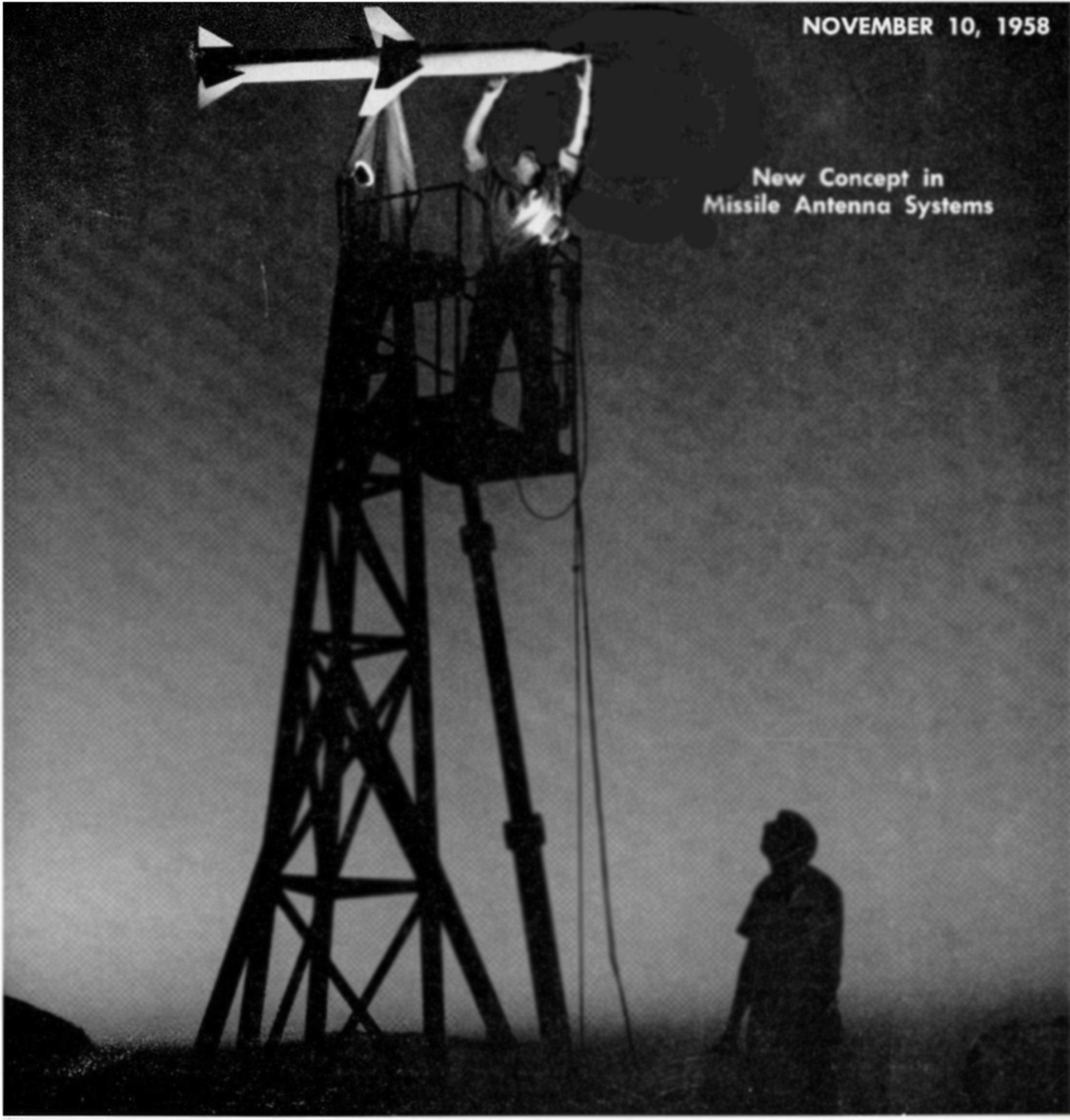
NOVEMBER 10, 1958

New Concept in
Missile Antenna Systems



missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

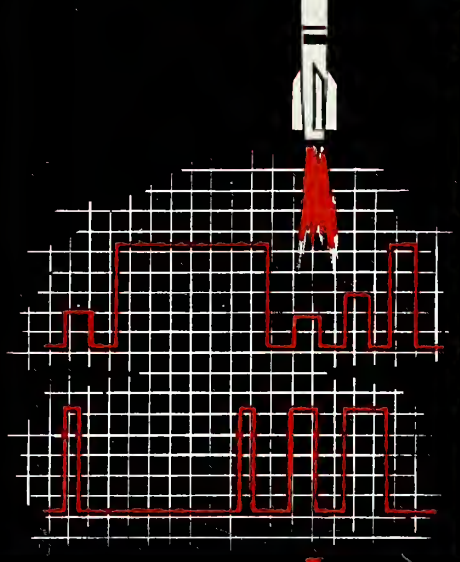
News and Business Edition

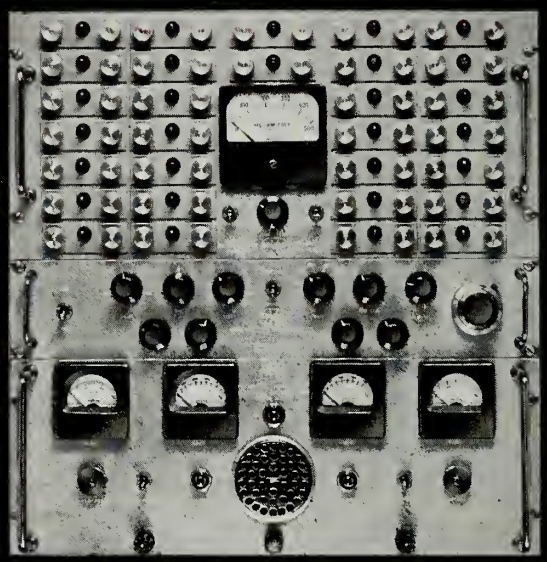
AN AMERICAN AVIATION PUBLICATION

New....ARNOUX miniature

DECOMMUTATOR

FOR PAM and PDM TELEMETRY SYSTEMS





The new Arnoux Model TDS30-1 Decommutation System is completely self-contoined within three chossis ossemblies consisting of: Goting Unit (TOP), Pulse Selector (MIDDLE) and Reguloted Power Supply (BOTTOM). The unit handles 28 channels of information and occupies only 19½ inches of panel height in a standard reloy rack. Overoll depth behind panel is 13 inches.

The Arnoux Model TDS30-1 Decommutation System is compactly designed for use in airborne or trailer installed telemeter receiving stations and in portable check-out equipment.

- Miniaturization is the natural result of a new circuit design allowing the entire system to contain only 76 tubes as opposed to several hundred in competitive systems.
- Modular construction permits eosy expansion of system to any desired channel capacity.
- Novel circuitry design does not reflect errors due to center frequency drift of sub-carrier oscillators, drift of discriminator D. C. output level, or tape playback speed errors.
- Built-in test selector permits visual inspection of waveforms throughout system for quick malfunction detection.
- Neon indicators on each goting unit give continuous visual indication of correct sequential operotion.
- System occepts all stondord IRIG inputs, either PAM or PDM, at any sampling rote from 75 to 900 per second.
- Overoll lineority is within ± ½ % ot maximum level. Long term level drift is within ± ½ %. Gain drift is negligible.
- Modulor plug-in goting units ollow quick replocement of faulty channels.
- Two spore units ore maintained on standby for instont use.
- Power required is 115 volts, 60 cps, single phase. Optional 115 volt, 400 cps, power supply avoiloble for oirborne opplicotion.

WRITE FOR
ARNOUX BULLETIN 800

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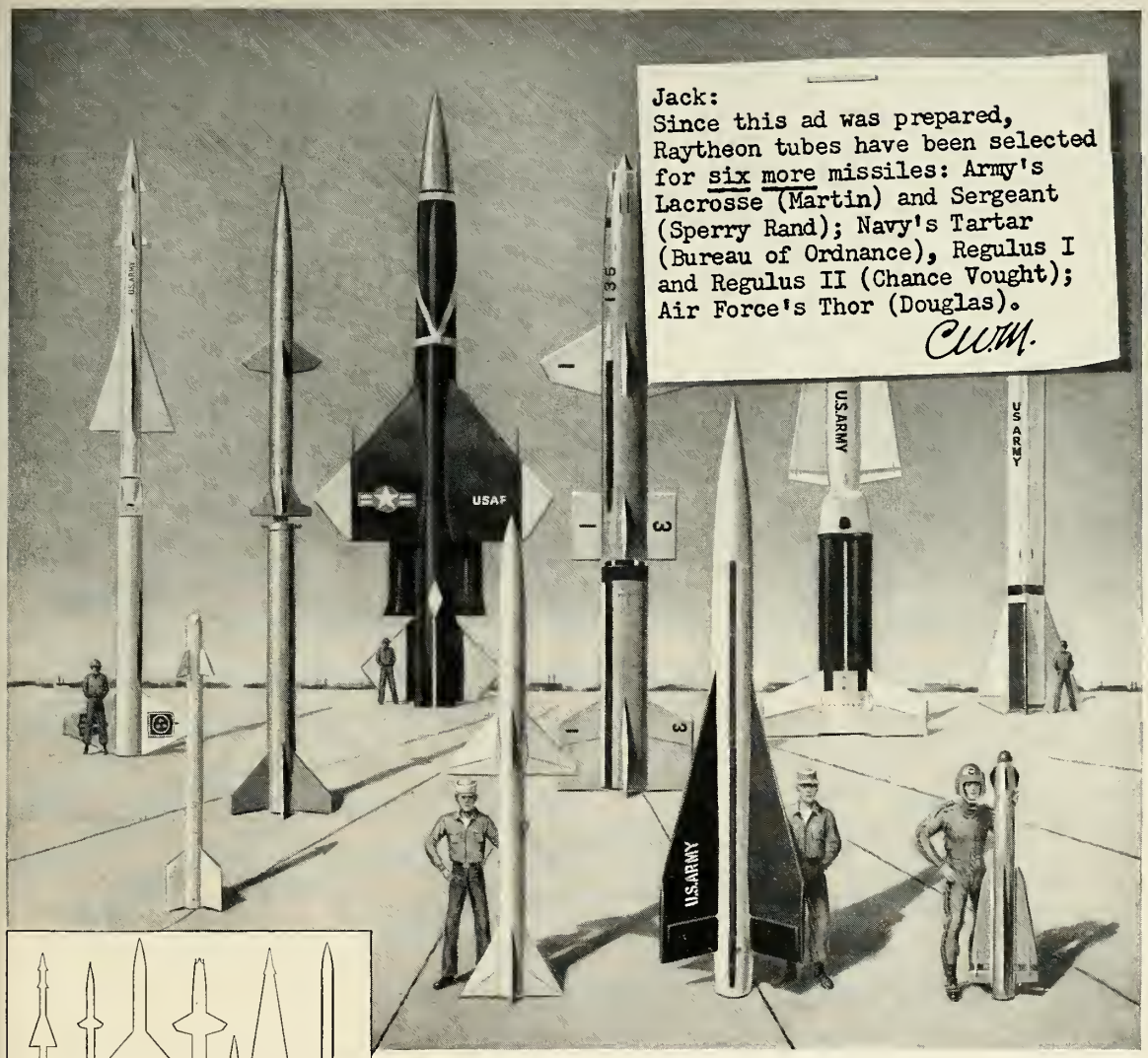
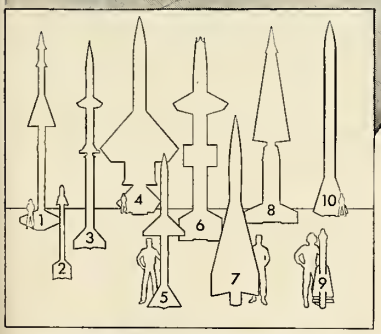


Jack:
Since this ad was prepared, Raytheon tubes have been selected for six more missiles: Army's Lacrosse (Martin) and Sergeant (Sperry Rand); Navy's Tartar (Bureau of Ordnance), Regulus I and Regulus II (Chance Vought); Air Force's Thor (Douglas).
CWM.



1. **Nike Ajax.** Army. Ground-to-air. Prime contractor: Western Electric.
2. **Sidewinder.** Navy. Air-to-air. Prime contractors: Philco; General Electric.
3. **Terrier.** Navy. Surface-to-air. Prime contractor: Convair.
4. **Bomarc.** Air Force. Ground-to-air. Prime contractor: Boeing.
5. **Sparrow III.** Navy. Air-to-air. Prime contractor: Raytheon.
6. **Talos.** Navy. Surface-to-air. Prime contractor: Bendix.
7. **Hawk.** Army and Marine Corps. Ground-to-air. Prime contractor: Raytheon.
8. **Nike Hercules.** Army. Ground-to-air. Prime contractor: Western Electric.
9. **Falcon.** Air Force. Air-to-air. Prime contractor: Hughes Aircraft.
10. **Corporal.** Army. Ground-to-ground. Prime contractors: Firestone; Gilfillan.

10 MAJOR U. S. MISSILES RELY ON RAYTHEON TUBES

Crushing acceleration and searing heat must be endured by the electronic tubes in guided missiles. Even under these grueling conditions, tiny Raytheon tubes produce guidance impulses with steadfast *reliability*. This reliability is achieved through capable engineering and painstaking manufacturing and testing techniques.

The choice of Raytheon Reliable subminiature tubes for use in these 10 missiles is another example of how the 31,000 men and women of Raytheon are contributing to the nation's security.

