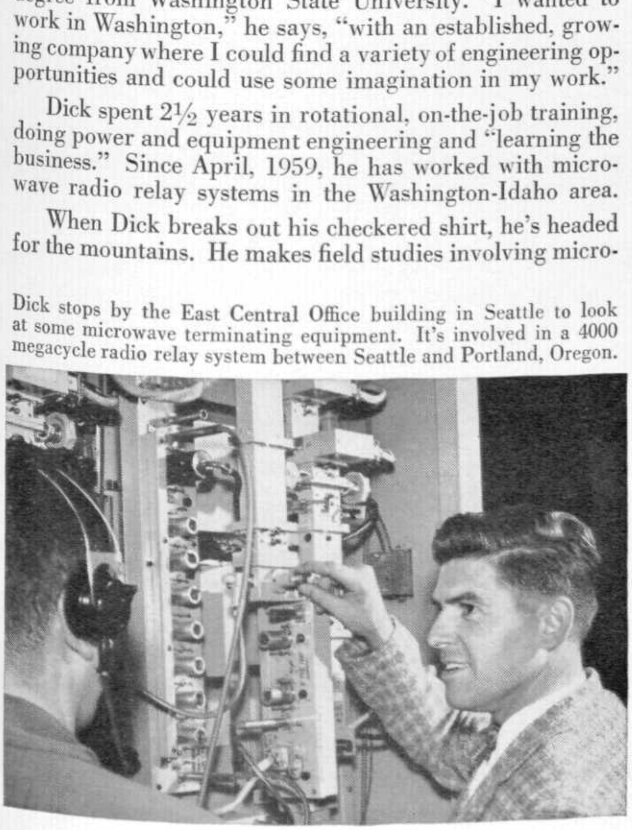
"I don't know where an engineer could find more interesting work," says Dick.

* * *

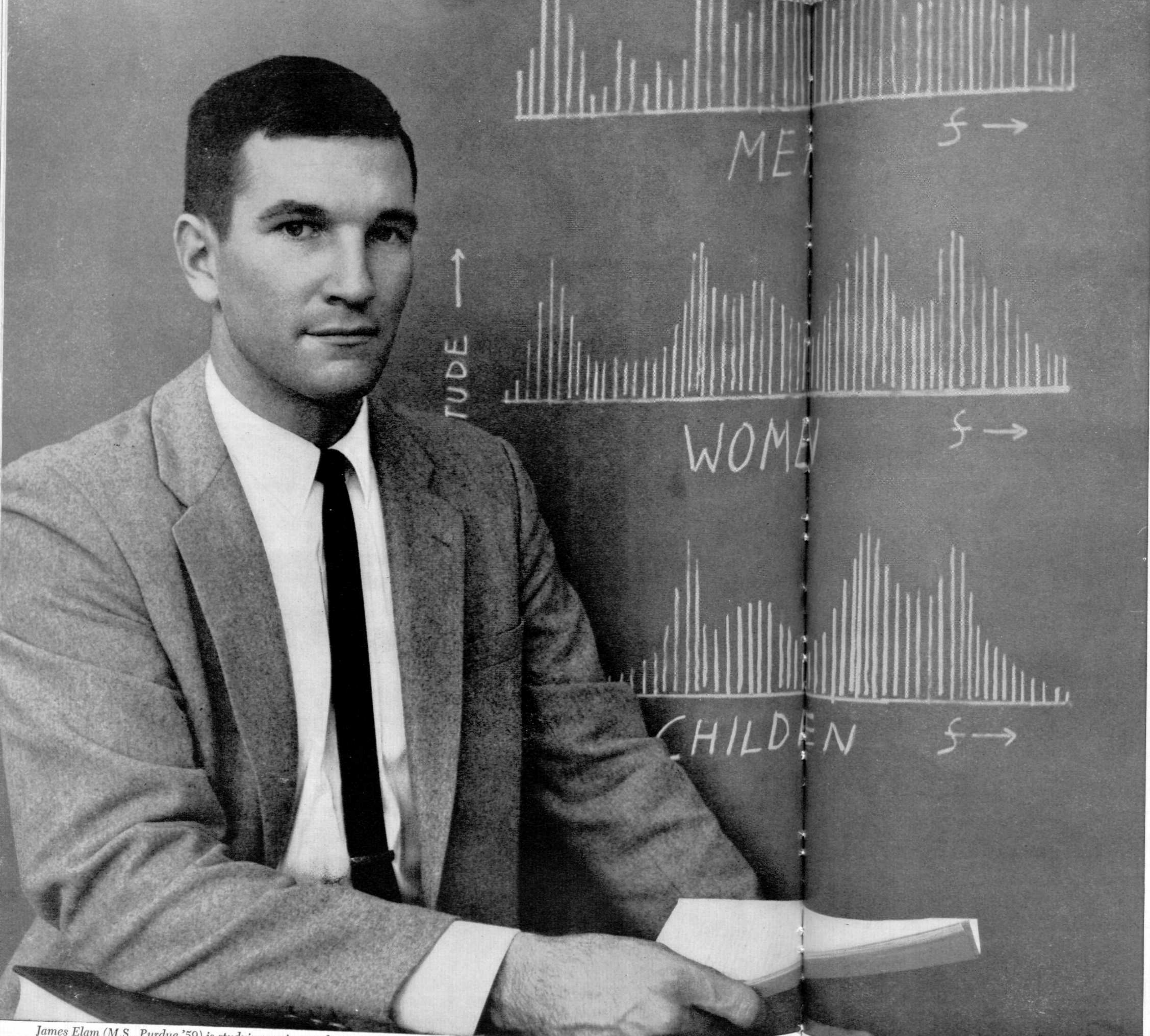
You might also find an interesting, rewarding career with the Bell Telephone Companies. See the Bell interviewer when he visits your campus.

BELL TELEPHONE COMPANIES

Dick stops by the East Central Office building in Seattle to look at some microwave terminating equipment. It's involved in a 4000 megacycle radio relay system between Seattle and Portland, Oregon.



In the Engineering Lab in downtown Seattle, Dick calibrates and aligns transmitting and receiving equipment prior to making a path-loss test of microwave circuits between Orting and Seattle.



James Elam (M.S., Purdue '59) is studying various techniques of speech analysis at IBM. The objective of this work is voice-machine communication.

He's breaking through sound barriers to find new applications of human speech

It is believed that once clear, distinct signals can be obtained from human speech sounds, the human voice can be used for direct communication with machines. James Elam is working in this direction.

Voice-Machine Communication Problems

The problems involved are formidable. Machine "understanding" of human speech will be limited by both the sensitivity and the number of electronic "recognizers" of speech-sound patterns that can be built into the machine. To further complicate matters, the human voice is capable of making an almost infinite variety and subtlety of sound patterns. Only in theory could a machine be built that could recognize all of them.

A Solution in "Phonemes"?

To further this work on voice-machine communication, James Elam is studying various techniques of speech analysis. In one scheme, recordings are made of voices reading words. These are then examined in their frequency spectrum, and a power within discrete bands is plotted. The plots, or spectrograms, are used to break down words into basic sounds called "phonemes." Each phoneme has a separate and distinct pattern and is capable of giving a clear signal. It is hoped that these signals can be used to communicate directly, through an audio input, with machines.

Fascinating Assignments

Because of its exciting future possibilities, James Elam finds his work fascinating.

If you would like to employ your talents in areas where exciting future possibilities are all part of a day's work, then you might consider the opportunities offered by IBM. When our representative comes to your campus, he will be glad to give you information about opportunities in research, development, manufacturing and other areas at IBM.

IBM®

INTERNATIONAL BUSINESS MACHINES CORPORATION

Your Placement Officer can tell you when an IBM representative will next visit your campus. Or you may write, outlining briefly your background and interests, to: Manager of Technical Employment, IBM Corporation, Dept. 846, 590 Madison Avenue, New York 22, New York.

Continued Growth Through Continued Reading – Never before has the young engineer's advancement been so dependent on consistent reading that broadens his viewpoint and keeps him abreast of developments in his own field.

No one has stated the case more concisely than did Francis Bacon in his famous quotation:

"Reading maketh a full man; conference a ready man; and writing an exact man. And, therefore, if a man write little, he had need have a great memory; if he confer little, he had need have a present wit; and if he read little, he had need have much cunning, to seem to know that he doth not."

It is sheer folly for any young engineer to take the attitude that because of the heavy demands on his time he just doesn't have time for serious reading anymore.

Admittedly the reading material now available to the young engineer is so voluminous that he must exercise discrimination in his selection of reading material. But it is a sure bet that if he can't manage to find time for reading that will keep him informed and make of him "a full man" he will never progress beyond the routine of his present job.

Writing Ability Can Make The Difference – Young engineers who have acquired the ability to turn out lucid, coherent papers and reports are so much in the minority today that their rapid advancement professionally is practically assured. On the other side of the ledger we find the many young men who appear blissfully unaware that lack of this ability can make the difference between a tremendously successful career and a very mediocre one.

