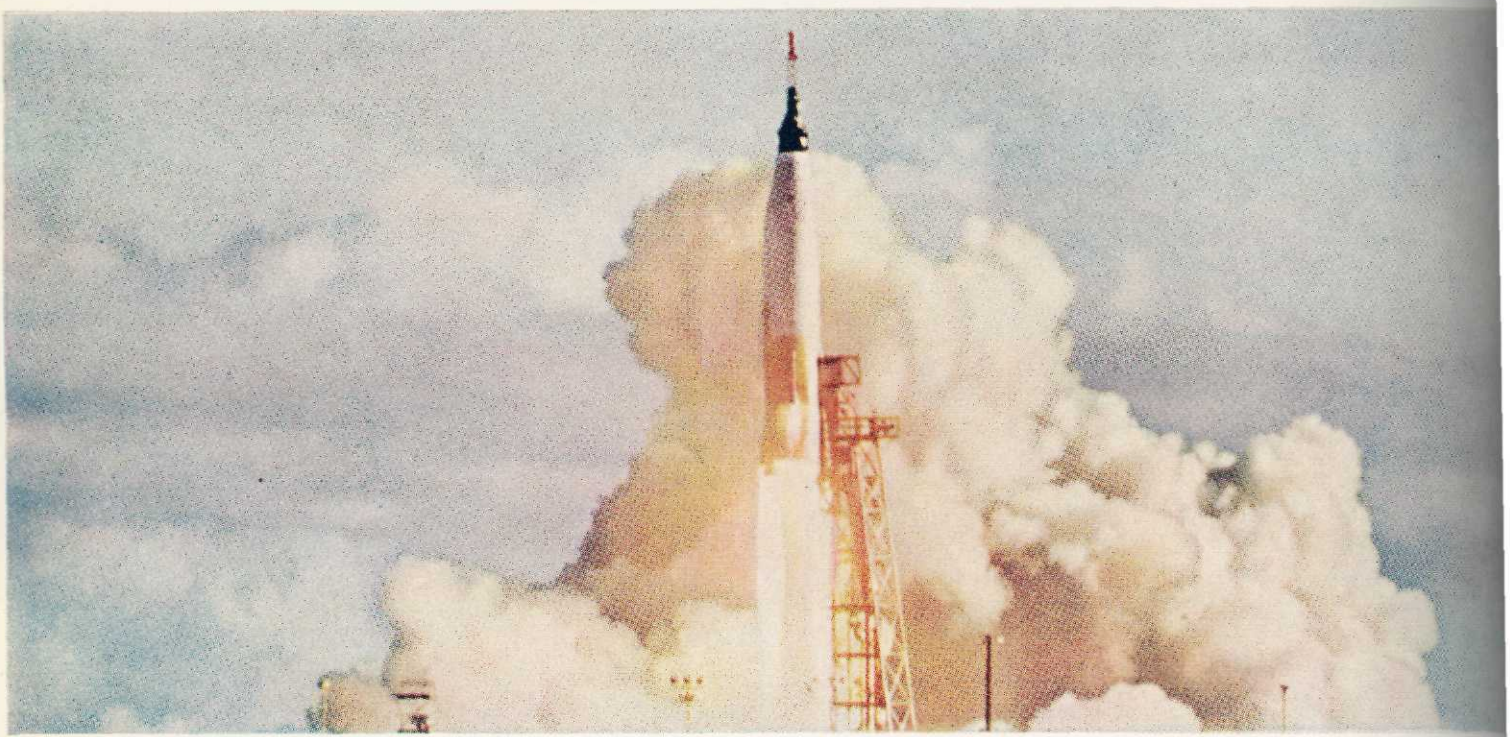
SPARTAN ENGINEER

NOVEMBER, 1964

25¢

Why would a scientist pay $3200 for this little coil of wire from Westinghouse?



Because it is leading to new discoveries in physics, electric power and space travel.

The little coil is made with a most remarkable wire. Cooled to 452°F below zero, it becomes a super-conducting magnet.

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Class _____ Major _____ Degree expected _____

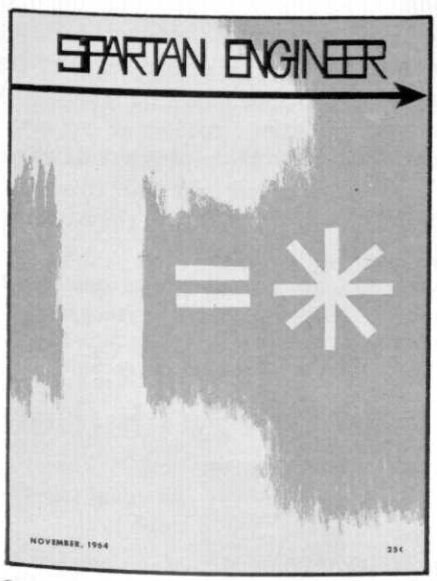
College _____

My address _____

City _____ Zone _____ State _____

SPARTAN ENGINEER

VOLUME 18 NUMBER 1 NOVEMBER, 1964



The Cover, drawn by Phil Frank, symbolizes atomic power equated to life. The theme reflects Dr. Edward Teller's concept of need of applied science.

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The lecture hall is filled. Hundreds of open and receptive intellects quiet in expectation. It is time. The esteemed professor enters the stage. He arranges some sheets on the lectern. Adjusting the neck microphone, he turns to the class. The class awaits.

His opening words are inaudible, but the students know they were great and powerful. As he continues, the professor exposes his vast intelligence and experience. The students try to ignore his monotone voice, lack of gestures, lack of humor, lack of visual aids, lack of volume, authority, and confidence. They tread through these faults to the words uttered and try to record them all. They sense immense meaning and information when the phrases are finally, coherently organized.

Each in his own way, let us pray. Pray that next year, this professor, and all like him, shall never have the opportunity to damage another student's education.

It is professors like this one that ruin a class for the students and make them dislike the entire subject. It is no fun and certainly not fair, to have to listen to a man address a large group when he is scared, ill-prepared, and literally incompetent for this type of teaching. He belongs in a small, informal recitation section. This is where his experience and knowledge is useful to answer all the questions and lead the students through their assignments.

The all too terrible reply to this problem is that there is no solution since there are not enough of the needed type of professor. There are desperately few who are qualified to lecture groups of over a hundred. So it is, that the teaching profession is pressed upon the freshmen with added zeal in an attempt to bring more into the field. With this extreme pressure, is the futile hope that a few more adept lecturers will stand out of the mass.

This is one of the most ignorant and outrageous modes of thought of this era.

Assuredly, many more teachers are needed to fill vacancies left by retirees and incompetents and new schools. However, if America were to apply the technological advancements of the last decade, the number of present teachers could be proportionately sufficient.

Let each college extract its best lecturers from the rest. Make them "professional lecturers." Separate from the remaining faculty, the best writers in each subject field. Make them "professional writers." Let the rest be recitation leaders.

The college first decides what the courses to be offered will be. Then, the professional writers write the term or semester lectures. These are given by the professional lecturers to huge lecture sections. After these classes, the students have a number of recitation sections at which to ask relevant questions, turn in homework, and receive new assignments.

To increase the number of students able to take any one course, the lecturer gives his talk to either live or film cameras. By means of screens or closed-circuit television sets in the recitation rooms, the students hear the lecture and stay for the recitation. Thousands of students can be taking the same course in this way, get the benefits of a particularly good speaker and still have all the advantages of small-group sessions.

If utilized, a method similar to the one outlined here could allow one man and a number of staff members to conduct a course for an unlimited number of students.

Let us hope that "space age" teaching methods are soon brought out of the experimental classrooms and given a chance to benefit all.

John Locke

SE

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A Rest-filled Aside

blackened eyes.
yellowed piano keys.
red nose.
whitened fence.
purpled hand-back raised veins.
green clothes.

soft blue robbins' eggs
held close by dry breasts of trees
trees so not like me.

A black boy asked my hand today,
And then he showed the sky to me,
And then he showed the dirt to me,
And then he said: "We'll overcome."

He said: "The choice is yours sweet one,
to see the stars, or see the mud."
Then, hand in mind and looking up,
He said: "We'll overcome.'

He looked up hard, then looked at me,
And with his eyes so full and wet,
With shaking voice, he dropped my hand.
"Some day we'll overcome."

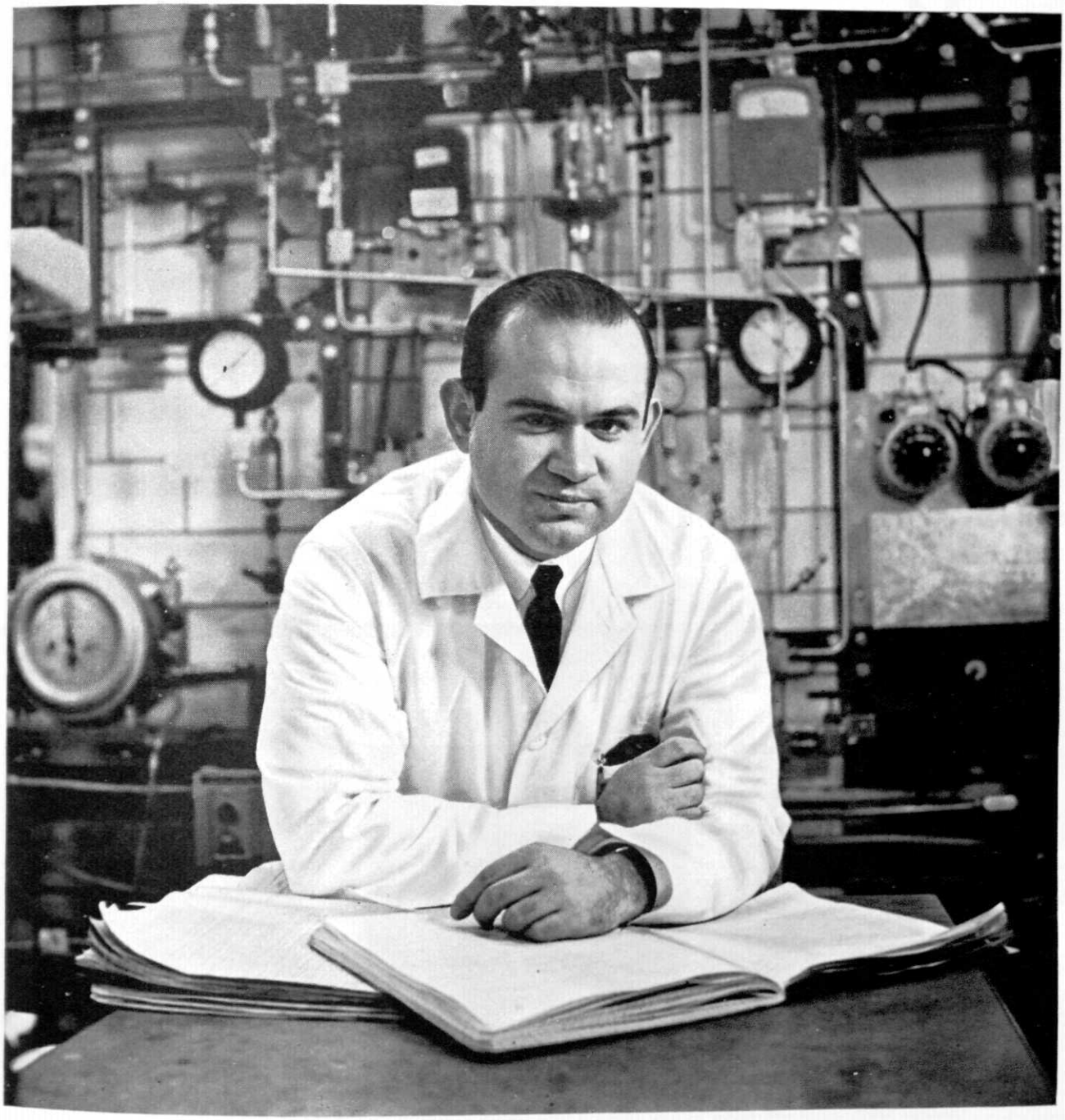
If skies are vast and infinite,
A robin's egg's the same color.

My love for you is like a drop of rain,
Crashing into an enraged, insensitive sea,
Unaware it's any fuller.

If to describe a woman's down, long neck
And breasts and thighs and tail and claws
And wing-like lips and eggs is exciting,
Why isn't a chicken?

The world is no-mean
if not too-much-with-us now
but only not-now.

MARIAN L. LOCKE



Anyone for hydrodesulfurization?

How about it? Want to hydrodesulfurize? Hydrodesulfurize oil, that is. Fuel oil. Dr. James Mosby, Purdue, '64 does. He experimentally optimizes the commercial procedure for removing sulfur. He's been working on hydrodesulfurization ever since he joined the American Oil Company as a chemical engineer last January. That's his pilot plant behind him.

Even if you'd rather not hydrodesulfurize, there are literally scores of other science and engineering opportunities at American Oil. If you're interested in a career in the petroleum industry, write to J. H. Strange for information. His address: American Oil Company, P. O. Box 431, Whiting, Indiana.

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AMERICAN OIL COMPANY

STANDARD

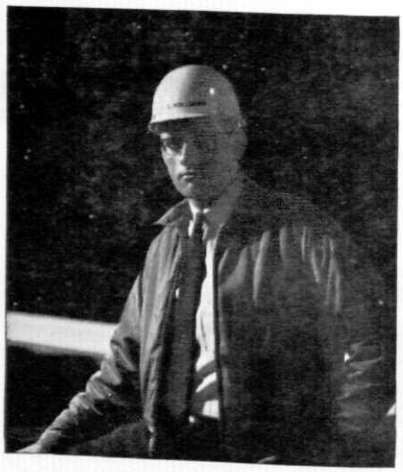
Men on the move at Bethlehem Steel

DON YOUNG, MET.E., DREXEL '62—Don is General Turn Foreman in our Bethlehem, Pa., Plant's electric furnace melting department, producing fine alloy and tool steels.

WALT BANTZ, E.E., SCRANTON '63—Engineer at our research laboratories in Bethlehem, Pa., Walt is shown evaluating performance of ultrasonic equipment for detection of flaws in steel plates.

DAVE SPARKS, MIN.E., OHIO STATE '60—Dave is Assistant to the Superintendent of one of our modern mines. His previous assignments covered virtually all aspects of our coal mining operations.

ROLAND MOORE, C.E., MICHIGAN '59—Rollie is our Sales Representative in Des Moines, Iowa. His technical training has been a valuable asset in selling steel products.



ROGER BOLLMAN, M.E., RENSSELAER '60—Roger is a production engineer in the Sparrows Point plate mills. He has been working on the development of rolling procedures for alloy steel plates.

JIM LESKO, CH.E., PENN STATE '60—As Turn Foreman in the coke works at our Johnstown, Pa., Plant, Jim applies both his undergraduate engineering background and his natural leadership abilities.

These alert young men are a few of the many recent graduates who joined the Bethlehem Loop Course, one of industry's best-known management development programs. Want more information? We suggest you read our booklet, "Careers with Bethlehem Steel and the Loop Course." Pick up a copy at your Placement Office, or write to our Manager of Personnel, Bethlehem, Pa.

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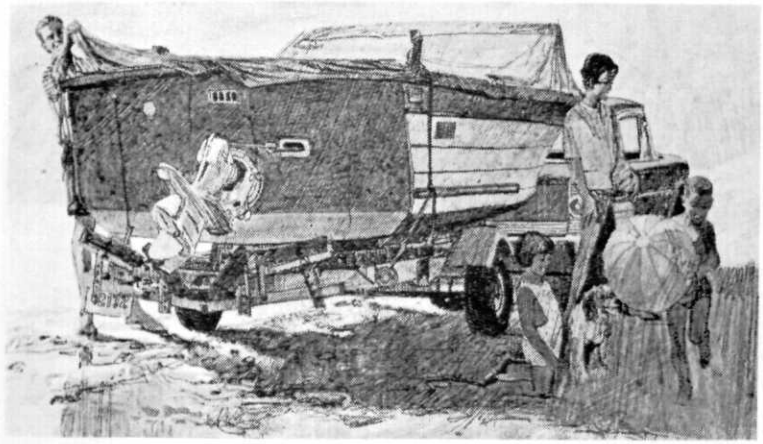

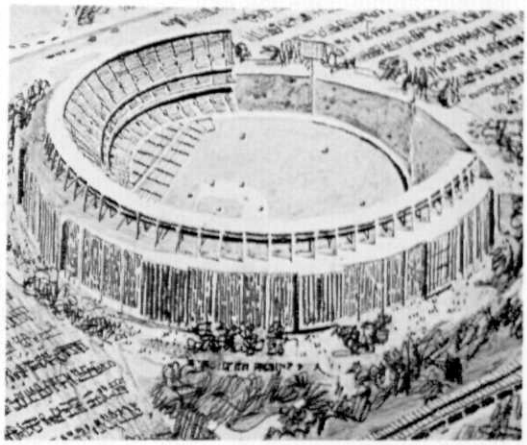

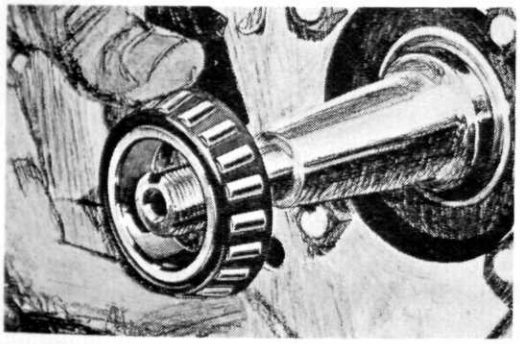

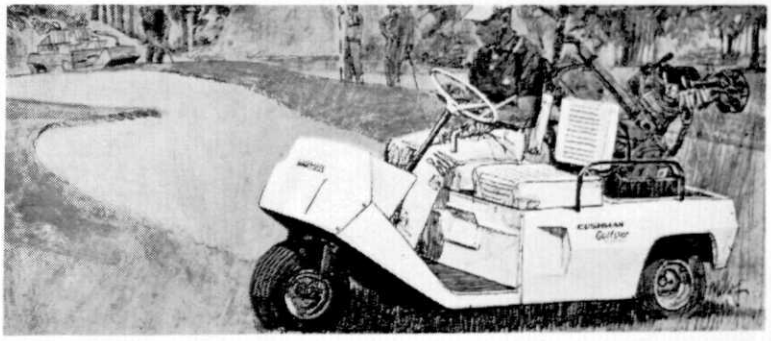

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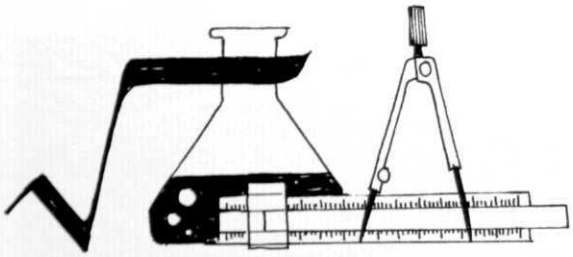


PLACEMENT BUREAU

December 1
Toledo Engineering

December 2
Richardson Homes Corp.

