SPARTAN Engineer

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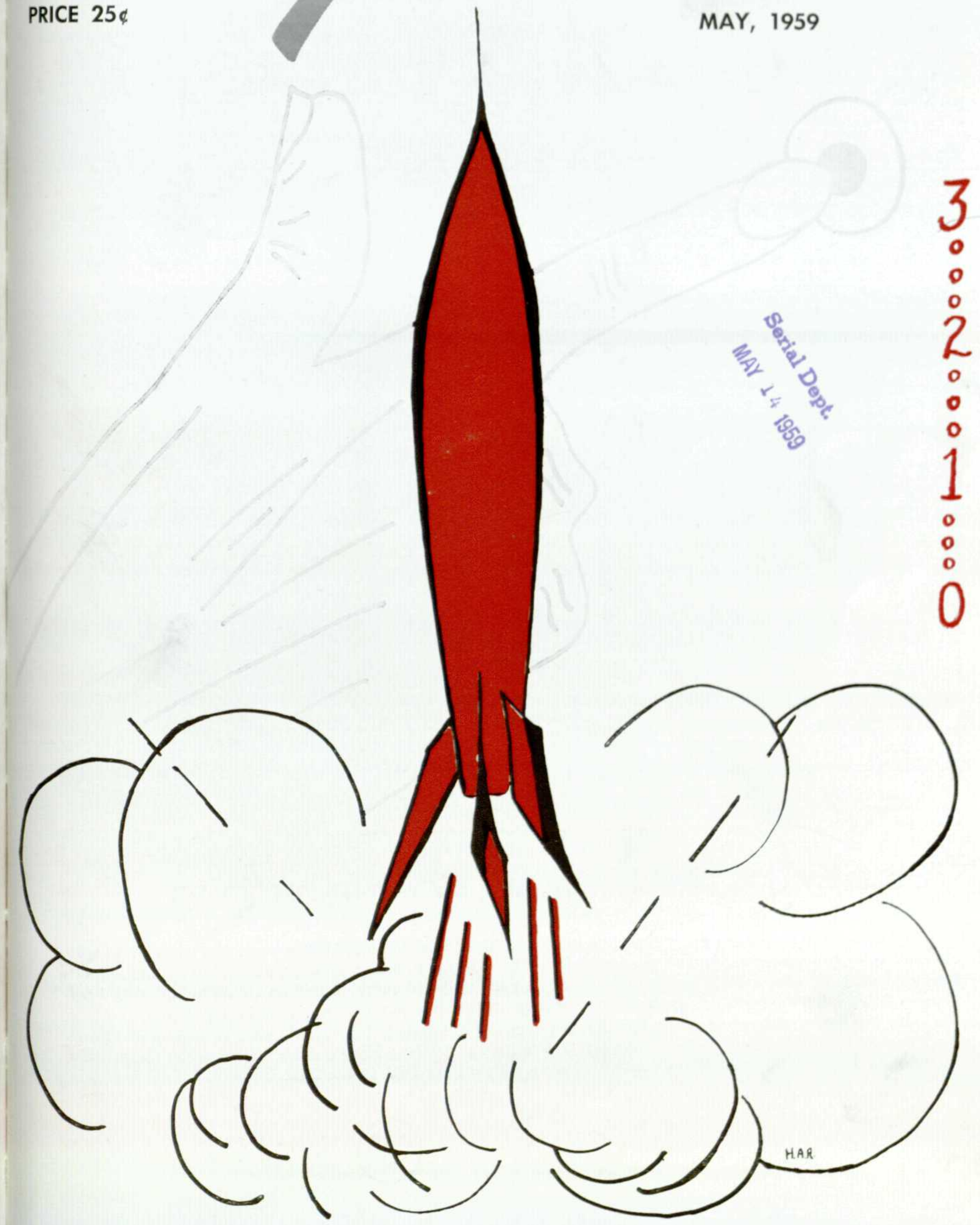

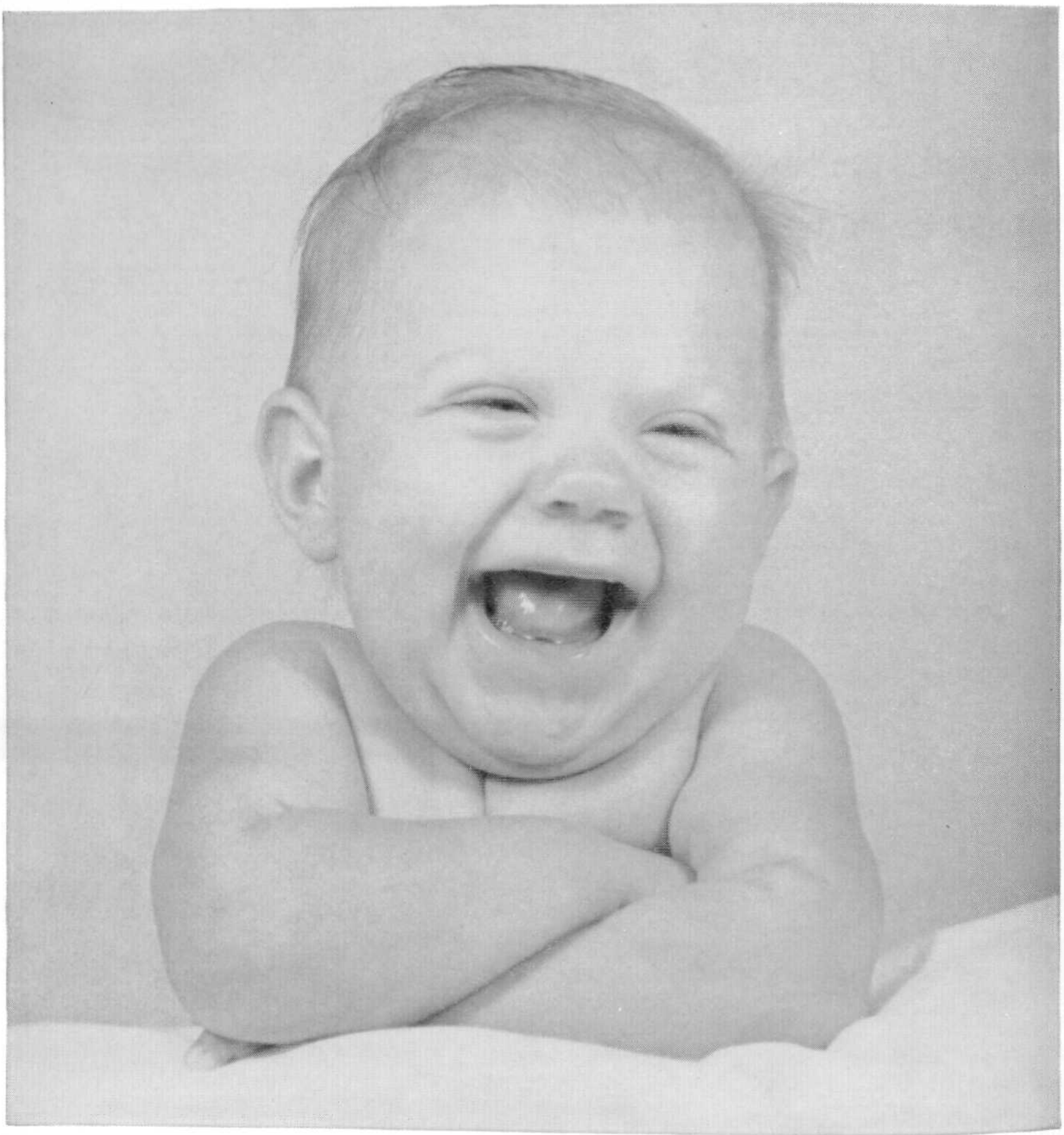

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Dean's Letter

THIS is a message to Seniors, about to graduate, whether in high school or in college. You are faced by an abrupt change in your life—leaving home and a close-knit circle of friends to enter a college, or the breaking of college bonds and the entry to the cruel cold world of reality where the pay is in checks rather than grades. You may be realizing that several years ago, as sophomores you went over the top of a curve, a peak in your own opinion of your own knowledge and that you have been knowing less while studying more ever since! Perhaps this reversal of your opinion has been aided by a few grades in advanced thermo, fluid mechanics, and electrical field theory or their high school equivalents. Are you doing a little second guessing—wishing you had taken that extra course in psychology, or economics, or mathematics, or social studies? With graduation imminent, perhaps you are counting up the many missed opportunities, or realizing that actually the whole field of learning really lies ahead of you.

This is being written to reassure all those having such doubting thoughts. It is probably true that you have missed opportunities, and we are sure you could have made several better grades, and could have profited by those additional courses—but you are still good students—those who went before missed the same opportunities and succeeded—and so will you.

The pre-graduation let-down is natural and good, since it tends to make one a bit more humble in facing the new job, and humility on the part of the new employee or the college freshman is much to be admired. This let-down is natural and we have all gone through it—but make use of this period to resolve that you will correct those deficiencies of which you are now aware—and miss no more opportunities to continue to learn—this is the path to engineering success.

Again may I offer reassurance: I am told that after retirement and as you approach seventy or seventy-five, you again repeat the cycle and realize that after a full lifetime you have learned so little.

Thus do we seem to prove that "What is Past is Prologue."

J. D. Ryder, Dean

MEMBER, ENGINEERING COLLEGE
MAGAZINES ASSOCIATED

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Spartan Engineer

of michigan state university

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FEATURES

DEPARTMENTS

COVER: The cover for this month's issue of Spartan Engineer was drawn by Hester A. Ray, a member of our staff. The cover tries to project the idea of the engineer behind the advances being made in technology today. It's a salute to today's, and tomorrow's engineers.


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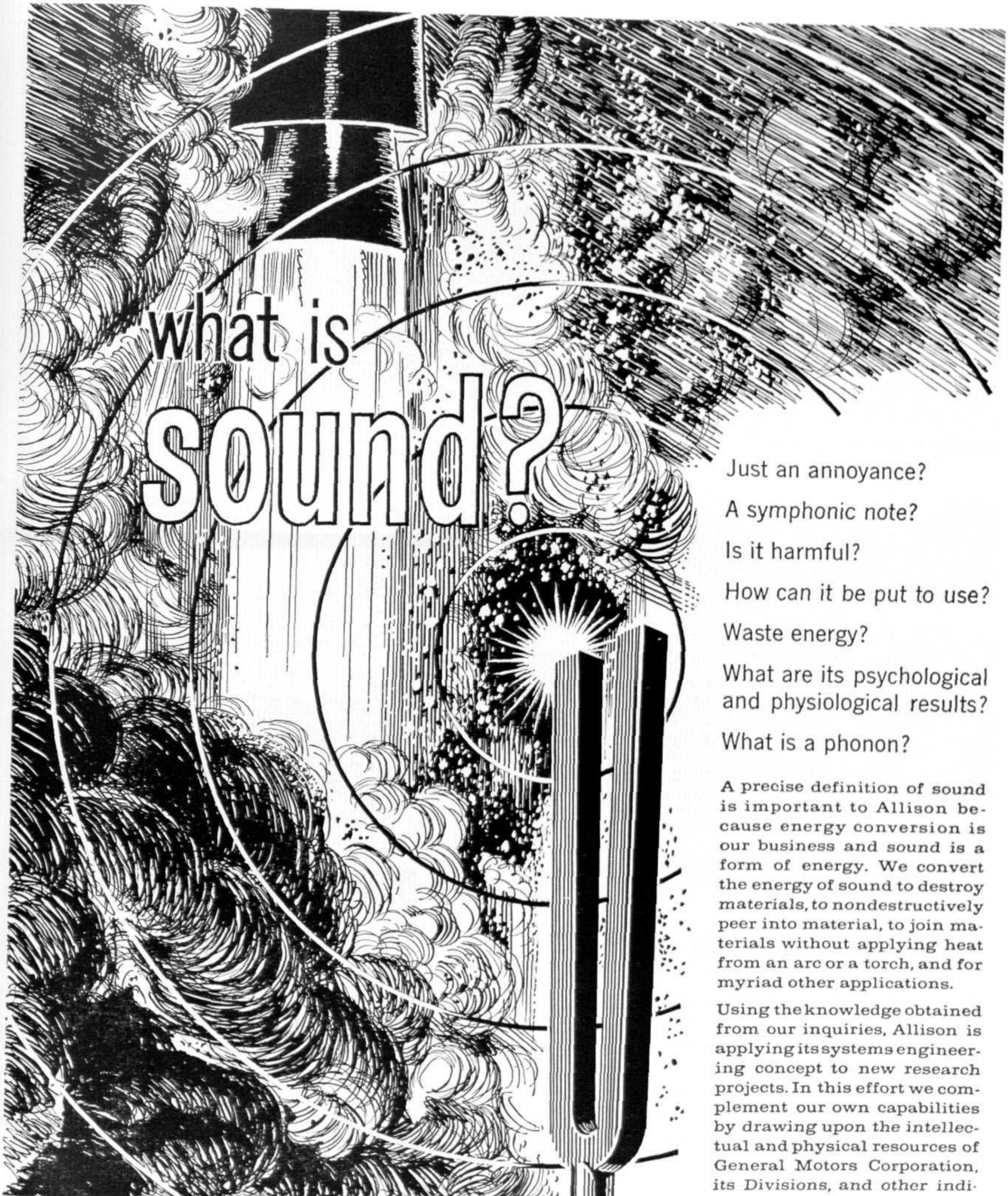
what is
sound?

Here's how PPG research put more FUN in boating

Take your pick—water skiing, skin diving, or just skimming along the surface. Afloat, boats mean fun. But there's a big difference ashore. Some boats demand wearisome hours of work—caulking, repainting, replanking. And here's where PPG•research comes in. Thanks to hulls made from PPG Selectron® and Fiber Glass, boat owners never have to worry about upkeep and costly repairs. PPG Fiber Glass hulls can't peel, can't rot or corrode. And what a beating their one-piece construction can take! There are no seams. No nails. No screws. No rivets to rust or loosen. There's new styling freedom, too. Boats of PPG Fiber Glass can take any shape, yet they're strong, light and durable.

