MAY 25, 1959

SEABORNE MISSILE TRACKER

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

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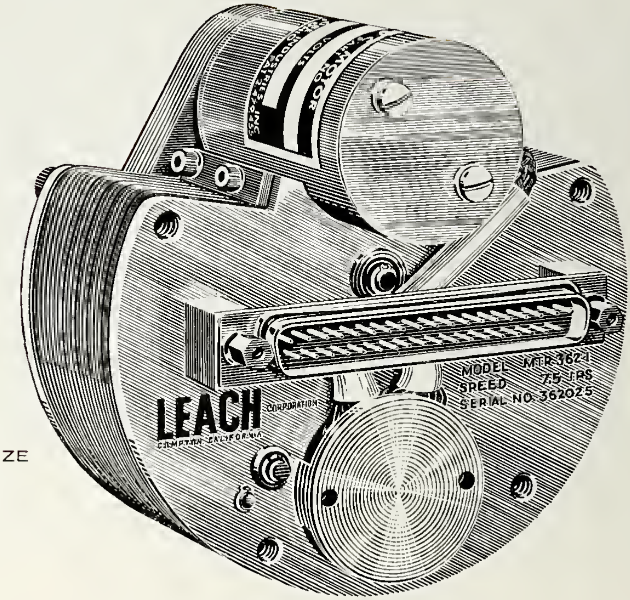

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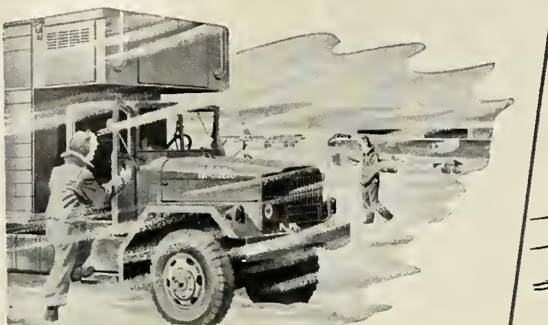

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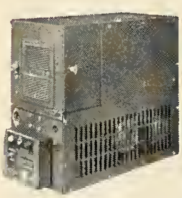

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missiles and rockets
MAGAZINE OF WORLD ASTRONAUTICS

MAY 25 HEADLINES

ASTRONAUTICS ENGINEERING

MISSILE SUPPORT

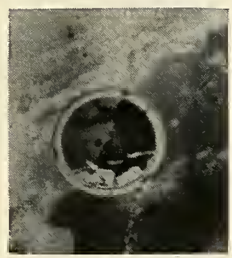
MISSILE ELECTRONICS

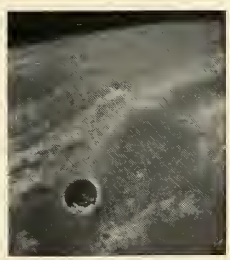
THE MISSILE WEEK

DEPARTMENTS

COVER: This large antenna is part of radar network on Army's missile tracking ship SS AMERICAN MARINER.

AND AWAY IT GOES!





125 MILES UP: A special ACR Electronics Corp. 16-millimeter camera snapped these sensational shots as the nose cone of a *Thor* separated over the Atlantic. Camera is of compact design capable of safeguarding film during impact with ocean. Pictures were taken through a quartz window of General Electric Co. recovery capsule located in the cone-shaped afterbody of the *Thor* nose cone. Capsule was ejected from nose cone shortly after it hit the water, 1400 miles from Cape Canaveral.

The Remarkable City of Huntsville

One of these days the technicians of the Army Ballistic Missile Agency at Huntsville will bolt a circular cluster of H-1 Rocketdyne engines to a modified *Jupiter* test stand and push a button. The act will unleash some million and a half pounds of thrust and the most horrible roar that has ever been heard in Alabama.

ABMA announced this week that it had received the first of the new engines (see page 36) and that the entire system, named *Saturn*, would be flight tested in 1960. Work has already begun on modification of the test stand to accommodate this monster of the Space Age and now it is a matter of forging the eight engines together in the approved configuration. This work cannot be done, incidentally, in the ABMA "fab lab" where other missile construction goes on. The three-story high ceiling is too low to accommodate the cluster.

Huntsville, Alabama, is probably the only town in the country where such a test could be carried out with the consent and approval of its citizens. ABMA will simply inform Huntsville to hold its collective ears, say, between and 9 and 10 a.m., on the designated day and Huntsville will cheerfully, even enthusiastically, run whatever risk to its *tympanum* that may be involved. Anyone who has ever stood a quarter of a mile away during the testing of *one* 150,000-pound-thrust engine can imagine the noise a cluster of eight will make. Yet, Huntsville will probably be both hurt and incensed at any suggestion that the testing should be done elsewhere.

In many ways Huntsville is quite a remarkable place. Settled during the early days of America because a big gushing spring provided ample fresh water, it became important, particularly in Civil War days, because it was the junction of north-south, east-west rail lines. But it was never really anything more than a sleepy Southern village until the Army decided to get into the missile business and chose Huntsville and the Redstone Arsenal there for its operating site.

Huntsville then blossomed and boomed from 15,000 to its present hundred and some thousand, depending on how far into the environs you want to go. It has been a relatively orderly boom with roads, housing developments, schools and law and order keeping pace under a remarkably wise municipal government. (In schools, for instance, the rate of progression has been one classroom a day for the past several months.) A solid local newspaper has helped immeasurably, too.

Chiefly, Huntsville cannot escape being notable for the enthusiasm it constantly displays for its missile and spacecraft building tenants. A new assignment for a new project in the cosmos brings cheers from the town—mayor, merchant and mill-worker. A cancellation, a setback or an adverse decision from the Pentagon brings corresponding gloom along Main Street. Roles and missions aren't involved. Huntsville is for the home team.

If this is a reflection of Huntsville's economic dependence on the Army's vast complex in the town's back (or front) yard, it is also a reflection of some highly-inspired labors in military-civilian relations with model results. Every military installation in the world could wish for such support.

A great deal of this amicable blending is, of course, traceable to the nature of the military establishment—the U.S. Army Ordnance Missile Command under the leadership of Maj. Gen. John B. Medaris. His organization at Huntsville is divided into two lesser commands—the Army Ballistic Missile Agency under Brig. Gen. John K. Barclay and the Army Rocket and Guided Missile Agency under Brig. Gen. John G. Shinkle. The redoubtable Wernher von Braun is, of course, director of development operations for the former, ABMA. Another occupant of the Huntsville complex, although a tenant, is the Ordnance Guided Missile School.

Obviously, the calibre of both military and civilians working in the three agencies must be and is a cut considerably above the norm in both education and intelligence. The Missile School, for instance, trains both Army and Air Force personnel in the operation of the *Jupiter*. It also trains NATO soldiers and airmen, both as individuals and in operational units, in the operation of Army missiles which have been or will be stationed overseas. (The curriculum is all set for the first Italian teams who will man the *Jupiter* IRBM stations in Italy.)

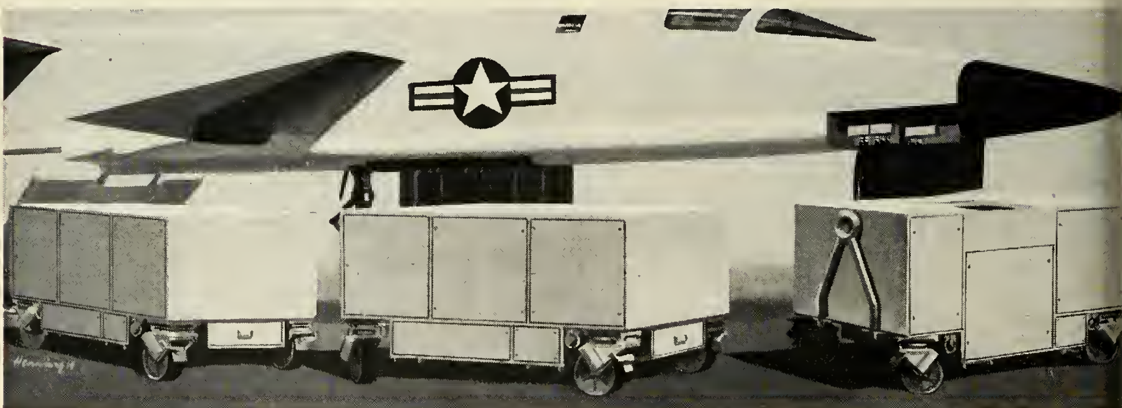
The 2000-person teaching and administration staff of the school, incidentally, averages (from secretary to commander) two years of college. Twelve months once passed without a court martial among the military personnel. The school introduced for the first time into military usage the Tele-PrompTer System of visual teaching and later added closed television circuits.

All in all, both Huntsville and the Army can be proud of military command and civilian population. Together they make a good team which, one of these days, will be holding its collective ears against the sound which will signal another step in man's adventuring in space.

Clarke Newlon

HOW TO FIND FAULT

...BEFORE COUNTDOWN



...BEFORE TAKEOFF

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Autonetics foresaw the day when the electronic systems inside a weapon would become as important as the frame that enclosed them... decided to automate the whole procedure. These automatic checkout controls—originally developed in cooperation with the Air Force and tested in the NAVAHO program—are now at work for both Air Force and Navy.

They're the heart of today's most *versatile* automatic checkout systems—only *practical* way to keep weapon system reliability at a ready-to-go pitch.

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washington countdown

IN THE PENTAGON

The death of Deputy Defense Secretary Donald A. Quarles can—and probably will—have far-reaching effects on the future of the Pentagon's widespread development set-up. Some of the effects of his death already showing up are . . .

In Dr. Herbert York's new Development & Engineering organization: The powerful centralized organization—a Quarles favorite—was just about to be given final approval by Defense Secretary Neil H. McElroy. Now a serious drive by the services and others is underway to lessen the power of York's office. But his chances of holding most of his own are considered good . . .

In top Pentagon development offices generally: The release of Quarles' strong hand is felt in many places. Once greatly-concentrated authority is flowing back into a more distributed pattern . . .

In Roy Johnson's ARPA: Many have thought that ARPA was headed for fairly rapid extinction. But now that McElroy has decided to stay on "indefinitely," it looks as if Johnson and ARPA will stay on "indefinitely," too.

• • •

The meaning: Control over development tightly held by Quarles could go to York . . . or partly to Johnson . . . or partly to the services. An inner struggle is on.

• • •

However, don't expect any drastic policy changes because of the appointment of Navy Secretary Thomas S. Gates as the new Deputy Defense Secretary. Like Quarles, Gates is known as an Administration man and will not try to alter the existing presidential party line.

• • •

A decision is expected very soon on selection of a prime contractor for *Dyna-Soar,* the boost-glide space missile launching platform. Competition is between Boeing and Martin. As M/R went to press the USAF Air Council had not received an evaluation report from Air Materiel Command but knew it was on the way.

• • •

Alterations on the *Redstones* which will be used to send the astronauts on their first trip into space will be made at Huntsville. The same capsule being developed by McDonnell for later use on the *Atlas* will be fitted to the early Army missile. First flight is expected before the end of 1959.

Watch for more big changes at Air Research and Development Command under new leadership of Lt. Gen. Bernard Schriever. Among those already announced: Maj. Gen. James Ferguson as ARDC vice commander, succeeding Maj. Gen. John Sessums who is expected to retire . . . Maj. Gen. William Canterbury as deputy commander for research, succeeding Maj. Gen. Leighton I. Davis.

ON CAPITOL HILL

One of the most significant moves by the 86th Congress is the attempt to tighten Congressional control over both missiles and space. Earlier this month the Senate Armed Services Committee called for requiring authorization of all missile programs as well as approval of appropriation requests. Now the House has called for authorization of all space programs for the next five years. All-out fights can be expected.

• • •

The Joint Congressional Atomic Research Subcommittee is preparing to crack down on the Administration over delays in development of the nuclear-powered plane—a proposed deliverer of the ALBM. The subcommittee understood a speed-up was planned. Then it was told that this was incorrect. If no speed-up is forthcoming, the subcommittee is all but certain to stage some of the hottest hearings of the year.

AT NASA

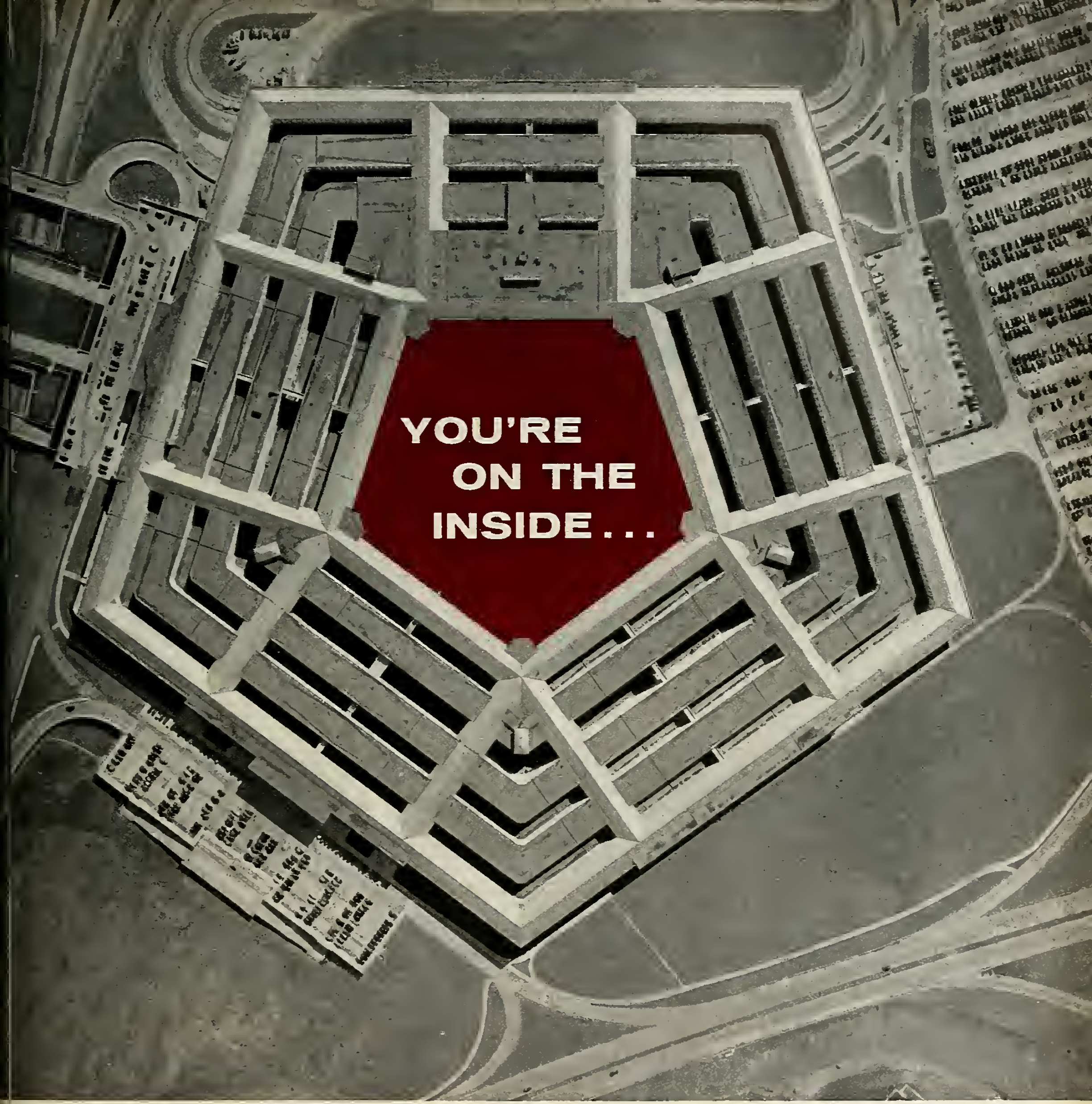
NASA is soon to announce the location of a site in North Dakota for one of four polar-orbit tracking and telemetry stations. Selection of the other three sites—in Alaska, Newfoundland, and Europe—is also supposed to be at hand.