Educators and business leaders alike are exhibiting increasing concern over the marked inability of many young engineers to write grammatically, spell, or punctuate correctly.

Bright young men entering industry's engineering programs today possess a high degree of facility in basic mathematics. However, a disturbing percentage of them are sadly lacking in ability to use language as a tool for reasoning and communicating.

One of our prominent educators, Dr. Eric A. Walker, president of Pennsylvania State University, has stated his conviction that this situation will not change until the professors – **all** the professors of **all** the courses – establish certain minimum standards for the students' written work and then make it clear to the students that violation of those standards is just as serious as violation of the basic principles of mathematics.

Dr. Walker says further that a program of this sort, if carried out conscientiously by the faculties of our engineering colleges, would soon make engineers the most literate of all professional groups in America today.

Failure to stress writing capacity early enough in the educational process has also been cited as a major cause of poor writing. Further, that the greatest trouble is with the written word – putting it down on paper. A college dean is quoted as saying, "You will find men who are very articulate orally who are shockingly incompetent in writing properly."

This situation is not likely to improve until aspiring young engineers are somehow made to realize the profoundly adverse effect that lack of writing skill can have on their own advancement professionally. And, most importantly, they must have the will and tenacity to do something about it.

P. B. Garrett – Publisher and Editor

Reprinted from Electric Light and Power, April 1, 1960

HILSCH TUBE

(Continued from Page 11)

must be used separately so as not to disturb the air flow. This means numerous changes during a particular run, and makes the experimental work tedious.

Dr. Lay's construction of the vortex tube from lucite gives him a good opportunity to study the flow patterns visually. Thus, he has injected various gasses and other materials into the tube. First Dr. Lay used smoke which showed up well at low pressures (thus low speeds), but at moderate or high pressures the smoke was invisible.

Next he tried balsa sawdust. It also did not show up well at high speeds. After balsa sawdust, fine confetti was tried, but in rubbing against the lucite, developed static electricity and clung to the walls of the tube.

The final and most successful method of flow visualization was to inject clear or colored water. First clear water was used, but in order to study the flow more thoroughly, Dr. Lay used colored water which could be photographed.

A major problem, says Dr. Lay, is to discover if there is a change of composition of the air as it splits up to leave either through the cool end or the warm end. He believes that no composition change takes place.

To date Dr. Lay and Bung Chung Lee have gathered most of the data needed from the experiment. Now comes the tremendous task of interpreting, and formulating theories about the effect.

STEAM CARS

(Continued from Page 12)

Actually, it's amazing the way the gasoline engine has been adapted to a purpose for which it isn't suited.

The steam engine is fundamentally a variable load and variable speed machine; this is shown by comparing it with a common horse. A horse can maintain a pull of about 120 pounds while walking three miles per hour, but when starting from a standstill he can exert up to 1,000 pounds if he has traction. Therefore, his starting effort or force is approximately 8½ times his running force. This shows that under certain conditions he can handle a load, for a short time, that eight horses would have a hard time hauling continuously.

If a steam engine has a full head of steam in the boiler, it can exert its maximum driving force almost instantly and for a while can continue to supply this driving force even though the output of power may be beyond the continuous capacity of the power plant. For example, a steam car with an engine rated at 20 horse power may exert as much as 85 horse power by drawing on its reserve steam.

The gasoline engine has no immediately available stored power other than that in the flywheel. The only way one can increase this power is by speeding up the engine. The greatest driving force the operator can utilize at any moment is that which the engine is capable of delivering at the speed it happens to be running.

This stored power in the steam car enables high torque at low speeds (½ to 5 mph) as compared to practically no torque at low engine speeds in the gasoline car. This means the operator has positive response in any driving situation.

The steam car is controlled by one valve and a reversing lever. The valve, or throttle, also stops the car at almost any desired rate.

There is no fuel or power wasted through idling, because the steam engine doesn't idle. The engine makes the same number of revolutions per mile while traveling at ½ or 70 miles per hour (if the wheels aren't slipping). Usually, the engine is geared to the axle at a 1 to 1 ratio.

A double acting two cylinder steam engine gets as many power impulses as an eight cylinder gasoline engine. A piston in a gasoline engine must go up and down twice for one power impulse; but when a double acting steam piston goes up and down twice, it has had four power impulses. The gasoline engine is run by explosions, but the steam engine's power comes from gently applied pressure giving uniform turning at any speed. There is complete lack of vibration, even at the highest speeds.

There is no smoky exhaust and the engine itself doesn't become contaminated with dust, gasoline or carbon.

The steamers have extraordinary acceleration and it sounds quite impossible today when we read that some of the old steams could go from 0 to 60 miles per hour in less than 5 seconds.

In view of all of these apparent advantages, why did the steam cars cease to exist? Is anybody doing anything to bring them back?

Russell A. Hill, retired machinist and inventor from Detroit, claims that the main disadvantage of steam was the use of water in the boiler. Also, many people were afraid that the boilers would blow up and sometimes they did.

Some of the old pot boilers were quite dangerous. If a small hole developed in one of them, there could be a bad explosion. Boiler designers decided to use tubes to reduce this hazard. The flash boiler could build up a head of steam in about thirty seconds, but it had no reserve power. The multi-tube boiler with horizontal and vertical tubes could burn out easily because the water could be pushed away from the heated region.

Hill has designed and copyrighted a safe boiler with diagonal tubes. There are twenty-four ¾ inch tubes 48 inches long connected to three 5 inch diameter headers, all of seamless steel tubing rated at 50,000 psi. It weighs 100 pounds as compared to the Stanley boiler which weighed about 400 pounds. There is approximately 125 feet of tubing as opposed to the 1,000 feet in the Stanley boiler. The Stanley pot boiler took twenty minutes to heat up; this design takes 1½ minutes for a head of 200 psi. Instead of using water in the boiler, Hill uses a mixture of glycol, water and steamer oil. Besides preventing freeze-ups, this mixture also lubricates the engine. Two boilers of Hill's design are now in use. One, in Massachusetts, has been driving a 2¾ ton Stanley for eight years. This car has cruised at 70 miles per hour for 75 miles without the boiler pressure falling below 700 psi. The other boiler has been driving a 20 horse power Stanley engine, installed on a converted Pontiac chassis in Texas, for four years. Both systems get about 17 miles per gallon of #2 fuel oil.

Hill and the Shaw Mercantile Co., San Francisco, California, hold patents in the U.S.A. and 6 foreign countries for a two cylinder double acting steam engine of Hill's own design, called the Hill-Alpha. Some of the features of the old Stanley engine are incorporated in it. The crankshaft incorporates a steel bar one inch in diameter, and mounts a counterbalanced crank at each end, 90 degrees out of phase. Four steel rounds called stanchions are run completely through the front and back plates on the cylinder heads. The stanchions of the old Stanley engine were just threaded into the bottom plate and often broke off. Cross heads slide on the stanchions which is adapted from a design used in the Worthington Hyde pump for over 50 years. The weight of the Hill-Alpha engine is 75 pounds; the Stanley weighed 300

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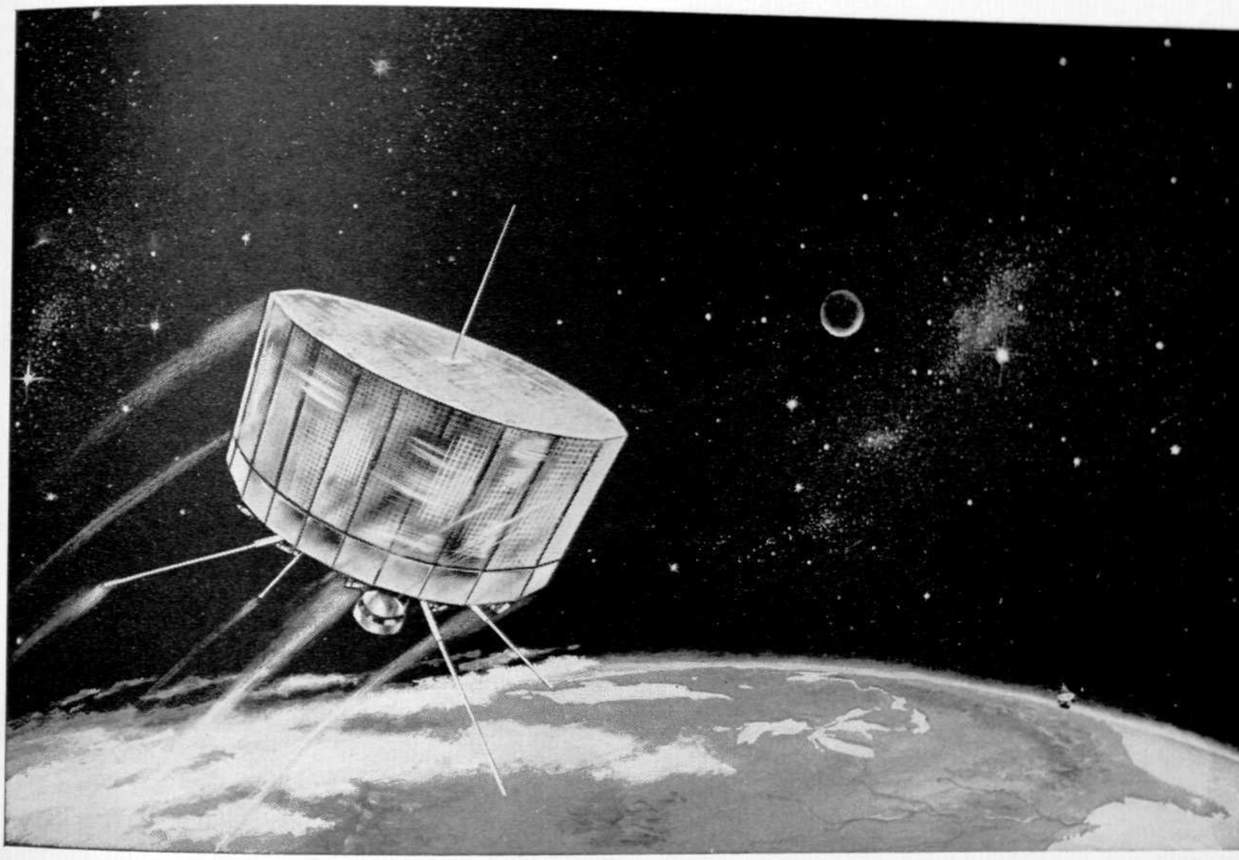