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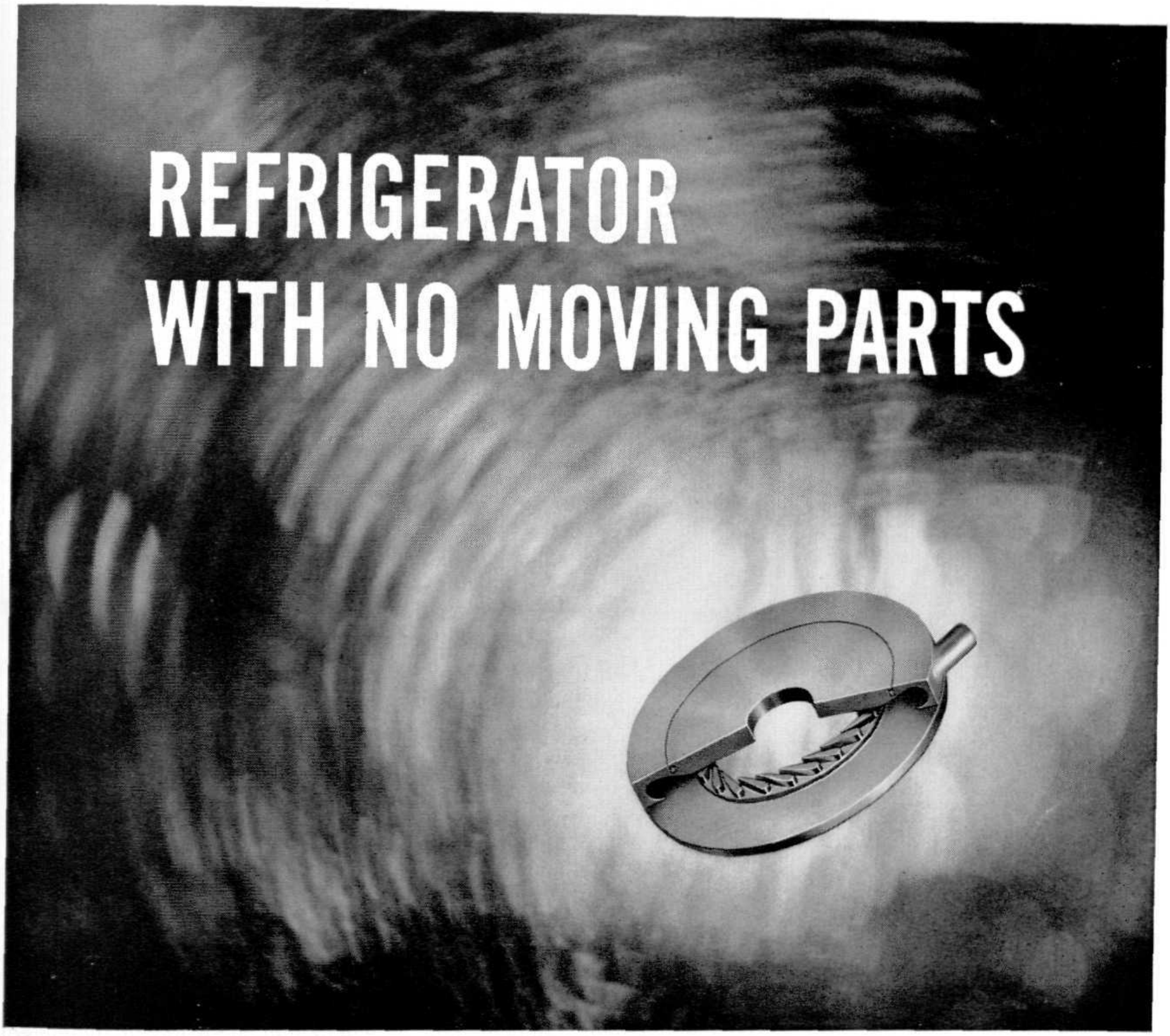

The vortex tube is a refrigerating machine with no moving parts. Compressed air enters the vortex chamber pictured here and spins rapidly down an attached tube. Pressure and temperature differences build up, forcing cold air out one end and hot air out the other. Requiring no maintenance, a large vortex tube developed by AiResearch scientists and engineers can be permanently sealed in nuclear reactors, and has many uses in industries with spot cooling problems.

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Modern technology presents

A CHALLENGE

to the metallurgist

for new and better materials

by Dr. A. J. Smith

Head of Metallurgical Engineering

(photos by Ron Murray)

The X-ray is used for determining the ultimate atomic structure of the metals. Harry Richter lines up a flat plate camera for determining crystal orientation.

BEFORE our present freshman has graduated from college it is entirely possible that someone will have climbed aboard a rocket and started for outer space, perhaps for the moon. Before he goes everything that is possible will be done for his comfort and safe return. Unlike the present satellite carriers, he must take his rocket or missile with him in order to reverse his path and after returning to earth's attraction to apply sufficient braking to insure against catastrophic landing.

What is our space traveller starting on this journey for? Surely he isn't starting out just for the ride—a Cook's tour of the heavens with proper restaurant and "rocketel" accommodations guaranteed in advance. Maybe one day that will come, but his is a voyage of exploration with greater hazard than confronted Ericson or Columbus. Unless he can report on what he has seen or sensed with his myriad of instruments, he might as well have not made the trip.

What can he take with him? Food and water, yes, for we have not yet learned to live without them. Then what? As he passes through Earth's atmosphere he must have some protection against the intense heat caused by friction and the sun's rays. Beyond the atmosphere there must be protection against the cold of the near vacuum of space.

And now he arrives at the moon. He has brought his own atmosphere with him in bottles of gas in order that he may breathe. Everything that goes with him is just what is essential to his survival and return. Each thing that he takes must be reduced to the smallest possible package. The knowledge he requires cannot be taken in books, it must be stored in his brain, the most efficient package the Lord created.

The drawings of the engineer are left far behind. Those drawings have been translated into material things. Was there a failure on the drawing board? Drawings can't fail—only material objects can fail. And when we say material objects we imply objects made of materials. What materials? The materials to resist heat and cold, to resist shock, to store oxygen and water, for instruments powered by material batteries—all of these ma-

The microscope is one of the most powerful tools for studying metal structure. Dale Koch prepares an oil immersion objective lens for examining his sample at the highest resolution obtainable with a light microscope.

terials which can fail and bring tragedy to this great voyage of exploration.

What are these materials on which so much depends? We shall not forget the older steels and brasses, aluminum and magnesium. But we shall also use a host of new materials, titanium, molybdenum, tantalum, zirconium, to name but a few, materials which very few years ago were purchased in gram lots but which today are sold in pounds and even tons.

A Goal

It is exciting for the young metallurgist to work on these exotic new materials but there is even more excitement in working on the old. There is so much not known about them. Before World War II a square inch cross-section of our structural steels would support a load of 60-70 thousand pounds, the heat-treated allow steels 150-175 thousand. Recently, quite by accident, it was found that some electrical devices were failing by the growth of tiny metal "whiskers" deposited from vapor. The properties of these whiskers were phenomenal. If one could be grown in the same manner up to a square inch of cross section it would support a load of 3-5 million pounds. These whiskers were not the exotic materials but our old friends tin, iron, copper and nickel. What a goal to shoot for!

We know now that the actual low strength found in our normal materials are due to the fact that mother nature does not pack the atoms together in the prefect order we had supposed, but leaves atoms missing from some geometrical positions and crowds too many together in other positions. We know now that these vacant sites allow the atoms to move around as in Chinese checkers and so allow us to alter arrangements through heat treatment; and that the crowded condition or "dislocation" allows the metal to flow under stress giving rise to ductility. Our "whiskers" have the very high strength shown as a result of growing from a single dislocation leaving the atoms behind in a state of almost ideal perfection.

The metals are greatly different from the non-metals in the pure state. The metals rate from excellent to relatively good conductors of electricity. The non-metals are in general insulators. Actually there is a complete range from almost ideal conductors to almost ideal insulators.

Great interest attaches to those elements which lie right in the middle, the semi-conductors. They conduct electricity, but, unlike the metals, they become better conductors as the temperature is raised. Their peculiarities, which may be altered at will, have led to such devices as the transistor, a device not yet ten years old. Combinations of metals and nonmetals lead to other interesting properties as in the ferrites, compounds of metal oxides, and useful, among other things for aerials for portable radios. These are two phenomena mother nature has tantalized us with for years. The transistor came about through scientific study of the catwhisker wireless detector, the ferrite from study of the material from which the first compass was made, lodestone or magnetite, the magnetic iron oxide.

Is It Good Enough?

All of these new developments are eagerly awaited by the rocket designers. Questions are not asked whether the new development is a metal, a non-metal, or one of those in-between elements. A device is wanted which will perform the best job for the purpose in the smallest package. Having produced a material that appears to perform satisfactorily the metallurgist is not permitted to sit back complacently. No matter how well the material per-

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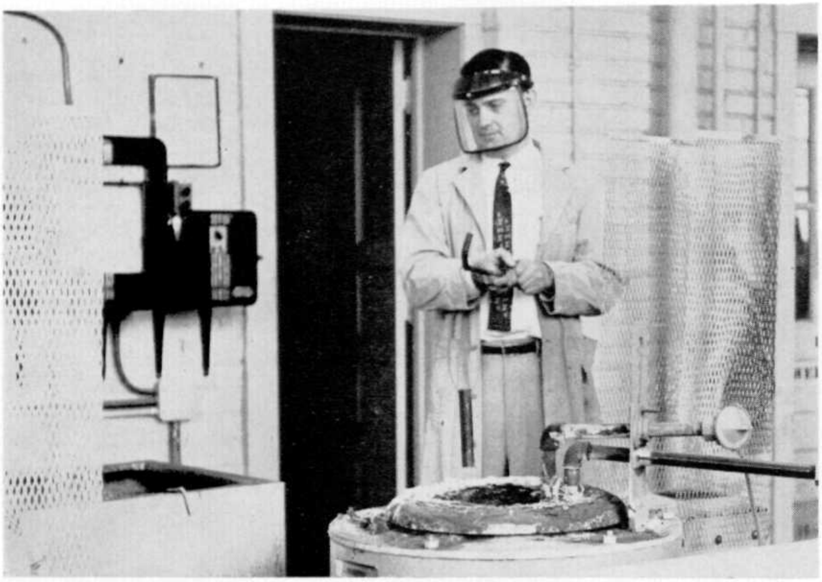


Modern materials require very precise control in heat treatment. Mr. Triponi demonstrates proper quenching technique.

A Challenge

(*Continued from Previous Page*)

forms, it is not good enough. No matter how small the package, it is not small enough.

The above suggests some of the things the modern metallurgist needs to know and some of the work he will have to do. Since he deals with real materials he must know the science and engineering of real materials. We say he must know the science—he can never *know* the science. No matter how deeply he probes the answer is always a little further away.

All matter is made up of atoms. We know that these atoms are made up of a nucleus with different numbers of electrons going around them like satellites, but, unlike satellites, sometimes close to the nucleus and sometimes far away. The metallurgist has little interest in the nucleus as such for the familiar properties of the elements depend on the extra-nuclear electrons. Their speed and position depends on their energy. Electronic energy interactions lead to the whole array of metallic and non-metallic properties. Thus, the metallurgist must study these energies and inter-actions. At this very fundamental level their is little difference between chemistry and physics. It is only when we get to assemblies of atoms that the two fields take off in separate directions. The metallurgist is concerned with both chemical and physical behaviour and needs to study both physics and chemistry. He undoubtedly makes more use of these fields in all the ramifications than any other engineer. Unlike the physicist and physical chemist, however, he is not concerned with the science of materials alone. It is up to him to make this knowledge useful in large masses. Even such a tiny package as a transistor contains as many as 100 billion trillion atoms, ten followed by twenty-two zeros. And yet he is concerned with the motion of individual atoms and must base his calculations on these individual motions. So he resorts to statistical methods, a somewhat different approach than the usual mathematics.

The Tools of the Met. Eng.

At the beginning of his instruction the modern metallurgist must become familiar with his subject. Time is spent learning what the metals are like, how copper differs from iron or aluminum. He must learn what the different materials look like under the microscope. A piece of ordinary steel can be made up of one, two, or three different constituents called phases. On the form and distribution of these phases the physical properties depend. It is possible through heat treatment to produce a new unstable phase which is extremely hard. By warming this hard phase it may be softened and toughened, "tempered," and so made useful for knives and other cutting tools. All this is evident under the microscope. So a large part of the early training of the metallurgist is in use of the microscope.

When the metals and alloys become familiar to him he is ready to refine his scale of observation and study the fundamental structure. The X-ray is a powerful tool in this direction. While we cannot see the individual atoms, we can bounce X-rays off of them and record their position on a photographic film or with a Geiger counter. Now the metallurgist can study how planes of atoms slide over one another as a piece of metal is deformed, how they can interchange position and distance apart as chemical reactions take place. While this is being learned he must not forget that he is dealing with real, useful materials, so he studies melting furnaces, heat treating furnaces, rolling mills and other tools. He is not interested too much in these devices in themselves, but how the metals respond when such tools are employed.

With this knowledge, which should be achieved with a bachelor's degree, the modern metallurgist should be able to enter industry and, after short training to become familiar with his company's product, he should be able to carry on technical control of the metallurgical operations, to devise new and improved production methods and to analyze failures, both in production and service.

Graduate Study

To carry out research, further intensive study is needed, self-study if necessary, in graduate school if possible. Now full use of physics and chemistry are really brought to bear. Most of the work to this point has been in response to the question, "how?" From this point on the question becomes, "why?" The classes and textbooks do not answer the question, they can only provide a background to ask the question intelligently. We shall, perhaps, never know the whole "why?" But as we achieve at least partial truths we come up with new materials and new devices to aid us in the space age.

And so our space traveller is waiting impatiently for the metallurgist to come up with answers to his problems. Materials to resist heat and cold and shock. Control devices that will not fail. For a means to become self-sufficient once he has reached his destination. These are problems for the metallurgist of both today and the future. Yet they are only a small part of the story. Fully as much could have been said of atomic power and coming closer to home of automobiles with jet engines. Suffice it to say that no matter what happens the metallurgist isn't going to run out of work and he is going to have so much fun on his job that his main regret will be that he just doesn't have time enough to do all that he wants to.

"AGGIE"

The sweetheart of eight thousand engineers

by Hester Ray, El. Ed. '62

THE engineers here at Michigan State University are lucky fellows because they have as their friend, Miss McCann. Aggie (as the old timers still call her) is now assistant to Dean Ryder, and has long been a part of the Engineering College. She started her career here at State in the Fall of 1917, and is the senior member of the staff of the Engineering College.