• • •

NASA also is speeding up its search for an appropriate site for the proposed $5 million high-energy rocket development and test center. The center was cut from the NASA FY '60 budget by House members because NASA couldn't tell the Congressmen where the center would be located. Ideally, NASA would like to build it near the Lewis Propulsion Laboratories in Cleveland.

AROUND TOWN

The National Aviation Club is going to honor Dr. Theodore von Karman, one of the world's top scientists, as man of the month for May. Von Karman is chairman emeritus of the USAF Scientific Advisory Board.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THE GENERAL TIRE

industry countdown

STRUCTURES

First nuclear-powered missile cruiser—Long Beach (to be commissioned in FY 1961)—will have two extremely high-speed fire control systems to launch the supersonic surface-to-air *Talos*. Mark XII magazine and mechanized loader being developed by General Electric under $8 million contract will weigh 350 tons—reportedly the largest single piece of ordnance ever ordered by the Navy. It is bigger than the fire control system for a battery of 16-inch guns. Two other nuclear cruisers also are programmed and will be similarly equipped for the Bendix-RCA *Talos*.

• • •

In the 1960 budget, the Navy discloses it is buying enough Raytheon *Sparrow III* air-to-air missiles to "provide slightly more than a month's combat usage." Amount for Martin air-to-surface *Bullpup* will last for "a little less than a month's combat."

• • •

Look for NASA to back off somewhat from its original decision to keep exclusive rights to inventions conceived under its contracts. Permanent regulations upcoming soon are expected to allow contractors to retain proprietary rights—but the final decision as to who gets the patent rights will come after the invention, and not before the contract is signed.

PROPULSION

North American engineers predict the missile-launching B-70 bomber may use 50 to 75 tons of steel products, mostly thin-gauge alloys and stainless sheets and honeycomb sandwiches. Plane will be built like a "flying fuel tank" with the basic load-carrying structure containing the fuel to eliminate internal tanks. Structure may be assembled by fusion welding to meet 400°F to 650°F temperature requirements.

ELECTRONICS

Competing for $12 million NASA contract to construct and manage *Mercury* range are: Thompson Ramo Wooldridge, Reeves Instrument, Aeronautics Systems, Cubic Corp., Austin Corp., IBM, Convair, Vitro Laboratories, Milgo Electronics, Temco Aircraft, Aircraft Armaments, Sylvania, J. G. White Engineering, Nat Harrison Associates, Chance Vought, Ralph M. Parsons Co., ITT Laboratories, Page Communications, Philco, RCA, Space Electronics, Collins Radio, Aerojet-General, Chrysler Corp., Westinghouse, Cook Electric, Western Electric, Brown & Root, Lockheed, Burroughs Corp. and Underwood Corp. Contract will be let July 1.

• • •

The Pentagon is earmarking $118.1 million in the 1960 budget for purchase of ECM (electronic countermeasures) equipment. ECM embraces both defensive countermeasures to help aircraft penetrate enemy defenses and electronic reconnaissance to obtain information on enemy missiles and other weapons.

• • •

Best guess of the Air Force is that it will be sometime in 1963—four years from now—before SAGE (semiautomatic ground environment) combat command system is completely finished. It is now operational from Bangor, Me., to Washington, D.C.

ASTROPHYSICS

Russia is reported to be very actively researching the dynamics of outer space travel, which some day may be scheduled around solar storm activity. Avco's Dr. Arthur Kantrowitz is urging more U.S. research to open up this entirely new field of meteorology.

• • •

Soviet astronomer Nikolai Barabashov refutes the "green cheese" theory about the moon. He says the moon is not one color but many—brown, yellow, blue and red as well as green. Instead of being covered by cosmic dust or volcanic ash, as suggested by other observers, the Russian says the lunar surface is covered by a layer of rock grains.

SPACE MEDICINE

Strictly paper combination of medical facilities at Brooks AFB and Lackland AFB in Texas and Gunter AFB, Ala., will be made soon to form the AF Aerospace Medical Center. All facilities will remain at their present locations.

More about the Missile Week on page 46.

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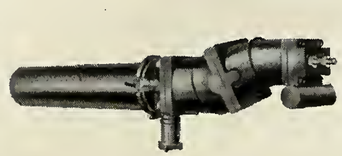
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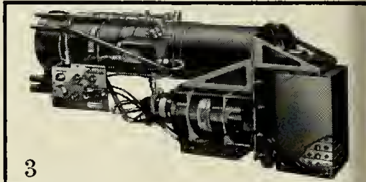
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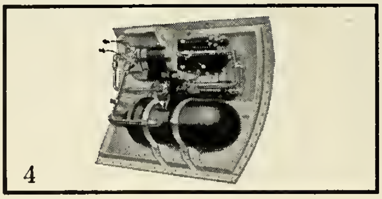
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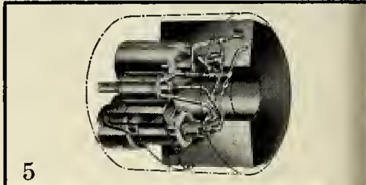
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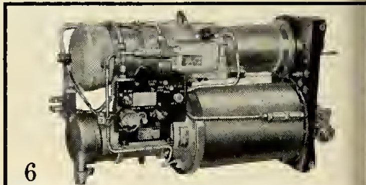
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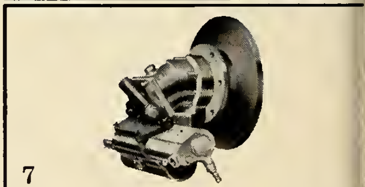
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Pitfalls of Missile Business Financing

Growth can be deadly. But here's where to get capital —while you still can!

An M/R Staff Report

WASHINGTON—Need money? Final-get that first really big contract only find you can't finance it? Short of ital for expansion, market develop-nt, new business, in-house R&D, ? Got backlogitis (symptom: ched bank account)?

In a word, are you suffering the ncial growing pains of a growth npany in a growth industry? If so, a money doctor—right away. erwise, lacking time to effect a e, you may end up being embalmed der the terms of the Federal Bank-tcy Act—for without a diet of bal-ed management and proper finan-l nourishment, growth can kill.

More and more companies in the iness are beginning to realize that hnological posers aren't the only daches plaguing missilery. There are ney problems, too, that can be every as tough as developing a leak-tight rine joint, a 283,000-psi solid rocket tor case, or a continuous space ver source rated at one kilowatt per ce of weight. What many compa-s don't know is that there is a good er's dozen or more of ways to ward these money troubles.

In 1950 the missile market came to mere $500 million. Today, if you lude missile, space and related sup-t procurement, it's nudging $9 bil-. For 1965, half a decade hence, n conservative estimates peg the al at $30 billion a year. It's one of most rapid growth patterns in peace-e history.

And with the growth of the indus-many companies are growing too—ne at a more rapid rate than they afford. Too many—particularly all businesses plunging headlong into business—find this out too late. en they lose an important contract, cause they can't finance it, and thus mage their reputation; are forced to rge with a larger, moneyed com-ny, with loss of identity and too en loss of the creative secret of their success; or, worst of all, are driven into bankruptcy.

The basic financial hazards of growth all add up to too little money to finance: expansion, current business (cost of materials and labor in servicing too big a backlog can be, and often has been fatal), new business, contract termination (other bad times), modernization, research and development, etc. And to these general hazards of growth must be added the numerous specific handicaps of current defense business policies. Here are just a few of these:

• **Tight competition** (sometimes from companies *buying* their way into the missile market) for advertised bid contracts, with resultant skinnier profit margins.

MANAGEMENT TRAPS

A. Poor Financial Planning
1. Inadequate Records
2. Cumulative Losses
3. Neglected Tax Payments
4. Expansion Beyond Resources
5. Excessive Fixed Costs

B. Poor Coordination Between Manufacturing and Selling
6. Lack of Product Development
7. Lack of Diversification
8. Lack of Data on Own Customers
9. Contracted Entire Output to Single Buyer
10. Lack of Market Research
11. Continued Policies of Bankrupt Predecessor
12. Legal Problems

C. Poor Other General Administration
13. Family Factors
14. Lack of Administrative Coordination
15. One-Man Management
16. Lack of Technical Knowledge
17. Absentee Management
18. Internal Conflict

• **Nature of CPFF contracts,** particularly in missilery, where often as not changes in requirements and technological modifications force the cost way, way up with no commensurate increase in the fee which, as the term says, is cost-plus-FIXED-fee. This reduces earning power of both working capital and equity investment.

• **Need to finance 20% of inventory** of certain cost-type contracts. This gets particularly worrisome during the shift from development to production phase when, again, change orders may pile up that inventory perilously high.

• **Contract termination,** sometimes with cancellation coming with the quick brutality of a telegram. This not only means loss of business, but you will have to finance termination costs until the red tape permits final payment.

• **High cost of much missile R & D,** where you may have the best technical qualifications in the world but, lacking evidence of financial ability, you lose the business.

• **Chances of losing the production contract** to someone else, after you made a profitless low bid on the R&D phase just to get into the program—figuring to make your money on the production run.

• **Obsolescence of a technology** in which you were leader, because of development of a newer, better method. Unless you've got the capital as well as the know-how to diversify or improve your own techniques, you're in trouble.

• **High materials costs** relative to processing costs, which could force you to give up a particularly lucrative piece of business. A recent example was a monstrously big, devilishly complex nozzle for a development rocket motor. Use of a so-called "exotic" metal pushed materials cost to over $400,000, compared to only $80,000 in processing costs—just for one nozzle. Business like this takes some heavy financing.

This usually happens because Washington doesn't want to upset its cash expenditure budget system—or, maybe, because (if you're a subcontractor) one of your best customers may be maneuvering for a merger and wanting to make his cash position look as good as possible.

• **Performance bond requirements** on some especially large contracts, such as engineering, manufacture and assembly of, say, a hypersonic wind tunnel—where the bond may run $500,000 or more.

• **Need to finance in-house R&D** if you're going to have any kind of favorable patent position. If developed under contract, patent rights usually belong to the government.

All these add up to increase the dangers of doing business in the missile market, and tend to make financial collapse, when and if it comes, all the more sudden. They also make it pretty obvious that defense business, in itself, does not always provide an easy route to expansion.

But for the company that looks to its financial future in time, there are many roads to relief. This is particularly true of smaller companies, due to Federal small business legislation. They range from going to the public with a stock issue, to a 100% government loan from the Small Business Administration.

Large companies face virtually the same financial problems as small companies—government limitations on earnings from defense business, renegotiation, taxes, hazards of CPFF contracts, etc., versus continuing and expanding needs for both equity and working capital.

Big company management, however, is usually well enough balanced between technological, administrative and financial know-how that it becomes aware of financial troubles at their onset. And, knowing of the impending danger, it is also aware of the various alternative solutions.

Small companies, however, are often built on the technological and/or sales abilities of one or two men who frequently don't recognize the impending danger until it's too late or, if they do, may be aware neither of the various solutions available to them nor of how to go about taking advantage of them.

• **Many sources**—There are many sources of money, both direct and indirect. Direct sources of capital break down between investment and borrowings. Indirect sources evolve from competent corporate management. Here are some of the direct sources open to both big and small companies:

• **Public stock issue**—Even if profit and loss and balance sheets seem to leave something to be desired, so long as you're in the missile business and not obviously bankrupt, your stock should be in good demand.

Look at the prices some missile stocks are bringing, and it's obvious that more often than not the public is buying on romance, rather than statistics. And the newer the "find," such as a missile stock on the market for the first time, the hotter the demand. By "missile company," we mean any company demonstrably connected with the business—not necessarily one of the big prime contractors. Some recent new issues have been over-subscribed tenfold or better.

Going to the public for money doesn't mean you have to give up control. You can usually keep control—and it doesn't require a majority interest. And of course there are many different kinds of stock—preferred without voting rights; common stocks that have a first call on dividends up to a certain point, with limited voting rights and which may be convertible to full voting shares; and many more. One currently successful money-raising technique is the issuing of subordinate debentures with stock warrants enabling holders to buy common stock at a favorable price. If you're interested in these possibilities, consult a recognized expert in the field.

• **Private investment**—This can be done by one of the big financial houses or an individual. Examples of the former are the Lehman Bros.-General Dynamics relationship, which has been very profitable for both, or the Johnston-Lemon-Atlantic Research relationship. This approach usually means participation in the management of your company by the investment house, but at least you'll get top financial advice—which may be just what the doctor ordered.

One problem missile companies may run into in going to, say, a Wall Street financial house, is that people there may not have a ready technical appreciation of just what it is your company is so good at. One financial consultant puts it this way: "You're trying to raise money for a bizarre and unestablished product on a whimsical money market." However, this problem is rapidly disappearing with the mounting business acceptability of missilery and space flight.

Two notable individuals in the business of picking up and backing "golden opportunities" are How Hughes and Laurance Rockefel What kind of deal you can make such an arrangement depends on individual, and individuals vary grea But odds are that one thing they have in common is a desire to fol their money with their control.

• **Long-term borrowings**—This can be from an insurance comp or, again, an individual. Banks are help, since long-term business lo aren't bankable. Long-term lo usually mean issuing first mortg bonds, general mortgage bonds (b of which must be more or less secu or debentures, which are little m than interest-bearing promises to p Usually it's tough for a small co pany to raise capital this way, un it can present a really convincing p ture of good management and g prospects.

In any case, make certain you d borrow so much at such an inte rate (on bonds now running ab 5%) that you eat up the meager pr allowance (7-14%) permitted on g ernment business.

• **"V" loans**—These are prima working capital loans whereby the m tary services (and certain other g ernment agencies) with ultimate sponsibility for your defense contr will guarantee up to 90% (excepti up to 100%) of a bank loan amounts limited by an "asset formu but not to exceed 90% of the "b rower's investment in defense prod tion operations."

Maturity dates are set to "conf reasonably to the borrower's financ requirements for defense product contracts on hand at the time of guarantee."

These are available to both la and small business and to both pri and subcontractors. What you're do must be essential to the national fense. The responsible military serv the local Federal Reserve Bank and bank that's going to actually loan the money all participate in appro first, of a certificate of eligibility, a second, of the actual guarantee.

One real advantage of this syst is that it can be arranged as a volving account—moving up or do with your volume of defense busin

• **State and local developmen** These are privately-owned corpor entities set up in states and local co munities for the double purpose bringing new business to the area a fostering the growth of companies ready there.

These are eligible for long-te loans from SBA up to the amount their borrowings from other sour This money they can use, in turn, provide equity capital and long-te ns to small business. However, un- their charters they can also help business in other ways—provision low-rent plant space, for example. re are over 2000 such development npanies in the U.S.

• **Agreements with larger firms**—e the larger company supplies both king capital and back-up produc- capacity. You may ask: But why uld a big company make such an eement? Why don't they go out and the business themselves?

The answer will usually be: Be- se they can't. They don't know their around the missile business yet don't have a technical familiarity n its problems and requirements. ur company, on the other hand, may e an intimate knowledge of all these ıgs. If so, you probably pass up e sales opportunities than you go r—because you haven't the physical nt and cold cash. So, you trade iness and know-how for cash and acity.

It's a good deal—if it works. But will work out over a profitable pe- l of time only if there's a rare meet- of minds and temperaments. Real- also that the larger company may k with you only long enough to the necessary know-how and then ll of a sudden he's no longer bene- or, but competitor.

Nevertheless, it may give you the athing spell you need. Should you er into such an arrangement, be pared to demonstrate both joint individual responsibility to your tomers.