RAYTHEON

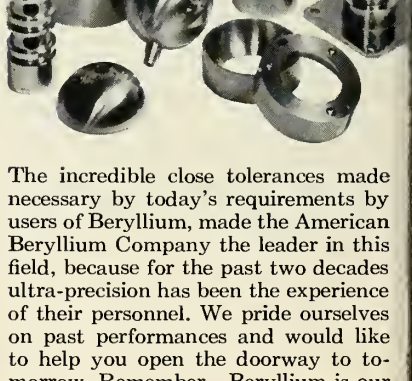
Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY, Waltham, Mass.

"BERYLLIUM"... IS OUR MIDDLE NAME

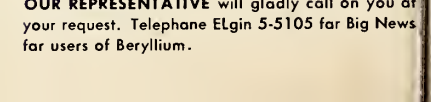
Experience is the best teacher and we have our Masters Degree in PRECISION MACHINING and FABRICATION of this atomic age wonder metal, BERYLLIUM.

You can expect the finest end product results when you deal with The American Beryllium Company. The heavy demand for our country's greatly accelerated missile and nuclear development programs brings the "Wonder Metal" — PURE BERYLLIUM — into the limelight.



The incredible close tolerances made necessary by today's requirements by users of Beryllium, made the American Beryllium Company the leader in this field, because for the past two decades ultra-precision has been the experience of their personnel. We pride ourselves on past performances and would like to help you open the doorway to tomorrow. Remember—Beryllium is our middle name.

SEND FOR OUR COLORFUL FREE BROCHURE — Complete information in full detail is yours. Wire-write, or phone. If you use Beryllium, you can use our services.



OUR REPRESENTATIVE will gladly call on you at your request. Telephone ELgin 5-5105 for Big News for users of Beryllium.

American Beryllium Company

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SARASOTA BRADENTON AIRPORT, P.O. BOX 3142, SARASOTA, FLORIDA

COVER: *Technicians from the Electronic Specialty Co., Los Angeles, position a scale model of a missile for tests of an integrated radiating system. Concept of systems engineering for complete communications package is thought to be necessity for missiles of the future (Page 30).*

missiles and rockets Vol. 4, No. 19, Nov. 10, 1958

Published every week by American Aviation Publications, Inc., 1001 Vermont Ave., N.W., Washington 5, D.C. Printed at the Telegraph Press, Harrisburg, Pa. Second class mail privileges authorized at Washington, D.C., with additional entry at Harrisburg. Copyright 1958, American Aviation Publications, Inc.

Subscription rates: U.S., Canada and Postal Union Nations—1 year, $8.00; 2 years, $12.00; 3 years, $14.00. Foreign—1 year, $20.00; 2 years, $30.00; 3 years, $40.00. Single copy rate—$.75. Subscriptions are solicited only from persons with identifiable commercial or professional interests in missiles and rockets. All subscription orders and changes of address should be referred to: FRANK R. WILLIAMS, circulation fulfillment manager.

in this issue

NOV. 10 HEADLINES

ASTRONAUTICS ENGINEERING

MISSILE ELECTRONICS

DEPARTMENTS

Every Job is an Interesting Job at DIVERSEY!

Above you see a recent one. It is a high pressure accumulator for a missile being finish machined by a Diversey craftsman. It's a tough alloy steel and the job requires closely controlled tolerances.

What makes this job interesting and significant to you is that Diversey can take a forging, run it through automatic contour turning operations, and finally apply the expert finish machining being done above.

Diversey does outstanding work in missile metal machining because they have the finest machinists, the largest facilities, and alert, capable, and progressive technical people. Bring your interesting and tough jobs to Diversey.

SEND FOR FREE BOOKLET

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FRANKLIN PARK, ILLINOIS • *A Suburb of Chicago*

FROM NOSE TO NOZZLE, FROM FIN TO FIN, CONTOUR TURNED PARTS—WITH PRECISION BUILT IN

In My Opinion . . .

. . . NASA is to be commended for its quick and foresighted action in taking immediate steps to invite industry to bid on our first worthwhile manned satellite study vehicle (see page 13). Only three weeks after its birth, NASA—on October 21—sent out a 31-page invitation to industry to bid. A classified meeting of interested bidders was scheduled to be held at Langley Field, November 7. Obviously, Administrator T. Keith Glennan is determined to show industry he means business. Congratulations!

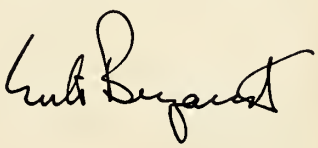
There's one important thing, however, that should not be overlooked about this undertaking: this is a joint NASA and ARPA undertaking! In the invitation to industry to bid NASA says in the very first sentence of the accompanying letter: "The National Astronautics and Space Administration, with the Assistance of the Advanced Research Projects Agency of the Department of Defense, is initiating a manned satellite project."

In other words, one of our first and most important space projects to date is scheduled as a joint ARPA-NASA venture; obviously because of the overlapping military and scientific interests. This approach has been and will continue to be inevitable for most space projects as long as the world is not at peace.

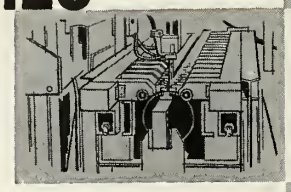
It is gratifying to us that one of the country's top astronautics experts, ARPA's Captain Robert Truax, in a speech before the American Rocket Society's National Capital Section in Washington a week ago, constructively suggests the establishment of a Space Center to coordinate ARPA and NASA programs for the sake of efficiency and practicality. It is also worth while to note that Truax' speech was cleared by Murray Snyder's security review censors—which might indicate that the Truax proposal possibly has the blessing of the Department of Defense.

Truax believes some of our actions in the past year have been somewhat frantic and not too well considered. Fortunately, he says, only three actions are necessary to set us on the right track. First, we must create an integrated organization devoted to the technical planning and management of the space program and answerable to both ARPA and NASA. Second, we must realize that the conquest of space is primarily an engineering problem to achieve a military objective, not, perhaps unfortunately, a scientific problem to achieve a humanitarian objective. Thirdly, we must devote a major effort to larger and more efficient space vehicles. Truax also added a fourth: "We must reach an adequate level of financing and sustain this level until we are definitely the world leader in space. The alternatives to what I propose are either tremendous expense, permanent loss of control of space to the U.S.S.R., or both."

We agree with you Bob Truax—one hundred per cent.



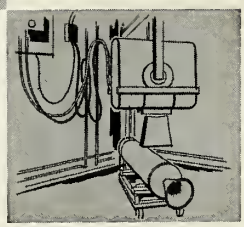
CAPABILITIES AND FACILITIES

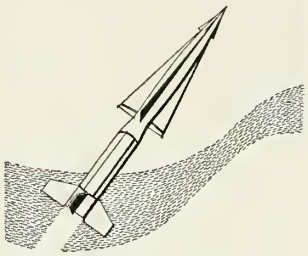


Now methods in forming rocket motor body shell.

Welding facilities assure strong, uniform welds.

Xray-inspection before annealing.





National Electric's Contribution to The Rocket and Missile Program

ENGINEERING... A staff of engineering specialists with extensive backgrounds in physics, mathematics, stress analysis, metallurgy, thermodynamics, hydraulics, electronics and structural, mechanical and electrical design. Their efforts have resulted in mass production methods and techniques for the fabrication of rocket bodies and components faster, more economically and to closer tolerances than ever before achieved.

RESEARCH AND DEVELOPMENT... Since 1949 National Electric has been executing classified research and development contracts for the government. The results . . . an enviable record of pioneering achievements in the production of rockets and guided missiles . . . from the first Jato motor bodies to the famous Nike Hercules.

MASS PRODUCTION... Mass production has been achieved through continuing technical advancements and modern techniques. Currently extensive research and development projects are being conducted on several highly critical and important rocket motor bodies including mass production on the Nike Hercules.

Write for your free copy of our Rocket and Guided Missile booklet. Our experience can be an added asset to your experience.

A NATIONAL ELECTRIC FIRST

Advanced heat-treating methods developed by National Electric provide new and highly important br through in rocket and missile production.

NATIONAL ELECTRIC PRODUCTS — ROCKETS • MISSILES

ROCKET AND GUIDED MISSILE DIVISION

National Electric Products Corporatio

TWO GATEWAY CENTER • PITTSBURGH 22, PA.

washington countdown

Lunar probsters preparing . . .

for November attempt as m/r went to press. High hopes were held for the shoot scheduled for early morning hours of November 7. NASA was to have had complete control with an information center in Washington. Steps have been taken to remedy control problem which prevented October vehicle from attaining programmed velocity because of guidance error. Increased angle caused gravity measuring gear to be shutting off first stage with several seconds fuel remaining.

Third probe . . .

except for improved scanner, will be essentially the same. NASA estimates chances of complete success (moon orbit) are about 25-to-1. Speed of 24,000 mph is required with guidance angle accuracy within 0.2 degrees.

Space Liaison Board . . .

named last week should lessen chances of future hassles such as developed when NASA asked for Army's Huntsville scientists. President named William M. Holaday as chairman of the civilian-military liaison committee for space and air matters. This may indicate that Holaday's position as director of guided missiles could be eliminated when a DOD Director of Research and Engineering is appointed. NASA members are: Hugh Dryden, Abe Silverstein, Homer J. Stewart and Ira H. Abbott. Military will be represented by one civilian—ARPA Director Roy Johnson—and three service reps: Maj. Gen. W. W. Dick, Army; VAdm. R. B. Pirie, Navy; and Maj. Gen. R. P. Swofford, Air Force.

One report . . .

gaining momentum in Capital circles is that DOD asked NASA to take Army space team and not vice versa, in an effort to solve some of the roles and missions problems. Could this account for DOD looking other way while Army's Trudeau and Maderis openly protested proposal?

No limitless budget . . .

is envisioned for NASA. Presidential Space Advisor Killian's suggestion for unlimited funds for investigating space isn't seriously taken at NASA. First, it takes some time to organize, even to spend money. And, Harry Byrd is still chairman of the Senate Finance Committee.

Deep in the heart of . . .

Texas will be the first *Nike-Hercules* sites for the Lone Star state. Contract for $4.1 million went to Kind Construction of Texarkana for work on four *Hercules* air defense sites in Dallas-Fort Worth area.

"Shrine of secrecy" . . .

is scored by report from the Moss Congressional committee on information. "Congress is no longer a band of silent men," the report said, and the right to know is fundamental. Report lists legislative developments in this area during the 85th Congress, which "serve as a warning to those executive officers who continue to worship at the shrine of secrecy."

Setting sights on sites . . .

is as far as U.S. has gone in locating missiles overseas. Trouble stems from agreeing to British insistence that natives man the bases in UK. Now other nations want to do same, but lack technical personnel. The three British sites are the only ones really nailed down for *Thors* or any IRBM. Three other *Thor* squadrons are planned for Alaska, and three are hoped for in Turkey, but that will take time.

***Jupiters* to Italy . . .**

is another fond hope, but not definite yet. Failure of France to close deal for *Jupiter* set search in motion for other homes.

***Nikes* are being readied . . .**

for deployment to several areas including Holland, Norway and Italy. Meanwhile, reports persist that when NATO countries demonstrate ability and know-how to make them, they will get blueprints for *Hawk* and *Sidewinder*.

R&E Director . . .

still wanted and military missile men are concerned about the failure of the administration to find someone to take the job with only two years of administration remaining, top jobs continue to go wanting. And when they are filled it is by "alternates", several steps down the line.

New extreme-high-temperature lubricants for missiles and supersonic aircraft **SHELL ETR GREASES**

One of the serious lubricating problems faced by designers of missiles and supersonic aircraft has been solved by scientists at Shell Research Laboratories.

The problem: to find a grease which would permit components to operate with certainty under extreme high temperatures. Co-operation with representatives of bearing manufacturers and military personnel resulted in a completely new class of greases—SHELL ETR GREASES.

These greases can easily withstand temperatures up to 600°F. They give superior lubricating performance because of a special thickener—an organic vat dye—which has exceptional heat stability and jelling efficiency.

If you are presently in the market for an ultra-high-temperature-range grease, we will be glad to provide more information on Shell ETR Greases.

SHELL OIL COMPANY

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SHELL

industry countdown

Bright earning outlook . . .

for Thompson Ramo-Wooldridge Inc., the name of the affiliate property acquisition of Thompson, is predicted. Total sales for the merged company is expected to be in excess of $325 million with a promise of an upward trend in sales and earnings for fiscal 1959. Space Technology Labs, which has been an autonomous division of Ramo-Wooldridge, was established last month as a separate subsidiary corporation with complete operational independence.

The heralded misfire . . .

of the Navy's second operational test *Polaris* could be attributed to propellant casing failure. Aerojet, propellant contractor, reports that the casing stress band at the top of the first stage gave way with the resultant loss of the upper chamber head. With the complete loss of pressure, the propellant proceeded to burn steadily for six minutes. The second stage blasted off eight-tenths of a second later when flames from the first stage entered the nozzle. However, a top ranking Navy official said *Polaris* failed when a malfunctioning of part of the destruct system lead to an abortion of the first stage and set off the firing mechanism of the second stage. Take your choice.

First *Nike-Hercules* inspection . . .

was made last week at the Douglas production plant at Charlotte, N.C. DOD has announced that both *Hercules* and *Bomarc* will be used as part of air defense of the U.S., apparently putting to an end the hassle over the respective merits of the two systems and any decision of one missile being selected over the other. This is in line with the defense-in-depth concept, dictating the employment of both. *Hercules* kill radius—30 to 75 miles, *Bomarc* kill radius—100 to 250 miles. *Hercules,* according to AOMC's General Medaris, can handle any foreseeable air threat for the next five years.

