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MONTHLY SUMMARY OF

# SPACE

Systems Division

# ACTIVITIES

EXEMPTED FROM DECLASSIFICATION IAW E.O. 12958

REVIEWED BY SL

DATE 4 Jul 88

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JUNE 1981

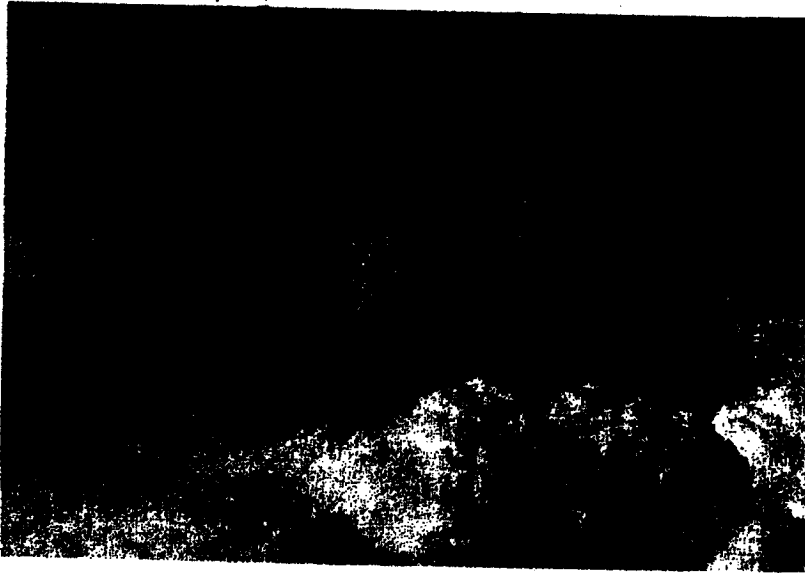
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**a foreword to...**



# SPACE

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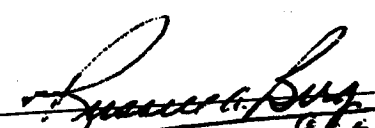
12 June 1961

**Monthly Summary of  
SPACE SYSTEMS DIVISION  
ACTIVITIES  
JUNE 1961**

**FOREWORD**

Two significant space successes were achieved in June. The first was the successful orbit of DISCOVERER XXV on 16 June and the successful recovery of the capsule following two days on orbit. The other was the highly successful TRANSIT 4A launch on 28 June which accomplished two firsts for the United States Space effort. It was the first time three satellites have been placed in orbit by one booster system and the first time a nuclear reactor has been used to provide electrical power for a satellite. A good orbit was achieved. This is the most successful flight of the TRANSIT navigational satellite series.

The monthly Summary of Space Systems Division Activities has been determined to be a Group 3 document in accordance with paragraph 6, AFR 205-2. This categorization applies to all previous issues. Holders of these documents are responsible for action promptly to place the correct notation on the document in accordance with this regulation.

*for*  
  
O. J. RITLAND  
Major General, USAF  
Commander

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# **SATELLITE**

## **SYSTEMS**



**DISCOVERER**  
**MIDAS**  
**BIOASTRONAUTICS**  
**BLUE SCOUT**  
**SAINT**  
**VELA HOTEL**

The DISCOVERER Program consists of the design, development and flight testing of two-stage vehicles, using the Douglas DM-21 Space Booster as the first stage and the AGENA as the second stage, satellite vehicle. The program was established early in 1958 under the direction of the Advanced Research Projects Agency, with technical management assigned to Space Systems Division. On 14 November 1959, program responsibility was transferred from ARPA to the Air Force by the Secretary of Defense. Prime contractor for the program is Lockheed Missile and Space Division. The DISCOVERER Program will perform space research in support of the advanced military reconnaissance satellite programs.

