AUGUST 4, 1958

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

News and Business Edition

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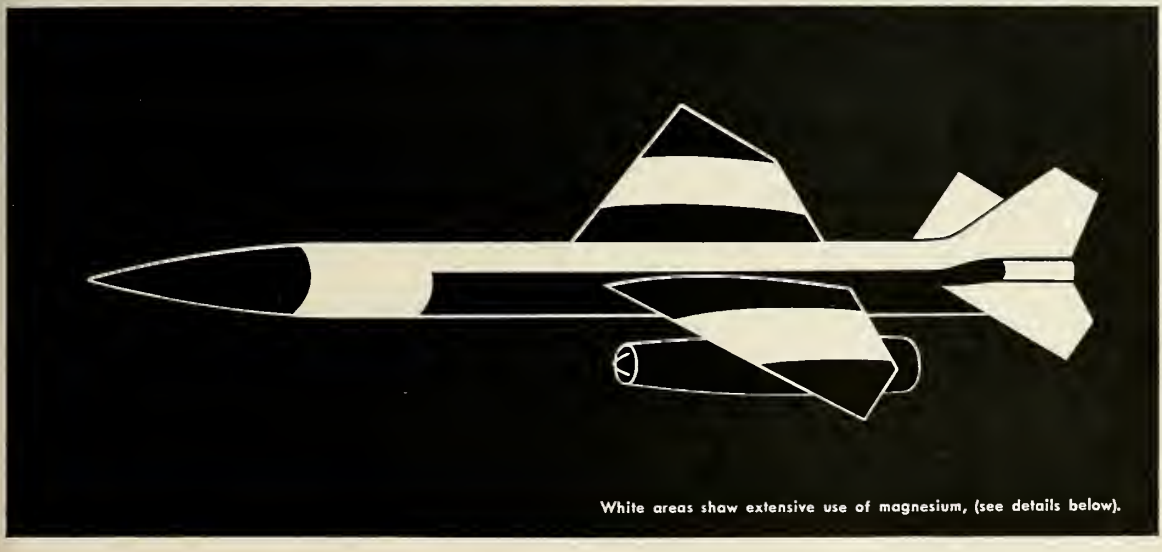

White areas show extensive use of magnesium, (see details below).

HOW ELEVATED-TEMPERATURE MAGNESIUM ALLOYS HELP BOMARC KEEP FIGHTING WEIGHT

Approximately 230 lbs. of magnesium is used in the airframe of the Bomarc, powerful surface-to-air missile. And for good reason: In each case, the specific application called for light weight and retention of strength, rigidity and other properties at elevated temperatures. The logical choice was sheet, extrusions or castings of elevated-temperature magnesium alloys.

EXAMPLES:

BODY. The body skin and doors of both nose and aft sections utilize 103 lbs. of HK31A sheet and castings. Resultant weight savings were 23 lbs., including a net reduction of 6 lbs. by using a magnesium casting for a door frame structure.

WING, FIN AND TAIL. 111 lbs. of HK31A sheet were used in the wing, elevators and elevator stubs, fin and rudder. All leading and trailing edges of control surfaces for wings and fin are HM31XA extrusions. Here another 8 lbs. were saved by using an elevated-temperature magnesium alloy.

These are but a few instances of how precious weight was saved in the Bomarc. For more information about the use of magnesium alloys in aircraft, rockets and missiles, contact the nearest Dow sales office or write directly to us. THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA 1407L-3.

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A TYPICAL INTRICATE JOB

Above you see a Mold Core for a solid propellant rocket motor. Previously it had been contour turned and now you see the contour taper being carefully machined by a Diversey master craftsman. He uses a tracer controlled Rockford Hydraulic Planer to machine the aluminum to a fine surface finish.

You have the largest facilities exclusively devoted to your guided missile and rocket hardware problems at Diversey Engineering. In missile metal machining we know what works and what won't. Contact us on your intricate jobs.

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editorial viewpoint . . .

Now—following Russia by three long, and perhaps disastrous years—the United States has formed a space agency. By title, it is half aeronautics and half astronautics. Nonetheless, it represents a well-meaning, though partial, effort by government to provide effective leadership and organization to bridge the gap in space technology between this nation and the Soviet Union.

The impetus for this new agency came last fall, when the U.S. found out that the world was on the threshold of a new frontier—but, that we were not the first to enter the space age. Suddenly, everyone was interested in space technology. "Authorities" grew up overnight, and an excited Congress went to work. The new National Aeronautics and Space Administration is the result.

We wonder whether today's space-minded Congress may become complacent when, and if, the U.S. matches Russia's current orbiting weight contest. Will money then be readily available for the next steps—the "peaceful" exploration of space, which Congress has demanded?

Or at that time will NASA recede to the position of the U.S. Weather Bureau and other agencies, which, although scientific in scope, eke out a yearly subsistence from Congress? Will we then have to use the hypocritical camouflage of "military necessity" to justify space exploration?

Ten months after *Sputnik* I, there is a growing tendency of the American public to take space technology for granted. It is assumed that in the U.S., our best—and that includes space technology—automatically is the best in the world. But, we have forgotten one fact: The U.S. is years behind, and Soviet Russia is working harder than we are to achieve pre-eminence in the exploration of space. Clearly then, the task ahead is education, both for Congress and the NASA.

NASA is beginning with many strikes against it. It will be unable to hire but a few top scientists because of ridiculously low salaries set by Congress—salaries ranging downward from a top of $22,500.

Within a couple of months, NASA will probably be "investigated" to determine why there have not been major technological breakthroughs. Add the forthcoming "differences of opinion" in the "gray areas" of what constitutes military vs. civil space exploration, and it spells rough days ahead for the new agency. But we wish NASA the best of luck. It will be needing it.

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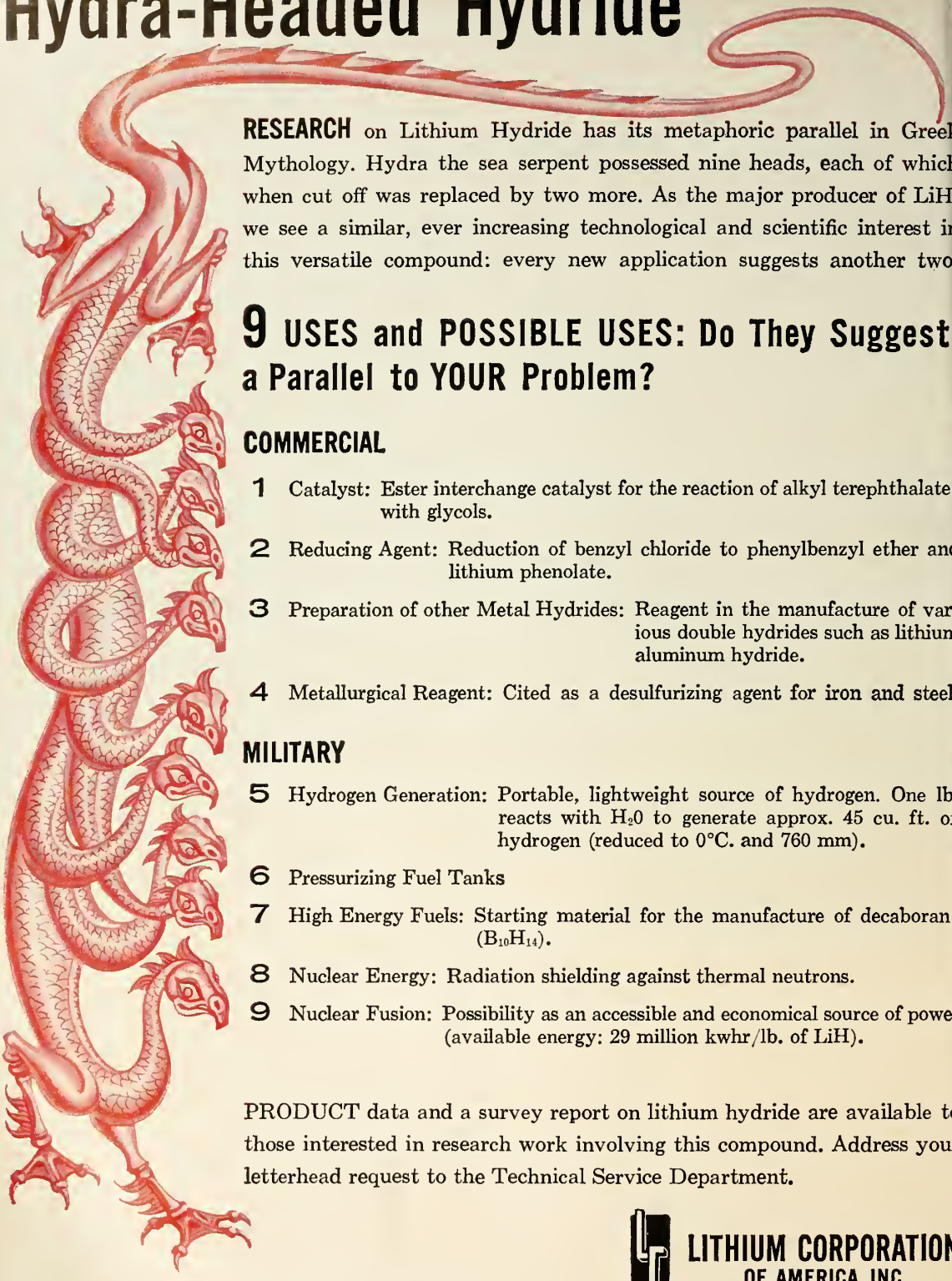
The missile that looks like a bomber hanging under the Navy attack plane is Royal Industries' Boar, a rocket-boosted "over-the-shoulder" toss bomb. The unguided missile, carrying a nuclear warhead, is now in operational service with the Navy. This is the first identifiable picture ever published of the Boar.

Hydra-Headed Hydride



RESEARCH on Lithium Hydride has its metaphoric parallel in Greek Mythology. Hydra the sea serpent possessed nine heads, each of which when cut off was replaced by two more. As the major producer of LiH, we see a similar, ever increasing technological and scientific interest in this versatile compound: every new application suggests another two.

9 USES and POSSIBLE USES: Do They Suggest a Parallel to YOUR Problem?

COMMERCIAL

1. Catalyst: Ester interchange catalyst for the reaction of alkyl terephthalates with glycols.
2. Reducing Agent: Reduction of benzyl chloride to phenylbenzyl ether and lithium phenolate.
3. Preparation of other Metal Hydrides: Reagent in the manufacture of various double hydrides such as lithium aluminum hydride.
4. Metallurgical Reagent: Cited as a desulfurizing agent for iron and steel.

MILITARY

5. Hydrogen Generation: Portable, lightweight source of hydrogen. One lb. reacts with H_20 to generate approx. 45 cu. ft. of hydrogen (reduced to 0°C. and 760 mm).
6. Pressurizing Fuel Tanks
7. High Energy Fuels: Starting material for the manufacture of decaborane ($B_{10}H_{14}$).
8. Nuclear Energy: Radiation shielding against thermal neutrons.
9. Nuclear Fusion: Possibility as an accessible and economical source of power (available energy: 29 million kwhr/lb. of LiH).

PRODUCT data and a survey report on lithium hydride are available to those interested in research work involving this compound. Address your letterhead request to the Technical Service Department.

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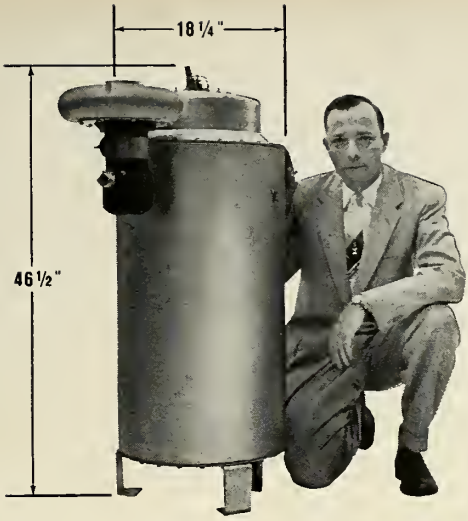


million btu/hr!

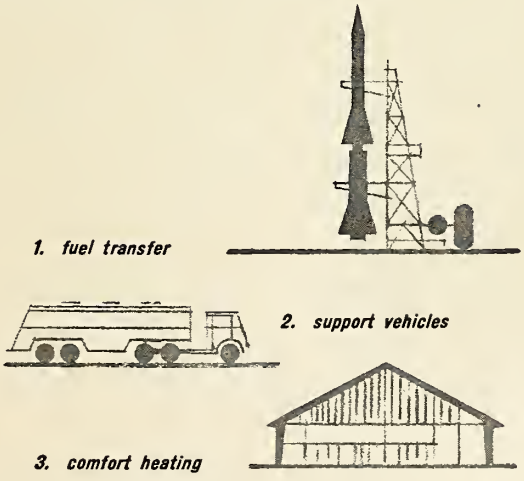
For missile ground support applications this compact new Janitrol liquid heater delivers heat up to a rate of 1 million Btu/hr. A complete variable output heating system, it automatically maintains liquid at any desired temperature . . . reliably.

This 257 pound package is ideally suited to such applications as heating missile fuel during storage and transfer, vaporizing liquids, and in a wide variety of support vehicles and buildings. For both material and personnel comfort heating the new Janitrol liquid heater is a simple, trouble-free way to get large quantities of controlled heat.

Heater burns either diesel fuel, gasoline, or JP-4, and can be converted with a simple adjustment. Radio noise shielding meets military specifications. It will operate in extreme environments to —65°F.

Janitrol's new liquid heaters may be used individually, or in multiples to meet virtually any heat requirement.

Wherever heat is needed in missile support equipment Janitrol may already have what you need. Contact your Janitrol representative now for the full story on liquid heaters. Janitrol Aircraft Division, Surface Combustion Corporation, Columbus 16, Ohio.



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INDUSTRY COUNTDOWN

MERGERS AND EXPANSIONS

Lockheed will build a $7 million addition at Sunnyvale, boosting capacity from 1,342,000 to 1,687,000 sq. ft. Plans call for completion by fall, 1959 . . . **Canadair Ltd. is constructing** a $1 million environmental lab for its missile programs in the Montreal suburb of St. Laurent . . . **Westinghouse Electric opened** a defense products sales office at 600 Old Country Road, Garden City, Long Island . . . **Mandrel Industries bought** the entire inventory, tooling, machinery and equipment of Hall-Scott Electronics division at Burbank . . . **Raytheon established** a Government Relations Office at Rome, N.Y. on August 1st . . . **Arnoux Corp. opened** a western regional office at 291 South LaCienega Blvd., Beverly Hills . . . **Pacific Semiconductors Inc. will build** a $10 million center employing 3,000 near the Los Angeles International Airport. When completed, it will comprise 300,000 sq. ft. . . .

Advance Industries of Cambridge, Mass. purchased 100% of the outstanding stock of The Electrolizing Corp. of Rhode Island. The acquisition includes Electrolizing's 100% stock of High Temperature Coatings Inc., Rhode Island, and 80% of Flame Ceramics Inc., Santa Monica . . . **Technitrol Engineering Co. of Philadelphia** opened a west coast office at 252 N. Irving Blvd., Los Angeles . . . **Hoffman Electronics Corp.** acquired 40,000 additional sq. ft. in Evanston to manufacture semiconductors and silicon solar converters . . . **First privately-owned** (by The Beryllium Corp.) integrated beryllium plant opened in Hazleton, Pa. Only previous comparable plant was owned by the AEC.

NEW FUNDS

Conference-approved version of FY 1959 appropriation of $101.1 million for NACA is low because of expected additional requests when NASA absorbs NACA . . . **ARPA will use** $24 million of its recently appropriated $50 million for a "highly classified project"—probably the bomb-powered rocket . . . **Senate Military Appropriations Subcommittee** went along with House increases of $609 million for four more *Polaris* submarine weapons systems. It also concurred with the House increases of $90 million for *Minuteman* and $48 million to step up *Hound Dog* . . .

Army plans to double its funds for basic research to prevent repetition of current R&D cycles, and will urge its contractors to follow suit . . . **Administration wants a temporary debt** ceiling of $288 billion until June 30, 1959, and then a permanent ceiling of $285 billion thereafter. DOD officials state that there will be no repetition of last years spending ceiling and weapons cutbacks if the debt limit is raised . . . **House-passed military construction bill** authorizing $1,218,815,000 in new funds went to the Senate. Breakdown was: $214,564,000 for the Army, a cut of $126,336,000; $282,751,000 for the Navy, a reduction of $85,502,000; and for the Air Force, $701,500,000, a reduction of $300,000,000.