TIROS satellite orbiting towards ground station in Eastern United States.

RCA-BUILT "TIROS" SATELLITE REPORTS WORLD'S WEATHER FROM OUTER SPACE

As you read these lines, the most remarkable "weather reporter" the world has ever known hurtles around our globe many times a day, hundreds of miles up in outer space.

The TIROS satellite is an orbiting television system. Its mission is to televise cloud formations within a belt several thousand miles wide around the earth and transmit a series of pictures back to special ground stations. Weather forecasters can then locate storms in the making . . . to help make tomorrow's weather forecast more accurate than ever.

The success of experimental Project TIROS opens the door to a new era in weather forecasting—with benefits to people of all lands. This experiment may lead to advanced weather satellites which can provide weathermen with hour-by-hour reports of cloud cover prevailing over the entire world. Weather forecasts, based on these observations, may then give ample time to prepare for floods, hurricanes, tornadoes, typhoons and blizzards—time which can be used to minimize damage and save lives.

Many extremely "sophisticated" techniques and devices were required to make *Project TIROS* a success—two lightweight satellite television cameras, an infra-red horizon-locating system, complex receiving and transmitting equipment, and a solar power supply that collects its energy from the sun itself. In addition to the design and development of the actual satellite, scientists and engineers at RCA's "Space Center" were responsible for the development and construction of a vast array of equipment for the earth-based data processing and command stations.

Project TIROS was sponsored by the National Aeronautics and Space Administration. The satellite payload and ground station equipment were developed and built by the Astro-Electronic Products Division of RCA, under the technical direction of the U. S. Army Signal Research and Development Laboratory.

The same electronic skills which made possible the success of man's most advanced weather satellite are embodied in all RCA products—RCA Victor black & white and color television sets, radio and high-fidelity systems enjoyed in millions of American homes.

RCA THE MOST TRUSTED NAME IN ELECTRONICS

RADIO CORPORATION OF AMERICA

MISS MAY ENGINEER

Nancy Sessions

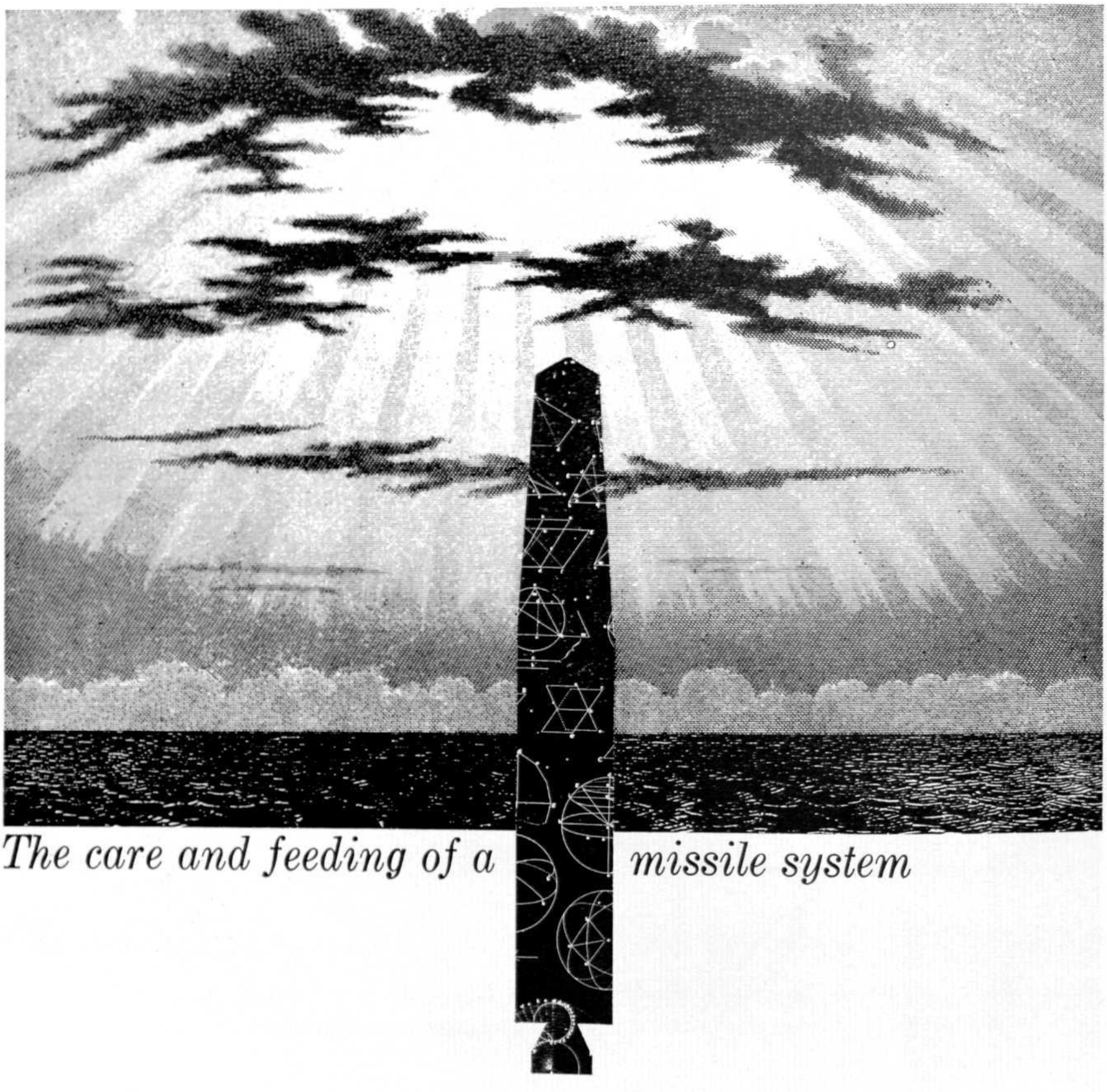
Hometown: Vicksburg, Michigan

Age: 21

Specs: 5′ 6½″
Brown Hair
Blue Eyes
36 - 25 - 37

Hobbies: Water Skiing
Swimming
All Sports

(Photos by Norm Hines)



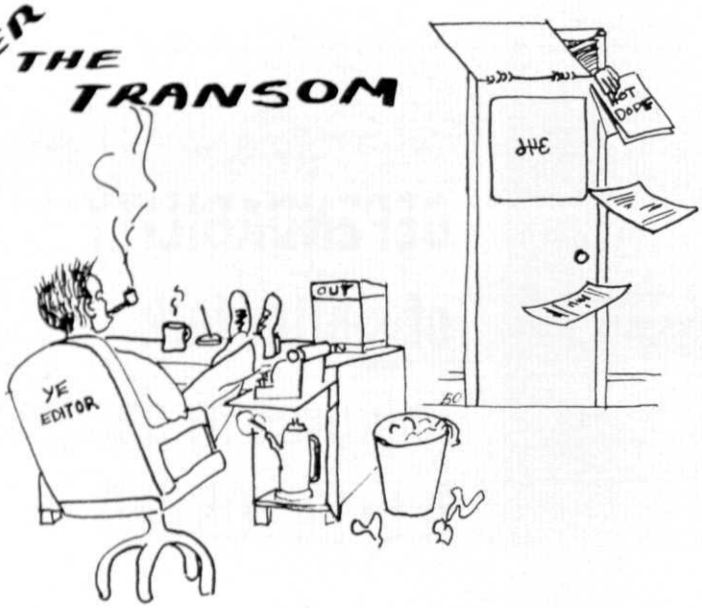
The care and feeding of a missile system

It takes more than pressing a button to send a giant rocket on its way. Actually, almost as many man-hours go into the design and construction of the support equipment as into the missile itself. A leading factor in the reliability of Douglas missile systems is the company's practice of including all the necessary ground handling units, plus detailed procedures for system utilization and crew training. This complete job allows Douglas missiles like THOR, Nike HERCULES, Nike AJAX and others to move quickly from test to operational status and perform with outstanding dependability. Douglas is seeking qualified engineers and scientists for the design of missiles, space systems and their supporting equipment. Write to C. C. LaVene, Box 600-X, Douglas Aircraft Company, Santa Monica, California.