North American forms . . .

new rocket development group at its Rocketdyne division for ARPA-ABMA clustered engine booster program. First work will be in connection with the H-1 satellite boost engine. The H-1 will use eight *Jupiter* engines clustered and manifolded into a single thrust unit developing 1.5 million pounds.

American Rocket Society . . .

Army Engineers and several missile industries have started a pioneering education program for space engineers and scientists of the future. The ARS National Capital Section in cooperation with the Army Engineers and missile industries has started a course for science teachers and students in the safe methods of high school education. Industry cooperation in the Capital area includes: Aerojet-General, Atlantic Research, Diversey Engineering, Melpar, Rocketdyne and Thiokol.

ARPA's look to the future . . .

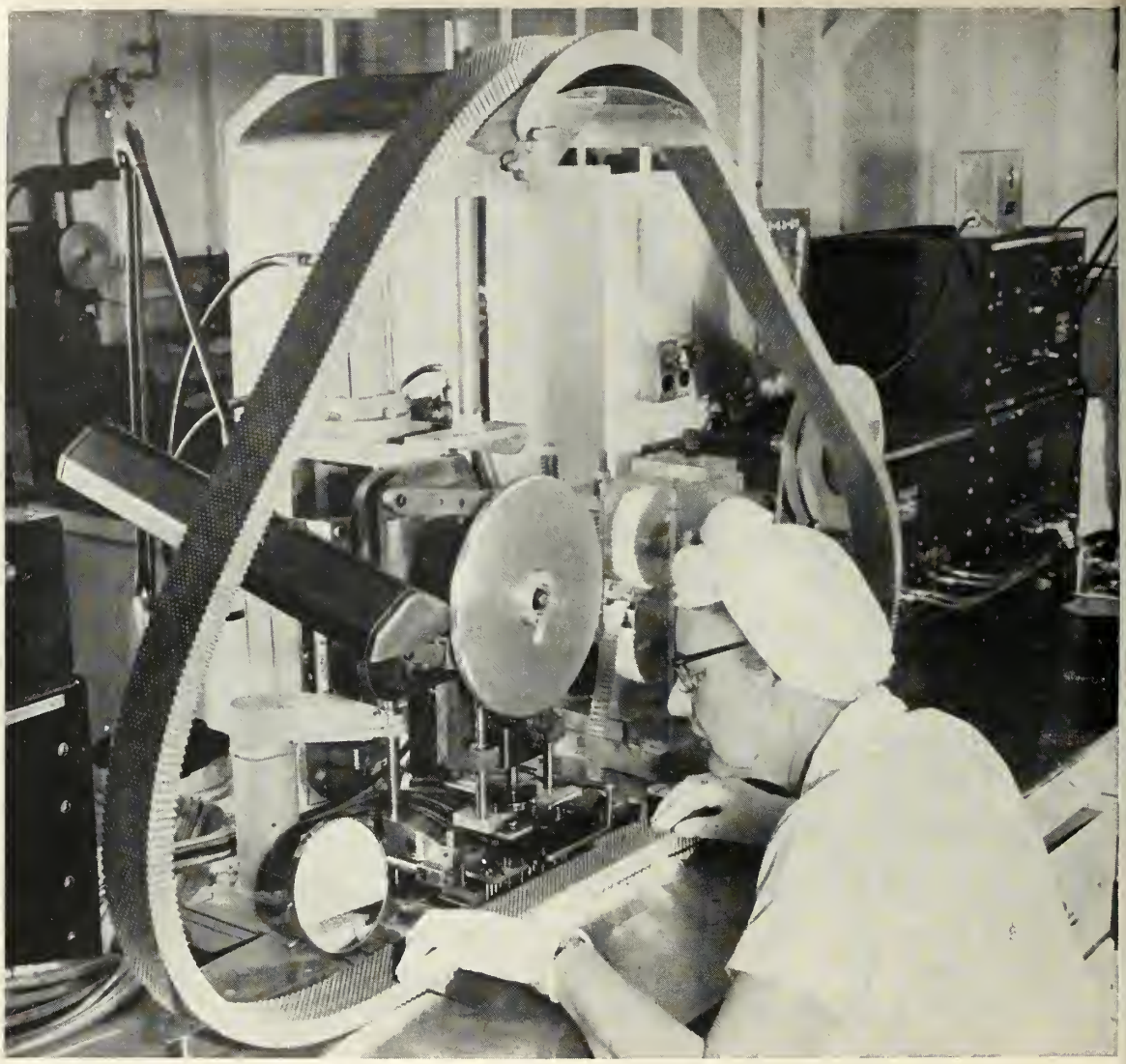
was further exemplified by its authorization to the Army, Navy and Air Force to negotiate major research contracts with four leading chemical companies for new chemicals in the solid propellant field. The firms are Dow Chemical, Esso Research and Engineering, Minnesota Mining & Manufacture and American Cyanamid. ARPA told m/r that this is not a propellant improvement program but an effort to move into an entirely new realm of solid development by searching for untried chemical formulations. Current solids use off-the-shelf chemicals that have been researched to the near maximum in an effort to increase their power output.

Research contracts target date . . .

is December 1, when $4 to $8 million will be awarded to the four selected companies at unit values of $1 to $2 million each. Thirty firms submitted bids in long range programs with ARPA selecting from eight. The contracts will call for out-of-the-lab small scale static testing.

Contracting procedures . . .

of the National Aeronautics and Space Administration will be handled in accordance with the Armed Services Procurement Act. NASA will have a major procurement and contracting program and will continue to purchase those types of services, materials and equipment ordinarily associated with the work at the laboratories it acquired from NACA. NASA plans to advertise for competitive bids whenever the Space Administration's requirements can be clearly defined. Contract awards on a fixed price basis will be made to the lowest responsible bidder. Contracts will be negotiated by NASA with educational institutions and other non-profit organizations, and small business firms will be given the opportunity to participate in supplying NASA procurement needs to the maximum extent practicable.



Solar skills—and unique techniques—produce top-quality all-metal honeycomb structures

PRECISION CORE is a fundamental requirement for top-quality all-metal honeycomb structures. At Solar, accuracy and uniformity are maintained by manufacturing core material on Solar-developed core-welding machines. A result of more than six years of research and development...the machines produce the core by forming foil-thin ribbons into corrugated strips and welding them together layer by layer. Materials used include PH15MO, 17-7PH, T-321, Inconel alloys, L-605, AM-350, AM-355 and A-286. Today, Solar honeycomb is being used in strong, lightweight structural panels for the B-58 and other leading jet aircraft, in gas seals for turbine engines, and in rocket and missile components.

Solar's automatic core manufacturing techniques—*plus advanced panel fabrication and assembly methods*—assure you of top-quality honeycomb structures that will withstand stringent service conditions. For complete information on how Solar's precision all-metal sandwich structures can serve you better, write to Dept. F-81, Solar Aircraft Company, San Diego 12, California.

SOLAR
AIRCRAFT COMPANY
SAN DIEGO
DES MOINES

NOVEMBER 10, 1958
VOL. 4, NO. 19

missiles and rockets
MAGAZINE OF WORLD ASTRONAUTICS

A m/r Exclusive

Atlas Will Fire First Manned Satellite

Specifications and flight program of the United States' first orbital manned satellite capsule which will be launched with an *Atlas-D* ICBM from Cape Canaveral have been learned by m/r. Details of the program were to have been given November 7 at Langley Field, Va., to 30 competing contractors attending a National Aeronautics and Space Administration bidders conference.

The unclassified specification prepared by NASA, with the assistance of the Advanced Research Projects Agency, outlines the technical design requirements for a manned satellite capsule to be used in initial research on manned space craft. It is concerned primarily with the psychological and biological aspects of the space environment and problems associated with the launch, orbiting and re-entry of manned vehicles.

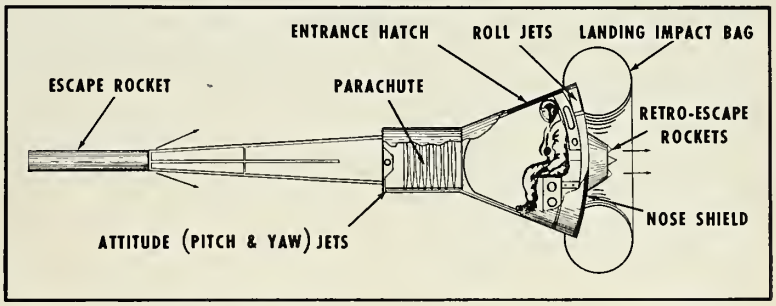
At the close of the November 7 meeting, manufacturers were to be invited to draw up formalized specifications, progress schedules, and estimates of contractual costs based on the formalized specifications.

Target date for submitting bids has been set for December 4. The contract for the complete satellite capsule, including design, fabrication and/or procurement, integration, and installation of all components will be awarded to the successful bidder within months, possibly after the first of the year.

• **Primary mission**—All the missions planned would be designed with a capability of accomplishment with or without a human occupant. First flights are expected to be with dummy payloads for evaluation of the launch safety factors of the mission. Later, appropriate animals will be sent aloft to determine biological reactions.

The capsules will be launched into semipermanent orbits and returned to the earth at a predesignated time and position with retro-rockets and aerodynamic drag. For the first orbital missions, two complete orbits are desired, although an arbitrary 18 cycles is considered possible. The vehicle will be equipped to stay in orbit for a maximum of 28 hours.

The capsule is to be designed (see illustration) to replace the nose cone of an *Atlas-D* (operation) ICBM with a minimum of modifications. The *Atlas* booster will be a standard weapon vehicle with no modifications in the propulsion system. An escape rocket mounted on the forward end of the capsule structure and designed to fire aft would lift the package free of the booster in case of failure. Retro rockets located on the base of the capsule for decay of re-entry velocity and *Atlas* nose cone separation rockets could assist the escape separation if deemed necessary.



NASA-ARPA Manned Satellite Concept

Attitude (pitch and yaw) and roll jets will position the capsule for proper re-entry. The satellite passenger will be traveling forward during the accelerating phase of the flight and in a rear-

(Continued on page 16)

U.S. Mobilizes Foreign Brains

by E. E. Halmos, Jr.

Despite criticism from the home front and abroad, the United States has done—and is doing—a great deal about mobilizing the brainpower of the free world for defense. At this moment, for example:

Several hundred European scientists, working under some 350 contracts, are pushing ahead investigations of pure scientific phases of space operations.

More than $40 million is invested in assistance to seven European nations to aid them in development of missiles and military hardware.

Information of highly technical—and often classified—nature is being exchanged daily.

And, although the net gain is a very difficult thing to evaluate, military men in charge of the programs are certain that the U.S. is getting somewhere in the neighborhood of five times its money's worth out of the program.

Amid the vast and confusing complex of agreements under which the U.S. has undertaken to aid its allies and protect itself since World War II, it is not surprising that the very real work on scientific subjects and on modern weaponry has been obscured in recent years.

A foreign scientist, working under a $2,000 grant in some foreign university on a subject such as mathematical formulas that will explain certain aspects of gas dynamics, does not make a spectacular subject on which a politician can base a public-winning speech.

But in the current context of an almost desperate search for scientific know-how with which to bolster defense of the free world, it is of major importance that industries in the U.S. which support missiles are made thoroughly aware of what is being done, and how.

• **Where and how**—With particular reference to missile work, the effort to mobilize foreign brainpower falls into two categories:

1—Matters of direct military application, administered by the Defense

(Continued on page 14)

Department's four-year-old Mutual Weapons Development program headquartered at Paris;

2—Work in the fields of pure science being conducted under direct supervision of Air Force and Army R&D teams, working out of central offices in Brussels. (The Navy also has R&D teams at work in the latter field, but most of the investigations under this program are concerned with purely nautical matters.)

The MWD program, set up under a provision of the 1953 Mutual Security Act, has had funds of up to $50 million within one year for its programs. The special R&D activities of Army and Air Force have in fact no money of their own—they act, in effect, as brokers of scientific research between European sources and U.S. agencies which supply funds.

Neither program is buying any actual hardware. The MWD group aids the R&D agencies of a foreign country (through government-to-government agreements) to develop missiles or missile components that can best add to the defensive capabilities of the country concerned.

In return for its monetary and technical aid, the U.S. also gets "first refusal" on the weapon or component, and complete information on its development including theory. Other allied nations have access to the weapons and the data as well.

• **Results**—Under the MWD program, the United States is bound by its agreements to observe classifications on information imposed on the project by the country doing the development. Thus if France, for example, determines that some of its work is "top secret," U.S. authorities may not release information on this work to other than authorized recipients. It is thus difficult to designate specific results.

However, one example of the MWD projects is France's wire-guided anti-tank missile, the SS-11, which can be fired from its container, from a vehicle, a helicopter or an airplane, and is guided by a "joy stick" control to its target. This missile is now being made available to free-world countries by France.

Another yardstick of the MWD work can be obtained through figures:

From 1954, when the program started, through June of 1958, a total of $385,864,739 had been spent by the U.S. and seven nations (France, Western Germany, United Kingdom, Norway, Belgium, Italy and The Netherlands) on MWD projects. Of this amount, the U.S. supplied $156.7 million, the "countries of origin" contributed $229.3 million.