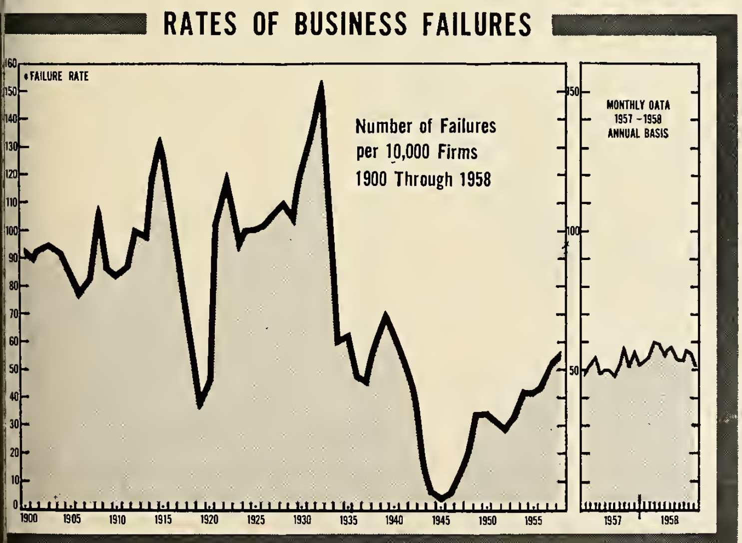
• **Special financial aids**—The gov- ment usually defines a small manu- uring business as a company with 250 employes or less, but with numerous exceptions up to 1000. Small services companies are those that gross $5 million or less—again with some exceptions. As a result of various acts of Congress there are now a number of special financial aids to small business—nearly all administered directly or indirectly through the Small Business Administration. Here are some of the aids it offers:

• **Participating loans**—In this case SBA goes in with a bank in loaning you long-term money (up to 10 years at 5½% interest) for working capital, expansion, research and development, modernization, consolidation of accounts payable, etc. In these SBA will supply up to 90% of the joint loan, up to $350,000 as its share.

• **Direct loans**—In this case, SBA supplies all the money. Maximum maturity is still 10 years; interest, 5½%. The top limit of an SBA direct loan is also $350,000. Actually just over three-quarters of the loan applications coming into SBA are for amounts under $50,000. During the July-December, 1958, period, 262 loans over $100,000 were approved, including 21 over $250,000.

However, few were missile companies. In March, of over 1000 loan applications coming into SBA, fewer than 10 could even be remotely connected with the missiles and space flight effort. Of this situation, SBA says:

"With exceptions, it is the opinion of the study team that the prime contractors were not familiar with SBA nor have they sought the assistance of SBA."



1958, there were 56 failures per 10,000 firms compared with 52 in 1957, but the of failures was 55 in the second half compared to 57 in the first half of 1958.

For an idea of how small business in general avails itself of SBA's loans, in the last six months of calendar 1958, 34.2% of the approved business loans were for working capital; 19.2% for facilities; 36.7% for consolidating obligations, and 9.9% for equipment.

Kinds of companies to whom loans go include: chemicals and allied products, fabricated metal products, machinery, electrical machinery, etc., as well as a wide variety of wholesaling, retailing and servicing companies.

• **Equity capital investment**—This is possible by one of the new Small Business Investment Corporations authorized last year by Congress and just now being set up. Seven have been established. Sixty applications are pending, of which 30 have tentative approval. Albeit indirectly, this puts government into equity financing for the first time.

SBIC's are authorized to supply equity capital in return for common stock not exceeding 20% of the SBIC's own capitalization, or to make loans in return for debentures that may be later convertible into common stock at the sound book value as of the day of the loan. SIBC's also make long-term loans secured against assets. On some of the money it lends, an SBIC may get between 8 and 12% interest—which may or may not be any bargain, depending on your need.

To be eligible for help from an SBIC, a company must be privately owned; not dominant in its field; not have over $5 million total assets; and must not have had annual earnings after taxes in the past three years in excess of $150,000. If its stock is traded or it has had a public stock issue of $50,000 or more, the company is not eligible.

Exceptions to all these regulations are possible through application to SBA, which has close control over the SBIC's due to the fact that (a) it licenses them, and (b), it puts up part of their capital.

To get this kind of aid, no change in Securities & Exchange Commission registration is needed, and you must buy stock in the SIBC up to 2% of the loan or $50,000, whichever is less. The investment company will not acquire control of your company unless your management turns out to be inadequate or its investment is jeopardized.

• **Dollars not answer**—For all these many ways to raise money, dollars alone won't assure a healthy maturity for the growth company. If its management isn't good, more money only means a more expensive funeral—if not today, then tomorrow.

Up to a point, sound management

(Continued on page 47)

Solid Rockets in Space: Where Do We Go?

Bright future seen for deep space probes where more than a simple ballistic trajectory is needed for exact astronavigation

by Paul Means

WASHINGTON—A strong argument for the suitability of solid rockets for space missions—even with the advent of some of the more exotic propulsion systems—has been made by Ben F. Wilkes, an applications engineer with Astrodyne. Speaking before the national aeronautical meeting of the Society of Automotive Engineers in New York, Wilkes said the basic advantage of solids in space work is their reliability, and the fact that solid propellants and motors can be designed to handle specific jobs during the various phases of a space vehicle's flight.

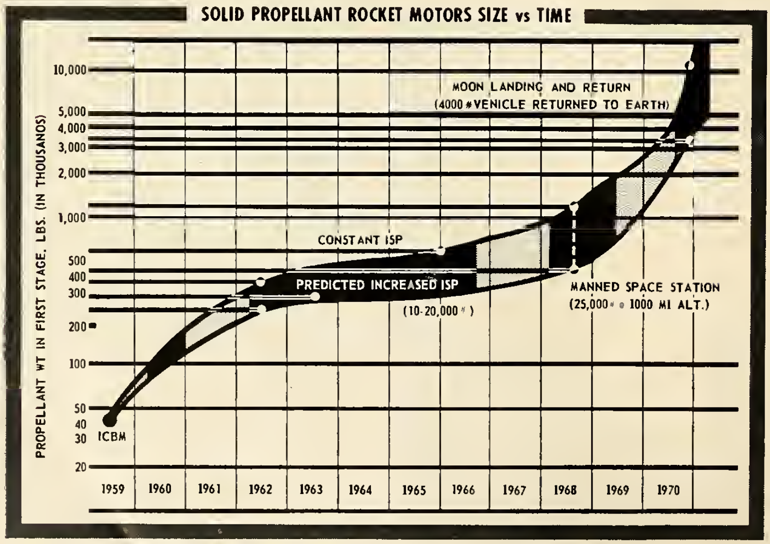
Whether solids will be used as a primary propulsion system in space vehicles 10 years hence depends on many undeterminable factors, principally on the relative progress made by other types of rocket motors. If ion, fusion, plasma, or nuclear rockets approach operational status within this period, they could be used for the upper stages, and conceivably for the boosters. Without them, rocket makers will have to rely on the more advanced liquid and solid chemical rockets.

Along with development of other propulsion systems, Wilkes believes following factors will help decide fate of solids as a prime propellant space vehicles:

- The upsetting of the space roc development timetable due to spe problems not now known—such as unexpected radiation levels encoun ed by the *Explorer* satellites.
- Changes in national and in national politics (and space resea budgets) which could accelerate slow down developments.
- Changes in military objectives plans versus, or in conjunction w commercial uses which could a types of propulsion systems to be u as well as time scales.
- **Upping energy**—As a space hicle launcher, solid propellants h the disadvantage of being at the end of the energy spectrum of prim energy sources (see table). Some provement can be expected. Wilkes lieves, in the ability to convert a sol reaction energy to kinetic energy

He is supported in this conclu by H. W. Ritchey, vice president the Thiokol Chemical Corp. In article in the House Astronautics Space Committee's staff report on *Next Ten Years in Space,* Ritc stated: "Although a 1 million-pou thrust liquid combuster may be fe ble, solid engines developing thr 10 to 100 times this figure present c straightforward engineering proble

- **Strong points**—Solids also n be considered as space vehicle laur ers, Wilkes feels, because of their liability, simplicity, quick response start, and the ease with which they be staged. Using five or six solid st



VERSATILE SOLIDS for space vehicles can grow in the next decade. Top curve assumes no change in available energy; bottom assumes increase.

d a space vehicle launcher, he re-
ds, allows increases in the payload
vh less going to gross load.

The other advantage in using a nti-stage solid space vehicle launch-r according to Wilkes, is that "if the rational and environmental require-nts for these motors are carefully csidered beforehand and one motor s ot expected to be everything, then rpellants and motors will be found handle specific jobs. For example, notor that is to operate in space hld not be required to meet the ae handling and storage require-nts that an everyday rocket motor o artillery use must meet."

The various stages, Wilkes believes, cld be designed to optimize perform-ie, i.e., "propellants with different and burning characteristics, propel-a weight ratios, nozzle designs, tmber pressures, throat area ratios, t"

Low motor weights could be util-z in the final launching stages, after h rocket has reached an altitude vre there are near-zero drag losses, eause the vehicle at that point could eaccelerated to theoretical maximum ecity independent of thrust.

Problems yet to be solved before cds become effective space vehicle aichers, Wilkes believes, are those of cieving close dimensional and weight orances of hardware and propellant rge, and possible close tolerances fballistic parameters and thrust ter-nation.

• **For moon trips**—An area in vch solids have an advantage over h greater-specific-impulse liquid pro-ants is in proposed manned, unpow-ed, round trips to the moon. High jection velocity, Wilkes points out, vld not allow the space vehicle to the moon's field as a source of sub-tial trajectory shaping. The idea is keep initial velocity low so that the powered vehicle will travel behind h moon and then be deflected around c its return trip to earth.

Low projection velocity, and its eilting increase in payload, would l be advantageous for missions need-n great increases in payload weight, h as missions requiring the expendi-e of large amounts of electrical rgy in flight, or manned flights vre the demands of nutrition and a ble environment increase with flight ation.

Low projection velocity solid rock-t would also give the "marked sensitivity of flight duration to small errors in this velocity," Wilkes asserts. The close scheduling needed for an unpowered flight into deep space and return to earth would "require very close control of projection velocity simply to prevent variation in flight time," and solid motors could be used "to give the minute corrections."

One area in which solids may have a promising future, according to Wilkes, is in deep space probes to planets or space stations where more than a simple ballistic trajectory is needed to allow the space vehicle to arrive at the exact point in space at the exact point in time.

• **Disturbing forces**—Besides the minute exactness of burnout velocity and position necessary for a space vehicle to start on its way into space, Wilkes lists 16 forces at work in the universe for which the rocket will need counteraction or thrust correction.

These are:

(a) The last-minute aerodynamic forces escaping from any atmosphere;

(b) Errors in burnout velocity and position of the vehicle—any residual propellant or unnecessary weight could affect the whole trajectory;

(c) The geomagnetic field of the earth, sun, planets, asteroids, etc.;

(d) Electrical forces, both known and unknown, and even the magnetic fields generated by induced currents in conducting parts of the vehicle itself;

(e) Radiation forces from the sun;

(f) Cosmic rays;

(g) Radio noise from the sun and other space objects;

(h) Temperature changes;

(i) Meteor impacts;

(j & k) Einstein Mechanics and Newton's Laws—will they hold true in space?

(l & m) Navigating in space, and the refraction and abberation of the instruments used for navigation;

(n) Bulge perturbations in the gravitational forces in the planets, sun, etc., and their effects on the space vehicle;

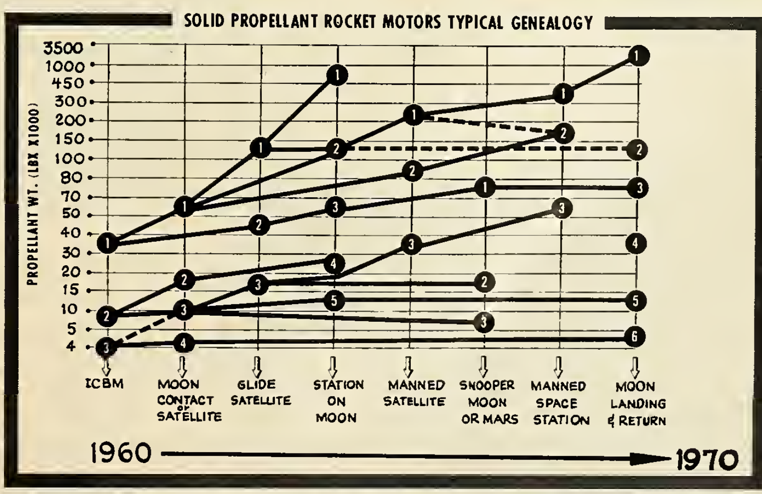
(o) Errors in earthly calculations and observations of mass and gravity of space vehicles;

(p) And the motions of the internal masses of the space vehicle.

Thrust correction and counteractions by solid-propellant rockets, Wilkes believes, could compensate for, and even eliminate, the effect of some of the forces. Others, he believes, could even be used to stabilize and orient the vehicle. Other forces, such as the effect of radio noises on guidance control from earth, would need man in the vehicle itself to correct.

• **Mars and back**—Wilkes describes how simple, reliable, solid-propellant rocket motors could provide the necessary guidance control for a space vehicle travelling from earth to Mars and back:

After arriving at an earth satellite space station, the vehicle would then make 377 revolutions about the earth until it arrived at the point where its



HERE'S HOW solids will grow in size and number of stages during the next 10 years of rocketry advancement in space exploration.

total energy would be equal to that of a body falling to infinity from that point.

Shortly after this point is reached, after 108 days of flight, the trajectory would start its hyperbolic path as the vehicle accelerated.

The problem now is to put the vehicle into a trajectory which will allow it to a-rive at Mars. If thrust is shut off before reaching the escape point from the earth's pull, the rocket would continue its eliptical orbit around the earth. If thrust is shut off after the escape point is reached, the rocket would go into orbit around the sun.

But by cutting off thrust slowly, the rocket's trajectory can be changed from a spiral to a circular one. As soon as the correct position is reached, thrust is switched on and the vehicle continues on a spiral path about the sun towards Mars.

The advantage of using solid rockets for thrust corrections during heliocentric departure, according to Wilkes, is to counteract the possible errors due to (1) technical cutoff errors in the escape hyperbola; (2) uncertainty in knowledge of the combined mass of Earth-Moon-Sun System; and (3) the uncertainty with which the mean Sun-Earth distance is known, which is detrimental to the accuracy of the transfer orbit because of its sensitivity to inaccuracies in tangential velocity.

• **Bending trajectory**—Guidance, which could be provided by small solid rockets motors, is needed during mid-course, and at the end of 194 days of flight, when thrust direction is reversed 180 degrees and the rocket decelerates.

Solid-Propellant Rocket Motors
Typical Advanced Propulsion Sys. Family

Series	Type	Wt. Pr plnt. Lbs	Thrust Lbs.	Dia. In.	Length Feet	Duration Sec.	Isp Lb. Sec./Sec.	'ropel'ant Fraction
1	General Application	4K-10K	10K-100K	38-54	4-13	40-90	> 225	>.89
2	Single Unit Lg. Total Impulse	120K 200K	500K 4500K	72-96	20 60	10-90	> 245	>.90
3	(1) Clustered Series I or 2	100K '000K	'000K 5000K	(1)	(1)	10 90	> 245	>.90
4	Specialized Hi Perfmce Might Be Used For Series I or 2	.1K 10K	2K 50K	10 48	2 10	6 60	> 255	>.90
5	Accessory Power	0 < 1K	.5 50	Small	Short	2 Sec. 3 Hrs.	100 to > 245	High

NOTES:
Reliability desired = 100%.
Operating temperatures always reaching for greater spans = <—65 to > 160°F.

FIVE DIFFERENT families of solids could handle most of a space vehicle's prop sion needs. Ultimately envisioned is 4.5 million pounds of thrust.

After 275 days, thrust is again reversed and the ensuing acceleration bends the trajectory toward the Martian ellipse. Wilkes estimates that correction impulses of only 200 to 400 fps will be sufficient to generate encounter distances of about 10,000 nautical miles.

Correction thrust is used again if the vehicle heads for the Martian ellipse too early or too late. If too early, according to Wilkes, it directs thrust first rearward then slowly toward the sun to compensate for the sun's attractive force. If it arrives too late, it reverses this process.

Solid rockets could also be used on the final approach, when the rocket needs some thrust to force it closer to Mars, and some side thrust to create a spiral so that it will not fall straig into Mars. The solids also would ideal as the retros and/or vernie which decelerate the rocket into circular orbit around Mars.

An analysis of this projected t to Mars, according to Wilkes, "ad up to the need for guidance contr Simple, reliable, solid-propellant roc motors used all along the way w make sure the desired terminal or is reached . . ."