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

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

OVER THE TRANSOM



1959—Engineering Bachelor Degrees From Colleges with ECPD Accredited Curricula

Aeronautical	1,363
Agricultural	443
Chemical	3,010
Civil	4,939
Electrical	9,837
General	668
Industrial	1,994
Mechanical	8,300
Metallurgical	710
Mining	213
Petroleum	683
All Others	1,535
Total	33,695
(From other Colleges)	4,429
Grand Total	38,124

Congratulations to the following Winter term four-pointers in engineering.

Seniors:

Elizabeth Buschlen
Edward Curtindale
James Eagan
John Engstrom
Phillip Fife
Charles Hansen
Robert Harger
Jon Hussey
John Sargent

Juniors:

Alvin Bailey
Galen Brown
John Hrinevich

Sophomores:

John Forsyth
James Ledvinka
Larry Osterink
Stanly Steinberg
Richard Synoradzki

Freshmen:

Raymond Eldridge

The American Society for Testing Materials will hold its biannial technical Photographic Exhibit in connection with its Apparatus Exhibit and Annual Meeting next June. They are particularly interested in student activity in the materials fields where photography, photomicrography, and electron micrography are important analytical and research tools. Anyone desiring further information contact J. D. Ryder, Dean of Engineering.

MILITARY SERVICE NEWS—The Scientific Manpower Commission has published an outline of ground rules on Selective Service and other regulations that are of particular concern to scientists and engineers. Intended as a general guide for employers and individual registrants that brochure "Critical Personnel and the Draft" can be obtained from SMC, 1507 M Street, NW, Washington 5, D.C.—single copy free, nominal cost in bulk. Assistance on indivdual problems can be obtained from both Commissions as a continuing service to industry and the professions.

Recent promotions in the Engineering Department, here at Michigan State University, include:

Tien Hsing Wu—Civil Engineering

Donald P. Brown—Agricultural Engineering

Bill A. Stout—Agricultural Engineering

Clement A. Tatro—Applied Mechanics

Karl L. Schulze—Civil Engineering

Henry Krause—Mechanical Engineering

Richard G. Pfister—Agricultural Engineering

These promotions are to the position of professor, and are effective July 1, 1960.

Also included in the above list is one of the *Spartan Engineer's* advisors, Denton D. McGrady.

A new appointment in the field of engineering was also announced by the Board of Trustees lately. Michael Erdei is to become an assistant professor of Electrical Engineering, May 9, 1960.

SELECTIVE SERVICE TESTS— The 1960 Selective Service College Qualification Test is scheduled for April 28. Last year only 5,258 students took this examination, the lowest number on record since the test was instituted. This was only 0.379% of the nonveteran male students population, which is estimated at approximately 1,385,000.

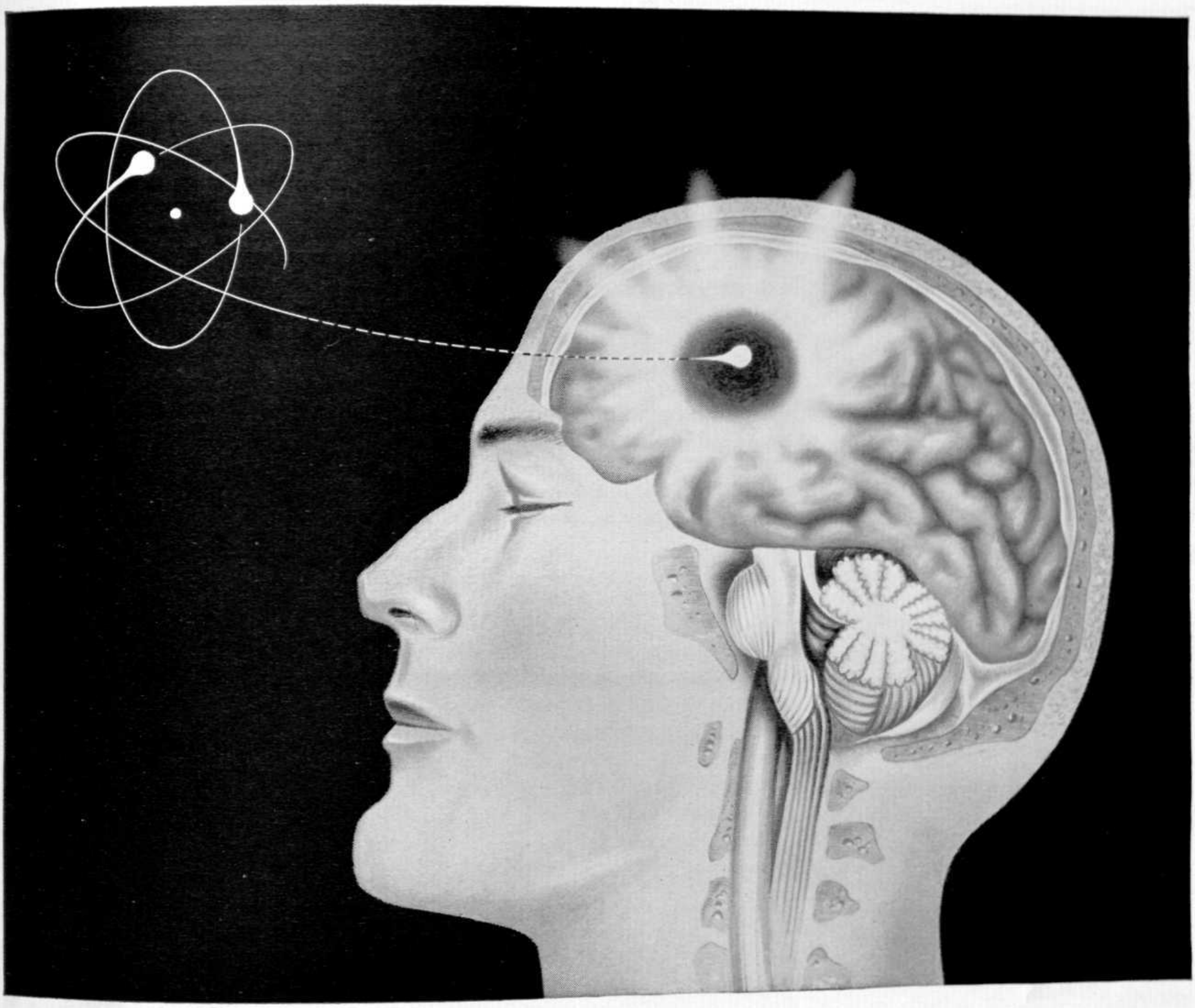
College administrators are urged to encourage undergraduates to take the test, especially if there is any possibility that they may enter graduate school. College graduates may qualify for deferment as graduate students if they stand in the upper quarter of the male graduates in the senior class, or if they get a grade of 80 or better on the SSQT. Since class standing is always problematical, taking the test is a worthwhile gamble. It does not commit the student in any way, nor does it extend his military liability.

ENROLLMENT FIGURES AT MSU COLLEGE OF ENGINEERING

For Fall Quarter (1959) there were 1616 undergrad students (including 18 women!) and 126 (4 women) graduate students registered in engineering. This included 530 (9 women) in freshman year.

S.A.E. REORGANIZATION

The Society of Automotive Engineers is reorganizing on the M.S.U. Campus. Any students desiring membership or information on their activities should contact Dr. Otto in Room One Olds Hall. Faculty members interested in this group might mention it in their classes.



Boron-10 vs. brain tumors

Physicians and scientists working in cancer research at Brookhaven National Laboratory, Upton, N. Y., are probing the use of Boron-10 isotope in treating a common type of brain tumor (glioblastoma multiforme).

Results of this therapy are so encouraging that Brookhaven and at least two other institutions are constructing additional nuclear reactors used in this therapeutic venture.

The method. In a technique known as Neutron Capture Therapy, the patient receives an injection of a Boron-10 compound. Cancerous tissue absorbs most of the neutrons.

In the split second that the Boron-10 becomes radioactive, it produces short-ranged alpha particles which destroy cancerous tissue with a minimum of damage to healthy tissue.

