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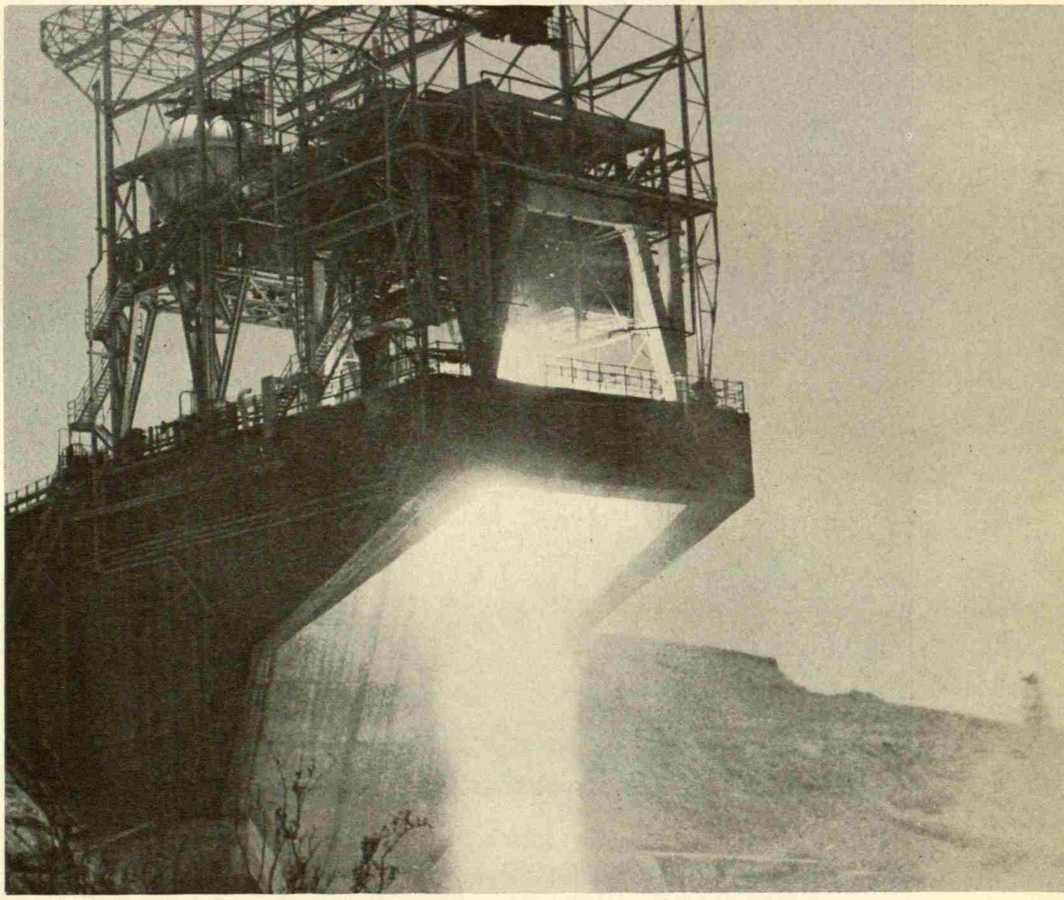
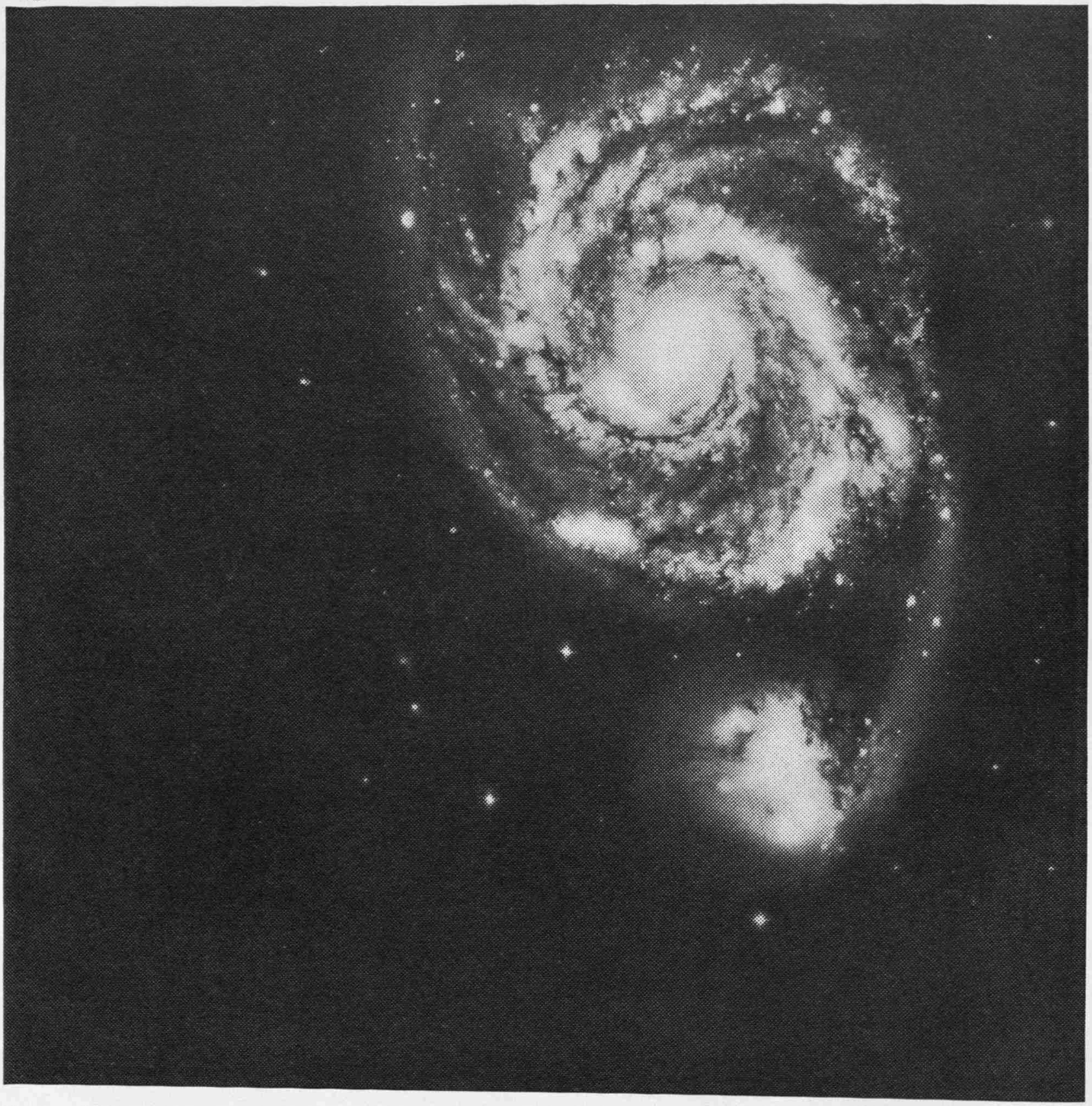
spartan ENGINEER

november 1961

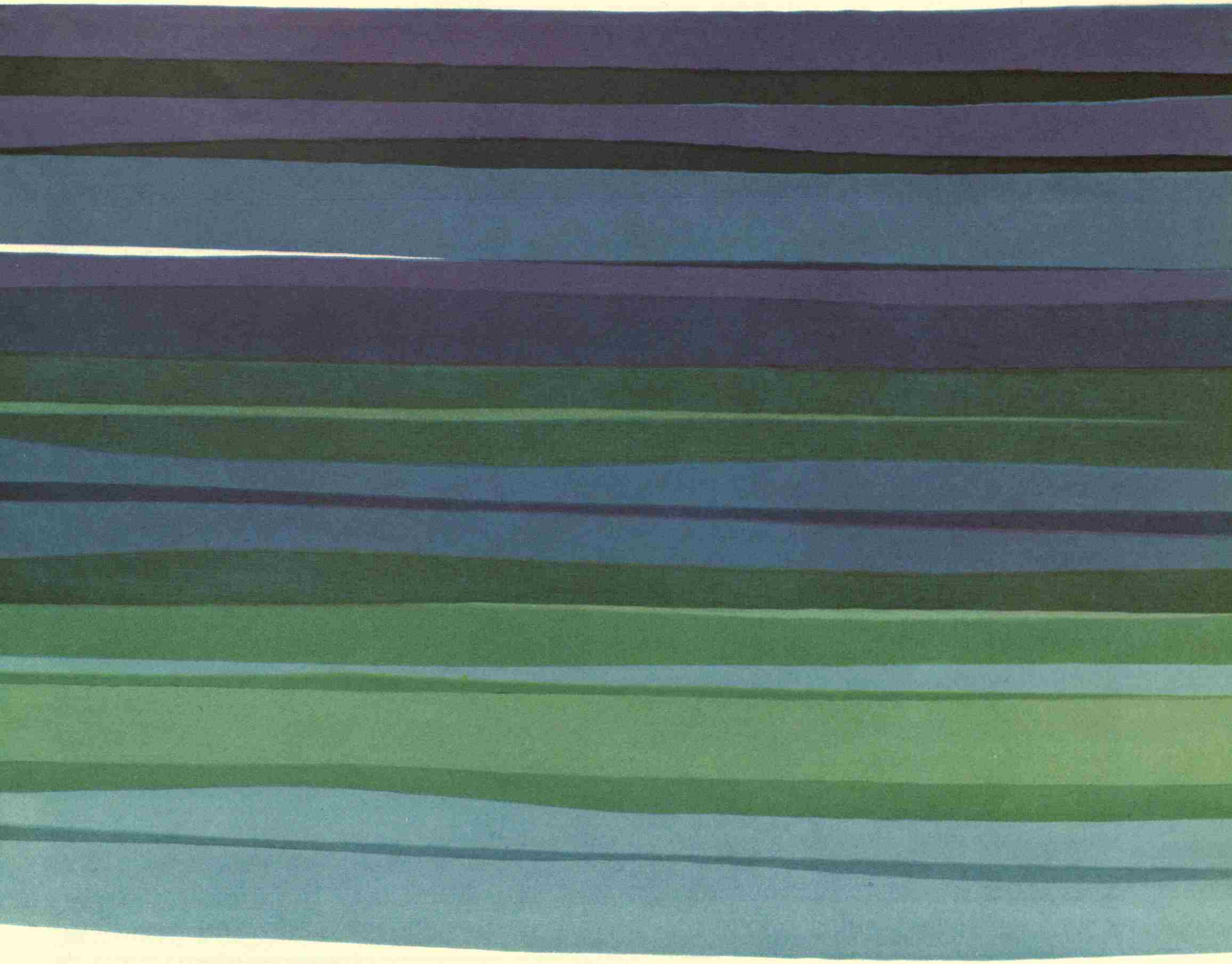


1.5 million pounds of thrust streams from the free-world's mighty F-1 rocket

see story on page 12



Things we know about tomorrow



FRESH WATER FROM THE SEA

"If we can develop low-cost means of bringing water to thirsty lands and people of the world, we shall bring a boon to mankind that is even more meaningful than the conquest of outer space . . ."—U. S. Senate Report.

In the desert sheikdom of Kuwait, a Westinghouse plant is now extracting nearly 17 million gallons of fresh water every week from the extra-salty Persian Gulf. In San Diego, another Westinghouse plant will soon be producing drinking water from Pacific Ocean water—seven million gallons a week.

Westinghouse scientists foresee "water factories" like these going up in seacoast cities all over the world. For peoples who never had enough water, a new kind of abundant life will be created.

This is just one of the exciting things going on at Westinghouse. To learn more about a career with Westinghouse, an equal-opportunity company, see the Westinghouse representative when he visits your campus or write: L. H. Noggle, Westinghouse Educational Department, Ardmore at Brinton Road, Pittsburgh 21, Pa.

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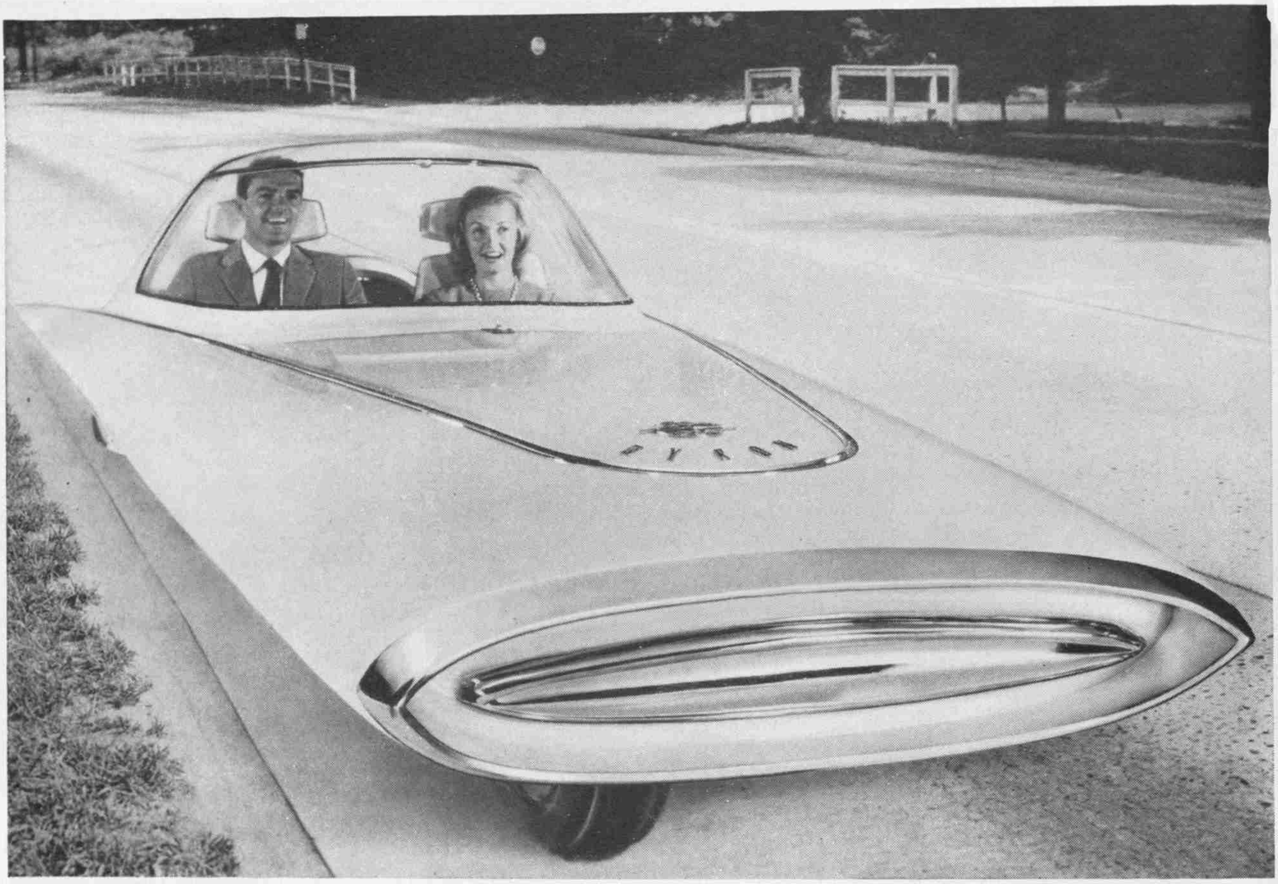

Gyron—dream car that drives itself. This two-wheeled vehicle of the future envisions automatic speed and steering control for relaxed "hands-off" driving. Designed by the advanced stylists of one of America's leading automotive companies, the delta-shaped Gyron would feature a computer that permits motorists to "program" their journey—distance, speed, arrival time—on a non-stop expressway. A gyroscope would stabilize the car in motion. Setting off the Gyron's sleek lines are parts coated with bright, corrosion-resistant nickel plating. The front bumper, exhaust ports, taillight bezel, control console, all get solid beauty-protection with this durable nickel coating system.

How Inco Nickel helps engineers make new designs possible and practical

The engineer is vitally concerned with design—inside and outside—whether it's an advanced new car or a nuclear-powered ship. With Nickel, or one of the many metals containing Nickel, he has a material that can meet the demands of a wide range of service conditions—providing an excellent choice for the equipment of today and the designs of the future.

Inco's List "A" contains descriptions of 200 Inco publications which are available to you, covering applications and properties of Nickel and its alloys. For List "A", write Educational Services.

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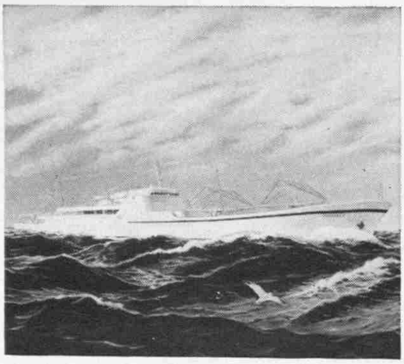
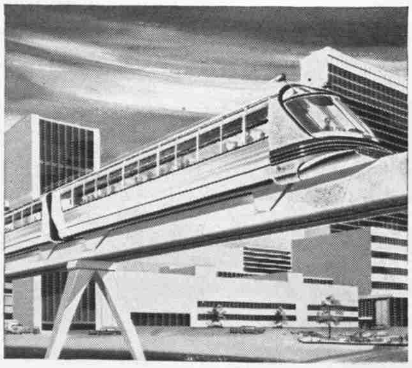


The Nuclear Ship Savannah is capable of sailing 350,000 nautical miles without refueling. Her uranium oxide fuel is packaged in tubes of Nickel Stainless Steel, more than 5,000 of them. Engineers specified 200,000 pounds of Nickel Stainless Steel for use in the ship's reactor to meet critical service demands.



Monorail "Airtrain"—a compact, high-speed transportation system that will be automatic, almost noiseless. Development is being explored by leading U.S. cities. Lightweight Monorail design demands strong weight-saving metals. Logical choice: Nickel alloys to take advantage of newest engineering concepts.

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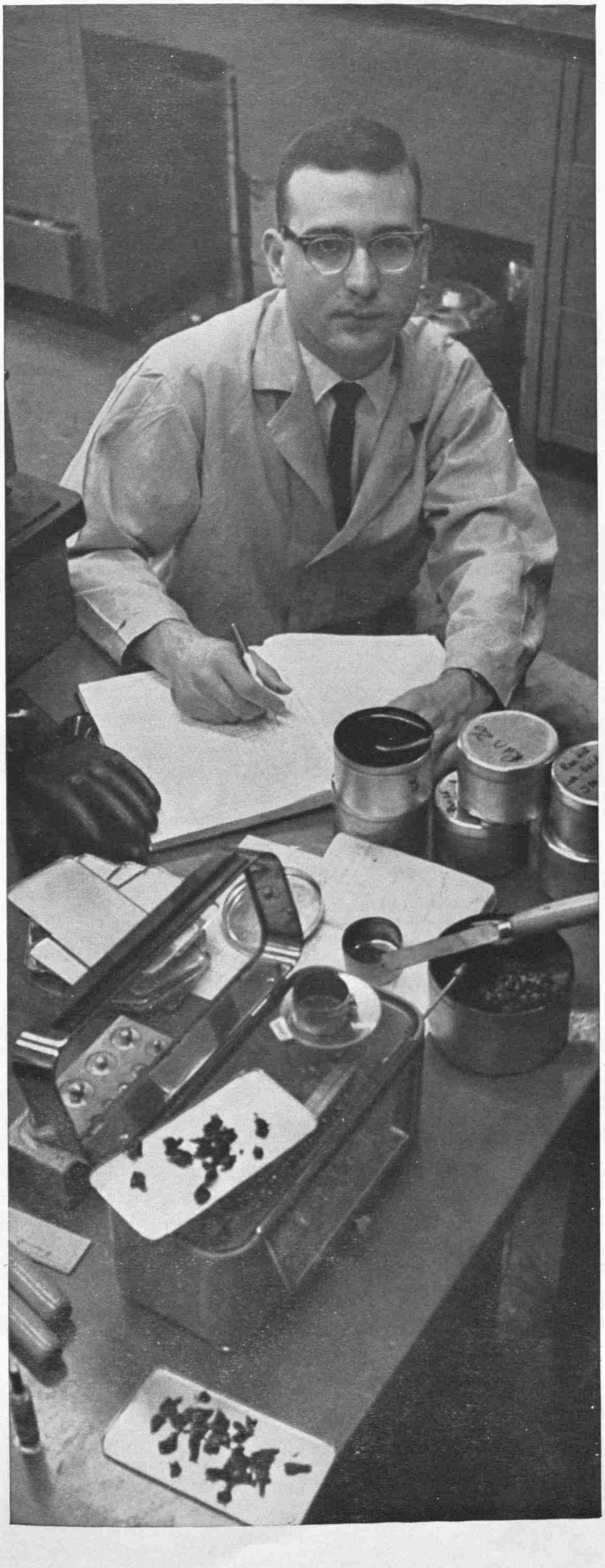

I chose a career, not a job!

by Pete Vossos

"I found a satisfying job right from the beginning—and more important, American Oil is diversified enough to offer varied opportunities for the future."