Miss McCann isn't an engineer, but she knows as much about the Engineering College as any other person, and she is the recognized source of information on the history, traditions and other little-known facts.

In one case her knowledge was of direct benefit to Tau Beta Pi. After World War II there was a sharp upturn in enrollment and class room space was at a premium. It was suggested that the Tau Beta Pi room on the fourth floor of Olds Hall be converted to a classroom, but Miss McCann located the original record of the grant for the construction of Olds Hall and R. E. Olds had included the condition that a room was to always be available to Tau Beta Pi in the building. This is only one example of the many times that she has aided the students and their organizations.

She is a very remarkable person who has many outstanding accomplishments that can be credited to her. Perhaps among the biggest of her accomplishments is the ability to keep track of her past students. She knows these alumni (about 8,000) personally, as individuals, rather than just by student number or name. She not only keeps track of the alumni but she also helps them keep track of themselves. She has the names, activities, and the location of most of the alumni at the tip of her tongue. She is interested in these engineers and follows their careers after they leave M.S.U. She keeps an alumni file and sends information to the alumni about their classmates. Yes, Miss McCann has adopted all the engineers as members of her family. Her life is centered about the engineering students and she is always looking out for them. You'll also find the alumni are interested in Miss McCann, in fact, the first place returning alumni go is to Miss McCann's office. They keep in contact with Miss McCann even though their careers may carry them to the far corners of the earth.

She is always understanding and ready to help an engineering student. At one time an engineering student who was working in the classification office had a sinus condition. In nasty weather he was always sniffing. During fall term of 1941 he wanted to take a trip between terms but working during the term usually meant working at vacation time also. When he asked Miss McCann if he could take the trip, she replied he could go if he didn't sniff between then and Christmas. Miss McCann tried

(Continued on Page 28)

This picture finds Miss McCann busy at work, but smiling as usual.

JETS

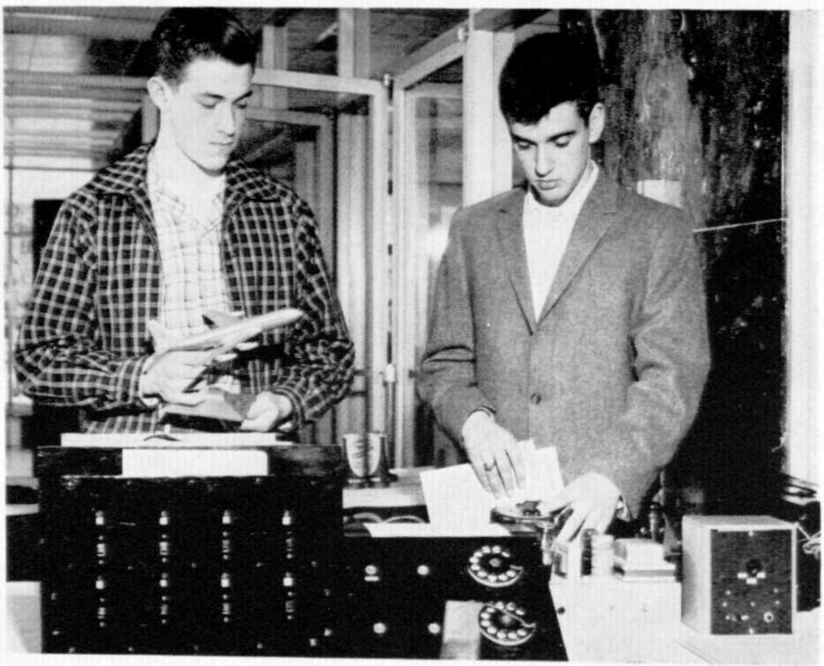
engineers and scientists of tomorrow

by Patrick J. Miller, Ass't Director JETS

IN connection with the M.S.U. Engineering Exposition, JETS, Junior Engineering Technical Society, will stage its seventh annual Engineering Exposition. JETS is a high school organization of about 480 chapters scattered throughout 40 states and Puerto Rico. Each spring, many chapters bring science projects to M.S.U. where they are entered in competition.

JETS was founded in 1950 by the M.S.U. Engineering College. Since its inception the program has gained national prominence. In January, 1957, JETS, Inc., was established as a nonprofit corporation. The U. S. Treasury Department declared it a tax-exempt corporation in 1958.

Final policy decisions are made by the newly formed JETS Board. Outstanding personalities from industry, education, and the professional societies unselfishly serve on this board so that the science education in American schools may be enhanced. The present board is comprised of seventeen members. The following highly respected men comprise the governing body: Mr. L. R. Baker, Director of Chrysler Institute of Engineering; Mr. R. E. Britner, Vice President of Keuffel and Esser Company; Dr. John C. Calhoun, Jr., Vice President for Engineering of Texas A. and M. College System; Mr. Kenneth Ellington, Vice President of Republic Aviation Corporation; Mr. Julian W. Feiss, Chairman of Engineering Manpower Commission; Dr. John A. Hannah, President of Michigan State University; Mr. Dan E. Karn, President of Consumers Power Company; Mr. Sidney D. Kirkpatrick, Vice President of McGraw-Hill Book Company, Inc.; Mr. S. M. Little, Corporate Employment Administrator of Boeing Airplane Company; Mr. J. B. Macauley, Ass't. Director Research and Engineering of the Department of Defense; Major General J. B. Medaris, Commanding General of U. S. Army Ordnance Missile Command; Mr. Horace Mourer, Instructor at Belleville Public Schools, Mr. George Rietz, Consultant Educational Relations of General Electric Company; Mr. Paul Robbins, Executive Director of the National Society of Professional Engineers; Dr. John D. Ryder, Dean of Engineering of Michigan State University; Major General B. A. Schriever, Commander of Air Force



Shown are John Gallagher (left) and Stanly Steinberg with their digital computer. Both students have received coveted scholarships to M.S.U. through their participation in JETS.

Ballistic Missile Division; Mr. Charles R. Sligh, Jr., Executive Vice President of National Association of Manufacturers, and Mr. John W. Groomes, Ex-Officio, Executive Director of JETS, Inc.

This group holds regularly scheduled meetings. A special meeting will be conducted on May 7, at M.S.U. Some of the members plan to remain on the campus May 8, to observe the exposition and personally talk with high school students participating in the JETS program.

The primary function of a typical JETS chapter is to guide students in careers in engineering or science. The individual group carries on numerous activities in this pursuit. These include academic study on science topics, construction of scientific projects, visits to industries and scientific exhibits, and the normal activities of a high school organization.

The JETS Engineering Exposition offers opportunities to members to learn more about the scientific professions. A major aspect of the program is the Engineering Exposition. All members are invited to enter their projects in the contest at the M.S.U. Library on the morning of Friday, May 8. Here a group of judges will view the entries and select the winning contestants.

All projects will be displayed in the Library for both May 8 and 9. The general public is invited to view the exhibit any time during this period.

Past contests have seen some outstanding entries. However, even better projects are promised for this year's event. First place winner in the group division last year was a digital computer by Stanly Steinberg and John Gallagher of Traverse City, Michigan. Stanly, a W. R. Brown scholarship recipient, is now a freshman engineering student at M.S.U.

John Gallagher, a senior at Central High in Traverse City, is still working on the computer. Last fall it was entered in the Westinghouse Talent Search where it gained recognition as one of the top five outstanding projects in Michigan. John's interest during the past year has been in enlarging the operational processes of the computer. In fact, the device today is quite different than that of just a year ago. This project will be entered in the contest.

In addition to his work on computers, John Gallagher has maintained an exceptional high school scholastic record. For his achievement, he has been presented the coveted M.S.U. Alumni Distinguished Scholarship Award. He plans to enter M.S.U. as an engineering student this fall.

Daniel S. Kasprzyk demonstrates his Handyman's Foundry Furnace. He has made additional developments on the project during the past year.

Another outstanding project of last year's contest was a "Handyman's Foundry Furnace" built by Daniel Kasprzyk of Hutchinson Technical High School, Buffalo, New York. This furnace was capable of producing a maximum temperature of about 2,000 degrees Fahrenheit. Dan, a senior, also spent the year in additional development of his project.

The project will be entered in this year's contest as a controlled atmosphere heat treat furnace. The importance of the device is that the work on specimens can be done under conditions of a neutral atmosphere. This does away with oxidation and decarbonization, as well as allowing better temperature control. Along with the furnace will be a display of some of the metals upon which the furnace has been used for research purposes.

Dan is the winner of this year's JETS Essay Contest. For this accomplishment he will receive a scholarship carrying a $1,000 per year stipend to M.S.U. He plans to begin his study in metallurgical engineering this fall.

It is estimated that there will be about 175 projects entered in this year's contest. The above examples show the type of student and work that is behind each successful project.

A highlight of the JETS Exposition will be an "Engineering Panorama," sponsored by the M.S.U. engineering departments. The program will commence at 2 P.M., May 8, in the M.S.U. Music Auditorium. Representatives of each department will briefly outline the various aspects of engineering that apply to their field of interest.

The main speaker at the Panorama will be Dr. Ernst Stuhlinger, Director of the Research Projects Laboratory,

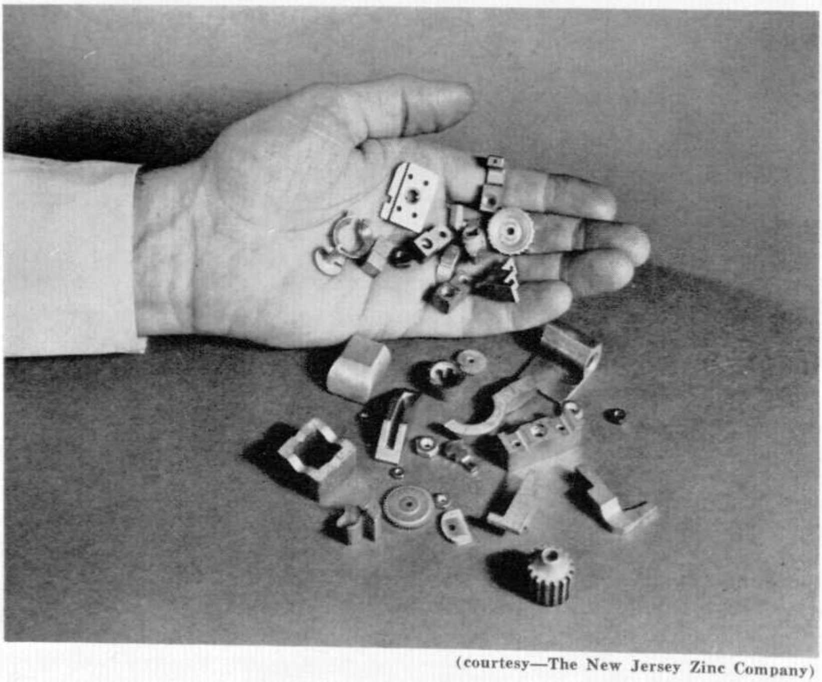
(Continued on Page 40)

POWDERED METALLURGY

an ancient technique meets the demands of modern technology

by Gordon Bonney, M.E. '59

SUPERFICIALLY, one might not expect to find much similarity between the metallurgical problems facing the metal workers of ancient times and those with which today's engineers are confronted. Yet, when one considers that furnaces capable of melting iron ore were not developed until the 19th century, he may wonder how the Egyptians produced tools, weapons, and ornaments of iron as early as 3000 years before Christ, how, over 1600 years ago, the smiths of India produced their famous "Delhi Pillar" of over six and one-half tons weight in iron, or how the ancient Incas were able to produce a platinum alloy which was malleable enough to work into intricate and beautiful ornaments. Since the melting points of these metals were higher than the temperatures obtainable in their furnaces, the problem was essentially one of handling "refractory metals" and the solution was similar to the modern methods of handling such metals as tungsten, tantalum, or molybdenum, that is, through powder metallurgy.



(courtesy—The New Jersey Zinc Company)

An assortment of typical powder metal parts.

Until the development of the smelting furnace, powder metallurgy was the only method of working metal and no distinction was necessary. When the furnaces were developed, however, it was much faster to produce iron and steel by fusion that the ancient methods were virtually forgotten. At about the turn of the present century—after a relatively short lapse of seventy-five years or so—a few metallurgists again turned their attention toward powder metallurgy in an effort to solve some of the problems they had encountered in smelting. It is not surprising that one of their more pressing problems arose out of their efforts to fuse the refractory metals. As our technology progresses, powder metallurgy has been providing the answers to an increasing number of problems. In the field of nuclear energy, for instance, powdered metals such as beryllium, uranium, thorium, and zirconium are used as moderator, fuel, and in the materials of reactor construction.

The field of powder metallurgy involves two essentially separate, yet closely related, industries—the production of metal powders, and the fabrication of parts from the powders. The following paragraphs are obviously not intended for a specialist in the field, but are mere descriptions of a few of the processes involved.

Production of Metal Powders

There are several methods of obtaining metal powders, and while more than one method may produce powders which are equally well suited for a particular part, it is generally found that each application requires special properties in the powder which can be obtained by one method of powder production more easily than by the others. Claus G. Goetzel, in the first volume of his three-volume "Treatise on Powder Metallurgy," indicates that the methods of metal powder production may be divided into two classes: "(a) mechanical processes, and (b) physiochemical and chemical processes."

The more important processes involved in the first class are machining, milling, shotting, graining, and atomization. In machining, a solid rod of metal is filed automatically to produce coarse, bulky chips. This method is used primarily for the production of magnesium powder since the malleability of magnesium make other mechanical processes difficult, and, because of the danger of explosion, particular care must be exercised when a finer powder is produced.

Milling is an important process in the production of powders from the brittle, friable metals such as tungsten, molybdenum, titanium, and many of their alloys and compounds, especially the carbides. A ball mill or disk mill is generally used to pulverize the material to a closely controlled particle size.

In shotting, the molten metal is often poured from a high tower into a hot water bath, and, due to the high surface tension of the metal in the liquid state, it solidifies into a spherical shaped particle during its fall. While nearly all metals and alloys can be shotted, the process is used most often with tin, lead, zinc, gold, silver, and aluminum.

Graining depends on the formation of an oxide on the surface of the particles as the metal is stirred during solidification. Because of oxide content, the usefulness of this method is somewhat restricted, its chief applications being in the manufacture of grained aluminum and brass for brazing purposes.