Producing the isotope. The plant furnishing Boron-10 to Brookhaven ordinarily turns out about three pounds during a 24-hour work day. Separation of the isotope takes place in what is described as "the world's most efficient fractionating system." In 350 feet of total height, six series-connected Monel* nickel-copper alloy columns enrich a complex containing 18.8% Boron-10 isotope to one containing 92% Boron-10.

Purification. To purify the 92% concentrate, a whole series of complicated processing steps are needed . . . including deep freeze. Columns, reboilers, condensers, vessels, pumps, and piping abound – each a constant challenge . . . both to the metal and to those concerned with equipment design and operation.

How would you meet such challenges? Some problems, of course, were unique and demanded ingenuity of a high order. But answers to most, 90% or more, could be found in the vast "experience bank" maintained by Inco . . . some 300,000 indexed and cross-referenced reports of metal performance under all manner of conditions.

Make a mental note: (1) that The International Nickel Company is a rich source of information on high-temperature and corrosion-resisting alloys; (2) that Inco makes this experience available to you.

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

STEAM CARS

(Continued from Page 24)

pounds. The bore is three inches and stroke six inches, and the indicated horse power at 1,000 rpm and 600 psi is 254.

Hill is making up a car with his boiler and engine for Shaw Mercantile Co., San Francisco, California, which is putting up the money. His goal is to make available to anyone a steam power plant that can be installed in conventional car bodies and chassis. The California firm plans to sell and install the complete system including gages, piping, etc.

The main advantages of steam over gasoline are the great reduction of parts needed and the higher torque at low speeds. The system Hill has designed has practically eliminated disadvantages among which were:

(1) Long time to raise steam.

(2) Danger of explosion (from pot boiler).

(3) Comparatively short life of boiler.

(4) Short water mileage (without condenser).

(5) Freezing problem in cold weather.

Many people believe that if as much time had been devoted to the development of the steam car as has been devoted to the development of the gasoline powered car that steam in the automobile would be a common thing today. Eventually, steam cars may come back and replace the internal combustion engine. Further developments in atomic power may boost this comeback. If it becomes practical to build small light weight atomic piles which would be cooled by water (same principle as atomic submarine) one would have an almost inexhaustible supply of heat. Cost of operation would be extremely low.

As he felt his way around the lamp post, the overloaded engineer muttered, "S'no use, I'm walled in."

° ° °

Four-year-old Bobby was stroking his cat before the fire. The cat began to purr loudly. Bobby gazed at her then suddenly seized her by the tail and dragged her away from the hearth. His mother said: "You must not hurt the kitty, Bobby."

"I'm not," he saiad, "but I've got to get her away from the fire. She's beginning to boil."

ROCKETRY

(Continued from Page 15)

which a wooden nosecone was fitted. The nosecone both streamlined the missile and held the radio antenna. Both the transmitter and the power supply were mounted on a light wooden frame that was slipped into the rocket.

In this experiment, we decided to limit the instruments to a 220 megacycle radio transmitter without a recovery system. The purpose of the test was to obtain information on whether the particular transmitter design would hold up under flight conditions and whether a narrow beamed signal could be received successfully during the short flight period. Most of the weight of the instrument section was due to the large batteries used to power the transmitter.

When completed, the X9-A stood slightly over five and one half feet tall and weighed 16½ pounds. About half of the weight was the propellant. The mass ratio, or the ratio of the weight of the fueled rocket to that of the empty shell was 2.06. Red and white stripes were painted around the motor tube to aid visual tracking.

The X9-A was taken to the flight area on April 26, 1958, the day of the firing. All plans as to order of firing, range layout and observer protection had been made out previously. Five qualified adults were on hand to supervise the firing.

The test ground was a rather desolate piece of land, four square miles in area, with one edge bordering on Lake Michigan. The shoot was to take place as early in the morning as possible to avoid high winds.

A blockhouse had been erected at a safe distance (at least 150 yards) from the launcher. It was constructed of railroad ties and reinforced with sandbags.

While the tracking and camera positions were being laid out, the firing area and blockhouse were checked. The launching rail was set at an angle of 88 degrees and the rocket put in position for loading. After everybody had reported in, the cameramen were allowed to photograph the rocket and launching setup. A pre-flight briefing insured that everybody knew his duty.

The firing area was cleared and two group members loaded the thrust chamber, a process consisting of sliding four propellant cartridges and an ignitor into the rocket and then bolting in the nozzle. The loaded rocket was then raised into firing position. A final check on the transmitter, and all was ready.

An elaborate countdown began, consisting mainly of interstation checks on the army surplus field phone system. A Very pistol was fired at X minus 30 seconds to alert tracking observers. At zero seconds, the switch was thrown. The X9-A rose rapidly at an acceleration of 45 gravities. Burning for 0.6 seconds, the motor pushed the rocket to a maximum velocity of 600 miles an hour. At 1000 feet, the instrument housing sheared off, causing the rocket to veer out over the lake. Although momentarily lost to view, it was soon seen moving in a nearly horizontal position. Peak altitude reached was about 3600 feet. Although the instrument section tumbled to the beach and was recovered, the spent thrust chamber landed about a mile offshore and was lost.

Now came the postflight inspection. This enabled us to determine what had caused the instrument section to shear off. One reason was that the heavy batteries had come loose. In turn, this set up such vibrations that the instrument section came loose. The batteries had pulled the radio to pieces, causing it to shut off during the flight.

Although the flight didn't appear to be successful to the average person, it supplied us with a great deal of information that would be useful in future tests. The flight had given our observers experience and the ground equipment a good testing. Besides the performance figures already stated here, we were able to get a wealth of information by examining movies and by mathematical analysis.

The flight of the X9-A illustrates that various things *can* go wrong in amateur rocketry, but through strict adherence to the proper safety rules, one can minimize the possibility of personal injury.

Editor's Note: The members of Morgan Park Rocket Society, through the proper approach to amateur rocketry have each learned a great deal about the principles of rockets and the ground equipment involved in their safe handling. The parents and advisors of the group also learned a great deal about rocketry. Several of the members have since gone into engineering. Some have as their goal, a position in the rocket industry.

IT'S LITERALLY ALL AROUND YOU!

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

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

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

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

SIKORSKY AIRCRAFT

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

ALUMNI NOTES

W. John Blyth ('38) and his wife Mary live at 251 Woodcrest Drive, Dearborn, Mich. He is a traffic superintendent for Michigan Bell Telephone Co. in Detroit.

* * *

Douglas E. Lake ('38) is a project engineer for the Dow Chemical Company in Midland. He lives at 3802 Devonshire St., Midland, Mich.

* * *

Robert W. Spinner ('40) is a staff engineer for Buick Division in Flint. His address is 2875 Hickory Grove Rd., Bloomfield Hills, Michigan.

* * *

Stuart Beekman ('41) is a manager in the jet engine department of General Electric in Evendale, Ohio. He lives in Cincinnati at 1235 Laurence Road.

* * *

W. Mack Finlan ('41) is a senior project engineer for Eastman Kodak in Rochester, N. Y. His address is 191 Denise Road.

* * *

John J. Shanahan ('41) is a sales engineer for Babcock & Wilcox Co. in Boston, Mass. He lives at 12 Bonagl Rd., Winchester, Mass.

* * *

Robert G. Parkhurst ('43) is manager in industrial electronics sales for International GE.

* * *

George H. Dye ('47) writes from 1367 Academy Lanes, West Englewood, N. J.

* * *

Donald E. Bennett ('48) is an engineer for Consumers Power Company in Jackson. He lives at 729 Christy.

* * *

Rudolph A. Jacobs ('48) is senior engineer for RCA's astronautic division at Princeton, N. J. His address is 616 W. County Line Rd., Lakewood, N. J.

* * *

Mac Rand ('48) is sales manager for the National Carbon Company in San Francisco. He and his wife Shirley live at 181 Avalon Dr., Los Altos, Calif.

* * *

Dart L. Ridenour ('50) is vehicle department superintendent for the Pittsburgh Plate Glass Corporation in Torrance, Calif. His address is 4684 Banner Dr., Long Beach, Calif.

Robert C. Patterson ('49) is vice president of a contracting firm in Buffalo, N. Y. His address is 43 Keats Ave., Tonawanda, N. Y. He has four children.

* * *

Wilbur A. Kurtz ('29) was recently elected president of B. O. Vannort Engineer, Inc., a firm of consulting engineers in Charlotte, N. C. He had been senior vice president and chief engineer for a number of years. His address is 1024 Sewickley Drive.

* * *

John A. Henry ('30) writes from 702 W. Ohio, Urbana, Ill. His son is a sophomore at the University of Illinois but is giving serious consideration to MSU's hotel management course. "If he does so, I shall be forced to become a more interested alumnus."

* * *

Marshall F. Parsons ('30) is a plant engineer for Textile Machine Works in Wyomissing, Pa. His address there is 5 Woodland Road.