HOW'S BUSINESS?

Martin Co. reports $91,864,495 sales and $1,896,740 net earnings (65 cents per share) for the 2nd quarter of 1958 compared to $96,361,490 and $1,693,531 (58 cents per share) for first quarter . . . **Profit of 22 cents per share** for the second quarter has reduced a first quarter loss of 44 cents per share to make a net loss of $104,000 for the first six months of 1958 for Fairchild Camera and Instrument . . . **Solar Aircraft's 1958 annual report** showed increased (by $1 million) working capital, decreased (to $5 million) bank loans and all-time high shareholder equity of $15,774,000 . . . **Thiokol Chemical anticipates** that sales of its Chemical Division will amount to $9.5 million for 1958, up 30% over 1957 . . . **Ling Electronics** announced receipt of $5 million in orders in the past 90 days . . .

Sales of Air Reduction for second quarter were $42,363,939 compared to first quarter figure of $46,815,125, a decline of 9.5%. Net income declined 18%, over comparable quarter in 1957, from $3,885,106 to $3,185,667. Regular quarterly dividend of 62½ cents per share will be paid, making it the 165th consecutive payment on common stock . . . **Ampex Corp. increased** earnings 41% in its FY 1957 ending 30 April on sales of $30,115,000 and after-tax earnings of $1,540,000, both new company highs . . . **Stavid Engineering received contracts** totaling $7,647,874 in first six months of 1958. Figure for comparable period last year was $4,859,926 . . . **Packard Bell's net** jumped 37% to $633,948 on sales of $26,401,343 for nine months ending June 30th . . . **Miniature Precision Bearings Inc.** recorded sales of $5,486,000 and after-tax profits of $297,000 for the fiscal year ending March 31st. Figures for the preceding year were $3,864,000 and $242,000, respectively . . . **Chance Vought earned** $4.35 per share in the first six months of 1958 on sales of $153,836,946, compared to $1.95 per share and sales of $86,044,763 in like period last year. Backlog climbed from $467 million to $542 million for same periods.

What's new in TITANIUM pricing:

Recent price reductions in titanium metal—the seventh initiated by Titanium Metals Corporation of America since 1954—have provoked renewed interest in the design properties of the material.

With prices down 45 percent from levels four years ago, and weight, heat, and corrosion problems severely increased in aircraft and missiles now being devised, titanium metal's role is growing ever more important.

The purchasing of titanium can sometimes be a complex task. TMCA hopes it can help you in that task by passing along some reminders on methods to save money on the "price extras" that apply to all orders of titanium metal. Of course, design considerations are paramount, but sometimes slight changes that can be tolerated by engineering can mean large cash savings.

✳ QUANTITY

Production costs decrease as the amount of material being processed increases. Therefore, quantity schedules have been established to pass along economies to the purchaser. A customer can often benefit by careful consideration of the amount of material he is ordering, compared to the quantity schedule as outlined in TMCA's Buyer's Guide. In many cases, because of applicable quantity extras, upwards of 1,000 pounds of titanium metal are available at no charge to the purchaser. For example, a 10,000 pound shipment of heat-treatable forging billet can cost exactly the same as a 9,074 pound order; a 5,000 pound shipment of plate can cost exactly the amount of a 4,802 pound order. TMCA's district sales managers are always willing to help you take advantage of the price breaks.

✳ PATTERN SIZES

Although ordering by pattern sizes is an established procedure with more common engineering materials, it isn't always the most economical method with titanium. For example, when small parts are to be cut from sheet, ordering "random size" will save you 75 cents per pound of material. The price allowance is applicable when *specific sheet sizes are ordered,* but shipment is permitted in widths ranging from −6″ to +2″ and lengths ranging from −18″ to +12″. Weight of random size sheets and exact size sheets of the same gage can be combined when computing quantity prices for a given order.

✳ TOLERANCE

Here important weight saving advantages are accorded designers and cost savings accrue to purchasing. Material specified ½ AISI tolerance weighs 10% less than standard-tolerance material.

TMCA's district sales manager will be happy to provide you information on grades and products where this tolerance schedule applies.

✳ WIDTH

If you determine the end use of metal before ordering, you will sometimes realize important cash savings. For example, titanium metal 24″ wide is classified as "sheet," and sheet prices apply. However, by ordering material 1/16″ less in width, strip prices apply at a savings of 50 cents to $1.00 per pound.

✳ THICKNESS

A more substantial saving is possible in specifying plate rather than sheet where the substitution meets design requirements. Metal 0.187″ thick is priced as sheet. However, metal 0.1875″ is priced as plate at a savings of $2.10 per pound.

✳ SIZE

A size extra of 20 cents per pound applies to billets 8″ or less in diameter. However, billets 8 1/16″ in diameter are supplied at base price. If the additional 1/16″ can be tolerated by design, the financial savings on material can be realized.

These are just a few examples of the money savings possible through careful study of the "price extra" sections of your Buyer's Guide.

Fixed, published schedules are vital in guaranteeing standard quotations to all customers in highly competitive work. By the same token, TMCA customers will receive every pricing benefit possible under these schedules.

* * * * * *

If you are placing an order for titanium, or considering purchase of titanium, contact the TMCA sales manager in your district. He can help save you money and time.

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- ☐ Bulletin 4 Mechanical Testing of Titanium
- ☐ Bulletin 5 Properties of Ti-155A
- ☐ Bulletin 6 Titanium Welding Techniques

WASHINGTON COUNTDOWN

• **THE PASSWORD** in Defense circles this week is reorganization. With the overall reorganization program closer to being law, all branches of the military stepped up their individual programs to fit into the new pattern.

• **THE NECESSARY MERGING** of functions and responsibilities will result in abolishment of a number of offices and the creation of others. Many of the functions now under military heads will move to civilian-skippered offices, and vice-versa. Indications are that the Navy, for example, will cut back to a maximum of three assistant secretaries, maybe only two. Also, the Undersecretary billet stands a good chance of being abolished.

• **THE OFFICE OF THE ASSISTANT SECRETARY FOR PERSONNEL** probably will get considerable face-lifting. One of the combined responsibilities mentioned is one assistant secretary for Finance and Personnel. A second for Research and Development and Material would provide for the Office of Naval Research remaining directly under the office of the Secretary of the Navy.

• **IN ONE WAY,** the reorganization is providing an opportunity for a number of changes long overdue. One of the changes which will be effected soon, if not immediately, is the establishment by the Navy of a Bureau of Weapons. Because of the complexities brought on largely by missile development in several different branches—such as the Bureau of Ships, Bureau of Ordnance and Bureau of Aeronautics—an overall Weapons Bureau seems the answer. Rear Admiral W. F. Raborn, head of the Special Projects Office supervising the Fleet Ballistic Missile program, is the best bet to head the new Bureau of Weapons when established.

• **A NEW SECRETARY OF THE NAVY** is another distinct possibility. Secretary Gates has made no bones about not wanting to stay much longer in his job, reorganization or no. As mentioned previously in this column Gates has said a man loses his usefulness after just so long in official Washington circles. Out front as choice for the top Navy executive's job is Assistant Secretary for Financial Management, J. Sinclair Armstrong. Armstrong has a number of things in his favor—his youth, his aggressiveness, his previous good record—not to mention his popularity in White House circles.

• **ONE APPROPRIATION BY CONGRESS** is being viewed with mixed emotions in some of the military circles. The lawmakers, many of whom have been the strongest voices for reorganization and elimination of competition between the services, boosted maintenance of the Offices of Information and the Offices of Legislative Liaison. In addition to many good reasons, the congressmen simply like being courted by more than one suitor.

• **AS ARMY SPACEMEN** planned the launching of the fourth *Explorer* satellite last weekend, it was obvious that the long time between shots (about four months) was due to something. In addition to instrumentation problems the delay could have been due to concurrent concentration on the first two or three lunar probes, which probably will be launched in late September or October.

• **MEANWHILE,** don't be surprised if the Air Force gets off a shot at the moon before the end of August. The main objective of these last *Explorer* shots is to measure and define more accurately the radiation band recorded by earlier satellites, and to try to determine whether its source is the sun or if it comes from interstellar space beyond the sun. Should it be found that the sun is not the source of all the radiation, a number of scientific theories will be up for revision.

• **THE RENEGOTIATION ACT** was scored by representatives of the Aircraft Industries Association, appearing before the House Ways and Means Committee, presently considering a two-year extension of the act.

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- A Whole Set of New Business Procedures in the Making
- Result will be Performance, Profit Check for U.S. Business

U.S. Readies Missile Makers' Planning Forms

by Seabrook Hull

After a frustrating four-and-a-half years, the Bureau of the Budget and the Armed Services appear at last to be on the verge of adopting a series of Missile Manufacturers Planning Report forms.

The MMPRs will be to missile makers what the Aircraft Manufacturers Planning Reports are to producers of aircraft and aircraft components.

Previously, missile-makers were asked to report on AMPR forms, but the data produced proved to be uncollatable. As a result, the Budget Bureau requested that new forms be developed that would be applicable to the peculiarities of missile and major missile segment production.

The current MMPR "M" forms, now in the final stages of adoption, are the outcome of this effort. It is expected that the first forms will be sent out to industry late this fall or in the first quarter of 1958.

A proposed handbook on the forms sets out the purposes of the reports:

• **Better reporting**—"The aim of the MMPR is to establish a clear and uniform reporting system that is designed to collect data that will best serve as a tool for military weapon system planners in their industry, contractor and program planning and evaluation, mobilization planning, and for other projection purposes."

Specifically, there is a current need for data that would enable the services to:

1. Make periodic surveys of the production status of companies.
2. Make periodic determination of the production capacities of facilities for mobilization purposes.
3. Plan and schedule feasible production programs.
4. Determine the manpower required to support such programs.
5. Measure the utilization of plant area and labor.
6. Develop a group of industry averages against which the reporting companies may measure performance.
7. Carry out research in order to refine currently-employed planning factors and to develop planning factors.
8. Maintain a library of missile weapon system data for use by the Government Services.
9. Provide production planning guidance to contractors by making available to them statistical parameters developed from the reporting system.
10. Develop formal studies and tools as required by other government services.

• **Broad coverage**—Under the heading "B. Scope," the handbook goes on:

"An MMPR will be submitted by all guided missile, rocket, drone and target missile contractors that have a pre-production and/or production contract unless specifically exempted by the contractor's cognizant service.

"The end use of the guided missile being produced is not the report determination criterion—the service's requirements for information in all instances will be the determining factor. The instructions and definitions provided in the following sections are guided missile and rocket oriented. Deviations necessary for drone and target missile reporting will be resolved individually with pertinent reporting contractors. . ."

• **Why necessary**—In summary, the Government wants a means of determining, first, what it takes in man-hours and facilities to make a missile and its parts; second, what the potential capacity of the country is—in case the need arises to push the "all-out" button and go on a wartime production basis.

Those expected to report will be the company that assembles the bird (prime contractor), and those companies responsible for making the major segments.

The MMPR instruction handbook defines these catagories as: guidance, power plant, structure (in government parlance, "airframe" is being dropped as a recognized missile term), mated segments, recovery system, armament, controls and multi-purpose energy systems, instrumentation.

MMPR Forms M-1, Production Support and Test and Checkout Data; and M-2, Direct Man-Hour and Flow Time Data; cover pre-production (non-recurring) effort (M-1) and actual production effort (M-2).

Form M-3, Composite Information, concerns itself with plant utilization—how much can be utilized as compared to the total available. Forms M-4 and M-5 cover Plant Area and Electrical Capacity; and Work Schedule of Direct Workers, respectively.

All-told, there are four quarterly reports to be made out and one semi-annual form (M-4).

• **Companies required**—Those companies used to supplying data under the Aircraft Manufacturers Planning Report will find nothing startlingly new in the MMPRs.

However, companies that now make major missile segments, but who have never done the same for aircraft, are in for an education in government paper work. Only those companies that make the completed segment need report; sub-segment suppliers and vendors probably will not be involved.

MMPR "M" series of forms include those parts of the bird that actually fly. Plans are now being instituted to work up an "S" series of forms for all support (non-flying) gear. These will cover all types of missiles—air-to-air, air-to-surface, surface-to-air and surface-to-surface. However, though the adoption of standardized forms and terms is expected to be more difficult than for the "M" series, less detail is going to be required, primarily because ground (or airborne) support and launching gear is usually a non-recurring expense.

• **Form development**—The forms illustrated with this article were interim. However, except for some

reports on use, cost of labor . . .

MISSILE MANUFACTURER'S PLANNING REPORT
MISSILE SEGMENT–
DIRECT MAN-HOUR AND FLOW TIME DATA
(MMPR M-2)
(DUE DATES: 30 January, April, July, and October)

WEAPON SYSTEM TITLE
MODEL IDENTIFICATION
CONTRACT NOS (Use separate sheet if necessary)
WEAPON SYSTEM PRIME CONTRACTOR
SEGMENT-PRIME RESPONSIBILITY
COMPANY MAILING ADDRESS
REPORTING PLANT
OTHER PLANTS INCLUDED

SEGMENT(S) REPORTED
☐ GUIDANCE
☐ POWER PLANT
☐ STRUCTURE
☐ MATED SEGMENTS
☐ RECOVERY
☐ ARMAMENT
☐ CONTROL & MULTI-PURPOSE ENERGY SYSTEMS
☐ INSTRUMENTATION AND MISCELLANEOUS
☐ _____

FORM APPROVED
BUDGET BUREAU NO.
REPORT CONTROL SYMBOL
FOR QUARTER ENDING

SECTION I – MONTHLY INFORMATION (On-Site)
DIRECT MAN-HOURS (000)

MONTHS		LAST CUMULATIVE SEGMENT ACCEPTED OR COMPLETED a	METHOD OF ACCT'G b	COMPLETE SEGMENTS: FABRICATION c	ASSEMBLY d	TEST AND CHECK-OUT e	ALL OTHER f	TOTAL FOR COMPLETE SEGMENT g	SPARES h	MISCELLANEOUS i	TOTAL SEGMENT EFFORT j
0. LAST MONTH OF PREV. QTR.			ACTUAL								
			STD.								
REPORT QUARTER	1		ACTUAL								
			STD.								
	2		ACTUAL								
			STD.								
	3		ACTUAL								
			STD.								
FORECAST	4		ACTUAL								
			STD.								
	5		ACTUAL								
			STD.								
	6		ACTUAL								
			STD.								
	7		ACTUAL								
			STD.								
	8		ACTUAL								
			STD.								
	9		ACTUAL								
			STD.								
	10		ACTUAL								
			STD.								
	11		ACTUAL								
			STD.								
	12		ACTUAL								
			STD.								
	13		ACTUAL								
			STD.								
	14		ACTUAL								
			STD.								
	15		ACTUAL								
			STD.								

SECTION II – LEARNING CURVE INFORMATION (On-Site)
AVERAGE DMH PER LOT OR UNIT

MONTHS		LAST CUMULATIVE SEGMENT o	METHOD OF ACCT'G b	FABRICATION c	ASSEMBLY d	TEST AND CHECK-OUT e	ALL OTHER f	TOTAL g
0. LAST MONTH OF PREV. QTR.			ACTUAL					
			DEV.					
REPORT QUARTER	1		ACTUAL					
			DEV.					
	2		ACTUAL					
			DEV.					
	3		ACTUAL					
			DEV.					
FORECAST	4		ACTUAL					
			DEV.					
	5		ACTUAL					
			DEV.					
	6		ACTUAL					
			DEV.					
	7		ACTUAL					
			DEV.					
	8		ACTUAL					
			DEV.					
	9		ACTUAL					
			DEV.					
	10		ACTUAL					
			DEV.					
	11		ACTUAL					
			DEV.					
	12		ACTUAL					
			DEV.					
	13		ACTUAL					
			DEV.					
	14		ACTUAL					
			DEV.					
	15		ACTUAL					
			DEV.					