Peter Vossos earned his Master of Science degree at Iowa State, '58. As a physical chemist, Pete's immediate project is studying fundamental properties of asphalts with the objective of improving their performance in roofing and industrial applications. About his 2½ years at American Oil, Pete adds, "This is a company that's big enough and dynamic enough to be doing important work, but not so mammoth that you get lost in the crowd."

Many ambitious and talented young scientists and engineers like Peter Vossos have found challenging careers at American Oil. Their choice could have special meaning to you. American Oil offers a wide range of research opportunities for graduate chemists, chemical engineers, mechanical engineers, physicists, mathematicians and metallurgists.

If you are interested in a career with the Research and Development Department of American Oil Company, write to: D. G. Schroeter, American Oil Company, P. O. Box 431, Whiting, Indiana.

IN ADDITION TO FAR-REACHING PROGRAMS INVOLVING FUELS, LUBRICANTS AND PETROCHEMICALS, AMERICAN OIL AND ITS ASSOCIATE COMPANY, AMOCO CHEMICALS, ARE ENGAGED IN SUCH DIVERSIFIED RESEARCH AND DEVELOPMENT PROJECTS AS:

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As the major horizons in electronics are explored and extended, Raytheon offers an increasing number of challenging projects for scientists and engineers. In order to accommodate this heavy investment in research and development, Raytheon is committed as never before to comprehensive programs for developing its technical staff. The new Advanced Study Program is one of these.

This program is available to a selected group of outstanding scientists and engineers. It enables present and prospective Raytheon staff members, who are accepted for graduate study at Harvard and M.I.T., to pursue at Raytheon's expense part-time study toward a master's and/or doctor's degree in electrical engineering, physics or applied mathematics. You too may be able to qualify for the Advanced Study Program.

For detailed information, visit your placement director, obtain the brochure, "Raytheon's Advanced Study Program," and arrange an on-campus interview. Or you may write directly to Mr. G. C. Clifford, Coordinator of College Relations, Raytheon Company, Gore Bldg., Watertown, Massachusetts.

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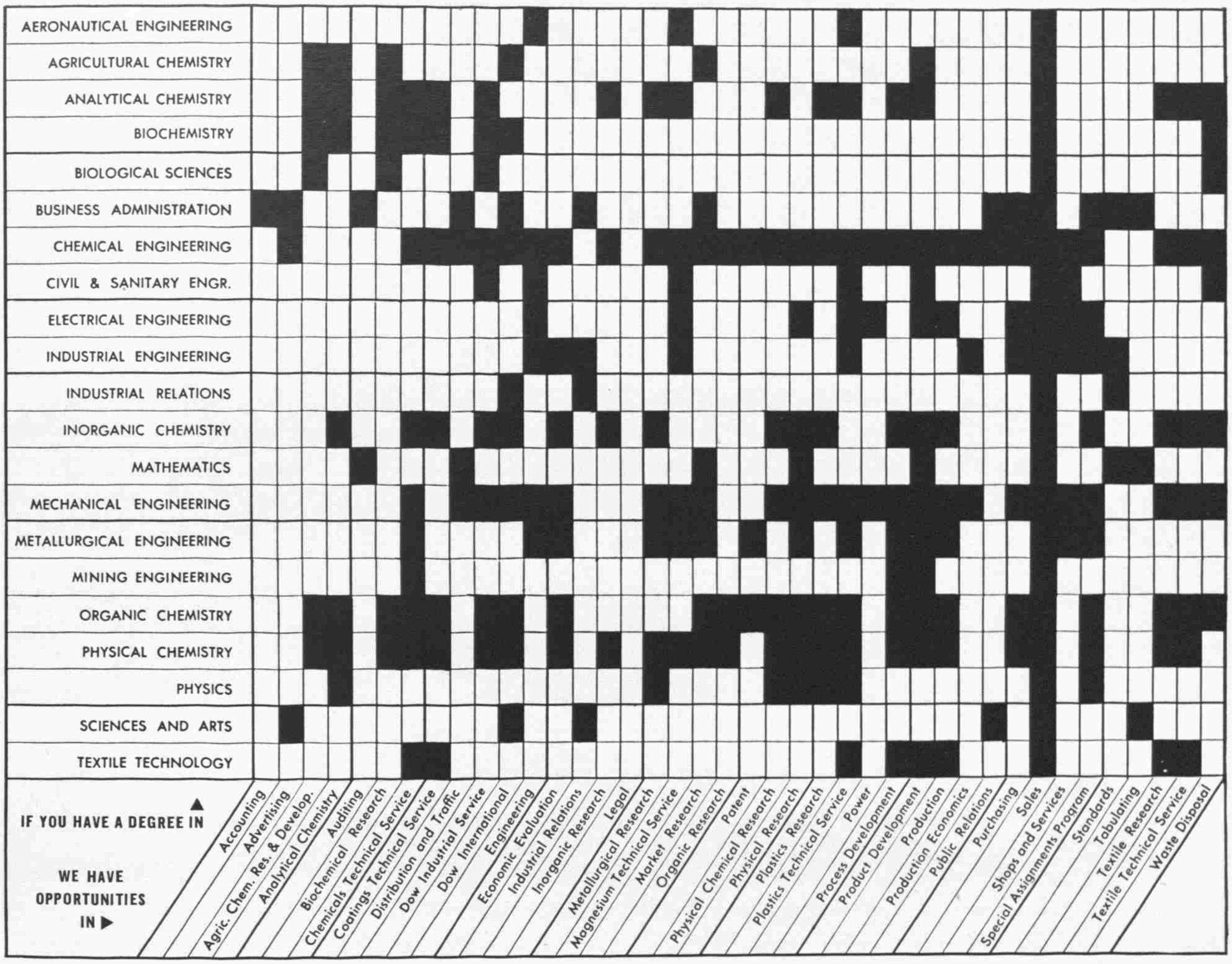

USE THIS CHART TO CHECK YOUR OPPORTUNITIES AT DOW!

We call this an 'opportunities chart.' It shows some of, but by no means covers all, the professional positions available at Dow for college graduates. What the chart cannot show is the keen interest that Dow management takes in the individual. Here, sound technical background and qualities of leadership are soon rewarded. Opportunities abound—on the job and through graduate study.

Dow is currently serving 200 industries varying from medicine to mining, paper to paint, tires to textiles, farming to foundries. Dow has major manufacturing operations in 23 locations in the United States in addition to associated and subsidiary companies. Exploration goes on endlessly at 50 separate laboratories. In addition, Dow has rapidly expanding marketing and manufacturing operations in 28 foreign countries.

Behind every product (and Dow has more than 700) is a story of achievement that comes with *opportunity*. Opportunity for individual and independent work by the people who created the product; by those who developed and engineered its manufacture; by the ones who produced, sold, and serviced it; and by those who continue to improve it.

Dow's fringe benefits are excellent also . . . life and hospitalization insurance . . . a yearly salary review plan (salaries are reviewed at least once a year, and the emphasis is on merit rather than length of service) . . . a pension and profit-sharing plan . . . an educational refund plan (provides financial assistance for employees who want to increase their job effectiveness through continued education) . . . and by participating in past stock purchase plans offered periodically, about 45 per cent of Dow's employees have become shareholders in the company.

For more detailed information about Dow, we invite you to visit or write the Technical Employment Manager at any of the locations listed below.

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Ohio—Dobeckmun Company, Cleveland
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THE DOW CHEMICAL COMPANY DOW Midland, Michigan

From The Editor's Desk

WHY ALL THE fuss about the race for space? Many people look upon it as a waste of the taxpayers' money. True, it is costly, but can we afford not to compete with Russia?

It is not just a race for space . . . too, and more important it is a fight for survival.

If Russia were to gain a monopoly on space knowledge and space weapons, we would be at their mercy. So, we must at least try to keep up with Russia in their bid to conquer space.

So far, it seems that neither the United States or Russia has any significant edge, but let's take a look at prospects for the future.

Statistics prove that Russia has been, and probably will continue turning out more engineers and scientists than the United States. This could be the determining factor in the space race . . . but it needn't be; the unbalance in numbers could be offset if our nation's talent is developed to its fullest. In other words, don't let your education (formal or otherwise) end with the B.S. degree; those of you who are seniors know that even though you've spent over three years learning, there is so much more to learn.

Anyone who is capable of going on to graduate school can usually find ways and means for doing so. Financial aid can be gotten in most cases, so there should be no excuse for not continuing your education.

Information can easily be obtained concerning financial aid, programs at various universities, etc., so take a few minutes to talk with your instructors or Dean Ryder about graduate programs.

Remember, there are engineers and good engineers . . . A good engineer's "thirst" for knowledge is never quenched, and for him the learning process never ends.

R. V. P.

Dean's Letter

ENGINEERING, WRITING, AND SPEECH!—we have just held a Kellogg Center Symposium bearing that title. Symposia on writing or on speaking would not surprise one, but why ENGINEERING writing and ENGINEERING speech?

Symposia are usually held because a problem exists, or there are questions needing answers, and it is hoped that by gathering a large group of people, all interested in the topic, the problem may be solved or questions answered. Perhaps this is a very pious hope and an optimistic process, but the human race seems to proceed on that basis.

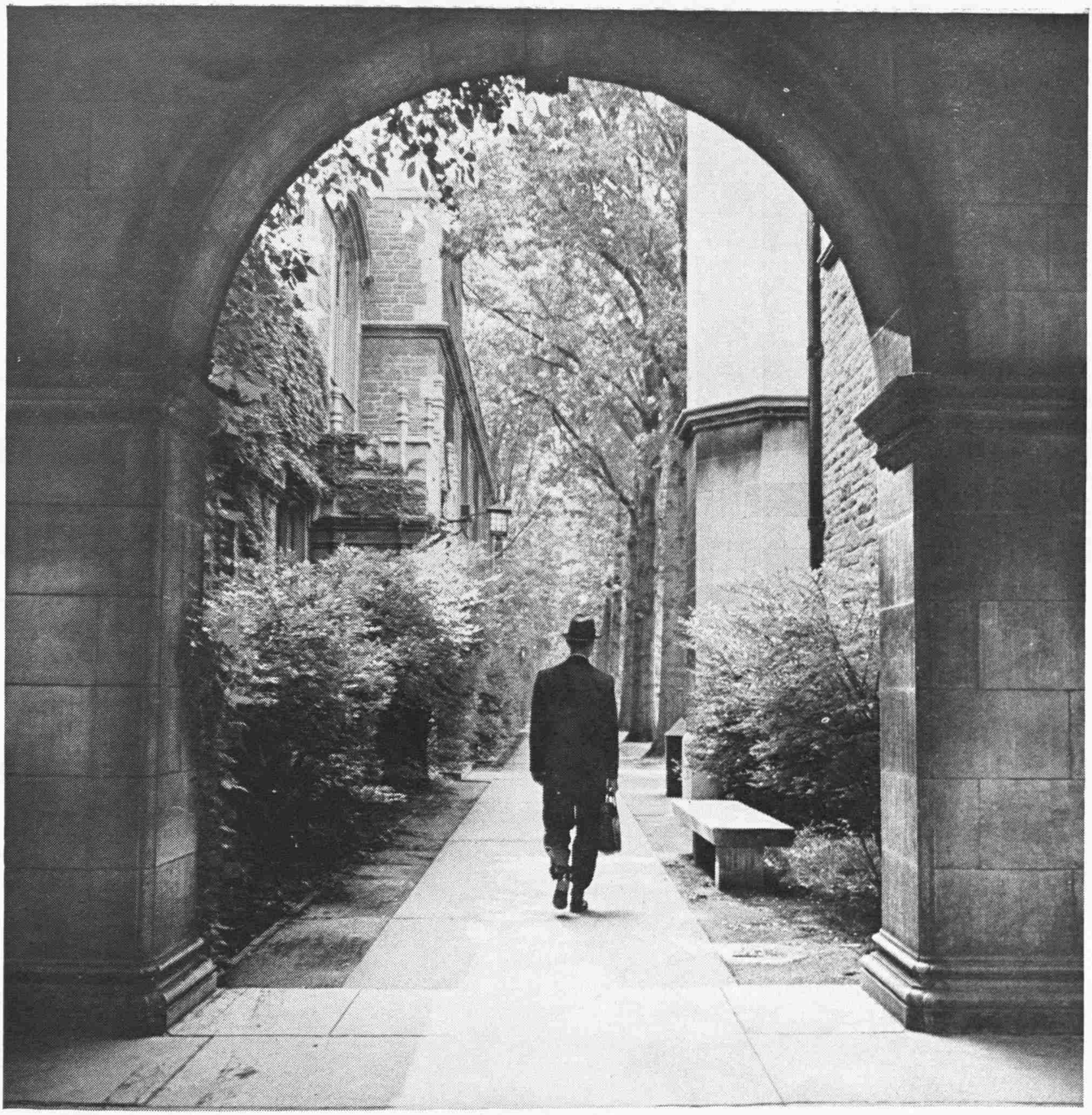
In this case the problem has existed for many years—engineers did not write well, and speech—that was for politicians, not for someone having a job to do! Yet engineers have traditionally had a difficult job in communications—that of explaining technical things to non-technical thinkers—and they have had little success in the past.

We used the opportunity offered by the Symposium to tell the group that we felt we were moving up! As we have worked to raise the scholastic level of our freshmen, required ever better scholastic performance in ever broadened curricula, pointed our students toward excellence in the profession of engineering—we have raised the overall abilities of our graduates in all areas, including the ability to communicate, as an engineer must.

Don't relax, however, you still may have to address your immediate supervisor in search of more adequate periodic compensatory treatment.*

J. D. RYDER, DEAN

*Our older graduates, not so skilled in English, said "Hit the boss for a raise!"



THE MIGHTY F-1

1.5 Million Pounds of Boost to Our Space Program

Edited by Reg Pilarsk.

THE National Aeronautics and Space Administration's F-1 engine, the most powerful rocket unit known, was shown to newsmen for the first time recently.

The F-1, which has a thrust of 1.5 million pounds, is being developed for NASA by Rocketdyne, a division of North American Aviation, Inc., under direction of the agency's Marshall Space Flight Center, Huntsville, Ala.

The test programmed today is another step in the build-up to a test of the engine at full thrust of 1.5 million pounds and a duration of two and one-half minutes.

THE decision to develop the F-1 was one of the first made by NASA after its establishment in October, 1958. The decision was made on the basis of an urgent, foreseeable need for a large thrust engine to power large space vehicles for such missions as manned circumlunar flights and landing a man on the moon and returning him to Earth.

Such a large vehicle—designated Nova—existed only as a design concept for several years.

On May 25, 1961, in his message to Congress on urgent national needs, President Kennedy urged an accelerated program to land man on the moon and return before the end of the decade. He requested that Congress appropriate $48.5 million to initiate design and development of the Nova vehicle.

The Congress approved the fiscal 1962 NASA appropriation bill on August 7 and design work will begin on Nova as soon as the bill is signed into law by the President.

It is possible, however, that first use of the F-1 engine could be in an advanced Saturn booster designed to approximately double the power of the Saturn C-1 booster. One possible configuration would be powered by a cluster of two F-1's for a lift-off thrust of three million pounds.

The Saturn C-1, with 1.5 million pounds lift-off thrust developed by eight Rocketdyne H-1 engines, will

(Continued on Page 30)

More than one million pounds of thrust streams from F-1 rocket engine during first series of tests of a complete flyable system. The F-1 is the free world's most powerful space booster engine.

WHY THE SPACE RACE?

by Dr. Eberhardt Rechtin
Chief, Telecommunications Division,
Jet Propulsion Laboratory,
California Institute of Technology

OUR COUNTRY is now engaged in an effort to conquer space at a tempo almost inconceivable little more than five years ago. We did not embark upon this course easily or without considerable controversy. And we are not the only country so engaged. It was the vigorous activity of the Soviet Union which prompted the scale of our own drive and which has given the exploration of space most of the elements of a race.

Superficially, one might give the present status of the contest by saying that the Russians are definitely ahead in terms of the size of their payloads, and the United States just as surely ahead in terms of the quality and quantity of information obtained from superior instrumentation. It is also fair to state that this particular race got off to a badly organized start. The two contestants did not start at the same time, and there is some question that they are going in the same direction. The scientific merit of the entire demonstration is certainly not obvious. If a year ago the question was, "Who says there's a space race?," then today the query might be, "What's the use of our racing for space?" or "What are we racing for?"

One of the remarkable things about human societies is that by the time a society is sufficiently well organized to plan everything ahead with complete knowledge of all its motivations, the society is on the way out. A dynamic society moving ahead generally embarks upon new ventures almost brashly, leaving it to later historians (from Homer to Parkinson, say) to fill in the reasons.

If our present space race were the first such venture of mankind, the reasons might be difficult to find now. But this is by no means the first time such new adventures have taken place. The motives are almost always the same, though the relative importance of one motive or another may be different.

One of the strongest motives is a demonstration of a successful society. A successful society must have sufficient organization, purpose, skill, energy and assets even to start large projects and certainly to complete them. It is far more difficult to accomplish a large and well-organized program than it is to perform a collection of smaller, independent ones. The societies which built the cities of ancient Crete, the Acropolis, the city of Rome, the magnificent churches of Europe and the wonders of the Far East were certainly not weak or anarchistic.

If the elements of competition are also present, such enterprises are carried on with salemanship and prestige in mind. We have had "World Fairs" for thousands of years. Cities of medieval Europe built towers whose numbers and heights were an indication of a city's wealth. Later these same cities built great cathedrals. The sales and public relations aspects of undertakings like these were tremendously important then—and are now—in acquiring a share of the world-trade market. For example, Soviet successes in space unquestionably have affected the world market in their favor. The Russians are now selling more bridges and roads, electronic equipment, automobiles and surgical supplies to the world at large than they did before *Sputnik I,* even though the launching of *Sputnik* had no more to do with these specific world-market goods than the towers of Europe had to do with local trade. To world-wide consumers, it seems readily apparent that a nation that can launch the first satellite is certainly capable of building a good bridge.