December 3
Simplicity Engineering

December 7
Lee C. Moore
Libby, McNeil, & Libby

December 9 & 10
Standard Oil Company - Ohio

December 10
U. S. Naval Avionics Facility

December 11
U. S. Army Material Command

January 13
The Pennsylvania Railroad Co.
Pennsalt Chemicals Corp.

January 14
Morse Chain Company
The Durion Company

January 15
Northrop Norair
Naval Research Laboratories

January 18
Naval Aeronautics & Space Adm.
Packaging Corp. of America

January 19
National Gypsum Co.
U. S. Army Engineer, dist. of Detroit.
Acme Steel Co.
Leeds & Northrup Co.

January 20
Union Carbide, Plastics Div.
U. S. Atomic Energy Commission

January 21
Hamilton Standard,
Div. of United Aircraft

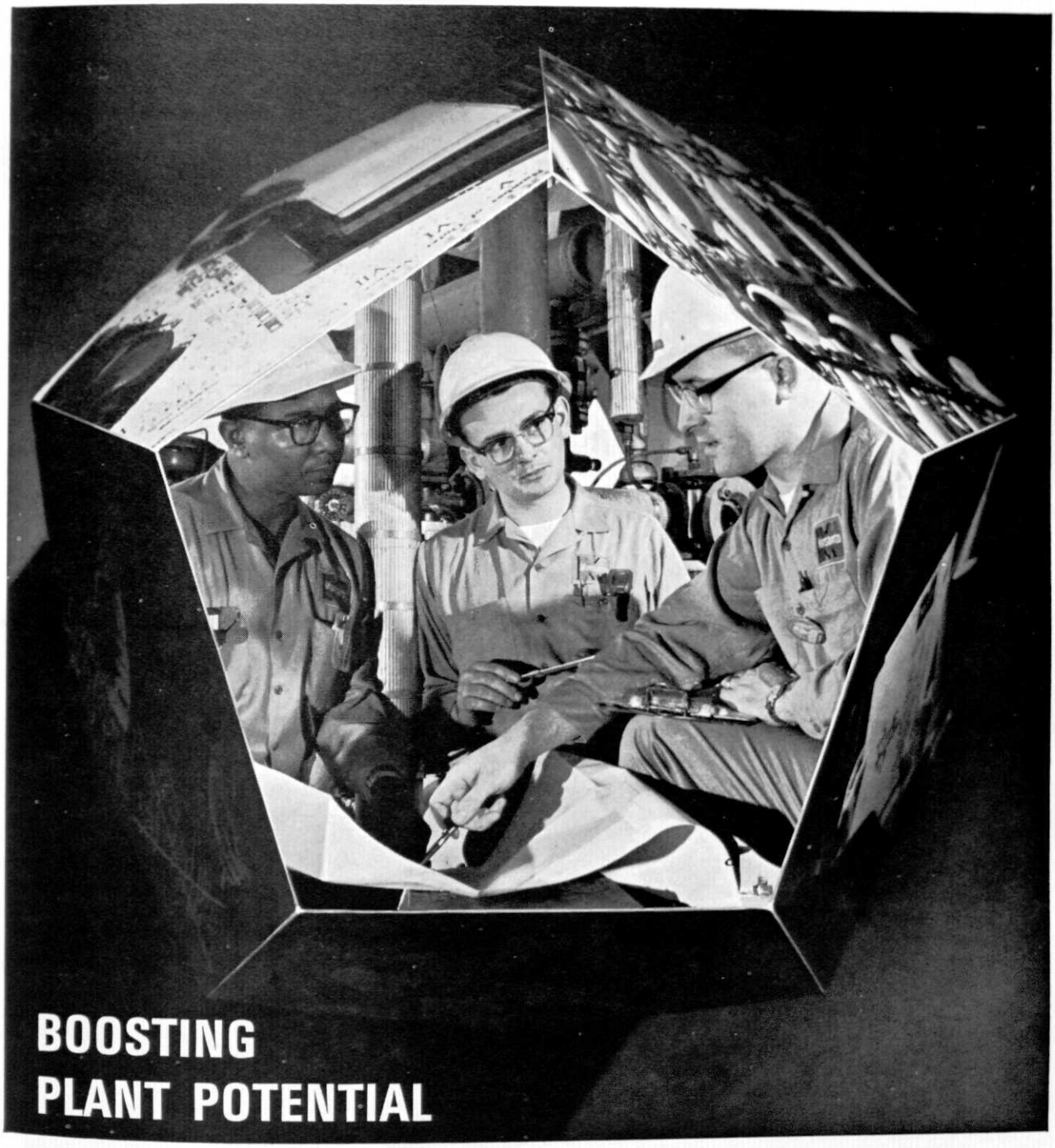
January 22
Corn Products Co.

January 25
American Enra Corp.
New Holland Machine Co.
Surface Combustion,
Midland-Ross
Federal-Mogul-Bower Bearings
Reynolds Metals Co.

January 26
General Telephone & Electronics
Swift & Co.

January 27
Owens-Illinois Tech Center
Columbia Gas of Ohio, Inc.
National Bureau of Standards
American Oil Co.

January 28
Mich. Bureau of Public Roads
W. R. Grace & Co.
Industrial Nucleonics
Allied Chemical Corp.
Lederle Laboratories,
American Cyanamid
Devea & Raynolds Co.



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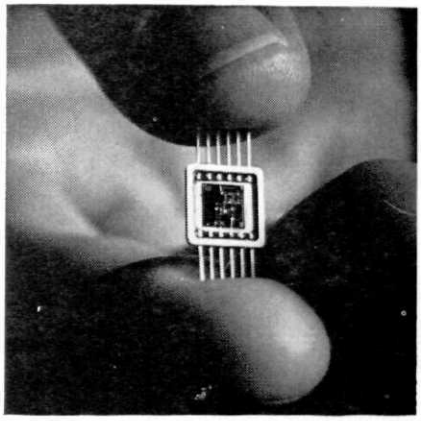
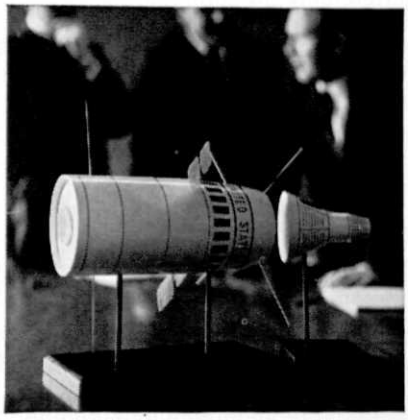
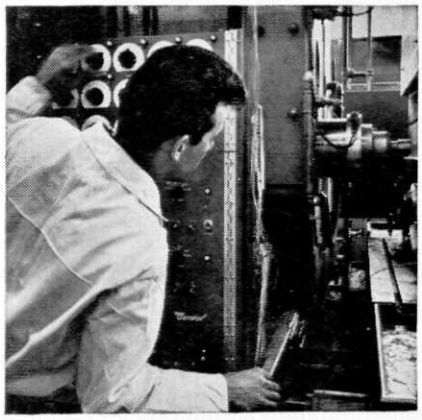


microcircuitry,

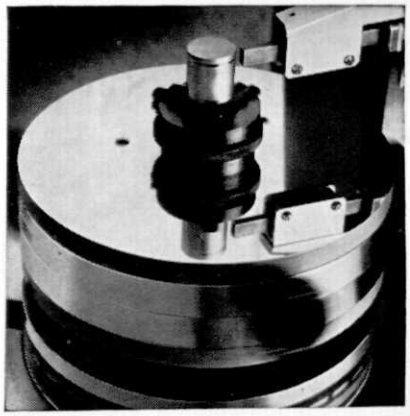


controls for space stations,

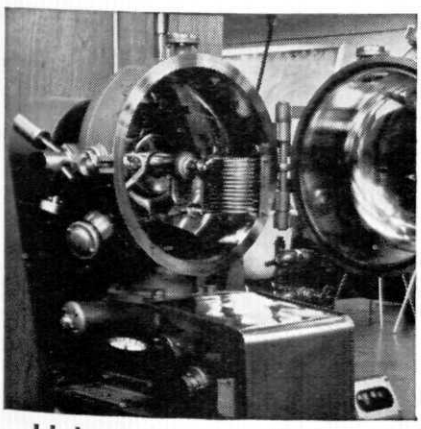
all-weather landing systems,



self-adaptive machines,

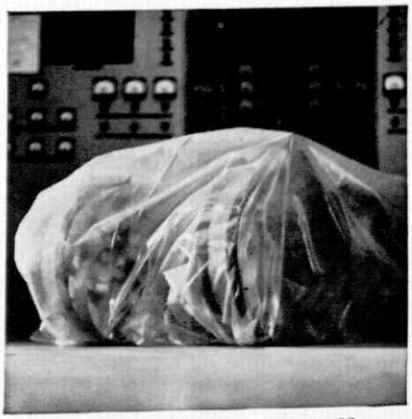


noncontact measuring gages,



high vacuum equipment,

automotive brakes,



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. . . What Can Be Done, Will Be Done

by Dr. Edward Teller

EDITOR'S NOTE: The following is part of a talk given by Dr. Edward Teller before the annual meeting of the Society for Engineering Science held at Kellogg Center at MSU.

I believe that the role of the inventor has changed. It is an important change and one which I would like to illustrate by referring you to the greatest inventor. He is a man who perhaps also has been the last of the inventors, Thomas Edison. He was, to my knowledge, the first to organize a research laboratory. Perhaps it was small on the scale of our present laboratories, but quite productive. Apparently, he recognized that even at that time, more than half a century ago, the world and science had become too complicated for a single man to be really effective in making inventions.

I would like to use Edison also in another connection by comparing him with a more modern inventor, a great scientist and a friend of some of us, Enrico Fermi. He participated, and was one of the leaders, in this inventive process that led to nuclear energy. I feel that it is amusing in one way to compare Fermi with Edison. Fermi started life as a theorist. Edison started life as a thinker. You would imaging that in this modern world, all the advantages would lie with the theorist. His guesses should be educated. He should not need to fall back on Edisonian methods of research of trying everything and sifting out something. Yet, in atomic energy there is historically a very well documented and remarkable story.

In 1931, the neutron was discovered and it changed the life of Fermi. He found that a particle, something like a nuclear particle, that has no charge so it can freely approach any nucleus, was much too interesting an object to be left alone. He organized a very remarkable experimental team and turned himself from a theorist to an experimenter.

In the course of Fermi's experiments, he bombarded practically all of the Periodic Table with neutrons, and discovered a great number of new isotopes and patterns of the neutrons. Many years later, he collected some money from these patents.

After he had done quite a bit of this, he finally turned to the activity of bombarding uranium with neutrons. Now, you know what happens when you bombard uranium with neutrons, but he didn't. What he found was that when you bombard some element, you get one, two, or four artificial radioactive substances. When he bombarded uranium, he got such an over-abundance of these substances that he and his collaboraters could not analyze and recognize them as anything. So, he said: "I've made transuranic elements," and, incidently, got the Nobel Prize for it. There was some doubt of how, by the bombardment of one substance with a neutron source that was not a particularly strong one, you should get all this wealth of new radioactive substances.

One day, Fermi got a letter from a German chemist, Mrs. Novac.

Mrs. Novac suggested what it was that he really had done. She said the neutron gave the uranium nucleus a sufficiently great amount of energy to split it in two and that the splitting could happen in a number of ways. This, she said, is the reason

Fermi found so many activities. Now, Fermi was a good physicist and an excellent theoritician and he immediately recognized that what Mrs. Novac suggested could not possibly be true. Why? Because he knew approximately how much energy was released when a neutron was added to a uranium nucleus. He also knew that when two parts of the uranium nucleus were to move apart to form individual nuclei, then a lot more energy would be needed than the amount of energy the neutron could possibly have carried in. He also knew that in quantum mechanics, in atomic theory, particles could surmount or, rather, leak through potential barriers. He also could calculate that this leaking through for as massive particles as uranium fragments, as fission fragments, had much too small a probability. He calculated and rejected Mrs. Novac's hypothesis as a mathematical impossibility. It was an admirably thorough piece of work. There was just one little thing wrong with it. The mass values upon which his energy values were based, values which, at that time, were accepted by all experimental physicists, were faulty. This, however, is not the end of the story. Fermi then conceived of a particularly interesting experiment. Realizing uranium spontaneously emitted alpha particles, he thought that if a neutron was added to the uranium substance, this added energy should help the alpha particle to escape and you should get particularly energetic alpha particles out of the uranium. This, he was to investigate.

But Fermi was a very careful physicist. He did not want these extra fast alpha particles to be mixed up with all the alpha particles that normally would be observed. So, he carefully covered his uranium sample with a thin foil just thick enough to absorb all the natural alpha particles. Then, he could look for the extra fast ones. Not in a single experiment did he forget to put on this extra foil. This was a pity, because this foil not only stopped the natural alpha particles, but also stopped those big fission fragments which Mrs. Novac so carelessly proposed and which would not have gone unnoticed had Fermi just noticed them once. It is strange to think what would have happened if Fermi had done a little more of his own research. Fission might have been discovered in 1935 rather than in 1938 and quite conceivably the history of the world, and I say that without exaggeration, might have been different. It is important to have more than one approach.

Professor Edward Teller, Assistant Director, Lawrence Radiation Laboratory, University of California, and Professor Tracy Y. Thomas, The Graduate Institute of Mathematics, Indiana University, talk in Kellogg Center before Dr. Teller's appearance.

I am telling you that modern invention is a very complex process, a process in which, in the Manhattan Project, thousands of people participated. There were engineers, physicists, some chemists, and mathematicians. The mathematicians were really first-class men, but they rarely made any relevant calculations. The chemists went slightly mad over the compounds that were asked to be delivered, which had impurities that never before had been required. The engineers had a sound and well-founded conviction that everybody except themselves was mad. The physicists, of which I was one, had a feeling of desperation that if anyone would listen to them, something conceivably might be accomplished. In fact, I'm quite sure that since the time the Babylonians took in their heads an impossible engineering enterprise, such confusion did not exist.

Dean Ryder, I am sorry to disagree with you, but all universities are not interdisciplinary. They never have been as disciplinary as they are now. Pure scientists have never been as pure, specialists never as special, and our young Ph.D's never as full of conviction that the only reasonable thing, the only dignified thing, to do is pursue knowledge for the sake of knowledge, and that no self-respecting person should dirty his hands or his mind with any work connected with applications.

When I talk of the education of the modern inventor, I am really doing nothing more than using a fancy word for engineering science or applied science, a no-man's land between pure science, which pays attention only to new knowledge, and engineering which, in its right, serves a very important purpose of doing again and better and safer and more economical, what had been done before. Applied science, the inheritor of the invention process, is something which is not in our curriculum and for which, we find it increasingly hard to find recruits. I am very glad to see that this need for the multifacited activity of applied science begins to be recognized now. Some of our best institutions like M.I.T. and California Institute of Technology, in some of their parts, begin to remember that they might have something to do

with technology. This Society clearly has an aim to sponsor the cultivation of this neglected area, neglected in this country, at least.

One of my younger friends, Chuck Lief, who started life as an honest physicist, later degenerated into a mathematician. He did a lot of hydrodynamic calculations with two independent space variables and one time variable very much needed for our explosive work. He has turned in the last few years to calculating weather. He disdains observation, but was willing to accept some empirical facts such as the earth is eight thousand miles in diameter, that it rotates, that there are oceans with a certain geographic distribution and even with a certain surface temperature, and from this data, he has calculated the weather in January all over the globe. I found that he is a little absent-minded in that he forgot about the Rocky Mountains. He promised me to put them in in another two years. But, even without these slight preservations, he managed not only to calculate the right velocities of the westerly winds, the rough location of the jet-streams, but also the fact that the weather in January is really lousy in the Aleutians and it's quite a bit worse in Iceland--facts well known to meteorologists but never heretofore calculated. He even realized the fluctuations of the weather and the way cyclonic disturbances drift across continents.

Now, to my mind, this promise of numerically better predictions is more than a hope to make an honest man out of a weather prophet. It also means that within a few years, we might be able to do something about the weather. For instance, some people want to do something about hurricanes. From what I have seen, this is a hopeless enterprise. Once a hurricane starts blowing, it has so much energy in it that I don't think it can be stopped or dispersed. It may not even be possible to deflect it by the puny means of energy, including nuclear energy, that happens to be at our disposal. But, to trigger a hurricane might be an entirely different thing.

Dr. and Mrs. Terry Triffet, far left, MSU coordinator for the second technical meeting of the Society of Engineering Science, listen to Dr. Teller at Wilson.