ARDC and Army R&D programs are even harder to measure by material results, since their objective is most often pure research information. But at the moment, the two services have more than 350 individual contracts in force with individuals and universities abroad, averaging perhaps $3 million or more per year.

• **Teams represent services**—The Mutual Weapons Development program is administered by the Assistant Secretary of Defense for Research and Engineering and the Assistant Secretary of Defense for International Security Affairs. The program's field work is carried on through the MDW teams headquartered in Paris.

These teams represent the three military services, operating out of the office of the defense advisor to the U.S. Ambassador to NATO, under government-to-government agreements.

The MWD teams annually screen proposals submitted by the participating countries and recommend certain of these proposals. These recommendations are in turn reviewed by the U.S. element of SHAPE (Supreme Headquarters, Allied Powers in Europe); reviewed again by technical staffs of the military departments; and still again by a steering group composed of outstanding civilians and consultants familiar with the problems confronting the U.S. in providing assistance to its allies.

When this review has been completed, and projects are selected in accordance with budgetary requirements, the individual countries are given a go-ahead for development work during a stated period of time. U.S. technical specialists and information are made available, and the teams monitor progress of the programs.

The R&D work is administered directly by the Army and Air Force, with small highly trained technical groups headquartered in Brussels.

These groups work on an entirely different basis. The officers—out of uniform—attend scientific meetings and otherwise mingle with the European scientific community, seeking out men and work that may be of interest. The area in which these groups work is again not limited to NATO countries.

• **Working operation**—Contact is established with a European scientist who has an interesting investigation to report or underway. In a series of personal visits and communication, U.S. specialists determine that the project may be of value. The scientist is then asked to submit a brief proposal outlining his work and the results he expects to achieve, along with probable costs and time involved.

Since the R&D teams have no money of their own, these proposals are reviewed and passed on to appropriate agencies in the U.S. that have money for such work—such as the Air Force's Cambridge (Mass.) center. Scientists there evaluate the proposal further, and, if approved, pass on to the R&D team the authority to contract for the work at a specified amount.

U.S. officials say the results have been amazing from a cost viewpoint. European universities can undertake work of this kind at anywhere from a third to a fifth of the cost of similar work in the U.S.

Some of the projects now under way include: basic research in metal corrosion, at the University of Modena, Italy, for one year, cost $8,500; thermochemistry of selected radical recombinations, at the University of Lund, Sweden, two years, cost $22,500; interaction of sound and turbulence, at the University of Gottingen, Germany, one year, cost $3,000.

The results of these investigations are first made available to the agency paying for them; then are circularized to interested U.S. industry and then made available through ASTIA.

Top Brains at Work For U.S. and Free World

Some of the free world's most famous scientists are now at work for the U.S. and its allies, gathering scientific information applicable to problems of space flight and missilery.

Working for Air Force ARDC, under a total of some 270 current contracts, are such top names as these:

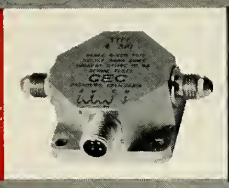
Prof. G. Bianchi, University of Modena, Italy.
Dr. Stig Sunner, University of Lund, Sweden.
Prof. W. Tollmien, University of Gottingen, Germany.
Prof. Toraldo di Francia, University of Florence, Italy.
Prof. I. Prigogine, University of Brussels, Belgium.
Dr. Marcel Levy, the Sorbonne, Paris.
Prof. Beat Hahn, University of Fribourg, Switzerland.
Prof. Kai Sigbahn, University of Upsala, Sweden.
Prof. Pol Swings, University of Liege, Belgium.
Prof. S. Gorodotzky, University of Strasbourg, France.

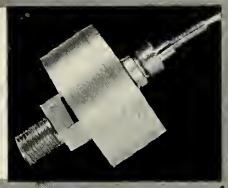
input devices

HIGH-TEMPERATURE PRESSURE PICKUPS

VIBRATI N PICKUPS

POTENTIOMETER PICKUPS





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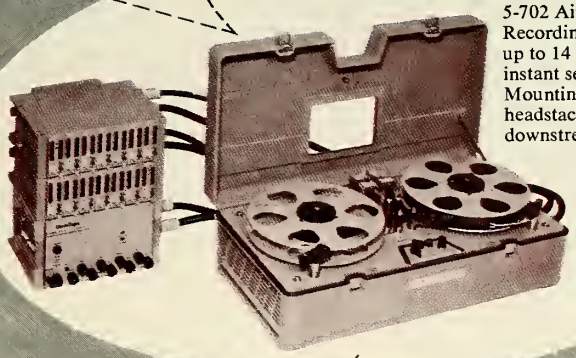
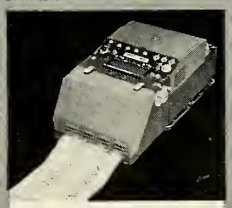
airborne recording system



5-702 Airborne Magnetic Tape Recording System provides up to 14 tape tracks, instant selection of tape speed. Mounting of reproduce headstacks permits downstream monitoring.

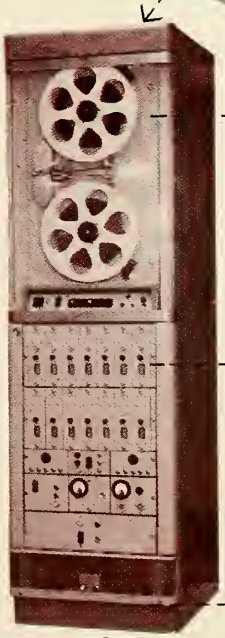
readout devices

MULTI-CHANNEL OSCILLOGRAPHS AND DIRECT-WRITING DATARITE MAGAZINES



CATHODE-RAY RECORDING OSCILLOGRAPHS

MILLISADIC HIGH-SPEED DIGITAL DATA PROCESSING SYSTEMS



ground recording system

5-752 Magnetic Tape Recorder/ Reproducer System features all-metal-surface magnetic heads to minimize wear. . . lower flutter, even at low tape speeds . . . complete front access.

ward-facing position during the re-entry deceleration phase. A heavy metal shield (at the passenger's back) will absorb or radiate the aerodynamic heat of re-entry. After the velocity has been sufficiently diminished, the shield will be ejected, parachutes will be forced into the slipstream, and a rubber landing bag will be inflated.

Launch will be from Cape Canaveral with direction of orbit initiation from 30 degrees north or south of east. The first flights for testing the components will be over the instrumented range to Ascension Island. Inhabited flights will be launched in a direction most suitable for an optimum recovery range.

The manned capsule, including the escape system components, has an effective launch weight target value of 2,400 pounds. Actual capsule weight that will be projected into orbit will be about 2,000 pounds. The escape system, consisting mainly of a forward thrust rocket and supporting framework, will be ejected after separation of the *Atlas* nose cone instrumentation section from the booster section. An extremely rigid orbit altitude requirement will demand precise power control and guidance. Orbit will be almost completely circular with an apogee of 120 nautical miles and a perigee of 110 nautical miles. This will require an eccentricity of no greater than five thousandths (0.005).

• **Recovery**—Initiation of the re-entry maneuver will take place at a point calculated to bring the capsule to an impact point as near the launching station as possible. In an emergency, the re-entry can be started at any point in the orbit. This is the reason for the critical tolerances in orbit altitude requirements.

Once the capsule is in orbit and approximately parallel with the earth's surface, the attitude jets will be activated to bring the payload into correct position for re-entry. Up until this time the passenger has been facing forward with the metal re-entry shield at his back. As the pitch jets flip the capsule over the roll jets rotate the vehicle in order to keep the passenger in an upright position.

When the manned vehicle has decelerated to a velocity of Mach 1, a drogue parachute will be deployed to provide additional dynamic stability. Provisions will be made for the inclusion of two landing parachutes in the case of failure of one. The first parachute will be deployed at an altitude high enough to allow time for the deployment of the second if necessary. Sinking speed will be 30 feet per second with a theoretical impact altitude of 5,000 feet.

Although it is planned to attempt recovery over water, the capsule will, in addition to its buoyant and water-stable characteristics, be designed for maximum protection from serious injury under conditions of land impact.

The vehicle will contain sufficient power and supplies to sustain the occupant and the recovery system for 12 hours after landing. Total internal operational capability—40 hours.

• **Design checkout**—Several checkout missions will be conducted prior to the first manned flight. Capsules, loaded with equipment and telemetry instrumentation, and later with monkeys aboard will be fired over the Cape Canaveral range for entry and recovery simulation. Accelerations and decelerations will be the same as those that will be experienced during the later space flight phase of the program. Acceleration and deceleration will not exceed nine "gs" (*Atlas* operates at less than this). This may be similar to Army's *Project Adam* proposal (m/r, June, 1958, p. 40).

The entry and recovery phases of the checkout flights will be carried out in the same manner as the orbiting flights. Until the *Atlas* is available for the flight simulation program the *Thor* or *Jupiter* IRBMs might be put into service.

• **Escape system**—Maximum emphasis will be placed on the safety of the passenger. An automatic payload separation and ejection system will be active until five seconds after the *Atlas* booster burnout. The system will stop the flow of propellants to the engines (either booster and/or sustainer, depending upon phase of burning) and a solid propellant escape rocket will be fired to separate the capsule from the *Atlas*.

If escape is necessary after the booster engines have burned out and the sustainer is still firing, the *Atlas* nose cone separation rockets will be fired to push the capsule farther from the booster. The retro-rocket system can also be fired to give an additional velocity increment.

The escape rocket system will provide enough thrust to accelerate the payload 250 feet during the first second at pad-phase of launch and to a maximum altitude greater than 2,500 feet from ground zero. From X minus zero to the burnout of the booster engines (approximately 160 seconds) the capsule must also accelerate to a minimum lateral velocity of 30 feet per second during the first second to carry it away from the path of the booster system. An automatic monitoring system for detecting unsafe conditions during launch and for aborting the booster is receiving top priority.

Missile Investments Boosted in Chicago

Stocks of missile companies recently received major attention at the Mutual Fund Convention in Chicago. Missiles-Jets & Automation Fund, which specializes in such securities, presented a program featuring astronautical scientists and had an exhibit of missiles. Some 1,000 mutual fund specialists attended the convention.

The Fund was described to the delegates as the first of its kind organized—not by Wall Street—but by men active in astronautics technology. Dr. Theodore von Karman, chairman of AGARD, is chairman of the Board, and Andrew G. Haley, president of the International Astronautical Federation, is president.

Dr. Wernher von Braun and three members of the technical advisory board, Dr. C. C. Furnas, Dr. Edwin R. Gilliland and Dr. Athelstan Spilhaus, were speakers.

Firms Bidding on NASA Satellite Capsule

The 30 firms invited to bid in the NASA-ARPA manned satellite capsule program, included:

Aeronutronics Systems, Glendale, Calif.; American Machine & Foundry Co., New York City; Avco Manufacturing Corp., Lawrence, Mass.; Bell Aircraft, Buffalo, N.Y.; Boeing Airplane Co., Seattle, Wash.; Chance Vought Aircraft, Dallas, Texas; Aerophysics Development Corp., Santa Barbara, Calif.; Convair, San Diego, Calif.; Cook Research Lab., Chicago, Ill.; Douglas Aircraft, Santa Monica, Calif.; All-American Engineering Company, Wilmington, Delaware; United Aircraft Corp., East Hartford, Conn.; Winzen Lab., Minneapolis, Minn.; Northrop Aircraft, Inc., Hawthorne, Calif.; Ramo-Wooldridge Corp., Los Angeles, Calif.; Republic Aviation Corp., Farmingdale, Long Island; Ryan Aeronautical Corp., San Diego, Calif.; Lear Inc., Santa Monica, Calif.; Allison Div., General Motors, Dayton, Ohio; Sperry Gyroscope Co., Great Neck, L.I.; Westinghouse Electric Corp., Washington, D.C.; Aero-Jet General, Azusa, Calif.; Fairchild Engine & Airplane Corp., Hagerstown, Maryland; General Electric Co., Philadelphia, Pa.; Goodyear Aircraft Corp., Akron, Ohio; Grumman Aircraft Engineering Corp., Bethpage, L.I.; Lockheed Aircraft Corp., Burbank, Calif.; Martin Co., Denver, Colo.; McDonnell Aircraft Corp., St. Louis, Mo.; North American Inc., Los Angeles, Calif.

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℞ 410-U	410	51410	5350B	A296-49T	MIL-S-16993A	05913T
℞ 416-U	416	51416F	5619E	A276-49T	MIL-S-862A-6	05910T

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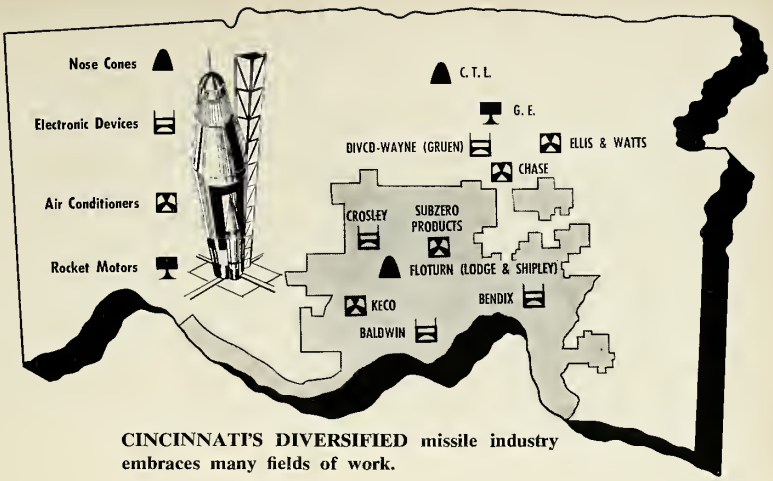
Area occupies strong secondary position in parts manufacturing



CINCINNATI'S DIVERSIFIED missile industry embraces many fields of work.