One of the more surprising but most compelling reasons for programs from the building of the Acropolis to the space effort is the need for channeling the excess energy of a society in a direction which will hold the society together. When Pericles was asked why he was proposing construction of the temples on the Acropolis, one of his strongest reasons was to provide an outlet for the energies of the youth of Athens as a way of minimizing juvenile delinquency! The late Louis Ridenour maintained that such seemingly wasteful projects as crash military programs and marginal space activities were a necessity in the United States because otherwise our excess productivity would lead to a depression. For the same reason, the U.S. Department of Labor is viewing the years 1965 to 1970 with some concern, because at that time there will be an enormous influx of raw labor resulting from the post-World War II birthrate surge. Large projects have real value as at least a partial solution.

Although it is difficult to measure the exact value of impressive memorial projects, there is little question of the economic and social benefits they produce: aqueducts, highways, harbors, electronic components, new military devices.

More than 100 years ago, Michael Faraday was demonstrating his electromagnetic equipment to a British government committee in the hope of obtaining government support. One member admitted he was fascinated, but asked Faraday, "What practical benefits can we expect?" "I can't answer that question," Faraday replied,

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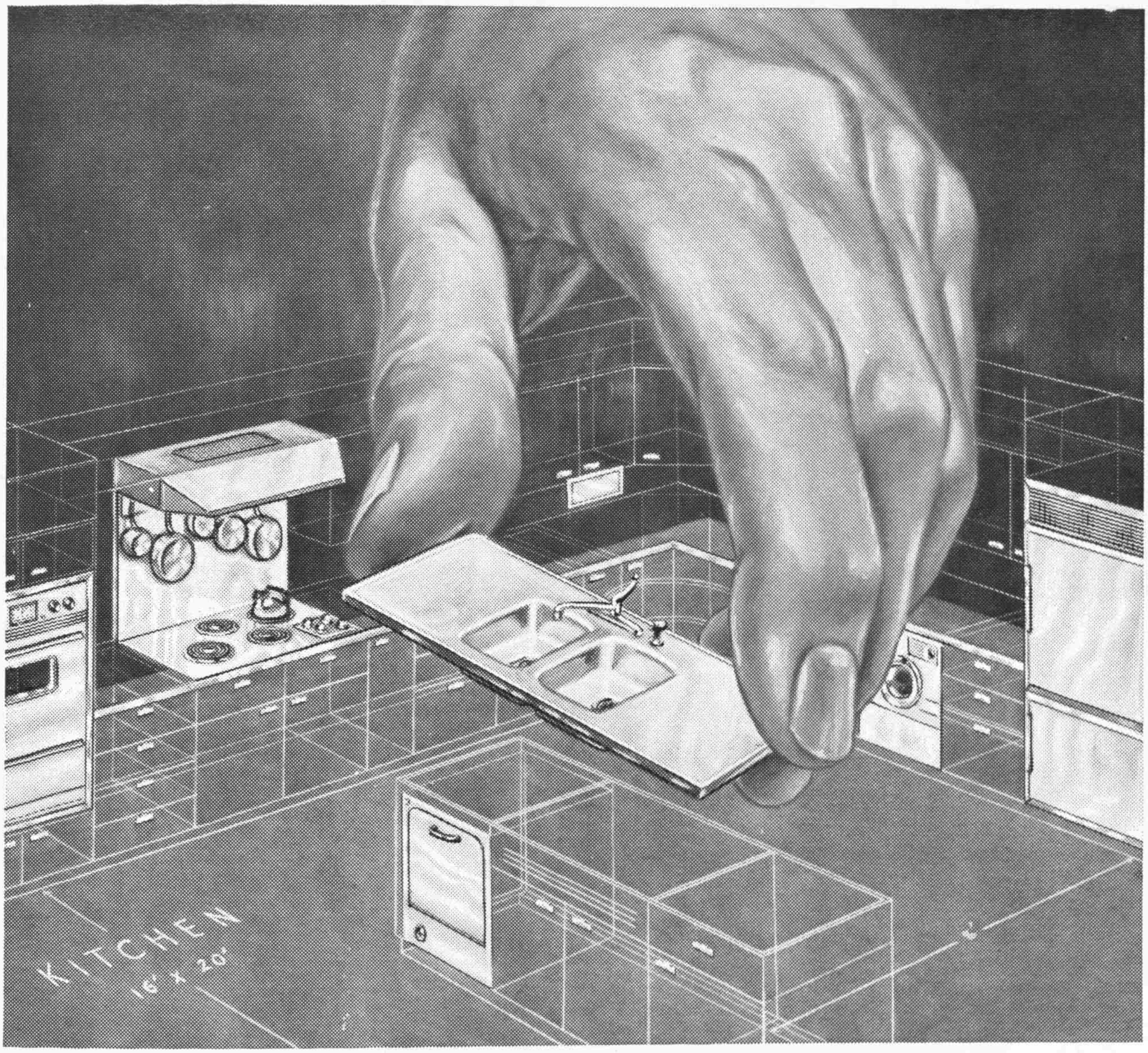
KITCHEN
16' x 20'

CONCRETE ARCHITECTURE

A Unique Application of Concrete Forms a New Look in Terminals

Edited by Dianne Caccamise

LONG AFTER it has become a familiar sight to world travelers—architects, engineers and builders throughout the world will look upon the TWA terminal as a remarkable achievement in design and construction.

Above the ground level, the structure is composed of only one piece of concrete; yet the execution of this deceptively simple design required unparalleled ingenuity and planning, long before the first cubic yard of concrete was ever mixed. The concrete—its design, delivery, installation, structural quality and final appearance—play such a momentous role in achieving the function and beauty of Saarinen's architectural idea.

From a distance, the raw concrete form seems gracefully poised for flight. Its breathtaking arch points, reaching delicately into space, appear almost to be in motion. Up close and from inside, the building is compelling and overwhelms everything within sight.

OF ARCH CANTILEVER design, the 5000 ton roof of the great building is of four monolithic concrete shells, flowing out of four sculptured buttresses. Joined integrally at a center plate, the shells vary in thickness from eight inches at their perimeter to 44 inches at the centerplate.

The building is one of the few major contemporary U.S. structures in which all actual structural elements represent the final exterior architectural form. Here especially, every detail in sight performs some engineering function to provide a perfect wedding of form and structure with design loads flowing so gracefully down to the ground.

While nearly every element of the structure represented a daring new adventure in construction, the sweeping 1¼ acre concrete roof presented the most staggering challenge to engineers and builders.

FACING THE builders was the monumental task of economically forming 3200 cubic yards of concrete into four perfectly balanced, monolithic roof sections, free of cracks, shrinkage stresses and construction joints, 60 feet above the ground.

The final scheme for placing the roof called for initial construction of a center plate that would act as a bulkhead against which to pour the four shells and also provide a control station for subsequent concrete operations.

Once the form work for the roof shells was built over a jungle of scaffolding, the concrete for the center plate and the four huge sculptured buttresses was placed. A total of 5,500 lengths of tubular steel went into the erection of 1,800 columns required to support the vast roof form and the reinforcing steel and concrete that would go into it.

Three 180-foot, 45-ton cranes hoisted the concrete to the roof in one cubic yard loads, with each bucket color coded with paint to assure its contents were being deposited in the proper area of the shell.

When pouring began, inspection crews of engineers and carpenters were stationed at key positions under the roof at ground level. Through a system of hanging plumbs, they were able to detect the slightest movement in the form work and radio this information to the central control station so the next bucket load of concrete could be directed for placement at a point that would compensate for the form movement.

Concrete for Buttresses		*Concrete for Shells*	
Cement, lbs.	564	Cement, lbs.	614
Sand, lbs.	1,350	Sand, lbs.	1,185
Trap Rock, lbs.	1,885	Norlite, lbs.	945
Pozzolith, lbs.	1.2	Pozzolith, lbs.	1.6*
Water, gals.	32.6	Darex, oz.	1.6
Air, %	4	Water, gals.	38.7
Slump, in.	5	Air, %	5
		Slump, in.	5

*Amount varied upward as retardation was increased.

IN DESIGNING the concrete mixes for the shell and buttresses, special consideration had to be given to four major factors: (1) it must have lowest possible unit water content and low cement content to minimize shrinkage; (2) there had to be careful control of slump, which had to be varied for different areas of the shell; (3) the setting time had to be retarded sufficiently to assure a completely monolithic structure for each shell; and,

Model of the new terminal at Idlewild Airport to be completed in late 1961.

(4) the setting time had to be varied according to a precise predetermined schedule to permit an orderly removal of counterforms or top forms, to allow finishing the surface of the shell to the final architectural contours.

Other mix design problems involved the selecting of a coarse aggregate for the normal weight concrete of the buttresses and a light weight aggregate for the shells—both aggregates of the same color to produce an overall uniform appearance for those areas that would ultimately be bush-hammered to achieve the striking surface texture desired by architect Saarinen. A low rate of heat evolution was desired in the buttresses and in the thick sections of the shells to prevent thermal stresses and cracking. Four-thousand psi strength at 28 days was specified for both the conventional and lightweight concrete.

Three test models were constructed to simulate the placing conditions that would be experienced in different areas of the shell. These duplicated the angle of incline and the contours of the shell and the amount of intricate reinforcing steel in these areas. Work with these models showed that counterforms would have to be used where the slope of the shell was steep and that 5″ slump was necessary to achieve easy placement of concrete beneath the counterform. In the less steep areas where counterforms were not necessary, the concrete could be placed with 3″ slump without flowing or sagging down the slope.

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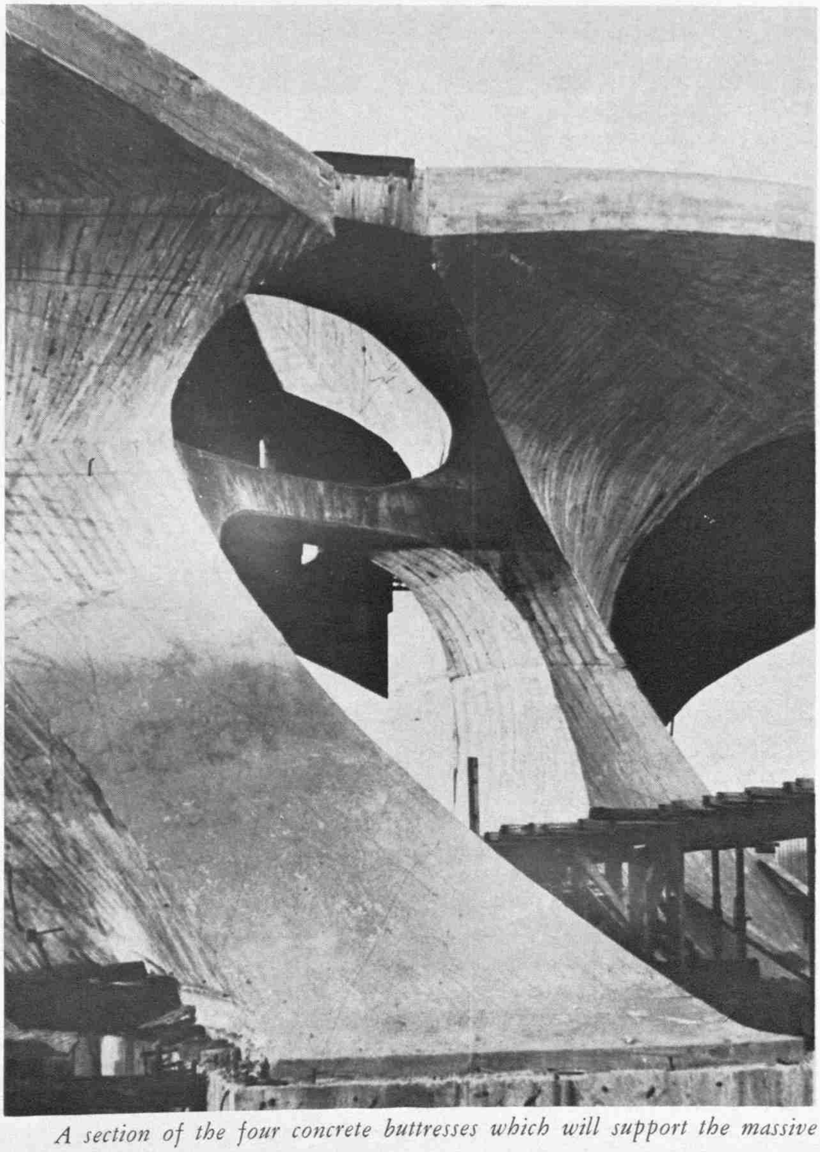


A section of the four concrete buttresses which will support the massive shell.

COMPUTERS IN THE SKY

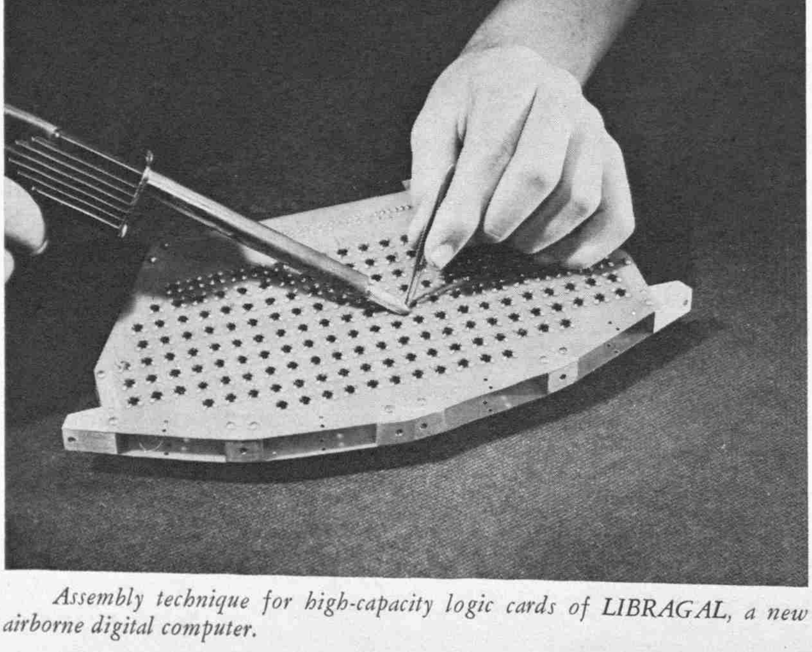
Applications of Digital Computers in Defense

by Roberta Huffmaster

ALTHOUGH most people know that computer systems are used in military operations, few realize the extent to which computers are employed in our national defense system. Their jobs range from testing jets to firing anti-missile missiles.

The computer system has gained such wide-spread use because man's reflexes are just too slow for the speed of modern missiles. Ballistic missiles have exceeded the speed of 10,000 mph, and a delay of 1/320 of a second in cutting off the power of the missile would cause it to miss its target by about one mile.

For the accuracy required, man's reactions fall far short. Therefore, before the accuracy now attained could be achieved, man had to develop a system of reactions that surpassed the best he had to offer. This is one function of the computer.



Assembly technique for high-capacity logic cards of LIBRAGAL, a new airborne digital computer.

There are two types of computers, the analog and the digital. The analog computer is not new, it has been used for 20 years. In the analog systems, the information is read in terms of electrical output signals, and the computer compares these signals with a master control system and then gives the answer.

The digital computer takes the analog signals, converts them to digital form, calculates the answer, and transforms it into analog form again—all within the computer. Until a decade ago the analog was used exclusively, but now the digital is taking over in the tracking and guidance fields.

This has occurred for many reasons. First, the accuracy of the analog was limited to + or — 2% which was insufficient for the high speeds reached today; secondly, it was limited in the number of operations it could control; and thirdly, it couldn't contain the logic circuitry that enables the digital to make decisions.

A method was needed to cut down the time and cost of flight testing jet engines, and this demand was satisfied by the use of computers. Radiations, Inc., of Florida, has developed an air-ground digital computer for use in this testing. As the name implies, there are two separate units to the system. The small one (3 cubic feet) is placed below the fuselage of the jet aircraft, and it collects its data on magnetic tape.

The specific things noted are, critical fuel-flow, temperature, pressure, and turbine blade stress. This information is then relayed to the big ground system (1600 square feet of floor space) which calculates the result and codifies it. This system was used for missile flight testing after telemetry units were introduced.

The Navy has developed a computer system called the Naval Tactical Data System (NTDS) that allows a fleet of ships to remain in practically instantaneous communication. It sends information concerning the position of enemy missiles and aircraft.

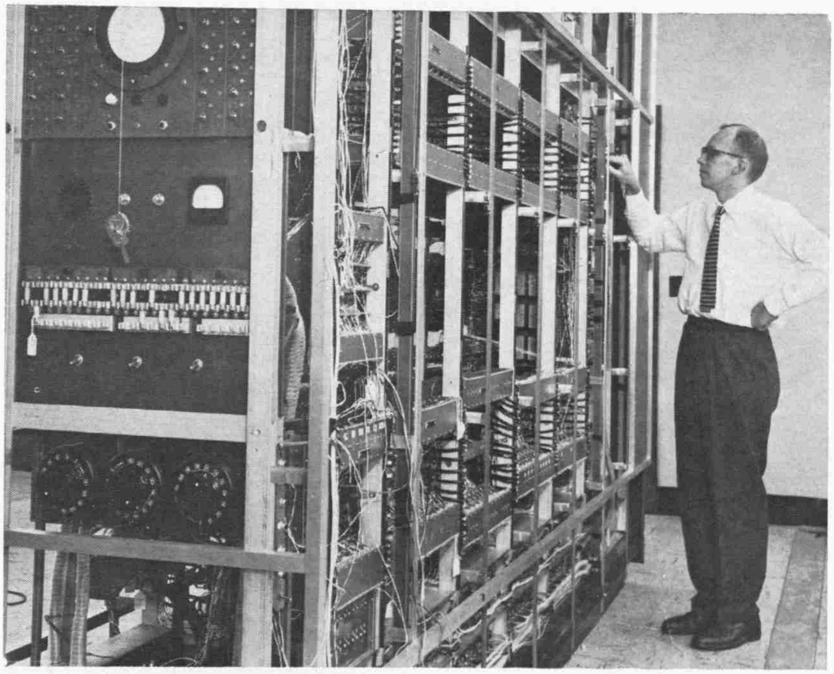
This system automatically collects, disseminates, and relays the information. By correlating all this data into a clear picture of the tactical situation, the decision required in selecting the right weapon can be easily made. The decision is then relayed to the weapons system and put into action.

The NTDS can identify the object according to size and location and detect its track and speed although the entire system is only 3′ x 3′ x 6′ and occupies 9 square feet of floor space. This small size is the result of using the transistor-diode circuitry rather than the conventional vacuum tubes. This is a giant step ahead in locating and destroying the new high-speed weapons that have recently been developed.

The Army has also developed its own computer system, called Athena after the Goddess of Wisdom; Athena controls, tracks, and guides the Air Force's Titan ICBM from the ground. The computer's control only lasts from the time of firing to the instant the power is cut off and the missile's course is set. During that time, however, the computer must solve complex problems, for the missile is affected by variables such as wind, temperature, rotation of the earth, gravity, and pitch, not to mention the speed, size, and altitude of the missile itself.

The computer works constantly figuring the speed, elevation, direction, and position of the missile and comparing this changing data with the desired figures in its magnetic memory. By instantaneously and automatically adjusting the missile's course to give the optimum trajectory at all times, the missile is assured of being exactly on course when the power is cut off.

The dream of missile-men is to put the complete computer system in the missile itself. They desire this because they realize that radio control from the ground has definite limitations. The most important one is that an enemy could jam the radio frequency, thereby leaving the missile in uncontrolled flight.



MISTIC—MSU's digital computer.

The only complete solution to jamming is to place the computer in the missile, but a major problem arises over the space needed for the computer. Until the transistor came into use, airborne digital computers were out of the question.

The newest of the airborne computers to be designed has come from General Precision Inc., and is called the Libragal. It weighs 56 pounds and occupies .9 cubic feet of space, while its density reaches a rate of 67.500 electronic components per cubic foot. This new computer is shaped to fit the contour of the inside of the missile shell, and uses a 60° sector of the circumference to within 6 inches of the central axis of the missile.