• **Solid versatility**—Wilkes adm that liquid propellants probably will ways be ahead of solids in the ava able propellant energy or specific i pulse, and that for this reason liqu will probably be the primary prop lant used for a large space vehi booster's first stage. But because their instant readiness and reliabili he thinks that solids will be used m and more for the rest of the stag And their great advantage is that th can be used in all areas of space flig

The accompanying tables indic how solid rocket motors will grow d ing the next decade to propel some the space vehicles now in the pl ning stage. Still to be overcome large solid rocket engine design are problems of making the propellant tain its shape and reliability throu out burning.

Wilkes forsees solid rocket mot developed up to a scale where th would be 200,000 lbs. in weight, 500,000 lbs. in thrust, 60 ft. in leng 96 inches in diameter, 90 seconds duration, and a .90 propellant (to to weight) fraction.

Clustering rockets of this size, smaller ones, according to Wilkes, go on ad infinitum, until structu material can't withstand the strain

Solid-Propellant Rocket Motors
Place In Energy Spectrum

Energy Source	Theor. Max. Isp Lbs. Sec./Lb.	Relative Energy Release (Ergs./Gm.)	Fraction of Annihilation Energy
1. Chem. (Solid or Liquid) 2. Suoer Chemical ($H_2 + O_2$)	225 to 300 364	1.0×10^{10} 1.3×10^{11}	1.1×10^{-11} 1.5×10^{-10}
Free Radical 3. Chemical ($H + H \rightarrow H_2$)	2140	2.2×10^{12}	2.5×10^{-9}
Nuclear 4. Fission	200 to 1×10^6	7.1×10^{17}	8×10^{-4}
5. Thermonuclear	5×10^5 — 3×10^6	3.6×10^{18}	4×10^{-3}
Matter 6. Annihilation	∞	9×10^{20}	1.0
7. Solar	1000 to 3×10^7	3.3×10^2 Calories/Sq. Cm./Sec.	

INDICATION OF low energy of solids compared to other primary energy sources. However, this can be overcome by staging and clustering.

...NEWS IS HAPPENING AT NORTHROP

Now being produced and delivered to the U.S. Army Signal Corps, the Radioplane SD-1 gives greater battlefield surveillance flexibility to combat units than ever before. (This photo of terrain was actually taken from an SD-1 at 1,000 feet.)

RADIOPLANE PRODUCES FIRST COMBAT-READY SURVEILLANCE DRONE

Meeting tough Army Signal Corps requirements and being produced in operational quantities, the SD-1 is proved and ready to fly unmanned photo reconnaissance missions for tactical troops.

Highly mobile, the camera-carrying SD-1 may be zero-length launched in rough terrain from a camouflaged position. It is flown by remote control over enemy installations on surveillance missions without risking a pilot's life or man-carrying aircraft. Within minutes after the SD-1 returns from its mission, photographs are delivered to the requesting unit.

Other specialized sensory equipment may be carried by the SD-1 depending on particular mission requirements.

This Army-Radioplane achievement exemplifies Radioplane teamwork with all of the U.S. Armed Forces. Radioplane provides a complete drone family spanning medium speeds through supersonic performances.

RADIOPLANE

Van Nuys, California, and El Paso, Texa
A Division of
NORTHROP CORPORATION

What's the future for electronics in GSE?

Electronic Output to Double by 1965

by William E. Howard

WASHINGTON—Plotted on a graph, fortunes of the Nation's electronic ustry resemble the upward arc of ICBM's trajectory. For the next ade the outlook is for the industry keep on expanding at an even dizzier e.

Propelling the industry on its head-g flight are demands to produce re and more complex missile systems d in with a growing and extremely ricate "decision-making" alarm net-rk to give the U.S. a capability for tant response to Soviet attack.

And as missiles become operational, industry is being pressed to manu-ture in greater and greater quanti-s the equipment to back them up on ground. Seventy-five percent of *an's* guidance and control system is the ground; *Minuteman's* is ex-ted to be in a 90-10 ratio.

Taking a looking into the future week, Electronic Industries Asso-tion President David R. Hull told R that the Nation's electronic out-must double by 1965. This will an at least 50% increase in existing nt capacity, he said.

He sees the government spending otal of $30 billion on missiles be-een now and 1965—with more than f that amount going into missile ctronics.

The EIA estimates for the elec-nic share of the missile budget for 1960 fiscal year is $2 billion. This more than half of the $3.922 billion al EIA expects the armed forces spend on missiles.

For the period through 1970, the ociation says "a total of over $100 lion" will be available for electronics penditures from this source alone. y the end of the period," it adds, -25% of the defense dollar will be marked for electronics."

• **Space funding**—General increases procurement by the government for ctronic equipment, for commercial ation and space activities are also pected to boost the industry's output. A believes ARPA's appropriations will fall off from $455 million in 1959 to about $170 million in 1964. But, says the association:

"NASA will probably finish fiscal 1959 with authorizations of about half a billion dollars, and will triple this by 1964. By 1970 space programs are expected to be operating at a level over $3 billion.

"FAA (Federal Aviation Agency) is expected to nearly double its 1959 fund level, reaching $1.2 billion by 1964. Increasing air activity will maintain this trend. By 1970 authorizations may exceed $2 billion."

EIA experts are inclined to discount suggestions that the defense budget will be enlarged abruptly by Congress short of an emergency. The current defense budget of close to $41 billion, they point out, along with the non-defense budget of about $36 billion is already pushing Federal credits to the limit.

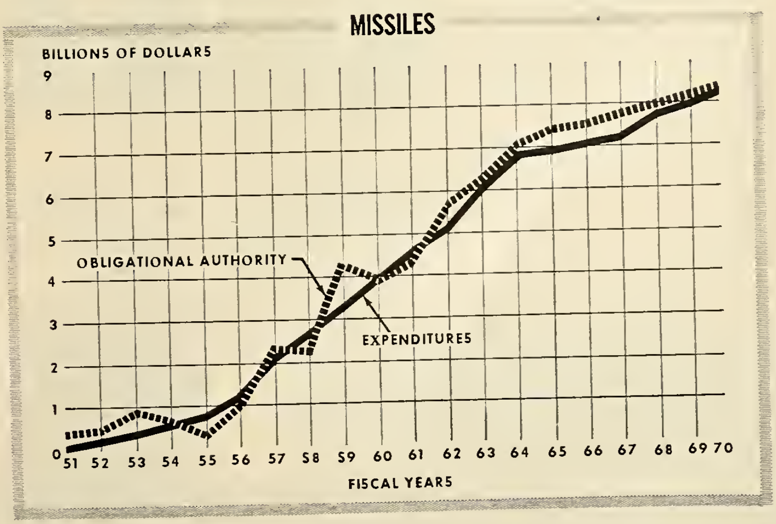
Accordingly, these experts believe actual defense spending will rise slowly over the next 10 years—in step with the gross national product—to a top of about $57 billion.

• **Ready to grow**—Individual electronic companies, Hull says, already are planning ways of coping with the expected expansion. He said a number have considerable reserve facilities and the government has some backup plants.

Third of a series on Missile Support

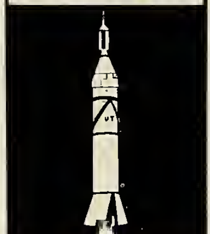
Estimated DOD Authorizations For Electronics
(Fiscal Years in Billions of Dollars)

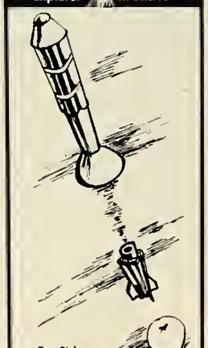
	59	60	61	62	63	64	65	66	67	68	69	70
Operations & Maintenance												
Dollars Authorized	9.4	9.6	9.8	10.0	10.3	10.6	10.9	11.1	11.3	11.5	11.8	12.1
Percent for Electronics	9	9	10.5	11	11.5	12	12	12	13	14	15	16.
Dollars for Electronics	.85	.86	1.03	1.10	1.18	1.27	1.31	1.33	1.47	1.61	1.77	1.94
Major Production & Procurement												
Dollars Authorized	14.3	15.3	16.0	16.7	17.8	18.2	18.7	19.2	19.7	20.0	20.3	20.6
Percent for Electronics	29	30	31	32	32.7	33.2	33.8	34.5	35.0	35.8	36.4	37
Dollars for Electronics	4.15	4.59	4.96	5.34	5.82	5.86	6.32	6.62	6.90	7.16	7.39	7.62
Research & Development												
Dollars Authorized	2.6	2.7	2.8	3.0	3.8	4.6	5.4	5.9	6.2	6.5	7.0	7.5
Percent for Electronics	19	21	24	27	29	31	32	33	34	35	36	37
Dollars for Electronics	.49	.56	.67	.81	1.10	1.43	1.73	1.95	2.11	2.28	2.52	2.78
TOTAL DOLLARS FOR ELECTRONICS IN ABOVE CLASSES	5.49	6.02	6.66	7.25	8.11	8.56	9.36	9.90	10.48	11.05	11.68	12.34



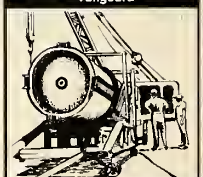

Mercury


The Dart


Explorer III and IV


Far Side


Vanguard


Nike-Zeus


Test Sled

Most firms presently are operatin one shift and a step-up to two and thr shifts a day alone might boost outp by over 100%. However, Hull sai training personnel looms as a maj problem and it has been industry experience that second and third shi operations are not as effective produ tionwise as the primary day shift.

To finance required additional fa cilities, Hull said the industry woul be able to lay out the capital for bric and mortar, but "we may have to ca on the government for special toolin and test facilities."

Hull feels any future expansio will follow the present pattern. Ne companies will be formed by "breal off" of personnel. "They will mer and re-amalgamate."

"There are amazingly few failures said Hull, pointing out that most ne companies are founded on know-ho in a specialized area of electronic He said he does not anticipate ar "radical expansion in any one area; a vancement of tubes and semi-co ductors probably will be balanced."

• **Ratio climbing**—The electron industry currently is devoting 52% its energies to military requirement In 1958 this translated into facto sales of $4.1 billion for military pro ucts and $3.8 billion in industrial a consumer goods.

Increasing demands from the mi tary, EIA believes, will shift the rat to 60-40 by 1965, with missiles a counting for most of the difference.

Pentagon procurement officials s their figures bear out the fact that ele tronics companies are getting a bigg and bigger share of the defense budg dollar. At present, 11 cents of eve DOD dollar is spent on some electron component or service, and out of eve "hard goods" dollar, 28 to 29 cen goes into electronic equipment.

In addition to missiles, this expen ture covers everything from walki talkie to wholly-transistorized compu ers for SAGE supercombat centers a giant radar dishes for BMEWS.

The actual number of componen produced by the industry for miss systems alone is staggering. It runs in the hundreds of thousands—from 35 ton *Talos* fire control systems to mini ture components so small that 600,0 may be crammed into a density of o cubic foot.

• **Challenges**—Hand in hand wi the exploding technology and expa sion of the industry is the creation new opportunities in both the milita and civilian markets. Missiles offer t greatest challenge.

Right now Hull says there is a ne for the industry to come up wi smaller, more complex and more re able test devices for system checko

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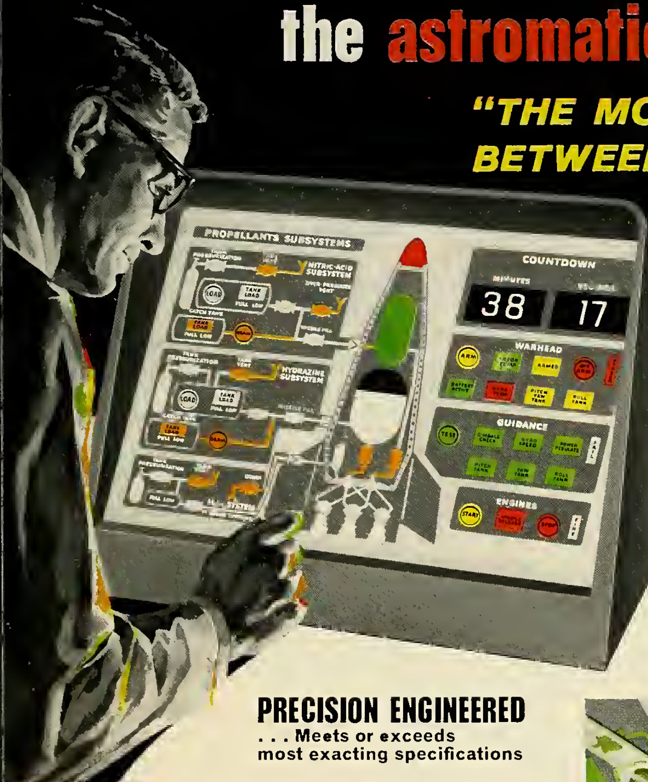

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GE Offers New Micro-Modular Concept

Company claims eraser-size device named TIMM utilizes heat losses and lends itself to stacking for varied uses

PHILADELPHIA—A different concept of building several radio tubes and their circuits in one tiny, ceramic, stacked module for space electronics has been announced by General Electric Research Laboratory.

The laboratory has produced new devices called TIMM's, for "thermionic integrated micromodules." Instead of trying to eliminate the heat in tightly-packed electronic equipment, GE scientists have confined this heat and put it to work operating vacuum devices.

A complete circuit, such as an amplifier or multivibrator, occupies a space no larger than that of a pencil eraser, said GE. Operating at nearly red-hot temperatures, it takes full advantage of the high-frequency and reliability features of thermionic electron tubes.

• **New twists**—The design and operation approach embodied in TIMM's differs chiefly from other micro-modular concepts in that (1) tiny heaterless electron tubes are used instead of transistors, and (2) auxiliary cooling is reduced or eliminated and the heat losses generated within an equipment are utilized.

This serves the purpose of increasing the overall efficiency of operation and contributes to the extended life and reliability of the equipment. The TIMM's can be stacked, like building blocks, to provide a variety of electron circuit functions.

Resistors built into the ceramic modules consist of a resistive film on the inside of evacuated and sealed ceramic insulators. Laboratory reports indicate resistances of 5K per square are possible, and resistors made in this fashion of from 1 ohm to 500K have operated stably at 700°C.

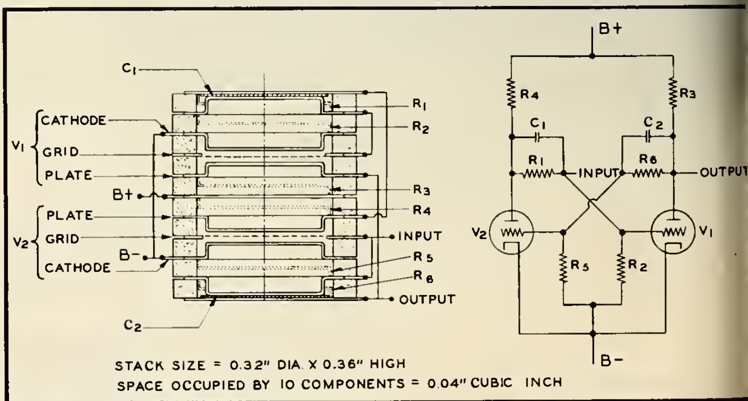
The preliminary data have shown changes of less than 3% in resistance in an operating temperature of 550°C, and similar stability in operation within a nuclear pile.

Built-in microminiature capacitors, with synthetic mica as the dielectric, in operation have shown a change of less than 5% over a temperature variation ranging from zero to 700°C.

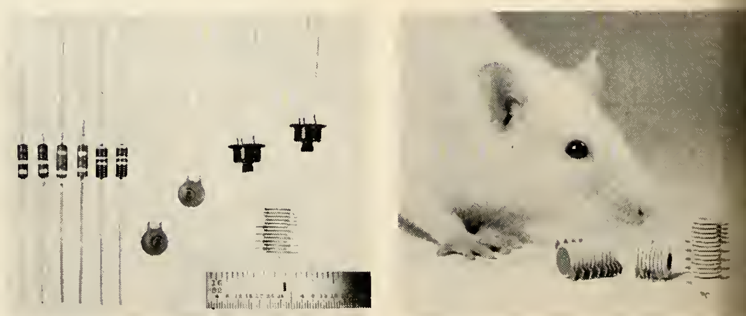
The heaterless electron tubes built into the stacks have a self-biasing characteristic—no grid current flows until the grid is at least two volts positive with respect to the cathode—thus eliminating the necessity for an external bias battery or a cathode-bias resistor and capacitor.