Atomization is the most popular method of producing powder from metals with low melting points. Similar to shotting, the molten metal is atomized by a stream of high pressure fluid as it leaves a small nozzle or orifice, and solidifies into spherical or teardrop particles. The size of the particles can be varied over a wide range by proper design of the nozzle, by controlling the temperature and rate of flow of the metal, and by controlling the temperature and pressure of the gas.

Among the physiochemical and chemical processes are the reduction of metal compounds, electrolytic deposition, vapor condensation, and chemical precipitation. Chemical reduction of pulverized metal compounds, usually an oxide, is accomplished by heating the oxide in a reducing atmosphere to form a spongy, friable mass of metal which is then ground to a fine powder. The ancient Egyptians used a method similar to this some 5000 years ago. Rather than grind the reduced metallic mass to powder, however, they would work it while still hot to drive out most of the slag and other impurities, and then forge it into useful shapes. In modern industry, most copper, iron, and tungsten powders are produced from the reduction of their oxides, and recently it was found that the reduction of uranium trioxide with cadmium is a practical method of obtaining spherical shaped uranium particles to be used in the development of reactor fuels.

Similar to electroplating, electrolytic deposition requires an electrolyte made of the salt of the desired metal, along with proper electrodes. Here, however, the deposition of spongy or powdery slimes is the desired result, whereas such formations would be ruinous in an electroplating operation. Variables such as the rate of current flow, intensity of the electrolytic solution, and the type of electrodes used made a finely regulated particle size possible.

Condensation of metal vapor, used primarily in the manufacture of zinc powder, is actually the combination of two chemical processes—reduction and condensation. Zinc oxide, heated in contact with a carbonaceous mixture such as powdered coal, reacts with the carbon monoxide which is formed and causes the pure metal to vaporize. The vapor is then condensed on a cool surface as a fine, high-purity dust.

Chemical precipitation is an effective method of obtaining powders from metals which are on the lower end of the electromotive series by introducing a metal which is higher in the series into their liquid solutions. Thus, copper may be dissolved in a solution of silver nitrate to obtain silver powder, gold may be precipitated from its solutions by zinc or copper, and etc.

Forming a Powdered Metal Part

As demand for powdered metal parts increased, the presses used to compact the powders soon lagged behind the requirements set for them. Powders do not flow from high to low compression areas as do fluids. Consequently, sharp corners and reentry angles in the die do not fill completely when pressure is applied, and areas of low density are formed. Larger presses were designed to accommodate larger and more complex dies. Automatic molding presses presently develop up to 150 tons per square inch, and some knuckle-joint

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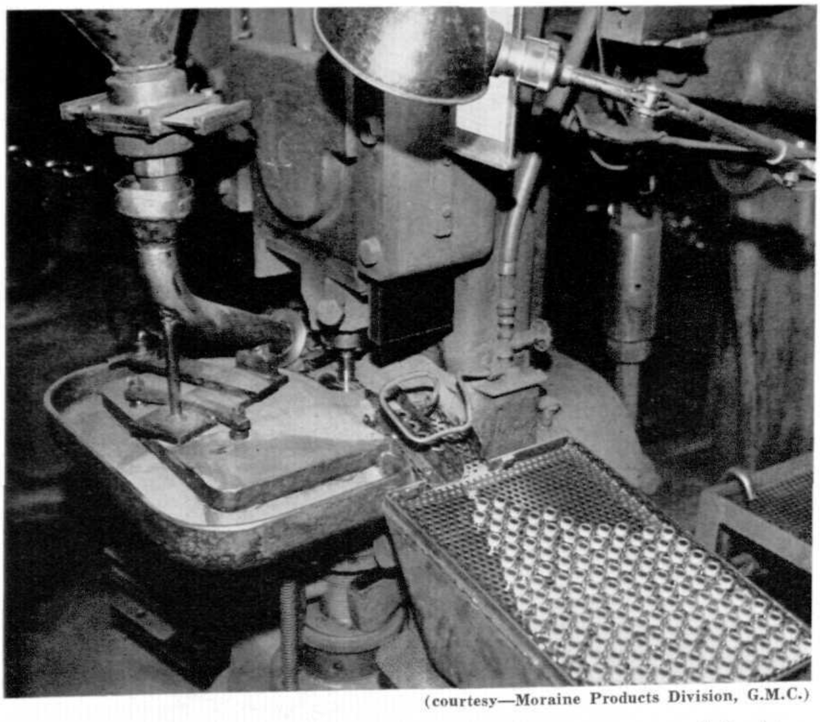

(courtesy—Moraine Products Division, G.M.C.)

A press used in compacting the metal powder into a small bushing.

Powered Metallurgy

(Continued from Page 17)

mechanical presses have capacities of 2000 tons per square inch. The rate of pressing decreases as the capacity of the press increases, however, so, for fully automatic operation, economics establishes an optimum power limit.

Several different methods are used in the effort to obtain a more uniform compact, the particular method depending primarily on the size and shape of the part to be made. Multiple action presses, applying pressure from as many as five directions, is a successful method for compacting some shapes, but the size and cost of the press increases rapidly when more than one direction of operation is desired. Centrifugal compacting, whereby a force is applied to each individual particle by whirling the mold at high speeds, is another method which is successful for compacting certain shapes of parts to a nearly uniform density.

After a metal powder compact leaves the press, it is somewhat fragile since the particles of metal are held together only by mechanical interlocking. To give the part its needed strength, it is heated to a temperature just below that of the melting point of the major constituent and held at this temperature while the particles are sintered together. Because of the large amount of surface area in powders, care must be taken to prevent oxidation during sintering. A reducing atmosphere is necessary in the sintering furnace to reduce any oxides that are present as well as to prevent their formation. After the particles of metal are sintered together, the compact has many of the characteristics of bar stock. A sintered steel compact, for instance, reacts in much the same way to heat treatment as does steel stock, and can be hardened and tempered as necessary.

Since the production of a powdered metal part requires the two separate steps of pressing and sintering, it was only natural that efforts would be made to combine these two operations into one. The simultaneous process of pressing and sintering is called "hot-pressing" or "hot-molding," and offers the obvious advantages in time and labor. The pressure required for hot-molding is considerably lower than that required for cold-molding, and the need for larger presses is thus alleviated. Then, too, it is possible to hot-press powders to solid density in one operation. The properties of hot-pressed metals and alloys are similar to those of hot-forged, or cold-worked and annealed, parts.

Unfortunately, hot-pressing presents many difficulties which must be overcome before it can become a widely-used commercial operation. Among these is the lack of suitable die materials to withstand the high temperatures involved (generally about the same as sintering temperatures). Since the surface of the metal particles is heated to a liquid state, welding of the compact to the sides of the die is always a possibility. Graphite has been used with some success, but a separate mold is required for each part produced, making the cost prohibitive for all but a very few special parts. Rapid heating of the metal powder presents another difficulty in that it increases the danger of oxidation. Finally, it is difficult to obtain a rapid enough cycle to make hot-pressing commercially practical for most applications.

Applications

The industrial applications of powdered metals may be roughly divided into five general categories: Mixtures of unalloyable metals, cermets (combinations of metals and non-metals), refractory metals, special or porous products, and competitive products. A brief description and example of each of these categories is given below.

When the powders of two mutually immiscible metals are thoroughly mixed, compacted into a useful shape, and sintered, the desirable qualities of both metals are often retained in the resultant part. This method is especially applicable to metals with widely different melting points and densities. An example of this is in the use of one of the refractory metals such as tungsten or molybdenum in combination with one of those metals with a high electrical conductivity such as copper or silver in the manufacture of electrical switches. The switches retain the high conductivity of the copper or silver as well as the high resistance to burning of the tungsten or molybdenum. As a result, the life of the switch is increased many times with no sacrifice of efficiency.

The term "cerme's" is a linguistic combination of the terms "ceramics" and "metals," and, as one would expect, it applies to that field of powder metallurgy wherein these two types of materials are combined in powder form and sintered in the desired shape. The applications of this technique are broad and include the combination of tungsten carbide particles cemented by cobalt or nickel to form high-speed cutting tools, diamond particles cemented with sintered metal powders to produce high quality drill bits, graphite powder cemented by copper or iron to improve electrical brushes and bearings, and copper-porcelain electrical resistors. Certain types of reactor fuel elements, such as uranium oxide cemented in a matrix of stainless steel or aluminum, is one of the more recent applications of cermets.

The Inca platinum smiths long ago found that they could produce a mal-

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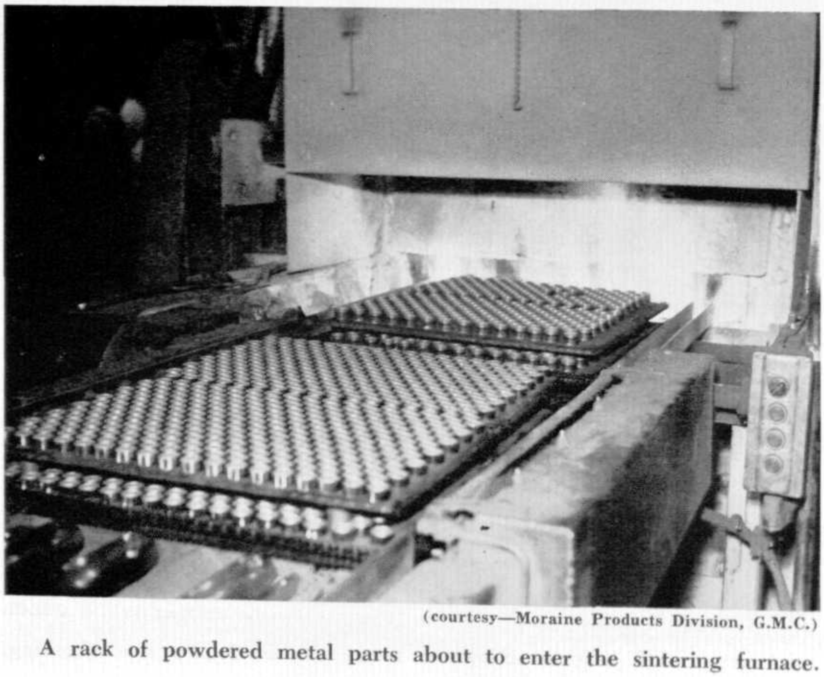

(courtesy—Moraine Products Division, G.M.C.)

A rack of powdered metal parts about to enter the sintering furnace.

TECHNORAMA

A proud addition to the educational facilities at M.S.U.

by Dr. D. P. Brown
Agricultural Engineering

CONSTRUCTION crews should soon be breaking ground for one of the most modern new educational facilities in the world. This unique structure, costing more than a million dollars, will provide an indoor educational and display center for the most up-to-date engineering for agricultural processes, equipment, and materials. It will also have an important area devoted to engineering for the home.

The original idea was derived from numerous requests and wishes of educators, agriculturists, and manufacturers for an opportunity to demonstrate new ideas to agricultural students, farmers, foreign visitors, and others. It is now receiving enthusiastic approval and support from industrial representatives who feel this facility and its extensive program will be of great service, not only to students and farmers, but also to teachers, homemakers, agricultural advisors, and industry itself. It is expected that many foreign visitors will find this as a focal point where the latest de-

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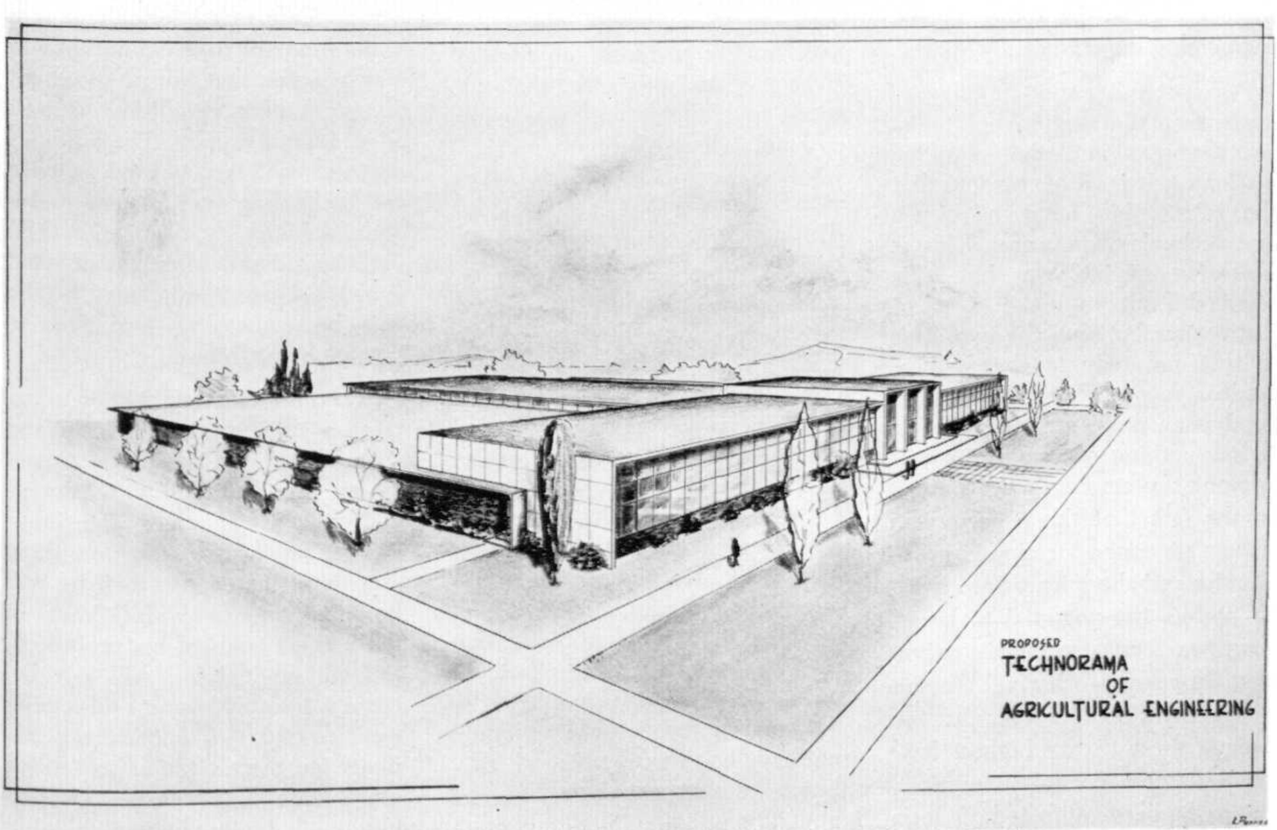


ENGINEER . . .