Weather is full of unstable situations and while we can't stop a hurricane, we might make one. Some of you might think this is not exactly what is desirable, but let me put it this way; we might do something about the birth-control of a hurricane. Instead of one big hurricane, we might be able to produce two smaller ones. There is energy at the lower-lying hot and ice layers over the tropical oceans. Probably, it is necessary that they discharge their energy in the form of hurricanes. But in how large units and where and when, may be up to us. Already now, we see some methods, such as causing updrafts with violent means such as nuclear explosions. Also, we have a much more gentle procedure such as seeding. We might indeed tip the balance in one of these unstable situations and we might be able so to trigger the hurricane at such time and place that they stay out in the Atlantic where they belong, rather than coming into Florida or North Carolina or New England. Of course, if we should ever be able to regulate the weather, any part of the weather, we might have done a dreadful thing. We might have lost our last safe topic of conversation.

Some might feel that we should not fool with big-scale phenomena like the weather. I believe that what can be done, will, in the end, be done whether we want it or not. To my mind, of the important and dangerous consequences is that, in one way or the other, we should indeed be prepared to set up the right national and international organizations to use this power in a beneficial way. On the other hand, I feel even more strongly, seeing these opportunities, of which weather prediction or weather control is only one, that we have the responsibility to exploit knowledge and create power based on knowledge.

This, to return to my topic, cannot be done in modern times by any other mechanism, as far as I know, except by the collaboration of our scientific and engineering talent which we can make available for this important applied work. This is what several excellent places throughout the nation are beginning to do and this is the aim to which our Society is dedicated. Some good steps have been made. I hope that we shall be successful.

SE

Dr. Teller attended a round-table discussion held in Wilson dormatory.

Is it possible that a builder of space simulation equipment has a hand in Becky Hull's ballet lesson?

You'd expect that the leading maker of arc carbons that produce the brilliant light for projecting motion pictures would be called upon to duplicate the sun's rays in space simulation chambers. These chambers are used to test space devices, such as the communications satellites and space vehicles... and even the astronauts themselves.

And it probably wouldn't surprise you to learn that a company that produces half a dozen different types of plastics would also create an anti-static agent as part of the vinyl plastic it developed for phonograph records. This keeps dust from sticking to record surfaces. The sound is improved. The record lasts longer. And Becky Hull's ballet lessons are performed to music that's more faithfully reproduced.

But would space simulation equipment and better materials for phonograph records come from one company? Indeed they would, in the unusual case of the company known as Union Carbide.

All kinds of seemingly unlikely side-by-side activities turn up at Union Carbide every day. As a leader in metals and alloys, it developed a new, stronger stainless steel, and among the results are better subway cars for New York City. In cryogenics, it manufactures the equipment for a technique in brain surgery based on the use of supercold liquid nitrogen. Its consumer products include "Eveready" brand batteries and "Prestone" brand anti-freeze. And it is one of the world's most diversified private enterprises in the field of atomic energy.

In fact, few other corporations are so deeply involved in so many different skills and activities that will affect the technical and production capabilities of our next century.

And we have a feeling that Becky Hull's future is just as bright as ours.

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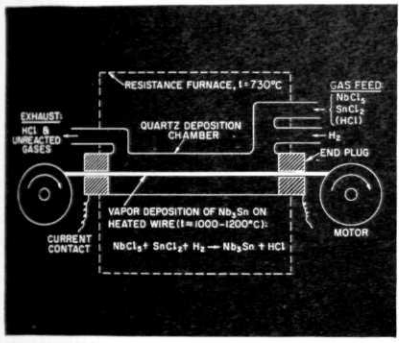
Superconductivity at RCA Laboratories

Vapor Deposition of Nb_3Sn



Apparatus for continuous vapor deposition of niobium stannide on ribbon.

Very-high-field solenoids capable of generating fields of 100,000 gauss now made with copper winding require about 100 tons of equipment and dissipate more than one megawatt of power as heat. Some superconductors, in particular the compound Nb_3Sn, can carry large electric currents with zero power dissipation even at high magnetic fields.[1] Hence, they can be used for the construction of light weight solenoids.

In the past, Nb_3Sn was prepared by metallurgical sintering techniques, which resulted in a porous and extremely brittle material not suitable for widespread use. In 1960, scientists in the Materials Research Laboratory, David Sarnoff Research Center, developed a vapor-phase transport process for preparing this compound for the first time in a dense crystalline state—and *in forms suitable for widespread use in both research and application.* It consists of a simultaneous reduction of gaseous mixed chlorides of niobium and tin by hydrogen at 900 to 1200°C.[2]

Based on this process, an apparatus was developed for continuous coating of refractory metal and ribbon with Nb_3Sn. The Nb_3Sn coated ribbon has both electrical and mechanical properties desirable for solenoid construction. It is very thin (typical cross section is 2 x 90 mil, thickness of deposit about 0.3 mil) and hence sufficiently ductile to wrap around diameters as small as ⅜ inch and it can support enormous currents densities: 1 x 10^6 amp/cm² at zero field, 3 x 10^5 amp/cm² in a transverse DC field of 92,500 gauss and 1.5 x 10^5 amp/cm² in a pulsed longitudinal field of 170,000 gauss. By comparison, copper can carry only 1 x 10^3 amp/cm² safely. Hence, superconductive solenoids approaching a field of 200,000 gauss appear feasible.

Reference—[1]*J. E. Kunzler, et al. Phys. Rev. Letters 6, 89 (1961).*

[2]*J. J. Hanak, "Vapor Deposition of Nb_3Sn," Proceedings of AIME Conference on Advanced Electronic Materials, August 1962.*

Parametric Amplifier

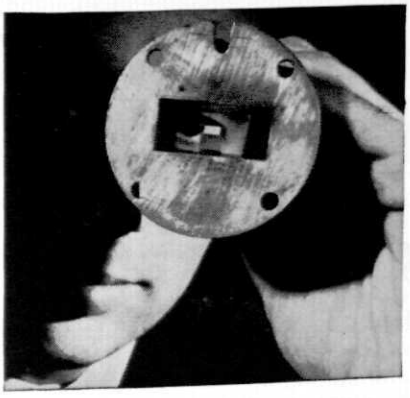
Experiments at RCA Laboratories show that superconducting films exhibit a nonlinear inductance at frequencies extending well into the millimeter-wave range. Frequency conversion was observed in tin films cooled below their critical temperature. Now amplification and oscillation have also been demonstrated. A superconducting "paramp" has been operated at 6 kmç with 11 db of net gain. Parametric oscillations at about the same frequency were also effected.

The superconducting film and the varactor differ markedly in many respects; hence, their circuit needs also differ. A study of the characteristics of superconducting films and parametric device requirements resulted in the concept of the "modified dielectric resonator." The resonator, which was used to demonstrate amplification, consists of a very low-loss, high-permittivity, dielectric cavity modified at one of its boundaries by a superconducting film.

The unit is placed in a waveguide where power is coupled to it with a movable short-circuit. The resonant frequency of the cavity is a function of its dimensions, the permittivity of the dielectric and the impedance of the film.

While it may be premature to speculate on the eventual role of the superconducting "paramp", it should be noted that the device, in principle, offers an outstanding set of features not to be found in the varactor or any other device. First, the frequency limit of superconducting films may extend into the sub-millimeter wave range. Secondly, it is expected that the noise performance of the device can match that of the maser. Furthermore, superconductors can be pumped with considerably lower power and at a lower frequency than either the varactor or the maser. Finally, since one can fabricate large-area films (as compared with lumped varactors), wide-band truly distributed traveling-wave parametric amplification may become possible.

Reference—A.S. Clorfeine, Applied Phys. Letters 4, No. 7, 131 (1964).
A.S. Clorfeine, Proceedings of the IEEE, Vol. 52, No. 7, July 1964.



Superconductive Magnet

Recently RCA developed a superconductive magnet believed to be the most powerful in the world, in a practical form that can revolutionize many aspects of solid-state electronics and high-energy physics research.

Success of this magnet and the attainment of zero current degradation using magnetic field stabilization followed research in superconductive degradation phenomena.

The device generates a magnetic field of 107,000 gauss. When commercially available, it will enable scores of small and medium-sized research laboratories to carry out experiments that now require large multi-million-dollar facilities in order to generate the immense magnetic fields needed for solid-state, atomic, and related areas of research.

Test data obtained under a NASA study contract played a significant part in RCA's development of the 107,000-gauss magnet. The present experimental unit has a bore of one inch, offering for the first time in a superconductive magnet a working area large enough for practical laboratory experiments. The company is continuing its work for NASA, exploring the feasibility of a 150,000-gauss superconductive magnet with a one-foot bore, designed for experiments in space propulsion techniques.

The experimental 107,000-gauss unit was built at the RCA Laboratories by an advanced development group of the RCA Electronic Components and Devices organization.

The experimental RCA magnet weighs 26 pounds and is about the size and shape of a half-gallon paint can. It is made superconductive by immersion in liquid helium and is started with the output of 6-volt storage batteries. By contrast, nonsuperconductive magnets developing similar magnetic fields require almost 1.5 million watts of power and enormous water-cooling systems.

Reference—Schrader, Freedman, Fakan, Applied Physics Letters, March 15, 1964
Schrader, Kolondra, RCA Review, Vol. (25), No. 3. 1964.

In addition to work in superconductivity, the David Sarnoff Research Center conducts a broad range of research projects requiring new concepts and ideas in materials, devices and systems. To learn about the many scientific challenges awaiting the advanced degree candidate in Physics, Electrical Engineering, Chemistry and Mathematics, please meet with our representatives when they visit your campus; or write to the Administrator, Graduate Recruiting, Dept. RL-9, RCA Laboratories, David Sarnoff Research Center, Princeton, N.J.

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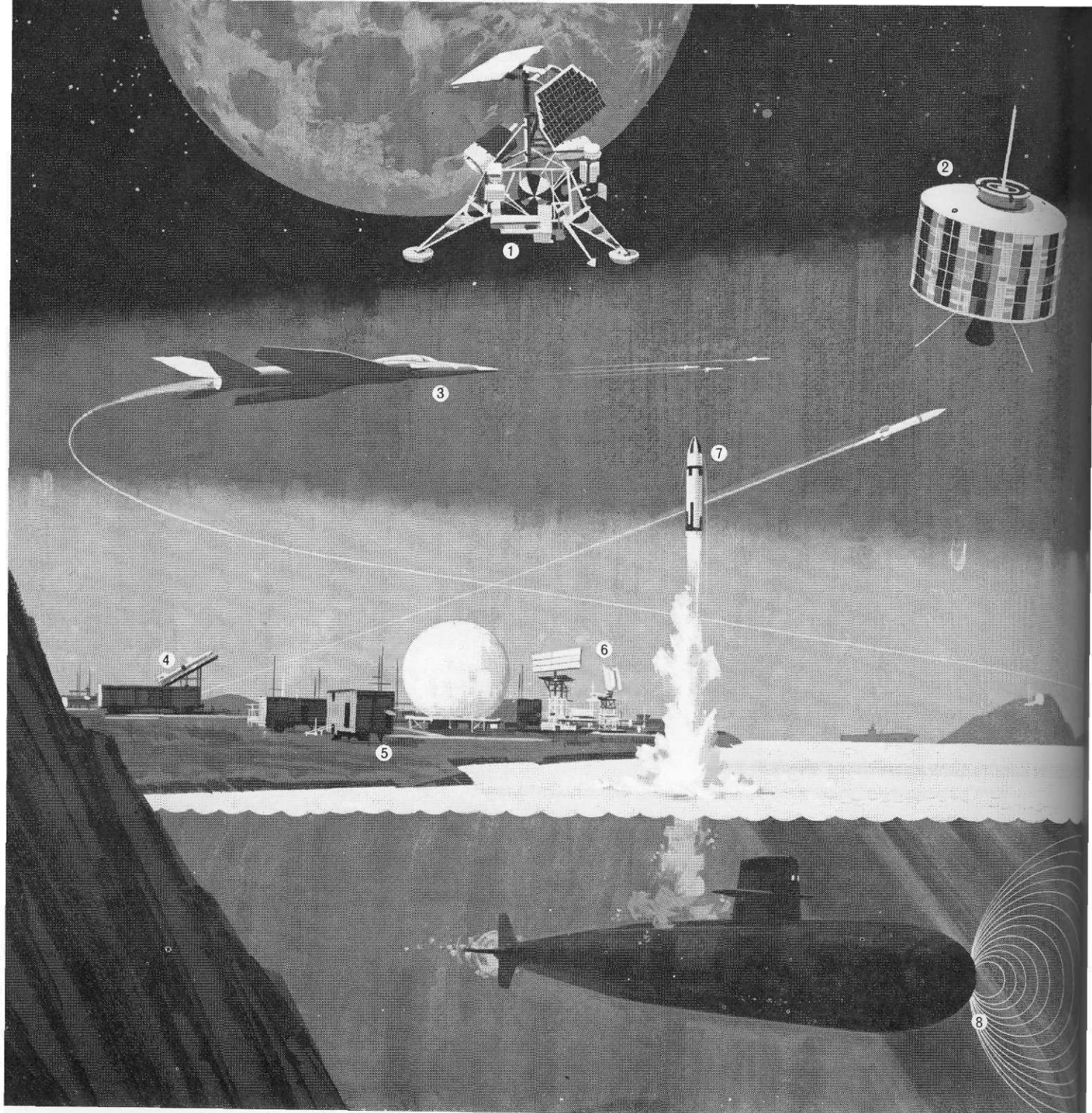

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Other responsible assignments include: *TAWCS* (Tactical Air Weapons Control Systems), Hard Point defense systems . . . advanced *infrared* systems, associative computers, advanced *communications* systems, *space* materials and devices, parametric *amplifiers* . . . and many others.

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CAMPUS INTERVIEWS

November 30, 1964

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The speaker was a brilliant young Navy scientist discussing his work, and he might well have been referring to the Naval Ordance Laboratory at White Oak, Maryland, where technological explorations are pursued to the ultimate advantage of the nation's posture of defense.

Who would have thought, especially before the advent of POLARIS, that a submarine could someday fire what appears to be an ordinary torpedo which would, a few seconds later, take off upwards into a ballistics trajectory . . . drop its rocket motor somewhere down-range . . . re-enter the water intact at supersonic speed . . . automatically arm itself . . . and let loose a nuclear blast that will decimate any number of submerged hostiles?

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But SUBROC—although an undertaking of incredible proportions—is just one in a long series of NOL projects in anti-submarine warfare, air and surface weaponry, aeroballistics, chemistry, explosives, and materials research. Many such dreams have become reality at NOL—seven new magnetic materials that have sharply upgraded magnetic amplifiers, magnetometers, and electromagnetic transducers . . . new ways to measure drag, stability, and heating effects of missiles traveling in excess of Mach 10 . . . the arming and fuzing devices for POLARIS . . . a new data reduction method for underwater acoustics that opens the door to *passive* sonar ranging . . . two new nuclear depth bombs . . . and literally hundreds more.

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- the stimulus of working with top people in their specialties, many of whom are staff members and lecturers at colleges and universities.
- the added stimulus offered by the Washington environment, now one of the top four R & D centers—private as well as government—in the country.

The same young Navy scientist we quoted earlier also remarked: "*. . . if a scientist wants the freedom to satisfy his intellectual hunger and open doors now closed to him, his best bet is to work for the Government.*"

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Miss Engineer

Mary Kluiber

Home town: Lansing, Michigan

Age: 19

Class: Sophomore

Sorority: Kappa Alpha Theta

Specs: 5'6"

Dark brown eyes

Dark brown hair

Major: Physical Education

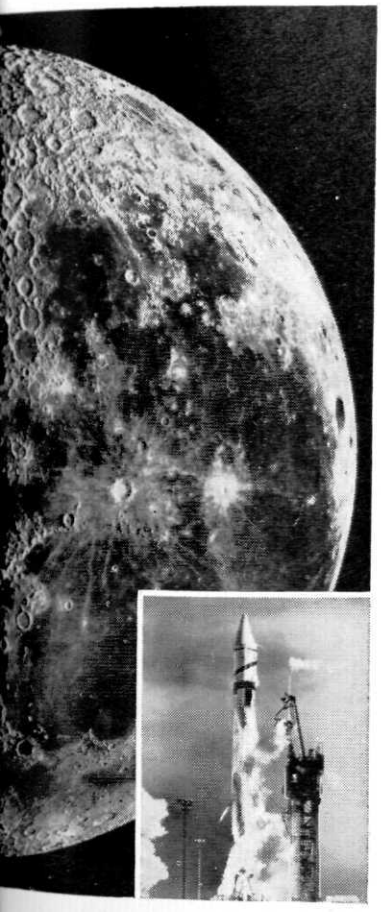
Hobbies: Tennis, Swimming, Gymnastics,

Cooking (Italian food), Sewing

Mary, a cheerleader, was Miss Lansing in 1963 and placed fourth runner-up in the Miss Michigan contest. The pretty Czechoslovakian worked as a playground director during the summer and plans to go directly into teaching.

Photos by: George Junne

Providing power for every environment . . .



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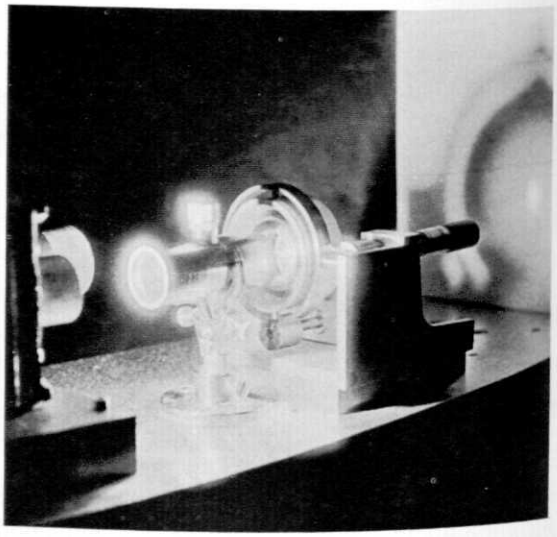
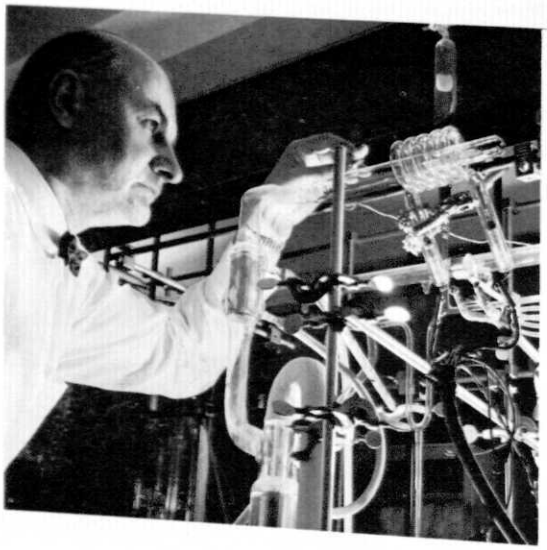
Industrial News

Moon bound apollo astronauts will know pretty much what to expect from acceleration and "G" forces thanks to "ANDY" the anthropomorphic dummy shown above getting his "brain". "ANDY's" skull, fitted out with 13 tiny electronic sensing and transmitting devices, together with the rest of the humanoid, is now undergoing drop tests and other pre manned flight experiments. These experiments are being conducted by North American's Space and Information Systems Division, Downey, California, for NASA's Manned Spacecraft Center, Houston, Texas, as part of the Apollo program.