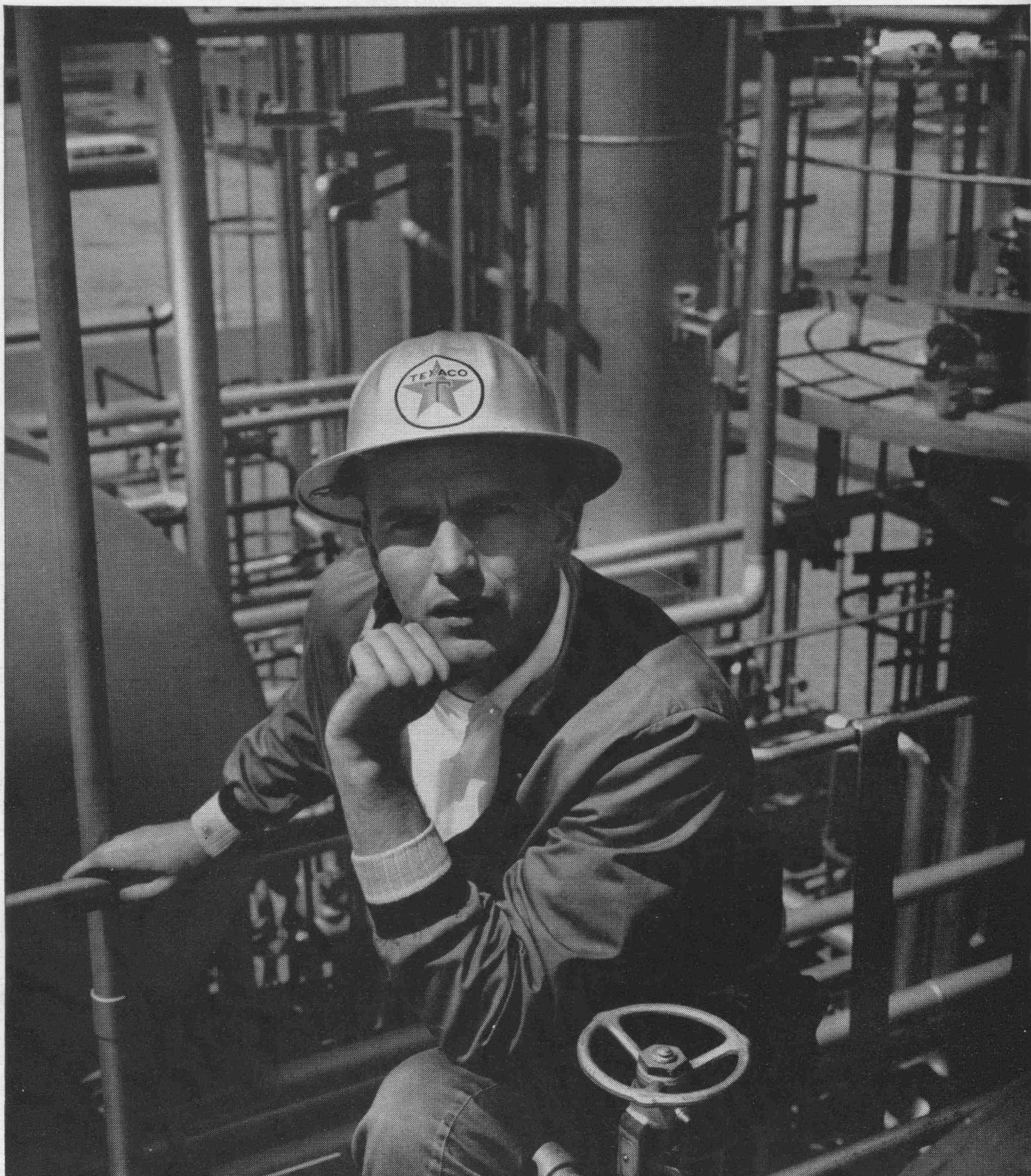
Libragal controls practically the complete operation of the missile. It determines the feasibility of an assigned target, decides whether the missile is up to the job, controls the countdown, raises the launcher, fires the missile, provides navigation and guidance in flight and detonates the missile at its target.

These multiple tasks are possible due to the design of the computer, which is in two sections. The first is the general-purpose digital computer with a high capacity, and the second is an input-output module which can be easily adapted to individual applications. In this way the computer has maximum reliability and the most advanced approach to the different tasks assigned it. Since the general computer has been proven, the time can now be spent on altering and adapting the separate input-output module to the job at hand.

This module consists of a high-speed accumulator and an integrator. Information is transferred from the accumulator to the integrator at the rate of 200 cycles per second. The integrator takes the data and develops velocity data, integrates that and distance information, generates time and "time-to-go" signal and generates output signals through digital-to-analog converters.

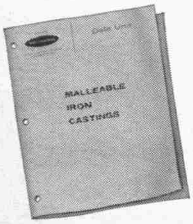
Libragal can operate at full efficiency in a temperature range from 0°C—70°C and will operate for 5 minutes with no coolant action. It can withstand vibrations of up to 2,000 cps, and will work within tolerances at accelerations of up to 20 g's.

So far, this is the latest and most advanced computer system available, but there is no doubt that soon this will be made obsolete by newer and better computers that exist only in the minds of the engineers of today.


TEXACO

Did You Know That Malleable Castings Can Be Stamped, Rolled, Punched, Spun?

Many people are unaware that castings can be finished by any method except cutting or grinding. But the ductility of Malleable iron castings permits use of a wide variety of high-speed forming techniques that can eliminate operations, cut finished costs or even lead to new designs. These examples illustrate the versatility you get only with ferritic and pearlitic Malleable castings. For a fuller understanding of how Malleable can help you, call any producer that displays this symbol —



Free Folder describing these techniques is available for your use. Just ask any member of the Malleable Castings Council for Data Unit No. 116, or write to Malleable Castings Council, Union Commerce Building, Cleveland 14, Ohio.

MEMBER
MALLEABLE
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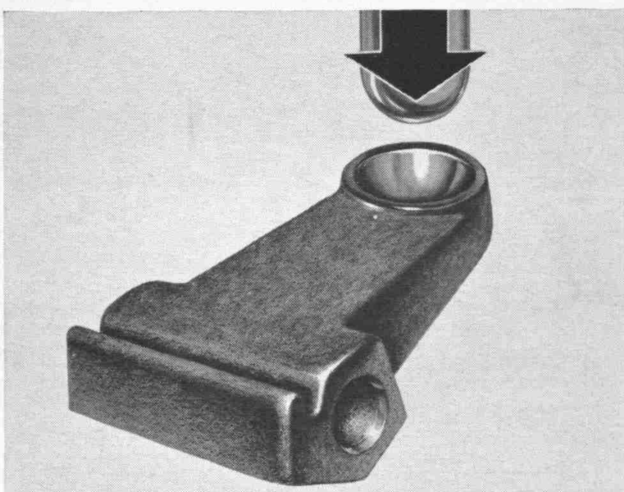
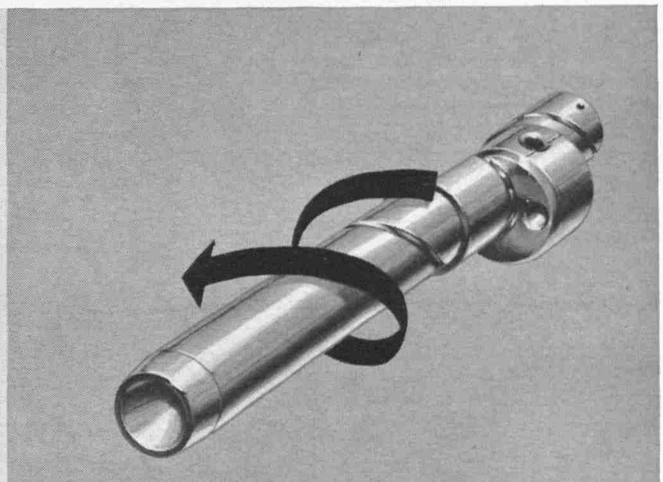
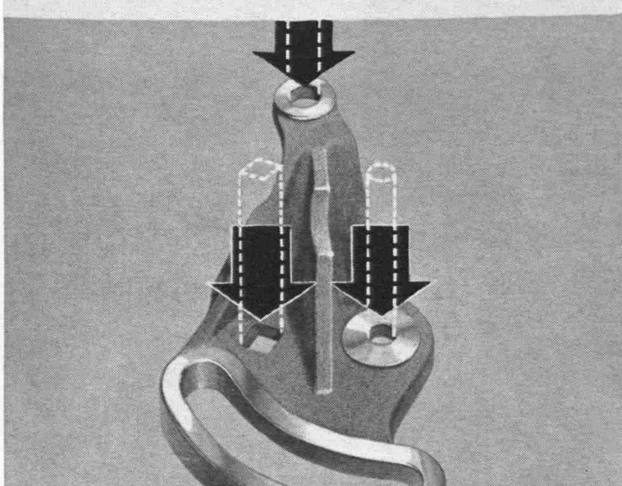


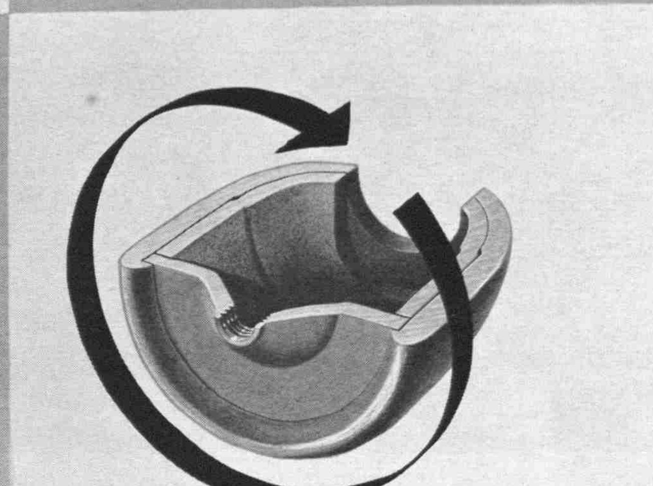
Hot Form It — Hot coining this Malleable transmission part reduces finished cost . . . eliminates three cutting operations required by the previously used steel part.



Roll It — Oil grooves in lawnmower crankshafts and splines in compressor crankshafts are just two of many places where rolling proves more economical than machining.



Punch It — Holes with diameters greater than the thickness of the metal can be punched in Malleable. Two round holes and a square hole are punched simultaneously in this idler arm.



Spin It — Malleable's ductility permits the sleeve and end disc in this ball joint to be held in place by spinning the Malleable housing into a strong, permanent flange.

BE PREPARED

POINTS TO REMEMBER WHEN BEING INTERVIEWED

by Roberta Huffmaster

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

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

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

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

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

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

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

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

Other questions asked in order to search out the applicant's sincerity, ability, personality and habits are: "What did you like to do most in college?" "Why did you choose engineering?" "Where did you spend your

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

The main lobby of the Placement Bureau. Many people will be seen in the lobby during days when interviews are being conducted.

summers?" "What organizations did you belong to and what offices did you hold?" (they're interested in active leaders, not joiners), and "Did you participate in athletics?" Although these may seem a little irrelevant to being an engineer, they help the recruiter see past your grade record to you as an individual.

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

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

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

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

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

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

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

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

The second block is the idea that from out of nowhere will come the only right job with the only right company. This is false. Any one of 5 or 6 organizations should be able to provide the opportunities you are looking for. The job then becomes one of

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JT3D

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THERE'S CHALLENGE TODAY FOR VIRTUALL

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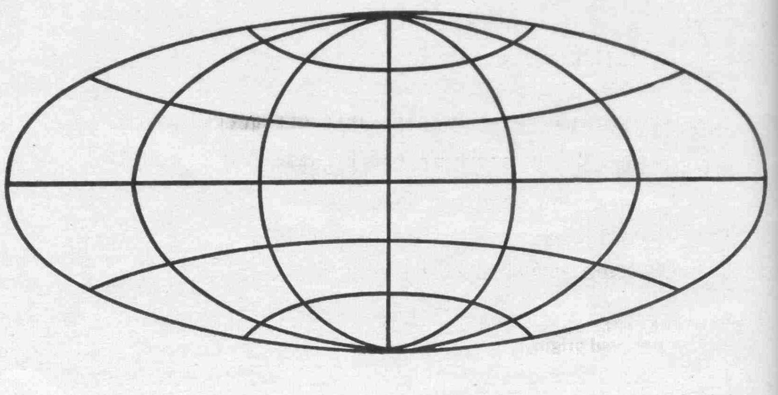

SPACE RACE

(Continued from Page 14)

"but I can tell you that 100 years from now you will be taxing something like this."

National-scale adventures or works have strikingly similar characteristics whether they occurred thousands of years B.C. or in our own time. Generally, such enterprises are undertaken in time of peace and are abandoned or interrupted by periods of war. Occasionally, a major task is launched which never is successfully completed. But ones which have proceeded for some time before they were abandoned as unsuccessful, or were interrupted by war, or were destroyed by a succeeding society, are still known to us. The Tower of Babel and the Sacred Circle at Stonehenge, England, are examples of the latter. Plans failing before they start are most often lost to history.

Regardless of the undertaking, there seems always to have been a running fire of criticism throughout — often long after project completion. The criticism generally proposes smaller goals of limited participation and of more immediate need. Criticism by certain groups in Athens over Pericles' construction of the Acropolis sounds surprisingly like the criticism of our own annual defense budget. Always there have been many people to maintain that, by spending only one per cent of the budget of the large program on their own particular one, the relative benefits presumably would be greater. Curiously enough, there are seldom critics who would propose alternate programs of the same scale as the large one—with the single exception of advocates of national defense whose proposals almost invariably are an order of magnitude greater.

Although these demonstrations of a successful society are strongly concentrated in the areas of engineering and technology, to be really successful they seem to need certain elements beyond those needed for strictly functional or utilitarian purposes. We find palaces with magnificent landscaping, churches with domes far higher than needed for air-conditioning. Supporting columns are sculptured, ceilings elaborately decorated, floors inlaid. And yet, it is often expensive departures from the ordinary that are the things remembered by future generations and are the real distinguishing marks of a great success. It is these elements which are destroyed first by any radically different society trying to replace the original one. It is also such features which are continuously modified and improved by a continuation of the original society. And it is the extraordinary that is often necessary to add uniqueness or identity to a project in order to excite admiration and respect of the audience. A modern example is that part of the generally practical space program trying to place a man on the moon and return him to earth—an effort whose immediate utilitarian value is certainly controversial at best.

In other words, we might answer the question, "What are we racing for?" by stating that we are racing for the same things which dynamic and successful societies have raced for from the beginning of history.

In the light of historical precedents, we might have some modern questions about the space program: we might question size of the budget . . . position of science in the space exploration program . . . value of the Mercury program . . .

Even the total space-program budget including all the military applications—is actually relatively small compared to similar projects in the past. In comparison, former societies customarily have carried out enterprises of far greater relative scope than this. Again on a comparative basis, we might predict that the space program can grow considerably if it can attract the same relative support that built the Palace of Knossos, the Colosseum, the great cathedrals and other monuments in the past.

Despite the great interest of scientists in the space program, science is not, and cannot be, the driving force for space exploration. The reasons for this are quite fundamental. Advanced science is so abstract and so little understood even by the scientist himself, that it makes very poor public relations and propaganda to people at large. Therefore, it is not reasonable to expect a ground swell of support for scientific projects just *because* they are scientific. Scientific exploration, by its very nature, is seldom successful more than 50 per cent of the time and is often successful less than 10 to 15 per cent. Consequently, any scientific proposal is immediately subjected to alternate ones whose presumed success ratio might be higher. For this reason, studies in space are often sharply criticized by scientists working in other fields because they maintain that by expending even a small fraction of the money put into the space program, they could obtain far greater results.

This criticism we have seen is classical. The more general disparagement might be paraphrased by the question, "Was it worth 150 million dollars to find out that earth was not quite round?" or "Was it worth 20 million dollars to discover the Van Allen belts?" The answer is most simply: *the purpose of such programs is not scientific but rather political, economic, social and psychological.*

If we must assign costs, we should start with these last requirements of the program first. In so doing we find that the net cost of performing a scientific experiment is actually quite small. It is no more correct to bill individual scientific experimenters for all of space technology—as such—than it is to bill the hydrodynamicist for the over-all cost of advancing oceanography, when he is simply searching for the optimum submarine shape. There are considerably more returns from the space effort than the merely scientific results.

It is true of science in one sense that no great discoveries are made until the technology is ready for them; and when that time comes, the discoveries are often made independently by a wide number of researchers. The underlying principles of physics presumably always have been the same; and yet, discovery of motions of the solar system had to await development of the telescope. Formulation of the laws of electromagnetism had to await development of simple electrical components first. Now, the amount of science which can be accomplished in space must await the launching of larger and larger payloads, better and better communications, guidance, control, etc. By any comparison, the expense of developing technology far overshadows the cost of novel scientific experiment.

One further feature of science precludes its being used as the driving force for the space program: the value of scientific results is very seldom

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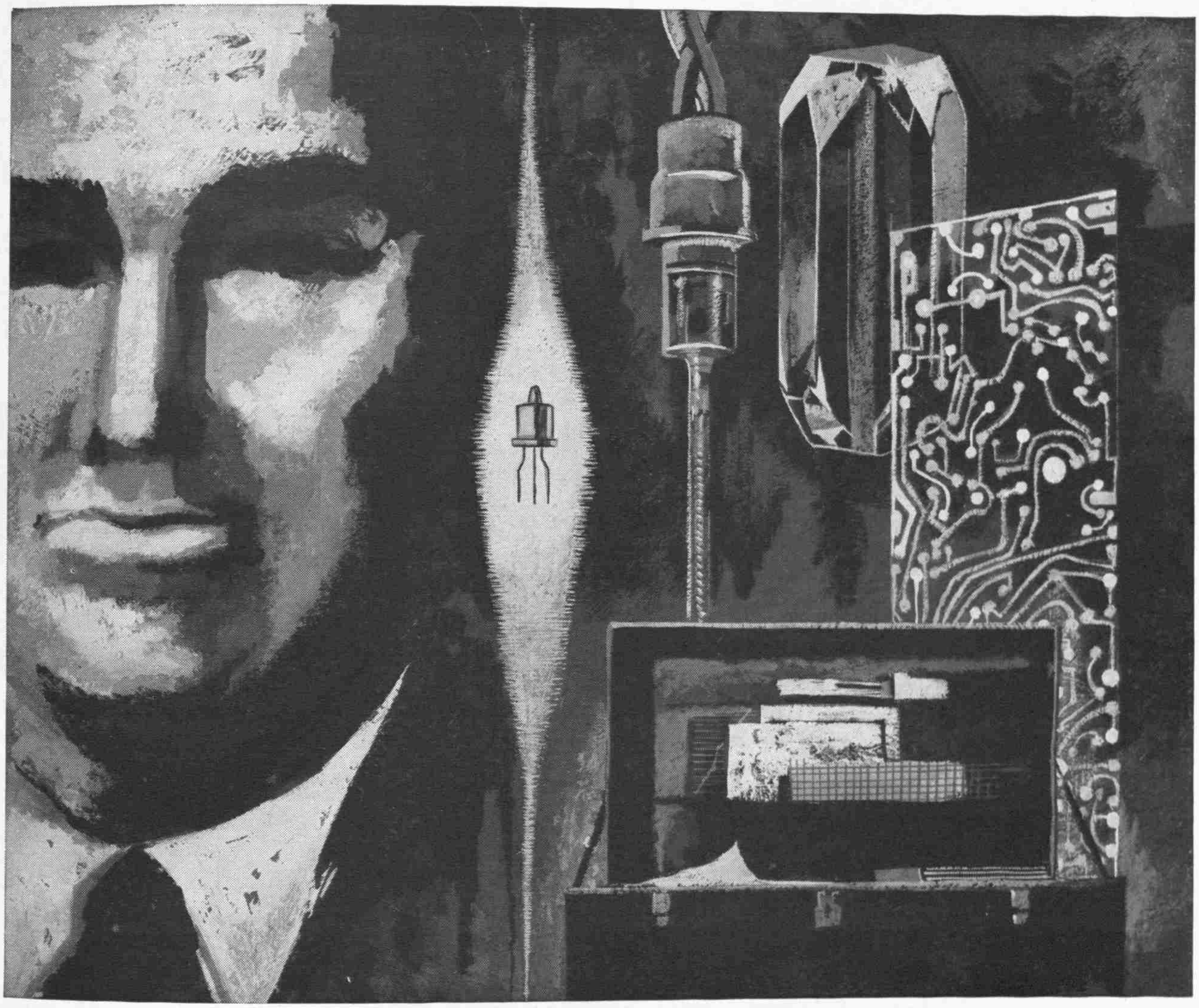

SPACE RACE

(Continued from Page 28)

known at the time of discovery and, unfortunately, there is no theorem stating that all scientific discoveries will be valuable. It is difficult to gain immediate support when the value of scientific results may not be determined until ten to a hundred years later.