**PROGRAM OBJECTIVES**

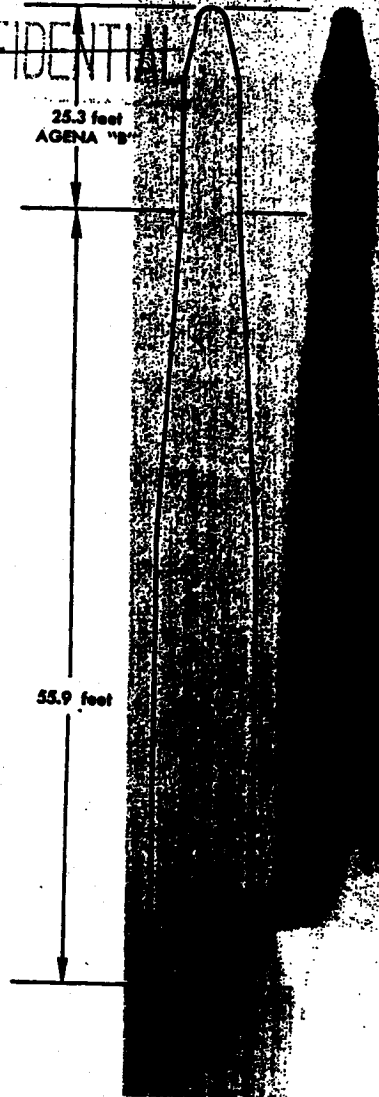
- (a) Flight test of the satellite vehicle airframe, propulsion, guidance and control systems, auxiliary power supply, and telemetry, tracking and command equipment.
- (b) Attaining satellite stabilization in orbit.
- (c) Obtaining satellite internal thermal environment data.
- (d) Testing of techniques for recovery of a capsule ejected from the orbiting satellite.
- (e) Testing of ground support equipment and development of personnel proficiency.
- (f) Conducting bio-medical experiments with mice and small primates, including injection into orbit, re-entry and recovery.

**PROGRAM SUMMARY**

Early launches confirmed vehicle flight and satellite orbit capabilities, developed system reliability, and established ground support, tracking and data acquisition requirements. Later in the program, biomedical and advanced engineering payloads will be flight tested to obtain support data for more advanced space systems programs. DISCOVERER vehicles are launched from Vandenberg Air Force Base, with orbital operational control exercised by the Satellite Test Center, Sunnyvale, California.

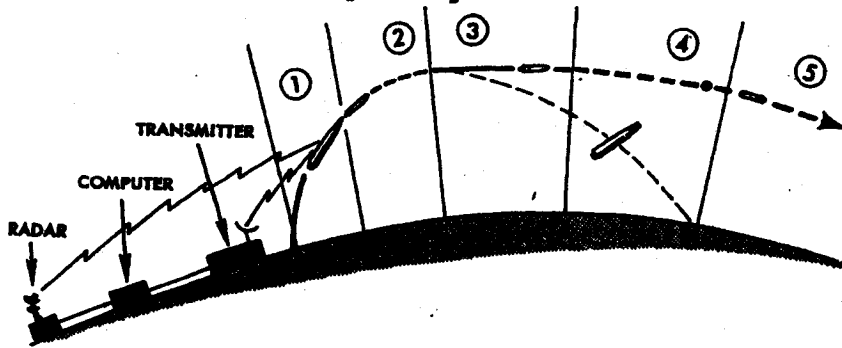
Tracking and command functions are performed by the stations listed in the Table on Page A-4. A history of DISCOVERER flights to date is given on pages A-5 and A-6.

D  
i  
S  
C  
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E  
R



	<b>AGENA</b>
	<b>"B"</b>
<b>SECOND STAGE</b>	
Weight—	
Inert	1,346
Payload equipment	915
Orbital	2,261
Impulse propellants	12,950
Other	511
<b>TOTAL WEIGHT</b>	<b>15,722</b>
Engine Model	XLR81-Ba-9
Thrust-lbs., vac.	16,000
Spec. imp.-sec., vac.	290
Burn time-sec.	240
<b>BOOSTER</b>	<b>DM-21</b>
Weight—Dry	6,500
Fuel	33,700
Oxidizer (LOX)	68,200
<b>GROSS WEIGHT (lbs.)</b>	<b>108,400</b>
Engine	MB-3
	Block 2
Thrust, lbs. (S.L.)	169,000
Spec. imp., sec. (S.L.)	248.3
Burn Time, sec.	148