* * *

R. O. Abel ('31) is a road design engineer for the Michigan State Highway Department. His address is 1314 Wood St., Lansing, Michigan.

* * *

Ivan C. Hepfer ('32) is president and general manager of the Furniture City Plating Company in Grand Rapids. His address is Rt. 1, Caledonia, Michigan.

* * *

William Sanders ('52) is an electrical engineer for the Bendix Aviation Corporation in Detroit. He lives in Pontiac at 780 E. Square Lake Road.

* * *

Bertrand Farber ('53) is a senior engineer at Sunstrand Turbo in Pacoima, Calif. His address there is 9719 Varna Ave.

* * *

William W. Hamilton ('55) is senior engineer at the Martin Company in Denver, Colo. He and his wife Carrie have two sons and live at 3651 S. Cherokee, Englewood, Colorado.

* * *

Ronald Friedmon ('57) is a research metallurgist at the Ford Motor Company in Detroit. He and his wife Joan live at 22735 Floral, Farmington, Mich. They have a son, Steven Douglas, born March 9, 1959.

GEMS

(Continued from Page 17)

appreciably slowed down. This information was extremely valuable for it proved there was a point at which conversion of diamond to graphite could be stopped. If this point could be found, artificial production would be feasible. Perhaps this could be done by raising the pressure and temperature to much higher levels. It was at this time that the General Electric people began basic research.

Work was in progress for a few months, but because of World War II the project was pigeonholed. Remarkable advancements in all fields during the war years, especially theoretical, made it feasible to predict the rate of transfer of graphite to diamond more precisely than ever. General Electric, in 1950, forecast that the Jessep-Rossini data must be revised upward in order for transformation to occur. The new estimate raised pressures to 3,000,000 pounds per square inch and the temperature to 7000°F. Thus the long struggle up the thermodynamic hill to the transformation point would require the best ingenuity and talent to prescribe a method to make the reaction go to completion.

Under the guidance of Dr. Guy Suits and with the aid of a new 1000 ton hydraulic press, experiments began. Although work was slow, it was soon found that the press was not capable of attaining the required pressures through concentration of the total output on a small area. The maximum performance was about 1,500,000 pounds per square inch, whereas 3,000,000 pounds pressure were required. Investigating along other lines, so that this disadvantage could be overcome, they employed an old chemical trick; a catalyst.

A catalyst is a substance which when added to reactants affects the rate of chemical change or reaction and yet may be recovered, itself unchanged, at the end of the reaction. Probings into the characteristics of several available catalysts, revealed that if a catalyst film was spread over the basic reactant, graphite, it would lower the temperature and pressure sufficiently so that reaction may be accomplished with the available equipment. The reduced pressure was between 800,000 and 1,800,000 pounds and the temperature between 2200 and 4400 degrees.

(Continued on Page 36)

GEMS

(Continued from Page 34)

The exact role that the catalyst plays is still a stubborn mystery. As nearly as can be figured out, at diamond-forming temperatures, the thin film of the metal catalyst exists as an interface between the unconverted carbon and the diamond crystal that is formed. The diamond always forms on the side of the catalyst film away from the carbon. Should a break appear in the film, diamond formation stops completely. Some of the catalyst films that have been effective are chromium, rhodium, palladium, cobalt, nickel, iridium, tantalum, and platinum. Each catalyst has special properties and will give the diamonds a particular characteristic.

With the catalyst, hydraulic press, and high-temperature-producing equipment, the procedure is almost complete, except for the significant device which holds the reaction. Such a device must be capable of withstanding extensive pressure and temperature and yet, allow a reaction to take place within. Such a mechanism was labeled "the belt" by the research staff. The belt is a spherically built donut chamber composed of several stress binding rings. The conical shaped pistons from the press induce its force upon the rings. The assembly for the production of diamonds is placed within the chamber. This consists of a holder for the graphite and catalyst, gaskets, and a current transmitting element.

The most important part of the assembly is the gaskets, for they restrict the fantastic pressure to the inside of the holder. The substance used for this purpose is prophyllite, a naturally occurring mineral (Aluminum silicate). This compound has some unique properties which make it adaptable to this process. First, at normal conditions the silicate melts at 2400 degrees, but under the extraordinary conditions it melts at 4800 degrees. Secondly, the substance can act as an insulator, both thermally and electrically, because the material is able to transmit the pressure of the piston enabling it to remain cool from the electrical heating device, thus prolonging strength and lifetime.

The mechanism is now complete and in early 1955 the first diamond was produced. Today they are being produced at substantial rates for industrial use. Since the diamonds are not of gem quality (that is they have flaws and are very small) they are being put to use for such things as resin-bonded abrasion wheels, and diamond-headed machine tools.

One interesting feature to note is that diamonds can be tailored to meet specific needs. You can get diamonds in assorted crystal shapes by varying the temperature. For instance, at low temperature, cubes are formed predominantly. Intermediate temperatures yield mixtures of cubes, octahedra, dodecahedra. Only octahedra are formed at high temperatures. Color can also be regulated; black low temperature, through dark green, light green, yellow, to white at high temperatures. Hardness is regulated in the same manner.


what is
magnetism?
S
N
An orientation to home?
Domain orientation?
The secret of a lodestone?
The cosmic ray accelerator?
An aspect of a unified field?
Fundamental to Allison's business —energy conversion—is a complete familiarity with magnetism in all its forms. This knowledge is essential to our conversion work.
Thus we search for a usable definition of magnetism—not only what it is, but why it is. And to aid us in our search, we call upon the capabilities within General Motors Corporation and its Divisions, as well as the specialized talents of other organizations and individuals. By applying this systems engineering concept to new research projects, we increase the effectiveness with which we accomplish our mission—exploring the needs of advanced propulsion and weapons systems.
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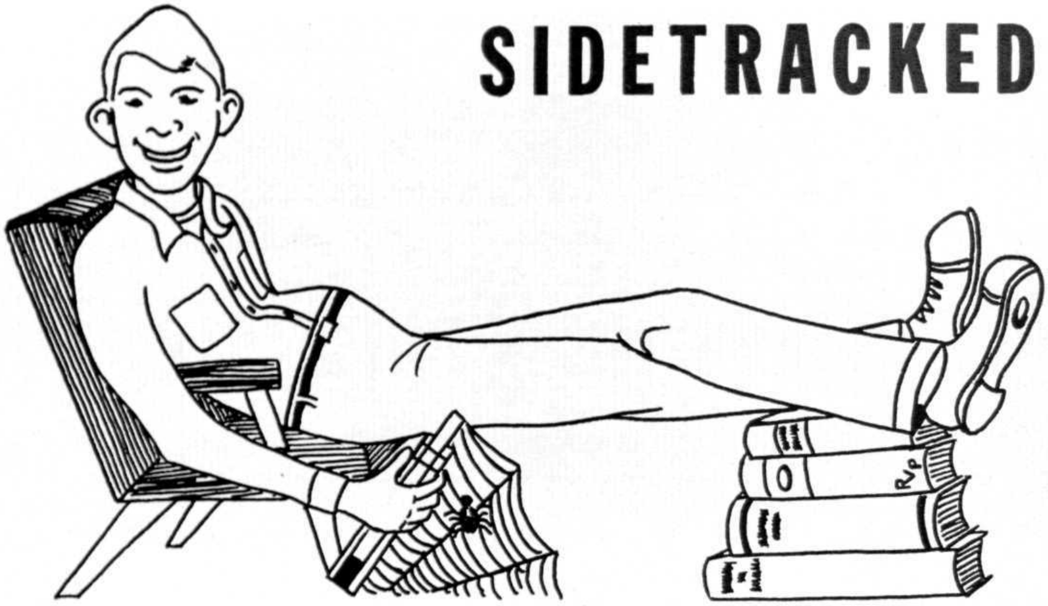


SIDETRACKED

"Who ever told that guy he was a prof? He might know it but he can't teach it. The trouble is that he is too far advanced. Every time he tries to explain something, he gets so far off the subject that no one understands anything about it. He oughta go back to the farm, or try teaching a more advanced course."

"Yeah, I flunked the course, too."

° ° °

Salesman: "Sir, I have something here that's guaranteed to make you the life of the party, allow you to win friends and influence people, help you forge ahead in the business world, and in general make life a more pleasant place and invigorating experience."

Engineer: "I'll take a quart."

° ° °

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

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

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

° ° °

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

° ° °

Then there is the sad story of the EE who went nuts trying to hook up a Laplace transformer.

° ° °

Chem. Prof.: "I'll bet you wish I were dead, so you could spit on my grave."

Chem.E.: "No, sir; I hate to stand in line."

No man is completely worthless—he can always serve as a horrible example!

° ° °

Some people have read so much about the harmful effects of smoking that they have decided to give up reading.

° ° °

I come from a small town. They won't allow you to use electric razors there. When you plug 'em in all the trolley cars stop.