DO YOU WANT TO FULFILL THE HIGHEST GOALS OF YOUR PROFESSION?

by Dr. S. J. Idzerda
Director of Honors College

THE student pursuing an engineering degree usually thinks that his first and only concern is with technology, with making better and bigger contributions to our gross national product. There is no doubt that this is the main activity of the technologist. The question is, can an engineer be satisfied with the pursuit of merely technical goals? If he does not attempt to become educated as a scientist, a technician and a humanist, I would suggest that he has little awareness of the problem of contemporary engineering, or the future of the engineering profession.

Perhaps it is easiest to demonstrate that the engineer of today and tomorrow must first of all be a scientist. It is all too obvious that the relationship between science and technology in many fields is becoming so intimate that it is often difficult to make clear-cut distinctions between the two. This is true not only in the field of nuclear power; plastics, alloys and production problems in antibiotics, to say nothing of automation and computer programming, all point to the fact that the persons who have a superior education in mathematics and the sciences are going to possess the potential to be tomorrow's engineers. This means that they must go beyond the survey courses in the sciences and pursue them to the highest level of abstraction possible. Our training to be effective in today's technology will surely be outmoded by tomorrow's science.

Naturally, technical problems or technological training cannot be ignored, because the future of science depends very heavily upon the quality of technics that accompany it. A simple illustration will suffice: the earliest developments in science usually come very close upon the heels of technical improvements—precise experiments are not possible before we have precision instruments. Look through any journal devoted to the sciences; the advertisements for high quality technical equipment make it abundantly clear that scientific and technical development go hand in hand.

But there is more to it than this. The ancient Greeks were great theoreticians but it was the Romans who had the capability, interest and organization necessary to transmute this theory into bridges and aqueducts. A technician does something more than just solve problems of production; he is capable of carrying on an understandable discourse with the scientist, but he also has the power and imagination to transmute scientific insights into workable, workaday effectiveness, in terms of goods, products or processes that can have almost infinite effect upon our human condition. Without the first-rate technologist we would not have had three industrial revolutions during the past hundred and fifty years.

But when we speak of "our human condition" and "industrial revolutions," we become aware immediately how easy it would be to foster science and technology if only there were no human beings around. Human beings are lovable and impossible creatures; they are something more than mobile blobs of protein with defective thinking machines, and something less than rarified psychic phenomena. Man's appetites, aptitudes and aspirations are circumscribed by natural, personal and social limitations. Yet within these limitations there is a broad range of freedom and power which means that the predicament of man has its wonderful as well as its fearful aspects. The studious engineer will go beyond science and technology and become a student of humanity too. Unless and until he has some inklings of what man has been, is, and may be, he will be something less than a human being himself.

When the engineer strives to become a scientist, a technician and a humanist, and has some capacity to communicate with himself and others concerning the interlocking ramifications of these three aspects of his career, then he will be on his way to the fulfillment of the highest goals of his profession. Indeed, engineering will not become a true profession unless sufficient numbers of engineering students see themselves as something more than highly expert technicians.

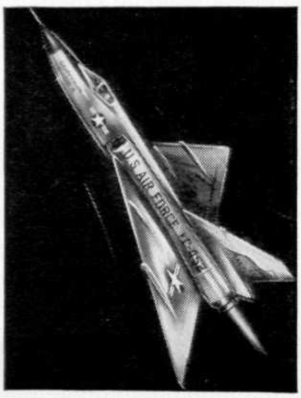
Metal quiz... you might have to take one like it again when you design equipment. Try your hand at it now. But remember to take advantage of the help INCO can give you when really tough metal quizzes come your way in your future engineering jobs.

See if you can tell which of these nickel-containing alloys proved to be the answer to these problems. Put the right number in the right box.

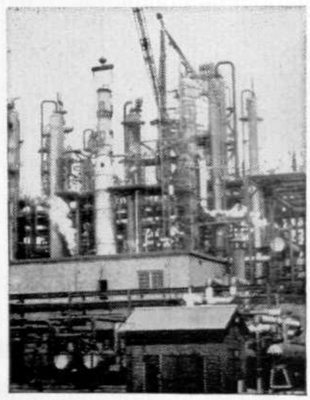
1. Ductile Ni-Resist*
2. Nimonic "75"* nickel-chromium alloy
3. Nickel-aluminum bronze
4. Ductile iron
5. Monel* nickel-copper alloy
6. Inconel* nickel-chromium alloy
7. Type 316 chromium-nickel stainless steel

See answers below

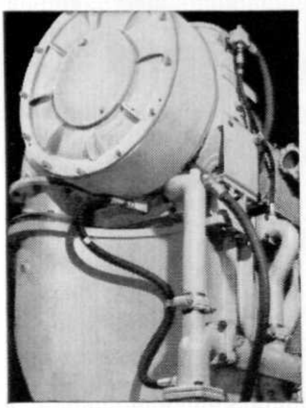
☐ **Refinery valve**—Needed: resistance to attack from petroleum products, thermal and hydraulic shock. Which alloy . . . ?



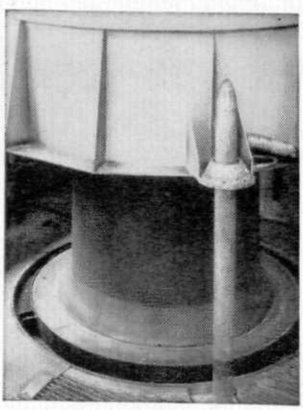
☐ **Turbojet afterburner shell**—Needed: strength plus corrosion resistance at high temperatures. Which alloy... ?



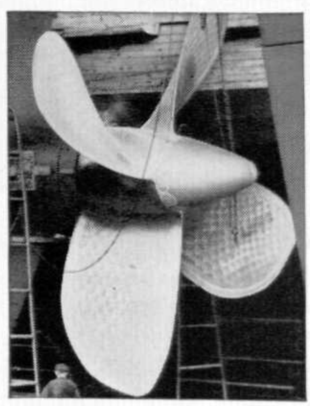
☐ **Recovery tower**—Needed: resistance to hot coke oven gases and aromatic chemicals, long service life. Which alloy... ?



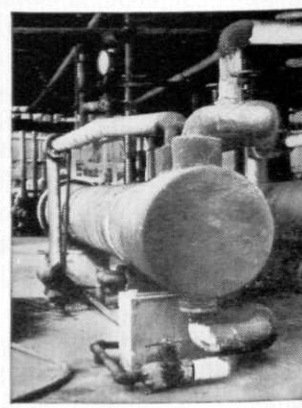
☐ **Diesel manifold**—Needed: scaling and oxidation resistance at 1200°F, resistance to thermal shock. Which alloy ?



☐ **Heat treating retort**—Needed: light weight, ability to endure destructive heating-cooling cycles. Which alloy... ?



☐ **Ship's propeller**—Needed: lighter weight and resistance to erosion and salt water corrosion. Which alloy... ?



☐ **Regenerator pre-heater**—Needed: trouble-free service handling hot caustics, fabricating ease. Which alloy... ?

When you start to design equipment, you'll have to select the proper material to meet given service conditions . . . a material that might have to resist corrosion, or wear, or high temperatures, or a combination of these conditions.

Over the years, Inco Development and Research has gathered information on the performance of materials in many such problems. Inco's List "A" and List "B" contain descriptions of 377 Inco publications which are available to you, covering applications and properties of Nickel and its alloys. For Lists "A" and "B", write Education Services.

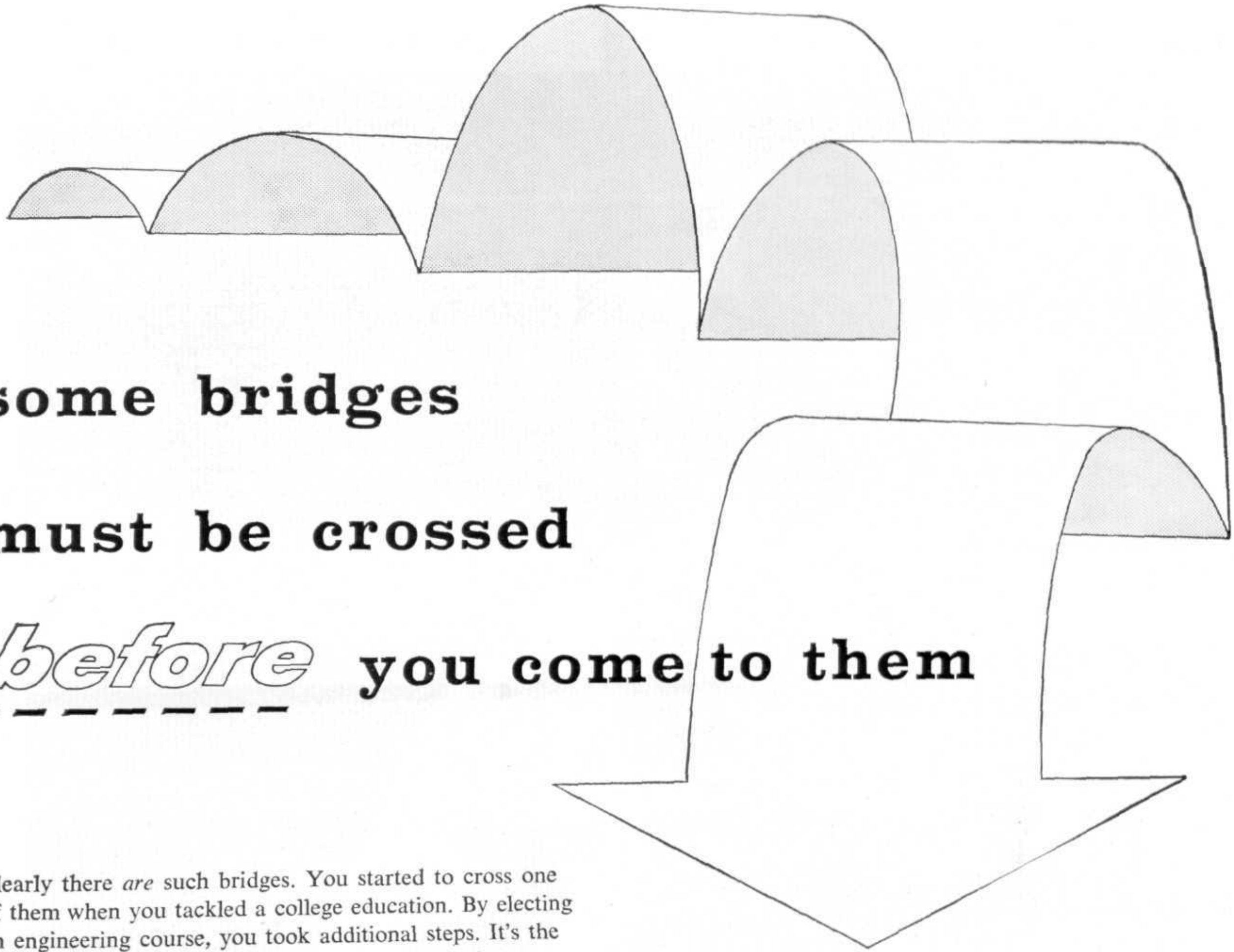
The International Nickel Company, Inc., New York 5, N.Y.

*Registered trademark

ANSWERS:
- Refinery valve . . . Ductile iron
- Turbojet afterburner shell . . . Nimonic "75"
- Recovery tower . . . Type 316 stainless
- Diesel manifold . . . Ductile Ni-Resist
- Heat treating retort . . . Inconel alloy
- Ship's propeller . . . Nickel-aluminum bronze
- Regenerator pre-heater . . . Monel alloy

Inco Nickel

makes metals perform better, longer



some bridges must be crossed *before* you come to them

Clearly there *are* such bridges. You started to cross one of them when you tackled a college education. By electing an engineering course, you took additional steps. It's the bridge that takes you from education to profession.

Perhaps several companies on the "profession side" will beckon to you. Naturally, you'll try to choose the firmest and highest ground accessible to a beginner—ground that leads to more challenge, more responsibility and greater reward. Companies situated on the firmest and highest ground will be those whose products or services enjoy a lively and continuing demand.

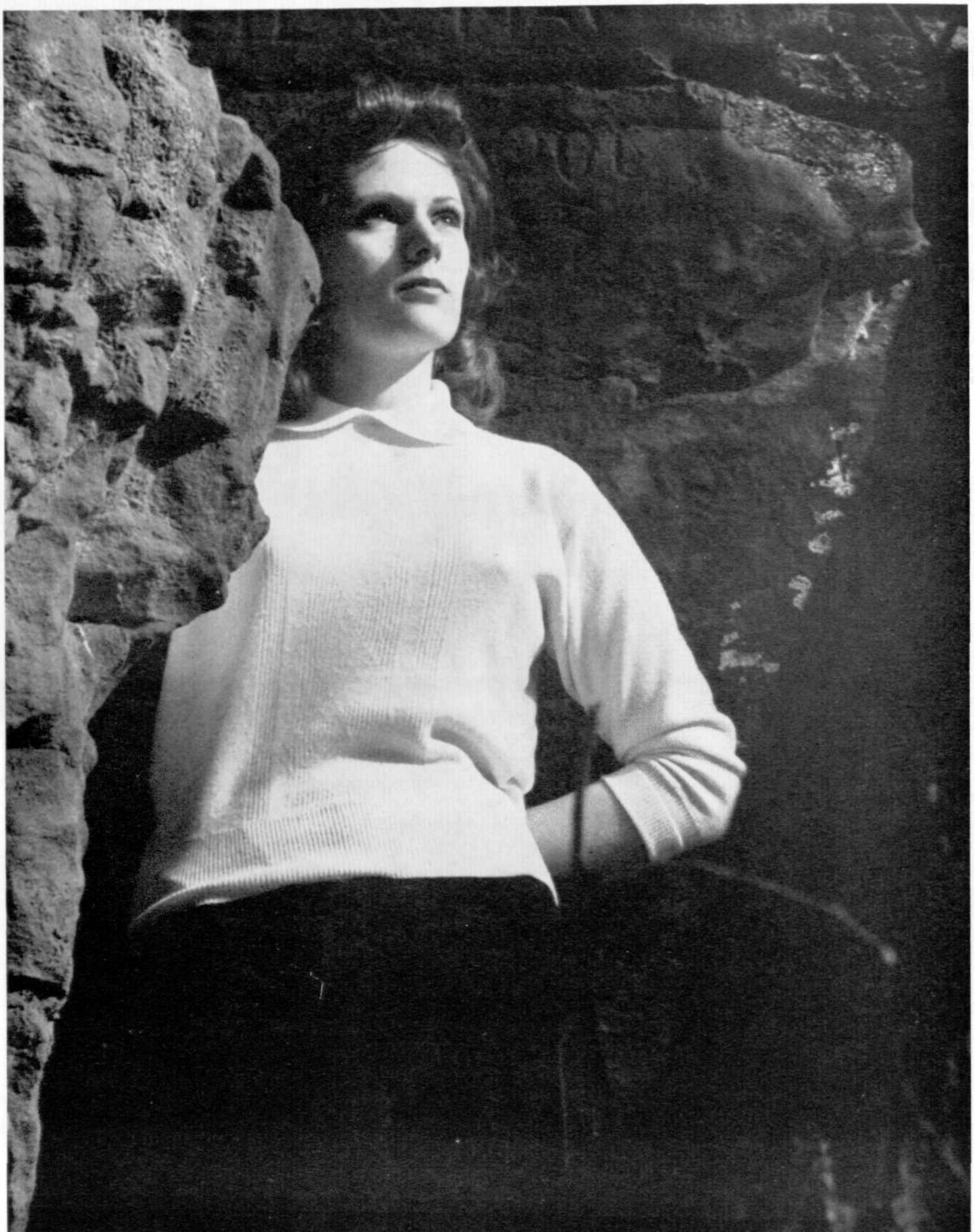
As a leader in a broad and exciting field, Sikorsky Aircraft is just such a company. And as an organization with its eye on the future, each year Sikorsky has openings for young men who show promise of being able to make outstanding contributions to the development of direct-lift aircraft.