It is characteristic of pursuits such as the space activity that they most represent technological achievements of considerable magnitude. Virtually by definition, therefore, the amount of effort and cost involved are largely devoted to technological advancement. The scientist who wishes to participate in such a program sometimes must do so at his own risk. To the technologist there always will be high value in reaching the moon, planets or stars even if there were too little weight allowance to permit any scientific measurements the first time. The technologist's point of view is only seldom understood by the scientist who would maintain that there is no point in having gone to your destination unless you can measure something while you are there. It would seem the scientist has the weaker argument: if you cannot get to your destination, you certainly won't make any measurements.

We must believe that the space program is inherently a good idea and that, after the difficult start, both the civilian and the military phases are proceeding in a generally worthwhile direction. Whether we are going ahead at a great enough pace is wholly another question. The answer lies in a comparison with the U.S.S.R. In this kind of a race it does not now pay, and never has paid, to be a poor second. It is not always necessary to be markedly out in front, but it helps. In many respects, the Soviet Union is presently the pace-setter, particularly in large chemical propulsion units, which directly affect the size of the launching booster. On the other hand, prediction of the future may be surprisingly bright for the U.S.

The United States has been compared unfavorably with other countries in terms of our stature in science. Contrariwise, we never have suffered when compared with any other nation in our astonishing technological ability. Inasmuch as the space race is a demonstration of technology, the U.S. has basic assets no other country, including the U. S. S. R., can claim. Whether or not these assets will be applied efficiently to the space program is again a separate question. One measure is the budget size. If the United States were to apply the same relative effort in the space program that the Soviets apply in theirs, we unquestionably would surpass them in less than ten years—even with a five-year Russian lead-time. We are not at present putting forth this effort, although we are exerting enough so that the gap will close slowly.

One encouraging aspect of most races is that the initial pace-setter does not necessarily win the race. Instead, the successful winner is often the one who has mastered the art of being second when it is not so important—and then being first at the final payoff. This is a real art. It involves crowding the pace-setter so that he will begin to make mistakes and to feel the pressure. As witness, U.S. technological successes in the space race seem to be pushing the Russians in a way that hurts: missed opportunities, long periods without successful launchings, evidences of incomplete engineering. Russian pictures of the back view of the moon were surprisingly poor considering the payload weight available. Engineering deficiency seems to have been in the communication link, an area in which the U.S. has done particularly well. Not long ago the Soviet publicists virtually had to "reprint" an older achievement of sending animals up to 120 miles.

In conclusion: a year ago there was some question as to whether or not we are in a space race. We now know that we *are* in a space race and that it is likely to be a fairly long one. We are not racing purely for science. We are racing to demonstrate that we are a successful and dynamic society. We are racing for the prestige necessary in a purely economic world-market situation. We are racing as one method of channeling our excess energy and productivity and for such side benefits as may result. We are racing to demonstrate that democracy is every bit as good if not far superior to communism. And, at times, we are racing out of the sheer joy and exuberance that long have been characteristic of a proud and capable people engaged in a pursuit of happiness.

BE PREPARED

(Continued from Page 25)

narrowing the field down. Once you make your choice, however, don't look back and wish. It gives a bad name both to the school and to you if you suddenly decide that the company's offer doesn't really take into consideration all that you are worth.

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

Editor's note:

This article first appeared in the January 1961 issue but due to the continuing relevance of the material contained herein, it was felt that it should be reprinted at this time.

MIGHTY F-1

(Continued from Page 12)

carry the three-man Apollo spacecraft in Earth orbital scientific missions of up to two weeks. The second stage is the 90,000-pound-thrust S-IV stage powered by six Pratt & Whitney RL-10-A3 liquid hydrogen-liquid oxygen engines.

First test launch of the C-1 booster with two innert upper stages is scheduled for later this year. The advanced Saturn referred to above could be used to place the Apollo spacecraft into orbit about the moon and return it to Earth. One configuration under study for the first stage would consist of two F-1 engines; the second (S-II) stage of four J-2 200,000-pound-thrust liquid hydrogen-liquid oxygen engines also under development by Rocketdyne; and the third stage would be the S-IV. This possible configuration would be capable of lifting an approximate 30,000-pound payload on a lunar mission.

THE mission of Nova will be to boost the Apollo to lunar landings and return to Earth. The configuration of Nova is under intensive study by NASA. Many of the versions under study employ F-1 engines in the first stage and some use F-1's in the second. One of a number of configurations employing F-1 engines consists of a booster made up of four clusters of two F-1's—or eight engines generating a total of 12 million pounds

(Continued on Page 50)

what comes after the wheel?

ford motor company's educated guess

Frankly, there is no practical substitute for the wheel today. But at Ford Motor Company, our scientists and engineers refuse to give "no" for an answer. They are tackling, among others, the problem of wheelless vehicles for tomorrow.

Is "tomorrow" really far off? Not according to the men at Ford. Already they've developed the Levacar as one possibility. It replaces the wheel with *levapads*, perforated discs which emit powerful air jets to support the vehicle. Air suspension—if you will—of an advanced degree. Imagine traveling swiftly, safely at up to 500 mph, riding on a tissue-thin film of air. Guided unerringly by a system of rails. Propelled by powerful turboprops. This is the Levacar.

Meanwhile we've still got the wheel. And the job of building better cars for today. So we hope you won't mind riding on wheels just a little longer while we concentrate on *both* tasks.

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INTERNATIONAL BRIDGE

The Construction of a Vital Artery between Two Friends

by Vic Humm

THE CROSSING of the St. Mary's River to connect the cities of Sault Ste. Marie, Michigan and Sault Ste. Marie, Ontario by a vehicular bridge, has been for many years a pressing need for the continued growths and development for this area.

The St. Mary's River is the outlet of Lake Superior to Lake Huron and marks the international boundary between the state of Michigan and the province of Ontario. The difference in elevation between Lake Superior and Lake Huron is approximately twenty-one feet. There, the famous Soo Locks have been in operation for over one hundred years. Through these locks pass more tonnage than any other set of locks in the world.

The location of the bridge has presented some problems for the engineers. While the present construction is going on it is very important that it does not interrupt the function of the locks and the ship canals. This hinders the engineers somewhat in that they cannot build dikes of continuous fills to aid in the construction of piers.

While causing some problems, the location has advantages too. It is situated in an area of shallow water and the depth to rock distance is reduced. This will allow the construction of relatively short spans and thus reduce the cost of construction. The bridge site is as far above the locks as possible, to minimize any hazard to the Soo Locks.

THE LENGTH of the bridge, including its approaches, is approximately 11,684 feet. The length of the structure is 9,280 feet. The two main structures over the American and Canadian ship canals have a total length of 5,540 feet. On the banks of the ship canals, the truss-span piers will be anchored securely into the rock. The diagram of the bridge including the approaches requires 62 piers, of which 38 are the two-legged type.

The U.S. main truss spans consist of a four-span continuous truss unit with arch-form top and bottom chords. The length of the spans are 830 feet. The steel work is being erected by cantilevering from the shore span. The material is then carried for the completed structure.

The total estimated tonnage of structural steel, including the Michigan approach, is 11,000 tons.

In the design of the bridge it was required that the roads meet the specifications with the Interstate Standards of the U.S. Bureau of Public Roads for those handling traffic at 50 mph. The traffic lanes are 14 feet in each direction. On each side of the bridge is a 2-foot emergency walkway. The roadway is composed of a concrete reinforced slab. Covering this is 1½ inches of asphalt wearing surface. The American roadway has a grade of 3¾ per cent and on the Canadian roadway the grade is 4 per cent. The curb has been designed to aid in snow removal by allowing the wind to blow it off the bridge.

The specifications require that the bridge withstand a static wind pressure of 75 lbs. per square foot. This is equivalent to a wind 100 times greater than ever recorded in that vicinity. Another problem arising is the ice which causes navigation to be suspended in that area during the winter months. The bridge is designed to withstand a force of 65,000 pounds per lineal foot for circular surfaces, and for a longitudinal pressure of 5,750 pounds to compensate for the ice.

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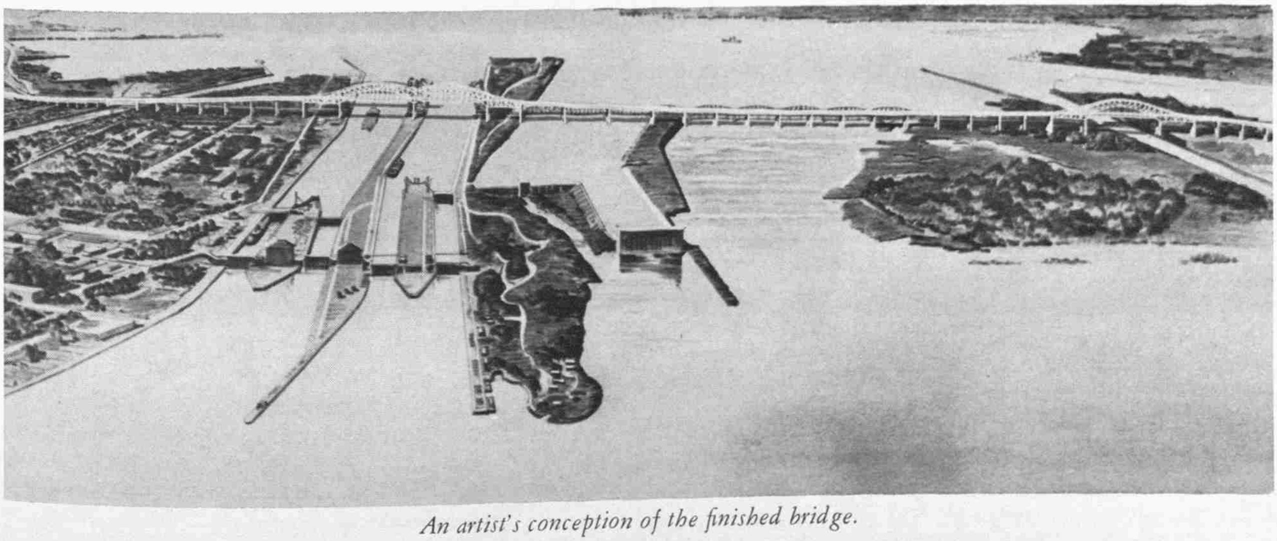
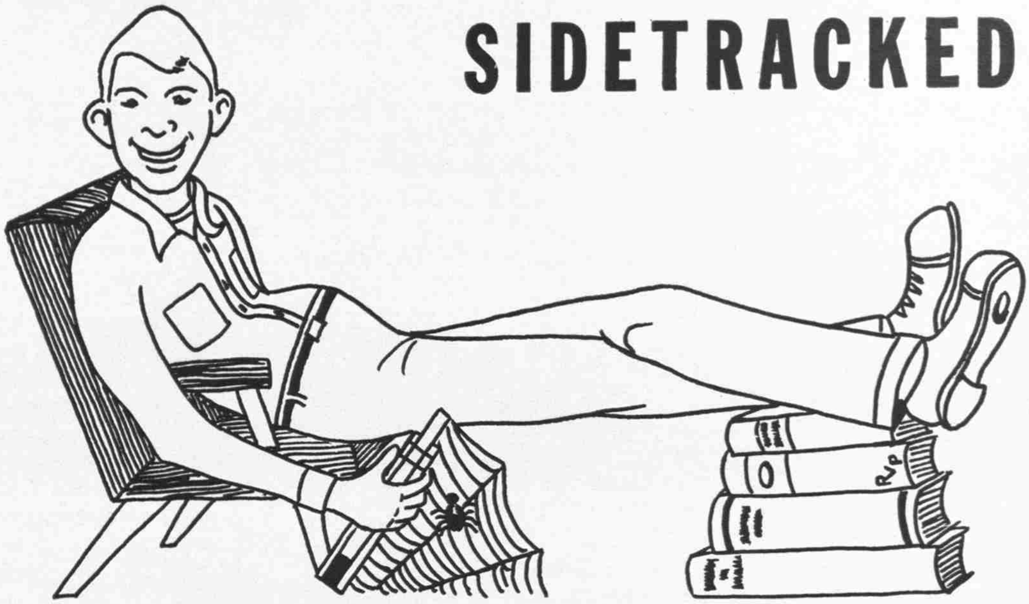


An artist's conception of the finished bridge.



SIDETRACKED

"Mommy, why is it that Daddy doesn't have much hair?"

"Because he thinks a great deal, dear!"

"But mommy, why is it that you have so much hair?"

"Finish your breakfast, dear."

* * *

Co-ed: "Where did you learn to kiss like that?"

M.E.: "Siphoning gas."

* * *

The dam burst, and the raging flood quickly forced the town people to flee to the hills.

As they gazed down sadly at their flooded homes they saw a straw hat float gently downstream for about fifty feet. Then it stopped, turned around and plowed slowly upstream against the rushing waters. After fifty feet, it turned and moved downstream again. Then upstream again. Then downstream again. "Say," said one of the townfolk, "What makes it act durn funny?"

"Well, I ain't sartin sure," spoke up a youth, "but last night I heard Grampa swear—come hell or high water he was gonna mow the lawn today."

* * *

Probably the reason God made woman last was that he didn't want any advice while creating man.

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

* * *

The dean of women at a very well known university recently began a speech to the students with these memorable words:

"The president of the University and I have decided to stop petting on campus . . ."

* * *

Complete thesis on the treatment of sewage: "Flush it."

* * *

He was once the toast of the classroom;
His spirits were happy and gay.
He was free with liquor and women;
Good judgment he did not obey.
The teachers soon came to despise him;
He fell low in student esteem;
His humor was sadly misguided
To where it ought not have been.
Will he sink lower and lower,
From the road of life to the gutter?
No one knows; none can tell what will happen
When he's kicked out of engineering.

* * *

Did you hear about the new medical discovery? Frozen band-aids for cold cuts.

Prof.: "I say there, you in the auto —your tubular air container has lost its rotundity."

Soph.: "What?"

Prof.: "I said, the cylindrical apparatus which supports your vehicle is no longer symmetrical."

Soph.: "Come again."

"Prof.: "The elastic fabric surrounding the circular frame whose successive revolutions bear you onward in space has not retained its pristine roundness."

Soph.: "What's that?"

Little Boy: "Hey, bud, you gotta flat tire."

* * *

A Texan newly arrived in England, was playing poker with a couple of natives. He was pleasantly surprised upon picking up his hand to see four aces. "I'll wager a pound," said the Britisher on his right.

"Ah don't know how y'all measure your money," drawled the Texan, "but Ah reckon A'll have to raise yuh about a ton."

* * *

Rumor has it that one of the E.E. professors is writing a text on AC-DC motors. Since it deals with some hot circuits, he plans to call it "FOREVER AMPERE."

MISS ENGINEER

Miss November Engineer is Patti Coleman.

Patti is a junior majoring in special education. She hails from Pittsburgh, Pa., has brown hair, blue eyes and stands 5′ 6″ high.

Among Patti's many activities, there is one which we feel you must be forewarned of . . . the JUDO CLUB! Be prepared to defend yourselves, men!

Patti's honors include being selected as a semi-finalist in the Miss M.S.U. contest.

We can't tell you her phone number, but as a starter we can tell you that Patti is a member of Delta-Delta-Delta sorority and you can take it from there.

1961 DECEMBER 1961

SUN	MON	TUE	WED	THU	FRI	SAT
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24/31	25	26	27	28	29	30

1962 JANUARY 1962

SUN	MON	TUE	WED	THU	FRI	SAT
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

TERMINAL

(Continued from Page 17)

In addition to its function as a water-reducing, plasticizing agent, Pozzolith was also used to control setting of the concrete mixes—to obtain different amounts of retardation from concrete placed in different areas of the shell. The range of retardation was one to four hours beyond the normal setting time of the mix. Automatic dispensing equipment at the two admixture dispatching stations facilitated the accurate addition of the material in amounts ranging from 0.25 to 0.40 pounds per sack of cement. In making these additions the technicians gave cognizance to the effect of changes in temperature over the 24 to 30 hour period during which the concrete was placed for each of the shells.

The counterforms were 2′ x 4′ sections of plywood, prefabricated and designed for easy removal. They were fastened to ⅞″ screed bars by lag bolts. When the concrete beneath the counterform had stiffened sufficiently to avoid flowing down the steep slope, the form was removed and the surface finished with a pair of shaped templates. A dozen or so pairs of these templates were clearly identified for use on specific areas of the shell—one for screeding the concrete in the direction tangent to the circumference and the other for screeding perpendicular to the radii.

The field-side shell required 840 cubic yards of concrete placed in an around-the-clock operation of 27 hours. The front shell took 449 cu. yards of concrete placed in 24 hours. Each side shell required 1006 cubic yards placed in 30 hours. The 28 day strength tests averaged 5000 psi.

When it is completed this fall, the breath-taking terminal will stand as a monument to a building material—concrete—and to the architectural, engineering and construction genius that created it.

BRIDGE

(Continued from Page 33)

The lighting system on the bridge had to be arranged so it would not interfere with the navigation lights of the lock waterways. This was accomplished by staggering the lights about the center line of the roadway every 175 feet. The minimum elevation of the lights above the canal waterway is 160 feet. This prevents the possible confusion of bridge lights with navigation lights.

In case of electrical power failure, each end of the bridge is provided with an emergency power supply to maintain navigation lighting and the operation of toll equipment.