° ° °

E.E.: "I know all about electricity. A politically minded ion hears that there is going to be an electron, so he goes to the poles and volts."

° ° °

And there was the heart-rending case of the man who spilt a whole bottle of hair restorer on his head and smothered before he could get to a pair of scissors.

° ° °

Sigma Phi: "Are you the barber who cut my hair last time?"

Barber: "I don't think so. I've only been here six months."

° ° °

She was the "Honey-Chile" in Dallas,
The sweetheart of the bunch,
But on the old expense account,
She was beer, cigars and lunch.

° ° °

Northern visitor: "Zeke, don't the mosquitoes bother the colonel?"

Body Servant: "No, sah, de furst part of de night de kernel is too full to pay 'tenshun to de skeeters; and de last part of de night de skeeters is too full to pay any 'tenshun to de kernel."

Pilot to Navigator: "What is our present position?"

Navigator to Pilot: "Due to my extensive training in calculus and trigonometry, I have calculated our position to be seven miles due south of infinity."

° ° °

Skidding is the action.
When friction is a fraction
Of the verticle reaction
Which won't result in traction.

° ° °

1st E.E.: "Take hold of that wire."
2nd E.E.: "This one? Okay."
1st E.E.: "Feel anything?"
2nd E.E.: "Nope."
1st E.E.: "Then don't touch the other one. It's carrying 3,000 volts."

* * *

Prof. "When the room settles down I'll begin my lecture."

Engineer: "Why don't you go home and sleep it off?"

* * *

A true lover of music is a man who, upon hearing a soprano voice in the bathroom, puts his ear to the keyhole.

* * *

"Do you know what good clean fun is?"

"No, what good is it?"

* * *

And then there was the freshman so dumb that he thought a logarithm was a lumber camp song.

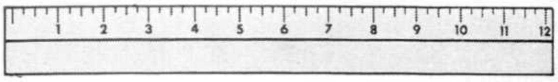
* * *

"Carry your bag sir?"
"No, let her walk."

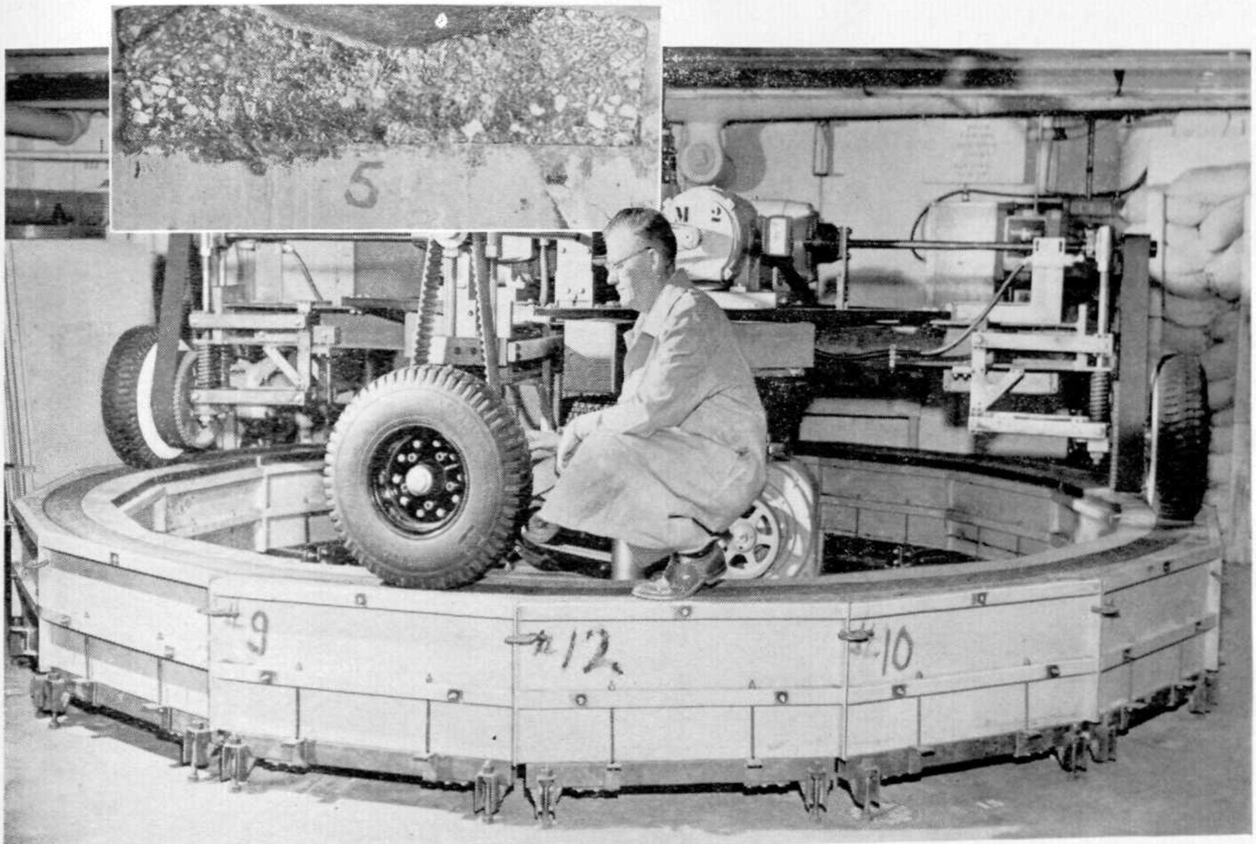
* * *

Typist: "But professor, isn't this the same exam you gave last year?"

Professor: "Yes, but I've changed the answers."



ONLY 12 INCHES WIDE...



Tom Speer, Senior Engineering Research Supervisor at Standard Oil, inspects one of the 12 sections in a new miniature road tester. Under simulated weather conditions, four wheels whirl around to reveal wear patterns and other vital information. (INSET) Ruler shows wear pattern after strip has taken pounding from tires during rain, freeze, thaw and heat.

...THIS 'ROAD' CARRIES

WORLD'S HEAVIEST TRAFFIC!

Say good-bye to washboard pavements and chuck holes—their doom may be sealed!

Key weapon in the war on costly road damage is a new miniature highway developed in the Standard Oil research laboratories in Whiting, Indiana. It is only 12 inches wide and 44 feet in circumference, but it carries heavier loads than any highway in the world. This Tom Thumb turnpike will eventually lead to methods of building longer-lasting, smoother, safer highways...at far less cost to taxpayers.

Four wheels whirling around hour after hour can give it any degree of traffic intensity desired. Pressure that corresponds to the weight of the heaviest trucks can be applied to the wheels. To simulate actual traffic, the wheels are placed on braking and acceleration 90 per cent of the time. Automated electronic equipment can quickly change "road conditions" from desert dry to cloudburst drenched. "Road conditions", too, can be changed from freezing to thawing.

Within weeks, the new test-tube roadway can determine what happens to roads during years of use in all kinds of weather. It can pretest paving formulas and techniques, and may show how to eliminate washboard pavement and chuck holes. Savings in highway research alone may run into millions of dollars. Even larger savings in auto and road repairs and possibly in gasoline taxes are in sight.

This test-tube roadway is just one of the many exciting developments at Standard. Every day, scientific research, pure and applied, points the way to new or improved products. This work holds great challenge and satisfaction for young men who are interested in scientific and technical careers.

STANDARD OIL COMPANY

910 SOUTH MICHIGAN AVENUE, CHICAGO 80, ILLINOIS

STANDARD

THE SIGN OF PROGRESS... THROUGH RESEARCH

TEN PILLARS OF YE STUDENTE ENGINEERS

1. Verily, I say unto you, bring ye volumes of manuscript as tribute unto the master of the Laboratory of Power, lest he unleash upon you his mighty fury. Remember well that he withholdeth the "A" as a mighty jewel, but lavisheth the "F" without mercy.

2. Be ye not present at the Place of Joe; neither be ye found at the Taverne of Kenneth on the eve of the great inquisition, lest thou appear for interrogation with fogged mind and blurred vision. Such appearance extracts not sympathy from the department head—neither will his staff comfort thee.

3. Thou shall diligently burn thy candle in the evening—yea, even unto the crowing of the cock, lest thy master be displeased with thine efforts.

4. Make thy comma and thy semicolon trusted friends unto thee. May they assist thee in traversing the province of Thomas the Blackhearted unscathed.

5. When thy master uttereth the big joke, be ye filled with mirth; when he smileth not, make thy countenance like unto stone.

6. Park not thy carriage in the stables of the Lords and Nobles —lest the constabularly confiscate thy silver and thy property—yea, even will they curtail thy personal liberties.

7. Be ye not tardy in returning thy fair damsel to the Hall of Currier; may thou never experience the wrath of the Keeper of the Harem.

8. Beware of the "Blind Date," she accepteth thy cigarettes and beer and squandereth thy shekels and promiseth unto thee mighty things that she will give to thee—yet she giveth only her thanks.