• **Component density**—A typic[al] circuit module 1/3 inch in diamete[r] and 2.6 inches in length can contain 1[?] diodes, 14 triodes, 14 resistors, and [?] capacitors. This total of 44 compo[-] nents yields an operating circuit den[-] sity of 250,000 components per cubi[c] foot. With different operating require[-] ments, densities of 1,000,000 compo[-] nents per cubic foot are possible, sai[d] the company.

A circuit function capable of 1[0] megacycle operation, selected as a[...]



CROSS-SECTION and schematic diagram of a typical GE TIMM.



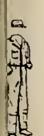
TINY CERAMIC micromodule (just above rule in photo at left and investigated b[y] mouse at right) is less than 1/3 inch in diameter, can be stacked several inches. [It] comprises equivalent of conventional units shown in the left-hand photo.

suit-ability

ROM PHILOSOPHY — TO FEASIBILITY STUDY — TO DESIGN AND PRODUCTION

GENERAL ELECTRIC'S GROUND-BASED GUIDANCE SYSTEM FOR THE ATLAS MISSILE REQUIRED A COMPLETE MAINTENANCE TRAINING METHOD FOR MILITARY PERSONNEL WHO WOULD BE ENTRUSTED WITH THE UPKEEP OF THIS MODERN WEAPON.

ERCO WAS SELECTED FOR THIS CRITICAL TASK.



ERCO TRAINING . . . TO FILL THE SUITS . . . TO SERVICE THE WEAPON

The requirements imposed by this intricote electronic problem were satisfied through unusuolly close engineering lioison, with appreciable economy and compressed schedules.

ERCO

NUCLEAR PRODUCTS — ERCO, DIVISION OF acf INDUSTRIES, INC., RIVERDALE, MARYLAND

AMERICAN CAR AND FOUNDRY • AVION • CARTER CARBURETOR • SHIPPERS CAR LINE • W-K-M example only, includes a pair of tripl input "and" gates, a bistable mult vibrator, and dual cathode follower ou puts. It contains 30 parts and repr sents a circuit density of 250,000 con ponents per cubic foot.

The circuit generates its own ope ating ambient temperature of 580 and requires less than ¾ of a watt c power from an external source. A con parable epoxy-encapsulated semicor ductor version of the same circuit, ca pable of 5-mc operation and built b present methods, would contain 3 parts and with a circuit density of onl 33,000 components per cubic foo would be limited in operation to a ten perature range of minus 55 to plu 71°C.

• **Advantages**—GE believes th ceramic micro-modules make possibl circuits which are smaller, lighter an generally require fewer component than their conventional encapsulate semiconductor counterparts.

Also, they seem to offer fewer ten perature problems, higher reliability longer life, greater ruggedness, resist ance to nuclear radiation and highe operating speeds without sacrificing th signal power levels of their printe board or encapsulated predecessors.

In systems applications, their com pactness should lead to improved elec trical performance and greater eff ciency through the useful applicatio of circuit power dissipation, said company spokesman. It also tends t reduce both weight and volume in sys tems where elevated temperature am bients are encountered.

The GE Receiving Tube Dept. i Owensboro, Ky., has announced that i already is planning the necessary ap plied research, development and pro duction engineering procedures t make the devices, and engineering sam ples could be developed in a relativel short time. Production in quantity ma be possible after another year, depend ing on the requirements of particula applications.

NCR to Research Photochromic Memory

HAWTHORNE, CALIF.—A one-yea $90,000 contract from the Wright Ai Development Center Aeronautical Re search Laboratory for photochromi memory research has been awarded t the National Cash Register Company Electronics Division.

Photochromic memory technique and devices leading to possible futur application in an ultra-high-densit memory will be investigated theoretic ally and experimentally.

Studies will be based on the encap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sulation technique developed by N research laboratories in Dayton, Ol in which a light-sensitive liquid dye stored in a gelatin capsule only millionths of a meter in diameter. cause the fluid has the necessary stable states for switching, the mic scopic chemical memory cell can st or give up information instantaneou in response to a beam of light. small size of the cells points computer memories of unpreceden density for airborne and spacebo applications, said NCR. It is belie possible to coat a square inch of with 1,000,000 of the capsules.

Eventual application of the resea findings will be in automatic cen control and data systems for high-a tude vehicles. The immediate goal is obtain all necessary data for a deta preliminary design of a feasibi model having optimum photochro memory. The program will be c cerned with simplicity of design, creased reliability, minimum rand access time, high storage density, weight, low power consumption, sensitivity to severe environmental c ditions, and low cost.

Unit Cools IR Gear to As Low As 60° K

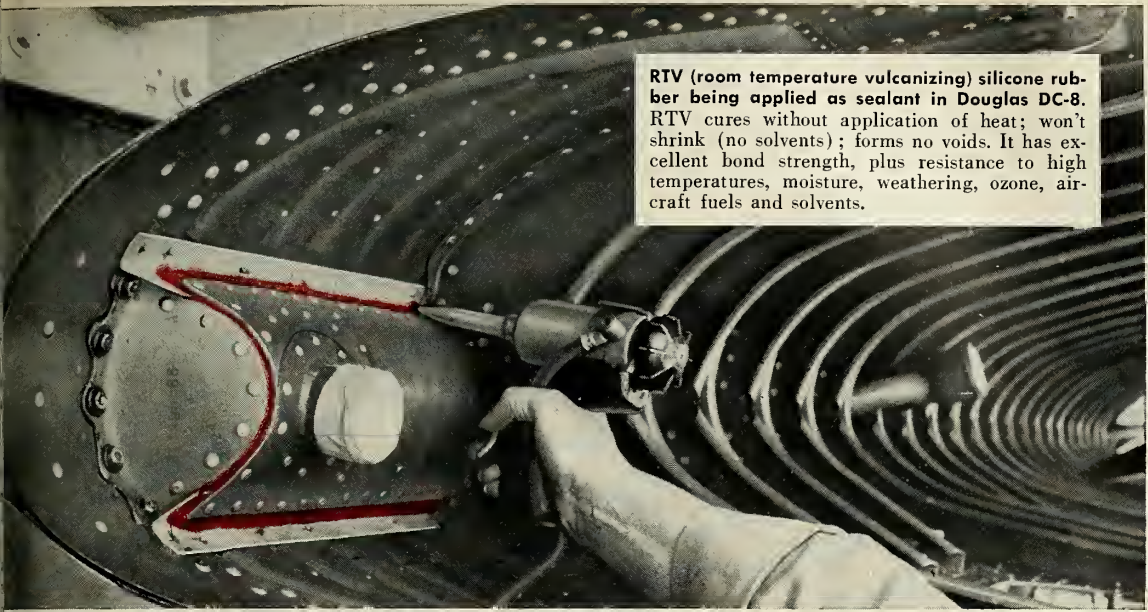
CAMBRIDGE, MASS.—A tiny coo device which super-chills infrared tection (IR) equipment to 60°K b new refrigerating technique has b developed by Arthur D. Little, I Cambridge research and enginee company.

The 8-ounce unit is the result the company's two-year research ject into extreme low-tempera equipment. Known as the min cooler, it will be shown at the Natio Missile Industry Conference (May 28) in Washington.

Believed to be suitable for airb operation in missiles or airplanes, current closed-cycle IR detection tem is designed to weigh less than pounds. Further development with new device is expected to reduce weight to less than 10 pounds, ADL.

In operation, helium gas exp from 300 psi in a ¼-inch-diam cylinder, 2 inches long. A tiny pl piston is the only moving part b room temperature. The cold end of tube refrigerates an IR cell to 6(

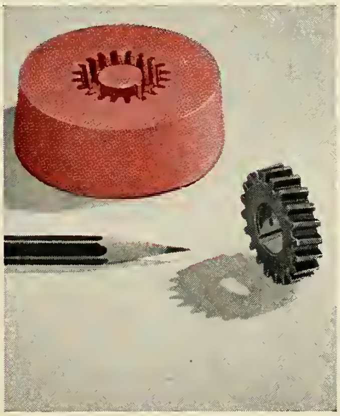
Cooling IR detectors to extre low temperatures increases their s tivity and makes them responsive a wider range of wavelengths. makes it possible to detect small ra tion differences between the "tar and its background.



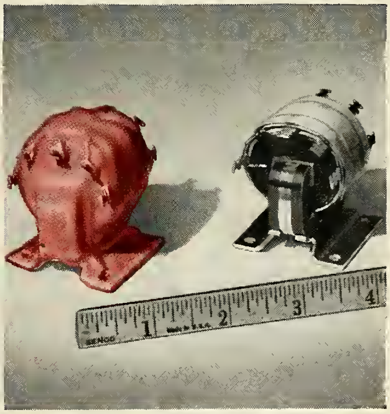
RTV (room temperature vulcanizing) silicone rubber being applied as sealant in Douglas DC-8. RTV cures without application of heat; won't shrink (no solvents); forms no voids. It has excellent bond strength, plus resistance to high temperatures, moisture, weathering, ozone, aircraft fuels and solvents.

G-E RTV silicone rubber—a superior material for tooling, encapsulating and sealing

rototype jet engine nose cone (right) cast n RTV mold. Epoxy parts cast in flexible TV molds have a bright, glossy surface and eproduce extremely fine detail. No parting gent is required for even the most complex arts. High tensile and tear strength is reained even after prolonged heat aging.



Close-tolerance, non-standard helix gear cast complete in low-cost, one-piece RTV mold. Previously such replacement parts had to be machined by hand. Now they can be quickly and inexpensively replaced by using the broken part as a master.



Potting and encapsulating of electrical components, such as this aircraft transformer, are easy with RTV. It can be poured, sprayed, painted or applied by dipping. Temperature resistant from −60°F to +600°F; excellent resistance to high altitude arc-over and corona. Comes in wide viscosity range.

For application data and samples of General Electric RTV silicone rubber, write to General Electric Company, Silicone Products Department, Section 052, Waterford, N. Y.

GENERAL ELECTRIC

Silicone Products Dept., Waterford, N. Y.

U.S. Seeks Ways to Close Translation Gap

by James Baar

WASHINGTON—Hundreds—possibly ousands—of scientists working on S. space and missile programs are sting their time. Much or part of the rk they are doing already has been ne by Russians . . . or Czechs . . . Red Chinese . . . or other Iron Curn scientists.

Moreover, the Iron Curtain scients have published papers on their rk. But their American counterparts y never know about it. The papers y never be translated. Or, if they e, the Americans may never see them til too late—if at all.

The solution to the problem may a new Spage Age weapon: The ctronic translator.

Or it may be a far broader coorating and distribution system for at already is being translated. Or it y be a long-range Russian language ining program. Any one of these uld cost millions but America's mise industry can provide the ingenuity.

The House Space Committee with the coming weeks will hold a series hearings to determine the scope of e problem and what ought to be ne. Most experts will tell the comttee that the problem is very great. t, they disagree as to the solution.

• **Soviet lead**—The Russians began mass attack on the problem of transing foreign scientific literature in 52 with establishment of the All ion Institute for Scientific and Techcal Translation (VINITI).

It has a full-time staff of 2300 edirs, publishers and assorted experts o screen the world's published scitific output. They draw on some ,000 Russian scientists to translate d abstract scientific papers and books.

VINITI publishes the vast *Referanyi Zhurnal* which provides Russian ientists each year with almost a halfllion abstracts of scientific works—% from outside the Soviet Bloc. The sections of the *Referativnyi* divided cording to field are distributed roughout Russia. Full translations are ovided by VINITI on request.

Besides VINITI, Russia also has ree other types of organizations abacting, translating and distributing reign scientific material. However, NITI acts as a centralizing point for ost of the other abstracting services.

The speed with which the Russians anslate and distribute foreign scientific papers varies greatly.

U.S. experts say many Russian scientists complain that sometimes they don't see a translation until more than a year after publication of the original article.

However, the Russians also provide an extremely rapid express service for articles and books considered to be of top importance. Such an article may be translated and put in the hands of a Russian scientist in Moscow one or two weeks after its original publication in New York.

• **Steps taken**—The United States within the last year has made two major steps toward improving the translation, coordination and distribution of scientific literature of Russia and other Soviet Bloc nations.

The National Science Foundation in December established the Science Information Service to help make foreign scientific literature more readily available to Americans through a variety of programs.

One of the main roles of the Foundation in carrying out the program is the subsidization through grants of more than 20 societies and universities for cover-to-cover translation of 35 of the most significant Russian scientific journals.

Meantime, the U.S. Office of Technical Services has undertaken a broad program of selling translations of Russian scientific work made by all government agencies. These include translations of the Soviet *Referativnyi.*

Among other OTS offerings are:

• Bi-monthly lists of translations of Russian scientific material available from government agencies or private translating firms.

• Abstracts of about 140 Russian journals.

OTS expects to provide abstracts of more than 170 Russian journals by the end of the year. It also expects to provide abstracts of about 30 Red Chinese journals.

At present, OTS is spending about a half-million dollars a year on its program. National Science Foundation is spending more than a million.

Finally, considerable quantities of Russian translating are being carried on throughout the country by private industry. Much of this is never distributed beyond the firm doing the work in order to avoid tipping off competitors as to what the firm is working on.

In all, Science Information Service officials estimate that the United States is doing about as much translating as Russia. Also, they say about the fastest translating jobs being done in the United States take about five months—although as in Russia there are exceptions.

"Where we're behind," one expert said, "is in distribution. It's harder for the average scientific working staff to find and get the stuff in the United States."

Moreover, the United States is behind in another vital area: reducing the need for translations.

More and more Russians today speak English. They begin studying a foreign language in the first years of school. The language they most often choose is English.

On the other hand, only about 2 per cent of U.S. scientists read Russian.

• **Electronic help**—One of the most hopeful immediate solutions is the possibility of developing electronic translators out of huge computers. Study programs at a half-dozen American universities have shown that the idea is promising. And the Machine Translation Research Project at Georgetown University already has claimed a reasonable degree of success with an IBM 704 computer.

Georgetown research workers have been able to translate both French and Russian texts at a rate of three words a second. They expect far better results with the much faster IBM 709 and 7090.

However, they say the principal drawback in computer translation today is the cost of having the foreign text punched on cards, making the entire operation more expensive than human translating.

"What we need to develop is an electronic scanner or reading machine," one said. "Then we'd have something."

Some officials say the best approach to the whole translating problem probably would be twofold: perfection of the electronic translator plus a Russian language training program.

They say this would solve both the problem both for the present and the future. And they stress that the problem must be solved as quickly as possible.

As one Russian-speaking expert put it pointedly: "Rossiya dumayut! (Russia is thinking!)."

ABMA Receives First of *Saturn* Engines

Jupiter test stand being modified to accommodate cluster of Rocketdyne H-1 liquid engines

HUNTSVILLE, ALA.—The Army Ballistic Missile Agency has received the first of eight Rocketdyne H-1 liquid engines which will be clustered to produce 1.3 million pounds of thrust and has already begun modifying a *Jupiter* test stand for static tests here.

The entire project, dubbed *Saturn*, is on schedule, project officers say. But they have yet to name a date for first tests. Since *Saturn* is due to be flight-tested at Cape Canaveral in 1960 it is entirely possible that the first static tests may be made sometime this fall.

The H-1 engine is a refinement of the device now powering both the *Thor* and the *Jupiter* IRBM's, somewhat more compact and probably slightly smaller. Components were repackaged to achieve better grouping and the turbopump is slung "side-saddle" on the thrust chamber in contrast to its former position on top of the chamber.

Each of the eight clustered engines, will, of course, have its own turbine. LOX and RP-1 will be supplied from a common fuel tank, a combination of present *Redstone* and *Jupiter* frames.

• **Departures**—Contrary to previous speculations, the engines will be clustered in a circle, with each engine gimballed separately and possibly in staggered depth. Provision is made for jettisoning the booster engines—with recovery by parachute a later development.

The engines are hypergolically ignited. Safety devices which will be built into *Saturn* include a provision that all eight engines must be functioning normally before the missile can be released, and compensating factors to keep the missile on course should one or even two of the engines fail during flight.