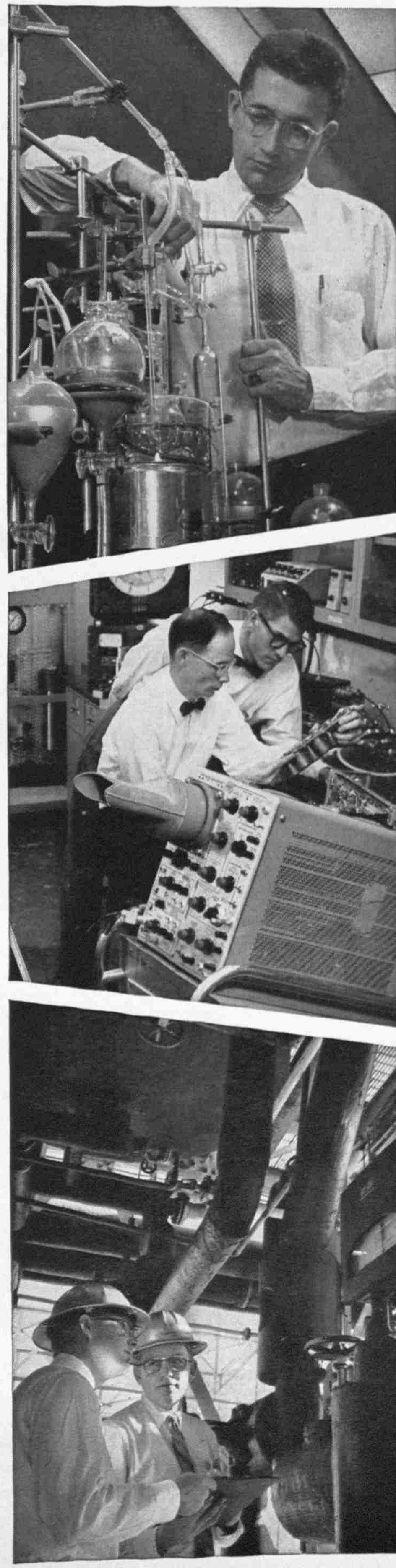
This bridge has been designed to serve the needs of the U.S. and Canada by providing a more rapid movement of materials between the two nations at a strategic point.

CONVERSION FACTORS

MULTIPLY	BY	TO OBTAIN
Abamperes	10	amperes.
Abamperes	3×10^{10}	statamperes.
abamperes per sq. cm.	64.52	amperes per sq. inch.
abampere-turns	10	ampere-turns
abampere-turns	12.57	gilberts
abampere-turns per cm.	25.40	ampere-turns per inch
abcoulombs	10	coulombs.
abcoulombs	3×10^{10}	statcoulombs
abcoulombs per sq. cm.	64.52	coulombs per sq. inch.
abfarads	10^{9}	farads
abfarads	10^{15}	microfarads.
abfarads	9×10^{20}	statfarads.
abhenries	10^{-9}	henries
abhenries	10^{-6}	millihenries.
abhenries	$1/9\times10^{-20}$	stathenries.
abmhos per cm. cube	1.662×10^{2}	mhos per mil foot.
abmhos per cm. cube	10^{3}	megmhos per cm. cube.
abohms	10^{-15}	megohms
abohms	10^{-3}	microhoms.
abohms	10^{-9}	ohms.
abohms	$1/9\times10^{-20}$	statohms.
abohms per cm. cube	10^{-3}	microhms per cm. cube.
abohms per cm. cube	6.015×10^{-3}	ohms per mil foot.
abvolts	$1/3\times10^{-10}$	statvolts.
abvolts	10^{-8}	volts.
acres	43,560	square feet.
acres	4047	square meters.
acres	1.562×10^{-3}	square miles.
acres	5645.38	square varas.
acres	4840	square yards.
acre-feet	43,560	cubic-feet.
acre-feet	3.259×10^{5}	gallons.
amperes	1/10	abamperes.
amperes	3×10^{9}	statamperes.
amperes per sq. cm.	6.452	amperes per sq. inch.
amperes per sq inch	0.01550	abamperes per sq. cm.
amperes per sq inch	0.1550	amperes per sq. cm.
amperes per sq inch	4.650×10^{8}	statamperes per sq. cm.
ampere-turns	1/10	abampere-turns.
ampere-turns	1.257	gilberts.
ampere-turns per cm.	2.540	ampere-turns per in.
ampere-turns per inch	0.03937	abampere-turns per cm.
ampere-turns per inch	0.3937	ampere-turns per cm.
ampere-turns per inch	0.4950	gilberts per cm.
areas	0.02471	acres.
areas	100	square meters.
atmospheres	76.0	cms. of mercury.
atmospheres	29.92	inches of mercury.
atmospheres	33.90	feet of water.
atmospheres	10,333	kgs. per sq. meter.
atmospheres	14.70	pounds per sq. inch.
atmospheres	1.058	tons per sq. foot.
Bars	9.870×10^{-7}	atmospheres.
Bars	1	dynes per sq. cm.
Bars	0.01020	kgs. per square meter
Bars	2.089×10^{-3}	pounds per sq. foot.
Bars	1.450×10^{-5}	pounds per sq. inch.
board-feet	144 sq. in.x1 in.	cubic inches.
British thermal units	0.2530	kilogram-calories.
British thermal units	777.5	foot-pounds.
British thermal units	3.927×10^{-4}	horse-power-hours.
British thermal units	1054	joules.
British thermal units	107.5	kilogram-meters.
British thermal units	2.928×10^{-4}	kilowatt-hours.
B.t.u. per min	12.96	foot-pounds per sec.
B.t.u. per min	0.02356	horse-power.
B.t.u. per min	0.01757	kilowatts.
B.t.u. per min	17.57	watts.
B.t.u. per sq. ft. per min	0.1220	watts per square inch.
bushels	1.244	cubic feet.
bushels	2150	cubic inches.
bushels	0.03524	cubic meters.
bushels	4	pecks.
bushels	64	pints (dry).
bushels	32	quarts (dry)
Centares	1	square meters.
centigrams	0.01	grams.
centiliters	0.01	liters.
centimeters	0.3937	inches.
centimeters	0.01	meters.
centimeters	393.7	mils.
centimeters	10	millimeters.
centimeter-dynes	1.020×10^{-3}	centimeter-grams.
centimeter-dynes	1.020×10^{-8}	meter-kilograms.
centimeter-dynes	7.376×10^{-8}	pound-feet.
centimeter-grams	980.7	centimeter-dynes.
centimeter-grams	10^{-5}	meter-kilograms.
centimeter-grams	7.233×10^{-5}	pound-feet.
centimeters of mercury	0.01316	atmospheres.
centimeters of mercury	0.4461	feet of water.
centimeters of mercury	136.0	kgs. per square meter.
centimeters of mercury	27.85	pounds per sq. foot.
centimeters of mercury	0.1934	pounds per sq. inch.
centimeters per second	1.969	feet per minute.
centimeters per second	0.03281	feet per second.
centimeters per second	0.036	kilometers per hour.
centimeters per second	0.6	meters per minute.
centimeters per second	0.02237	miles per hour.
centimeters per second	3.728×10^{-4}	miles per minute.
cms. per sec. per sec.	0.03281	feet per sec. per sec.
cms. per sec. per sec.	0.036	kms. per hour per sec
cms. per sec. per sec.	0.02237	miles per hour per sec
circular mils	5.067×10^{-6}	square centimeters.
circular mils	7.854×10^{-7}	square inches.
circular mils	0.7854	square mils.
cord-feet	4 ft.x4 ft.x1 ft.	cubic feet.
cords	8 ft.x4 ft.x4 ft.	cubic feet.
coulombs	1/10	abcoulombs.
coulombs	3×10^{9}	statcoulombs.
coulombs per sq. inch	0.01550	abcoulombs per sq. cm
coulombs per sq inch	0.1550	coulombs per sq. cm.
coulombs per sq. inch	4.650×10^{8}	statcouls. per sq. cm.
cubic centimeters	3.531×10^{-5}	cubic feet.
cubic centimeters	6.102×10^{-2}	cubic inches.
cubic centimeters	10^{-6}	cubic meters.
cubic centimeters	1.308×10^{-6}	cubic yards.
cubic centimeters	2.642×10^{-4}	gallons.
cubic centimeters	10^{-3}	liters.
cubic centimeters	2.113×10^{-3}	pints (liq.).
cubic centimeters	1.057×10^{-3}	quarts (liq.).
cubic feet	2.832×10^{4}	cubic cms.
cubic feet	1728	cubic inches.
cubic feet	0.02832	cubic meters.
cubic feet	0.03704	cubic yards.
cubic feet	7.481	gallons.
cubic feet	28.32	liters.
cubic feet	59.84	pints (liq.).
cubic feet	29.92	quarts (liq.).
cubic feet per minute	472.0	cubic cms. per sec.
cubic feet per minute	0.1247	gallons per sec.
cubic feet per minute	0.4720	liters per second
cubic feet per minute	62.4	lbs. of water per min.
cubic inches	16.39	cubic centimeters.
cubic inches	5.787×10^{-4}	cubic feet.
cubic inches	1.639×10^{-5}	cubic meters.
cubic inches	2.143×10^{-5}	cubic yards.
cubic inches	4.329×10^{-3}	gallons.
cubic inches	1.639×10^{-2}	liters.
cubic inches	0.03463	pints (liq.).
cubic inches	0.01732	quarts (liq.).
cubic meters	10^{6}	cubic centimeters
cubic meters	35.31	cubic feet.
cubic meters	61,023	cubic inches.
cubic meters	1.308	cubic yards.
cubic meters	264.2	gallons.
cubic meters	10^{3}	liters.
cubic meters	2113	pints (liq.).
cubic meters.	1057	quarts (liq.).
cubic yards	7.646×10^{5}	cubic centimeters.
cubic yards	27	cubic feet.
cubic yards	46,656	cubic inches.
cubic yards	0.7646	cubic meters.
cubic yards	202.0	gallons.
cubic yards	764.6	liters.
cubic yards	1616	pints (liq.).
cubic yards	807.9	quarts (liq.).
cubic yards per minute	0.45	cubic feet per second.
cubic yards per minute	3.367	gallons per second.
cubic yards per minute	12.74	liters per second.
Days	24	hours.
Days	1440	minutes.
Days	86,400	seconds.
decigrams	0.1	grams.
deciliters	0.1	liters.
decimeters	0.1	meters.
degrees (angle)	60	minutes.
degrees (angle)	0.01745	radians.
degrees (angle)	3600	seconds.
degrees per second	0.01745	radians per second.
degrees per second	0.1667	revolutions per min.
degrees per second	0.002778	revolutions per sec.
dekagrams	10	grams.
dekaliters	10	liters.
dekameters	10	meters.
dollars (U.S.)	5.182	francs (French).
dollars (U.S.)	4.20	marks (German).
dollars (U.S.)	0.2055	pounds sterling (Brit.)
dollars (U.S.)	4.11	shillings (British)
drams	1.772	grams.
drams	0.0625	ounces.
dynes	1.020×10^{-3}	grams.
dynes	7.233×10^{-5}	poundals.

(Continued on Page 40)

Why college men choose careers with Du Pont



Every year, several hundred new college graduates choose Du Pont. Many Masters and Ph.D.'s do, too.

Recently we asked some of them what factors influenced them to decide for Du Pont. They cited more than half a dozen reasons. Here are some they almost all agreed upon:

OPPORTUNITY AND RECOGNITION

They were aware that college-trained beginners go right to work with men who have achieved. For example, research chemists work with individuals who've done successful research. New engineers work with pros, some of whom have designed new plants, or devised new manufacturing methods, or distinguished themselves in some other way. And other graduates, with B.A. or M.B.A. degrees, go to work with leaders who've been successful in Sales or Advertising or Treasurer's, or another of Du Pont's many departments.

RESEARCH CREATES NEW PRODUCTS; NEW PRODUCTS CREATE NEW JOBS

Men like working for a company that believes in research, enough to invest in it . . . $90 million a year! The fact is that important new products come from Du Pont laboratories and go to Du Pont manufacturing plants with frequency.

Here are but a few since World War II: "Orlon"* acrylic fiber followed nylon (soon after the war). Then came "Dacron"* polyester fiber, "Mylar"* polyester film, "Lucite"* acrylic lacquer and "Delrin"* acetal resin. These, and many others, have created thousands of new jobs . . . in research, manufacturing, sales . . . in fact, in *all* Du Pont departments.

DU PONT BACKS EMPLOYEES WITH HUGE INVESTMENT

New graduates feel that every facility is provided for doing the job well. Last year, Du Pont's operating investment per employee was $32,500. Since much of this was expended to provide the most modern and best of equipment to work with, it further increases the chance for individual achievement.

DU PONT PROVIDES STEADY EMPLOYMENT

Career seekers appreciate the importance of security. Today, the average annual turnover rate at Du Pont is less than one-third that of industry nationally.

If you'd like to learn more about job opportunities at Du Pont, just clip and mail this coupon. And be sure to tell us your course of study, so we can send you the appropriate booklet.

E. I. du Pont de Nemours & Co. (Inc.)
Room 2419-12, Nemours Building, Wilmington 98, Delaware

Please send me the booklet outlining opportunities in my major field (indicated below).

Name__________

Class__________ Major__________ Degree__________

College__________

My address__________

City__________ Zone__________ State__________

An equal-opportunity employer

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

* REGISTERED DU PONT TRADEMARK

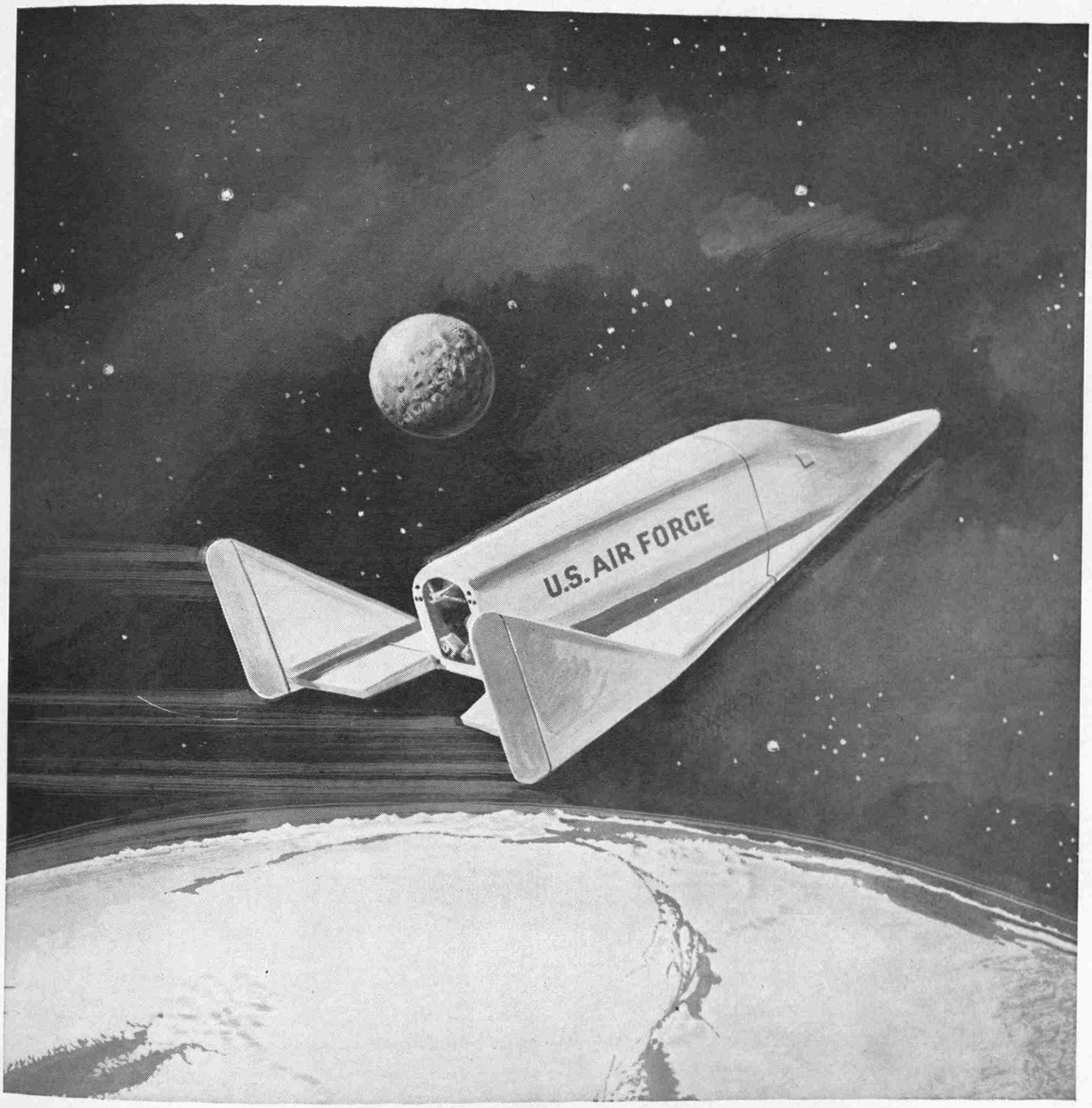
CONVERSION FACTORS

(Continued from Page 38)

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

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

(Continued on Page 42)



Cooling space pilots from launch to landing

New concepts in airborne cooling have become vital to the progress of America's space program. For example, Garrett is now developing an advanced system for the Boeing Dyna-Soar manned space glider. It will use the liquid hydrogen fuel for the vehicle's own accessory power system to control the temperature of the pilot and equipment throughout the flight. This is another of the many systems in development by Garrett to further the conquest of space.

Project areas at Garrett with which you might wish to become identified include space life support systems, solar and nuclear power systems, electronic systems, air conditioning and pressurization systems, computer systems and small gas turbines for both military and industrial uses.

Available to newly graduated engineers is a several month orientation program to help you determine your future.

For further information about a career with The Garrett Corporation, write to Mr. G. D. Bradley in Los Angeles. Garrett is an "equal opportunity" employer.

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CONVERSION FACTORS

(Continued from Page 40)

MULTIPLY	BY	TO OBTAIN
kilometers	0.6214	miles.
kilometers	1093.6	yards.
kilometers per hour	27.78	centimeters per sec.
kilometers per hour	54.68	feet per minute.
kilometers per hour	0.9113	feet per second.
kilometers per hour	0.5396	knots per hour.
kilometers per hour	16.67	meters per minute.
kilometers per hour	0.6214	miles per hour.
kms. per hour per sec.	27.78	cms. per sec. per sec.
kms. per hour per sec.	0.9113	ft. per sec. per sec.
kms. per hour per sec.	0.2778	meters per sec. per sec.
kms. per hour per sec.	0.6214	miles per hr. per sec.
kilometers per min.	60	kilometers per hour.
kilowatts	56.92	B.t.u. units per min.
kilowatts	$4.425x10^{4}$	foot-pounds per min.
kilowatts	737.6	foot-pounds per sec.
kilowatts	1.341	horse-power.
kilowatts	14.34	kg.-calories per min.
kilowatts	10^{3}	watts.
kilowatt-hours	3415	British thermal units.
kilowatt-hours	$2.655x10^{6}$	foot-pounds.
kilowatt-hours	1.341	horse-power-hours.
kilowatt-hours	$3.6x10^{6}$	joules.
kilowatt-hours	860.5	kilogram-calories.
kilowatt-hours	$3.671x10^{5}$	kilogram-meters.
knots	6080	feet.
knots	1.853	kilometers.
knots	1.152	miles.
knots	2027	yards.
knots per hour	51.48	centimeters per sec.
knots per hour	1.689	feet per sec.
knots per hour	1.853	kilometers per hour.
knots per hour	1.152	miles per hour.
Lines per square cm.	1	gausses.
lines per square inch	0.1550	gausses.
links (engineer's)	12	inches.
links (suveyor's)	7.92	inches.
liters	10^{3}	cubic centimeters.
liters	0.03531	cubic feet.
liters	61.02	cubic inches.
liters	10^{-3}	cubic meters.
liters	$1.308x10^{-3}$	cubic yards.
liters	0.2642	gallons
liters	2.113	pints (liq.).
liters	1.057	quarts (liq.).
liters per minute	$5.855x10^{-4}$	cubic feet per second.
liters per minute	$4.403x10^{-3}$	gallons per second.
log^{10} *N*	2.303	log_{10} *N* or *ln N*.
log_{10} *N* or *ln N*	0.4343	log_{10} *N*.
lumens per sq. ft.	1	foot-candles.
Marks (German)	0.238	dollars (U.S.).
Marks (German)	1.233	francs (French).
Marks (German)	0.04890	pounds sterling (Brit.).
maxwells	10^{-3}	kilolines.
megalines	10^{6}	maxwells.
megmhos per cm. cube	10^{-3}	abmhos per cm. cube.
megmhos per cm. cube	2.540	megmhos per in. cube.
megmhos per cm. cube	0.1662	mhos per mil foot.
megmhos per inch cube	0.3937	megmhos per cm. cube.
megohms	10^{6}	ohms.
meters	100	centimeters.
meters	3.2808	feet.
meters	39.37	inches.
meters	10^{-3}	kilometers.
meters	10^{3}	millimeters.
meters	1.0936	yards.
meter-kilograms	$9.807x10^{7}$	centimeter-dynes.
meter-kilograms	10^{5}	centimeter-grams.
meter-kilograms	7.233	pound-feet.
meters per minute	1.667	centimeters per sec.
meters per minute	3.281	feet per minute.
meters per minute	0.05468	feet per second.
meters per minute	0.03	kilometers per hour.
meters per minute	0.03728	miles per hour.
meters per second	1968	feet per minute.
meters per second	3.284	feet per second.
meters per second	3.0	kilometers per hour.
meters per second	0.06	kilometers per min.
meters per second	2.237	miles per hour.
meters per second	0.03728	miles per minute.
meters per sec. per sec.	3.281	feet per sec. per sec.
meters per sec. per sec.	3.6	kms. per hour per sec.
meters per sec. per sec.	2.237	miles per hour per sec.
mhos per mil foot	$6.015x10^{-3}$	abmhos per cm. cube.
mhos per mil foot	6.015	megmhos per cm. cube.
mhos per mil foot	15.28	megmhos per in. cube.
microfarads	10^{-15}	abfarads.
microfarads	10^{-6}	farads.
microfarads	$9x10^{5}$	statfarads.
micrograms	10^{-6}	grams.
microliters	10^{-6}	liters.
microhms	10^{3}	abohms.
microhms	10^{-12}	megohms.
microhms	10^{-6}	ohms.
microhms	$1/9x10^{-17}$	statohms.
microhms per cm. cube	10^{3}	abohms per cm. cube.
microhms per cm. cube	0.3937	microhms p. in. cube.