SEC. III – OFF-SITE DATA
OUTSIDE DOLLARS PER UNIT a

SECTION IV EVALUATION CRITERIA
SUBCONTRACTED (Segment weight and other significant measures)

MONTHS		% EFFORT PER UNIT b	DOLLARS AND % PER UNIT c	MEASURE d	ON-SITE FABRICATION e	ALL OTHER OUTSIDE PURCHASE f	SUBCONTRACTED g	OPE s	TOTAL t
0. LAST MONTH OF PREV. QTR.			$	SW					
			%	OSM					
REPORT QUARTER	1		$	SW					
			%	OSM					
	2		$	SW					
			%	OSM					
	3		$	SW					
FORECAST			%	OSM					
	4		$	SW					
			%	OSM					
	5		$	SW					
			%	OSM					
	6		$	SW					
			%	OSM					
	7		$	SW					
			%	OSM					
	8		$	SW					
			%	OSM					
	9		$	SW					
			%	OSM					
	10		$	SW					
			%	OSB					
	11		$	SW					
			%	OSM					
	12		$	SW					
			%	OSM					
	13		$	SW					
			%	OSM					
	14		$	SW					
			%	OSM					
	15		$	SW					
			%	OSM					

SECTION V – FLOW TIME (Work days) (Last unit completed in third month of report quarter)

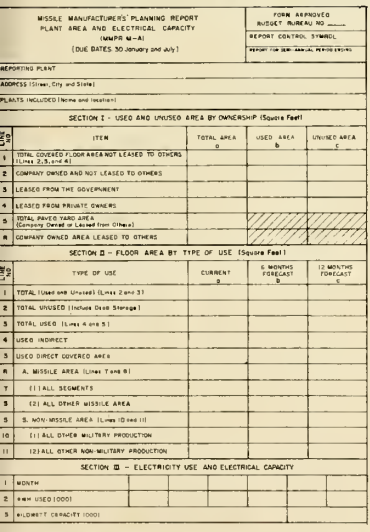
UNIT NO g	STARTING DATE b	COMPLETION DATE c	ELAPSED TIME (Workdays) d	e PERCENT DIRECT UNIT MAN HOURS PER TIME INTERVAL IN WORK DAYS: LAST (5) 30	(6-10) 31-60	(11-15) 61-90	(16-20) 91-120	(21-25) 121-150	(26-30) 151-180	181-210	211-240	241-270	271-300	301-330	331-360	OVER 360

REMARKS (Enter on reverse side)

PREPARED BY (Name) (Title) (Date)
MAKE INQUIRY TO (Telephone No.) (Ext.)
APPROVED BY (Name) (Title)

DD FORM 22 NOV 1957 (PROPOSED)

. . . plant capacity, production, will be required.


MISSILE MANUFACTURER'S PLANNING REPORT
PLANT AREA AND ELECTRICAL CAPACITY
(MMPR M-4)
(DUE DATES: 30 January and July)

FORM APPROVED
BUDGET BUREAU NO.
REPORT CONTROL SYMBOL
REPORT FOR (SEMI-ANNUAL PERIOD ENDING)

REPORTING PLANT
ADDRESS (Street, City and State)
PLANTS INCLUDED (Name and location)

SECTION I – USED AND UNUSED AREA BY OWNERSHIP (Square Feet)

LINE NO	ITEM	TOTAL AREA a	USED AREA b	UNUSED AREA c
1	TOTAL COVERED FLOOR AREA NOT LEASED TO OTHERS (Lines 2,3, and 4)			
2	COMPANY OWNED AND NOT LEASED TO OTHERS			
3	LEASED FROM THE GOVERNMENT			
4	LEASED FROM PRIVATE OWNERS			
5	TOTAL PAVED YARD AREA (Company Owned or Leased from Others)			
6	COMPANY OWNED AREA LEASED TO OTHERS			

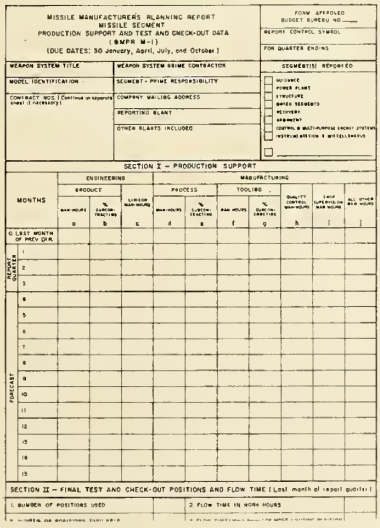
SECTION II – FLOOR AREA BY TYPE OF USE (Square Feet)

LINE NO	TYPE OF USE	CURRENT a	6 MONTHS FORECAST b	12 MONTHS FORECAST c
1	TOTAL (Used and Unused) (Lines 2 and 3)			
2	TOTAL UNUSED (Include Dead Storage)			
3	TOTAL USED (Lines 4 and 5)			
4	USED INDIRECT			
5	USED DIRECT COVERED AREA			
6	A. MISSILE AREA (Lines 7 and 8)			
7	(1) ALL SEGMENTS			
8	(2) ALL OTHER MISSILE AREA			
9	B. NON-MISSILE AREA (Lines 10 and 11)			
10	(1) ALL OTHER MILITARY PRODUCTION			
11	(2) ALL OTHER NON-MILITARY PRODUCTION			

SECTION III – ELECTRICITY USE AND ELECTRICAL CAPACITY

1	MONTH											
2	KWH USED (000)											
3	KILOWATT CAPACITY (000)											

changes in the first three, they are pretty much what will be sent out. One of the areas of dispute between the industry representatives and the government representatives is the differentiation (if any) between "quality control" and "test and check-out." This also is one of the basic differences between the AMPR and MMPR forms: AMPR had no test and checkout column.


MISSILE MANUFACTURER'S PLANNING REPORT
MISSILE SEGMENT
PRODUCTION SUPPORT AND TEST AND CHECK-OUT DATA
(MMPR M-1)
(DUE DATES: 30 January, April, July, and October)

FORM APPROVED
BUDGET BUREAU NO.
REPORT CONTROL SYMBOL
FOR QUARTER ENDING

WEAPON SYSTEM TITLE
WEAPON SYSTEM PRIME CONTRACTOR
MODEL IDENTIFICATION
SEGMENT-PRIME RESPONSIBILITY
CONTRACT NOS (Continue on separate sheet if necessary)
COMPANY MAILING ADDRESS
REPORTING PLANT
OTHER PLANTS INCLUDED

SEGMENT(S) REPORTED
☐ GUIDANCE
☐ POWER PLANT
☐ STRUCTURE
☐ MATED SEGMENTS
☐ RECOVERY
☐ ARMAMENT
☐ CONTROL & MULTI-PURPOSE ENERGY SYSTEMS
☐ INSTRUMENTATION & MISCELLANEOUS

SECTION I – PRODUCTION SUPPORT

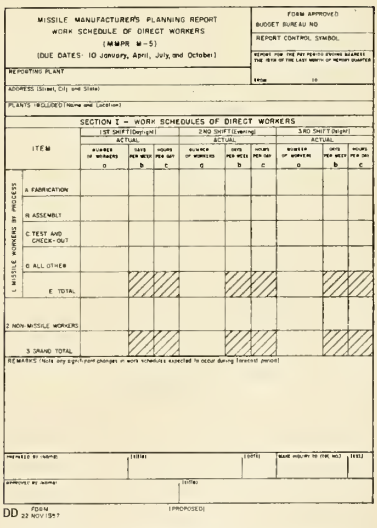
MONTHS		ENGINEERING: PRODUCT MAN-HOURS a	ENGINEERING: PRODUCT % CURRENT TRACKING b	ENGINEERING: TOOLING MAN-HOURS c	MANUFACTURING: PROCESS MAN-HOURS d	MANUFACTURING: PROCESS % CURRENT TRACKING e	MANUFACTURING: TOOLING MAN-HOURS f	MANUFACTURING: TOOLING % CURRENT TRACKING g	MANUFACTURING: QUALITY CONTROL MAN-HOURS h	MANUFACTURING: 1ST SHIFT SUPERVISION MAN-HOURS i	MANUFACTURING: ALL OTHER MAN-HOURS j
0. LAST MONTH OF PREV. QTR.											
REPORT QUARTER	1										
	2										
	3										
FORECAST	4										
	5										
	6										
	7										
	8										
	9										
	10										
	11										
	12										
	13										

SECTION II – FINAL TEST AND CHECK-OUT POSITIONS AND FLOW TIME (Last month of report quarter)

1. NUMBER OF POSITIONS USED
2. FLOW TIME IN WORK HOURS

The MMPR forms were developed by the Economics Division of Stanford Research Institute, under a contract with Army Rocket and Guided Missile Agency, in cooperation with the Navy Bureau of Aeronautics and the USAF Air Materiel Command.

The presiding (judging) group for final approval of the MMPR form is known as the Committee on Missiles, which works with the Bureau of the


MISSILE MANUFACTURER'S PLANNING REPORT
WORK SCHEDULE OF DIRECT WORKERS
(MMPR M-5)
(DUE DATES: 10 January, April, July, and October)

FORM APPROVED
BUDGET BUREAU NO.
REPORT CONTROL SYMBOL

REPORTING PLANT
ADDRESS (Street, City and State)
PLANTS INCLUDED (Name and Location)

SECTION I – WORK SCHEDULES OF DIRECT WORKERS

ITEM	1ST SHIFT (Day) ACTUAL: NUMBER OF WORKERS a	1ST SHIFT (Day) ACTUAL: DAYS PER WEEK PER SHIFT b	1ST SHIFT (Day) ACTUAL: HOURS PER DAY c	2ND SHIFT (Swing) ACTUAL: NUMBER OF WORKERS d	2ND SHIFT (Swing) ACTUAL: DAYS PER WEEK e	2ND SHIFT (Swing) ACTUAL: HOURS PER DAY f	3RD SHIFT (Night) ACTUAL: NUMBER OF WORKERS g	3RD SHIFT (Night) ACTUAL: DAYS PER WEEK h	3RD SHIFT (Night) ACTUAL: HOURS PER DAY i
1. MISSILE WORKERS BY PROCESS: A. FABRICATION									
B. ASSEMBLY									
C. TEST AND CHECK-OUT									
D. ALL OTHER									
E. TOTAL									
2. NON-MISSILE WORKERS									
3. GRAND TOTAL									

REMARKS (Note any significant changes in work schedules expected to occur during forecast period)

PREPARED BY (Name) (Title) (Date) MAKE INQUIRY TO (Tel. No.) (Ext.)
APPROVED BY (Name) (Title)

DD FORM 22 NOV 1957 (PROPOSED)

Budget. Companies with representatives on the Committee include General Dynamics Corp.; Raytheon Mfg. Co.; The Martin Co.; Westinghouse Electric Corp.; Aerojet-General Corp.; North American Aviation, Inc.; Convair; Chrysler Corp.; General Electric Co.; The Sanborn Co.; Douglas Aircraft Co.; Firestone Tire & Rubber Co.; Western Electric Co.; A.C. Sparkplug div.; Thiokol Chemical Corp.

Soviets Push Missile Plastics

by Alfred J. Zaehringer

Behind Nikita Khrushchev's recent call for more plastics production is seen the growing need for missile plastics. Only a small amount of plastics is now going into the civilian market. A large portion of the plastics production that is planned will go into vital military areas.

Prominent among these military applications will be plastics for missiles, rockets, and space flight ventures. In 1957, m/r reported on the cartel associations of the USSR, and the satellite countries' chemical industry, in particular, the vast new plants that were planned. Many of these are now in production, and a lion's share of the output is going into the missile field. Here are some informal estimates of plastics now being used in missiles:

1. *Epoxies.* 10-20 million lb/yr. Production in USSR, East Germany, Poland. Use for high-energy solid propellant fuel-binder. Most epoxies going into plastic tooling, glass-plastic laminates, and corrosion-proof coatings. Adhesives for honeycomb structures and metal bonding. Also vital in missile electronics potting compounds.

2. *Fluorocarbons.* Production at least 1 million lb/yr. in USSR. Much, if not all fluorocarbons going into atomic processing plants with small amount being fabricated into seals, etc. for liquid propellant rockets.

3. *Phenolics.* Production estimated at over 25 million lb/yr. Heavy emphasis on phenolic-glass-reinforced solid propellant rocket motors and components. Possibly also burn-away ballistic missile nose cones.

4. *Polyesters.* About 20-30 million lb/yr. May be used for fuel-binders, laminates and most assuredly for missile radomes.

5. *Polysulfides.* Perhaps 5 million lb/yr. Being de-emphasized for solid propellant fuel-binders.

6. *Polyethylene.* Unknown production. But ethylene oxide plants known to be in operation. Very limited missile use.

7. *Polyurethane.* Production is about 5-10 million lb/yr. Heavy use for fuel-binders, adhesives, seals, liners, and coatings. Little foam applications, unlike U.S.

8. *Silicone.* Production figures not known. High temperature missile laminates appear to dominate other applications.

According to Dr. Herman F. Mark, a world authority on polymer chemistry and Director of the Polymer Research Institute of Polytechnic Institute of Brooklyn, the Soviets have invested heavily in plastics research. Aside from production, Dr. Mark gives the following polymer research centers: Moscow, Leningrad, Baku, Tashkent, Charkov, Sverdlovsk, Kazan, Kiev, Novosibirsk, and Irkutsk. At these centers, Dr. Mark estimates the following levels of manpower at 60-80 full professors, 600-700 Ph.D's, and about 2,000 laboratory workers.

In general, the laboratories are as well equipped as in the West, and in some cases much more heavily stocked. Some of the research work in plastics and their significance to the missile field are related below:

Karpov Institute of Physical Chemistry, Moscow. Polymerization is kinetically studied. Monomers and related materials studied (butadiene, isoprene, and styrene) indicates interest in synthetic rubber fuel-binders and polyesters. Another group is studying the degradation of plastics under influence of heat and high intensity radiation. Of particular significance for ballistic missile warheads and effects of anti-missile weapons.

University of Moscow. Nobel prize-winner Semenov, who is working on free radicals, is interested in polymers. Thus, there may be the possibility of stabilizing free radicals by "tying them up" in plastics that could also be used in solid propellants. Another group is working on stresses in plastics, and the outcome could be better missile structures—possibly pre-stressing.

Institute of Element Organic Compounds. Prof. A. Nesmenov, president of the USSR Academy of Sciences and director of the Soviet satellite efforts, heads this research organization. Purpose is the synthesis of metal organics.

Institute of Macromolecular Chemistry. This group is vitally interested in "giant molecules" that make up synthetic rubber and the new plastics.

Institute of Oil and Coal Research. At work on high pressure polymerization; also turning out boron alkyl compounds.

Institute of Organic Chemistry. Particularly active in cellulose chemistry, now of vital importance in new homogeneous solids containing nitroglycerin and nitrocellulose. Russia produces 2.4 million tons of cotton per year, a vital cellulose source.

In conclusion, it can be stated that demands for plastics in missiles has skyrocketed in the USSR. Much time and effort has been invested in research, and now production is the important step. Last year, the *Sputniks* were considered spectacular by Western scientists. These gains were based on a plastic technology that was five years old.

Nike-Cajun Measures Humidity

Humidity in the upper atmosphere is being measured by a hygrometer installed in the nose of the IGY *Nike-Cajun* High Altitude Carrier Rocket. Secret of its operation is a lead sulfide cell.

Lead sulfide is photosensitive, so electrical reactivity of the cell is directly proportional to intensity of sunlight or radiation beamed on it. Intensity of sunlight, in turn, varies inversely as the amount of water vapor in the atmosphere between the instrument and the light source—the sun.

The proportionate change in output of the lead sulfide cell, which is telemetered back to earth, is thus a measure of the humidity of the rare outer atmosphere in which the rocket does its work.

Exposure of the cell to solar radiation is held constant by a sun-follower, an optical system that stabilizes attitude of the instrumentation with respect to the sun regardless of pitch, yaw or spinning motion of the rocket. The grating filters the sun's light into its components as to wave length. The collimator is a beaming device to focus

the reflected light on the lead sulfide cell in the nose of the rocket.

New Propellant Battleground: Aircraft-Carried Missiles

Liquid propellant motors have again entered into battle with solids—this time in the case of missiles carried by aircraft.

Efforts have been under way for some time to develop liquid pre-packaging methods for big birds like ICBM's and IRBM's, in order to build up their readiness. With the small missiles, however, the problem is not so much readiness, as it is safety and reliability.

In a word, aircraft performance threatens to outstrip missile technology. The problem is to develop a rocket motor that will withstand all of the environmental conditions that it may encounter from factory to firing, and yet still operate reliably when the firing button is pushed.

It is a problem of temperature—and is so critical that some aircraft may have to limit their combat performance when they are carrying today's air-to-air and air-to-ground missiles, such as *Sparrow III, Sidewinder, Falcon* and *Bullpup*. It is currently a solid-propellant problem, but pre-packaged liquids may take over if the temperature tolerance of solid propellant grains cannot be appreciably widened. It's both an on-the-ground climatic and an in-flight operational problem.