9. Be not first—nay, be thou not even early unto thy class; neither be ye the last to leave—nor may thou engageth in discourse with thine instructor lest thou incur the condemnation of thy fellow peons.

10. Prepare thee well for thy day of judgment; know ye that thy masters punish with impunity.

My children, endear these maxims to thine heart. Enter upon thy journey with the opened eye and closed mouth; tread with light step and never-ending vigilance. Keep thy sliding rule ever ready to fend off the attacks of the inquisition. May it please Allah that thou may succeed. Godspeed!

JETS

(Continued from Page 18)

Even after seeing the projects completed by these students, some people might raise the question, "How does this really affect our scientific developments?" Obviously, the program does teach the students to be more creative and gives them a good scientific background. However, the program is not meeting its ultimate goal unless these JETS members continue their scientific work. The clubs *are* meeting their goal. A recent survey showed that ninety-one percent of all JETS graduates have entered a college or university and sixty-four percent of the total enroll as engineering students. Many of these students are recipients of the JETS scholarships.

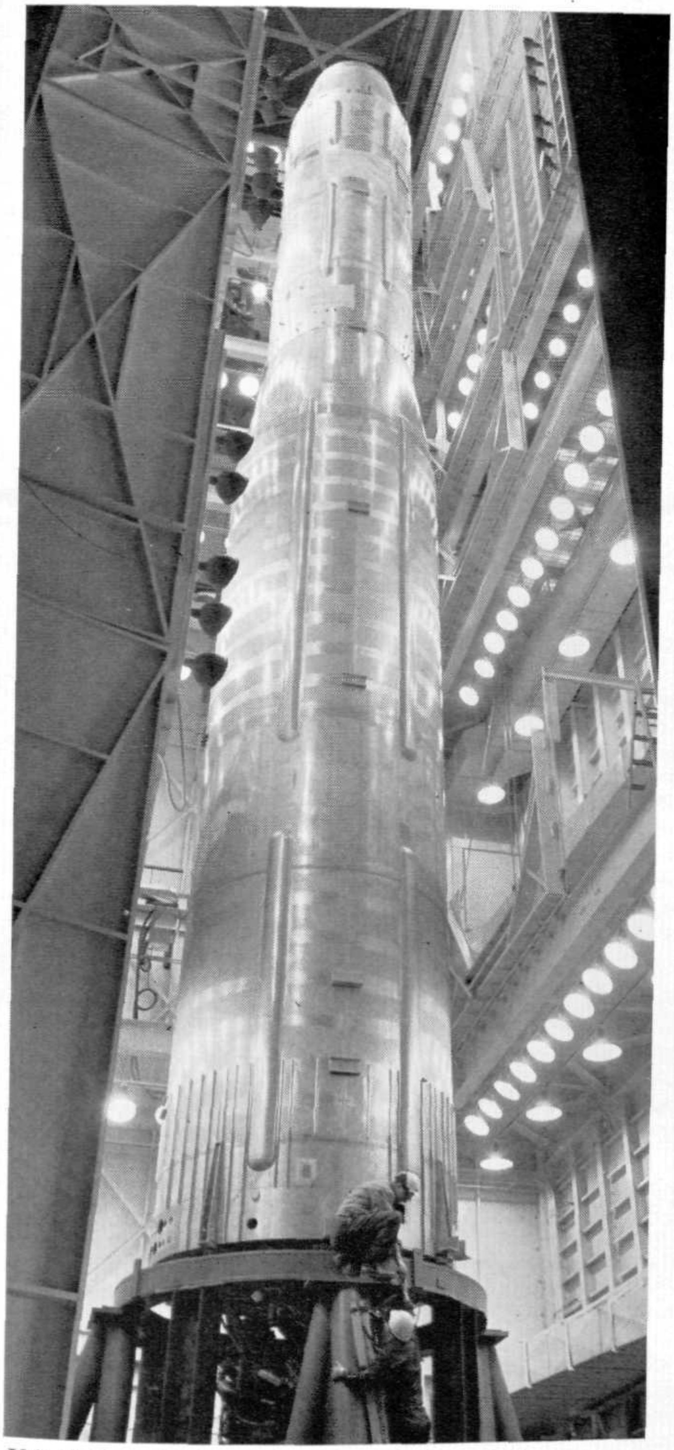
Yes, JETS is meeting the challenge offered by a modern technological society! Creativity is being inspired and the members are having fun, too.

As an engineering or science student, you are in an excellent position to assist the JETS program. Every two weeks, a new academic unit is needed. If you are interested in learning more about JETS or wish to help in any way, write to JETS Inc., Box 589, East Lansing, Michigan.

ADVERTISERS' INDEX

If your sights are set 

on outer space–



U.S. Air Force I.C.B.M. "Titan" shown in the vertical test laboratory at the Martin Company, Denver, Colorado.

–you'll find

Photography at Work

with you.

From the time a scientist's mind first sparks an idea for exploring space, photography gets to work with him. It saves countless hours in the drafting stage by reproducing engineers' plans and drawings. It probes the content and structure of metals needed by photomicrography, photospectrography or x-ray diffraction. It checks the operation of swift-moving parts with high-speed movies—records the flight of the device itself—and finally, pictures what it is in space the scientist went after in the first place.

There's hardly a field on which you can set your sights where photography does not play a part in producing a better product or in simplifying work and routine. It saves time and costs in research, in production, in sales and in office routine.

So in whatever you plan to do, take full advantage of all of the ways photography can help.

CAREERS WITH KODAK:

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

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

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Kodak

TRADEMARK

One of a series

Interview with
General Electric's Byron A. Case
Manager—Employee Compensation Service

Your Salary at General Electric

Several surveys indicate that salary is not the primary contributor to job satisfaction. Nevertheless, salary considerations will certainly play a big part in your evaluation of career opportunities. Perhaps an insight into the salary policies of a large employer of engineers like General Electric will help you focus your personal salary objectives.

Salary—a most individual and personal aspect of your job—is difficult to discuss in general terms. While recognizing this, Mr. Case has tried answering as directly as possible some of your questions concerning salary:

Q Mr. Case, what starting salary does your company pay graduate engineers?

A Well, you know as well as I that graduates' starting salaries are greatly influenced by the current demand for engineering talent. This demand establishes a range of "going rates" for engineering graduates which is no doubt widely known on your campus. Because General Electric seeks outstanding men, G-E starting salaries for these candidates lie in the upper part of the range of "going rates." And within General Electric's range of starting salaries, each candidate's ability and potential are carefully evaluated to determine his individual starting salary.

Q How do you go about evaluating my ability and potential value to your company?

A We evaluate each individual in the light of information available to us: type of degree; demonstrated scholarship; extra-curricular contributions; work experience; and personal qualities as appraised by interviewers and faculty members. These considerations determine where within G.E.'s current salary range the engineer's starting salary will be established.

Q When could I expect my first salary increase from General Electric and how much would it be?

A Whether a man is recruited for a specific job or for one of the principal training programs for engineers—the Engineering and Science Program, the Manufacturing Training Program, or the Technical Marketing Program—his individual performance and salary are reviewed at least once a year.

For engineers one year out of college, our recent experience indicates a first-year salary increase between 6 and 15 percent. This percentage spread reflects the individual's job performance and his demonstrated capacity to do more difficult work. So you see, salary adjustments reflect individual performance even at the earliest stages of professional development. And this emphasis on performance increases as experience and general competence increase.

Q How much can I expect to be making after five years with General Electric?

A As I just mentioned, ability has a sharply increasing influence on your salary, so you have a great deal of personal control over the answer to your question.

It may be helpful to look at the current salaries of all General Electric technical-college graduates who received their bachelor's degrees in 1954 (and now have five years' experience). Their current median salary, reflecting both merit and economic changes, is about 70 percent above the 1954 median starting rate. Current salaries for outstanding engineers from this class are more than double the 1954 median starting rates and, in some cases, are three or four times as great.

Q What kinds of benefit programs does your company offer, Mr. Case?

A Since I must be brief, I shall merely outline the many General Electric employee benefit programs. These include a liberal pension plan, insurance plans, an emergency aid plan, employee discounts, and educational assistance programs.

The General Electric Insurance Plan has been widely hailed as a "pace setter" in American industry. In addition to helping employees and their families meet ordinary medical expenses, the Plan also affords protection against the expenses of "catastrophic" accidents and illnesses which can wipe out personal savings and put a family deeply in debt. Additional coverages include life insurance, accidental death insurance, and maternity benefits.

Our newest plan is the Savings and Security Program which permits employees to invest up to six percent of their earnings in U.S. Savings Bonds or in combinations of Bonds and General Electric stock. These savings are supplemented by a Company Proportionate Payment equal to *50 percent* of the employee's investment, subject to a prescribed holding period.

If you would like a reprint of an informative article entitled, "How to Evaluate Job Offers" by Dr. L. E. Saline, write to Section 959-14, General Electric Co., Schenectady 5, New York.

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