Cincinnati: Job Shop for Missile Industry

by John C. Smith
Special m/r Correspondent

CINCINNATI—Diversification, long a Cincinnati watchword, has somewhat obscured the rise of the missile industry in the Cincinnati area. The area's contribution to the missile business is kept in the background by this diversification.

"Made in Cincinnati" appears on very few products, but few products are made that do not contain parts made in Cincinnati or produced on Cincinnati-made machinery. Here's why:

Area industry occupies a strong secondary position in the missile age. Relatively few "end products" are produced. Mostly, it is supporting elements for other industries and products. A big job shop, in other words. But the supporting role is of an essential nature to the missile business. Scope of activity can best be described by the industries themselves. Here's what they are doing:

• General Electric

Rocket motors and jet engines are made at General Electric's plant in Evendale. GE built the X-405 rocket motor for the *Vanguard* first stage and is building the *Regulus II* J-79, plus power for the F-104 and the B-58. The J-93, reportedly a "chemical" jet engine, is under development.

A "stretch-out" in defense orders caused layoffs, trimming the plant force at Evendale to 14,000 at the start of 1958. But employment has climbed to 15,000. Recently, the Aircraft Nuclear Propulsion Department received $3.8 million from the AEC to increase and improve equipment. Some viewed this as a hint that a production-type atom engine may be near. Operating expense for the AEC at Evendale for fiscal 1959 was reported to be $45.7 million.

In June, transfer of the Electric-Auto-Lite buildings adjacent to GE boosted floor space to five million square feet and acreage to 405. This is part of the three-year, $500 million expansion plan now in its third year. The Auto-Lite complex added 14 buildings, 135 acres and three million square feet of floor space. Price, around $15 million. The weekly payroll now is $1.5 million.

• Avco-Crosley

The Crosley Division of Avco Manufacturing Corp., with headquarters in a plant in Evendale too, makes an interesting study in change. During World War II Crosley was pretty well taken up with war work. In 1946, Avco made Crosley a full operating division and the company went into the appliance and television fields. Then in 1956, Crosley almost entirely withdrew from appliances to intensify defense work. Until recently, defense work was about 70%. Now Crosley is moving the other way again, trying for a 50-50 basis.

Crosley's Nashville plant produces airframe components and soon will produce a new stainless steel honeycomb sandwich, called Avcomb, which will be useful for missiles. It reportedly has the strength of solid steel at tenth the weight and can take air friction temperatures up to 600 degrees F.

Crosley's Richmond Division makes stabilizer assemblies for the Hughes *Falcon* and metal shipping containers for the missile. Other parts that have been manufactured at Richmond include rudder drives for the *Redstone, Jupiter* and a major part for the *Sergeant.*

The Arlington Street Plant in Cincinnati is manufacturing a command receiver unit capable of command and destruct. Crosley long has been associated with fuzing in the missile and rocket field and has worked with the Navy in developing fire bombs.

In July, Crosley received a contract for mobile radar, worth $5 million. This, and a *Polaris* electronics contract is pushing Crosley past the $50 million mark in 1958.

• Keco Industries

Largest of four Cincinnati area firms in the specialized refrigeration field, Keco Industries, Inc. supplies a unit to cool electronic equipment for the *Atlas* during pre-launch checkouts. The unit disconnects upon firing. With a volume of approximately $4 million a year, Keco employs 200 persons.

• Other Industries

Cincinnati Sub-Zero Products makes equipment for rivet storage, cold-stabilization of metals, expansion fitting and environmental testing.

Ellis & Watts Inc. provides cooling for electronics in mobile vans, dry air for pressurized radar wave guides and temperature stability for radomes to

. . . Cincinnati

abet radar accuracy. It has 80 employees; a 22,000-square-foot factory, and a volume of $1 million last year.

Chase Industrial Refrigeration Equipment & Engineering Co. is mostly in aircraft ground cooling units. Navy is its big customer. The units are mobile trailers designed to supply cooling for aircraft electronics during checkout on the ground.

• Cincinnati Testing Labs

Cincinnati Testing & Research Laboratories (CTL) developed the nose cones used in *Jupiter* tests this summer through its "Floturning" process; a method of cold-working metal. It was used also to form the nose cones for *Explorer* satellites.

CTL is working on the re-entry body for *Polaris*. A preliminary contract was reported at approximately $500,000. The company was founded in 1946 as an independent testing laboratory for high temperature and structural plastics. Test equipment and facilities for limited production are housed in a 21,000-square-foot structure.

The company is an illustration of local boys making good. The founders are Elmer P. Warnken, president; and Melvin N. Korelitz, vice president and treasurer, both chemical engineers. CTL has 75 employees and holds 11 patents in plastics rotor and stator blades for jet engines. Other products include rocket nozzles for the third stage *Vanguard* rocket, blast tubes for *Talos* and *Terrier* missile and parts for *Juno II*.

• Formica Corp.

Formica Corp., subsidiary of the American Cynamid Co., known for

NOSE CONE for *Explorer* is product of Cincinnati Testing Labs. "Floturning" is the process.

burn-resistant laminated plastic table and counter tops and surfacing material for homes and business, produces bases for printed circuits widely used in the electronics industry. Formica's copper clad laminated plastic cards are used in the miniaturized circuits of the *Vanguard* satellite.

Another grade, FF-89 for printed circuits, can be "rolled up and tucked away in a corner." Modified Formica FF34 is used by the Temco Aircraft Corp., in the XKDT-1 *"Teal"* target drone. The laminate serves as a thermal barrier between the solid propellant motor and the motor case and also is insulating material in the rocket motor's blast tube.

The Formica liner is bonded to aluminum walls. Perforating the walls along with an exhaust system cancel shock waves that otherwise would be formed. During tests, wall shock waves would reflect on the test object, giving erroneous results. ARO chose the Formica as back-up for the liner because of its high machinability, light weight and ability to dampen noise and vibration. The closed-circuit wind tunnel tests aircraft and missile propulsion systems mounted as they would be in flight. It can also be used for testing full-scale models.

• Divco-Wayne Corp.

Electronics has some strange "bedfellows" in Cincinnati. Divco-Wayne Corp., manufacturer of special vehicles such as delivery trucks, recently entered the missile scene through purchase of the Electronics Division of Gruen Industries Inc. The new division probably will be known as Divco-Wayne Electronics, but the company is not yet settled on a name.

When with Gruen, the company was somewhat hampered by lack of capital and was forced to forego some contracts as a result, but Divco-Wayne capital should boost the capacity and yearly contract value should be doubled in 18 months. Present output is approximately $3 million a year.

D-W Electronics inherited some 200 employees, of whom 40 are engineers. Sale price was around $1.5 million. It became a Gruen division three years ago, having grown from within the company. It built electronic timers for the *MB-1* Genie with .002 seconds accuracy, and digital readouts and printers for the *Atlas*. Convair also gets gyro test tables and flight control tables from the former Gruen division.

• Baldwin Piano Co.

It is probable that Baldwin Piano Co. got into the missile and military electronics pie through its production of electronic organs. Last year Baldwin consolidated, selling its Ancor plant near Cincinnati and moving its work to the main plant near the downtown area. The approximate earnings for

PLAYING AN important part in Cincinnati's missile business is the Crosley Division of Avco Manufacturing Corp., active in *Polaris, Jupiter* and *Redstone* systems.

GENERAL ELECTRIC'S gigantic Evendale facility employs about 15,000 and has a three-year expansion program which will call for expenditure of $500 million.

...speaking of

Missile Ground Support **MOBILITY**

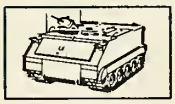
U. S. ARMY PHOTO

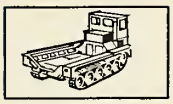
THIS PROJECT WAS MADE-TO-ORDER

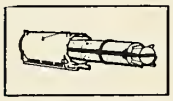
FMC has designed and produced more military-standardized tracked vehicles than any other company in America. So, when Northrop Aircraft, Inc., subcontractor to Raytheon Manufacturing Company on the Army's new HAWK weapon system, needed a rugged mobile transporter-erector, they came to FMC. The vehicle had to be capable of operating in rough terrain, powerful enough to transport three HAWK missiles, and light enough to be air lifted by helicopter. Northrop and FMC engineers worked out the design concept, FMC engineered and built the vehicle portion of the unit; and today this speedy carrier is in production at FMC as part of the Army's HAWK weapon system.

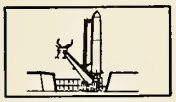
With more than 17 years' experience in the design and production of military equipment, FMC is prepared to handle your missile ground support equipment project – from concept to delivery – on schedule. *Consult FMC at the initial stage of project planning.* Contact us for more information.

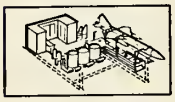
FMC'S PROFILE OF EXPERIENCE:


Multi-Purpose Vehicles


Prime Movers


Shipping & Storage Containers


Launcher-Erectors & Power Units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Putting Ideas to Work

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. . . Cincinnati

1955 were $32.5 million. This figure dropped to near $28.7 million in 1956. Much of the difference was due to a drop-off in military contracts, it was reported.

The piano part of the company is 94 years old. Through electronic organs, leading to defense contracts, Baldwin has developed engineering experience in transistor and printed circuitry, miniaturization, analog-digital conversions, and precision photoelectric and optical assemblies.

In May, Baldwin bought A.R.T. Electronics Inc. of North Little Rock, Ark. The firm is in electronics research for government armament.

• Bendix

Bendix Aviation Corp.'s Cincinnati division handled cable assembly operations for the *Nike,* but now is largely concerned with development and manufacture of electronic test equipment. It recently marketed a telemetering instrument.

• Ohmart Corp.

The Ohmart Corp. entered the Cincinnati missile picture with its radiation level gauge.

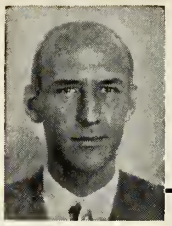
Ohmart developed a method of measuring liquid level in a tank which consists of a radiation source placed on one side of the tank with a cell on the other. The Ohmart cell produces an electric current in relation to the amount of radiation striking it. It does this directly, needing no ionization chamber.

In one application, as used at Redstone Arsenal, the gauge shows the LOX level in loading operations, Ohmart reports. There now are 700 installations in the country. The device also can determine the specific gravity of liquid flowing in a pipe. With this method, nothing has to be put inside the tank or pipe. It is all done from outside.

Int'l Conference Set For Science Information

An International Conference on Scientific Information, dealing with the problems of storage and retrieval of reports and other results of scientific investigation, will be held at the Mayflower Hotel, Washington, D. C., November 16-21.

The conference, comprised of representatives of more than a dozen countries, will be under the sponsorship of the National Academy of Sciences, National Research Council, National Science Foundation, and American Documentation Institute.



propulsion engineering

by Alfred J. Zaehringer

Computers will aid at least two propulsion areas. Arthur D. Little scientists figure advancements will aid in developing new, un-made plastics for fuel-binders and structures, and combustion rate and equilibrium calculations for new fuels and propellants. Both are now characterized by a high number of complex variables that are amenable to digital analysis. The "grass-hopper" method is used for multi-components, while "Monte Carlo" methods are used for high energy rocket fuels.

Electrical or plasma jet rocket may not be near. Rhodes and Bloxsom, Canoga Park, Calif. firm, has expanded air at temperatures of 9,000°K and pressures of 40,000 psi through a supersonic deLaval nozzle. Throat erosions are very severe with heat inputs near 2.5 million watts per square inch. Nozzle vaporization times, ranging from carbon to tungsten and molybdenum, are measured in milliseconds. Electrical spark gas discharges are used.

Ramjets may be superior to turbojets for many up-and-coming regimes of high-speed commercial aircraft. Within the tropopause, Israel Institute of Technology aero engineers favor ramjets from the standpoint of propulsive efficiency at speeds over Mach 3. Some of this years commercial jets will be able to hit near Mach 1.

Vernier rocket engines for Atlas use LOX-RP-1 propellant. Fuels are contained in separate tanks, though main turbo pump system also serves verniers. The gimbal-mounted verniers are squib-ignited and burn during entire flight. The double-walled engine is made of spun 4130 steel. Copper wire, helically brazed to the inner jacket, forms the fuel passage. Since the head end of the vernier engine sticks into the airstream, an asbestos loaded, phenolic/silicone plastic protects against aerodynamic heating. Engines put out constant thrust, but directions can be changed on demand.

Nitrogen tetroxide substitute for LOX has been under evaluation since 1947. Allied Chemical Corp. producers reveal that they have made tank car shipments to the rocket industry since April.

More LOX for Redstone. Linde will build an air-separation plant near Huntsville, Ala., that will also produce argon and nitrogen.

Lithium propellants may be in the works. Lithium Corp. of America has been consulting with an outside firm on high-energy fuel studies and may be ready to hook up with Astrodyne in lithium research. Whether the work will be concerned with lithium perchlorate oxidant or lithium fuels is not known. High costs have delayed lithium propellant use. The hydroxide, starting point for the perchlorate and possible fuel derivatives, for example, took a price hike and now sells for about $0.75 per pound. AEC controls on lithium stocks may be responsible. AEC contracts on lithium are scheduled to run out soon, which may make for a less restrictive lithium market.