• **Mass production at stake**—Less than a million dollars a year is being spent by Navy, Army and Air Force on research for a solution. This is a small amount of money, but on the outcome rests a considerably larger volume of production and sales, for these are truly the "mass production" missiles. Both current and potential suppliers of both systems have a large stake in the battle. At the moment, virtually all missiles in these categories are solid-propellant powered, but the decision that may change all this is due in about 12 months.

Generally speaking, specifications for in-production solid propellant missiles call for the motors to be able to withstand from –65°F to +160°F without cracking of the grain, spontaneous ignition, warping, necking, or buckling. However, many motors become unsafe and unreliable after exposure to –40°F, or may blow up on firing at temperatures of 200°F or over.

Contrast these figures with, say, a typical combat mission by an interceptor taking off from Thule under winter conditions. The temperature on the ground may be –65°F. The plane takes off, climbs to 40,000 feet and flies for 15 minutes at Mach 2.2. Regardless of the adiabatic air temperature at that altitude (probably about –40°F), the effective temperature of the air passing over the aircraft skin and the skins of any externally slung missiles is on the order of 200°F or more. Then the missile is fired and has a peak velocity of, say, Mach 3.5. Aerodynamic heating temperatures may top 300°F.

The sharp contrast between the temperature on the ground and the high in-flight temperatures results in a double danger; first, that the missile motor may blow up at the moment of firing—due either to a damaged grain or simply to the heating—and take the wing of the plane with it; or, secondly, it may explode after leaving the launching aircraft before it achieves its mission. In either case, the problem is great.

• **Navy headache?**—It is more a Navy than an Air Force problem, since most of Navy's carrier planes sling their stores externally, while Air Force usually pods them. However, all three Services have an interest in improving the performance and tolerances of their small birds.

For the Navy, Aerojet-General has the prime responsibility for trying to improve solids, while the Reaction Motors Division of Thiokol Chemical Corp has been given the liquid task.

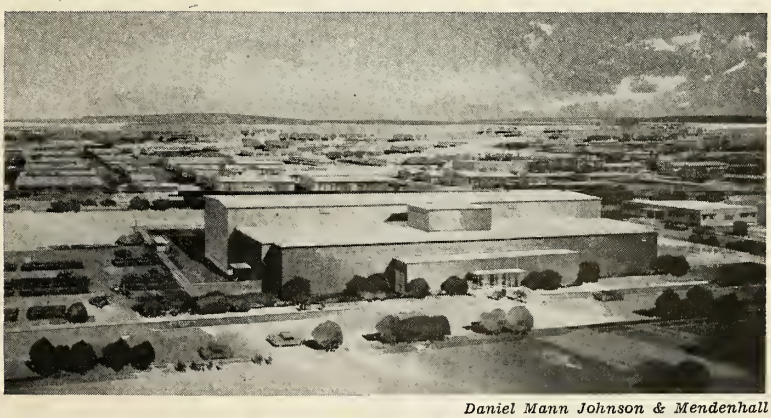
Generally speaking, the parameters of the desired system are a temperature tolerance of from –65°F to +300°F (though they'll take 240°F), and a specific impulse of something over the presently operational 200 seconds. The motor, whether it's solid or liquid, should not require fueling or internal inspection for a minimum period between two and three years. And, at that time, provision must be made for returning it to the factory for checking and inspection.

Solids already meet the inspection-free requirement. Liquids can cope with the temperature requirements. The problem is to make one or the other fulfill both sets of conditions.

The liquid approach to pre-packaging is relatively simple. There are no pumps and, in fact, only a couple of moving parts in the whole motor. Solid propellant pressurization is used. Standard materials make up the tankage. However, as in all liquid systems, control of propellant flow rates is a major headache.

The solution to the solid propellant's problem lies primarily in chemistry—development of a binder that retains its basic properties (flexibility) over a wider temperature range. Aside from the rocket companies themselves, both Shell Development Corp. and Sinclair Refining Co. are working towards such a binder. An additional problem, of course, is a propellant combination that will not spontaneously ignite in the higher temperature ranges.

Navy's Ordnance Test Station at China Lake demonstrated the feasibility of the pre-packaged liquid system when, several years ago, it developed and fired the *LAR* (Liquid Aircraft Rocket) successfully. This utilized red-fuming nitric acid and aniline. Propellants of this nature freeze at –65°F to –85°F, and are not generally bothered by the upper ranges under consideration.



Daniel Mann Johnson & Mendenhall

TRAINING FACILITY for power plant operation and fueling systems procedures for *Atlas, Titan* and *Thor*, to be erected by Air Training Command, Chanute AFB, Ill. Other facilities will be at Sheppard and Keesler AF bases. Project cost to be $11 million.

Senate OK's $40 Billion for Military

The Senate Appropriations Committee, in reporting out a $40.03 billion Fiscal Year 1959 Defense Department appropriation bill, last week upped the House total by $1.623 billion. The Senate version was also $1.24 billion more than that requested by the Administration.

(The bill must now be acted on by the whole Senate, and then go into a joint Senate-House conference to iron out the differences.)

The Department of Defense will get at least as much as it asked for, in all probability. The international situation being what it is, the inclination of the Congressional conferees will be to compromise upward, rather than down. Administration requests came to $38.8 billion, up $3.9 billion.

For Navy aircraft and related procurement, which includes missile funds, the Senate committee recommends $2.08 billion—$133 million more than the House, but $9 million less than was requested. Respective figures for the Air Force are $6.9 billion, plus $570 million and plus $472 million. Army would get $1.67 billion, which is $14.7 million more than the House-approved bill and $51 million more than the official request.

Recommended research and development appropriations come to a total for the three services of $2.063 billion, which is $86.2 million more than was asked for, and agrees precisely with the House-approved total. Like the House, the Senate committee recommendation includes funds for six *Polaris*-launching submarines, instead of the two asked for by the Defense Department. It also approved $11 million for speeding construction of three *Regulus*-launching submarines. This would go along with the House in adding $43.7 million to the *Polaris* Fleet Ballistic Missile program. Additional funds for *Minuteman* and *Houndog* passed by the House were approved in the report.

The Senate Committee recommends the appropriation of a $150 million emergency fund to the Department of Defense, plus a transfer authority of up to $200 million—$100 million more than that approved by the House—and far short of the $1 billion transfer authority requested.

• **Research urged**—Throughout its report, the Senate Committee strongly urged much greater concentration by all three services on basic research, as compared to applied research and development. The Committee spoke of "an absolute necessity (to do this) if we are to maintain a lead in the technological developments which will produce scientific supremacy a decade from now."

The Committee also had some words of warning for the Air Force: it called for "careful reappraisal in connection with the expenditure of funds appropriated by this bill . . . (since) AF has allowed duplicate testing facilities to be built by private contractors while permitting Government-owned facilities to remain idle."

Senators said they were "at a loss to understand the thinking behind the reduction made by the Air Force of highly trained technical and professional personnel in this selective area of space conquest . . . the committee notices a growing lack of energy in the AF in space activities, and strongly advises AF to survey its (R&D) bases with a view to utilizing one or more of these installations as a laboratory for space biology and biodynamics."

The committee also deplored rising costs of contracts with private industry: "The general lack of a pressing need for economical production, once competitive marketing is removed, is inimical to the public interest and weakens our defense armor."

The Defense Department was directed to make a study of this problem and submit a report on its findings by January 15, 1959. The Senate group also refused to go along with provisions to fund price differentials on contracts that are directed towards depressed areas. This will mean, if the deletion survives the conference, depressed areas will not get preferential treatment in the awarding of defense contracts unless their prices match that of the lowest bidder.

JUPITER **AND** *REDSTONE* **ballistic missiles move down parallel production lines at the Warren Missile Plant of Chrysler. The number of** *Jupiters* **shown indicates quantity production is being achieved. A** *Jupiter* **tank assembly undergoes dynamic tests at the missile plant (right). The missile section has been lowered into a test pit below the floor level for this operation. Heavy presses and other production equipment used for manufacture of components can be seen in the background.**

Top m/r Coverage Planned For August IAF Meeting

Following its policy of providing top news coverage of world events for its readers, Missiles and Rockets magazine will send two top editors to the Ninth Annual Congress of the International Astronautical Federation at Amsterdam, Holland, August 25-30.

Erik Bergaust, executive editor, and Anthony Vandyk, chief of American Aviation Publications' European correspondents, will attend the sessions and report on the meeting for m/r readers. Also, several of the magazine's contributing editors and members of its advisory board, including Dr. Wernher Von Braun, will attend the Congress, and will assist in preparing a full report.

Kincheloe's Standby Pilot Takes Place On X-15 Team

Captain Robert M. White has been named by the Air Force to succeed Captain Iven C. Kincheloe, Jr., as the AF member of the three-man team training to take the X-15 into space. Captain Kincheloe was killed July 26 when his F-104 jet fighter crashed while he was flying "chase" at Edwards Air Force Base.

Roll-out of the North American X-15 is expected about November 1, probably at Edwards AFB. First flight tests are slated for early in 1959. However, the Air Force is not expected to fly the X-15 for about a year.

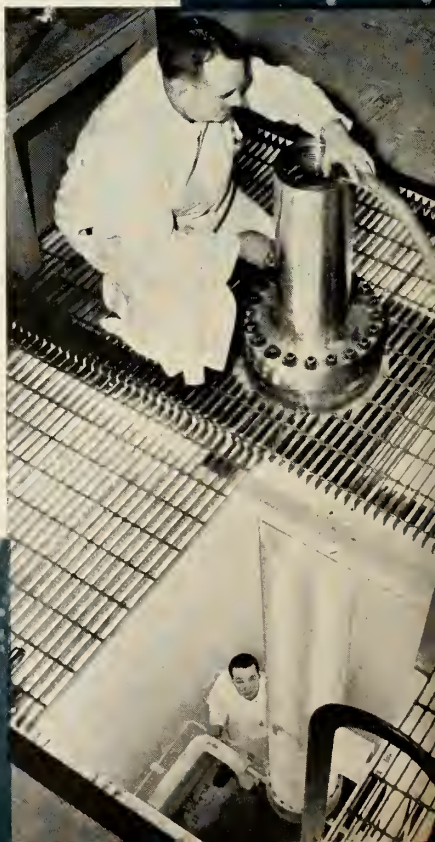
TAPCO INTEGRATED FACILITIES

provide components and assemblies for propulsion systems and complete auxiliary and accessory power sub-systems

Over 50 years of experience in developing metals and designing components for power plants gives the Tapco Group a vast experience in research, development and manufacturing of assemblies and components for propulsion and power systems and sub-systems.

Now, Tapco's capabilities have been broadened to include most phases of nuclear-power plants and accessories. Research is under way on the special metallurgical problems associated with radiation effect.

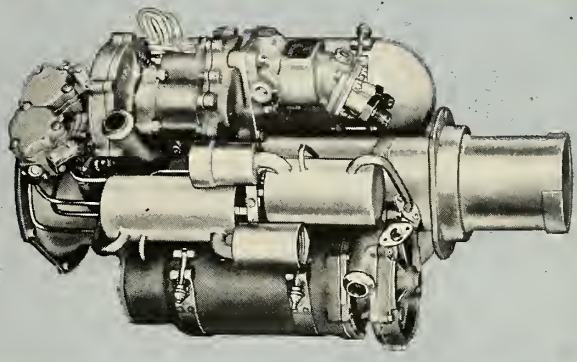
Fuels for all types of engines and power plants are collateral research projects at Tapco, where complete facilities for research and evaluation on solid-state, liquid and nuclear fuels are in existence.

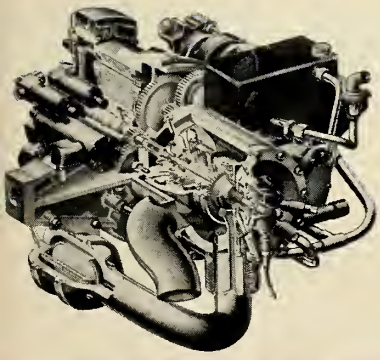


Function testing of nuclear reactor control rod drive mechanisms ▶ in a simulated vessel head; part of Tapco's continuing research project on nuclear reactor components and control systems.

◀ Special problems of forming, heat-treating, and resistance welding were solved at Tapco in producing this large weldment for jet engines.

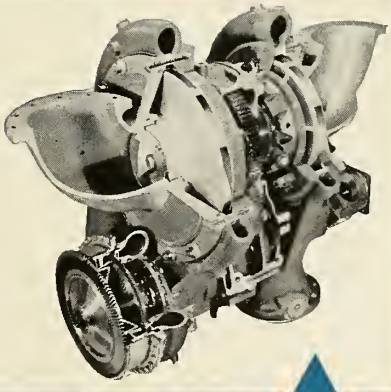
Self-contained solid-propellant auxiliary power unit designed and built at Tapco to produce electric and hydraulic power. ▼





At left: Combination main and afterburner engine-driven fuel pump now providing thousands of hours of trouble-free service in production fighter aircraft.

At right: Rocket engine turbo pump now in production at Tapco for use in several of America's leading missiles.



TAPCO GROUP

consisting of Accessories, Jet, Electronics, Pneumatics and West Coast Divisions

OTHER INTEGRATED SERVICES FROM TAPCO INCLUDE DESIGN, DEVELOPMENT OR PRODUCTION IN THE FIELDS OF STRUCTURES, ELECTRONICS, METALLURGY AND NUCLEAR POWER.

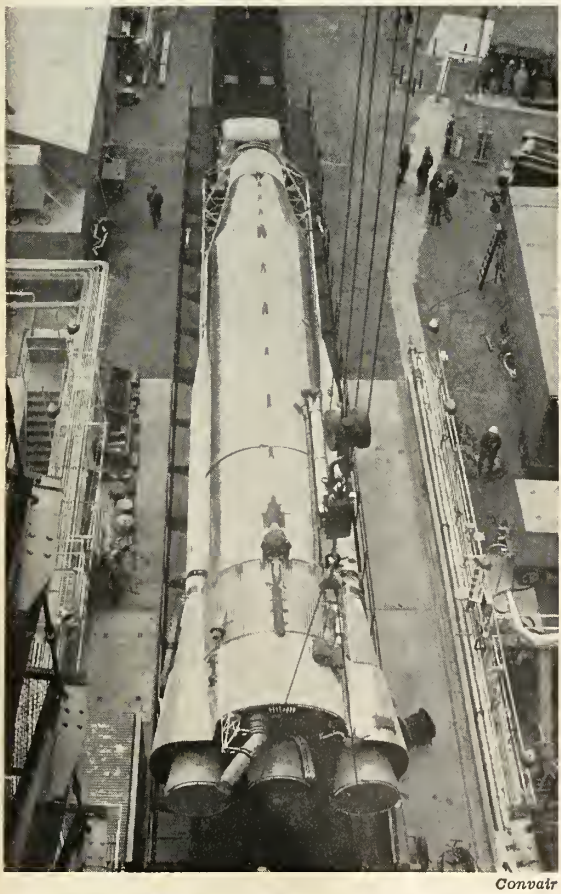
Thompson Products, Inc. CLEVELAND 17, OHIO

Convair

N. L. Baker

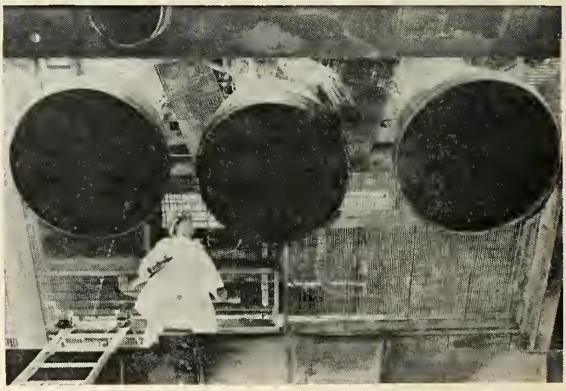
Convair-Astronautics recently dedicated its new $40 million Kearny Mesa plant near San Diego. The plant was constructed specifically for development and production of the *Atlas*. Officials who attended the dedication included (left to right): J. R. Dempsey, manager CA; Lt. Gen. C. S. Irvine; J. V. Naish; RAdm. Hartman; Maj. Gen. Wade; K. J. Bossart; Maj. Yokie.

ATLAS in the News



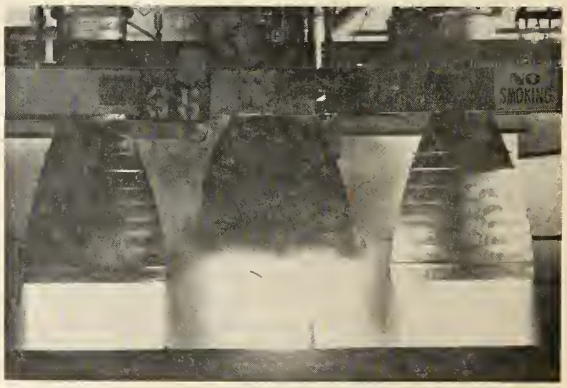
Convair

The engine cluster that will power the missile during its 5,500-mile flight is shown in this overhead view. The missile pictured was destroyed after forty-five seconds of flight.