It is believed that the more compact H-1 engine will also produce a greater thrust, probably from 180,000 to 190,000 pounds, producing a combined total of the 1.3 million pounds desired. The big booster is intended to lift into satellite orbit loads of some 20,000 pounds. Under its present design, the cluster will be so high that it cannot be assembled in ABMA's "fab lab" where such work is normally done. It would almost touch the ceiling cranes necessary to move it.

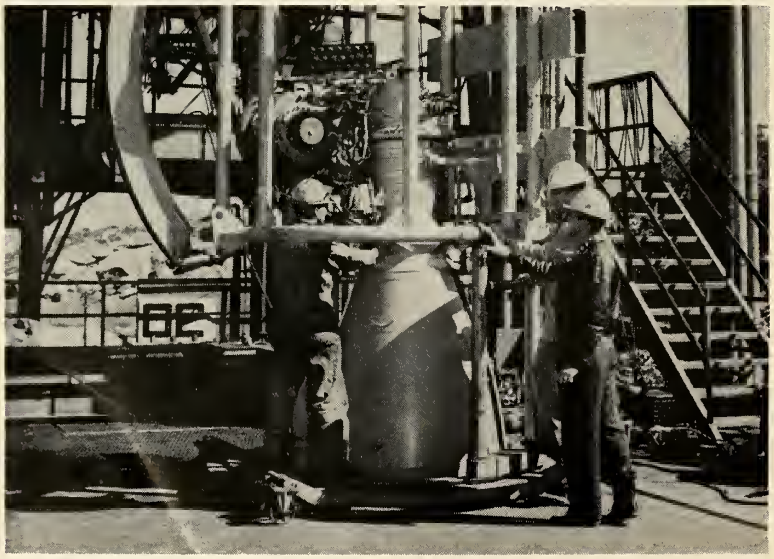
In September ABMA was authorized by the Advanced Research Projects Agency to develop the super booster. During the same month, Rocketdyne received the contract from the Army Ballistic Missile Agency to develop the basic engine. ARPA said that the cluster concept has been uti because of the proven "extreme ability of the Rocketdyne engine."

The entire *Saturn* system, wh enters flight test in 1960, will an the nation's urgent demand for q relatively inexpensive, reliable deli of an extremely high-thrust bo capable of lifting into satellite orb outward to space journeys, a mul load of instrumentation. The thrust be nearly four times that of the nat currently most powerful flight-te propulsion system, the *Atlas* IC cluster of engines.

No details of the overall config tion of the *Saturn* space vehicle been released, but in other multi-s rocket powered vehicles the boost jettisoned after operating for the grammed duration, permitting the per stages and instrumentation to tinue on the space journey. Parac recovery of the booster is under st

The start sequence is the sim yet provided in the family of Roc dyne engines. Safety devices have built in; one of the safety factors is assurance that all eight engines r function normally before the mi can be released.

Hypergolic ignition (self-ignit will further increase the reliability the H-1. Combustion within the th chamber occurs above 500°F.



THE FIRST of eight H-1 Rocketdyne engines arrives at the Army Ballistic Missile Agency for clustering into Project *Saturn*.

Army Redesigning Air Supply Tank for *Corpora*

LOS ANGELES—The Army will a redesigned internal air supply t for the *Corporal* and other mis which eliminates multi-cell structi characteristics.

The tank, developed by the F stone Tire and Rubber Co. guided r sile division here, is called a " cell." It is comprised of two half-sh joined longitudinally and welded 30-inch-diameter hemispherical dr heads.

Fabrication costs of the steel cell are estimated at about 50% multi-cell construction. Weight will reduced by about 50 pounds.

In redesigning the tank, Firest says it considered increased safety operating personnel, cost reducti improved reliability and higher prod tion rate.

letters

'Optik' or 'Vel'?

To the Editor:

I have read Maj. W. C. Mannix's article on the "optik" (M/R, April 27) with considerable interest and applause. His solicitation for comment prompts me to suggest a velocity unit based upon the escape velocity which, for earth considerations, approximates 7 miles per second. The monosyllabic term "vel" could be used to denote this equivalence.

Unlike the optik, the vel does not have the advantage of being absolute. However, the vel would seem to have a flexibility and convenience not shared by the optik. For example, the Mach unit has proven to be useful since it is associated with and automatically defines certain aerodynamic phenomena. By the same token, the vel would automatically define certain astronautical characteristics. For earth considerations, this table depicts the relationship between a space vehicle's burnout, orbital velocity at perigee (in vel units), and orbital eccentricity:

Vel Units	Eccentricity	Orbit
About 0.7	0	Circular
Between 0.7 and 1	less than 1	Elliptical
1	1	Parabolic
greater than 1	greater than 1	Hyperbolic

As a matter of interest and information, the following equivalences are slide rule approximations:

	miles/ hour	feet/ sec	einsteins (roemers)	optiks
millivel	25.2			
vel	25.2x10³*	37.0x10³	3.76x10⁻⁶	37.3
kilovel	25.2x10⁶			

(*By coincidence, this figure yields a minor convenience in that it approximates the earth's circumference in miles.)

Reuben B. Moody
Lt. Col., USAF
622 Upchurch Circle
Montgomery, Ala.

To the Editor:

Please accept this note as representing my approval for Maj. William C. Mannix's efforts to introduce the "Optik" system related to measurements of speed and velocity in the missile era.

His article on this subject in the April 27 issue of Missiles and Rockets was a most concise presentation of the problem; he should be commended on the clarity of thought which he set forth.

Ray Okonski
Director of Sales
Dynamic Filters Inc.
Detroit

Spec Writers Defended

To the Editor:

After reading your editorial "Six Lines for the V-2" in the March 23 issue, I feel that it could not be let pass without some comment on my part, specifically because I have a background in both industry and government.

The editorial unfortunately conveys the impression that:

a. Government specifications are written arbitrarily by people not as "realistic" as industry engineers.

b. A manufacturer will provide an optimum piece of equipment on a government contract regardless of availability of previous tooling, availability of components, engineering time etc.

Having observed and operated on both sides of the fence, I have found that both of these are dangerous generalizations. In most cases, military equipment specifications are written by an engineer who has considerable background on the equipment for which the specification is being written. He also has a reasonably good background on the applicability of the various new types of components. Many engineering reports on research contracts are available to him to help him keep his specifications realistic. These reports are seldom immediately available to industry.

In my opinion, the engineer writing military specifications is probably closer to the equipments than most of the contractors who bid to manufacture the equipment. He must consider having to "live" with the equipment for many years and must be "realistic" in both his specification and the design for which he must give final approval. Because of these facts, I believe the government engineer must be at least as realistic as his industrial brother.

As to point b., it is quite obvious that a manufacturer is not in business as a philanthropic organization—he must make a profit. He is required by contract to meet only the minimum requirements of the specification. He would be a poor businessman indeed to discard previously developed tooling, engineering and components if they could be used on a new equipment with a minimum of change. This approach, while good business, does not lead to improvement of equipment by application of new techniques, ideas and components.

I would suggest that you investigate the difference between a research and development contract, an applications engineering contract and a production contract. I believe that you would find that spec. writers are as flexible as the situation allows insofar as the use of components, new designs, etc., is concerned in both R&D and applications engineering. In production there is very little allowance for flexibility . . .

John F. Hyland
914 Timber Lane
Vienna, Va.

Miscredit

To the Editor:

I am writing in regard to the article: "Story Behind The Death of a Missile" which appeared in your May 4, 1959, issue.

I note that the photograph facing the first page of the article is credited, by implication, to your photographer, Mr. Cornell Capa. This photo illustrates the actual explosion of the Convair missile in the test stand at Edwards Air Force Base.

I wish to state that I am the photographer who took the picture at great personal risk and I feel that crediting this photo to another photographer, by implication or any other means, is a gross violation of existing ethics.

Allen D. Rice
1209 W. Milling St.
Lancaster, Calif.

Our apologies to the Air Force, which released the picture, and to Photographer Rice. Cornell Capa was, of course, taking pictures in the blockhouse at the time of the explosion.

Suggestion Box?

To the Editor:

Your editorial of May 4th and the statement by Dr. Walter Dornberger on page 30 touch on two aspects of one idea. The editorial points out that since every *Minuteman* missile will need a hole in the ground 100 feet deep, the military is looking for a more efficient and economical way to do it than by present methods. You quote a Pentagon official predicting that if a solution is found it will probably come from "a little guy with an idea."

In the profile on Dr. Dornberger, he is quoted as speaking up for a financial slice for the scientists who come up with ideas: "Creative thinking and imaginative engineering should be paid for . . . the government should guarantee a share in the profit of later production for the original creative mind."

Occasionally some obscure "little guy's" idea does get used, but the lack of a channel for submitting ideas is still a major problem. Why not marry the two concepts above with a missile problems program based on the breakfast food contest idea? They set out a problem, state their rules, tell where to submit, when it will be judged and the reward.

It seems to me that Missiles and Rockets is in a position to arrange such a plan on missile problems. You are in closer contact with military leaders—which is the first obstacle for the "little guy." You might even be able to act as receiving and forwarding agency for submitted problem solutions suggested. The military agency could be contest judge.

What do you think?

H. E. Manning
Value Analyst
Convair Division
General Dynamics Corp.
San Diego

We're not sure.


VEST POCKET POWER

contract awards

AIR FORCE

$29,300,000—**General Electric Corp.,** for further development of the J93 jet engine. (This is in addition to the $8,300,000 contract previously announced.)

$510,000—**United Enterprises, Inc.,** New Orleans, for construction of an assembly hangar at Cape Canaveral for the *Mace* tactical missile.

$350,000—**Burroughs Corp.,** Detroit, for coordinating data on transmitting set compatibility to Montgomery sector radars.

$326,500—**General Electric Corp., Defense Electronics Dept.,** Syracuse, N.Y., for miscellaneous telemetric components.

$170,700—**Douglas Aircraft Co., Inc.,** for technical services.

$151,300—**General Motors Corp., AC Spark Plug Div.,** Milwaukee, for technical services.

$131,500—**North American Aviation, Inc., Rocketdyne Div.,** for technical services.

$83,093—**Hallamore Electronics Co., Div. of Siegler Corp.,** Anaheim, Calif., for data insertion converter rack.

$64,815—**Bendix Aviation Corp., Freiz Instrument Div.,** Towson, Md., for miscellaneous replacement parts for airborne weather equipment, radiosonde receptor and radiosonde dispensing sets.

ARMY

$6,462,384—**Independent Contractors & Engineers,** Dallas, for construction at the *Atlas* site, Forbes AFB, Topeka, Kan.

$3,370,000—**Douglas Aircraft Co.,** Santa Monica, Calif., for launching equipment for the *Nike-Hercules.*

$1,442,315—**Industrial Metal Fabricating, Inc.,** Wayne, N.J., for 500 prefabricated buildings.

$1,375,010—**General Electric Co.,** for generators.

$777,886—**Douglas Aircraft Co., Inc.,** Santa Monica, Calif., for launching items (four contracts).

$510,618—**Rheem Mfg. Co.,** Downey, Calif., for fuzing system for warheads (two contracts).

$450,000—**Firestone Tire & Rubber Co.,** Los Angeles, for modification of guided missiles.

$180,499—**Harvey Aluminum,** Torrance, Calif., for study of weapon systems.

$169,512—**Data Instruments Division, Telecomputing Corp.,** for fixed camera reader.

$74,886—**Gilfillan Bros., Inc.,** Los Angeles, for repair parts.

$56,419—**Ordnance Engineering Associates, Inc.,** Chicago, for testing including thruster XM-11 PMTS, cartridge and load assembly.

$46,651—**Hufford Corp.,** El Segundo, Calif., for spherical heads.

$46,047—**Librascope, Inc.,** Glendale, Calif., for tape cartridge memory system.

$38,205—**Airtemp Div., Chrysler Corp.,** Dayton, Ohio, for engineering orders applicable to ballistic missiles.

$30,000—**University of Utah,** for investigation of chemical reactions.

NASA

$175,000—**Callery Chemical Co.,** Pittsburgh, for evaluation of a new classified solid-liquid rocket propellant.

$135,480—**Consolidated Electrodynamics Corp., Datalab Div.,** Pasadena, Calif., for design and development of airborne magnetic-tape recorders to monitor the first manned orbital space flight under Project *Mercury* (a subcontract from McDonnell Aircraft Corp.).

(The instrumentation will record physiological reaction of the pilot and monitor environmental conditions of the McDonnell space capsule.)

(Because of military applications, NASA scientists said only that the propellant was of a new non-cryogenic type that would permit substantial increase in payload weight. Callery is expected to explore feasibility of the new concept, which has both liquid and solid applications, and report its findings to NASA in about eight months. A major subcontractor in the evaluation is **Reaction Motors Inc.,** of New Jersey, a division of **Thiokol Chemical Co.**)

$46,000—**Space Electronics Corp.,** Glendale, Calif., for a study of requirements for the proposed Project *Mercury* control center.

(The center will serve as the basic decision-making facility of the project's world-wide range of tracking, telemetry and computation centers. A scale model of the center will be developed under the contract, and requirements and specifications for the center's equipment will be assessed.)

people

President Eisenhower has nomin **Joseph V. Charyk,** chief Air Force sc tist, to be an assistant secretary of Air Force succeeding **Richard E. Hoı** now Associate NASA Director. Ch formerly was with the Jet Propul Laboratory at Cal Tech.

A. C. DeAngelis has been ele vice president of Dynamics Corp. America. He is president of DC communications sidiary, Radio gineering Labor ries, Inc. Be joining DCA 1950, DeAngelis president of Gen Armature and M ufacturing Co.

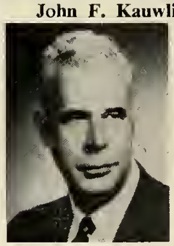
DeANGELIS

General K. **Nichols,** former Atomic Energy Comı sion general manager, and **Dr. Jerry** **Afee,** vice-president-engineering in C Oil Corp's manufacturing departm have been elected to Callery Chem Co.'s board of directors.

Gordon S. Burroughs has been pointed vice pı dent of CBS Lal atories in charge the newly-expan Military and Ind trial Electronic tems Departm and will direct s projects as mili application of t vision, high-res tion reconnaissa and surveillance systems. Formerly pı dent of Burroughs Engineering, assets which were acquired by CBS Laborator Burroughs previously served as Head the Electronic Systems Department Olympic Development Co.