If you're almost across that education-to-career bridge, write for information about careers with the world's pioneer helicopter manufacturer. *Please address Mr. Richard L. Auten, Personnel Department.*

SIKORSKY AIRCRAFT

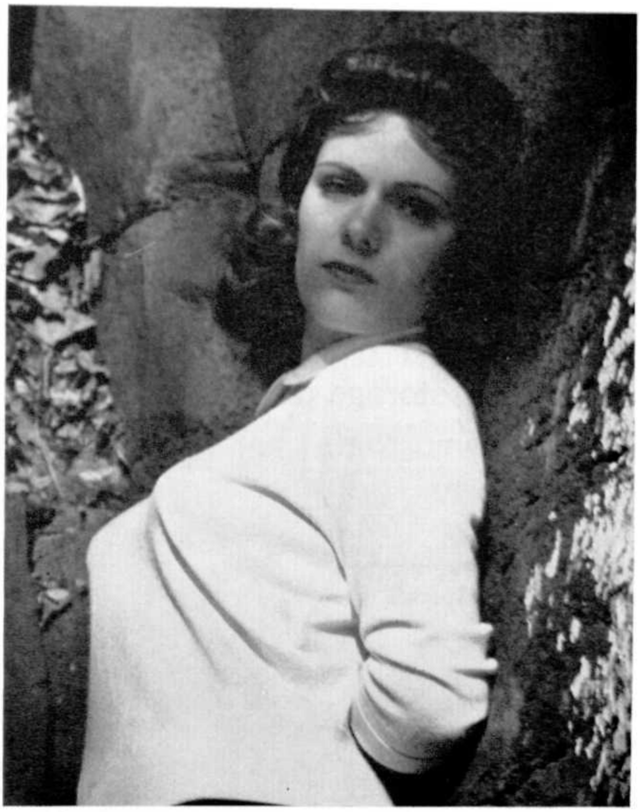
ONE OF THE DIVISIONS OF UNITED AIRCRAFT CORPORATION

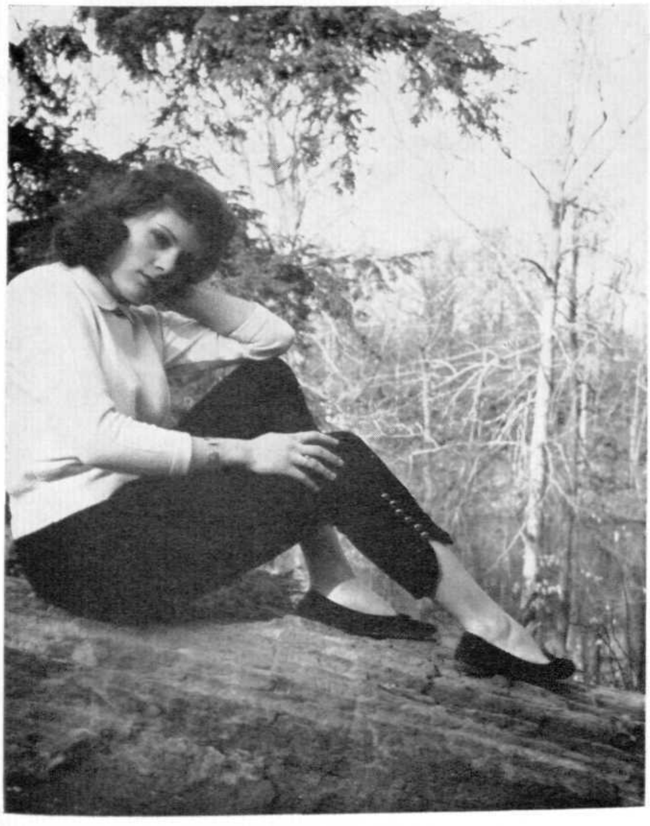
STRATFORD, CONNECTICUT



PRISCILLA SHAPTER

MISS MAY ENGINEER





PRISCILLA SHAPTER

Home town: Muskegon, Michigan

Age: 20

Dorm: Phillips Hall

Specs: 5′ 4″
Brown hair
Brown eyes
37-24-36

Major: Art

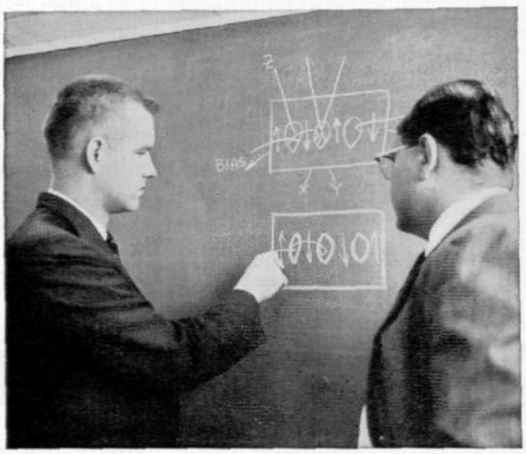
Hobbies: Voice
Fashions

Ambition: Fashion Illustrator

Photos by Jim Johnson

Product Development at IBM

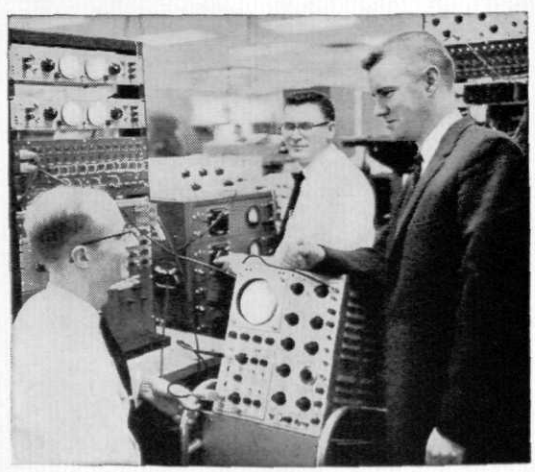
IBM Engineer Richard R. Booth explores electronic frontiers to develop new, faster and larger storage devices for tomorrow's computers.



Computing time cut from six months to one day

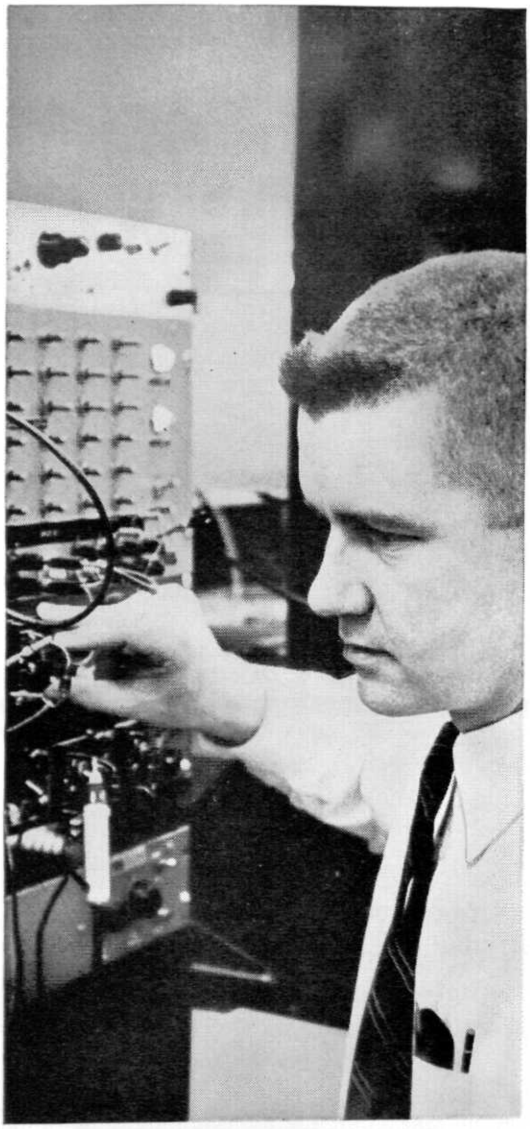
"My job is to design and develop new, high-speed storage devices for a powerful new computer that will perform, in one day, operations requiring six months on present equipment," said Dick Booth as he began a typical day recently. A product development engineer at the IBM Laboratories in Poughkeepsie,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

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



Increasing responsibility

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



Preparing for the future

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

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

A chance to contribute

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

* * *

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

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

IBM®

"AGGIE"

(*Continued from Page 13*)

to help each student in every way she could. Some of the lengths to which she has gone to help the students are as amazing as her memory of the former students.

During the depression, and in the years following, Miss McCann made it a policy to hire students to do as much of the work in classification as possible. This worked a hardship on her in many ways since it was necessary to break in help, and in many cases to answer for these student's mistakes.

She is always ready with a word of encouragement for her engineers. One student who had set a B average as his goal found encouragement from Miss McCann. She told him with a little more effort he would be eligible for Tau Beta Pi. She encouraged him to bear down a little and the student started to work, and continued at a high average. It would be found that Miss McCann has helped many students by her friendly encouragement. The number of times she has helped with students problems are innumerable.

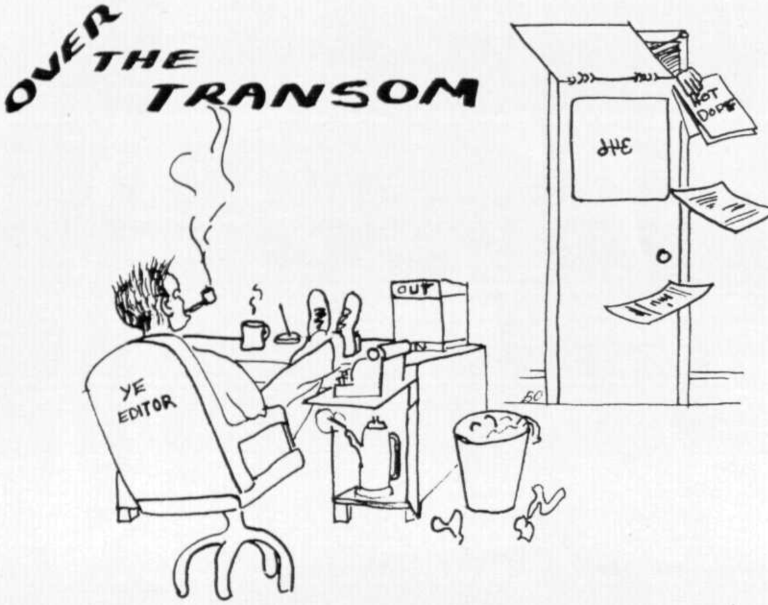
When Miss McCann handled all the engineers at registration time (at one time she was sole keeper of the records) she worked practically around the clock getting their schedules right. She wasn't crabby under the strain but did her best to get the students through on schedule for registration so they could get out of school in the minimum length of time. Sometimes on the last night making up schedules she would get so she couldn't write any longer so she would dictate to someone to do the writing. She would help anyway she could to schedule students so they could work part time if they needed to. Sometimes when she was very busy she got a little snippish with students who were trying to pull fast ones on her.

Miss McCann also helped students in other ways such as helping line up interviews for jobs for graduating students through the Dean's Office, before the Placement Bureau was established.

She also worked with many student organizations. In fact the Spartan Engineer was helped by Miss McCann. She has also helped the Engineering Council, Engineering Wives and a number of others. She has loaned her car to students a number of times for such things as dates, all night problems, and etc. The students have shown their appreciation in a number of ways such as shoveling the snow out of her driveway and other little favors like this.

In 1941 she was made an honorary member of Tau Beta Pi. This is a unique distinction for she is the only women on the Michigan State University campus to have this cherished honor. She was given a sweetheart pin by the members of the fraternity. It seems she didn't attend the banquets and other Tau Beta Pi functions for about a year and a half because she had lost the pin. As things turned out the pin had been turned into the

(*Continued on Page 36*)



THE time has again arrived when the MSU College of Engineering will open wide the doors to show its laboratories, equipment, demonstrations and special exhibits to parents, alumni, high school students and the rest of the University.

The 1959 Engineering Exposition will open at noon on Friday, May 8, when all industrial, departmental and student exhibits will be displayed in Olds Hall, Electrical Engineering, Chemical Engineering and Ag Engineering buildings. Judging of the departmental and student exhibits will take place Friday afternoon. A new rule has been added this year. Any student exhibit which has previously entered competion in the Exposition will not be eligible for individual prizes but will be included in the judging of the best departmental exhibit. The results will be announced immediately after the judging and ribbons placed on the winning exhibits. All exhibits may be seen until 6 p.m. on Friday.