North American Aviation

Engine cluster mounted on test stand at Rocketdyne's Santa Susana facilities. The primary units are boosters on the left and right. The sustainer unit is located in the center.



North American Aviation

The free world's most powerful engine system. In flight, each booster develops 150,000-lb. thrust for 140 seconds, while sustainer chamber develops 54-60,000-lb. for five minutes.

missile business

by Seabrook Hull

Watch ARPA. The Advanced Research Projects Agency right now is just feeling its way along, but by this time next year it will have clearly defined its "roles and missions" and should be in a position to execute them. Potentially, ARPA may be the number one starting point for a large volume of space-age business.

Meanwhile, ARPA's listening. Director Roy Johnson, Rear Admiral John E. Clark, Dr. Herbert York, Captain Bob Truax and others are spending a large portion of their time hearing proposals from the three military services and industry. Whenever possible any and all of the "top 35" in ARPA sit in on these presentations. For one thing, it's a good concentrated education in space-age talk, concepts and costs.

ARPA's budget is small—$520 million. But whether it's a contract to launch a moon probe costing millions; or a components improvement order to research and develop a better rocket motor casing or a space auxiliary power system for $100,000 or less—the knowledge and technical capabilities acquired in each case will give the contractor an edge over his competitors in getting future business in the field.

Also, ARPA's budget will grow. So will its control over other space-age budgets. Today's space flight costs are peanuts compared to what will follow. ARPA's future is roughly equivalent to that of the Soviet Academy of Science's Commission for Interplanetary Travel, and in that respect it should ultimately become one of the most important market factors in the field of astronautics.

If you have an idea for advancing America's space technology and you have that idea down in some kind of coherent form, make an appointment with ARPA. That's why they're there—to listen and sift through ideas and to pick the best for financial support.

Concern over big U.S. liquid propellant ballistic missiles as weapons systems capable of supplying this country with an immediate retaliation capability is mounting. The goal, of course, is missiles that will be off their launching pads and on their way within 15 minutes of the decision to fire. Otherwise, the assumption is, enemy missiles will wipe out launching sites first.

The minimum fueling and countdown time now is (theoretically) two hours, though this has never been achieved, even at Cape Canaveral, where there are a maximum of facilities. Much the same thing would be true of both *Titan* and *Atlas*.

Nor is the proposition of continually cycling fuel and oxidizer necessarily feasible. One of the missiles can't even have its LOX tanks topped off again if the countdown is delayed and too much is vented off. All of them have oxidization and freezing problems if the LOX remains in the tanks too long.

As an interim alternative, until solid propellant missiles come along, the suggestion is being kicked around that Fairchild's *Gander* might be a better missile for Europe. Largely plastic constructed, it provides a radar target that is one-tenth that of an F-86. Thus, even though it is subsonic, it could be virtually on top of its target before intercepion. Range: 2,000 miles. Payload: One megaton.

Big advantage: It can be readily manufactured in Europe, at a cost to the U.S. of less than $500,000 in special tooling.

contract awards

LAST MINUTE AWARDS

Navy gave $385,000 to the Martin Co. for "engineering studies" on a nuclear-powered seaplane . . .

Air Force gave $23 million to Laboratory for Electronics, Inc. for production of AN/APN-105 doppler type airborne navigation gear . . .

ARDC's Rome Air Development Center gave $12 million to General Electric for production of advanced long range search radar systems for air defense . . .

Consolidated Western Steel Division of U.S. Steel Corp. gave $300,000 to Siegler Corp. for producing components for the *Nike-Hercules* launching system . . .

Corning Glass Works received a military contract of $104,000 for establishing pilot plant facilities for production and testing of high stability glass capacitors.

DEFENSE DEPT.

By Military Petroleum Supply Agency:

Tidewater Oil Co. received $651,929 for rocket fuel.

General Petroleum Corp. received $672,427 for rocket fuel.

By Corps of Engineers, Office of the District Engineer:

Steenberg Construction Co. received $5,883,850 for construction of *Nike* installations.

By Pittsburgh Ordnance District:

Westinghouse Electric Corp., Micarta Division, received $63,190 for testcones.

By Corps of Engineers, Omaha District:

Sioux Falls Construction Co. received $467,000 for construction of rocket storage facilities & group O&T building.

M. A. Garland Construction received $754,569 for construction of underground missile storage, *Nike* site.

Peter Kewit Sons' Co. received $487,509 for construction of additional *Nike* facilities, conversion & paving.

By Engineer Division, New England Corps of engineers:

Plantation Construction Co., Inc. received $112,435 for construction of field unit integration facilities at seven *Nike* sites.

By Procurement Office, Aberdeen Proving Ground:

Harwood Engineering Co. received $25,580 for missile launcher assy-charger & vacuum pump.

M. B. Mfg. Co., a div. of Textron, Inc., received $27,943 for testing system automatic sine wave vibration.

By Ordnance District, Los Angeles:

Firestone Tire & Rubber Co. received $170,000 for engineering services related to *Corporal* missile system.

Gilfillan Bros. Inc. received $185,134 for engineering services related to *Corporal* missile system.

Genisco Inc. received $33,775 for accelerometer.

Firestone Tire & Rubber Co. received 2 contracts totaling $2,086,215 for surface-to-surface guided missile.

Gilfillan Bros. Inc. received $91,695 for telemetry and instrumentation packages; $465,030 for field engineering services related to *Corporal* missile ordnance guidance equipment; $27,646 for telemetry ground receiving equipment; $133,824 for replenishment requirements of spare parts for *Corporal* missile; $52,643 for modification kits for *Corporal* equipment; $26,939 for *Corporal* ground guidance control equipment, amplifier, electronic control.

Firestone Tire & Rubber Co. received $519,853 for field engineering services related to guided missile artillery.

Douglas Aircraft Co. received 2 contracts totaling $33,923,649 for launching area items; $53,600 for supplies and services relating to the *Honest John* missile; $557,716 for *Honest John* fin assemblies, containers, accessory items.

contracts

ARMY

By Ordnance District, Los Angeles:
Grand Central Rocket Co. received $26,736 for loading and delivery of 100 phase I loki boosters.
Radioplane Co. received 4 contracts totaling $2,380,808 for supplies and services regarding missile targets.
Rheem Manufacturing Co. received $365,589 for *Nike* warhead and fuze.
Radioplane Co. received $720,921 for target drones.
Grand Central Rocket Corp. received $81,935 for propellant development.
Aerophysics Development received $49,896 for *Dart* antitank guided missile.
Convair, a div. of General Dynamics, Corp. received $284,338 for feasibility study of red-eye system.
Nortronics, a division of Northrop Aircraft, Inc., received $976,000 for maintenance shop set for *Nike-Hercules*.
North American Aviation received 2 contracts totaling $173,864 for digital computer.
Giannini Plasmadyne Corp. received $210,704 for hyperthermal research tunnel development and transport property measurements.
California Institute of Technology received 3 contracts totaling $5,148,500 for engineering research and development regarding guided missiles, free rockets, materials and wind tunnel operation.

By Boston Ordnance District:
Bolt, Beranek and Newman, Inc. received $45,720 for research and development study.
The Hicks Corp. received $42,600 for warhead guided missile inert XM 15, complete with attaching hardware.

By Corps of Engineer, Office of the District Engineer:
Thomas W. Yoder Co. Inc. received $263,382 for construction of modifications and additions and conversion of tactical facilities at *Nike* sites.

By Ordnance District, Los Angeles:
Ryan Aeronautical Co. received $50,000 for drone support equipment.
Firestone Tire & Rubber Co. received $62,737 for decontamination kits and shop sets for *Corporal* missile system.
Douglas Aircraft Co., Inc. received $151,376 for *Nike* field change kits; $870,345 for flat bed missile booster transporter; $192,346 for launching area items.
Fruehauf Trailer Co. received $27,024 for flat bed missile booster transporter.

By Engineer District, Chicago Corps of Engineers:
Mayfair Construction Co. received $1,879,800 for construction of additional facilities at special AAA sites.
M. H. Wolfe & Co. received $1,689,003 for construction of facilities at special AAA sites.
Fruin-Colnon Contr. Co. received $5,372,850 for construction of facilities at special AAA sites.

NAVY

By Bureau of Aeronautics:
Motorola Inc. received $253,994 for evaluation models drone tracking system airborne and surface units.
Climax Moiybdenum Co. of Michigan received $40,917 for development of refractory metal alloys.
Cook Electric Co. received $35,183 for study of temperature and stress distributions in bonded structural panels under transient thermal loading.
The Garrett Corp. received $111,931 for four wheel trailers for gas-turbine driven-ground support units.
Acme Precision Products, Inc. received $20,022 for linear actuator test stand.
General Electric Co. received $45,954 for study for water depth determination using pulsating light technique.
Radio Corp. of America received $30,474 for study of appiying advanced techniques to an airborne electronic commutator.
Bausch & Lomb Optical Co. received $56,568 for modifying government-owned rectifier to provide automatic dodging and exposure control.
University of Pittsburgh received $36,787 for conducting test on avionics equipment and parts.
Air Products, Inc. received $632,558 for liquid oxygen generator plants in accordance with specifications.
Resin Research Laboratories, Inc. received $44,414 for research and development of improved heat resistant, steospecific resins and adhesives.
Syracuse University received $100,340 for conducting research program to determine effects of stress concentrations.
Allen B. Dumont Laboratories, Inc. received $357,114 for development of meteorological radar set.
Owens-Corning Fibergias Corp. received $33,290 for properties of fiberglass at elevated temperature.
Chance Vought Aircraft, Inc. received $77,817 for flight capsule feasibility study.
Westinghouse Electric Corp. received $262,349 for development of heat resistant alloys, with the objective of developing materials for use in gas turbine engines and other components subject to extreme heat.
Grumman Aircraft Engineering Corp. received $36,842 for conducting a study to design and develop an inflight thrust measurement system for turbo-jet powered aircraft.
Air Products Co. received $69,229 for pressure suit ventiiating units.
Greer Hydraulics, Inc. received $68,245 for study to determine the optimum equipment and arrangement required for installation in a hydraulic pneumatic maintenance van.
Food Machinery and Chemical Corp. received $186,501 for hydrogen peroxide service vehicle.
Crucible Steel Co. of America received $419,848 for improved titanium alloy sheet.

By Bureau of Ordnance:
Autonetics, a division of North American Aviation, received $6.7 million for designing and fabricating the system which is regarded as the key to the successfui launching of Polaris-type fleet ballistic missiles.

By District Public Works Officer, Eighth Naval District:
Pitman Construction Co. received $133,000 for A.N.G. rocket storage checkout and assembly building.

By Naval Training Device Center:
Joaneil Laboratories received $86,000 for design, development and production of *Nike* handling trainers.
Guardite Co. received $413,488 for design, development and erection of aititude training rapid decompression chamber; $216,861 for development, construction and instaliation of rapid decompression chambers.

AIR FORCE

By HQ, Cambridge Research Center, ARDC:
The Perkin Elmer Corp. received $98,700 for optical system (to be incorporated in satellite tracking camera).
Boller and Chivens, Inc., and Joseph Nunn and Associates received $195,000 for satelilte tracking camera.
Aerojet-General Corp. received $112,861 for studies, testing and services in connection with rockets.
Polytechnic Institute of Brooklyn received $225,000 for theoretical and exploratory research in electro-magnetics networks and related solid state and plasma topics.
International Business Machines Corp. received $186,000 for design and analysis of high-speed computer circuits.
General Electric Co. received $26,993 for services and facilities for tracking satellites; $47,953 for feasibility study of the use of phase reversal keying.
Lockheed Aircraft Corp. received $37,988 for research of the absorption coefficients of hot gases for the analysis of nuclear fire balls and other high temperature sources.
Stanford Research Institute received $114,000 for research on radiation effects in magnetics and dielectrics.
Stavid Engineering, Inc. received $200,883 for research directed toward the installation, testing and development of Badge experimental equipment.
Melpar, Inc. received $41,760 for research on anti-jam communication systems using redundant transmission.

By San Antonio R&D Procurement Office, Wright Air Development Center, ARDC:
University of Rochester received $30,915 for additional research & reports on oxygen poisoning.

HQ, Ogden Air Materiel Area:
Del Mar Engineering Laboratories, Inc. received $1,129,983 for scorer, radar-optic, 2.75 rocket types SXU-1/A and SXU-2/A.

By HQ, Mobile Air Materiel Area, Director of Procurement:
Mercantile Paper Co., Electronics Div., received $123,785 for installation of a complete closed circuit monochrome T.V.

New Metals Enter Market For Missile Applications

A series of new metals and production methods has emerged from various laboratories to aid the missile industry.

General Electric has introduced a high-temperature alloy, trademarked René 41, designed for use in jet engines and structural members. The nickel-base, titanium-aluminum hardened alloy can be formed, welded and machined with relative ease in comparison to other metals intended for use in the 1,800°F temperature range.

According to GE, the new metal can be welded without problems. It can be inert-arc welded with or without filler material, and also offers strong, ductile spot welds. Welds strongly approach the strength of the base metal.

National Research Corp. has achieved commercial production of very high purity tantalum metal. As part of the research program which brought about the possibility of producing the metal in large quantities, NRC also developed a new type vacuum arc-melting furnace for conversion of tantalum powder to large high-density ingots. The firm is now producing 30,000 lbs. of tantalum annually.

Metal Hydrides Inc. has introduced two new grades of high-purity zirconium hydride for the nuclear industry (MHI Grade R) and for commercial applications (MHI Grade C). According to the company, the latter, intended for use in such applications as electronics, pyrotechnics and related fields, is superior to zirconium metal as a getter in electronic tubes because it does not oxidize during seal-in or exhaust operations.

Martin's New Computer To Test Missile Data

One of the most advanced analog computing systems ever developed has been installed at the Martin Company's new guided missile and electronic facility at Orlando.

Called GEDA A-14, the system, which weighs five tons, is digitally controlled and is housed in a series of console cabinets extending 40 feet.

Goodyear Aircraft, a supplier of analog computing equipment for more than ten years, designed and produced the system to Martin specifications, and completed its installation at Orlando within a 13-month period. The company was awarded the contract following design competition with five analog computing equipment vendors.

Martin's GEDA A-14 is programmed and controlled digitally through the keyboard of an electric typewriter or punched paper tape.

Venus, in blue light. 200-inch Palomar telescope.

SPACE FLIGHT and NUCLEAR PROPULSION

A drastic reduction in vehicle mass ratios... substantially increased specific impulse values... a capability for achieving very high speeds... these are some of the significant advantages that will come from the application of nuclear energy to space flight.

A number of different propulsion systems have been proposed to utilize nuclear reactions. The simplest system consists of a fission reactor through which the propellant is passed, heated, and then expanded through a rocket nozzle. Fission reactors can also be employed as a source of energy to generate electric power, which in turn can be used to accelerate ions or charged particles, or to create and accelerate a plasma. And fusion reactors, when developed, can be used to generate electric power for the same purposes. In addition, in the case of the fusion reactor, there is the attractive possibility that the reaction energy can be used directly without conversion to electric power.

The fission-powered thermal propulsion system will probably constitute one of the next major advances in space technology. As an example of the gain which can be achieved, consider a vehicle with a payload weight of about 25 tons for a manned flight to one of the nearer planets, landing, and returning. Powered by chemical rocket engines, the takeoff weight for such a vehicle would be 50,000 tons. But powered by a fission-thermal propulsion system, weight at launch would not exceed 500 tons... a 100-fold reduction in the mass ratio. Considerably greater gains are predicted for the more advanced systems.

Systems studies and advanced research in the application of nuclear energy to the requirements of space flight are in progress at Space Technology Laboratories. This work illustrates the emphasis at STL on the exploration and development of new concepts and techniques in ballistic missile and space technology.

Both in support of its over-all systems engineering responsibility for the Air Force Ballistic Missile Program, and in anticipation of future system requirements, STL is engaged in a wide variety of analytical and experimental research. Projects are in progress in electronics, aerodynamics, hypersonics, propulsion and structures.

The scope of activity at Space Technology Laboratories requires a staff of unusual technical breadth and competence. Inquiries regarding professional opportunities on the STL Technical Staff are invited.