MULTIPLY	BY	TO OBTAIN
microhms per cm. cube	6.015	ohms per mil foot.
microhms per inch cube	2.540	microhoms p. cm. cube.
microns	10^{-6}	meters.
miles	$1.609x10^{5}$	centimeters.
miles	5280	feet.
miles	1.6093	kilometers.
miles	1760	yards.
miles	1900.8	varas.
miles per hour	44.70	centimeters per sec.
miles per hour	88	feet per minute.
miles per hour	1.467	feet per second.
miles per hour	1.6093	kilometers per hour.
miles per hour	0.8684	knots per hour.
miles per hour	26.82	meters per minute.
miles per hour per sec.	44.70	cms. per sec. per sec.
miles per hour per sec.	1.467	feet per sec. per sec.
miles per hour per sec.	1.6093	kms. per hour per sec.
miles per hour per sec.	0.4470	M. per sec. per sec.
miles per minute	2682	centimeters per sec.
miles per minute	88	feet per second.
miles per minute	1.6093	kilometers per min.
miles per minute	0.8684	knots per minute.
miles per minute	60	miles per hour.
milligrams	10^{-3}	grams.
millihenries	10^{6}	abhenries.
millihenries	10^{-3}	henries.
millihenries	$1/9x10^{-14}$	stathenries.
milliliters	10^{-3}	liters.
millimeters	0.1	centimeters.
millimeters	0.03937	inches.
millimeters	39.37	mils.
mils	0.002540	centimeters.
mils	10^{-3}	inches.
miner's inches	1.5	cubic feet per min.
minutes (angle)	$2.909x10^{-4}$	radians.
minutes (angle)	60	seconds (angle).
months	30.42	days.
months	730	hours.
months	43,800	minutes.
months	$2.628x10^{6}$	seconds.
myriagrams	10	kilograms.
myriameters	10	kilometers.
myriawatts	10	kilowatts.
Ohms	10^{9}	abohms.
Ohms	10^{-6}	megohms.
Ohms	10^{6}	microhms.
Ohms	$1/9x10^{-11}$	statohms.
ohms per mil foot	166.2	abohms per cm. cube.
ohms per mil foot	0.1662	microhms per cm. cube.
ohms per mil foot	0.06524	microhms per in. cube.
ounces	8	drams.
ounces	437.5	grains.
ounces	28.35	grams.
ounces	0.0625	pounds.
ounces (fluid)	1.805	cubic inches.
ounces (fluid)	0.02957	liters.
ounces (troy)	480	grains (troy).
ounces (troy)	31.10	grams.
ounces (troy)	20	pennyweights (troy).
ounces (troy)	0.08333	pounds (troy).
ounces per square inch	0.0625	pounds per sq. inch.
Pennyweights (troy)	24	grains (troy).
Pennyweights (troy)	1.555	grams.
Pennyweights (troy)	0.05	ounces (troy).
perches (masonry)	24.75	cubic feet.
pints (dry)	33.60	cubic inches.
pints (liquid)	28.87	cubic inches.
poundals	13,826	dynes.
poundals	14.10	grams.
poundals	0.03108	pounds.
pounds	444,823	dynes.
pounds	7000	grains.
pounds	453.6	grams.
pounds	16	ounces.
pounds	32.17	poundals.
pounds (troy)	0.8229	pounds (av.).
pound-feet	$1.356x10^{7}$	centimeter-dynes.
pound-feet	13,825	centimeter-grams.
pound-feet	0.1383	meter-kilograms.
pounds-feet squared	421.3	kgs.-cms. squared.
pounds-feet squared	144	pounds-ins. squared.
pounds-inches squared	2.926	kgs.-cms. squared.
pounds-inches squared	$6.945x10^{-3}$	pounds-feet squared.
pounds of water	0.01602	cubic feet.
pounds of water	27.68	cubic inches.
pounds of water	0.1198	gallons.
pounds of water per min.	$2669x10^{-4}$	cubic feet per sec.
pounds per cubic foot	0.01602	grams per cubic cm.
pounds per cubic foot	16.02	kgs. per cubic meter.
pounds per cubic foot	$5.787x10^{-4}$	pounds per cubic inch.
pounds per cubic foot	$5.456x10^{-9}$	pounds per mil foot.
pounds per cubic inch	27.68	grams per cubic cm.
pounds per cubic inch	$2.768x10^{4}$	kgs. per cubic meter.
pounds per cubic inch	1728	pounds per cubic foot.
pounds per cubic inch	$9.425x10^{-6}$	pounds per mil foot.
pounds per foot	1.488	kgs. per meter.
pounds per inch	178.6	grams per cm.

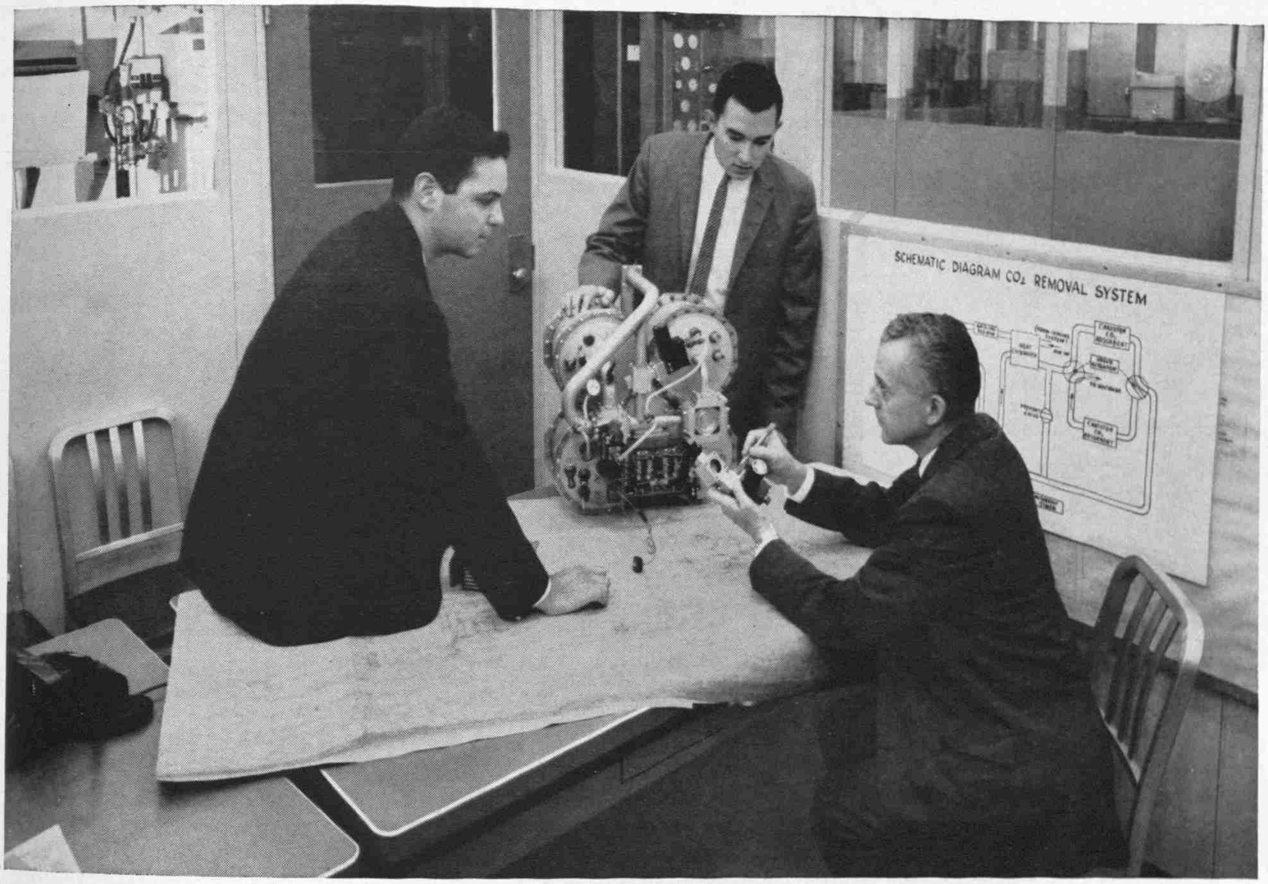
(Continued on Page 44)

CONVERSION FACTORS

(Continued from Page 42)

MULTIPLY	BY	TO OBTAIN
pounds per mil foot	2.306×10^{6}	grams per cubic cm.
pounds per square foot	0.01602	feet of water.
pounds per square foot	4.882	kgs. per square meter.
pounds per square foot	6.944×10^{-3}	pounds per sq. inch.
pounds per square inch	0.06804	atmospheres.
pounds per square inch	2.307	feet of water.
pounds per square inch	2.036	inches of mercury.
pounds per square inch	703.1	kgs. per square meter.
pounds per square inch	144	pounds per sq. foot.
Quadrants (angle)	90	degrees.
Quadrants (angle)	5400	minutes.
Quadrants (angle)	1.571	radians.
quarts (dry)	67.20	cubic inches.
quarts (liq.)	57.75	cubic inches.
quintals	100	pounds.
quires	25	sheets.
Radians	57.30	degrees.
Radians	3438	minutes.
Radians	0.637	quadrants.
radians per second	57.30	degrees per second.
radians per second	0.1592	revolutions per second.
radians per second	9.549	revolutions per min.
radians per sec. per sec.	573.0	revs. per min. per min.
radians per sec. per sec.	9.549	revs. per min. per sec.
radians per sec. per sec.	0.1592	revs. per sec. per sec.
reams	500	sheets.
revolutions	360	degrees.
revolutions	4	quadrants.
revolutions	6.283	radians.
revolutions per minute	6	degrees per second.
revolutions per minute	0.1047	radians per second.
revolutions per minute	0.01667	revolutions per sec.
revs. per min. per min.	1.745×10^{-3}	rads. per sec. per sec.
revs. per min. per min.	0.01667	revs. per min. per sec.
revs. per min. per min.	2.778×10^{-4}	revs. per sec. per sec.
revolutions per second	360	degrees per second.
revolutions per second	6.283	radians per second.
revolutions per second	60	revs. per min.
revs. per sec. per sec.	6.283	rads. per sec. per sec.
revs. per sec. per sec.	3600	revs. per min. per min.
revs. per sec. per sec.	60	revs. per min. per sec.
rods	16.5	feet.
Seconds (angle)	4.848×10^{-6}	radians.
spheres (solid angle)	12.57	steradians.
spherical right angles	0.25	hemispheres.
spherical right angles	0.125	spheres.
spherical right angles	1.571	steradians.
square centimeters	1.973×10^{5}	circular mils.
square centimeters	1.076×10^{-3}	square feet.
square centimeters	0.1550	square inches.
square centimeters	10^{-6}	square meters.
square centimeters	100	square millimeters.
sq. cms.-cms. sqd.	0.02402	sq. inches-inches sqd.
square feet	2.296×10^{-5}	acres.
square feet	929.0	square centimeters.
square feet	144	square inches.
square feet	0.09290	square meters.
square feet	3.587×10^{-8}	square miles.
square feet	.1296	square varas.
square feet	1/9	square yards.
sq. feet-feet sqd.	2.074×10^{4}	sq. inches-inches sqd.
square inches	1.273×10^{6}	circular mils.
square inches	6.452	square centimeters.
square inches	6.944×10^{-3}	square feet.
square inches	10^{6}	square mils.
square inches	645.2	square millimeters.
sq. inches-inches sqd.	41.62	sq. cms.-cms. sqd.
sq. inches-inches sqd.	4.823×10^{-5}	sq. ft.-feet sqd.
square kilometers	247.1	acres.
square kilometers	10.76×10^{6}	square feet.
square kilometers	10^{6}	square meters.
square kilometers	0.3861	square miles.
square kilometers	1.196×10^{6}	square yards.
square meters	2.471×10^{-4}	acres.
square meters	10.764	square feet.
square meters	3.861×10^{-7}	square miles.
square meters	1.196	square yards.
square miles	640	acres.
square miles	27.88×10^{6}	square feet.
square miles	2.590	square kilometers.
square miles	3,613,040.45	square varas.
square miles	3.098×10^{6}	square yards.
square millimeters	1.973×10^{3}	circular mils.
square millimeters	0.01	square centimeters.
square millimeters	1.550×10^{-3}	square inches.
square mils	1.273	circular mils.
square mils	6.452×10^{-6}	square centimeters.
square mils	10^{-6}	square inches.
square varas	.0001771	acres.
square varas	7.716049	square feet.
square varas	.0000002765	square miles.
square varas	.857339	square yards.
square yards	2.066×10^{-4}	acres.
square yards	9	square feet.
square yards	0.8361	square meters.
square yards	3.228×10^{-7}	square miles.
square yards	1.1664	square varas.
statamperes	$1/3\times10^{-10}$	abamperes.
statamperes	$1/3\times10^{-9}$	amperes.
statcoulombs	$1/3\times10^{-10}$	abcoulombs.
statcoulombs	$1/3\times10^{-9}$	coulombs.
statfarads	$1/9\times10^{-20}$	abfarads.
statfarads	$1/9\times10^{-11}$	farads.
statfarads	$1/9\times10^{-5}$	microfarads.
stathenries	9×10^{20}	abhenries.
stathenries	9×10^{11}	henries.
stathenries	9×10^{14}	millihenries.
statohms	9×10^{20}	abohms.
statohms	9×10^{5}	megohms.
statohms	9×10^{17}	microhms.
statohms	9×10^{11}	ohms.
statvolts	3×10^{10}	abvolts.
statvolts	300	volts.
steradians	0.1592	hemispheres.
steradians	0.07958	spheres.
steradians	0.6366	spherical right angles.
steres	10^{3}	liters.
Temp. (degs. C.) +273	1	abs. temp. (degs. C.).
Temp. (degs. C.) +17.8	1.8	temp. (degs Fahr.).
temp (degs. F.) +460	1	abs. temp. (degs. F.).
temp. (degs. F.) —32	5/9	temp. (degs. Cent.).
tons (long)	1016	kilograms.
tons (long)	2240	pounds.
tons (metric)	10^{3}	kilograms.
tons (metric)	2205	pounds.
tons (short)	907.2	kilograms.
tons (short)	2000	pounds.
tons (short) per sq. ft.	9765	kgs. per square meter.
tons (short) per sq. ft.	13.89	pounds per sq. inch.
tons (short) per sq. in.	1.406×10^{6}	kgs. per square meter.
tons (short) per sq. in.	2000	pounds per sq inch.
Varas	2.7777	feet.
Varas	33.3333	inches.
Varas	.000526	miles.
Varas	.9259	yards.
volts	10^{8}	abvolts.
volts	1/300	statvolts.
volts per inch	3.937×10^{7}	abvolts per cm.
volts per inch	1.312×10^{-3}	statvolts per cm.
Watts	0.05692	B.t.u. units per min.
Watts	10^{7}	ergs per second.
Watts	44.26	foot-pounds per min.
Watts	0.7376	foot-pounds per sec.
Watts	1.341×10^{-3}	horse-power.
Watts	0.01434	kg.-calories per min.
Watts	10^{-3}	kilowatts.
watt-hours	3.415	British thermal units.
watt-hours	2655	foot-pounds.
watt-hours	1.341×10^{-3}	horse-power-hours.
watt-hours	0.8605	kilogram-calories.
watt-hours	367.1	kilogram-meters.
watt-hours	10^{-3}	kilowatt-hours.
webers	10^{8}	maxwells.
weeks	168	hours.
weeks	10,080	minutes.
weeks	604,800	seconds.
Yards	91.44	centimeters.
Yards	3	feet.
Yards	36	inches.
Yards	0.9144	meters.
Yards	1.08	varas.
years (common)	365	days.
years (common)	8760	hours.
years (leap)	366	days.
years (leap)	8784	hours.

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



1961 Graduates, Ron Bullota (Villanova, BS-ME) and Robert Schwartz (R. P. I. MS-ME) review contaminant (CO_2) removal system for space vehicle with Fred Young (Penn State, BS-ME, '43), Project Engineer—Advanced Development

You'll be on a working assignment from your first day at Hamilton Standard . . .

From the start, you'll be *working* as a full member of a group, and your training will be mainly *on-the-job* training. Your particular group may be concerned with design, or analysis, or development work. Your fellow members will be men of varied experience . . . some will be leading men in their fields.

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If you'd like to know more about work as a group member in this highly diversified aerospace organization, ask your Placement Officer about Hamilton Standard, or write direct to Mr. Robert J. Harding, Supervisor of College Relations, at

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HAMILTON STANDARD DIVISION

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WHAT'S NEW

THERMOELECTRIC AIR-CONDITIONED SUIT

A self-contained air-conditioned suit which can keep the wearer comfortable in outside temperatures ranging from 40 degrees below zero to 135 degrees Fahrenheit has been developed by scientists of the Westinghouse Electric Corporation and the U. S. Naval Supply Research and Development Facility.

Heating or cooling of the experimental garment is done by thermoelectricity—a refrigeration technique that eliminates the need for conventional moving apparatus. Cooling is accomplished simply by passing an electric current through thermoelectric couples made of semiconductor materials. Reversing the current causes the materials to heat instead of cool. The heating or cooling is done automatically, and a temperature of about 80 degrees Fahrenheit is maintained inside the garment.

The only moving parts in the suit's entire air conditioning system are two small fans which circulate and distribute the conditioned air around the wearer. Batteries permit the suit to be independent of any other power source for one hour.