The simplicity of a new technique developed by IBM's Research Division for producing giant pulses from a ruby laser can be seen in this picture, which shows all the apparatus required. The ruby crystal and flash lamp are contained in the box at left. The large circular object at center is a mirror, which completes the laser cavity. Between the ruby and the mirror is a cylinder, with windows at both ends, containing a metal phthalocyanine solution. This solution absorbs ruby light strongly, thus initially preventing laser oscillation. When as a result of heavy pumping the ruby's emission exceeds a certain level, the solution suddenly "bleaches", permitting all the stored energy in the ruby to be emitted in a giant pulse. The spot of light on the screen in the background was produced by a giant pulse lasting less than 20 nanoseconds.





A xenon flash-discharge lamp is used by Bell Laboratories as the basis of a new fast method for determining the gas and carbon content of thin metallic films. William G. Guldner, who developed the method, is shown checking connections to the xenon lamp.

To weld the complex floor system of the Verrazano-Narrows Bridge, American Bridge Division of United States Steel Corp. used a high-tensile-streng th Murex electrode produced by M&T Chemical, Inc. Some 3288 sections of steel flooring, each 9'6" by 50' by 4¾", will be welded into place to reinforce the bridge's roadway. Concrete will be poured through the connected system and 1½" above it.

TRANSISTORIZED ITALIAN COMPUTER MAKES U.S. DEBUT. World's first all-transistor desk top computer, introduced early this year by Industria Macchine Elettroniche, S.p.A., Rome, a subsidiary of Italy's giant Edison group, will be distributed in the United States and Canada by IME/USA, Inc., Los Angeles, it was announced today (Oct. 19, 1964). Revolutionary new device, dubbed the IME-84, offers instant input verification without reference to tape, and automatic visual decimal point placement.

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BOOKS

Announcing a new book--DISTILLED WISDOM (Prentice-Hall $5.95) by Alfred Armand Montapert, to be released to the public, week of November 16th.

Every man's heart cries out for a better life. DISTILLED WISDOM is a wonderful Master Plan for Living, based on the wisdom of the world's greatest men, that will help you to be many times more effective, productive, successful and happy.

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The author, Alfred Armand Montapert, was former president of seven industrial corporations.

❖ ❖ ❖ ❖

The following is a brief summary of BRAZIL: CRISIS AND CHANGE, by Charles Wagley, director of the Institute of Latin American Studies and professor of anthropology at Columbia University.

This HEADLINE SERIES booklet, published by the Foreign Policy Association, analyzes relations between Brazil and the U.S. before and since the present regime of Humberto Castelo Branco; reviews the political, economic and cultural history of Brazil; and discusses the implications of these developments for Brazil and its relations with the U.S.

This issue is available at the Foreign Policy Association, 345 East 46th Street, New York, N.Y. 10017, at $.75 a copy.

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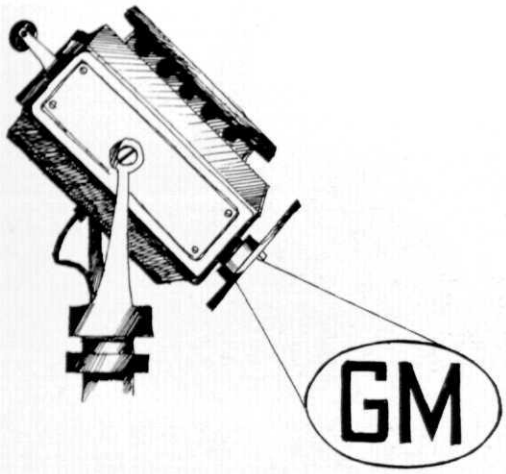


INDUSTRIAL SPOTLIGHT

The general field of mechanical design has for years depended on the techniques of drafting as a means of design prior to the making of models. Graphics--the art of science of drawing--serve as the basic means of man-to-man transmittal of design information.

In the late 1950's the General Motors Research Laboratories began a study of the potential role of computers in the graphical phases of design. Prototype hardware and software components were developed to investigate the problems of processing graphical data. For example, a breadboard setup using an IBM 740 cathode ray tube recorder demonstrated that lines on film could be scanned and digitized under the control of computer programs. Programs were written for the manipulation of images in three dimensions.

As reported to the 1964 Fall Joint Computer Conference by Edwin L. Jacks, assistant head of the GM Research Laboratories' Computer Technology Department:

"On the basis of these early feasibility demonstrations, the decision was made to establish a more comprehensive laboratory for graphical man-machine communication experiments. The facilities were to permit the computational power of a large scale digital computer to be brought to bear on the problems of graphical design in a manner which fully recognized the importance of the man in design. The project has since become known as Design Augmented by Computers.

"The initial goal of the DAC-I project was the development of a combination of computer hardware and software which (a) would permit 'conversational' man-machine graphical communication and (b) would provide a maximum programming flexibility and ease of use for experimentation. This goal was achieved in early 1963."

The DAC-I system has been in operation eight hours per day since then. Mr. Jacks reports: "From the standpoint of a laboratory facility, the system is performing excellently. We are learning that man and machine can communicate readily via graphical means."

DAC-I Hardware

The present DAC-I hardware complex consists of an IBM 7094 digital computer and an IBM 7960 special image processing system.

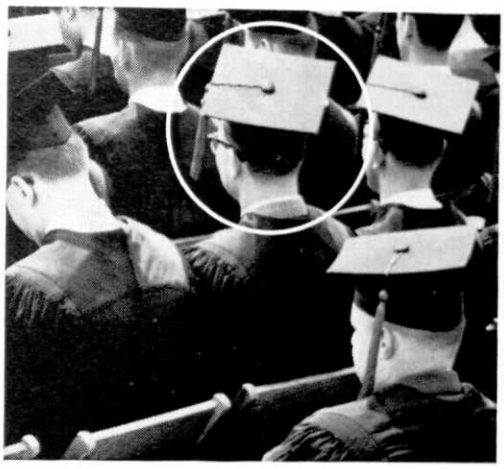
The 7094 computer has an extra-large 64K core memory unit, half of which is available for multiprogrammed use on DAC-I problems. In addition the computer has extended storage facilities: two 55-million character 1301 disk files and three 1-million character 7320 drum units.

The 7960 special image processing system was developed and built by IBM's Data Systems Division to specifications provided by GM. The specifications were based upon early GM experiments with computer displays, recording devices, and program-controlled image scanners. Its two main units are:

1. A graphic console which provides for a dynamic two-way communication between the designer and the computer. The console is equipped with:
   a. a cathode-ray-tube (CRT) display screen;
   b. an electric position - indicating pencil, used by the man to respond to the computer by pointing to an area of interest on the display.
   c. 36 program control keys and program status lights. The man at the console can monitor the status lights and control the program execution with the keys.
   d. two data entry devices. One is an alphanumeric keyboard for "typing" mess-

CONTINUED ON PAGE 34

A computer programmer takes the role of an "automotive designer" to test out the new GM DAC-I system. The console can be used to monitor and control the computer's progress on a design problem. At any design stage the designer may request a permanent photographic copy of a new drawing using the special image processor.



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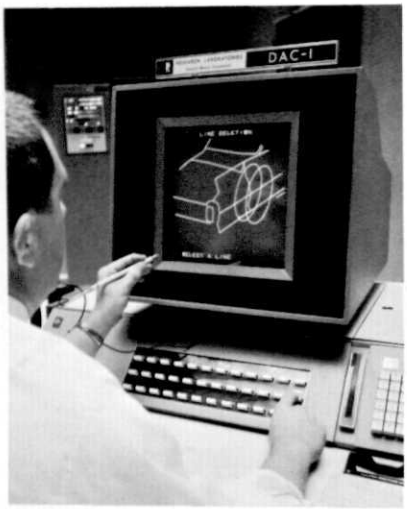


Here at the graphic console of DAC-I, a research engineer checks out a computer program that allows him to modify a design "drawing." A touch of the electric "pencil" to the tube face signals the computer to begin an assigned task, in this case, "Line Deletion," where indicated. The man may also instruct the computer using the keyboard at right, the card reader below the keyboard, or the program control buttons below the screen. -

CONTINUED FROM PAGE 32

ages into the computer. The other is a card reader with which the man enters data and "sign-on" identification.

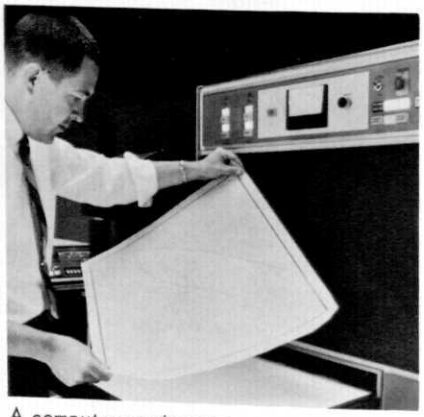
2. An image processor used for the input and output of graphical data.
   a. Input operation. A sliding drawer allows the designer to enter key lines drawn on 20-by-20 inch paper or vellum. A camera translates the image to 35mm film which is developed in 30 seconds. A GM-developed computer program then controls the positioning of a CRT beam optically focused on the 35mm image. A photomultiplier response back to the computer indicates if the beam is on clear or opaque portions of the image. The program searches for opaque lines on a clear background. In its present state of development, the scanner can detect and digitize lines as thin as .01 inch with an average accuracy of plus or minus .015 inch. The line scanning is controlled from the console and in areas of difficulty, e.g., a finger smudge, the man can help guide the computer past the difficulty using the electric pencil and a TV sweep display of the localized area.
   b. Output operation. A second high-resolution CRT is used as a recorder for exposing frames on either of two 35mm film transports. The film is automatically developed and ready for viewing on a 20-by-20 inch screen within 30 seconds after exposure. Drawings from both film trains can be projected simultaneously on the screen, allowing the designer to compare differences and similarities in the information. A film buffer allows up to 20 images to be exposed before processing begins.

DAC-I Software

The computer instructions--or software--which operate the computer complex are all new and give DAC-I its unique design capabilities. Among the advanced software techniques incorporated in the DAC-I system are four major departures from conventional programming techniques:

1. Multiprogramming monitor. Allows the computer to be working concurrently on two different problems. It thus permits a designer to be working "on line" with the computer efficiency.
2. New compiler language, NOMAD. Ninety per cent of the DAC-I software system was written in a very flexible and fast compiler called NOMAD, a GM Research revision and extension of the University of Michigan's MAD system (Michigan Algorithm Decoder.)
3. Program storage allocation control. Permits the computer program to make "at the moment" decisions on efficient allocation of core memory to meet the changing data and program demands of the problem being solved.
4. Disk - oriented system for storage and retrieval of programs. Allows access within a fraction of a second to millions of words of program and data. System is so arranged as to permit continued growth of DAC support programs with no change to control programs.

In addition special software has been devised for programming the graphical input/output hardware.



A computer engineer prepares to insert a 20 by 20" drawing into a program-controlled drawing reader. The new image processor acts as a TV "eye" for the electronic digital computer and is a major feature of the GM-developed DAC-I system. Inside the machine, the key lines on this drawing are automatically photographed onto film and the lines are tracked by a high resolution cathode ray tube that is directed by special computer programs. The resulting digitized information is stored on the computer's large magnetic disk files. The new DAV-I hardware was developed and built to GM specifications by International Business Machines Corporation based on early experiments carried out with laboratory equipment at the GM Research Laboratories.

The drawing on the screen of the image processor (background) has come from a mathematical model – series of equations – stored in the memory of a large electronic digital computer. A GM-developed computer program records the drawing directly on 35mm film and, within 30 seconds, the developed film is projected on the view screne. Enlarged drawings can be made from the film after it is removed from the unit.

SE

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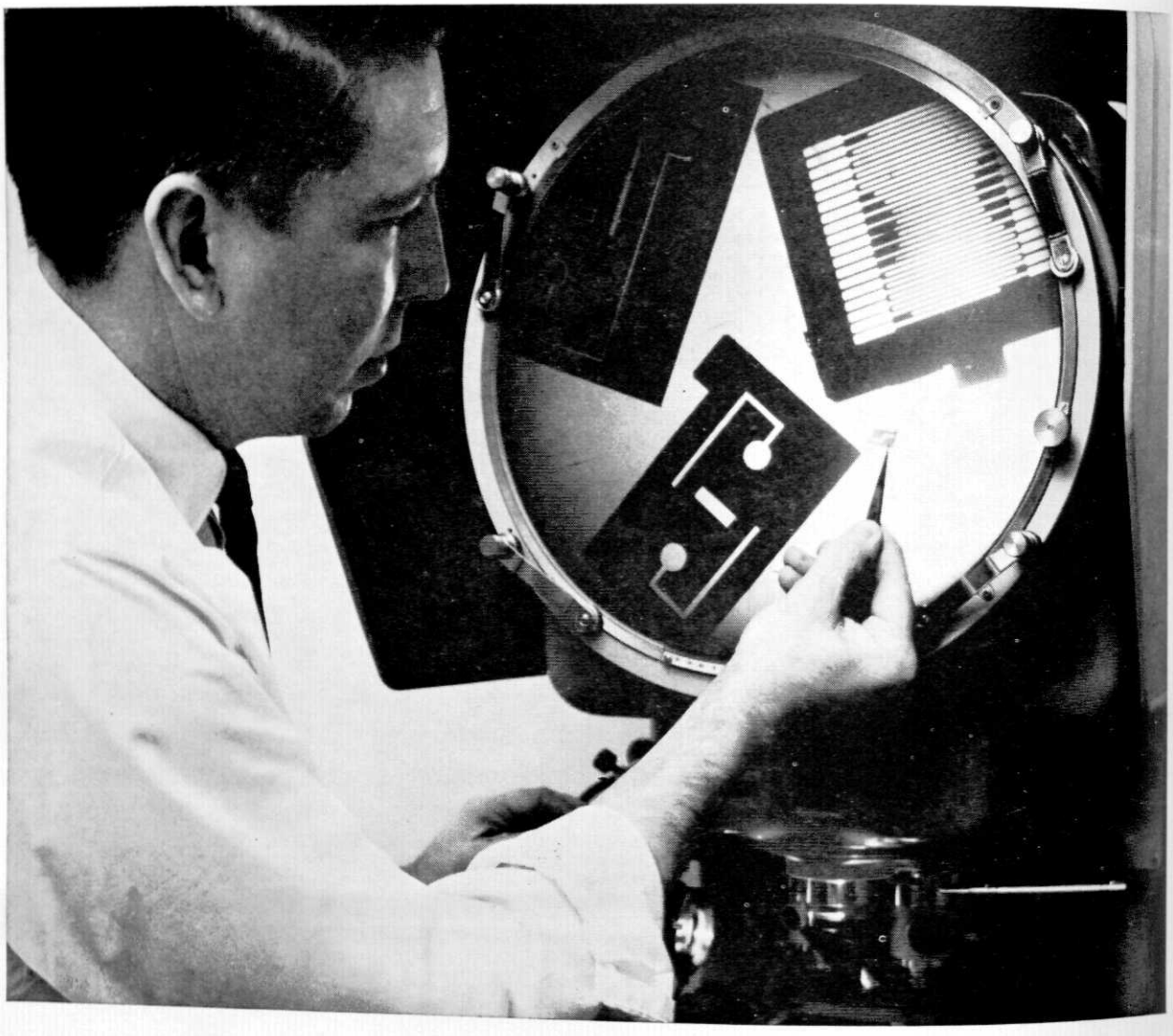

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Water Recovery In The Space Environment

by Richard L. McCandless

EDITOR'S NOTE: This paper was prepared as a part of a program of an Engineering Undergraduate Research Assistantship during 1963–64. It was supervised by Carl W. Hall, Department of Agricultural Engineering.

About sixty per cent of the human body's weight is made up of water. It is the medium in which the basic chemical processes of life take place. As man leaves the earth, the supply of water becomes a prominent problem; it has received great attention in recent years. This is a review of some of the methods which have been and are being considered for the recovery of water in space.

The average human intake of water is about 2500 milliliters per day: 1200 as drinking water, 1,000 in food, and about 300 from the metabolic oxidation of hydrogen in foods. Although the water demand is flexible, a minimum of about one liter per day, depending on activity, is required for human life. Three major sources account for almost all of the body's water output--urine (about 1400 ml per day), feces (200 ml per day), and evaporation, both from the skin and within the lungs (900 ml per day).[1]

To the present date, water has been stored for all manned space missions. However, allowing 28 liters, or 62.4 pounds, of water per man per week for all purposes, the weight of stored water soon becomes prohibitive. As flight durations grow, the point is soon reached at which the weight of recovery and recycling equipment is less than that of extra water and storage containers. At this point recovery of at least part of the water excreted by the body becomes economical, although complete recovery of water would not be practical for missions of less than about 100 days.