SPACE TECHNOLOGY LABORATORIES

A Division of The Ramo-Wooldridge Corporation

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Complex Weapons Tough For Small Firms

by Frank G. McGuire

The downward trend in the amount of defense contracts awarded to small business is a result of the increasing complexity and costliness of modern weapons systems, according to Defense Department spokesmen.

Testifying before a Senate procurement subcommittee, military and civilian procurement officials cited the problem of complexity and said that only the larger contractors can handle the latest systems. They noted that even large firms have had to team up to take care of some jobs.

Sen. George A. Smathers (D-Fla.) commented on the DOD opening statement by saying, "the Defense Department usually makes nice statements, but statistics often fail to back them up." Thereupon, the committee counsel ticked off the percentages of total procurement awards to small business in the past eight years:

1951—20.9%	1955—21.5%
1952—17.0%	1956—19.6%
1953—16.6%	1957—19.8%
1954—25.3%	1958—16.2% (11 mos.)

"This," the committee charged, "is hardly an 'upward trend' in procurement awards to small business."

The Air Force's procurement awards to small business in the first 11 months of fiscal 1958 were 6.4% of the total for that period. The comparable figure for fiscal 1957 was 8.2%.

According to Air Force spokesmen, Air Force contracted for $1.7 billion more in the first 11 months of fiscal 1958 than in the entire 12 months of the preceding fiscal year. Because of this huge increase, they said, participation of small business dropped.

Air Force officials commented that they are not at all complacent about the drop, but added that each year there has been an increase in the actual number of dollars awarded to small business participants, and "it is with dollars that payrolls are met."

Army procurement officials noted that although the small business is at a "distinct disadvantage" in bidding on prime contracts for the modern weapons system, the Army has attempted to influence its prime contractors to let out the maximum in subcontracts.

During 1957, they stated, small business firms received $80.9 million from prime contractors as first tier subcontractors. This represents 14.4% of the total defense contract receipts received by prime contractors during July-December, 1957.

The prime contracting situation as concerns small business was shown in better light. Of the total prime contracts awarded by Army, 35% of the dollar value went to small firms—or 79% of the contracting actions involved.

The apparent large discrepancy in Air Force/Army procurement awards to small business is due to the nature of the items procured, and the tremendous complexity of Air Force equipment.

Industry Directed To Aid Future Engineers

Defense Secretary Neil McElroy's directive ordering the military to cooperate in youth science education, and assuming responsibility for the program, contains a section calling for industry participation.

The Defense Department's "expectation" that industry will participate in the program is taken as a sign that the government expects its contractors to help train future engineers, scientists, and other technical personnel.

Such assistance would take the form of making facilities available, providing lecturers, and other cooperation. Most likely to emerge as a formal organization is the "Youth Science Corps," suggested by the executive director of the Association of Missile and Rocket Industries, Kendall K. Hoyt, and presented to Congress by Sen. Edward T. Thye (R-Minn.).

Present military reserve facilities would be made available under the proposed plan; including classroom facilities, training films, safe demonstrations, and visits to defense installations such as *Nike* sites.

Moon Probe Shot Due By AF In Mid-August

August 14-19 appears to be a likely date for the Air Force to make its first lunar probe attempt, using *Thor* as the booster vehicle.

The Defense Department's Advanced Research Projects Agency declines to confirm or deny these dates. However, it is understood, barring any unforeseen setbacks in the program, that an attempt will be made at that time.

ARPA plans to have the press present for the shoot from Cape Canaveral, but will attempt to insure no advance publicity in case of failure.

Indian Head Begins Rehiring Personnel

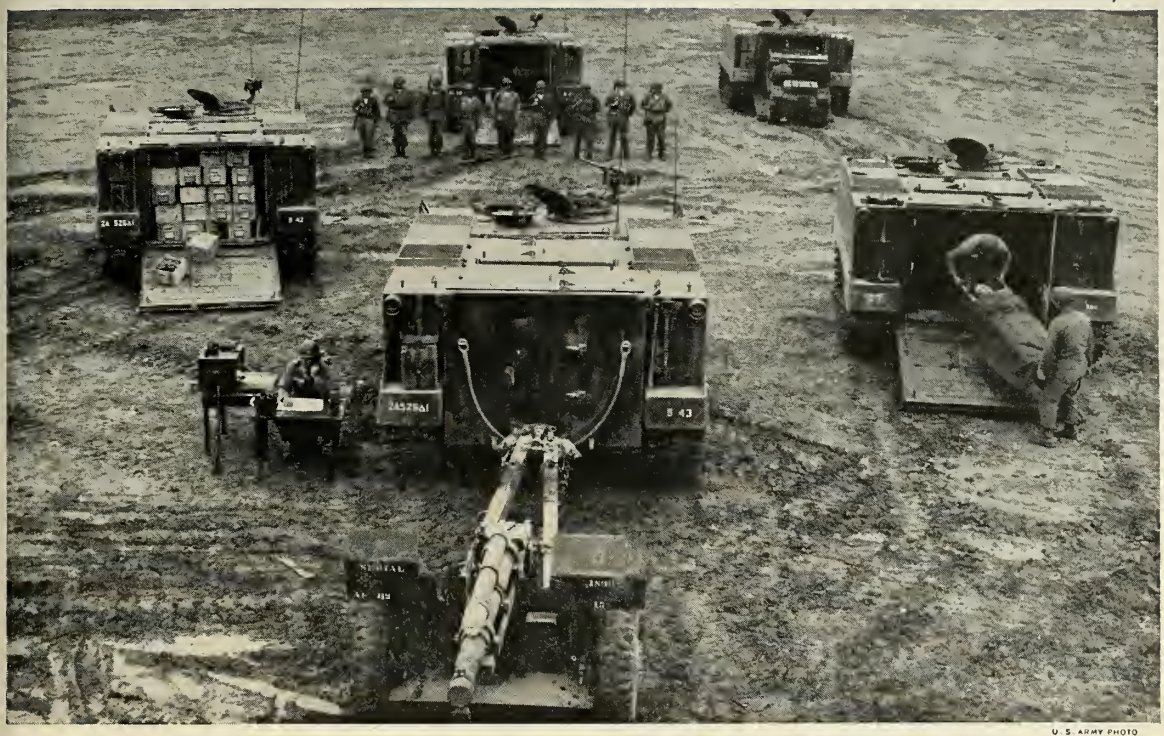
The Navy has indicated that 117 persons have been hired at its Indian Head, Md., powder factory. The plant was recently the subject of an investigation by a Congressional committee looking into charges that the Navy paid Aerojet-General several millions of dollars for solid-propellant production facilities, while ignoring its own plant at Indian Head.

Rehiring of the personnel is seen as an indication that some solid propellant work is being undertaken at Indian Head.

AMERICA'S FIRST B-52G missile platform bomber rolled off the production line in Boeing-Witchita recently. This new type of B-52 will carry a GAM-77 *(Hound-Dog)* missile under each wing. Reported range of the missile, now under development by North American, is 300-400 miles with the capability to fire at two different targets simultaneously. The long-range air-to-surface missile will allow the B-52G, with its own increased range, to fire at targets now impervious to attack because of their distance from launching sites.

...speaking of

Missile Ground Support **MOBILITY**



U. S. ARMY PHOTO

WE DESIGN WITH STANDARDIZATION IN MIND

For example the FMC-designed M59 Armored Personnel Carrier was produced as a multi-purpose vehicle using many standard Army Ordnance components. This vehicle, designed in 1951, is still being produced for the Army. FMC is now developing a whole new family of military vehicles with a brand new concept. Substantial cost savings are anticipated based on standardization of many components.

The ability to design, engineer and produce mobile equipment based on standards already worked out can be applied to missile ground support equipment, providing lower costs for your program. Perhaps we already have a solution to your missile ground support equipment problem. *Consult with FMC at the initial stage of project planning.* Write today for more information.

Creative Engineers: Find stimulating challenge at FMC's Ordnance Division

FMC'S MISSILE SECTION IS IDENTIFIED WITH:

HAWK	Mobile loader vehicle
THOR	Transporter-erector and power control trailer
REDSTONE	Tracked prime mover
NIKE-HERCULES	Shipping and storage containers
BOMARC	Erector-launcher and Decontamination system
NAVAHO	Transporter-erector and vertical access tower

Putting Ideas to Work

FOOD MACHINERY AND CHEMICAL CORPORATION

Ordnance Division

Missile Equipment Section 1-D

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We have more GSE* experience than anyone

...and now we can put it to work for you

***Ground Support Equipment— mainstay of modern weapon systems**

A strong statement? Yes. But we can back it up.

We were the first company to have complete responsibility for a major supersonic missile weapon system. The Navaho—America's pioneer long-range missile—produced such a wealth of technological data that the entire missile program now draws on it.

Ground support equipment for the Navaho and the X-10 developed a new concept for checkout trailers, engine run-up dollies, instrumentation checkout consoles, hydraulic servicing units, ground power units, jet engine starters, ground cooling carts, ground hydraulic power supplies, ground pressurization equipment, ground fire-fighting equipment, access and support stands, air transportation dollies, and a wide range of other test and launching equipment.

This was done through the ability to integrate numerous single elements into complete, smooth-running ground support systems.

Specialized engineering and production skill and facilities in this new field are available to do an outstanding job for you, quickly and economically—on individual items or complete, coordinated ground support systems—either military or commercial.

Interested? Write or call Manager, Special Products, Missile Division, North American Aviation, 12214 Lakewood Blvd., Downey, Calif.

MISSILE DIVISION

North American Aviation, Inc.

propulsion engineering

by Alfred J. Zaehringer

It will take 5-10 minutes for AEC's atomic rocket engine to come up to full thrust. Reason: it can't come up to full pile temperature and then dump the working fluid all in the period of a few milliseconds. As the pile heats up, the coolant working fluid will have to be pumped through and exhausted. Working at low pressures, almost no thrust will be developed during the first minute or so while cooling takes place.

Best bet is that hydrogen will be used as the working fluid and coolant. For cooling, sweat or film cooling may be used in the hot parts. Except for ground static tests, regenerative cooling may not be used. First test atomic rocket motor will have a thrust of 5-50,000 pounds. First run-up will be in a few weeks. Incidentally, thrust-to-weight ratio of conceivable atomic engines will be inferior to chemical rockets.

Storable, safe, high-energy liquid monopropellants are in the works at Wyandotte Chemical. Hope is for an I_{sp} of over 300 sec in "Fuel-X." Practical conditions, however, will limit the liquids to 240-260 seconds. Trade talk is that Wyandotte's approach is through organic synthesis, and may be based on ethylene or propylene oxides as the starting point. The firm is already making a cellulose perchlorate for solid propellant use.

Olin Mathieson may enter the fluorine oxidizer picture. OM is already producing HF at its Joliet, Ill. plant. HF is the first step in the preparation of elemental fluorine. OM may enter as an oxidizer producer to sell fluorine-hydrazine propulsion systems. NACA calculates that the maximum I_{sp} for such systems would be about 315 seconds at a chamber pressure of 300 psi, and an exit pressure of 1 atmosphere.

The third boron fuel pilot plant is undergoing tests before production begins. The plant was designed and constructed by AFN (American Potash, Food Marchinery, and National Distillers), and is under the sponsorship of the Air Force. Located at Henderson, Nevada, the plant will produce a new alkyl borane.

It had previously been announced that the Henderson lab work was concerned with decaborane for solid propellants. The announcement raises the speculation that this will be the first plant to produce a boron fuel additive or polymer for solid propellants. Callery Chemical and Olin Mathieson are also operating pilot plants for the borons, in addition to large-scale facilities for aircraft boron fuels.

Triple-bonded compounds are being investigated as new fuel ingredients. Acetylene is already under observation, as are the substituted acetylenes (viz., methylacetylene) and other alkynes.

Effects of sound waves on chemical reactions will be under study by Aeronutronic Systems, at its new aerothermochemical laboratory at Newport Beach, Calif. The Ford subsidiary will pay particular attention to combustion reactions involved in new propulsion systems.

Aircraft, Missile Firms Rate High in "Top 500"

Twelve firms which are heavily in the missile field are included in FORTUNE magazine's latest listing of the 500 largest U.S. industrial corporations.

Top firm during 1957, from the standpoint of sales, was Boeing Aircraft, which, with $1.6 billion in sales, rose from 32nd among all companies in 1956 to 19th in 1957. Top company in 1956 was Douglas in 27th place, but 1957 figures show it as 33rd, with $1.09 billion in sales.

Thirty-seven companies in the U.S. reported sales of over $1 billion for 1957. These included Boeing, General Dynamics, North American and Douglas. A newcomer to the group was North American. Greatest jump in standings among missile companies was Chance Vought, which went from 303rd place to 183rd.

Among the companies in the missile field in the top 50 in sales were Boeing, General Dynamics and North American, who were rated in the top 50 most profitable firms.

Other firms changing position on the list: Lockheed, from 47th to 44th; Bendix, from 65th to 51st; Martin Co., from 103rd to 91st; Bell, from 185th to 208th; Fairchild which held close to steady, from 261st to 262nd.

Brooklyn Polytech Offers Space Curriculum

A new curriculum leading to a master of science degree in astronautics or space technology has been inaugurated by the Polytechnic Institute of Brooklyn.

Developed as a joint project of the departments of aeronautical engineering and electrical engineering, the curriculum will be offered in September 1958.

The new option will require 34 graduate credits, which is two more than is generally required for the master's degree. Courses will include Minimal Principles of Structural Analysis I and II; advanced Calculus I and II, Viscous Compressible Flow; Supersonic Flow; Hypersonic Flow; Mechanics and Thermodynamics of Real Gases; Dynamics; and Space Medicine.

In announcing the new curriculum, Dr. Antonio Ferri, head of the department of aeronautical engineering and director of the aerodynamics laboratory, noted that "to exploit, develop and support activities in space technology requires engineers with sound fundamental and science-oriented graduate training." To this end, Dr. Ferri said that the Department of Defense was "vitally interested" in encouraging Polytechnic's program.

Army Does It Again:

Third *Explorer* Satellite In Orb
Three More Shots Authorized

Staff photos by Baker

Enthusiastically describing their latest satellite success are the top members of the *Explorer* team. Those present were Prof. Oberth, Dr. Froehlich, Dr. Pickering, Adm. Clarke, Gen. Colby, Gen. Barkley, Dr. Von Braun, J. Boehm, and S. Spear, USAF.

by Norman L. Baker

CAPE CANAVERAL, FLA.—The Army satellite team has again demonstrated its "rocket know-how" by its ability to meet almost impossible schedules with admirable results.

Last week's launch of *Explorer* IV was the fourth attempt for the Army and the third success. It was also the first satellite launching to be sponsored by the Advanced Research Projects Agency, in line with its managerial position for all Department of Defense space projects.

Rear Admiral John E. Clark, deputy director of ARPA, announced, after *Explorer* VI's orbit was confirmed, that the Army has been authorized to make three additional satellite shots. At least one—and perhaps all three—will be fired over a northeast course. The new Army satellite will include an inflated aluminum balloon for visual observation, one for cosmic ray measurements, and another for further radiation belt investigation.

ABMA received the go-ahead for the *Explorer* IV satellite shot during the last week of May, after evaluation of the transmitted data from *Explorer* III.

Launch time had been previously set for 8:00 A. M. July 26. This was postponed by a matter of two hours, with pad lift-off occuring at a few seconds before 10:00 A. M. Dr. Jack E. Froleick, JPL project director, noted shortly after launching that this "X-O" time was only 17 minutes short of the optimum launch time. Last countdown hold was called at X minus 40 minutes. When resumed, the count continued through to ignition without further delays.

One hour and 30 minutes of the two-hour delay was due to a re-check of the radar link between the satellite vehicle and ground tracking stations.

The new northeastern launch direction required maximum coordination between Cape Canaveral ground tracking stations and the rocket, due to danger to the eastern seaboard from jettisoned parts of the launching vehicles. The course selected was the northernmost that could be used without going over U.S. land areas.

All sea lanes under the flight path were cleared hours before launch to prevent a million-to-one chance of danger to vessels. The main-stage *Redstone,* and the 14 rockets of the second and third stages should have fallen into the sea southeast and northeast of Cape Hatteras, respectively.