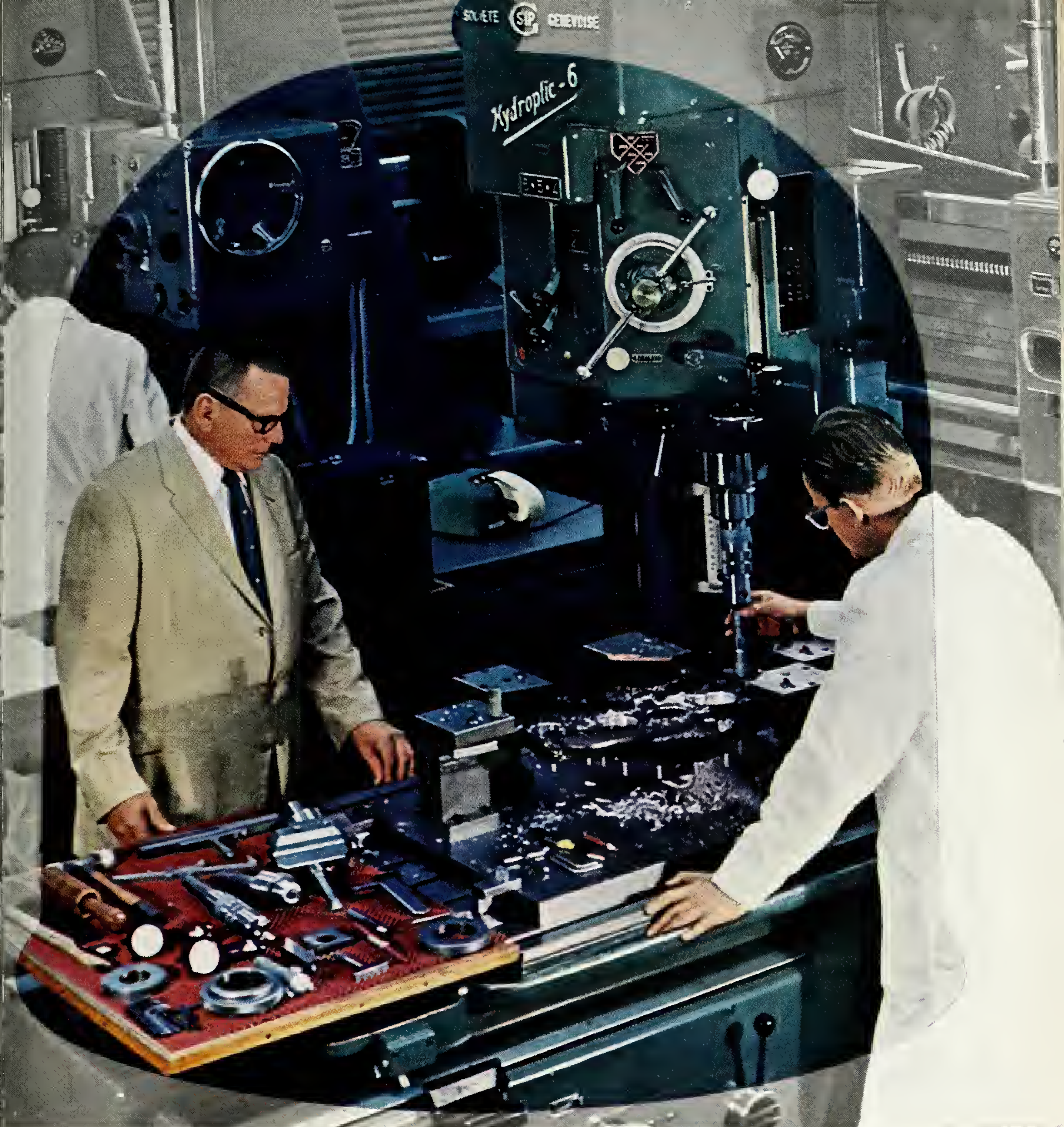
BURROUGHS

John F. Kauwling is the new gen manager of Electronics Divis of Elgin Natic Watch Co. joined Elgin in 1 as operations m ager of the E tronics Division prior to that plant manager Standard Coil Inc.



KAUWLING

Hughes Aircraft Co. has tap **Thomas D. Hanscome,** former U.S. N Research Laboratory scientists, and **Walter G. Wadey,** former Yale Univer research physicist, for its nuclear el tronics department. Hanscome, as ch scientist for the Chesapeake Bay anı of the Naval Research Lab, prepared fi experiments for several nuclear tests Nevada and the Pacific and was proj officer on weapons tests for nuclear rad tion measurements. Wadey worked Yale on design and development of hi current linear electron accelerators, n



Like in a huge bell jar, temperature and humidity are controlled to exacting standards in I. G. W.'s precision jig bore room.

AIRBORNE RADAR...

The APS-67 Airborne Radar . . . designed and developed by *The Magnavox Company* in conjunction with the Navy Department, gives eyes that see by both day and night to the Crusader.

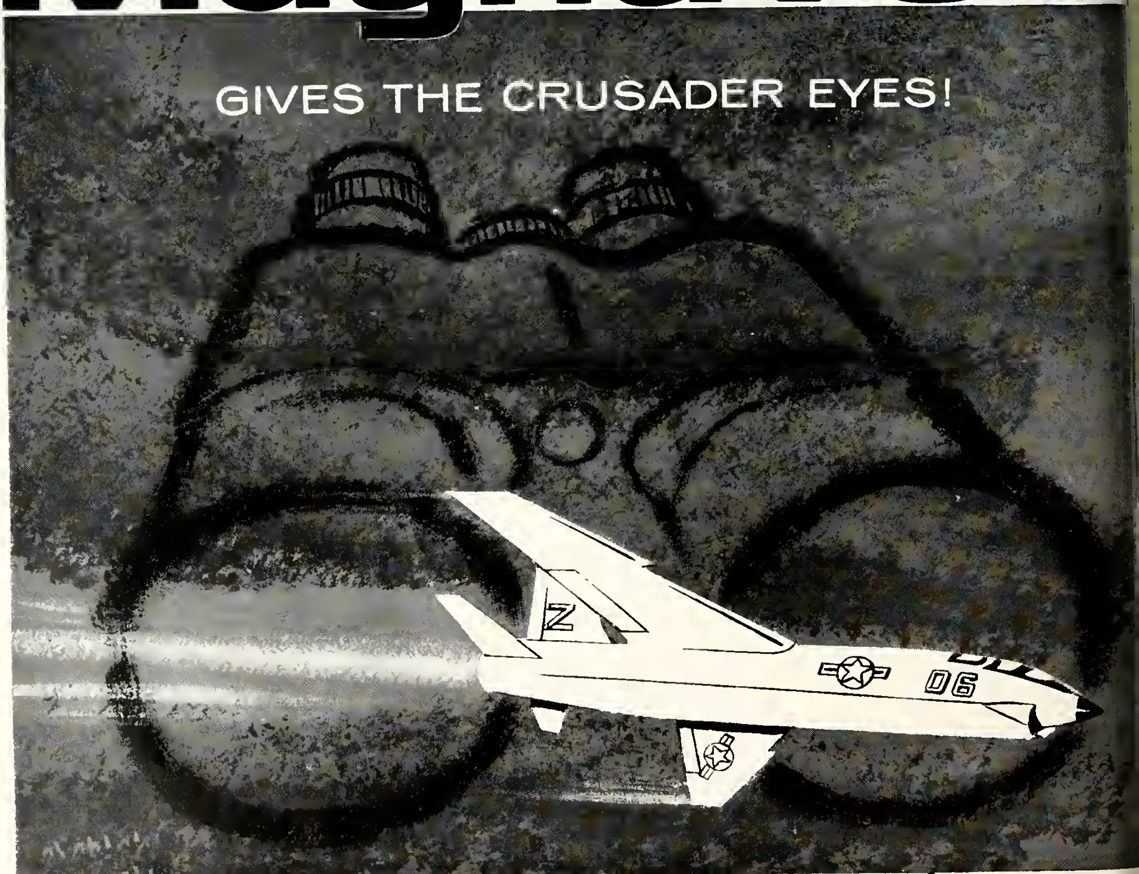
The APS-67 delivers the utmost in performance and reliability for this Navy Fighter . . . clearly demonstrating *The Magnavox Company's* ability to produce and work as prime contractor on a complex electronics project.

MAGNAVOX capabilities are in The Fields Of Airborne Radar, ASW, Communications, Navigation Equipments, Fusing and Data Handling . . . your inquiries are invited.

PRODUCTS THAT SEE BY THEMSELVES

Magnavox

GIVES THE CRUSADER EYES!



THE MAGNAVOX CO. • DEPT. 68 • *Government and Industrial Division* • FORT WAYNE, IND and gamma ray spectroscopy and arch laboratory design. **Dr. Roger** **man** has joined Hughes as head of physics department of the materials arch laboratory, semiconductor di- on. He was formerly with General tric's research labs.

Barnet R. Adelman and **Herbert R. Lawrence** have been elected vice presidents of United Research Corp., subsidiary of United Aircraft Corp. Both scientists have been active in the missile propulsion field and have worked on development of the engines for the *Atlas, Titan, Thor* and *Minuteman* missiles.

ADELMAN

American Rocket Society's 1958 C. Hickman award for outstanding contributions to solid-propellant rocketry awarded to Adelman. Lawrence ed a leading role in the development the first shock wave engine and the pulse jet capable of operating at -sonic speeds.

Dr. Koto Matsudaira, Japan's ambas- r to the United States, was elected rman of the 18-nation committee on peaceful uses of outer space. **Dr. io Amadeo** of Argentina was chosen chairman.

Recent changes at Space Technology oratories: **Dr. Richard D. De Lauer** ed director and **Harold Hirsch,** asso- director of the Vehicle Development oratory, Research and Development ision; **Dr. Robert Bromberg** appointed ctor and **Arthur F. Grant,** assistant di- or of the Propulsion Laboratory, Re- rch and Development Division.

Robert E. Root, former manager of Rheem Manufacturing Co.'s Military Research and Development Laboratories, has been appointed division manager of the Electro-Mechanical Division of American Electronics, Inc. At one time, Root worked in the Ordce Division of Northrop Aircraft.

ROOT

Appointment of **Wilhelm F. Juptner** and **Gilbert Heavin** to executive engineering and production posts, respectively, has been announced by Babcock Relays, Inc. Juptner has been promoted from chief engineer to engineering vice president and chief engineer, and Hea- who recently joined the company, es over the duties of production man- r. Before joining Babcock, Juptner was h the Electronics Division of Elgin tional Watch Co. Heavin was formerly h the production department at Halla- re Electronics, Inc.

JUPTNER

The House has passed (294-128) and sent to the Senate a $480 million authorization bill for NASA. The measure does not carry any appropriation.

High-strength steel sheets from .005 to .100 inches thick and up to 125 x 240 inches in size are being evaluated at request of Air Materiel Command by 16 propulsion and missile/aircraft manufacturers. Aerojet-General and National Northern will apply series of explosive forming techniques to determine if sheets can be deep drawn for missile applications.

NASA contracts for April amounted to $27.6 million—the largest $24 million to Douglas Aircraft Corp., for three stage launching vehicle *Delta*. Other contracts went to: MIT, $50,000, for the development of a cesium vapor atomic clock, and gamma ray detection instruments; University of Maryland, $60,000, to investigate the forces between atoms, molecules, and ions; Itex Corp., $170,000, for development of upper-atmosphere sounding rocket instruments; New York University, $100,000, to instrument two *Aerobee-Hi* rockets for neutron intensity measurements; AOMC, $150,000, radiation satellite payloads; Univ. of Chicago, $300,000, to build cosmic ray measuring instruments; General Mills, $60,000, for nine 100-foot diameter plastic balloons for communications satellite tests; RCA, $60,000 for *Mercury* ground tracking and instrumentation studies; American Potash & Chemical Co., $50,000, for 161,000 pounds of ammonium perchlorate for solid research; rensselaer Polytechnic Institute, $80,000, for mathematical investigation of control systems; and Rice Institute, $150,000 for wind tunnel studies and research into physics of solid materials at high temperatures.

Lockheed Aircraft is moving into the missile electronics field with the acquisition of Stavid Engineering Inc., Plainfield, N.J. Terms are 2½ shares of Lockheed stock for every share of Stavid. No changes in management or policies of the smaller firm, which has 1000 employes and 1958 sales of $11.2 million, are contemplated. Stavid cc tracts have covered scale model launc ing, silo instrumentation for *Minu man,* airborne radar beacons for t *X-15* and guidance and controls f several other weapon systems.

Labor troubles have hit the miss ranges. An *Atlas* shoot at Vandenbe AFB was delayed by a May 18 wal out of machinists protesting Conva living allowances. On the same d there was a double failure of an *Atl* and a *Polaris* during a work stoppa by carpenters at Cape Canaveral.

Test stand at Martin's Denver pla was severely damaged May 15 l explosion of *Titan* first stage. No pe sonnel injuries were reported and t missile's second stage, only 10 fe away at the time, also escaped u scathed.

Air Force is now investigating Ra theon's proposed "sky station"—dis shaped structure to be kept aloft l beaming high-powered microwave e ergy to run mechanical rotor. Key ite is amplitron microwave tube whi eliminates need for bulky reflectors a power converters. Potential early app cations are missile and aircraft dete tion, skypath link for long-range, larg capacity communications and meteo ological observation.

Space Recovery Systems Inc. is b ing formed by the Columbia Broa casting System jointly with Steinthal Co. Inc., a parachute R&D and man facturing concern. The new ventu will specialize in equipment to trac locate and recover missile and spa vehicle components and payloads.

Name changes: Yielding to tl Space Age, Aircraft Industries Assoc ation has switched to Aerospace Indu tries Association. Henceforth CD Control Services Inc., Hatboro, Pa manufacturer of advanced compute integrated electronic controls, wish to be known as the CompuDyne Cor And stockholders of Mid-Century In strumatic Corp., New York City, hav voted a change to Computer Systen Inc.

What makes plastics crack? Th Wright Air Development Center ha awarded a $28,000 contract to Brool lyn Polytechnic Institute to find out particularly on plastics subjected t space flight conditions.

. FINANCING

(Continued from page 19)

arry-forward, carry-back tax pro-ns; whether or not to take quick rtization (where there's a choice— fast write-off certificates for vital ase facilities); general manage-: of capitalization techniques; etc. Other aspects of good management de knowing and calculating capi-eeds against growth and planning *d* to meet them; building of a nced management—between ad-stration, finance, sales, production technology. Perhaps the most pre-ous corporate structure is the one-company. Odds are he's not as as he should be in all the basic agement areas. Even if he is, it's ally certain there aren't enough s in the week for him to give er attention to all of the areas that and it. And what if he's suddenly available (as in illness or death)?

The year 1958 saw two records e. There were 150,268 new busi-incorporations, an all-time high—pared to 136,697 in 1957. And e were 14,964 business failures—the est since the end of World War II mpared to 13,739 in 1957. How y of these companies were among 50,000-odd now calculated to be cipating in missiles, spaceflight and porting activities the figures don't y.

However, you need only to look the continuing rash of mergers attempted mergers to know that no l number are running into financial ations on their growth. More often not this is the basic reason for at half of the mergers—though y we've seen cases of companies ring for a merger, that looked like thought the other had money!

n the theory that no one is too old earn, SBA has developed a num-of programs to provide manage-t know-how. They include a series regular publications, a series of agement courses and other serv-The agency has 14 regional and field offices around the country. A k with SBA may be worth the time effort.

The basic point is: If you've reach-he point where you're having to musical chairs with your creditors' ars, you'd better start thinking ut remedies. There are many dif-nt approaches, most of them out-d above. Almost all of them take e time—SBA and "V" loans, for nple, take from three weeks up. A stock issue takes even longer to organized and cleared through SEC. , of course, the development of a d management team—the most ele-tary of all—sometimes takes years.

MAGNETOHYDRODYNAMICS

EXPANDING THE FRONTIERS OF SP

missile business

by William E. Howard

Anemia, insofar as the Defense Department is concerned, apparently is no cause for alarm. Missile makers must show acute starvation before the Pentagon will even consider changing the policy line it adopted toward profits in 1957 and still does today.

Precisely what the profit factor should be when doing business with the government is one of those questions not easily resolved. As matters stand now, the government holds virtually complete control. And its decision is to keep profits as low as possible, regardless of the fact that the economic health of its suppliers is critically important to the defense effort.

In essence this is the DOD position set forth for a House Appropriations subcommittee recently by Perkins McGuire, Assistant Defense Secretary for supply and logistics. The aircraft industry early last year asked for a higher profit factor. It said the money was needed to expand industry's research and development facilities for defense. "The Department gave this recommendation considerable study," McGuire said, "which resulted in our conclusion that our profit objective for the industry as a whole was not too low considering all of the factors under which the industry operates."

The assistant secretary's statement left unanswered in the text the question of whether the R&D effort might be too low. Industry spokesmen have long claimed that R&D—particularly basic research—is underfunded. Many companies admit they are skimping their stockholders to put all the money they can into R&D now, and it still isn't enough.

Interestingly, McGuire's statement was accompanied by some figures from the Air Force graphically indicating the profit-shrinking trend. The Air Force compiled published financial statements of Boeing, Douglas, Lockheed, Martin, McDonnell, North American, Northrop and Republic. It found the profit ratio on sales before taxes had slipped from 4.9% in 1957 to 4.1% in 1958 and after taxes the ratio was 2.45% in 1957 and 2.02% in 1958. The Air Force estimates the 1959 profit ratios will be the same as last year.

Reporting on another industry recommendation to increase the return on DOD R&D cost-plus-fixed-fee contracts, McGuire told the lawmakers that a study showed these fees: Army—4 to 9% with most less than 7%; Navy—token fee of $1 to a high of 10% with the average about 6.5%; ARDC—4 to 10% range with the average 6.1%; Air Materiel Command—4 to 7% range, average on small business contracts 6.25%.