Erosive burning of homogeneous solid propellants is related to the gas flow along the fizz zone. Studies made at the Aeronautical Institute of Brussels University indicate that turbulence in the fizz zone causes erosive burning.

Rocket fires caused by the accidental ignition of such fuels as alcohol, gasoline, furfuryl, or xylidine with nitric acid or LOX can be put out by carbon-bromine-fluorine compounds. The Air Force names two as extinguishers: $CBrF_3$ or CBr_2F_2.

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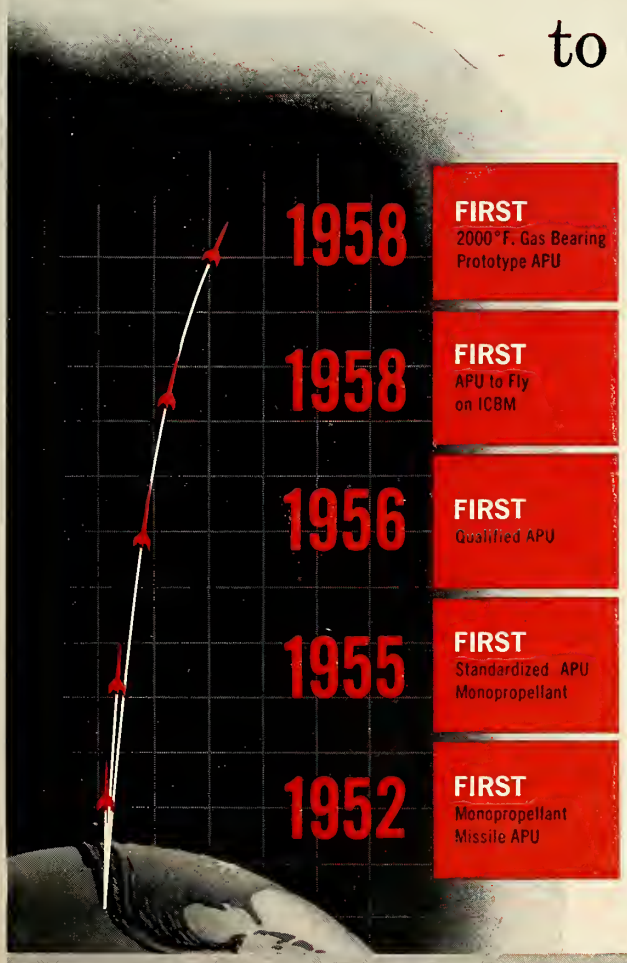

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west coast industry

by Fred S. Hunter

A few weeks ago a major components manufacturer in the Los Angeles area wrote out a check for $1,000 to the Strategic Industries Association and became a sustaining member. This voluntary action was taken in appreciation of SIA's accomplishments in its campaign for better protection of proprietary rights in defense contracting.

SIA doesn't make a point of inviting sustaining memberships, but it has a few among larger companies who feel that the work this association of small, independent firms is doing is beneficial to the entire industry and therefore deserves support. Sustaining members have no voice in the actions or policies of the association, but SIA does make its reports and other information services available to them.

The SIA has come to be a rather remarkably effective trade group. One reason for this seems to be the rational and reasonable approach it takes in presenting its programs. It maps out its various projects with care, pursues them vigorously but without ostentation, takes its victories and its defeats in stride, and avoids trying to "fight city hall." Its work on the proprietary rights issue is a case in point.

A good many people have tried to do something about proprietary rights in military contracts, but without much success until SIA came along and succeeded in getting the defense department to consider revisions in that section of the Armed Services Procurement Regulations covering copyrights and data. SIA took the position that privately financed research and development for advanced defense materials requires the incentive of protection for the proprietary rights of the firms which originate new designs. The high complexities of missile design make this more important than ever.

SIA acknowledges that a fixed percentage of defense purchasing or defense subcontracting for small business firms is impractical, although in 1954, when the association was first formed under the name of Small Defense Industries Association, its members were of the opinion that a law fixing such percentages was just what they needed.

Another of SIA's basic policies puts it in conflict with another west coast group of small business firms in the defense field, the San Fernando Valley Small Plants Association. The latter organization is a strong advocate of advertised procurement. SIA favors competitive negotiated procurement, which it contends is a fair and effective means of obtaining the best buy for the government. Advertised bidding, it contends, paves the way to below-cost bids which may result in contract default, loss of time and dollars to government, and injury to contractors, the industry and the nation.

Like any trade group, SIA has some sore spots, such as the free use of government facilities. It has published a 40-page report carrying the title of "Government's Facility Fallacy" outlining its views on this subject in detail. But this is one area where, so far at least, it hasn't had much luck.

Industry roundup: Telecomputing Corp., Los Angeles, has received three additional contracts totalling $515,000 from Western Electric for production of gyros for Nike-Ajax . . . Big sales increase for Douglas Aircraft Co. For the nine months ending August 31, sales were $888,766,637 for net earnings of $16,546,190. These figures compared with $828,417,314 in sales and $24,710,406 in net earnings for the first three quarters of 1957.

when and where

NOVEMBER

School of Aviation Medicine, International Conference, Physics and Medicine of the Atmosphere and Space, Hilton Hotel, San Antonio, Texas, Nov. 10-12.

Society for Experimental Stress Analysis, 1958 Annual Meeting, Hotel Sheraton-Ten Eyck, Albany, N.Y., Nov. 12-14.

National Security Industrial Association and Air Research and Development Command, USAF, Symposium on Molecular Electronics, Washington, D. C., Nov. 13-14.

Conference on Scientific Information, AFOSR/Directorate of Research Communication, NAS, NSF and the American Documentation Institute, Mayflower Hotel, Washington, D. C., Nov. 16-21.

American Society for Quality Conference, Sixth Annual Aircraft and Missile Division Conference, Biltmore Hotel, Dayton, Ohio, Nov. 17-18.

American Rocket Society, 13th Annual Meeting and Astronautical Exposition, Hotel Statler, New York, N. Y., Nov. 17-21.

Eighth National Plastics Exposition, International Amphitheatre and Plastics Conference, Hotel Morrison, Chicago, Ill., Nov. 17-21.

Northeast Electronics Research and Engineering Meeting, Mechanics Hall, Boston, Mass., Nov. 19-20.

Lockheed Missile Systems Division's Research Laboratory, Third Symposium on Magnetohydrodynamics, Palo Alto, Calif., Attendance by invitation, Nov. 21-22.

The Convertible Aircraft Congress, designing and operating missiles from unprepared sites, Franklin Institute, Philadelphia, Penna., Nov. 28.

First Electronic Computer Exhibition and Symposium, Olympia, London, England, Nov. 28-Dec. 4.

DECEMBER

Third EIA Conference, Reliable Electrical Connections, Dallas, Texas, Dec. 2-4.

Mid-American Electronics Convention, sponsored by Kansas City Section, Institute of Radio Engineers, Municipal Auditorium Arena, Kansas City, Mo., Dec. 9-11.

American Astronautical Society, Fifth Annual Meeting, Hotel Statler, Washington, D. C., Meeting will be held in conjunction with the 125th Annual Meeting of the American Assn. for the Advancement of Science, Dec. 27-30.

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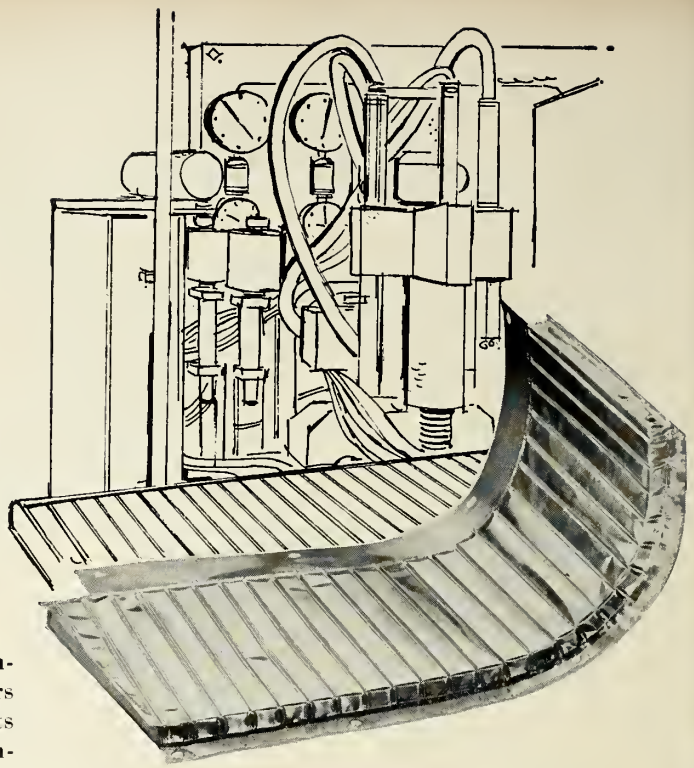

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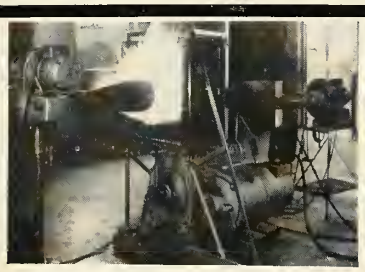

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Frangible Plastic Case Proven on *Nike* Booster

Epoxy Resins Aid In Reinforced Plastics

by C. L. Meeter*

SIXTY-INCH diameter tube demonstrates fabrication size possible with epoxy laminations.

Developed several years ago, the *Nike-Ajax* missile was one of the first successful surface-to-air weapons and is now paired with the *Hercules* as a major means of defense against attacks by high speed, high altitude jet aircraft.

When deployment of these missiles around major cities began a few years ago the public reacted adversely. In addition to worrying about accidental explosions of the missiles while on the ground, there was great concern about the impact of the heavy steel casings of the booster units.

To alleviate as much as possible the public's fears, a research and development program was undertaken to find a frangible booster—harmless to life and property. Many methods and materials were investigated before an epoxy resin laminate was given the go-ahead. However, not until recently has it been possible to discuss the use of reinforced epoxy resins for development of this frangible booster.

The booster is known officially as the T48E3 Self-Destroying *Nike-Ajax* Missile Jato, and was developed for the Department of the Army in conjunction with the Army Ordnance Corps. Fabrication of the Jato required performance characteristics never before achieved by reinforced plastics. This called for new materials, new processes, quality control techniques for the material and production standards and controls.

The Jato accelerates the missile to operational altitude and velocity and is then jettisoned. After separation from the missile, the Jato destroys itself at high altitude by the use of primacord explosive. The resulting non-lethal dust and small pieces descend to the ground at a low speed and low energy level.

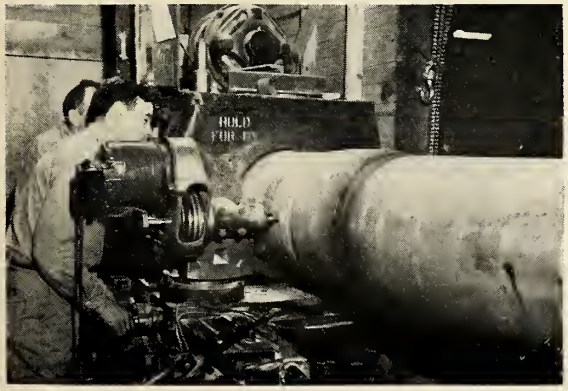
The Jato is over 13 ft. long and 18 in. diameter, and consists of four major elements: the case, solid propellant fuel, stabilizing fins and explosive components to effect self-destruction.

Parts of the Jato, constructed of the fiberglass reinforced epoxy resins, consists of the cylindrical case; main chamber; forward sleeve, which retains the thrust bulkhead and serves as the socket to engage the missile; rear sleeve, which retains the nozzle and provides sockets for support of the three stabilizing fins; adapter ring; head plate; igniter and springs.

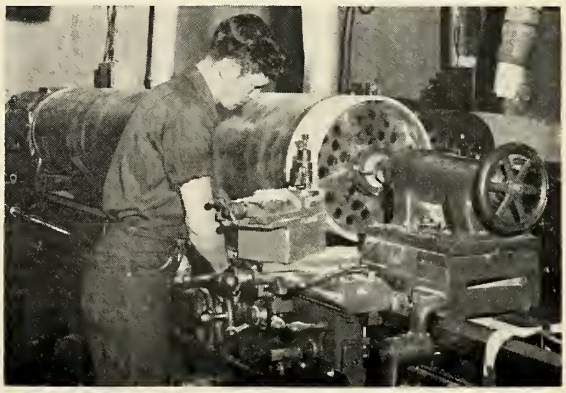
In designing the reinforced epoxy Jato, the basic requirement demanded equal weight and performance in comparison to the standard unit which was constructed of high strength, heat-treated steel. Since self-destruction features consisting of explosives and their encasing shrouds had to be incorporated in the Jato, the basic booster had to be 20% lighter than a steel unit.