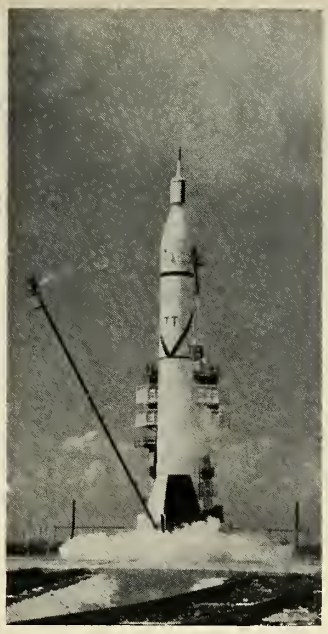
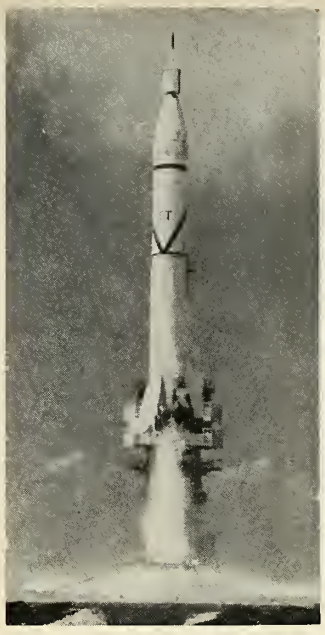
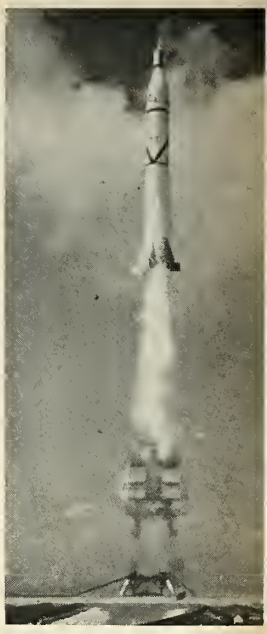
• **Radiation study**—*Explorer* IV was designed for an intensive study of the corpuscular radiation belt detected by *Explorer* III. The new orbit, which will take the satellite to 50.82 degrees latitude, was chosen to provide radiation data from areas in space not yet sampled (m/r, June, '58, p. 34). This orbit brings the satellite nearer the polar areas, a valuable area of exploration for studying magnetic field-corpuscular radiation relationship.

Explorer IV, consisting of payload and the final-stage rocket motor, is heavier than I and III, but identical in size and configuration. Payload weighs 25.76 lbs. with a total satellite weight of 38.43 lbs. Earlier *Explorers* had a payload weight of 31 lbs. The added weight in IV is in instrumentation, and was made possible by improvements at JPL in the solid propellants of the final two stages of the *Jupiter*-C vehicle.

Instrumentation includes two Geiger Mueller tubes and two scintillation counters to measure cosmic ray intensities.

The tubes and counters are designed to measure a wide energy spectrum. One of each is shielded to eliminate data below certain energy levels, and the unshielded scintillation counter's data is directed into two radio channels reporting different levels of energy. Two radio beacons with continuous transmission relay data over 5 common channels. One radio operates on 108.00 Mc, the other on 108.03 Mc.

Earlier *Explorers* reported only the gross amount of radiation encountered, while *Explorer* IV's instruments will record not only the total number of energy particles, but also what fraction of this total falls within certain preselected energy levels. It is suspected that only a very small number of the particles counted in the radiation belt previously were caused by high energy particles and identified as cosmic rays. Now, in *Explorer* IV, the shielded counters will respond only to high en-

Department of Defense photos

. . . ignition! *Explorer* IV Begins Journey Into Space

ergy particles while the unshielded counters will record all particles.

• **Communications tracking**—A communications network, involving 10 Microlock tracking stations located in and along the east and west coast, provided much of the early data on the performance of the *Jupiter*-C launching vehicle and the satellite.

The Army tracking stations are located at Cape Canaveral; Redstone Arsenal; Fort Monmouth; Van Buren, Me.; Aberdeen; White Sands; Cedar Rapids, Ia.; NOTS; Camp Irwin, Calif.; and Temple City, Calif. JPL and ABMA cooperated in setting up the Microlock ground radio network.

The NRL's Minitrack network is also receiving telemetered data from the satellite.

Adm. Clark headed a group of key defense leaders present for the countdown and launching. Included in the group were Brig. Gen. J. M. Colby, Deputy Commanding General of the Army Ordnance Missile Command; Brig. Gen. J. A. Barclay, Commander of ABMA; Dr. Wernher von Braun, Director, Development Operations Div., AMBA; Dr. W. H. Pickering, Director of JPL, Dr. Ernst Stuhlinger and Prof. Hermann Oberth, ABMA Research Projects Lab.; Dr. Walter Haeusserman, Director, ABMA Guidance and Control Lab.

Thirteen congressman were also present to witness the firing. They were accompanied by Maj. Gen. W. P. Fisher, chief of Air Force legislative liaison.

DOD Outlines Monitoring To Check Contractors

A new reliability monitoring program to supplement contractors' regular reliability monitoring activities has been recommended by an ad hoc committee and approved by Guided Missile Director William M. Holaday.

The report pointed out that a significant number of guided missile weapons systems have failed to meet the required standards insofar as both time-schedule and estimated costs.

The reliability monitoring system is based on the premise that reliability can be "quantitatively specified, estimated, assessed or measured at predesignated steps or monitoring points and that it can be controlled throughout the phases of design, development, production and major product improvement".

The committee visualizes increased costs in implementing the system, but anticipates savings in both time and money in attaining the desired performance and reliability. Additional savings are seen in the reduction of indirect costs in maintenance and maintenance training, spare-parts inventories, programs for material surveillance and product improvement and use of guided missile range facilities.

The first of the eight monitoring steps is implemented when the contract is awarded. The eight points may be varied or omitted to fit the nature of the particular program, and are designed to supplement rather than replace the contractor's own system.

The monitoring points are: (1) Detailed design study, (2) Preprototype, (3) Prototype, (4) Preproduction demonstration, (5) Demonstration of service readiness, (6) Service evaluation, (7) Full-scale production, (8) Demonstration of major product improvements.

It was the conclusion of the committee that reliability can be measured and controlled during all phases, that such a system is feasible during the growth cycle, and that the system will greatly increase assurance of adequate reliability.

The proposed program incorporates many comments made by contractors and others through the American Ordnance Association, the Aircraft Industries Association and the Electronics Industries Association.

Members of the committee were: G. N. Beaton, Hughes Aircraft; K. J. Bossart, Convair-Astronautics; D. C. Cain, Navy Special Projects; R. F. Ohlemacher, Bendix Aviation; H. R. Powell, Ramo-Wooldridge; M. R. Seldon, Chance-Vought; O. E. Thomas, Boeing Airplane; and H. C. Wroton, Martin-Denver.

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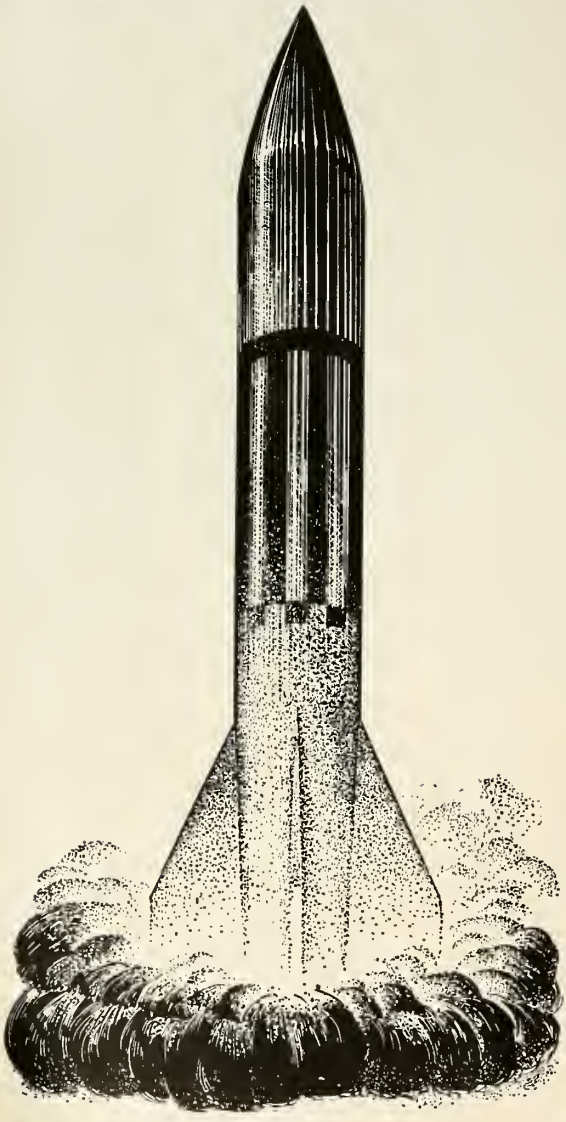

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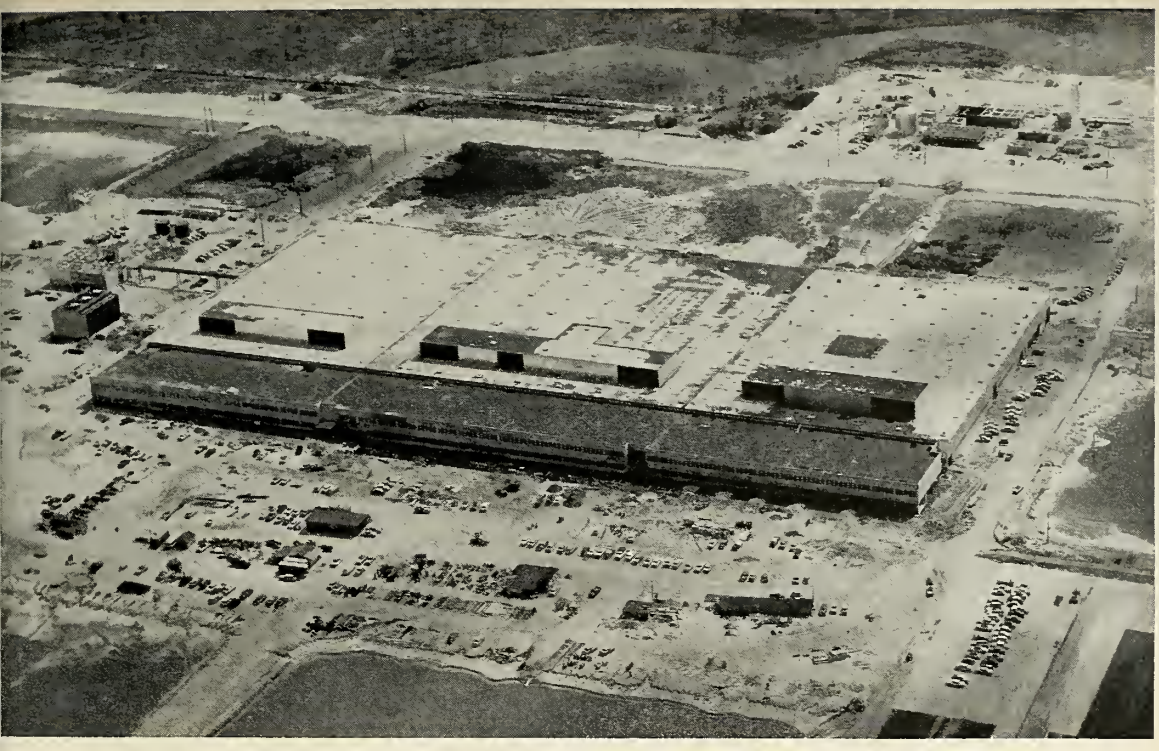


THE MAIN PLANT of Pratt & Whitney's new Florida facility is slated for a big role in missile plans

A Billion-Dollar Firm Shifts Into Space

by Erica Cromley

HARTFORD, CONN.—"Everybody's getting into the missile act." That was the reaction carried back from the Army's recent big missile shoot by Wright A. Parkins, vice president of engineering and manager of United Aircraft's newly unveiled Missiles and Space Systems division.

The new missile chief pointed to the diversity of the industries represented at the White Sands demonstration (m/r July 7, p. 36). "There were representatives of the tire people and the automobile industry. The radio people are deep into electronics; the oil people are in propellants."

Although the transition to missiles seems a more natural one for the air craft industry, United, last of U.S. aircraft's "big five" to get into the act, didn't initiate its missile division until June 24 of this year. Reason is that until recently, the billion-dollar corporation was up to its fuel lines trying to keep even with jet engine orders.

However, a heavy cutback in Air Force procurement last summer forced United's largest division, Pratt & Whitney Aircraft, (with 40,000 of the corporation's 60,000 personnel) to shear 5% of its employees. The board of directors, which had been "studying the situation" since 1956, decided in May to take the plunge and enter the competitive missile business in June.

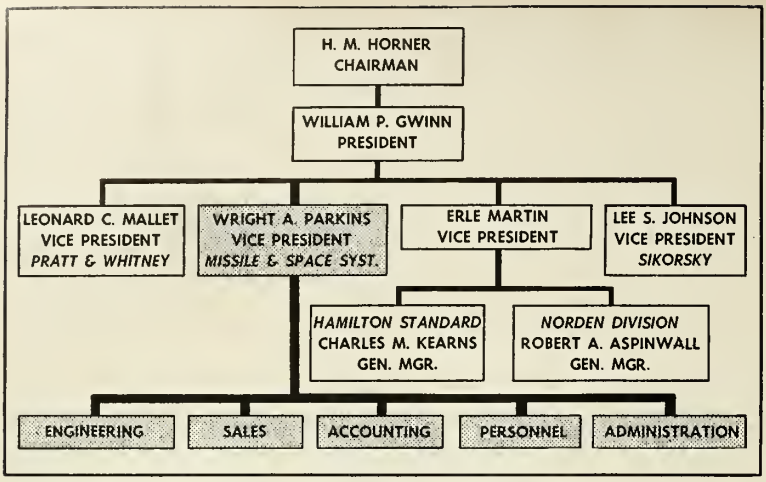
DYNAMIC MAN in a dynamic job, Wright Parkins was "the inevitable choice" to head United Aircraft's new Missiles and Space Systems division.

• **Norden is key**—United's earlier acquisition of the Norden-Ketay Corp., designer and builder of electronics systems, had rounded out the company's missile systems capability. Transfer of ownership was made July 1, on the basis of one share of United common stock for 20 shares each of Norden-Ketay's 1.3 million shares outstanding.

Norden Laboratories had been working on development and production of guidance and control equipment for such missiles as *Atlas, Titan, Redstone, Jupiter, Bomarc,* and *Regulus.*

Acquisition of the two new divisions spurred some reshuffling of UA's top brass. Vice President Erle Martin was moved up from general manager of the Hamilton Standard Division to director of both HS and the new Norden divisions. Charles M. Kearns, Jr., moved from assistant general manager to manager of HS; and Robert A. Aspinwall, assistant general manager of the Sikorsky Division, was made general manager of Norden.

Participation of United's four older divisions in UA's missile plans is expected to look like this: Pratt & Whitney — propulsion; Sikorsky — frames;



UNITED AIRCRAFT CORP.'s new organizational structure and departments. It will operate missile division from East Hartford, Conn., UA's main center of operations.

Hamilton Standard—fuel controls and accessory equipment; Missiles and Space Systems—overall management, development, and design.

Important roles will also be played by United's Research and Development and Advance Planning departments. To monitor advanced technical projects for both missiles and aircraft, the company added a new position to its top group: vice president and chief scientist. The post went to Perry W. Pratt, formerly engineering manager of Pratt & Whitney.

• **Test center available**—P&W's new Florida facility, which was opened in May of this year, can be used for outdoor testing of large rocket engines. Main work currently is on J58 Mach 3 jets.

Construction on the 7,000-acre site started in 1956 with an eye to future missile potential. The company invested a reported $30 million of its own capital funds into the non-severable equipment. This was matched dollar-for-dollar by the Navy Department for "severable" equipment such as machine tools.

Expansion of the facility to handle missile projects is now under way. New additions include labs, test stands and other test devices and rigs.

Parkins cites three plus-factors for the Everglade Swamp facility: (1) isolation (2) climate ideal for testing (3) location 17 miles northwest of Palm Beach, which has attracted an adequate number of skilled help.

• **Further expansion**—H. M. Horner, chairman of United, said the corporation will spend $50 million on additional plant facilities. Part of this will go to expand Pratt & Whitney's Willgoos Laboratory in East Hartford, Conn., which is "the most advanced and largest privately owned turbine test facility in the world."

• **Divisional setup**—Missiles & Space Systems has as yet no missile contracts. However UA's operating divisions, which cover each of the principle components in the missile system, are being groomed for their new tasks. M&SS will be purely a "white collar" operation and will farm out the work to operating divisions or to subcontractors. (Pratt & Whitney alone has over 9,000 subcontractors.)