"On the basis of these fee ranges, coupled with the fact that the payment of these fee levels did not hamper efforts to obtain research and development or adversely affect expeditious performance and quality of research and development work, the conclusion was that no general increase in the DOD fee objective was indicated," McGuire said. "Accordingly," he added, "there has not been any general increase in our profit objectives in 1957, 1958 and 1959, and, although the final pricing results are not generally available, we do not believe that the final negotiated prices showed an increase. With respect to the fees allowed, our studies definitely establish the fact that there has been no general increase."

What's ahead for 1960? The defense official doesn't say. But several airframe manufacturers aren't waiting for an increase from the government. They are in the process of diversifying to broaden their profit base, which may make the DOD happy. But unfortunately diversification takes money, too—money that otherwise might go into research vital to winning the technological race against Russia.

NEW THEATER OF AIR FORCE ACHIEVEMENT

The first astronauts have been chosen by the National Aeronautics and Space Administration, and Air Force pilots are among them. These men will blaze a trail into space. The first step will be soon — a boost into orbit, a capsule parachute journey back to earth. Next will come very high flights with controlled, glider-like landings. Then, one day, astronauts will pilot space cruisers throughout our solar system. Air Force, Navy and Marine pilots are taking the first step toward use of space in the NASA program, bringing the military pilot a giant stride forward in the evolution to spaceman.

ADVANCED WEAPONS · ASTRONAUTICS · ASW · ELECTRONICS · MISSILES AIRCRAFT · G · RANGE SYSTEMS

CHANCE VOUGHT
DALLAS, TEXAS

propulsion engineering

Binders of future solid propellants may be oxidizers insteac fuels. At least that is the line of thought opened up in the chen industry by the recent announcement that the Army Rocket Guided Missile Agency's $750,000, one-year study contract on s propellants went to Allied Chemical's General Chemical Divis The division makes fluorine, chlorine trifluoride, and bromine pe fluoride—all under study, or in development, as super oxidizers. present, binders are fuels that hold together such oxidizers ammonium perchlorate or ammonium nitrate.

Talk that the roles of fuels and oxidizers in solids may rev has been heard several times in recent years. Allied's entry propellants in a big way (it has been in the business "through back door" for several years as a supplier of fluorine and o chemicals) almost certainly means that at least one solid prope will feature a fluorine-based oxidizer-binder holding an unspec fuel. The result could be a fluoro-plastic oxidizer-binder homogen with a rubber or urethane fuel-binder. Allied will conduct the v in its General Chemical research laboratory, Morristown, N.J.

Look for a major research effort to push chlorine into mis possibly as an ingredient in a synthetic structural material, mayb a propellant system. Reason for the chemical industry push: C capacity. The industry was caught in a bad squeeze when n ethylene glycol manufacturers switched from a chlorine process r over to the ethylene oxide route of producing the glycol.

Further overtures to missile business by the chemical industry seen in several of the newest chemical plants now in produ or under construction. Examples: Air Reduction's new oxygen nitrogen facility has started production at Denver; National Cyli Gas Division of Chemetron Corporation has put its new $1,750, 35 ton/day liquid oxygen, nitrogen, and argon plant on strear Los Angeles; Texas Alkyls, Inc., has begun a new $1 million minum alkyls plant at Houston.

The Texas Alkyls plant is a joint venture of Stauffer Chen and Hercules Powder, both already in the missile supply busi making mostly fuels and oxidizers. The aluminum alkyls will two major uses in the missile industry: They will be highly effe catalysts in vital chemical process operations; and they will be as, or in, self-igniting hypergolic propellants for upper rocket st Initial production will exceed 1 million lbs./year, beginning late year or early next.

Foote Mineral Company still is chafing under the Atomic En Commission's order ending purchases of lithium hydrides, but ex to make a major comeback almost immediately. Foote chen under research director Dr. E. M. Kipp, have developed a new lit hydride—or type of hydride—that is a much more reactive redu agent than present commercial lithium hydrides. Foote says not about the missile applications, but in a propellant system the oxi is complemented by the reducer as a fuel.

Lithium nowadays almost always gets into fuel conversat wherever missilemen meet. Foote is part owner of HEF, Inc., w is gearing up for a major role in propellants. However, Foote it will be several years yet before HEF contributes substantiall Foote's income. In the meantime, Kipp and his associates have c up with two more items of missile interest: A new series of hi reactive and very uniform lithium dispersions (metallic); an cheap, controllable process for turning out lithium butyl as cat for several reactions.

But if you want to try, do this:

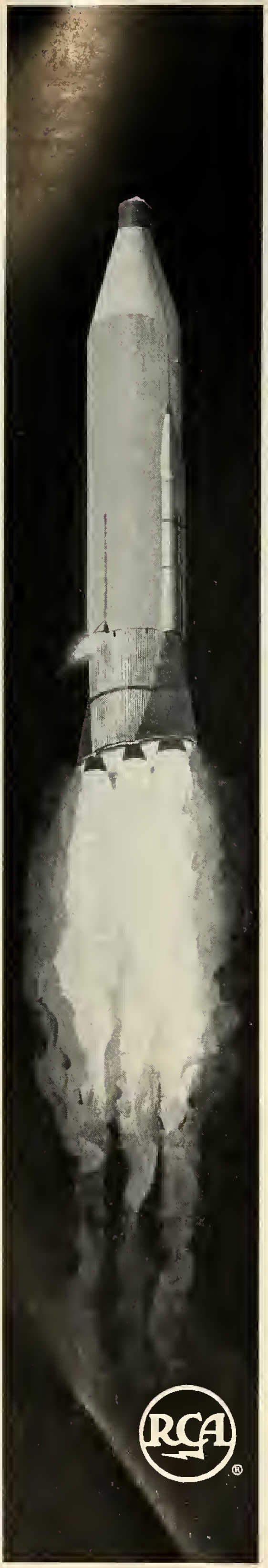
- Spend 20 years applying advanced metallurgy to production.
- Shake down 35 high-temperature alloys in the laboratory.
- Fabricate these super-alloys into critical hot-part components for prototype power plants.
- Swing into volume production of proved designs.
- Prove, over and over again, that you know what you're doing—with jet, propjet and piston engine components and afterburners, ramjets and rocket motors.
- Make your name a byword for high-temperature research and development . . . for precision-made components and complete power packages.

Better still—take a 20-year stride by putting Ryan to work on your heat problems.

RYAN BUILDS BETTER

AIRCRAFT · POWER PLANTS · ELECTRONICS

Ryan Aeronautical Company, San Diego, Calif.



British Astronautics

U.K. is Develop
A-Warheads for T

by G. V. E. Thompson

LONDON—At present the only listic missile in Britain capable of ing fired is the *Thor,* supplied f America with its atomic warhead. that Britain can be completely i pendent in the manufacture and of atomic weapons, British warh are being developed.

In addition to those for the A artillery and for bombs, there wil H- and A-bombs warheads for *Blue Streak* ballistic missile, the I tol/Ferranti surface-to-air *Bloodho* and the English Electric surface-t *Thunderbird.*

• **Upper atmosphere densities**- G. King-Hele of the Royal Airc Establishment, Farnborough, has lysed the orbits of artificial earth s lites to estimate the mean densit the amosphere at heights between and 400 km. The chief difficulty in analysis is the evaluation of the qu tity SC_d, (in which S is the mean cr section of the satellite perpendic to the direction of motion, and C the drag coefficient). Its value dep on the shape of the satellite, the n ner in which it is rotating, and way in which the air molecules are flected from its surface.

It is particularly difficult to mate for cylindrical satellites (*plorers 1, 3, 4* and *Atlas*). King-H thinks that these, and the rockets the Russian satellites, have rot about their axis of maximum mon of inertia—that is, about an axis pendicular to their length. The a between this axis and the directior rotation has varied—the extreme c are motion like a propeller and tur ing end-over-end. The following va for mean density were obtained:

Height, km.	Air density/-sea level density	Mean de (g./cm.
200	3.4×10^{-10}	4.1 x 1
220	2.0×10^{-10}	2.5 x 1
240	1.2×10^{-10}	1.5 x 1
260	7.6×10^{-11}	9.3 x 1
280	4.6×10^{-11}	5.6 x 1
300	2.9×10^{-11}	3.6 x 1
320	2.0×10^{-11}	2.4 x 1
340	1.4×10^{-11}	1.7 x 1
360	9.7×10^{-12}	1.2 x 1
380	7.1×10^{-12}	8.7 x 1
400	5.3×10^{-12}	6.5 x 1

The actual density naturally varies f day to day. The factor of error for figures is not greater than 1.5.

Missile secrets plane lost—A ered Avro Tudor plane carrying nissiles (believed to be the *Fire-* ;) and secret documents to the nera rocket range was recently re-d missing in Eastern Turkey. It it first feared that the plane might been captured by the Russians, flight path lay close to the Soviet er, but its wreckage was later ed on a snow-capped plateau 1000 elow the crater of the extinct vol- 14,434 ft. Mount Subhan. The F. mountain rescue team sent to te were impeded by snow, difficult ing conditions, bears and wolves; eaching the wreckage they found all twelve occupants were dead. t material was removed and the ish army has been asked to ex- the missiles.

n enquiry into the accident will eld, and in future such flights will bly be routed via Africa to avoid ig too near Russian territory.

Underwater escape tests—Since five-sevenths of the earth's sur- is covered with water, the possi- of a manned satellite vehicle des- ng in the ocean is quite high. A of experiments made by the U.K. iralty Hydro-Ballistic Research lishment is of interest in this con- on.

tandard aircraft ejection seat ment was fired under water and urements were made continuously e acceleration of the seat and of mmy it contained; the pressures e gun, at various points close to the gun separates, and at the and abdomen of the dummy.

he maximum velocity of the seat letermined by using it to move a permanent magnet over equally- d coils fitted to the fixed frame- . The dummy was ejected satis- rily under water, but the pressures ed may be too high for a pilot. gun pressure dropped from 2000 o 1000 psi. at discharge; an en- d bubble then formed and water ance maintained the pressure for ger period than in air. Near the ny, the pressure varied from 0 to si.

To meet numerous requests m readers, M/R has made ilable reprints of the recent ies of articles by Dr. S. Fred ger on the meaning of Project gus. Copies of the combined ies may be obtained by writing the magazine. The rate is 50¢ a single order (bulk rates on uest).

Spacecraft Materials Probed by Symposium

by Frank G. McGuire

PALO ALTO, CALIF.—Technical pects of temperature, erosion, spu ing, lubrication and vacuum effects materials were thoroughly discusse the first Symposium on Surface Eff on Spacecraft Materials, co-sponsc by Lockheed and ARDC. Over hundred scientists from throughout country attended the meeting, the of its kind to deal with thermal de and surface effects exclusively.

• **Vacuum effects**—Dr. M. R. A ter of the Naval Research Laborat reported on research involving changed characteristics of mater under high vacuum conditions. creep strength of some metals goes when in a vacuum, Dr. Achter s but with high temperatures they r actually be weaker in space than earth. This reversal will have to be c sidered in designs of future spacecr

Changing many of the parame of testing could completely reverse results of a test, according to Ach The loading of the sample, as wel great changes in temperature, cc substantially alter the end result i creep-strength or fatigue test.

Other researchers, discussing sublimation of materials under l vacuum, stressed the need for l vapor-point materials in the const tion of spacecraft, because vacuum fects them less than other mater As one extreme example, it is poss for a spacecraft to vanish due to "ev oration" of the metal, and resul changes in the bulk properties.

Experiments on plastics and cer metals have been conducted to st this effect at various temperatures. far, these experiments have shown portant changes in materials follow prolonged exposure to vacuum. M subtle effects due to absence of surf gas layers include changes in the efficient of friction, fatigue and cre rupture characteristics.

• **Lubrication**—It probably will necessary to use solid-film lubricants space, but graphite has virtually b ruled out due to the necessity of hav water vapor in the environment s rounding the lubricant. Dr. Bruce D iel, Midwest Research Institute, t the symposium that the best solid-f lubricants found so far are molybden disulfide and tungsten disulfide, but t they are not as efficient as desi under high-temperature conditions.

Work is under way at Midwest search Institute to determine the act mechanics of friction by use of gra ite whiskers. These hard-to-prod

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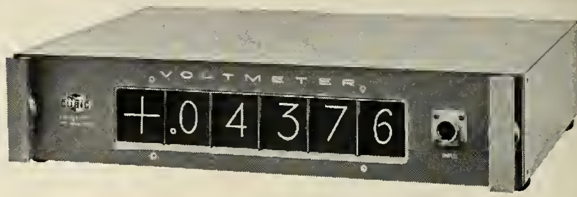

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strands of graphite are used as specimens for tensile-strength tests, and for examination into the crystalline structure.

The crystalline structure of graphite is similar to that of molybdenum disulfide and tungsten disulfide, but where graphite needs water vapor in its environment in order to act as an efficient lubricant, the other two use sulphur.

• **Erosion**—The action of particles of varying sizes in space on the surface of a spacecraft was looked at from a number of angles: micrometeorites, dust, and individual atoms and molecules. (Results of a collision with a full-scale meteor were so obvious as to eliminate need for discussion.)

Erosion by interplanetary dust, reported Dr. David B. Beard of the University of California, probably will amount to negligible damage to a satellite. The actual amount is calculated to be 10^{-5} to 10^{-6} particles larger than 4 microns impacting cm^2/sec. (i.e. 30 to 300 impacts/cm^2/year).

Calculating the origins of comets within the solar system has indicated they are "balls of fluff" generally found in the cold regions of space until a passing body sets them in motion. When these comets pass near the sun, dust is thrown off and gradually populates the solar system. The dust, which also comes from other sources, is the cause of the "Zodiacal light" observed at night, since it reflects the light of the sun to the dark side of earth in minute quantities, leaving a milky haze over the sky.

To remain in the solar system, these particles must be at least 3 microns in size—a smaller particle would be forced out of the system by radiation pressure. Density of this dust is greater near the earth due to gravity, where it reaches about 10^{-12} particles per cubic centimeter, as compared with an average density of 10^{-14} or 10^{-15} per cubic centimeter throughout the solar system in general. A particle of 4 microns or larger, therefore, is needed to register appreciable damage on a surface.

A particle having a mass of 10^{-13} grams (low mass but high velocity) would immediately vaporize upon striking a satellite surface. However a greatly prolonged exposure might show appreciable damage, and in some cases could surpass that inflected by larger, but less frequent, particles.

To gain more knowledge of this dust, consideration is being given to exposing a sheet of sticky mylar film on a rocket or recoverable satellite to capture some and bring it back for analysis.

when and where

JUNE

Institute of Radio Engineers' Professional Group on Microw Theory & Techniques, National Symposium, Harvard U versity, Cambridge, Mass., June 1-3.

Armed Forces Communications and Electronics Associati 13th National Convention, Sheraton Park Hotel, Washingt D.C., June 3-5.

Institute of Radio Engineers' Professional Group on Product Techniques, Third National Conference, Villa Hotel, S Mateo, Calif., June 4-5.

The Pennsylvania State University's Missiles System Engine ing Seminar, University Park, June 7-13.

Aero Club of Michigan, Industry Missile and Space Conferer Sheraton-Cadillac Hotel, Detroit, June 8-9.

American Rocket Society, Semiannual Meeting, El Cortez Ho San Diego, June 8-11.

United Nations Educational, Scientific and Cultural Organi tion, UNESCO House, Paris, June 15-20.

Cornell University Industry Engineering Seminars, Cornell U versity, Ithaca, N.Y., June 16-19.

Institute of the Aeronautical Sciences, National Summer Me ing, Ambassador Hotel, Los Angeles, June 16-19.

Institute for Practical Research on Operations, The Univers of Connecticut, Storrs, June 21-July 3.

American Institute of Electrical Engineers, Air Transportati Conference, Olympic Hotel, Seattle, June 24-26.

Nuclear Industry Division, Instrument Society of America, S ond National Symposium, Idaho Falls, Idaho, June 24-26.

Institute of Radio Engineers' Professional Group on Milit Electronics, Third National Convention on Military El tronics, Sheraton Park Hotel, Washington, D.C., June July 1.

Pennsylvania State University, Summer Seminar on Plastic Its Mechanical Properties, Design and Applications, U versity Park, June 29-July 3.

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