Four major sources of water are available in space craft: expired air, wash water, feces and urine. A large amount of water appears as vapor in expired air and can be condensed on a cold object. Although water so recovered may have a slight odor, it may be used for washing or, after percolation through activated carbon, for drinking. Wash water will contain several impurities which must be removed by filtration before it can be used. These include human sweat substances, skin tissues, hair, bacteria, particles of clothing, particles of the materials composing the space cabin and its equipment, and soap or detergent. Feces or solid wastes hold many bacteria; because they contain about one fourth of a pound of water per day, they will be a source only on comparatively long missions.

Urine promises to be the most fruitful source of water in space, since it contains about 95 per cent potable water. The composition of urine is given in table one.[2]

TABLE 1

Constituent	Avg. % by Wgt.
Water, total	94.9
Solids, total	4.9
Urea	2.2
Nitrogen, total	1.1
NaCl	.95
Na	.3
K	.15
P	.09
S, total	.08
Ca	.015
Mg	.01

In small amounts: Amino Acids, organil acids, Harmones, Lipids, pigments, vitamins, miscellaneous compounds.

The disagreeable properties to be coped with in the purification of water from urine are color, odor and taste. Regardless of the purification system used, urine must first be filtered of materials such as skin cells, nuclei, large protein molecules and bacteria, though, as it is excreted from the healthy body, the urine does not contain any pathogenic organisms. The most abundant solid impurity in urine is urea, $CO(NH_2)_2$, the principle end product of protein metabolism. Urea makes up about 50 per cent of the total solids in urine and accounts for 80 to 90 per cent of the nitrogen content. Although urea is promptly excreted by the kidneys, it should be completely eliminated from drinking water, as each gram of urea taken in by mouth increases the blood urea nitrogen (BUM) by 1.5 to 2.5 mg per cent in man, and a level of about 45 mg per cent can produce toxic symptoms.[3] Therefore, the elimination of urea has been considered in the proposals of all water recovery systems.

DISTILLATION

Distillation is the simplest method for recovering water from liquid wastes. If enough energy were supplied, a simple still would recover most of the water from urine. A slightly heavier still could be run by the astronaut's body heat, which is more than enough to recover all of the water from his daily urine output.

An air evaporation system provides a very simple solution. In

such a system warm cabin air, or hotter air which has been used to cool equipment, is passed over warm wicks which have been soaked with urine. Water evaporates and is recovered from the vapor in a centrifugal separator. Moisture so collected is easily filtered and made fit for drinking. There are several disadvantages to an air evaporation system, however. The vapors from which water is collected are corrosive. A large wick area is required and the wicks soon become clogged with solids which must regularly be removed. The air used as a vapor carrier cannot be used for breathing unless it is filtered. An air evaporation system, however, has the advantage of making efficient use of the hot air generated by equipment which must, under any conditions, be cooled.

An atmospheric distillation system for the removal of water from urine has the advantages of simplicity and low equipment weight. The power requirement for such a system is estimated by Frand J. Hendel at about 180 watts per man per day; under zero G conditions, the still and the condenser used must revolve to insure separation of the vapors. Liquid condensed in such a still has a high pH and often an ammonia odor from urea, which reacts in the following way: $CO(NH_2)_2 + H_2O = CO_2 + 2NH_3$. Urine must be pretreated before distillation. J. Sendory and H. A. Collison tried pretreatment of urine with sulfuric acid, resulting in hydrolysis and the liberation of volatile products as well as the formation of hydrochloric acid and the carry-over of chloride ion into the distillate. However, the formation of ammonia and its carry-over were reduced by the acid pretreatment. The use of both sulfuric acid and potasium dichromate in pretreatment reduced volatile impurities, but may have formed other impurities by hydrolysis, oxidation, or the breakup of conjugated compounds. Sendroy and Collison nevertheless attained an 85 to 87% yield of potable water. Recovered water was post-treated with activated carbon to remove odors and tastes.[4]

Thermo-electricity has been used in the distillation of urine by E. F. Cox of the Whirlpool Corporation.

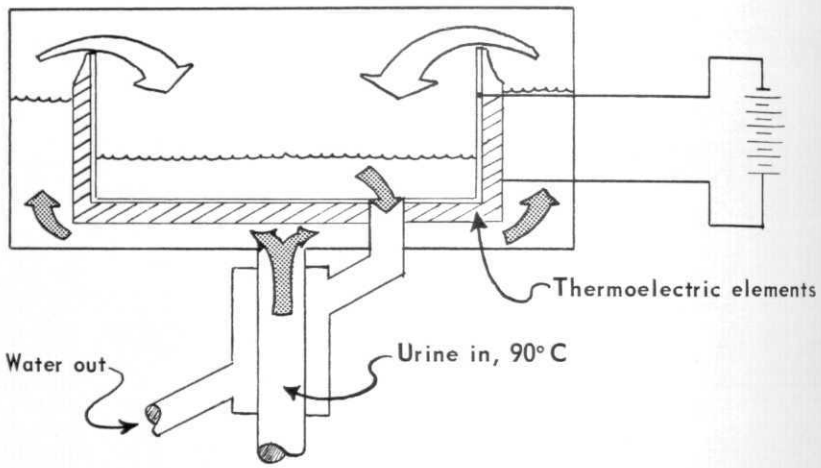


FIGURE 1
Thermoelectric Still

His thermoelectric still uses 4300 thermocouples, consumes only 7 1/2 watts and processes about 1.48 gallons daily.[5]

Solar stills have also been proposed for the atmospheric distillation of urine in space. In such a system, light shining through a thick glass or plastic panel heats a shallow depth of impure liquid, which evaporates. Water is condensed from the vapors. The construction and operation of such a still is greatly simplified under conditions of artificial or natural gravity. It might be much better suited then for use on the moon than for use in space craft. Such a system has the disadvantages of being large and heavy and of being unusable at great distances from the sun.

An active vapor compression distillation system holds great promise for space applications. Wastes are placed in a still over which a compressor creates a partial vacuum of about 0.5 psia at the cabin temperature. The warm vapors which form may be used to supply heat to the liquid being processed before being compressed, condensed, and filtered. The removal of solid residue from the still is required after each batch has been processed. Energy requirements are reduced as the temperature difference between the still and condenser is reduced, but a larger condenser surface is required. If a still-condenser temperature difference of about 20 degrees F. is maintained, about 40 watts per man per day are required to distill all human wastes. The still must be designed to rotate under weightless conditions to concentrate the liquid on the sides and to keep it out of the compressor system. The distillate is forced through a millipore filter, an ion-exchange resin, and an activated carbon filter. Because urea does not decompose below 98 degrees C. This process does not produce ammonia in the distillate. However, as the temperature of the still is lowered, the carry-over of bacteria into the distillate is increased and sterilization or filtration through a bacteriological filter may be required. It has been proposed that solid and liquid wastes be placed in the evaporator portion of such a still in a plastic bag which could be removed with solid residues after distillation. The greatest disadvantage of such a system is that these solid residues would have to be destroyed or stored. An active vapor distillation system however, has the great advantage of not requiring heat rejection to space, since the heat of condensation is used to speed vaporization if condensation is allowed to take place on the outside of the evaporation tank. Vapor compression distillation is presently recommended for crews of more than three and flight durations of more than 14 days.[6]

Electric Boat and American Machine and Foundry Corporations have built batch-type vapor compression distillation stills. The American Machine and Foundry still has a volume of 1.9 cu. ft. and operates on 150 watts, weighing 45 pounds with supplies for 30 batches. It has a six-hour operating cycle and can recover 10 pounds per cycle with an 85 per cent yield of potable water.

"Hyamine 1622," an odor-bacteria control, and Dow-Corning "Antifoam C" to control foaming and carry-over are added before cycling.[7]

Passive vapor compression distillation systems have also been proposed. Heat transfer radiation panels are used in these systems to eliminate the heat of condensation to space. R. A. Bambanek and J. D. Zeff have designed such a still in which liquid wastes at 80 degrees F. are placed in sponges which are exposed to a partial vacuum created by venting the evaporation chamber to space. Water evaporates from the sponges, passes through a filter screen and is directed into cooler, bellows-like receptacles where it is condensed on doughnut shaped sponges at 60 to 70 degrees F. The sponges are removed and squeezed through purification cartridges, yielding potable water. The major disadvantage of such a system is its use of a radiation panel. The size of such a panel is governed by the size of the batch to be distilled, and the efficiency of the system depends on the exact control of the radiation of heat to space.[8]

Post-treatment in distillation units is largely eliminated by the use of the "pyrolysis of vapors" technique demonstrated by J. J. Konikoff and others. Before condensation, the vapors are passed over platinum gauze at 1000 to 2000 degrees F, and volatile impurities are oxidized or destroyed. Water, carbon dioxide, and oxides of nitrogen are produced at the platinum gauze. The water can be condensed and is potable. This technique requires considerable power.[9]

In all types of urine distillation, care must be taken not to exceed the boiling point of urine, since without special still-heads of additives, a foaming action at that point allows unwanted constituents to be carried over into the condensate.

Activated carbon can be used after any type of distillation to remove objectionable tastes and odors from the distillate. The dosage required is small--on the order of one to two pounds per million gallons. Odors and tastes can also be removed by aeration, if fine bubbles are forced through the water.[10] Most distillation systems for urine have the advantage of comparatively low power requirements.

MEMBRANES

There are several proposals for the purification of urine which involve the use of membranes. In ordinary electrolysis, an anode and cathode in a tank of impure water are surrounded by membranes through which ions may pass. Waste gases are given off at the anode. Concentrated wastes from within the membrane around the cathode could be pumped to the anode to react with these waste gases, forming a concentrated solution of waste. Herein, though, lies the greatest disadvantage of the electrolysis of urine: the great amount of concentrated waste to be disposed of or stored.[11]

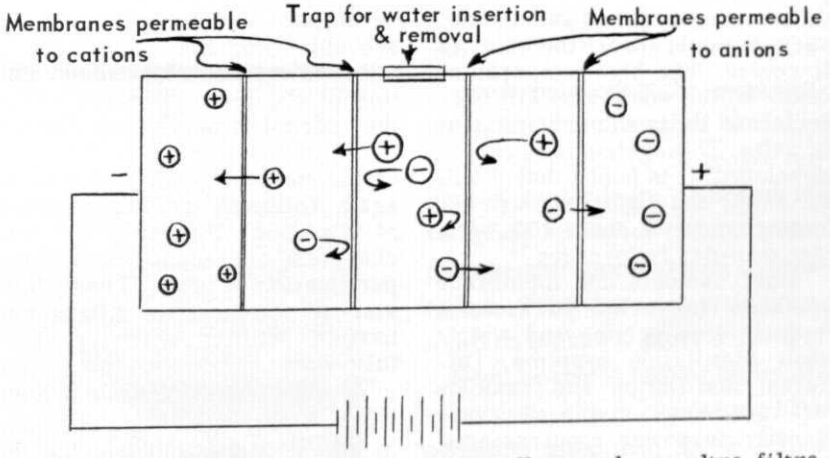


FIGURE 2--
Electro-osmosis Cell

In this process, a container of impure wastes is divided into several parts by membranes, permeable either to anions or cations, but not both. When the ends of the full container are oppositely charged, ions migrate in opposite directions through the membranes, leaving purer water in the center than in the end compartments where the impurities collect. Pure water can be removed from the center sections of the container and the impure water in the end sections retreated to further concentrate the wastes. If this system works over long periods of time and the residual amounts of unusable water can be minimized, it could be very profitable for long-term space trips.

Another process known as reverse osmosis has been described in a report from the office of Science and Technology of the Executive Office of the President: "When pure water and a salt solution are placed on opposite sides of a semi-permeable membrane (ideally, permeable to water but impermeable to salt), fresh water will flow through the membrane and dilute the salt solution. This is the well-known process of osmosis. If fresh water flow is prevented, a hydrostatic pressure, known as the osmotic pressure, builds up in the salt solution in proportion to the concentration of the salt. Under these conditions, an application of hydrostatic pressure to the salt solution, in excess of the osmotic pressure, will generate a flow of fresh water from the salt solution, through the membrane, to the fresh water side."[12] This process, known on a smaller scale as ultra-filtration, provides a promising technique for urine purification. Its value is increased by its operation ambient temperatures with mechanical energy. A system has been designed to filter urine on this basis. It could be used for very long periods of time; however, it has the disadvantage of utilizing a filter which must be periodically flushed.[13]

A process known as thermo-osmosis depends on the fact that membranes are available which will pass only water at certain temperatures. Such a process would require the heating of urine on one side of the membrane and the cooling of purified water on the other. To the present time, very little work has been done with this process.

Ionics Incorporated proposed to force urine under slight pressure into contact with a heating element and a membrane in a boiler unit.

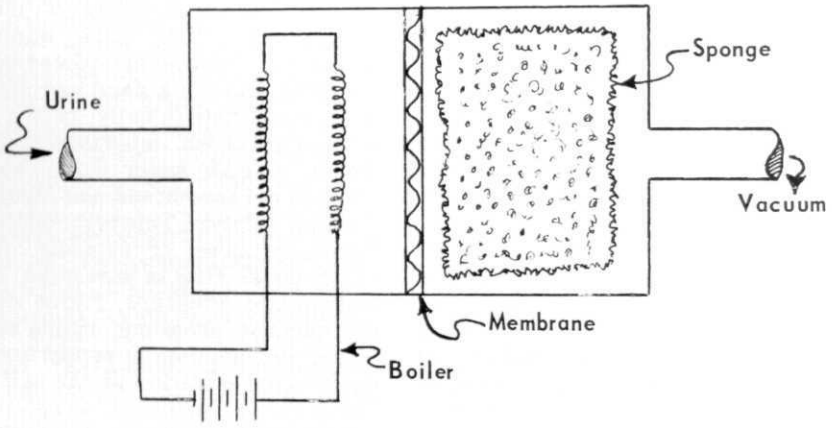


FIGURE 3--
Boiler Purification Unit

The boiler would raise the temperature of the urine to a point at which only water would permeate the membrane. On the other side, a sponge in a partial vacuum would absorb the water as it cooled. The high temperature of the boiler would also kill bacteria and delay the precipitation of salts. This system is as yet undeveloped. It is hoped that it will be small and light, but a power requirement of about 100 watts per man-day is foreseen.[14]

Most osmosis and membrane methods for urine purification require less volume and weight than distillation systems. Different distillation and osmosis or membrane methods vary greatly in power requirements.

CHEMICAL PROCESSES

Several chemical processes are available for use in the purification of urine. A major problem is the removal of urea from urine, since it is not an ionic substance and is not removed by distillation, ion exchange, or osmosis. An additive is therefore required to break down urea prior to other treatment. The enzyme urease, obtained from jack beans, holds promise. It reacts with urea to yield products more easily handled: $CO(NH_2)_2 + 2H_2O$ + urease = $2NH_2 + CO_2 + H_2O$. The amount of time required for complete conversion of one man's daily waste by this process varies with the amount of urease used but is on the order of several hours; a three hundred gram supply of urease would be enough for six men for about six weeks. It is possible that the enzyme could be added to an ion exchange column, reducing the number of steps required for the complete purification of water.

Two types of ion exchange treatments are available for the purification of liquids. The first is the percolation of pretreated but impure liquids through cation and anion exchange beds in turn, followed by electrical regeneration of the beds. The second is the percolation of the impure liquid through a bed of mixed cation and anion exchange resins, again followed by regeneration of the bed. Inorganic ion exchangers are suggested for the purification of urine. These consist of mixtures of silver and barium zeolites which react as follows:

Zeolite (Ag_2) + 2NaCl = Zeolite (Na_2) + 2AgCl (s)

Zeolite (Ba) + $MgSO_4$ = Zeolite (Mg) + $BaSO_4$ (s)

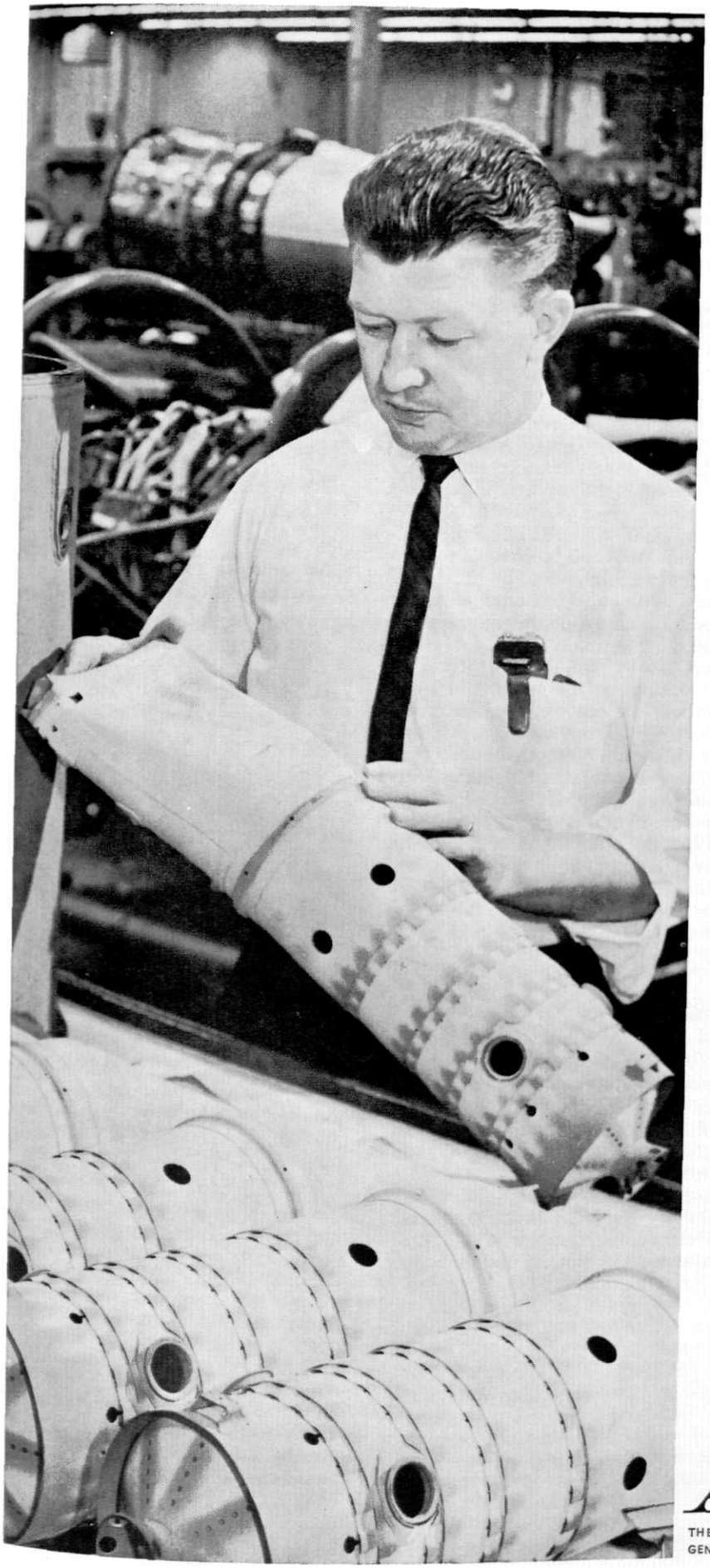
The solids are then separated from the precipitated zeolites. All of the anions and cations found in normal urine, including small amounts of iron, ammonia, and sulphates, can be removed by such processes. The cation and anion exchange beds can be regenerated if the anion exchange resin is made a cathode and the cation exchange resin an anode. The ions are thus forced out of the resins and through semi-permeable membranes, forming a brine of concentrated impurities which may be stored or eliminated. Water recovered from urine by ion exchange should be treated with activated carbon and other absorbents to remove impurities. The efficiency of ion exchange resins depends on the surface areas of the granules. Their use may be limited by the amount of resin required. Although both pre and post-treatments are required, ion exchange has the great advantage of requiring little space.[15]