The crowning of the engineering queen and the race at 9:30 in the morning will re-open the Exposition Saturday, May 9. After the 1959 engineering queen has begun her reign, eight micro-midget cars owned by the Electrical Engineers, SAE, Chemical Engineers, Mechanical Engineers, Agricultural Engineers, Civil Engineers, Triangle and Chi Epsilon, will speed around the course by Kedzie, EE, and Chem Engineering. The EE's have won the race for three straight years to retire the trophy and will be trying again to speed across the finish line in first place, but pushing hard behind them will be the rest of the organizations several of which have built completely new cars to get back into the running. After the race all exhibits with their gimmicks and flashing lights will be on display until 6 p.m.

The Exposition will conclude Saturday night with the final event, the all-University May Hop at the Union Ballroom. Bob Eberhardt's orchestra will play for dancing from nine until twelve. At the intermission all prizes and trophies will be awarded, the Knights of St. Patrick will tap their new members and Phi Lambda Tau will announce the 1959 outstanding senior engineer.

Tau Beta Pi elected the following officers:

President: Milton Lutchansky
Vice President: Gordon Barnes
Recording Secretary: Ernest Kollar
Corresponding Secretary: Hal D. Smith
Treasurer: Dave Willets
Cataloger: Ray Lafrey

ARE you interested in an extracurricular activity that is different? If you are, give some thought to a position on the staff of the *Spartan Engineer*.

A number of positions will be open for the coming year. As most of you know the *Spartan Engineer* is staffed by students. We are mostly engineers, but this is not a requirement for a position on the staff. The only prerequsite is to be interested and to be willing to work. It would only require a small amount of your time, and you will find the work interesting.

Some of the things done by the staff include: getting or writing articles for the magazine. These articles may range from a light fiction article through information on engineering college to technical articles. For those with an artistic inclination, there is work on each issue's cover as well as illustrations or perhaps the drawing of some cartoons.

Since we are a self substaining publication, there is a certain amount of business dealings that must be taken care of. These involve working with ad agency and distributors. Other items which must be taken care of are publicity, lay out of magazine, editing of articles, and etc.

Members of staff will be available for interviewing persons interested in staff positions for the 59-60 school year, during the remainder of the school year. Come up and see us at the Spartan Engineering Office—346 Student Service Building.

The following staff changes have been announced:

PROMOTION TO PROFESSOR

James T. Anderson	M.E.
Herman E. Koenig	E.E.
Joachim E. Lay	M.E.
Leo V. Nothstine	C.E.
Irving Pflug	Ag.E.
Howard Womochel	Met.E.
George E. Mase	Ap.Mech.

PROMOTION TO ASSISTANT PROFESSOR

Hiremaglus K. Kesavan	E.E.
Richard J. Reid	E.E.
Bill A. Stout	Ag.E.

APPOINTMENT TO INSTRUCTOR

Eugene Neil Russell	C.E.

APPOINTMENT TO ASSISTANT INSTRUCTOR

Gerald Skellenger	M.E.
Grover C. Way, Jr.	C.E.
Paul H. Woodruff	C.E.

RESIGNATIONS AND TERMINATIONS

Richard L. Ditsworth	M.E.
Allan F. Moore	C.E.
Carl L. Shermer	C.E.
Rodney Wood	M.E.

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"Anodizing Aluminum Alloys in Chromic Acid"...... American Society for Testing Materials—Trade Papers

"Sulfonation and Sulfation"...................... *Industrial and Engineering Chemistry*

"Epoxide Yield Factors in Epoxidation Reactions".... *Journal of the American Oil Chemists' Society*

"Description of New Process for Uranium Hexafluoride" Section of Atomic Energy Commission book on uranium technology

"Isocyanate Resins" ...... *Modern Plastics Encyclopedia*

"Greek Position Indicators in Organic Chemical Nomenclature".... Nomenclature Symposium, American Chemical Society Annual Meeting

"Diazotization" .... *McGraw-Hill Encyclopedia*

"New Uses for Hydrogen Peroxide"................ *The Journal of Commerce*

"Analytical Chemistry of Chromium".............. Treatise on Analytical Chemistry

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"The Determination of Total Organic Matter as Carbon, in High-Strength Hydrogen Peroxide"............. Pittsburgh Conference on Analytical Chemistry and Applied Science

"Urea: Backbone of the Amino Resin Economy"..... *Journal of Commerce*

"Application of Low Molecular Weight Polyethylene in Rubber Compounding".............. *Rubber Age*

"Magnesium Dichromate Hydrates"............... *Journal of the American Chemical Society*

"Fluoro-Chemicals: Outlook for the Future"........ *Petroleum Refiner's Petrochemical Handbook*

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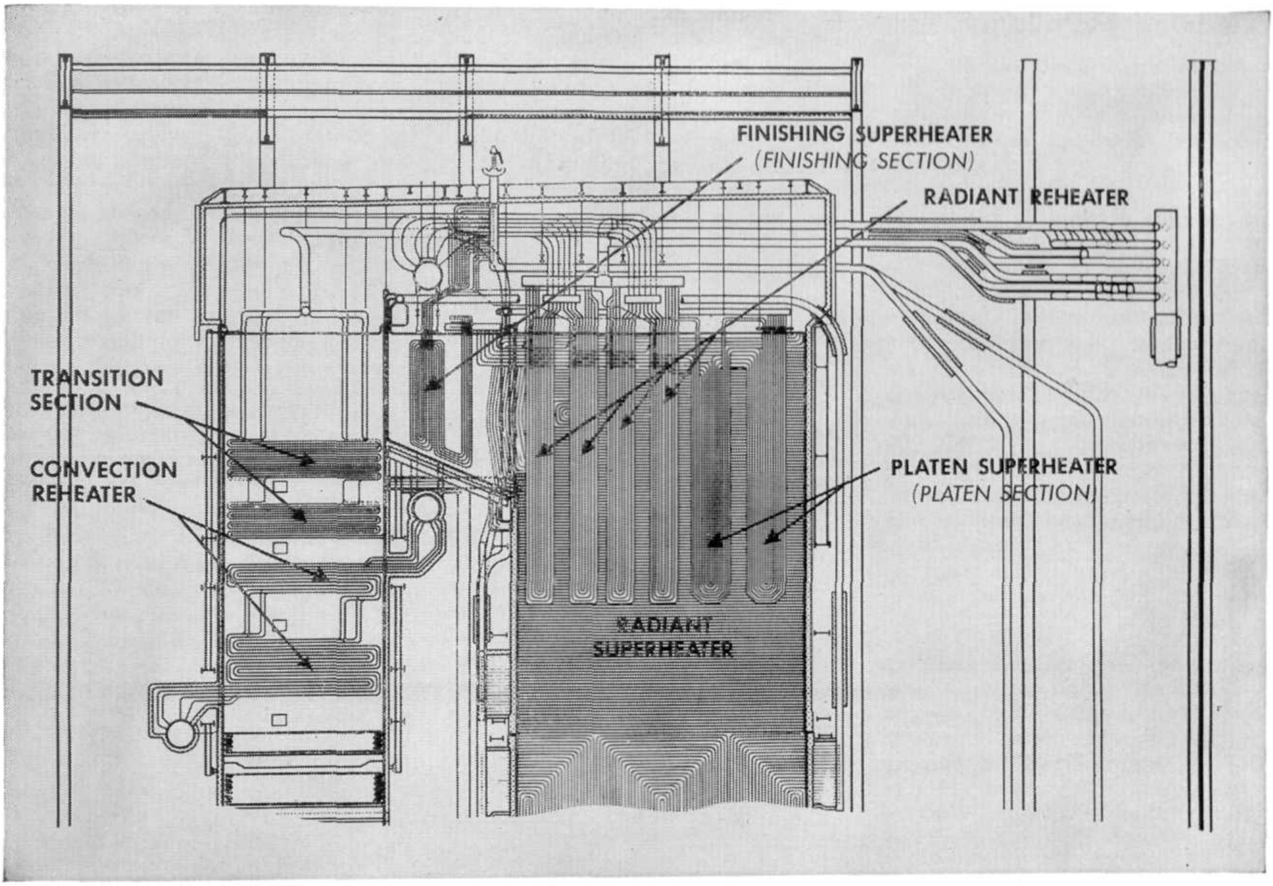

How to get steel tubes to harness highest steam pressures and temperatures

IN constructing Philadelphia Electric Company's revolutionary new Eddystone power plant, engineers had to harness the highest combination of pressure and steam ever achieved in a central station with 5,000 psi at 1,200°F. This called for superheater tubes (see diagram above) of a special stronger steel never before used in steam power plants. No one had ever succeeded in piercing this tougher steel to make seamless steel tubing.

The problem was given to Timken Company metallurgists, experts at piercing steels for 40 years. And they turned the trick. They made the steel for the platen and finishing super-heaters with the alloying elements in just the right balance for perfect piercing quality. They pierced *20 miles* of tubes free from both surface and internal flaws.

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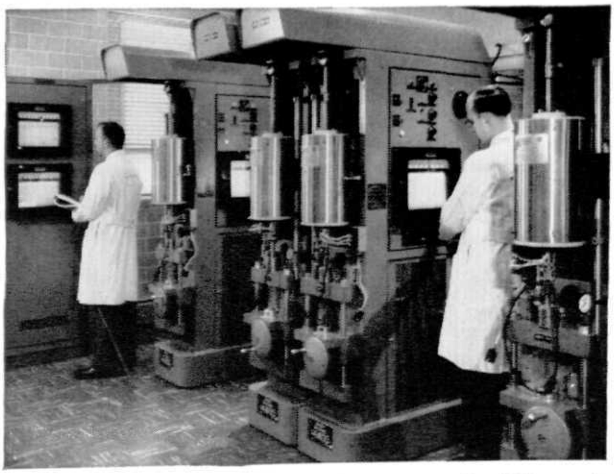

Creep-Stress Rupture Laboratory in our new Steel Research Center. Here we test the resistance of steels to deformation at temperatures as high as 1800°F.

TIMKEN® *Fine Alloy* STEEL

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Powdered Metallurgy

(*Continued from Page 18*)

leable platinum alloy by mixing platinum and silver in powder form, heating until the surface of the silver became molten and cemented the particles of platinum in place, and then obtaining a workable alloy of varying amounts of platinum as diffusion took place between the particles of the two metals. The refractory metals of today are handled in a similar fashion. Tungsten, for example, is impossible to work by conventional machining operations and, with a melting point of 6100F, impractical to cast commercially. These hard, refractory qualities are desired in many applications, however, and the development of a ductile tungsten through powder metallurgy has made this and similar metals commerically important.

Controlled porosity is another unique feature of powder metallurgy which was recognized early by the modern experimenters. Compacts may be produced with a porosity ranging from fifty percent voids to virtually absolute density. The so-called oil-less bearing was developed in 1916 using this feature of powder metallurgy. After pressing a porous metal compact, it is sintered in oil and, as it cools, the vacuum created in the pores of the compact literally suck in a supply of oil that will lubricate the finished bearing for long periods of time. Other porous metal parts are used as filters for gases, refrigerants, lyes, and other chemical solutions.

Besides those products which depend entirely on powder metallurgy for their unique qualities, powdered metals are favored in many competitive areas of production. Although metals are more expensive in powder form, and the initial cost of the equipment is high, many manufacturers elect to produce parts by powder metallurgy because of the overall savings they may enjoy. This is particularly true when a large number of comparatively small parts are to be produced. Virtual elimination of waste in the form of scrap, and the ability to utilize unskilled personnel are some of the economic reasons for turning to powder metallurgy.

Future Potential

New developments in powders, techniques, and equipment are continually widening the scope of powder metallurgy. Because of the ever-increasing metal requirements of a modern industrial civilization, and the need for a wide variety of qualities in metal parts, powder metallurgy will undoubtedly continue to play a more and more important role. In fact, as our needs become greater while our supply of metals becomes smaller, it is entirely within the realm of reason to predict that powder metallurgy will one day be the only feasible method of producing metal parts.

While powder metallurgical methods have become increasingly popular during the last few years, the continued growth of the field is largely dependent on education. Before World War II, only three or four schools offered courses in powder metallurgy. Today, of the schools offering degrees in metallurgy, over thirty offer courses in powder metallurgy. Many universities offer a chance to do research in the field. Powder metallurgy today places the prospective student in the comfortable position of having a firm foundation on which to work, along with a very promising future.

"AGGIE"

(*Continued from Page 28*)

Dean's Secretary and for the year and a half had laid in her drawer. Miss McCann had worried about how to order a replacement pin without letting the members of the fraternity know it had been lost.

Another time the class of 1943 bought Miss McCann a string of pearls and decided to present them to her at the Engineers Ball. They had a difficult time getting her to the ball, in fact, three engineers and their dates had to practically kidnap her to get her there, as she felt she might keep the students from having a good time, by being present.

Progress has caused many changes in the College of Engineering. The University is much bigger, and many more engineers are graduating now, but you'll find Miss McCann just as friendly as always. The transfer students with whom she is working will be glad to back up this statement. It's too bad every engineering student here at State doesn't get to know her better, because she sure thinks they are a swell bunch.

Technorama

(*Continued from Page 19*)

velopments in the application of engineering to industry and agriculture can be seen.

Technorama, as the building is to be called, will provide the most modern radio and television equipment from which many national programs and demonstrations will originate. Conference rooms and demonstration halls will also have closed circuit television, providing latest instructional data by lectures, demonstrations, and training sessions for many groups such as the Future Farmers, Agricultural Engineers, and industial societies.

As a direct benefit to the students at M.S.U., the Technorama will provide additional research facilities, teaching materials, part-time employment, additional job contacts, and excellent opportunities for developing scholarships and grants for education and research.

Technorama, in addition to providing its many teaching and research facilities, will be a major tool of the University in accomplishing the third great objective of a land grant university, namely, extension service which has for its purpose the conveyance of new ideas and principles to the people.

The present rate of contracts being received and promised by the Agricultural Engineering Department for display area reservations is excellent. It is expected that these displays will increase the number of visitors annually to M.S.U. from about 800,000 to well over a million persons. Of this number over 40% will be directly concerned with food production and handling. Technorama with Kellogg Center for Continuing Education, will be one of the largest and most modern conference centers in the world owned by a university.

The main structure is to be erected on Farm Lane, and will have 108,000 square feet of floor space. The attractive two story front section will be 60 feet long and 300 feet wide. The main exhibit area will be 200 feet by 180 feet and will be primarily for large, complex equipment. Designated areas will be used for special interest exhibits such as:

Transportation – irrigation and drainage – processes – materials – handling – structures – power and machinery – fuels and lubricants – electric light and power – communication – household equipment – chemicals – safety – health – agribusiness – weather – etc.