ENGINEERS' SALARIES

Engineers' salary levels rose approximately 5% per year between 1958 and 1960 according to an EMC survey just off the press. The overall median annual salary now stands at $9,600. The recent increase of 5% may be compared with an average annual increase of 6½% between the years 1953-1958. Seven years ago (1953), the median salary for engineers was $6,500. These findings were made public by the Engineering Manpower Commission in the fourth of a series of surveys entitled, "Professional Income of Engineers—1960" which covers approximately 200,000 engineering graduates in industry, education and government.

The report also shows that engineers are a young group, with median age of about 32, based on a graduation average of 22. Salaries increase more during the early years of an engineer's career and begin to slow down at about 20 years of experience.

* * *

Southern translations

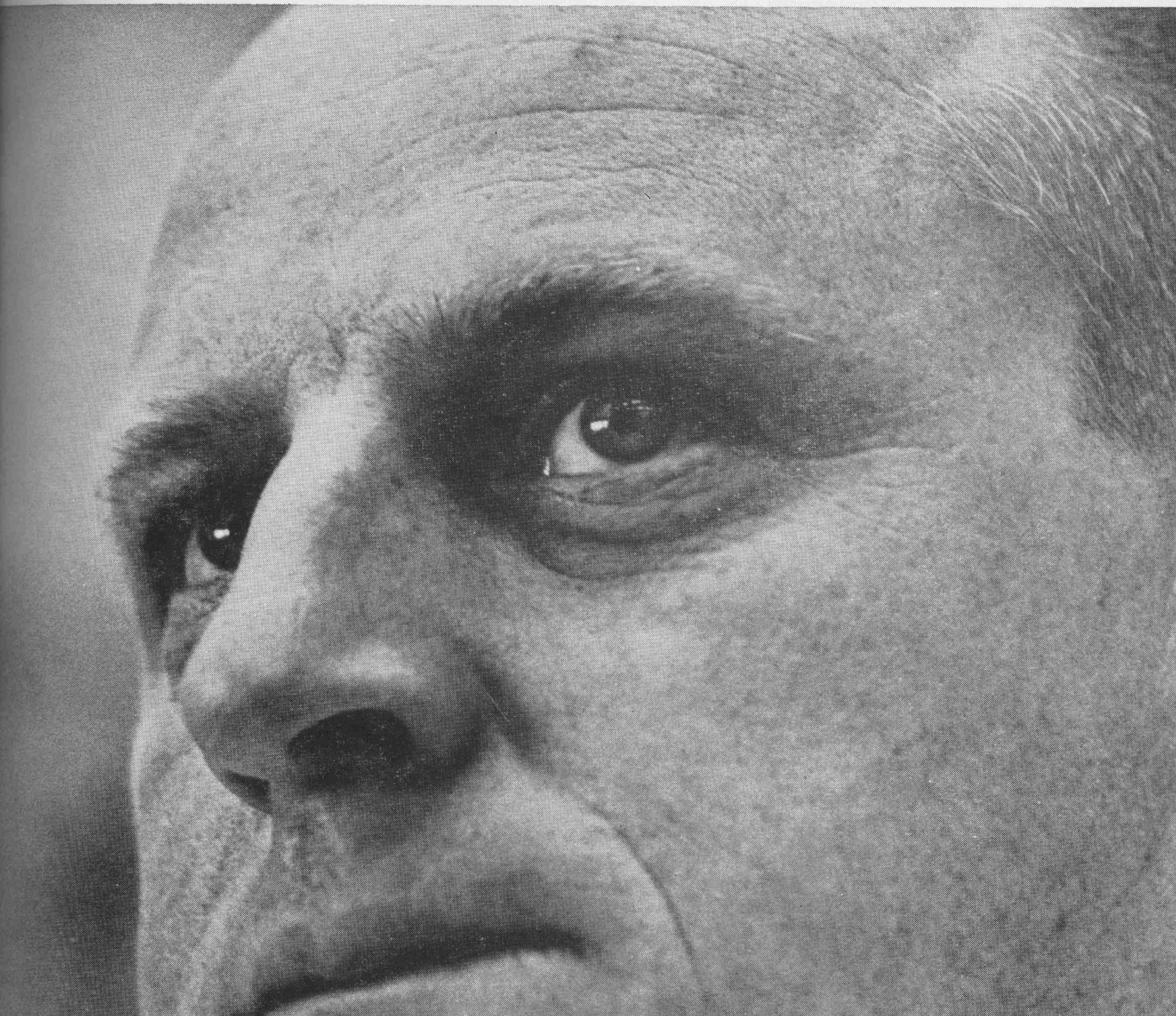
Abode—Wooden plank.

Balks—A container, such as "match balks."

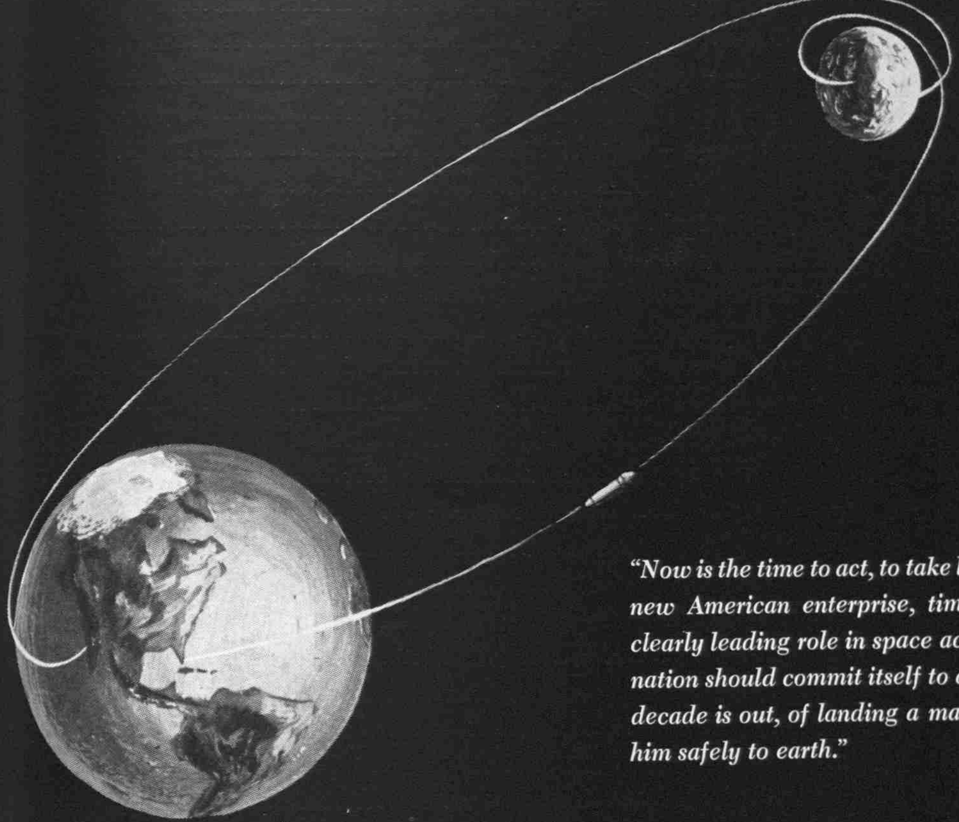
Beckon—Meat from a pig, usually eaten at breakfast with eggs.

Coat—A place of justice. "Coat's in session."

Faints—A barricade, usually surrounding a house.



National Aeronautics and Space Administration



"Now is the time to act, to take longer strides, time for a great new American enterprise, time for this Nation to take a clearly leading role in space achievement. I believe that the nation should commit itself to achieving the goal, before the decade is out, of landing a man on the moon and returning him safely to earth."

The President
of the United States
May 25, 1961

The nation has committed itself to accelerate greatly the development of space science and technology, accepting as a national goal, the achievement of manned lunar landing and return before the end of the decade. This space program will require spending many billions of dollars during the next ten years.

NASA directs and implements the nation's research and development efforts in the exploration of space. The accelerated national space program calls for the greatest single technological effort our country has thus far undertaken. Manned space flight is the most challenging assignment ever given to mankind.

NASA has urgent need for large numbers of scientists and engineers in the fields of aerospace technology who hold degrees in physical science, engineering, or other appropriate fields.

NASA career opportunities are as unlimited as the scope of our organization. You can be sure to play an important role in the United States' space effort when you join NASA.

NASA positions are available for those with degrees or experience in appropriate fields for work in one of the following areas: Fluid and Flight Mechanics; Materials and Structures; Propulsion and Power; Data Systems; Flight Systems; Measurement and Instrumentation Systems; Experimental Facilities and Equipment; Space Sciences; Life Sciences; Project Management.

NASA invites you to address your inquiry to the Personnel Director of any of the following NASA Centers: NASA Space Task Group, Hampton, Virginia; NASA Goddard Space Flight Center, Greenbelt, Maryland; NASA Marshall Space Flight Center, Huntsville, Alabama; NASA Ames Research Center, Mountain View, California; NASA Flight Research Center, Edwards, California; NASA Langley Research Center, Hampton, Virginia; NASA Wallops Station, Wallops Island, Virginia; NASA Lewis Research Center, Cleveland, Ohio.

Positions are filled in accordance with Aero-Space Technology Announcement 252B.

All qualified applicants will receive consideration for employment without regard to race, creed or color, or national origin.

MIGHTY F-1

(Continued from Page 30)

thrust. A possible second stage would be a cluster of two F-1's. The 200,000-pound-thrust J-2 engine—in a cluster of four—would power the third stage in this study configuration. This vehicle would have a capability of lifting some 160 tons into Earth orbit or some 50 tons on an escape mission.

The F-1 has been under development by NASA for two and a half years. But earliest feasibility studies on a million-pound thrust single chamber engine date back to 1955—two years before Sputnik—when Rocketdyne proposed such an engine to the Air Force.

In January, 1959, a $102 million NASA contract for development of a full-scale 1.5-million-pound thrust engine was initiated. This was followed by a long series of exacting tests. Each component was tested and re-tested to assure maximum reliability and top performance. Then, in a series of carefully prepared tests, the components were gradually assembled for full-system firings.

The first complete engine test was made on June 13, 1961, at the $15-million-high thrust test area at Edwards, Calif. Approximately one million pounds of thrust was generated at that time. This achievement was of high significance to the U.S. space effort.

Attending the F-1 briefing, Erich Neubert, associate deputy director for research and development at Marshall Space Flight Center, noted that Marshall undertook technical direction of the F-1 project after the center became part of NASA on July 1, 1960. "The Marshall Center's experience in the Saturn development program well suited it to move into the F-1 and Nova programs," he said. "In addition, the launching of Saturn vehicles, scheduled to begin later this year, will give the Marshall Center experience in the launching of very high thrust rockets by the time Nova moves to that stage."

J. P. McNamara, Rocketdyne vice president, liquid propulsion operations, told newsmen at the demonstration that more than 140 tests at over a million pounds of thrust had been made to date in the F-1 development program. The tests included a thrust chamber test during which a record thrust of 1,640,000 pounds was achieved.

"Progress in development of the F-1 has been unprecedented," McNamara said. "The early decision by NASA to take advantage of proven design is paying off in development of this very high thrust single chambered engine for manned space flight. The F-1 uses the same propellants and basic designs as the Rocketdyne engines that power the Atlas, Thor, Jupiter, and Saturn vehicles and have launched 43 of the nation's 47 successful satellites and space probes.

"It is this extensive background in development of high thrust engines that is enabling Rocketdyne to design into the F-1 the highest reliability ever specified for a large rocket engine. Our goal is higher than the reliability established by the Redstone engine, with only 78,000 pounds of thrust, which carried this country's first astronauts into space on their suborbital flights."

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Kodak beyond the snapshot...

(random notes)

A little x-ray news

More precious than rubies is confidence in the importance of what one does for a living. One thing we do for a living is to manufacture x-ray film. Unkind words are rarely spoken about society's need for x-ray film. Now we have news about x-ray film and need to make it seem important. Easy.

The first piece of news has it that Kodak x-ray film of high contrast and fine grain is now obtainable with emulsion on one side only. Ties in to the current push for great structural strength in small mass. Load-bearing members are now getting so thin that putative flaws on their radiographs have to be checked out with a microscope. Since a microscope can focus on only one side of the film at a time, it's better to have the other side blank. Simple, yes; trivial, no. Manufacturing and distribution problems on our scale are rarely trivial.

The second piece of news much exceeds the first in importance. You have been given estimates by various authorities of how much radiation you and your children can expect to soak up, barring disaster. You have been told how much to figure for medical and dental radiological examination over a lifetime. Meanwhile we have been quietly goofing up the statistics! We have been upping the response of the films. With the latest step, the same amount of examination requires half or a third as much radiation as before. Just privately rejoice a little at how the deal has been sweetened a bit for you, statistically.

To John!

We are not alone in polypropylene. Seven other large and reputable companies are known to be playing in the game against each other and us. All we players must be very brave, hide our nervousness, and raise our glasses high in a toast to the memory of Senator John Sherman, who believed in the great public good that comes of free and untrammeled competition.

(Other nations have ambitious polypropylene plans of their own and are outproducing the U.S. in polypropylene right now in the aggregate. The peoples of the earth had better start making their artifacts out of polypropylene—and fast!)

As the game gets under way, we hold certain strong cards. Our Tenite polypropylene

- Can be polymerized from propylene by two completely different processes of our own devising, both free and clear of the U.S. patents of others.
- Comes in many flow rates.
- Comes in the widest variety of reproducible colors.
- Is exceedingly well fortified by our own antioxidants against oxidative deterioration.
- Has "built-in hinge," i.e. tremendous fatigue resistance under flexure.
- Weathers very well when extruded in monofilament for webbing and cordage, because of our own ultraviolet inhibitors.
- Has high-enough softening temperature so that when it is extruded as sheet you can cook in it and yet on a yield basis it costs less than cellophane.

A familiar force

Here is a picture of the basic amplifier

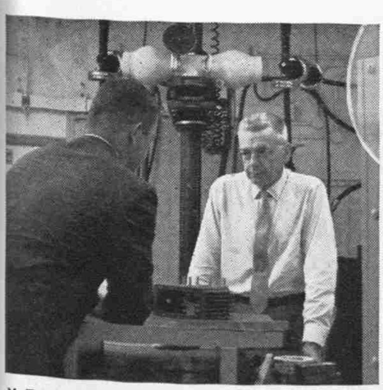
used in photography. This amplifier can provide a gain of 10^9. There is a genie in the bottle. Familiarity with him breeds not contempt but admiration.

Once upon a time, it was customary to summon the genie by retiring to a little darkroom and pouring him out of his bottle into a white enameled tray. No longer does he demand such ceremonious treatment.

Our wet friend now works unseen inside a box, responding to push buttons. His very fluidity has been replaced by a kind of viscosity which need little concern the client, who merely inserts a probe into a disposable cartridge. When the work is done, the genie uses his private exit to the sewer.

This newly announced Eastman Viscomat Processor does 36 feet of 16mm film per minute. Not entirely by coincidence, this happens to be the rate at which film runs through a projector. The film spends about one minute in the processor. It emerges processed to standard commercial quality, ready to project. It can be stopped for seconds or days and restarted without loss of quality. Were we not so touchy about processing quality, the gadget would have been on the market long before.

Note: Whether you work for us or not, photography in some form will probably have a part in your work as years go on. Now or later, feel free to ask for Kodak literature or help on anything photographic.



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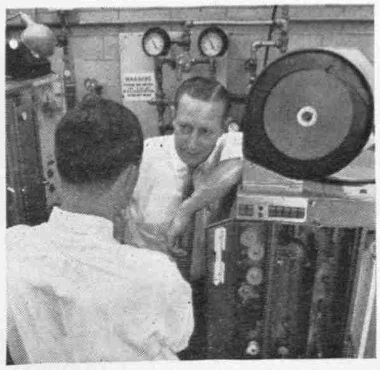

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One of a series . . .

Interview with General Electric's Dr. J. H. Hollomon

Manager—General Engineering Laboratory

Society Has New Needs and Wants—Plan Your Career Accordingly

DR. HOLLOMON is responsible for General Electric's centralized, advanced engineering activities. He is also an adjunct professor of metallurgy at RPI, serves in advisory posts for four universities, and is a member of the Technical Assistance panel of President Kennedy's Scientific Advisory Committee. Long interested in emphasizing new areas of opportunity for engineers and scientists, the following highlights some of Dr. Hollomon's opinions.

Q. Dr. Hollomon, what characterizes the new needs and wants of society?

A. There are four significant changes in recent times that characterize these needs and wants.

1. The increases in the number of people who live in cities: the accompanying need is for adequate control of air pollution, elimination of transportation bottlenecks, slum clearance, and adequate water resources.

2. The shift in our economy from agriculture and manufacturing to "services": today less than half our working population produces the food and goods for the remainder. Education, health, and recreation are new needs. They require a new information technology to eliminate the drudgery of routine mental tasks as our electrical technology eliminated routine physical drudgery.

3. The continued need for national defense and for arms reduction: the majority of our technical resources is concerned with research and development for military purposes. But increasingly, we must look to new technical means for detection and control.

4. The arising expectations of the peoples of the newly developing nations: here the "haves" of our society must provide the industry and the tools for the "have-nots" of the new countries if they are to share the advantages of modern technology. It is now clearly recognized by all that Western technology is capable of furnishing the material goods of modern life to the billions of people of the world rather than only to the millions in the West.

We see in these new wants, prospects for General Electric's future growth and contribution.

Q. Could you give us some examples?

A. We are investigating techniques for the control and measurement of air and water pollution which will be applicable not only to cities, but to individual households. We have developed, for example, new methods of purifying salt water and specific techniques for determining impurities in polluted air. General Electric is increasing its international business by furnishing power generating and transportation equipment for Africa, South America, and Southern Asia.

We are looking for other products that would be helpful to these areas to develop their economy and to improve their way of life. We can develop new information systems, new ways of storing and retrieving information, or handling it in computers. We can design new devices that do some of the thinking functions of men, that will make education more effective and perhaps contribute substantially to reducing the cost of medical treatment. We can design new devices for more efficient "paper handling" in the service industries.

Q. If I want to be a part of this new activity, how should I plan my career?

A. First of all, recognize that the meeting of needs and wants of society with products and services is most important and satisfying work. Today this activity requires not only knowledge of science and technology but also of economics, sociology and the best of the past as learned from the liberal arts. To do the engineering involved requires, at least for young men, the most varied experience possible. This means working at a number of different jobs involving different science and technology and different products. This kind of experience for engineers is one of the best means of learning how to conceive and design—how to be able to meet the changing requirements of the times.

For scientists, look to those new fields in biology, biophysics, information, and power generation that afford the most challenge in understanding the world in which we live.

But above all else, the science explosion of the last several decades means that the tools you will use as an engineer or as a scientist and the knowledge involved will change during your lifetime. Thus, you must be in a position to continue your education, either on your own or in courses at universities or in special courses sponsored by the company for which you work.

Q. Does General Electric offer these advantages to a young scientist or engineer?

A. General Electric is a large diversified company in which young men have the opportunity of working on a variety of problems with experienced people at the forefront of science and technology. There are a number of laboratories where research and advanced development is and has been traditional. The Company offers incentives for graduate studies, as well as a number of educational programs with expert and experienced teachers. Talk to your placement officers and members of your faculty. I hope you will plan to meet our representative when he visits the campus.

A recent address by Dr. Hollomon entitled "Engineering's Great Challenge — the 1960's," will be of interest to most Juniors, Seniors, and Graduate Students. It's available by addressing your request to: Dr. J. H. Hollomon, Section 699-2, General Electric Company, Schenectady 5, N.Y.

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All applicants will receive consideration for employment without regard to race, creed, color, or national origin.