Organic solvents such as tertiary octylamine are available which dissolve more water at low temperatures than at high. Waste water could be added to an extraction column of such solvents at low temperatures; the solvents would absorb water, but not impurities. They could then be removed and heated to drive off pure water which, after treatment with a carbon absorber, would be potable. Under weightless conditions, impurities would have to be removed from the extraction column and pure water from the solvent in centrifugal separators. This process, known as solvent extraction, has the disadvantages of great bulk and weight and of presenting the danger of organic solvents escaping into the cabin air. However, it has the advantage of a low power requirement, and might be useful in space applications. Heating and cooling stages of the process can be combined in two heat exchangers, further reducing the power requirement.[16]

A similar process, known as the solid gas hydrate process, has been investigated for the purification of sea water. Water is treated with a light gaseous hydrocarbon -- CH_2ClF, CH_3Br, $CHCl_2F$, and propane have been examined -- to form solid crystals of a compound $M{\cdot}xH_2O$, which are removed and melted to recover pure water from the hydrating agent. The process operates well at 50 to 60 degrees Fahrenheit. However, it too presents the danger of the escape of organic solvents. Inorganic hydrating agents do not work as well because they release water only in the vapor phase, requiring more power to separate water from the crystals.[17]

It is unlikely that chemical means alone will be used to purify urine. The cost in heat, energy, or materials of regenerating chemical agents may be great; more chemical agents might be necessary to regenerate those used directly in the purification process. Filters and other meta-filters are available which can be built to almost any size and shape, to operate under vacuums or pressures. It is possible that these will be applied in long term missions.

FOOTNOTES ON PAGE 48



■ Reuben C. Gooderum, BSME Wisconsin, 1962, is shown examining combustion liners after a thermal paint engine test at Allison Division, General Motors, Indianapolis, Indiana. Thermal paint, developed by Allison, is used to determine temperature gradients existing on engine parts.

Gooderum is one of the young engineers at Allison assigned to design and development of air-cooled turbine engine hardware. This work involves rig testing of turbine engine parts to determine optimum configurations. Parts later are endurance-tested on engines to prove the design.

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GM GENERAL MOTORS

GROUP COUNSELING PROGRAM AT MSU

by Roger D. Augustine
Harold W. Phend

EDITOR'S NOTE: The following is a portion of a report given before the annual meeting of the American Society for Engineering Education. R. D. Augustine is a student affairs counselor of the Mechanical Engineering Department at MSU. H. W. Phend is the Assistant Director of Admissions and Scholarships at MSU. The Program was conducted Winter and Spring terms, 1964.

Freshman and sophomore engineering students participated in an exploratory Group Counseling Program designed to help them strengthen their academic achievement, increase their understanding of the engineer's professional role in society, clarify their career goals, and improve their self-understanding and personal-social adjustment. The program included special attention for underachieving students. Leadership was provided by advanced master's and doctoral candidates from the College of Education who had related academic and professional experience in the area of counseling and guidance. The explanation of the results includes both a description of certain common characteristics which seem to typify engineering students and a summary of the curricular, administrative, and student personnel implications of the findings.

A total of 170 students participated in the winter term group counseling program. 120 of these students were second quarter freshmen and 50 students were upperclassmen representing the departments of electrical, mechanical, and civil engineering. A pool of potential student participants was established by each academic advisor by random selection from his list of advisees. An invitation to participate was then extended to each student by his advisor in a private interview designed to explain the Group Counseling Program. About 80 to 90 per cent of the students contacted in this manner accepted the opportunity to be involved in the project. The common reason given for not participating was lack of time due to a heavy work load or academic schedule.

Selection of Group Leaders

The fifteen group discussion leaders were advanced master's or doctoral candidates in the Department of Guidance and Personnel Services, College of Education at MSU. These people were recommended by their department on the basis of their specialized graduate course work and their employment on a full or part-time basis in the field of education or as personnel specialists in non-school agencies. Thus, in terms of academic and professional experience, they were considered to be personally qualified and professionally competent. Their work was supervised by a faculty member from the Department of Guidance and Personnel Services who met with them in a supervision session each week.

Evaluation of the Winter Term Program

At the conclusion of the winter quarter, discussion leaders were asked to provide their evaluations of the Group Counseling Program. These reports were submitted to the group counseling supervisor, George S. Weston of the Department of Guidance and Personnel Services. The results discussed below are based on Mr. Weston's personal appraisal of the program and his synthesis of the thinking of the discussion leaders.

Students were given an opportunity in the group sessions to "let off steam" in the presence of an adult who felt no need to defend those practices or objects attacked by the group members. Students criticized grading practices, courses, the impersonal atmosphere of a large university, and many other things undergraduates are apt to complain about. Having expressed their criticisms, students were often better able to view the situation more objectively and to approach their problems more constructively. In some instances students were helped to examine their grievances and to recognize the real bases of their antagonisms.

Some students were helped to take a closer look at themselves. One student said the meetings "caused me to think about things I had never thought about to any great extent before." Thus, some students began to examine problems which they had not fully resolved previously. They came to realize they were unsure as to whether they wanted to attend college, go into engineering, get married, etc. By reopening these questions they were better able to deal with them. A number of students stated at the end of the term that they were more comfortable and were more willing to discuss their personal concerns with others. More important, a number of students indicated an increased readiness to seek assistance for the personal problems which concerned them.

For many students it was reassuring to find that others faced similar problems: doubts about their academic abilities, difficulty with their course-work, and uncertainty about their professional goals. The discussions contributed to an increased sensitivity to others' feelings and to an acceptance of other peoples' viewpoints. And finally, a number of students felt they had established important friendships.

A question might be raised about the value of having students express their gripes, of aiding

them in the process of introspection and of helping them communicate more honestly and freely with their fellows. We feel, however, that these activities do have "cash value" in the educational setting. For instance, we would expect that the students who benefited in the areas indicated above would perform better academically, make more mature vocational decisions and would present fewer behavior problems.

One of the purposes of the Group Counseling Program in Engineering was to "identify concerns of lower division engineering students in order that appropriate staff members may consider the administrative, curricular and student personnel implications of this information." Each of the fifteen discussion leaders involved in the program were asked to include in their written reports an analysis of the types of problems discussed in their meetings as well as any recommendations they might have regarding these problems. The following section describes five major problem areas identified by the group leaders.

PROBLEM NO. 1. Students are very aware of and concerned about the pressures of the academic program. There is so much to do and too little time to do it. They feel that the endless round of classes, examinations, assignments and laboratory work leaves them with little time or energy for attending the lecture-concert series, University athletic events, or participating in student organizations. On one hand they are extremely anxious about successfully handling their academic work load, and on the other hand they feel they are missing an important part of college life.

Recommendations:

1. One solution to the problem is to reduce the credit requirements for the engineering degree. Possibly certain courses could be eliminated from the present program without reducing the program's quality.
2. It also seems feasible to recommend reduced academic loads for certain students. Students, who because of their ability, deficient academic preparation or outside demands on their time, may well be encouraged to plan a less ambitious academic program.
3. It may be necessary to re-evaluate some courses in the engineering curriculum. More specifically, some courses were felt to demand a disproportionate share of the student's time in terms of the purpose and the credit granted for the course.

PROBLEM NO. 2. Many students fail to see the relevance of individual courses they are required to take and many question the relevance of the total engineering curriculum. For example, in the first instance some students see little relationship between some mathematics courses as they are taught in the Mathematics Department and their future functioning as an engineer. Those who question the relevance of the engineering curriculum seem to feel it is either too theoretical or that it is too narrow in its specialization.

Recommendations:

1. If there is justification for students' criticism of courses in mathematics, the College of Engineering might consider offering these courses within the College itself. If this is not feasible, special sections for engineering students could be established for some mathematics courses.
2. The College of Engineering has the responsibility for developing the type of curriculum which it feels best prepares students for the professional role of an engineer. It seems, however, that many students are inadequately informed about the nature of the role for which they are being prepared. Lacking adequate information about the underlying philosophy of the program, students are often resentful, frustrated and dissatisfied.

   a. One way to meet this problem is to inform the College's interested audience about the engineering program. An important part of that audience is composed of Michigan high school counselors as well as science and mathematics teachers. These people, especially, should be informed of the College's program and of the "kind of engineer" being educated at Michigan State University. They in turn can better aid students in deciding whether this program is consistent with the kind of education the student is seeking. Orientation of teachers and counselors could be conducted on campus as well as at regional meetings throughout the state.

   b. Orientation of teachers, counselors, and prospective students may also be provided by means of brochures and film strips.

   c. The need for orientation exists even after the student starts his engineering program. Students can be helped to develop a better understanding of the College's program and their future role as engineers through a series of small group meetings with appropriate College personnel. These meetings should also produce improved student morale, a better sense of direction and a developing identification with engineering as a profession.

PROBLEM NO. 3. Many students indicated dissatisfaction with their present academic performance and expressed concern about their chances of successfully completing their academic program. Previous academic performance in high school and measures of academic achievement and aptitude indicate that most of these students have the necessary ability for success in their studies. Some, however, are handicapped by poor study habits, poor reading skills, or inadequate preparation in specific subject areas.

Recommendations:

1. Provision of study table programs and tutorial services may prove beneficial for some students.
2. As part of a broader orientation program for first year students or as part of a more limited program, students could be helped to develop improved skills in studying, in reading technical materials and in preparing for examinations.
3. Students might also be encouraged to enroll in courses or programs which are designed to assist them in improving their reading and study habits.

PROBLEM NO. 4. Some students feel that no one is interested

in them as an individual, that they are just another number as far as their professors are concerned. They are frightened by the impersonal climate of a large university and by their feelings of anonymity.

Recommendations:

1. Students seem eager for an opportunity to meet informally with professors outside the classroom setting. Periodic student - faculty mixers, annual or semi-annual student-faculty athletic events would help demonstrate faculty interest in students.
2. Social mixers which provide an opportunity for students to meet in an informal setting and to become acquainted with other engineering students seems to be an important need for some students.

PROBLEM NO. 5. A number of students, including upperclassmen, expressed uncertainty as to career goals. They are not sure whether engineering is what they really want to study, but as they are unaware of other alternatives, they remain in engineering.

Recommendations:

1. Again this problem might be dealt with in an orientation program offered during the freshman year. During the first quarter, students should be provided a broad introduction to engineering as well as related professional fields. Prior to selecting an engineering specialty, students should be informed of the various options available to them and assisted in the process of selecting a departmental major.
2. Speakers could be scheduled to talk about engineering specialties as one means of informing students about the nature of these various occupations. Ideally, these presentations should be made to groups of no more than 35 students and should provide ample opportunity for students to question the speakers.
3. A file of career information could be made available in the College's library. The file would contain information about engineering specialties and related career fields. Development of a career library is relatively inexpensive and would meet an expressed student need for occupational information.
4. Summer jobs provide an excellent basis for determining the suitability of an occupational choice. Reading about an occupation or listening to a description of an occupation may be helpful in making a career choice, but the opportunity to observe engineers at work and to perform engineering functions is probably the best way of deciding whether engineering is an appropriate professional role or not.

The problems outlined above and the accompanying recommendations were offered by the group discussion leaders and the group counseling supervisor. In addition to securing their evaluation of the program, an effort was made to discover the reactions and feelings of student participants. A student evaluation questionnaire was mailed to each of the 170 participants at the end of winter quarter, immediately following the conclusion of the group counseling sessions. Of the 170 participants, 104 students or 61.2 per cent returned their questionnaires within a ten-day period. It was both interesting and encouraging to note that the assessment of the problems and concerns facing the students made by the group leaders correspond very closely with the responses of the students themselves. There was widespread agreement among both leaders and students that the Group Counseling Program should be continued in spring quarter. We were pleased to see that a number of their recommendations reinforced the emerging patterns of curriculum and orientation revision already under discussion by our engineering faculty. We were equally pleased to have their criticisms and recommendations for improvement of the program. Thus, in planning for spring term, we determined that we would focus special attention upon the needs of underachieving students. Also, we resolved to make every effort to insure that the spring term would truly be a voluntary one. Academic advisors need special caution when talking with students so as to avoid giving the impression that students were expected to accept the invitation to participate in the group counseling sessions.

DESCRIPTION OF THE GROUP COUNSELING PROGRAM FOR SPRING QUARTER

Ten discussion groups were organized with about seven student participants in each group. Meetings of one and one-half hours were held weekly for a period of from eight to ten weeks during the term. Ten group leaders, none of whom had previously been connected with the program, were selected upon the recommendation of the Department of Guidance and Personnel Services on the basis of their academic performance in graduate school and their professional competence as demonstrated in their work in the field of education. We continued to stress the importance of establishing a permissive atmosphere in which students could express their feelings and attitudes candidly so that they might more quickly be able to come to a meaningful understanding of the concerns which they faced.

Of the 68 student participants in the spring term Group Counseling Program, about 25 per cent volunteered to participate after receiving a general invitation extended to all College of Engineering students at spring term registration. These students represented the full range of academic achievement in contrast to the other 75 per cent of the student participants, all of whom were underachievers. It should be noted that this 75 per cent consisted of two groups of underachievers: one group (30 per cent) was comprised of students who responded to the first letter of invitation sent by academic advisors to underachievers while the second group (45 per cent) included those students who did not volunteer until they had received a second, more strongly worded letter, recommending that they participate in the Group Counseling Program. Each academic advisor defined underachievement within the context of his own department. In all cases, however, underachievement was defined as a significant discrepancy between the academic performance of the student, as indicated by his grade-point average, and his academic potential as assessed by the orientation test battery given upon each student's arrival at the University. The 68 student participants were

enrolled in the following majors: 25 from the freshman office, 15 from the Electrical Engineering Department, 24 from the Mechanical Engineering Department, one from the Chemical Engineering Department, and three from the Civil Engineering Department.

Objectives of the Spring Term Program

The over-all objectives of the group counseling program remained the same during the spring quarter. However, as we began to focus on the needs of underachievers, we also began to define our objectives more precisely with respect to the growth which we hoped to promote. Accordingly, we structured the following specific objectives to guide our spring term efforts:

1. To strengthen the academic achievement of all student participants, especially underachievers.
2. To stimulate general cultural growth and clarify the broader role of the engineer in society.
3. To enhance each student's interpersonal capacity and skills.
4. To promote greater self-understanding and improved personal-social adjustment.

Analysis of the Spring Term Results

The validity of any program designed to assist underachievers must be established, in the final analysis, on the basis of the subsequent performance of the participants. Such a longitudinal study of the students involved in the spring term Group Counseling Program will be conducted. These long-term plans, however, should not blunt our efforts to make some immediate assessment of the effectiveness of our program. Accordingly, we solicited the evaluative comments and suggestions of both the student participants and group leaders in a manner similar to that used at the end of winter term. We again received thorough and perceptive reports from each of the group leaders. Much of their thinking paralleled the observations made by the winter term counselors and these have been extensively reported earlier in this paper.

New food for thought, however, was provided by the responses to the student evaluation questionnaire. Of the 68 participants, 45 students or 66.2 per cent responded quickly enough so that their questionnaires could be analyzed for the purposes of this report. In analyzing the student reactions, John P. Hartzell, the group counseling supervisor, discovered four underlying themes which corresponded very closely with the original objectives of the Group Counseling Program structured prior to the beginning of spring term. The interpretations which follow draw heavily upon Mr. Hartzell's analysis of the student questionnaires and the reports of the group leaders.

The four organizing themes in this analysis are academic achievement, cultural-role interests, interpersonal capacity, and personal-social adjustment. As one can see, these relate directly to the four specific objectives previously identified as guiding our spring term efforts. Table No. 2 demonstrates the shift in concerns as expressed by students at the outset of the term, during the group counseling experience, and finally at the conclusion of the program. Mr. Hartzell uses this framework as the basis for his evaluation of the spring term project.

The initial emphasis given to the problem of underachievement --during the recruitment phase-- was considerably modified by group experience. This shift is seen as desirable and therapeutically necessary in order that the psychological dimensions characteristic of the underachiever may be modified, thus freeing him for more effective participation in the academic enterprise. Such an approach is based upon considerable research evidence which views the underachieving, male college student as being characterized by a lack of realistic goals and purposes, a high need for affiliative, dependent relationships (although consciously denied), a sense of self-perception that is experienced as grossly inadequate and inferior, an inability to directly express anger, a fear of the loss of impulse control (leading to overcontrol, periodic displacement and/or intrapunitive behavior), high degrees of anxiety, frequent moods of depression, as well as poor study habits, poor motivation and inappropriate attitudes relating to the same. Students experiencing some combination of these symptoms are unable to recognize and utilize their potential in academic situations. They are the underachievers.