All exhibits are planned to be of educational nature, showing principles of operation, materials, and methods of construction and systems, as well as models or actual equipment. The motif of these exhibits will be modern, rather than museum-like, while the general tone will be that of new ideas, new developments, and new processes.

Operating as a separate section of the Agricultural Engineering Department, it will be manned by an additional staff, so it will not interfere with present teaching and research programs. This staff will have complete responsibility for leasing space, conducting demonstrations and tours, and developing interest in all areas.

The building is expected to be completed in early 1960, and will be open on a year-round basis, with plans calling for a seven day week for exhibitors. Exhibit space will be leased to commercial concerns and the money obtained from this source will be used to finance the building and its operation, including custodian services, utilities and personnel. From a potential field of 2,000 exhibitors, about 200 can be accommodated at

(*Continued on Page 40*)

ADVANCED WEAPONS STUDIES AT CHANCE VOUGHT

ASTRODYNAMICISTS. OCEANOGRAPHERS. Their perspectives are worlds apart. But a broad search for advanced weapons is bringing them and other diverse specialists together at Chance Vought.

Opportunities are unlimited for young engineers as Vought advances into new weapons areas.

This advance is the natural outcome of 42 years of successful design and manufacture of high-performance weapon systems. Vought ranks among the nation's topmost sources of fighter aircraft, with the F8U-1 *Crusader* fighter and the F8U-1P *Crusader* reconnaissance aircraft on duty with both Fleets. An even deadlier version of the *Crusader*, the F8U-2N, is scheduled for Fleet service in 1960.

FROM SPACE EXPLORATION TO ANTISUBMARINE WARFARE . . . THEY OFFER BROAD OPPORTUNITIES TO COLLEGE GRADUATES

Today at Chance Vought, development work fans out into virtually every dimension of weapon systems.

ANTISUBMARINE WARFARE (ASW). Vought is engaged in ASW studies under the Office of Naval Research and the Bureau of Aeronautics. Extensive research and development is being done in the vital detection and classification phases. Goal is to bring detection abreast of destruction capabilities.

Vought applies to this work a pre-eminent background in sea-going missiles: 11 years' experience in installing, testing, observing Regulus Fleet missiles; an intimate knowledge of submarines.

ASTRONAUTICS. Vought is advancing the technology of the man-carrying portion of space vehicles. A reputation for "human factors" know-how in advanced aircraft development has won contract assignments for space capsule development. The company is adding research and test facilities for advanced regimes of speeds and heats. And, through "space seminars," the company's most experienced space scientists are orienting the entire engineering organization for space projects.

WEAPON SYSTEM PLANNING, ANALYSIS. Vought specialists are determining future weapons requirements; defining new areas for closer evaluation. For example, Vought's advanced weapons thinking has branched out into the area of new, sophisticated battlefield weapons. This area has proved promising and well within Vought's weapons development capabilities. Also under way are studies of nuclear-powered missiles and other original applications for today's growth of propulsion possibilities.

In this area, breakthroughs already have been scored in antenna design, in structural design for re-entry heat, and in controls and hydraulics.

CHANCE VOUGHT AIRCRAFT

DALLAS, TEXAS

SIDETRACKED

A farmer was phoning a veterinarian. "Say, Doc," he said, "I've got a sick cat. He just lays around licking his paws and doesn't have any appetite. What shall I do for him?"

"Give him a pint of castor oil," said the vet.

Somewhat dubious, the farmer forced the cat to take a pint of castor oil. A couple of days later he met the vet in town.

"How's your sick calf?" inquired the vet.

"Sick calf! That was a sick cat I had."

"My gawd, did you give him the pint of castor oil?"

"Sure did."

"Well, what did he do?" asked the vet.

"Last time I seen him," said the farmer, "he was going over the hill with five other cats. Two were digging, two were covering up, and one was scouting for new territory."

° ° °

This idea for balancing the national budget without further taxes was advanced the other day in Economics class: The government should put all the men on one island and all the women on another—then go into the ferry business.

° ° °

Little boy watching milkman's horse: "Mister, I bet you don't get home with your wagon."

Milkman: "Why?"

Little boy: "Cause your horse just lost all his gasoline.

° ° °

Once upon a time, as the story goes, the fence between Heaven and Hell broke down. Satan appeared at his side of the broken section and called out to St. Peter, "Hey St. Peter, since all the engineers are over on your side, how about sending a few to fix the fences?"

"Sorry," replied St. Peter, "my men are too busy to fix fences."

"Well then," said Satan, "I'll have to sue you if you don't."

St. Peter: "Guess you win; you've all the lawyers on your side."

° ° °

Suitor: "Sir, I have an attachment for your daughter."

Father: "Young man, when my daughter needs accessories, I'll buy them myself."

° ° °

"Oh, here's the place Mother told me to stay away from—I thought we'd never find it."

Fraternity brother: "Did you know that we maintain seven homes for the feeble-minded?"

Pledge: "I thought you had more chapters than that."

° ° °

A small boy was seated on the curb with a pint of whiskey in his hand, reading Esquire and smoking a big cigar. An old lady passed and asked, "Little boy, why aren't you in school?"

The infant replied, "Dogonit, lady, I ain't but four."

° ° °

Of course you've all read the immortal words of Benjamin Franklin: "Kid, keep your damn hands off my kite."

° ° °

LIFE OF A JOKE

1 minute: Freshman thinks of a joke and tells it one night to his girl friend.

1 day: Joke circulates through the women's dorm and senior engineer overhears it.

1 week: Senior sends joke in to humor editor, claiming origination to himself. Humor editor thinks joke is miserable, but since deadline has been set up one day and he is desperate for five more lines he decides to use it.

1 month: Joke appears at bottom of gag page. Humor editor is forced into exile.

1 year: Joke circulates through every engineering college magazine from Alabama to Canada, and from New York to Washington.

2 years: Gag writer for a radio program finds local college magazine on a bus and sees joke therein. Joke appears on next week's program. Gag writer loses union card.

2½ years: Reader's Digest prints joke from radio program.

4 years: College professor finally gets around to reading the issue of Reader's Digest and laughs heartily at joke.

5-30 years: College professor uses joke to start off his lectures at beginning of each term.

35 years: Joke passes on as does college professor.

° ° °

Prof: "These reports should have been written so that even a high-grade idiot could understand them."

Engineer: "Yes, sir. What part don't you understand?"

The trouble with Russian Roulette is that there aren't enough Russians playing it.

° ° °

Chem. E.: "I haven't touched a drop in two months."

M. E.: "Neither have I, friend, but don't you think we'd better knock on wood?"

Chem. E.: "Sure, let's go and pound on a bar."

° ° °

An old Indian visited the big city the first time in his life. He entered a building and watched a little old lady step into a small room.

The doors closed behind her. Lights flashed and a dial above the door moved from one up to ten and back again. A bell tinkled. The doors came open, and a beautiful young girl stepped out of the elevator.

Blinking in amazement, the Indian grunted, "Me should have bring um squaw."

° ° °

A young man whose father had been hanged was filling out a college application. After the usual hereditary questions there was one asking the cause of the death of his parents. He thought awhile and finally put down this answer: Mother died of pneumonia. Father was taking part in a public ceremony when the platform gave way.

° ° °

A business efficiency expert put the following sign on the wall of a big concern: PUT IT OFF NO LONGER—DO IT NOW. That same day the office boy kissed the secretary, the bookkeeper punched the treasurer in the nose, the porter broke three windows, the salesman burned his sample case, and the cashier left town with $100,000 and the boss' wife.

° ° °

Imagine the newspaper boy's embarrassment when he opened the wrong door in the depot waiting room and yelled, "Extra paper!"

° ° °

District Attorney: "And you mean to say that you had sixteen beers and didn't move from the table the night of the fight."

° ° °

A fishing pole, some women say, is a stick with a worm at both ends.

° ° °

"Here's to the land we love, and vice versa!"

JETS

(Continued from Page 15)

Development Operations Division, Army Ballistic Missile Agency, Huntsville, Alabama. Dr. Stuhlinger has selected "Where Is the Limit" as the title for this talk. He will cover past and present achievements, plans for the near future, and the possibilities for manned space travel. Special emphasis will be placed on chemical, nuclear, electric, and photonic rockets, regarding their usefulness and feasibility.

Dr. Stuhlinger brings to the program a varied background in scientific research. After receiving his doctorate in physics at the University of Tuebinger in 1936, he was appointed assistant professor of the physics department at the Berlin Institute of Technology. During his tenure at the institute he worked closely Dr. Hans Geiger, developer of the well known Geiger counter.

In the spring of 1943, he joined the Rocket Development Center at Peenemuende under the direction of Dr. Wernher von Braun. Here Dr. Stuhlinger carried on research in connection with the development of guidance and control systems for the V-2 guided missile.

Dr. Stuhlinger came to the United States in 1946 under the auspices of the ordance Corps, U. S. Army. He conducted research and development work with guided missiles at Ft. Bliss, Texas, and assisted in high altitudes research firings of captured V-2's at White Sands Proving Grounds, New Mexico.

From 1950 to the present time, Dr. Stuhlinger has been a member of the guided missile team at the Redstone Arsenal, Huntsville, Alabama. Recently he has gained recognition for his feasibility and design studies of electrical propulsion systems for space ships.

Concluding the program for JETS will be an awards presentation at the Kiva of the Education Building at 7:30 P.M. on May 8. Dean J. D. Ryder, will present the awards to the winners of the project contest. In addition, Dean Ryder will present scholarships to the recipients who are JETS members. Another feature of the event will be a reading of the winning paper of the JETS Essay Contest, "The Engineer and Tomorrow's Society," by the author, Daniel S. Kasprzyk. All students and faculty members are invited to attend any or all parts of the JETS program.

Technorama

(Continued from Page 36)

any one time. The Technorama will bring new money and jobs to the campus and will provide many distinct advantages to the regular teaching and research program.

This is an effort to bring new ideas in better living, better farming, and better processing of agricultural products to all concerned and to further the services of a land grant institution towards meeting the educational needs of the people.

ADVERTISERS' INDEX

Though the building is not yet built, this is a view from one of the apartments.

How to look out a window before the building is up

With 180 "view" apartments to sell, the developers of The Comstock turned to photography to get a jump on sales

A feature of The Comstock, San Francisco's new co-operative apartments on top of Nob Hill, will be the spectacular panoramic views of the Bay area from their picture windows.

How could these views be spread before prospective buyers—before the building was up? The developers, Albert-Lovett Co., found the answer in photography. From a gondola suspended from a crane, color photos were made from the positions of the future apartments. Now, the sales representative not only points out the location of a possible apartment on a scale model, but shows you the view from your window as well.

Photography rates high as a master salesman. It rates high in other business and industry tasks, too. The research laboratory, the production line, the quality control department and the office all get work done better and faster with photography on the job.

Whatever your field, you will find photography can save you time and cut costs, too.

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TRADEMARK

General Electric interviews Dr. Richard Folsom, President of Rensselaer Polytechnic Institute, to explore . . .

Teaching— A Career Opportunity For the Engineer

Leading educators, statesmen and industrialists throughout the country are greatly concerned with the current shortage of high-caliber graduates who are seriously considering a career in the field of science or engineering education. Consequently, General Electric has taken this opportunity to explore, with one of America's eminent educators, the opportunities and rewards teaching offers the scientific or engineering student.

Q. Is there in fact a current and continuing need for educators in technical colleges and universities?

A. Colleges and universities providing scientific and engineering educational opportunities are hard pressed at the present moment to obtain the services of a sufficient number of well-qualified teachers to adequately carry out their programs. Projected statistical studies show that this critical need could extend over the next 15 or 20 years.

Q. Why is this need not being met?

A. There are probably three main reasons. These might be classed under conditions of financial return, prestige associated with the position, and lack of knowledge and understanding on the part of the college student of the advantages and rewards teaching as a career can afford.

Q. What steps have been taken to make education a more attractive field to engineering students?

A. Steps are being taken in all areas. For example, we have seen a great deal in the newspapers relating educators' salaries to the importance of the job they are doing. Indications are that these efforts are beginning to bear fruit. Greater professional stature is being achieved as the general public understands that the youth of our nation is the most valuable natural resource that we possess . . . and that those associated with the education of this youth have one of the most important assignments in our country today.

Q. Aside from salary, what rewards can a career in education offer as opposed to careers in government or industry?

A. The principal rewards might be freedom to pursue your own ideas within the general framework of the school, in teaching, research and consulting activities. As colleges and universities are normally organized, a man has three months in the summer time to engage in activities of his own choice. In addition, the educator is in direct contact with students and he has the satisfaction of seeing these students develop under his direction . . . to see them take important positions in local and national affairs.

Q. What preparation should an engineering student undertake for a teaching career?

A. In college, the engineering student should obtain a basic understanding of science, engineering science, humanities and social sciences with some applications in one or more professional engineering areas. He should have frequent career discussions with faculty members and his dean. During graduate work, a desirable activity, the student should have an opportunity to do some teaching.

Q. Must an engineering student obtain advanced degrees before he can teach?

A. It is not absolutely necessary. On the other hand, without advanced degrees, advancement in the academic world would be extremely difficult.

Q. How valuable do you feel industrial experience is to an engineering or scientific educator?

A. Industrial experience for a science educator is desirable; however, with a senior engineering educator, industrial experience is a "must". An ideal engineering educator should have had enough industrial experience so that he understands the problems and responsibilities in carrying a project from its formative stages to successful completion, including not only the technical aspects, but the economic and personal relationships also.

Q. What do you consider to be the optimum method by which an educator can obtain industrial experience?

A. There are many methods. After completion of graduate school, perhaps the most beneficial is a limited but intensive work period in industry. Consulting during an academic year or summer is a helpful activity and is desirable for older members of the staff. Younger educators usually need experience in "living with the job" rather than providing consultant's advice to the responsible individual.

Q. Based on your experience, what personal characteristics are possessed by successful professors?

A. Primarily, successful professors have an excellent and growing knowledge of their subjects, are interested in people, and transmit enthusiasm. They have an ability to explain and impart information with ease. They generate ideas and carry them out because they are devoted to developing their fields of knowledge. They desire personal freedom and action.

For further information on challenging career opportunities in the field of science and engineering education, write to: Mr. W. Leighton Collins, Secretary, American Society for Engineering Education, University of Illinois, Urbana, Ill. 959-10

GENERAL ELECTRIC