• **Weight major factor**—A square foot of 1/8 in. fiberglass reinforced laminate weighs about one pound—a steel plate of the same thickness would

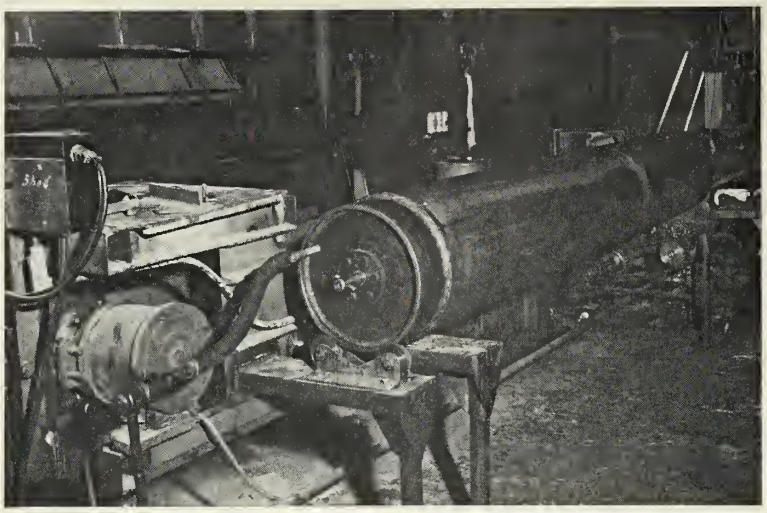
*Vice President—Plastics Division, Universal Moulded Products Corp. Bristol, Virginia



ASSEMBLED epoxy laminated *Nike-Ajax* booster is secured in jug chuck for drilling access holes.



HIGH STRENGTH of the reinforced epoxy lamination simplifies thread cutting in main chamber.



CURING laminated booster case after glass cloth has been wound on mandrel.

FIBERGLASS fin over foam core.

weigh about 4.3 lbs. per sq. ft. However, a tensile strength of 75,000 lbs. per sq. in. in such a laminate is a reality. The comparative strength for the same weight in steel would be 325,000 lbs. per sq. in., a feat not technologically possible at the present time.

While the strength-to-weight advantage is of course necessary for further missile developments, epoxy resins possess other advantages worthy of note—they are non-corrosive, electrically non-conductive and heat resistant. Such reinforced plastics offer both load-carrying and thermal insulating properties at the same time. They also permit the close control of weight and dimensions with a precision unobtainable with metals. Where complex configurations are required, they are economical to produce.

• **Epoxy laminate advantages**—Actually, the major achievements in reinforced plastic construction for missiles were realized only with the use of epoxy resins. It was then possible to obtain the high shear strengths, particularly interlaminar shear strength, that made it possible to cut threads that would not peel, and also to tap holes in the laminates.

The basic difference between the epoxies and other resins such as the polyesters is the superior wetting of glass fibres obtainable with the epoxies. This enabled the achievement of higher strengths—tensiles up to 20%, flexurals up to 20%, and compressive strength up to 50%. The interlaminar shear strength between fiberglass plies is at least three times greater.

When investigations begun in 1953 revealed that the epoxies would improve the interlaminar shear, Epon 828 was selected. Later the switch was made to Epon 820 because of its lower viscosity. Both curing agents Z and D have been used—Z to achieve higher strengths at elevated temperatures, and D where such requirements are not so critical.

• **Cloth buildup**—The majority of parts for the reinforced epoxy booster were fabricated by convolutely winding glass cloth on a mandrel, the cloth being impregnated with the Epon resin formulation as it was being wound onto the mandrel.

NIKE-AJAX with frangible booster.

These parts included the main cylindrical section of the Jato, the forward and aft sleeves, the forward missile-to-booster adapter which is part of the forward sleeve, and the retaining springs which hold the propellant aft.

The head plate, igniter plug and the thrust bulkhead which is located inside the missile tube booster adapter were made up of woven roving and resin molded under pressure to form a laminate. The main parts of the stabilizing fins, such as the spars and skins, consisted of fiberglass laminations over a cellulose acetate foam core.

Self-destruction of the chamber is accomplished through an external wrap of primacord, while destruction of the heavier internal structural components and fins is achieved by internal containers of primacord.

The work on the *Nike-Ajax* booster is the beginning of engineering progress in using fiberglass reinforced epoxy laminates in ordnance applications. This booster was just a small one. Development is now underway on a much larger booster (more than twice the size) where solid propellants will be used. In the future, greater developments are anticipated inasmuch as considerable weight can be saved in missiles in comparison with metal construction.

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Integrated Package A Must for Antennas

All antenna components should be matched to eliminate discontinuity and power loss

by Raymond M. Nolan

In these days of design competitions to determine the complete weapons system requirements before any hardware is begun, there is real opportunity to bundle all of the antenna requirements into an integrated radiating package.

This means, along with the systems engineering required, that antenna manufacture could be taken out of the metalworking shop and assigned to qualified radiation systems specialists for development and production.

For it is becoming increasingly important that all components, from the transmitter out, and from the antennas back to the receiver or transceiver, be matched to eliminate or cut down on discontinuity and power loss, while at the same time assuring maximum pattern coverage with lowest VSWR.

Today, all missiles, including test versions of the big ballistic birds, have to depend on some sort of radiated intelligence, either active or passive, to accomplish their mission.

Common practice is to stick one antenna after another on a missile as various types of equipment are added for guidance, monitoring, telemetering or command signals. This frequently leads to test versions of missiles that have a resemblance to an hors d'ouvre with toothpicks sticking out all over.

• **Integrated approach**—But at least one company is taking a systems approach to the radiation problem and is delevoping its products as an integrated package. The firm is the Electronic Specialty Company of Los Angeles. According to C. Raymond Harmon, assistant to the president, the emergence of this type of thinking was brought about largely by customer demand.

"People were getting tired of specifying a whole range of antennas and associated switching and matching units with no attempt to look at the possible cumulative losses that were building up throughout. So we've been asked frequently to come up with systems that could be purchased by a customer under one part number, specifying only the db gain or loss and allowable VSWR. This is what we are presently doing in many of our programs and we hope this will be the forerunner of a trend wherever radiating systems are used," Harmon said.

Harmon pointed out that since the majority of missile-borne equipment in use today required broad band applications, experience showed that, even using completely impractical close tolerance component specifications (which would result in excessive costs), the discontinuities and mismatches occurring often add in one frequency range and subtract in another.

Discontinuities, he said, are very often the result of such simple things as incompatible connector and cable assemblies and can only be eliminated by the practice of matching each and every component, one to the other.

Electronic Specialty Co. recognized the vulnerability of existing procurement practices and for several years has been working with Wright Air Development Center and the Bureau of Aeronautics on system procurements. Part of the task was to convince systems planners that the only possibility of developing the optimum communication system is a truly matched radiating system purchased under a single specification, defining the total capabilities of all the components.

The overall system checkout procedure is another element which should also be included in the system specification. The specification then fixes the overall performance in which the efficiency is measured with a system mock up similar to the installation in the missile.

Harmon feels that the era of individual component manufacture or procurement with complete disregard for its end use in sophisticated systems is rapidly coming to an end.

He adds that it is becoming absolutely necessary that a true radiating system contractor have the capability to study the complete problem, including: the location studies in conjunction with the manufacturer of the flight vehicle, the bands to be used for most efficient pattern coverage, minimum interruption of structures by the use of multiple arrays, and the choice of dual antennas with multiplexing and power dividing.

As a sequel to the system study, the radiation specialist must have the capability to develop the required component and microwave assemblies, including such items as filters, power dividers, diplexers, matching networks, cabling assemblies, and switches.

• **Important criteria**—Electronic Specialty Co. admits that with so many antenna requirements, some sort of compromise is almost always involved. The company says the following criteria are important in evaluation of the antenna system:

1. **Aerodynamic**—Obviously, the missile cannot come out looking like

ANTENNA SYSTEM on missile model being checked at Electronic Specialty Co.'s test facility.

a porcupine. As many antennas as possible must be made flush, combined with other needs, faired into existing structure, or be designed of proper fineness ratio.

2. **Structural**—As antennas are built flush, openings in the skin must be evaluated for stress, under static, dynamic and heating conditions. Radome and cover plate materials must be developed.

3. **Omni pattern**—The most difficult pattern to achieve is that of omni directional coverage, and this is often a requirement for certain systems to insure full operational flexibility. Usually there is only a single optimum area for the omni antenna, and this single antenna must be diplexed to several uses.

4. **Voltage breakdown**—At high altitudes, and in high power circuits, voltage breakdown is a very critical consideration for all antenna system components. With a suitable low standing wave ratio, a greater power handling capability is achieved.

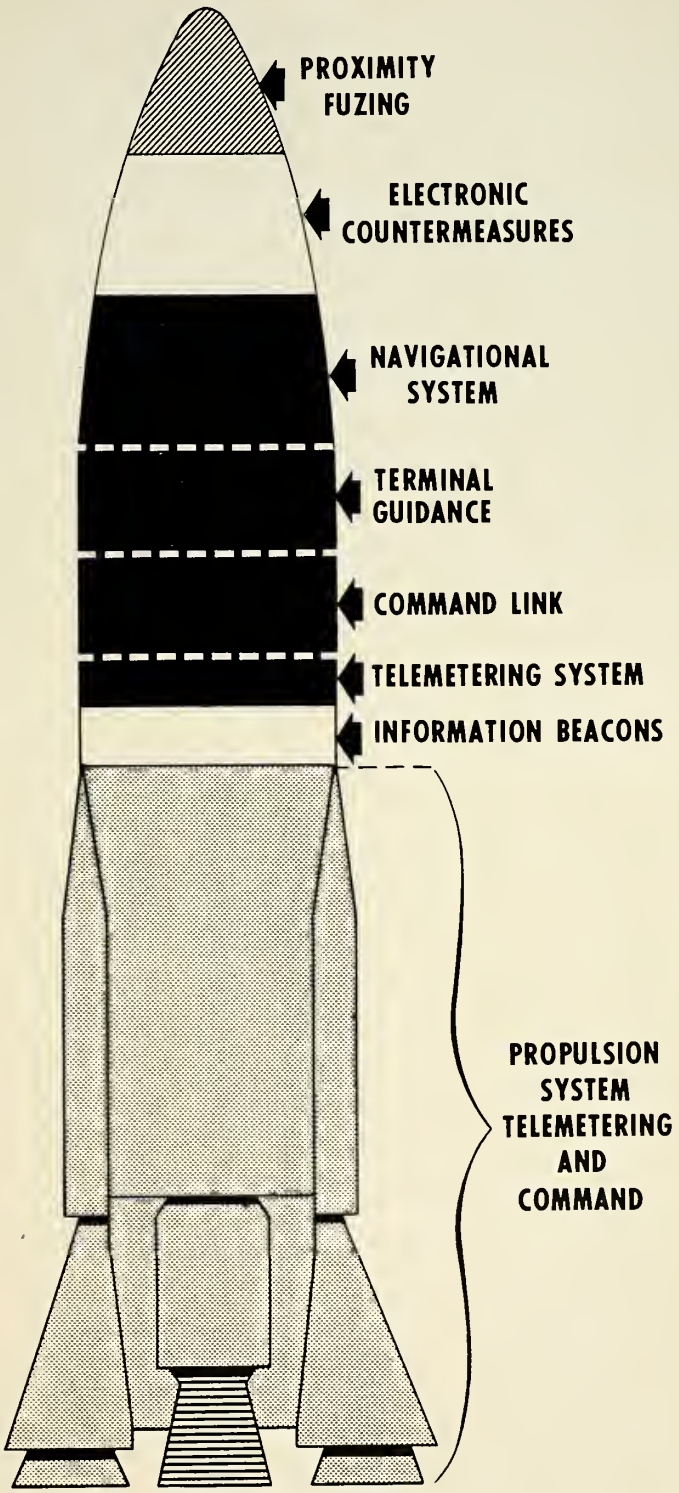
5. **Attenuation**—Standing waves, resulting from poorly matched components or devices, also result in signal attenuations. Typical improvements shown in a recent missile were VSWR reduced from 3:1 to 1.5:1, with an associated reduction in attenuation of about 20%.

6. **Cross-talk**—Interference between systems is a very serious problem and one that must be solved early in the antenna system layout. Antenna isolation, side lobes, filter characteristics, switching arrangements, are critical in this study.

7. **Weight-space**—Very often these factors force antenna system design into a certain configuration, just as will aerodynamic and structural considerations. Antennas will be made smaller than is desirable electrically, and a better matching unit will be used. Running a single cable to a single antenna will force diplexing to save weight over two cables and two antennas.

8. **Reliability-complexity** — These need to be studied critically. Since most matching and filter devices have no moving parts, complexity can often be reduced with corresponding improvements in system reliability.

9. **Cost**—It has been demonstrated quite convincingly that a system of matched components works better and costs no more than a composite system. One of the reasons that this is so is that more realistic specifications can be assigned to each component.



SOME OF the antenna requirements on a typical missile. (Right).

New Infrared Detector Uses Germanium

An infrared detector that can respond to less than one-twentieth of a billionth of a watt of radiation promises to have application in missile detection programs now underway.

The ultra-sensitive detector was developed by scientists of the Westinghouse Research Laboratories in consultation with Dr. Henry Levinstein of Syracuse University. It is a photoconductor unit, uses germanium, and operates at –320°F.

Germanium, a solid material, changes its ability to conduct electricity when radiations such as infrared or visible light strike its surface. Because of this, intensity changes in infrared radiation reaching the photoconductor are converted into changes in electrical current flow.

The germanium used in the detector is not standard, but has been made sensitive to infrared by doping it with gold. The addition of gold as an impurity has two advantages: it provides increased sensitivity and increases response to the longer infrared wavelengths.

Longer wavelengths, corresponding to lower IR temperatures, are often the ones most desirable to detect, but are often the most difficult. Very little difficulty is encountered in observing a red-hot object with a temperature of somewhere around 1,500 degrees and an IR radiation wavelength of three microns (100 millionths of an inch.)