Starting with a nucleus of 200 scientists and engineers transferred from Hamilton Standard, Parkins estimates that his division will swell to about 300 in a few weeks; will reach 500 by 1960; and will draw talent from other divisions as needed.

Hamilton Standard's electronics department, which terminated when its scientists moved into the new missile division, has been at work "in recent years on missiles." Proposals to manage small missile projects were made, but although some of these are still under consideration, none have yet been accepted.

There will be five main subdivisions of M&SS: engineering, sales, accounting, personnel and administration. Department heads for the first four will be transferred from other divisions. At present, the administrator is still to be hired.

• **Missileer in the making**—The man who heads United's missile unit joined Pratt & Whitney as development engineer in 1928, three years after it began operations in a garage with a total employment of six. The budding company's first design was the Wasp aircraft engine. That, and successive engines, helped the U.S. achieve a position of military world leadership within four years. P&W's engines powered 50% of all U.S. aircraft in World War II, and a substantial chunk of America's allies.

It was for this reason that United entered the jet field late. "When jets came along," Parkins said, "the military denied us entry into the field because they needed our piston engines. It wasn't until 1948 that UA stepped into the jet field with the J-57. Then jet engines took up so much of our effort and time, we couldn't get into the missile business that was coming up. We had the bulk of the jet engine business and that kept us plenty busy. Now jet engines are moving over to make way for the missile."

As the company grew, Parkins grew with it, moving up to Pratt & Whitney's engineering managership in 1944; assuming complete direction of both current and advanced engineering in 1949; and becoming a vice president in 1956, a post he still holds in addition to his new one.

Plus his high technical ability, Parkins has enormous physical energy, and a tenacity based on this philosophy: a machine is only as good as its reliability. Said one company official: "Parky was a natural for the job in light of his qualities and demonstrated ability to bring things through. He has played a vital role in bringing the airplane engine from 400 hp to production of the J-75 engine that delivers over 93,000 hp."

The company gives Parkins credit for the development of Pratt & Whitney's postwar piston engines, and points to his supervision of the several thousand engineers and technicians who developed present jets.

• **Optimist**—Understandably loathe to project M&SS' future into estimates, Parkins will only say that he is optimistic, and that the company is in the missile business to make money. "We've done some jobs for the government where we couldn't get a return, and we possibly would again, but we're going into this missile program on our own. There was no request from the government. We're going in to further our future. We can do all this with practically no help from the government for additional facilities."

Two years ago United's missile chief made a statement on United's progress which he may well be pondering now as he faces the new challenge: "We've come a long way from the horse. But if we're to get wherever it is we're going, we've got a confounded long way to go."

Russian Development May Aid WS-117 Program

With some 50 subcontractors involved and millions programmed in the next several years, Lockheed Aircraft Corporation's Missile Systems Division is pushing for test firings this fall using *Thor-Able's* for the WS-117L reconnaissance satellite program.

And ironically, it appears that a Russian development, accidentally stumbled on from translation of technical documents, may provide the light-weight nuclear power source needed to operate the satellite's reconnaissance equipment in advanced models. Many researchers feel the revolutionary discovery may provide a very close approximation of direct conversion of atomic energy into electrical energy, thus paving the way for the so-called "exotic" electrical propulsion systems.

WS-117L now consists of three programs under the code name of SNAP (Secondary Nuclear Auxiliary Power). Originally, the WS-117L program started out as Big Brother, but had its name changed to Pied Piper because of name conflict with an organization devoted to the aid of underprivileged youth. Succeeding reports called it the Sentry satellite, but SNAP now appears to be the settled code name.

Defense Department and Lockheed, under strict orders from the White House and Department of State, are not permitted to discuss WS-117L because of its international "Peeping Tom" implications.

It is known, however, that an *Atlas* booster with a second stage solid—presumably the same as used on Lockheed's *Polaris*—ultimately will orbit one to 1½ tons, although initially most of the weight will be batteries. More useful payloads will have to await development of auxiliary nuclear power sources. This part of the program involves:

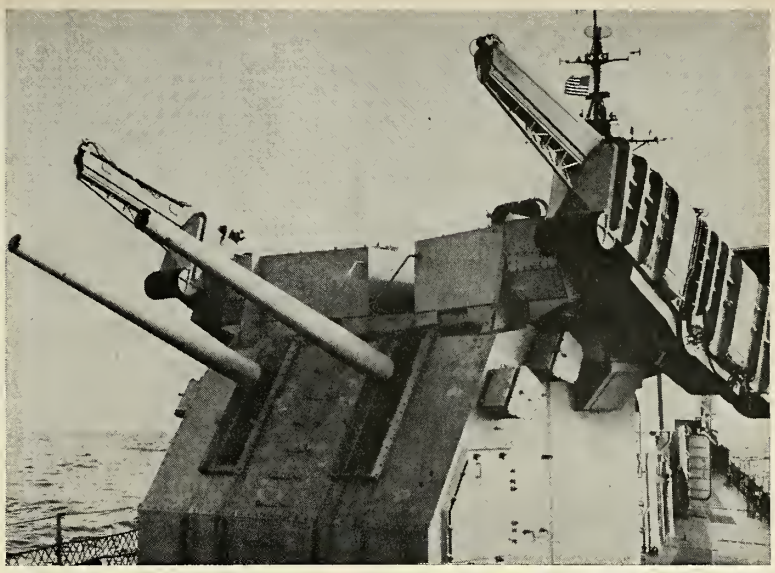
SNAP I—Here, radioactive isotopes, rather than a nuclear reactor, would be used as a heat source. Martin Company has a prime contract in excess of $1 million to investigate the use of Cerium 144. Cerium reportedly is cheaper and poses less radiological hazards. Thompson Products has a subcontract for some machinery in this program phase.

SNAP II—This involves installation of a thermal reactor in the satellite. Atomics International, which has invested some $885,000 in facilities and research, has the prime contract. Cosmodyne Corp., Los Angeles, reportedly is doing some research work. Thompson Products also is assisting in this phase.

SNAP III—This is the program where the Russian development is being used, which could lead to the close approximation of direct conversion of atomic energy into electrical energy. The device, it was learned, initially would give out three watts of electrical energy for 6 months and probably would not weigh 10 pounds. Early uses could be for a *Vanguard* satellite.

The gadget reportedly is about 8% efficient, and possibly could go to a 25% efficiency. Westinghouse, in cooperation with Navy, is doing research, and it is felt that materials used would not be damaged by radiation.

The Defense Department has assigned top priority to its reconnaissance satellite program. The rate of expenditure on the WS-117L program will triple in fiscal year 1959, over 1958. ARPA has $152,000 million programed for 1959, compared to $55 million spent in 1958. The satellites will be launched in Polar orbits from Cooke Air Force Base, Calif.



THE ROCKET-ASSIST TORPEDO ***(Rat)*** **launching system utilizes the after five-inch gun mount and fire control system of destroyer to provide an anti-submarine weapon of greatly improved accuracy and extended range of about five miles. Solid propellant first stage by Allegheny Ballistics boosts torpedo into flight and propels it along ballistic flight path to general vicinity of submarine. Nose cone and parachute separate as *Rat* enters water to acoustically home on target.**

Republic Launches $35 Million R&D Effort

Republic Aviation Corp. has begun a $35 million research and development program, designed to capture a position of leadership for the firm in the field of astronautics.

The four-year program includes erection of a $14 million engineering Research and Development Center at the firm's Farmingdale, L.I. facility. A major expansion of the company's technical personnel is also contemplated.

The program has the overall aim of developing new, more sophisticated forms of missiles and aircraft; and simulating manned vehicles for space travel.

Nose Cone Recovery Balked by Lack of Gas

CAPE CANAVERAL, FLA.—The attempt to recover the mouse-carrying nose cone of the latest *Thor-Able* test flight was once again beset with failure and frustration through a series of accidents.

According to reliable sources two Air Force search planes sighted the nose cone as it reentered the atmosphere and a short time later located it floating in the ocean. One plane circled the cone for three hours radioing the ships assigned to the recovery program. Sailing at full speed, the ships were nearing the area when the plane's fuel supply became so low that it had to leave and return to base.

The ships searched the position radioed by the plane for several hours without success. The search was finally abandoned even though Wickie, the mouse, was expected to live for several days.

This was the third *Thor-Able* firing in recent weeks. Another *Able* type vehicle is being readied in its gantry for what could well be the first Air Force lunar probe attempt sometime this month.

missile people in the news

Industry

R. W. Cook, former deputy general manager of the Atomic Energy Commission, has joined American Machine & Foundry Co. as director of administration, Government Products Group. Cook resigned his AEC post in June. He had been associated with the nation's atomic energy program since 1944, and with the Commission since 1947.

J. R. Moore has been appointed senior program administrator for Rocketdyne programs sponsored by the Navy, Wright Air Development Center, Office of Scientific Research. **W. E. Buchanan** continues as senior program administrator for programs sponsored by the Ballistic Missile Office, and **B. F. Deming** will continue in the same function for programs sponsored by the Army Ordnance Missile Command.

Adm. Selden B. Spangler, USN (Ret.) is the new director of research for the Garrett Corp., Los Angeles. Spangler, whose appointment is effective August 1, recently retired from the Navy after 39 years of service. His achievements include the directorship of the Power Plant Division of the Navy's Bureau of Aeronautics during World War II.

Fred W. Schwier has been appointed general sales manager of Aeroquip's Jackson Division. Schwier was recently assistant aircraft sales manager, and has been associated with Aeroquip Corp. in a sales capacity since joining the company in 1951.

Instrumentation

J. R. Dempsey, manager of Convair - Astronautics, was appointed vice president of Convair Division of General Dynamics Corp. He is the Convair executive directly responsible for delivering an operational *Atlas* intercontinental ballistic missile to the Air Force's Strategic Air Command.

L. Rene Gaiennie has been elected vice president of industrial and public relations of ACF Industries, Inc. Gaiennie's duties will encompass labor relations, public relations, personnel, wage and salary administration.

Company Officers

Joseph Meisler has been appointed technical commercial manager of the Cryogenics Department, Philips Electronics, Inc. He will have charge of low-temperature problems and applications involving the Norelco liquid air and liquid nitrogen generators.

Robert R. Miller and **Thomas V. Jones** have been elected to offices as senior vice presidents with Northrop Aircraft, Inc. Northrop also elected **Richard R. Nolan** and **Irving Roth** as corporate vice presidents, and assigned Nolan responsibility as general manager of the Northrop Division.

Charles W. Sinclair has been appointed vice-president-engineering for divisions of the Kelsey-Hayes Co. Sinclair, who has been with Kelsey-Hayes since 1911, was chief engineer for the automotive division.

Charles H. Rodgers was elected vice president of Consolidated Diesel Electric Corp. with primary responsibility for financial operations. He was previously associated with Servomechanisms, Inc., where he was secretary-treasurer for eight years.

Louis A. deRosa, Sven H. Dodington, Armig G. Kandoian, Arnold M. Levine, Dr. Charles D. W. Thornton have been elected vice presidents of the consolidated IT&T Laboratories. The newly-formed organization combines the research facilities of Farnsworth Electronics Co. and Kellogg Switchboard and Supply Co., both IT&T divisions, with Federal Telecommunication Laboratories, the former research division of IT&T. The officers and their fields of responsibility are: deRosa, electronic countermeasures; Dodington, avionics; Kandoian, communication systems; Levine, missile systems; Thornton, physical sciences.

Paul Dulong has been appointed manager of the Engineering Services department, Epsco, Inc. He will supervise all drafting, mechanical design, mechanical engineering, standards, technician training and testing facilities.

John A. Grimes has joined Consolidated Diesel Electric Corp. as general manager, Test Equipment Division. Grimes has been with the company for three years as administrative engineer and assistant to the president.

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Cleveland: 244 Hanna Bldg., 1422 Euclid Ave., Cleveland 15, Ohio. Douglas H. Boynton, regional advertising manager. Phone: PRospect 1-2420.

Detroit: 201 Stephenson Bldg., Detroit 2, Mich. Kenneth J. Wells, regional advertising manager. Phone: TRinity 5-2555.

Canada: Allin Associates, 12 Richmond Street East, Toronto 1, Ontario. Phone: EMpire 4-2001. Allin Associates, 1487 Mountain St., Suite 4, Montreal, Que.

Geneva: American Aviation Pubs., 10 Rue Grenus, Geneva, Switzerland. Anthony Vandyk, European Director.

London: The AAP Company, 17 Drayton Road, Boreham Wood, Hertfordshire, England. Phone: Elstree 2688. Cable address: STEVAIR, London.

Paris: Jean-Marie Riche, 11 Rue Condorcet, Paris (9e), France. Phone: TRUdaine 15-39. Cable address: NEWS AIR PARIS.

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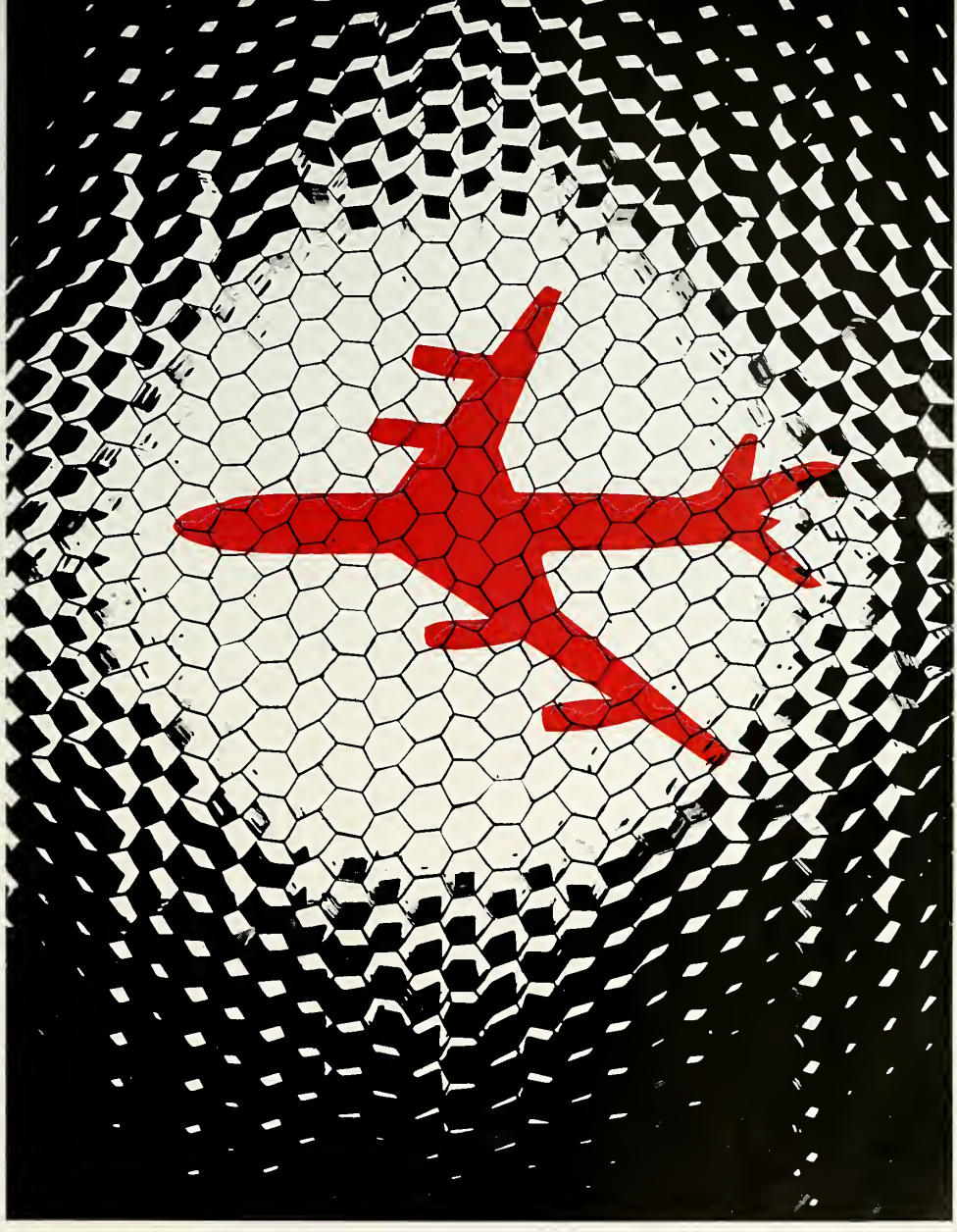

Avco's honeycomb "sandwich" takes pounds off

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