TABLE NO. 2

The Shift in Primary Concerns Expressed by Student Participants in the Spring Term Group Counseling Program

Reaction to initial set (N = 45):	
Academic achievement	16
Cultural-role growth	4
Interpersonal	5
Personal-social adjustment	18
Uncertain	2
Level of involvement (N = 45):	
Academic achievement	7
Cultural-role growth	4
Interpersonal	9
Personal-social adjustment	18
Marginal (generally negative)	3
No response	4
Recognized gains (N = 45):	
Academic achievement	6
Cultural-role growth	4
Interpersonal	9
Personal-social adjustment	12
Marginal (generally negative)	10
No response	4

The concern for cultural-role interests, while showing moderate shift for two persons, remained unchanged in spite of group experience. This static condition suggests that, while the individual (who initially expresses such interests) was able to seek out and pursue them in group interaction, apparently little weight was given to this area by his group members and counselor. The question is thus raised regarding the appropriateness of this variable as a goal in group counseling, that is, as to its feasibility in short-term treatment.

A slight increase of interest was evident in the interpersonal area. The relatively low value given to interpersonal relations by the group members, generally, may be partially understood in view of the brevity of the experience (the total number of sessions between groups having varied from eight to ten). It is also possible that many members--who may have been inclined to select this area as a primary interest--were unable to distinguish it from the personal-social adjustment area, which was strongly emphasized and more clearly labeled by their counselors.

The obvious preference for the

CONTINUED ON PAGE 48

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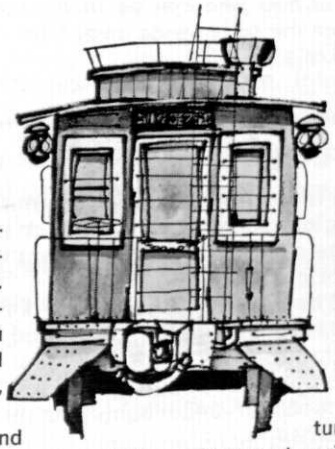

Sometimes an engineer can get so sidetracked in the course of a project that he forgets where it was going in the first place. This is calamitous. The engineer loses interest, and the wheels start to slow down in a dozen different places. ☐ Hamilton Standard follows the project management concept, which enables the engineer to keep sight of the entire program, providing the "what and when" direction, establishing and maintaining responsibility for the "how" and excellence of work required to accomplish the programs. Specifically, the engineer will have the opportunity to participate in and pursue a program from the beginning to final production, including phases of ☐1) Precontract — prepare R&D proposals, defining the tasks, technical as well as costs and schedules. 2) Planning — developing complete detailed plans covering each element of the contract. 3) Design & Analysis — creating the hardware ideas — applying the state-of-the-art, and assuming responsibility for the basic structure of the final product. 4) Development & Qualification — preparing development and qualification test programs to determine and demonstrate product performance, conducting these tests, evaluating results, solving the problem areas to assure complete product development and technical integrity, serve as technical consultant to manufacturing and maintain customer coordination, analyzing in-service or field product performance. ☐ Some of the present projects involve *space and life support systems, environmental conditioning systems, v/stol propulsion systems, micro-electronics, ground support equipment, turbine and rocket engine controls, industrial valves, electron beam machines, air induction and special controls.* ☐ Hamilton engineers are encouraged to broaden their personal capabilities by taking advantage of in-plant technical courses lectures and seminars. Enrollment in useful short courses at various colleges and universities is also authorized. Engineers may also qualify for the company's rotational program. This provides opportunities for assignments in several departments to broaden the individual's knowledge of the company's scope of operations. ☐ In summary: an engineer's future with Hamilton Standard is limited only by his ability and desire to make a contribution to the team effort — and his capacity to shoulder responsibility. He's got a wide-open track to personal progress. ☐ *We invite you to climb aboard for an immediate interview and to submit a resume of your qualifications to this equal opportunity employer — write to Mr. Timothy K. Bye, Supervisor of College Relations, Windsor Locks, Conn., or see your Placement Office for an appointment with our representative when he visits your campus.*

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WATER RECOVERY IN THE SPACE ENVIRONMENT

CONTINUED FROM PAGE 40

FOOTNOTES

1. B. Harrow and A. Mazur, *Textbook of Biochemistry*, p. 526
2. Frank J. Hendel, "Recovery of Water During Space Missions", *ARS JOURNAL*, XXXII (Dec., 1962), p. 1848.
3. W. R. Hawkins, "Feasibility of Recycling Human Urine in a Closed Ecological System", *Journal of Aviation Medicine*, XXIX (July, 1958), p. 533.
4. Hendel, *Op. Cit.*, p. 1848.
5. *Loc. Cit.* Fig. 1 adapted from this source.
6. *Ibid.*, pp. 1851 - 1852.
7. *Loc. Cit.*
8. *Ibid.*, p. 1849
9. *Ibid.*, p. 1851
10. *Hawkins, Op. Cit.*, pp. 533-534
11. Hendel, *Op. Cit.*, pp. 1854, 1855
12. Office of Science and Technology, Executive Office of the President, "An Assessment of Large Nuclear Powered Sea Water Distillation Plants", pp. 28 - 29.
13. See Hendel, *Op. Cit.*, pp. 1853-1854.
14. *Loc. Cit.* Fig. 3 adapted from this source.
15. Hendel, *Op. Cit.*, pp. 1854-1856
16. *Loc. Cit.*
17. *Loc. Cit.*

SE

BRAIN SPRAINERS

EDITOR'S NOTE: Answers to the following puzzles will appear in the January issue of the Spartan Engineer.

Bill is half as old as Alfred will be when the latter is twice as old as Charles was 10 years ago. Alfred is twice as old as Charles was when the latter was half as old as Bill will be in 12 years' time. Bill is half as old as Charles will be when the latter is three times as old as Alfred was 18 years ago. What are the ages of the three?

SE

If Sara shouldn't, then Wanda would. It is impossible that the statements: "Sara should," and, "Camille couldn't," can both be true at the same time. If Wanda would, then Sara should and Camille could. Therefore Camille could. Is the conclusion valid?

SE

If a hard-working bookie is to realize a profit on his endeavors by giving odds AGAINST the possibility that in a room full of men there will be two men with the same birthday, what is the maximum number of men who can be in the room before the odds swing away from the bookie's favor?

SE

Using only mathematical signs and without changing the position of any of the figures, can you make this into an equation?

2 9 6 7 = 17

Problem A Day, R. M. Lucey

SE

If Smith does not beat his wife, and has no friend called Jones, who is a bachelor, then either there is not any equality in the world or there is not any independence – or else, all is right with the world. But if there is independence in the world, Smith beats his wife. If Smith has a bachelor friend, Jones, or forgets to bring his wife flowers, then he does not beat his wife. If he does not beat his wife, there is something wrong with the world. If it is false both that Smith has no bachelor friend called Jones and that he forgets to bring his wife flowers, then it is also false that either nothing is wrong with the world or there is equality in the world. But there is equality in the world. Does Smith bring flowers to his wife? Is there independence?

SE

GROUP COUNSELING PROGRAM AT MSU

CONTINUED FROM PAGE 45

personal-social adjustment area far outweighs any other single interest, both in terms of pre- and post-counseling experience. It is interesting to note that the same number of persons expressed primary concern in this area prior to and during treatment, suggesting again the importance of motivation or pre-counseling set--that is, one finds what one anticipates in a group counseling experience of this nature. As is evident in individual, personal-social counseling, not much progress can be realized in this adjustive area without a definite, clear commitment from the client prior to treatment.

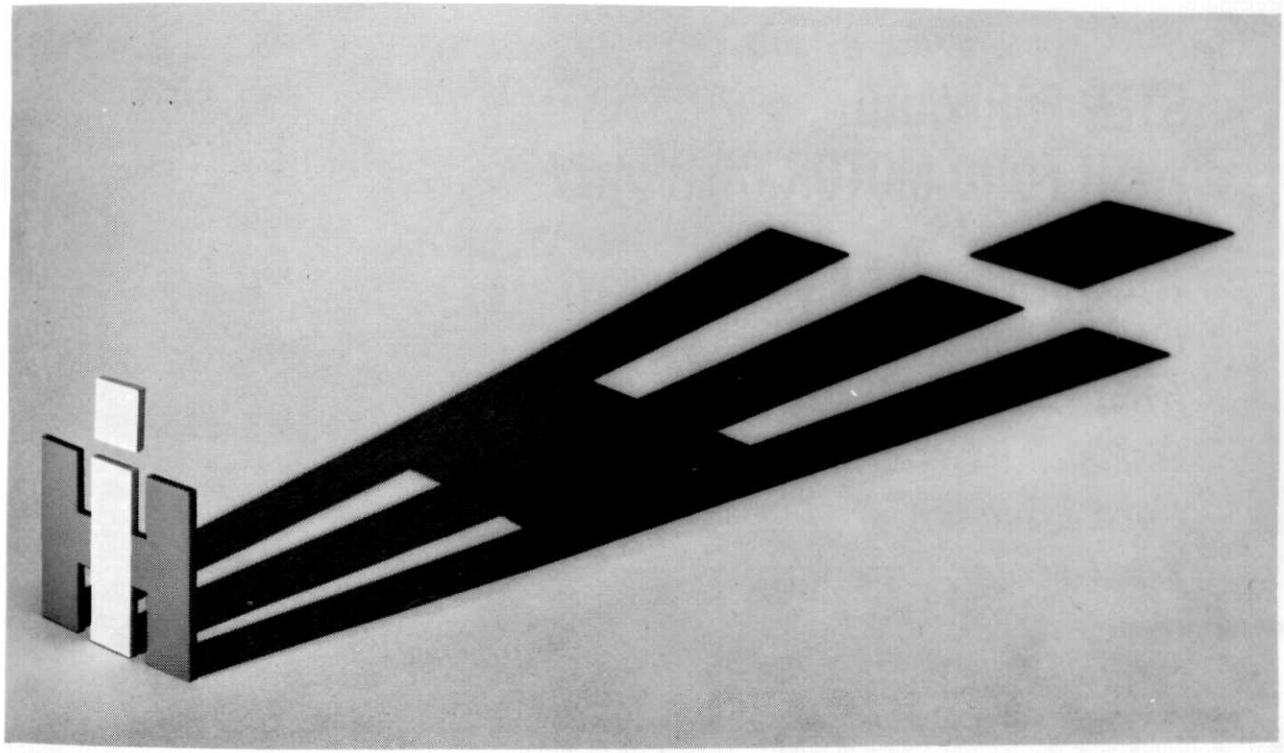
OUTCOMES AND IMPLICATIONS FOR FURTHER STUDY

The Group Counseling Program has contributed significantly to the effectiveness of the work of the Engineering Student Affairs Office. In closing, I would like to outline briefly the primary conclusions we have drawn on the basis of both the winter and spring term sessions.

1. The Group Counseling Program should be continued in the future with a continuing emphasis being given to the needs of underachieving students.
2. Ways should be sought to achieve a more voluntary quality of counseling commitment on the student's part prior to the group experience.
3. Adequate follow-up studies of student participants should be conducted in an effort to properly validate the techniques used in the Group Counseling Program.
4. It has become more evident that engineering students need and desire additional help in clarifying their career goals, in understanding the basic rationale underlying their academic programs, and in gaining deeper insight into the nature of the branches of engineering. This suggests that increased interaction between students and faculty outside of the classroom would be both welcome and useful. Perhaps the student branches of the various engineering societies could bring this about.
5. Further experimentation with programs and techniques of this type should prove valuable in enlarging our repertoire of approaches essential in meeting the needs of engineering students.

In conclusion, we are particularly encouraged as a result of the Group Counseling Program, not solely because of the frequently substantial benefits derived by individual student participants but also because of the deeper understanding we have gained of their unique characteristics as people and as future engineers.

SE



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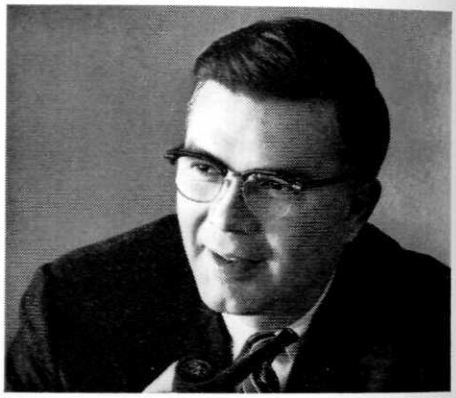
STEP FORWARD WITH FORD MOTOR COMPANY

An Open Letter to the 1965 College Graduate from Donald N. Frey, Assistant General Manager, Ford Division of Ford Motor Company



Donald N. Frey was awarded a bachelor's degree in metallurgical engineering by the University of Michigan in 1947 and a doctorate in 1950. One year later, he joined Ford Motor Company as manager of the Metallurgical Department in the Scientific Laboratory. In 1962, Dr. Frey was appointed assistant general manager of the Ford Division with responsibility for all engineering, product planning and purchasing activities. He is 41 years old.

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It will take people to accomplish this objective. Engineering, finance, styling, marketing, product planning, sales—all require people with the knowledge, judgment and personal drive to avail themselves of the unprecedented opportunities offered by a great industry.

The automobile business is growing. More cars are being bought now than ever before. With increases in population and consumer buying power, even more will be bought in the future. Realizing this, Ford Motor Company seeks to attract college graduates who have the capacity to grow with the company and the market.

Right now, our plans call for employing about a thousand of the best 1965 graduates we can find, with all types of educational backgrounds. We need specialists, but we also need persons with broad liberal-arts training who can handle a wide variety of assignments. Actually, in our company, many graduates grow into jobs totally unrelated to their degrees. They have discovered that Ford offers intellectually challenging opportunities for those with the ability to seize them. We invite you to make the same discovery.

Contact your Placement Office and arrange to see our representative.

Donald N. Frey

Ford
MOTOR COMPANY
The American Road, Dearborn, Michigan

An Equal Opportunity Employer

FORGINGS—HOW THEY IMPROVED THE RELIABILITY OF THIS CROSSHEAD . . .

yet cut cost 20%

Originally, this crosshead for a lift truck was not a forging. Now it is **forged** in steel. Here's why . . .

The lift truck builder wanted to increase the safety factor to meet greater bending and shear stresses. He also wanted to increase the fatigue strength of the part. And all without any increase in weight or cost. He also wanted to reduce tool breakage caused by irregularities, voids, and inclusions.

He changed over to FORGED crossheads.

Now the crosshead has the required strength and stress-resistance, costs 20% less when machined and ready to assemble, increases production rates 14% by reducing tool breakage and increasing machining speeds.

Forgings are better for these reasons; they:

1. Are solid, free from voids and inclusions
2. Have high fatigue resistance
3. Are strongest under impact and shock loads
4. Have a higher modulus of elasticity
5. Have a unique stress-oriented fiber structure
6. Are low in mechanical hysteresis

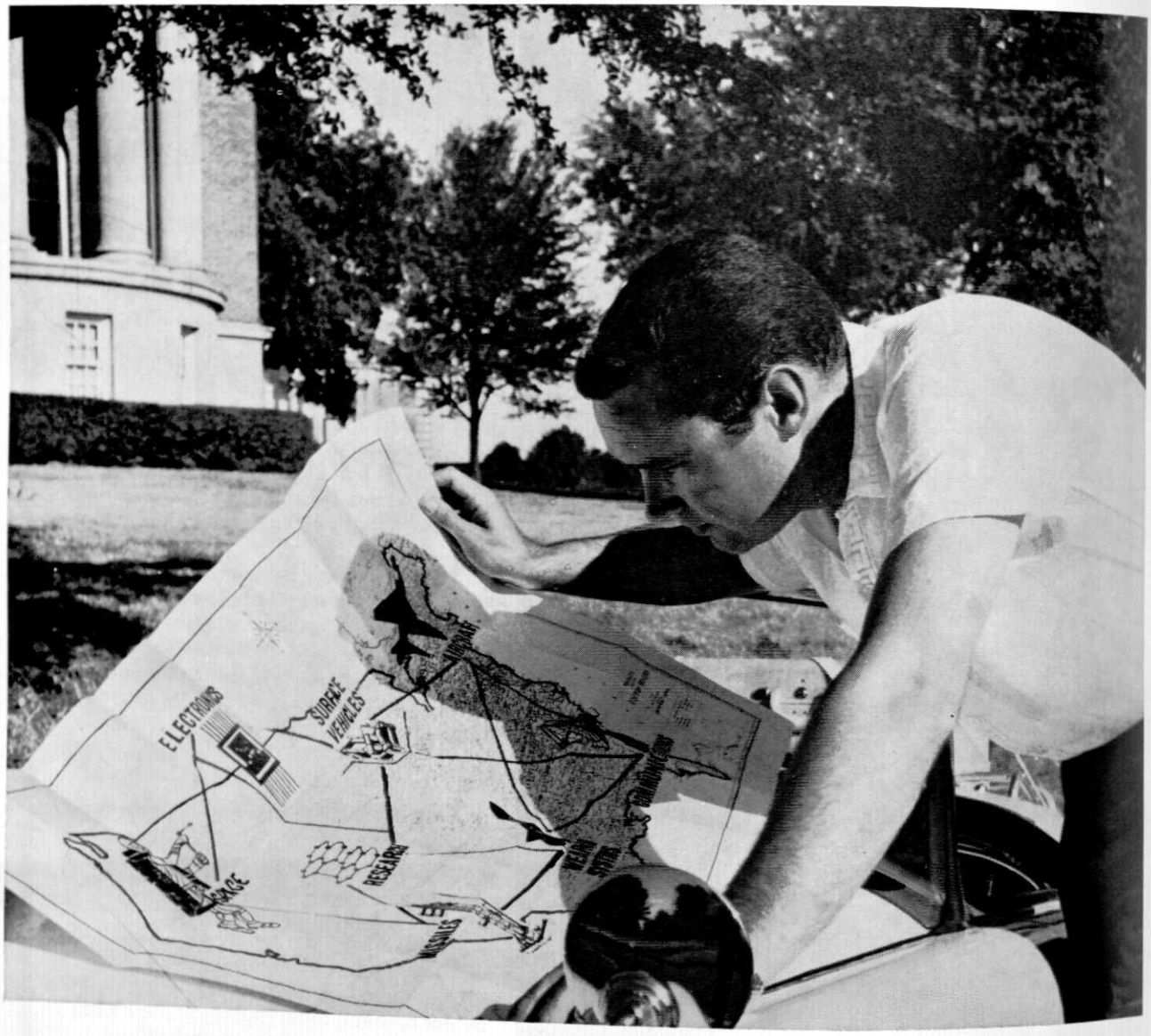
Memo to future engineers:

"Make it lighter and make it stronger" is the demand today. No other metalworking process meets these two requirements so well as the forging process. Be sure you know all about forgings, their design and production. Write for Case History No. 105, with engineering data on the lift truck crosshead forging shown above.