However, when it is necessary to detect an object at body temperature (98.6°F), an entirely different situation exists. Peak infrared radiation has tripled to a wavelength of about nine microns and total energy emission has dropped to less than one-hundredth of its previous value.

The problem that faced Westinghouse was to provide a detector that responded to the long-wavelength radiations, had good sensitivity over the range of IR frequencies and reacted rapidly enough to be useful in practical situations.

According to Dr. J. W. Coltman, manager of the Westinghouse electronics and nuclear physics department, the new detector is highly sensitive up to a wavelength of 10 microns, which corresponds roughly to the peak radiation at room temperature. "At the same time," Dr. Coltman said, "it is about 10 times faster than any previously measured photoconductor detector." It is so fast in its response, he said, that special laboratory apparatus had to be developed to test its speed.

Westinghouse uses a mechanical light chopper that breaks infrared into pulses only a few billionths of a second duration. The pulses, reflected to the surface of a detector, show its time constant to be two-tenths of a millionth of a second. The detector is cooled to its operating temperature by surrounding it with liquid nitrogen.

Because of the initial success of its IR program, Westinghouse plans early production of the new detector.

International Electronics Competition Threat to U.S.

Electronic engineers attending the 30th anniversary of the Radio Fall Meeting were warned that they face serious international competition by Electronic Industries Association President David R. Hull.

He spoke at a three-day technical conference held October 27 to 29th, Rochester, N.Y. The 30th anniversary of the Radio Fall Meeting, sponsored jointly by EIA and IRE, drew more than 300 engineers.

Speaking on "Engineering Maturity," Hull told industry engineers that their high salary and living standards are at stake unless they avoid wastefulness from over-design and help overcome foreign competition by better engineering to bring about greater production.

Tracing the rise in importance of electronic engineers during the past decade, Hull said that there are now 50,000 engineers and an equal number of electronic technicians.

An admission of ignorance, willingness to seek help from others and a study of earlier successes and failures in the same field were mentioned by Hull as examples of engineering maturity.

The mature engineer solves his problems by simplification and deletion, not by added complexities, he said.

Some 24 technical papers were presented during the conference.

Ready to Go

A MOUSE, whose offspring may someday be a space traveler, inspects an autopilot gyroscope manufactured by Minneapolis-Honeywell for the *Thor* and *Atlas* missiles. The two-pound unit can withstand 100-g shocks and operates from —65 to +175°F.

Missiles Figure Heavy in Electronics Applied R&D

Ninety-eight per cent of the $1.4 billion spent in 1956 for electronics applied research and development came from fifteen industrial categories. Of the fifteen categories, ten are concerned with missiles.

The figures were released by the Electronics Industries Association. The study, which resulted in this preliminary data, was performed by the National Science Foundation and the statistics were compiled by the U.S. Bureau of Labor Statistics. This is the first comprehensive survey ever made of the total electronics R&D picture.

Total R&D expenditures, both basic and applied, jumped from $3.6 billion in 1953 to $6.5 billion in 1956, an increase of 76%. Of the fifteen categories, Aircraft and Associated Parts show the largest growth, up 174% in the three-year period.

During 1956, nearly half, or $3.1 billion, of the total came from the government. The comparable figure for 1953 was about one-third, or $1.4 billion.

NSF held itself to the standard industry classifications and excluded numerous activities which would have added a considerable amount to the total. The sectors of the economy excluded were government, universities, commercial laboratories and non-profit institutions. Costs of quality control, routine product testing, market research, sales and technical services were also omitted from the study.

A final report covering more detailed aspects of 1956 industrial research is scheduled to be released by NSF in the near future and information about subsequent years will be available soon afterward.

Parts for electronic-electrical systems totalled $669.6 million in applied R&D. In the same category, machinery (including computers), was $182.1 million; telecommunications and broadcasting, $137 million; professional and scientific instruments, $64.5 million.

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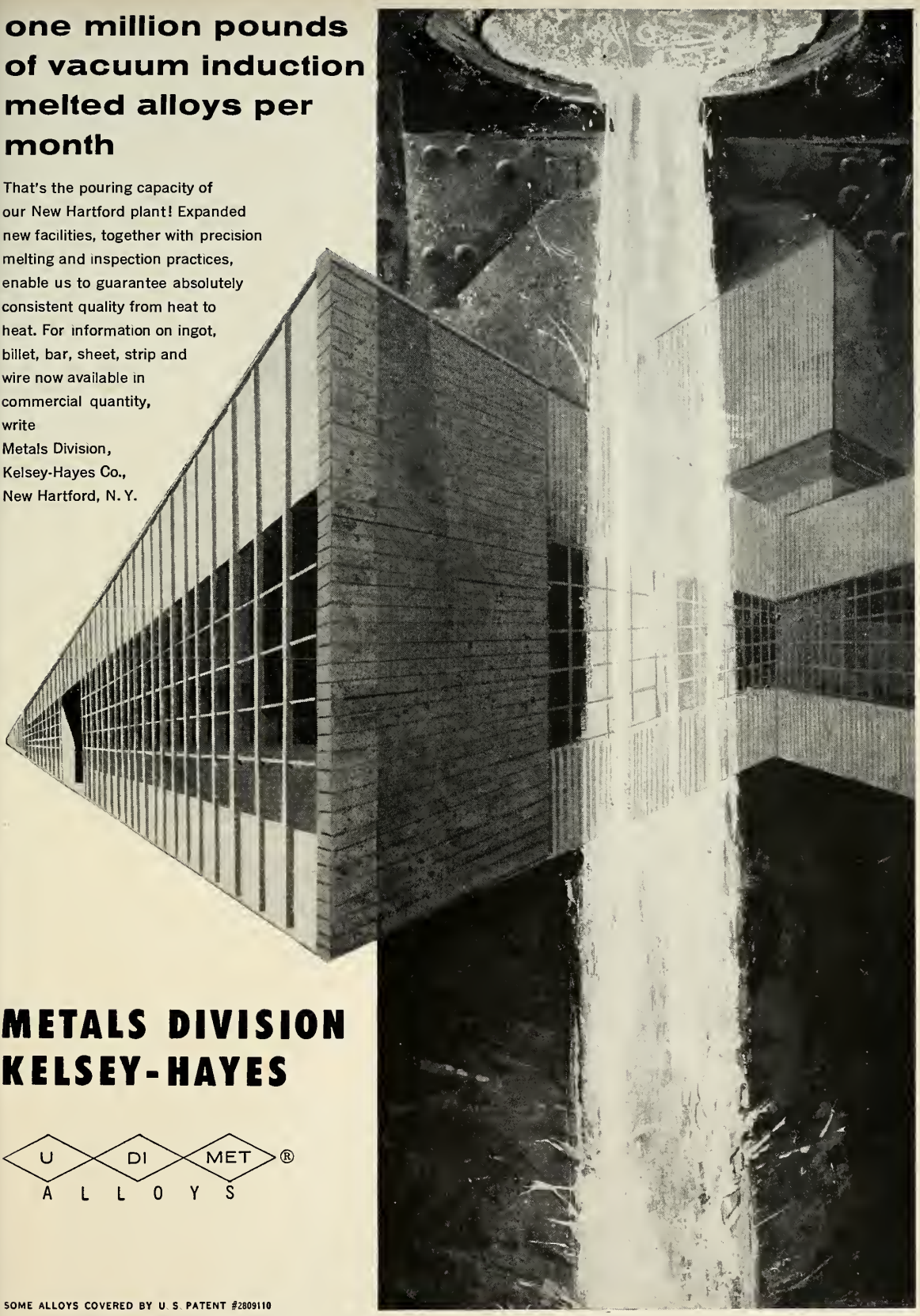

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letters

ABMA Transfer

To the Editor:

I was somewhat more than surprised to see the story on The Association of the U.S. Army Annual Meeting in your October 27th issue under the headline, "AUSA Avoids ABMA Transfer."

I quote from the first paragraph the following sentence: "There was absence of any mention of the proposed transfer of Army Ballistic Missile Agency (ABMA) to the National Aeronautics and Space Administration (NASA) and the discussed possibility that Army may be on its way to losing its coveted missile capability."

I recognize that you were working against an early deadline which made it necessary for you to work from prepared text. However, it is disturbing to have this erroneous impression carried in such a widely circulated publication as yours.

The facts are these: Our Resolution No. 1 (which asks the President to continue to maintain the present general organization of the Army Ordnance Missile Command) was unanimously passed by the Association at the meeting. A letter to the White House directed by this resolution has already been transmitted.

Both Gen. Trudeau and Gen. Medaris discussed this subject candidly and freely during the panel discussion on our Wednesday morning program.

The story as it appeared gives the definite impression that the Association studiously avoided a most important topic of our National Defense, which would in effect indicate that we are reluctant to face important Defense issues simply because they happen to be somewhat controversial.

We would very much appreciate anything that you can do to set the record straight.

Robert F. Cocklin
Director of Public Relations
Association of the U.S. Army

The article specifically said "in prepared texts, no mention was made of the proposed transfer of ABMA." The subject was brought up in a panel discussion and a press conference on the last day of the meeting, after m/r had gone to press. While the association avoided the subject during the first two days, it did, however, take action on the last day. . . . Ed.

The editors of MISSILES AND ROCKETS welcome contributions from readers in the form of letters. Letters should be addressed: "To the Editor, Missiles and Rockets, 1001 Vermont Ave., N.W., Washington 5, D.C." They should be signed and should include company or other affiliation of the writer.

Equatorial Site

To the Editor:

I am writing concerning the articles in m/r about plans to build an equatorial launching site for putting satellites into low-latitude orbits.

In the February 1955 issue of the JOURNAL of SPACE FLIGHT, publication of the Chicago Rocket Society, Lewis J. Grant, secretary, published an article entitled "Location of a Permanent Rocket Base."

In this article, Mr. Grant suggested using the extinct craters of Mt. Kilimanjaro, a volcano in Kenya, Africa, as a permanent base, not only because it is near the equator but the high altitude of the launching site would greatly increase the efficiency of the rocket motors. Atmospheric backpressure at the 18,000-ft. altitude is only half that at sea-level (14.7 psi).

Also, since the base is only some 100 miles from the Indian Ocean, rocket stages could be dropped where they could be recovered and would not be a hazard to people living on the land beneath the rocket's flight path.

However, Mt. Kilimanjaro is at a disadvantage for a launching site due to its great distance from the continental United States, and its relative inaccessibility to land transportation.

There is, however, a possible launching site much closer to the United States; that is Mt. Popocatepetl in Mexico.

George Carruthers
Member, Chicago Rocket Society

contract awards

ARMY

By Headquarters, Redstone Arsenal, U.S. Army OMC, Redstone Arsenal, Ala.:

Norris Thermador Corp., Los Angeles, Calif., received $38,446 for fabrication of T-273 rocket motors and T-273 rocket warheads; and $33,815 for designing, developing, and fabrication of 17 rocket motor cases.

By the U.S. Army Electronic Proving Ground:

Tele-Dynamics Inc., Philadelphia, Pa., designer and producer of telemetry equipment for missiles and drone aircraft, has been awarded a $320,000 contract to design, manufacture, and install radio telemetry equipment for flight testing of surveillance drones.

By U.S. Army Engineer Dist., N.Y. Corps of Engineers:

S.T.G. Construction Co., Inc., New York, received $67,800 for Fy-59 special AAA facilities, construction of missile assembly and test bldg. and warhead facilities, Ft. Hancock, N.J.

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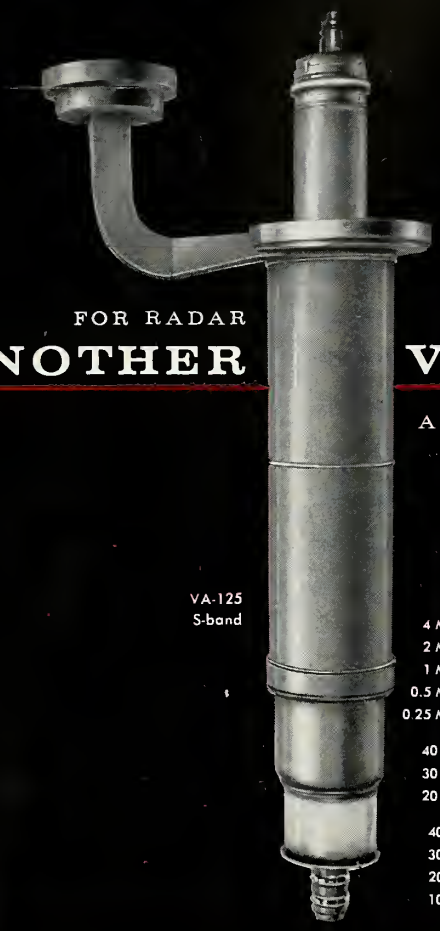

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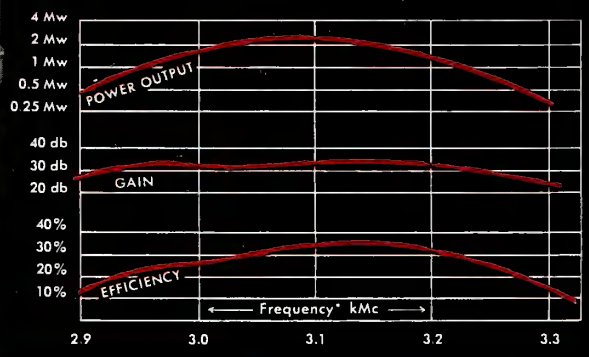

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