DROP FORGING ASSOCIATION
55 Public Square • Cleveland 13, Ohio

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

FORGED



GOING OUR WAY?

If you're mapping out your career destination, Ling-Temco-Vought offers a wide choice of exciting and challenging routes to your personalized goal.

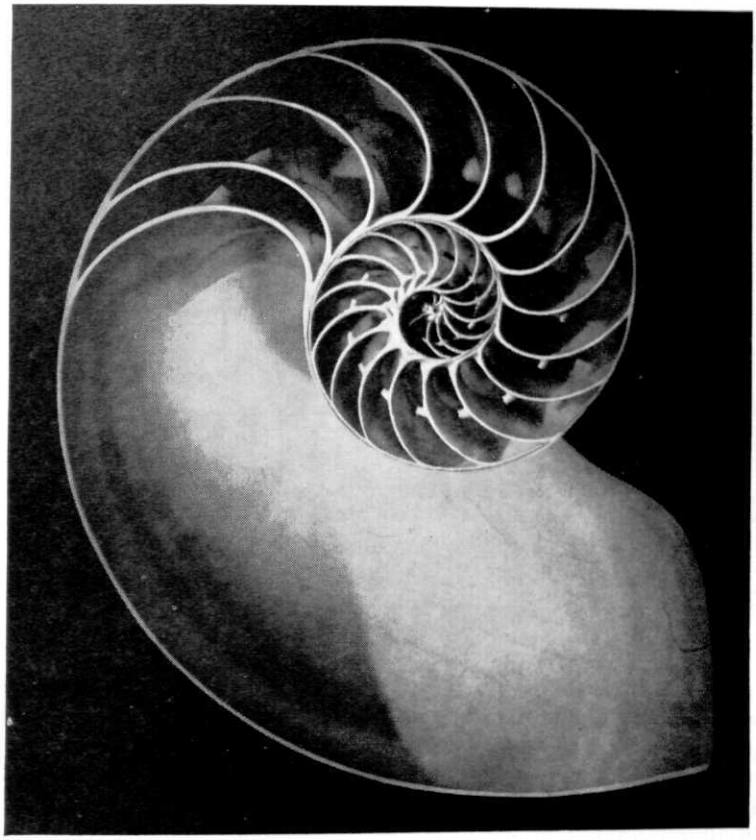
Here at LTV, young, alert engineers are "going places" in the fields of aircraft, missiles, space, mobile surface vehicles, weapons systems, ground and airborne communications, electronics, and range services. Supporting these activities is an excellent engineering climate providing the opportunity to contribute and professional advancement which is a direct function of the contribution. Assignments are diversified and stimulating in such areas as: **aerodynamics • avionics and instrumentation • dynamics • systems design • propulsion • stress analysis • communications design • telemetry and tracking • reconnaissance systems • amplifier and computer design • electromagnetic interference control • technical administration . . .** among others.

In addition to a rewarding professional environment, LTV offers engineers the opportunity to earn advanced degrees through company-financed graduate education programs.

Before selecting your industrial home, investigate the career avenues available with Ling-Temco-Vought. Get complete details from your Placement Office or write College Relations Office, Ling-Temco-Vought, P. O. Box 5907, Dallas, Texas 75222. LTV is an equal opportunity employer.

LTV LING-TEMCO-VOUGHT, INC.

LTV DIVISIONS AND SUBSIDIARIES: LTV ALTEC • LTV ASTRONAUTICS • LTV CONTINENTAL ELECTRONICS • LTV LING ELECTRONICS • LTV MICHIGAN • LTV MILITARY ELECTRONICS • LTV RANGE SYSTEMS • LTV RESEARCH CENTER • LTV TEMCO AEROSYSTEMS • LTV UNIVERSITY • LTV VOUGHT AERONAUTICS • KENTRON HAWAII, LTD.



You hear a lot of talk about growth these days...

So did Archimedes. Undoubtedly. Even today, his ancient spiral formulations survive in the form of devices which do much of the world's work... and as mathematical and symbolic reflections of nature's laws of growth.

At Sylvania Electronic Systems, your professional growth may not be preordained by the acceleration formula of an Archimedes spiral, but you will find a set of definite policies here which have been designed to encourage progress and development at your own best rate.

Sylvania helps you keep on top of the state-of-the-art... through the small group form of organization, providing cross-communications within each R&D laboratory and between all 19 labs and 4 manufacturing plants... through Division-wide conferences, in-plant seminars and post-graduate study plans conducted on an unusually generous scale.

And three distinct routes for advancement are offered, all with equal rewards – technical specialist, administrative manager, program/project manager.

You will enjoy a choice of advanced work from a long and diversified program list, including space/earth communications... electronic reconnaissance, detection, countermeasures... radar... data processing... arms disarmament and control... command and control systems... and world-wide engineering support services.

Sylvania Electronic Systems is a major division of Sylvania Electric Products Inc., supported by the technical and financial resources of the parent corporation, General Telephone & Electronics.

SYLVANIA ELECTRONIC SYSTEMS
Government Systems Management
for GENERAL TELEPHONE & ELECTRONICS

For further information see your college placement officer
or write to Mr. Robert T. Morton
40 Sylvan Road – Waltham, Massachusetts 02154
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R&D Laboratories are located suburban to Boston, San Francisco and Buffalo. Manufacturing facilities are located at Buffalo, New York, Needham, Massachusetts, Muncy, Pennsylvania, Santa Cruz, California.

ENGRINEERS

There once was a college professor, a wise and learned man, to be sure, but one who had no talent or training for teaching. Still, one has to make a living, so he got a job at a large, Midwestern college.

"Do you know what I'm going to talk of today?" he asked his first class.

"No," was the mumbled reply.

"Well, if you don't know, you are not worthy to have it taught to you," he said and stalked out of the room.

The next day the room was once again filled with students when the professor came into the room. "Do you know what I'm going to talk of today?" he asked.

"Yes, yes, we do," was the general reply of the students who weren't about to be caught the same way again.

"Well, if you do, then there's no sense in me repeating what you already know," and once again the professor walked away and left the students dumbfounded.

The third day the students were prepared, and when the professor asked "Do you know what I'm going to speak of today?" some said, "Yes, of course," while others said, "No, no, we don't."

The professor was startled for a moment, but then he thought, and said, "Well, there's no reason for me to tell you. Let those of you who know explain to those who don't know!" and he walked away.

SE

Soph: "I failed my Physics exam."

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

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

SE

I like an exam.
I think they're fun.
I never cram.
I never flunk one.
I'm the professor.

SE

It was the sleepy time of the afternoon. The professor droned on and on; formulas, constants and figures. An engineer, sitting in the second row, was unable to restrain himself and gave a tremendous yawn. Unfortunately, as he stretched out his arm, he caught his neighbor squarely under the chin, knocking him to the floor. Worried, he bent over the prostrate form just in time to hear a murmur, "Hit me again, Sam, I can still hear him."

SE

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

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

SE

Drunk: "Shay, do you know what time it is?"

2nd Drunk: "Yesh."

1st Drunk: "Thanksh."

SE

How do you tell an engineer from an elephant?

If he's got a slide-rule in his trunk, he's an engineer.

SE

Teacher (warning her children against catching cold): "I had a little brother seven years old, and one day he took his new sled out in the snow when it was too cold. He caught pneumonia and three days later he died."

Silence for ten seconds.

A voice from the rear: "Where's his sled?"

SE

A politician, a missionary, and an engineer went into the jungle of a newly formed African country, looking for votes, conversions, and oil respectively. Instead of being welcomed by the chief of the region, however, they were taken prisoner.

"You should be killed," said the chief, who, although he had learned English at a university in Ann Arbor, had failed to learn any manners, "but, if you can solve a problem for me, I will let you live. I have a throne, and a large brass bed I got from the central government, but there is only room for one in my grass hut. What can I do?"

"That's easy!" said the politician. "Just put a second floor on your hut." The chief knew the impracticalities of a second floor on a grass hut, however, and had the politician beheaded.

"Well," said the missionary, "I suggest you should sell the bed and give the money to the poor, and that way gain grace in the eyes of God." The missionary was killed instantly.

The engineer didn't say a word, but silently rigged up two pulleys, got some tough vines to use as rope, and showed the chief how he could stow the bed up near the roof during the day, and look up at the symbol of his wealth while sitting in his throne, and stow the throne up there at night, so he could lie in bed, while looking at the symbol of his power. The chief was pleased, and the engineer left, with exclusive oil rights to a whole region.

Unfortunately, vines wear through rather quickly, and one night, while the chief was lying in bed, the vine broke, and the chief was crushed beneath his throne.

Moral: People who live in grass houses shouldn't stow thrones.

SE

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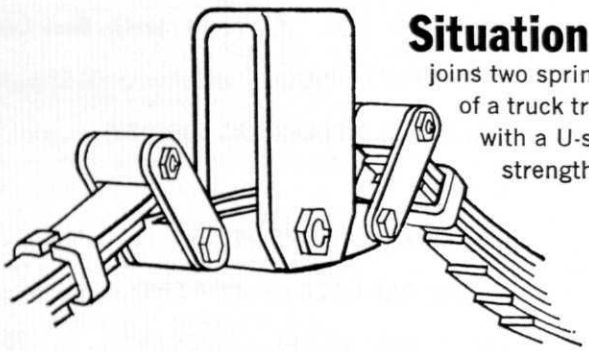
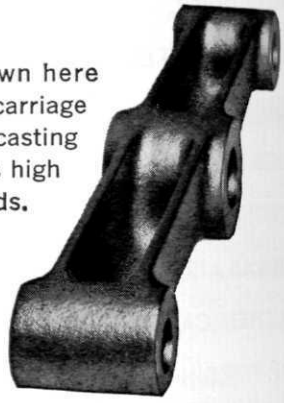
How Would You Solve This Design-Material Problem?



Situation: The equalizer bar shown here joins two spring assemblies to the undercarriage of a truck trailer. It is a Malleable iron casting with a U-shaped cross section. It has high strength and weighs only 3.8 pounds.

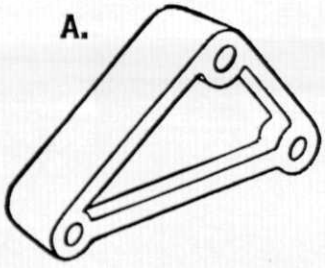


Problem:

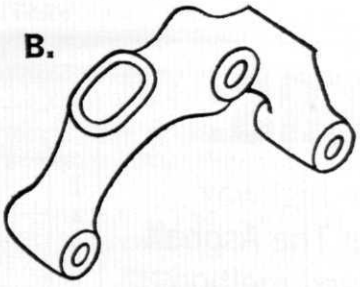
To raise the center hole 3 inches so that the unit can be adapted for use on house trailers. Costs must be kept to the absolute minimum to be successful in this highly competitive field.

Which design would you use?

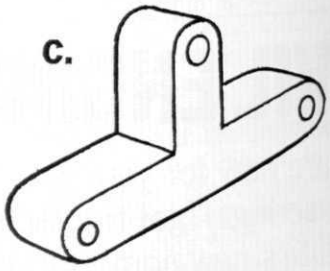
A.



B.



C.



Solution:

Illustration B, the curved tubular shape, has the best stress distribution characteristics because metal is placed where the load occurs—at the outer edges of the part. In this situation a solid cross section isn't indicated because very little of the load occurs at the center line. The material selected was again Malleable iron, combining high strength with design freedom.

Is this the solution you would have chosen? If not, it may be to your advantage to learn more about Malleable castings. Their many unique abilities are described in a new digest called "Design Criteria for Malleable Iron Castings". Send for your free copy today.

MALLEABLE FOUNDERS SOCIETY

MALLEABLE FOUNDERS SOCIETY · UNION COMMERCE BUILDING · CLEVELAND, OHIO 44114

Sophisticated engineers can rise rapidly here

Ed, Bob, and Hipparchus (their true identities hidden here against pitiless kidding by all-too-real colleagues) are three Kodak mechanical engineers on their way to a management meeting for the up-and-coming. Let us consider differences rather than similarities.

Ed works on those inexpensive, sure-fire cameras that Americans as well as citizens of the rest of the civilized world think of when "Kodak" is mentioned. The big boss who chose Ed for his department says: "Along with Ph.D.s in solid-state physics, I look for B.S. and M.S. mechanical engineers from whom I can expect the unexpected. The spots for sophisticated engineering don't always have a sign over the door that says 'SOPHISTICATED.' Who would ever have dreamed ten years ago that low-price zoom lenses and automatic exposure-setters and through-the-lens finders could deliver the performance they do today? The doozers we have ready to unveil next year and the year after that are well in hand, fortunately. Then what?" Then what is Ed's responsibility. He will need help from fellows now in college. Maybe you.

Bob works on data-recording and information-retrieval photographic systems. His work has to impress cost-minded brother engineers in other companies as well as banks and other hard-nosed commercial customers. He meets the requirements of a boss who says: "The type I need was called an 'inventor' a generation ago. The difference is that in 1965 he will need a lot more mathematics, engineering physics, chemistry, hydraulics, electronics, and other book-learning than an inventor needed in 1925. When it comes time to relax, though, you'll find him building something with his hands, and it's probably something pretty clever and unusual that works real well." As it happens, Bob's main hobby is neither bridge nor folk singing.

Old Hip calls square dances and doesn't care who knows. Policy proscribes discussion of the nature but not of the philosophy of his engineering. His boss puts it: "In consumer and commercial products, where regular service can easily be part of the engineering plan, perfection would carry a price tag that made no sense. With us, a perfect score is the only acceptable goal. Nothing less makes economic sense. Before our guys can think of what is sensible, they have to think of what is possible. It can be very enjoyable for the right type of smart apple."

Drop us a line if you can see yourself as any of these three right types, whether in mechanical engineering, chemical engineering, electronic engineering, chemistry, or physics.

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Business and Technical Personnel Department, Rochester, N. Y. 14650
An equal-opportunity employer offering a choice of three communities:
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Kodak

Advancement in a Big Company: How it Works

An Interview with General Electric's C. K. Rieger, Vice President and Group Executive, Electric Utility Group

C. K. Rieger

■ Charles K. Rieger joined General Electric's Technical Marketing Program after earning a BSEE at the University of Missouri in 1936. Following sales engineering assignments in motor, defense and home laundry operations, he became manager of the Heating Device and Fan Division in 1947. Other Consumer-industry management positions followed. In 1953 he was elected a vice president, one of the youngest men ever named a Company officer. Mr. Rieger became Vice President, Marketing Services in 1959 and was appointed to his present position in 1961. He is responsible for all the operations of some six divisions composed of 23 product operations oriented primarily toward the Electric Utility market.

Q. How can I be sure of getting the recognition I feel I'm capable of earning in a big company like G.E.?

A. We learned long ago we couldn't afford to let capable people get lost. That was one of the reasons why G.E. was decentralized into more than a hundred autonomous operating departments. These operations develop, engineer, manufacture and market products much as if they were independent companies. Since each department is responsible for its own success, each man's share of authority and responsibility is pinpointed. Believe me, outstanding performance is recognized, and rewarded.

Q. Can you tell me what the "promotional ladder" is at General Electric?

A. We regard each man individually. Whether you join us on a training program or are placed in a specific position opening, you'll first have to prove your ability to handle a job. Once you've done that, you'll be given more responsibility, more difficult projects—work that's important to the success of your organization and your personal development. Your ability will create a "promotional ladder" of your own.

Q. Will my development be confined to whatever department I start in?

A. Not at all! Here's where "big company" scope works to broaden your career outlook. Industry, and General Electric particularly, is constantly changing—adapting to market the fruits of research, reorganizing to maintain proper alignment with our customers, creating new operations to handle large projects. All this represents opportunity beyond the limits of any single department.

Q. Yes, but just how often do these opportunities arise?

A. To give you some idea, 25 percent of G-E's gross sales last year came from products that were unknown only five or ten years ago. These new products range from electric tooth brushes and silicone rubber compounds to atomic reactors and interplanetary space probes. This changing Company needs men with ambition and energy and talent who aren't afraid of a big job—who welcome the challenge of helping to start new businesses like these. Demonstrate your ability—whether to handle complex technical problems or to manage people, and you won't have long to wait for opportunities to fit your needs.

Q. How does General Electric help me prepare myself for advancement opportunity?

A. Programs in Engineering, Manufacturing or Technical Marketing give you valuable on-the-job training. We have Company-conducted courses to improve your professional ability no matter where you begin. Under Tuition Refund or Advanced Degree Programs you can continue your formal education. Throughout your career with General Electric you'll receive frequent appraisals to help your self-development. Your advancement will be largely up to you.

FOR MORE INFORMATION on careers for engineers and scientists at General Electric, write Personalized Career Planning, General Electric, Section 699-11, Schenectady, N. Y. 12305

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