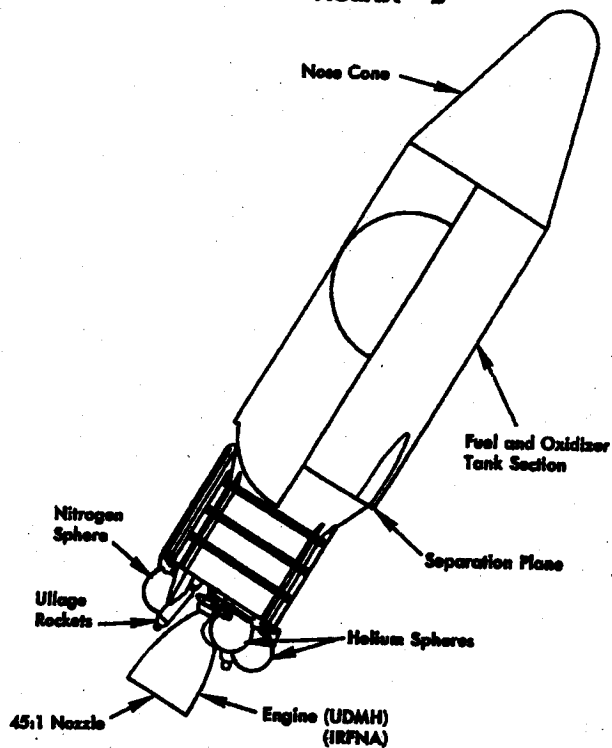
### Powered Flight Trajectory



1. First Stage Powered Flight - 2.5 minutes duration, 78 n.m. downrange, guided by programmed autopilot.
2. Coast Period - 2.4 minutes duration, to 380 n.m. downrange, attitude controlled by inertial reference package, horizon scanner, gas reaction jets. Receives AGENA time to fire and velocity to be gained commands thru the BTL system.
3. Second Stage Powered Flight - Approximately four minutes or until injection velocity is attained. Pitch and yaw stabilization achieved by gimbaling the engine and roll by gas reaction jets. Engine shutdowns achieved by integrator accelerometer cutoff command.
4. Vehicle Reorients to Nose Aft - 2 minutes duration. Guided and attitude controlled by inertial reference package, horizon scanner and gas reaction jets.
5. In Orbit - Controlled (same as 4).

Telemetry ships are positioned as required by the specific mission of each flight. Illustrations on the opposite page show a typical launch trajectory from Vandenberg Air Force Base and a typical orbit. An additional objective of this program is the development of a controlled re-entry and recovery capability for the payload capsule. The recovery operation is also shown on the opposite page. An impact area has been established near the Hawaiian Islands and a recovery force activated. Techniques have been developed for aerial recovery by C-119 and JC-130 aircraft and for sea recovery by Navy surface vessels. The recovery phase of the program has provided advances in re-entry technology. This information will be used in support of more advanced projects.

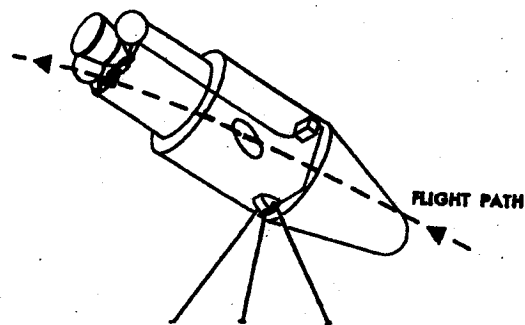
### AGENA "B"



### AGENA VEHICLE DEVELOPMENT

The AGENA vehicle was originally designed as a basic satellite vehicle for Military Space Programs. The first AGENA "B" used the Bell XLR-81Ba-7 engine and was first flown on DISCOVERER XVI. The latest AGENA "B" vehicles use the 16,000 pound thrust XLR-81Ba-9 engine which has a restart capability. This larger vehicle permits achieving higher injection altitudes with equivalent weight payloads and the restart provision permits orbital adjustment.

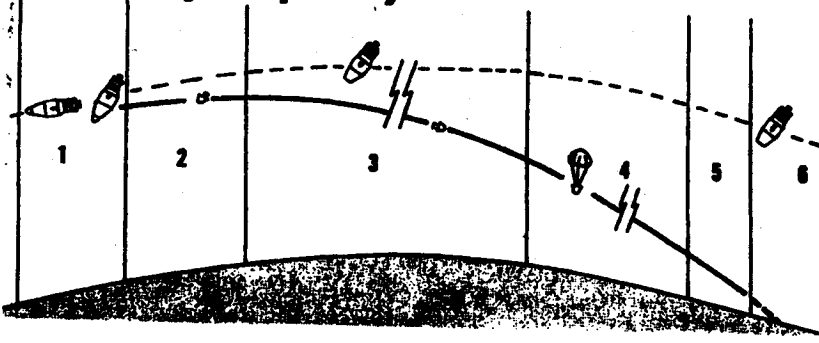
### DISCOVERER/AGENA



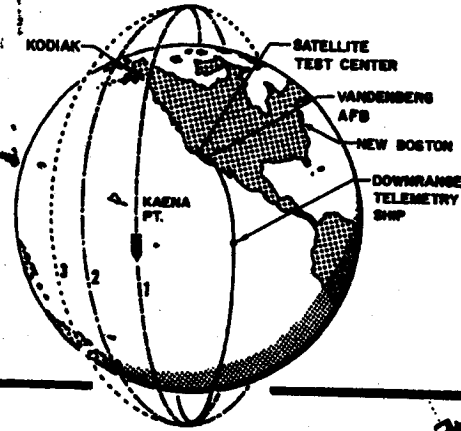
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### Recovery Trajectory



1. **Vehicle Reorients to Separation Attitude**—83.5 seconds duration, 2,000 nautical miles north of impact point. Pitch reorientation starts and vehicle assumes separation attitude.
2. **Capsule Separation**—14 seconds duration, capsule separates, spin rockets fire, retro rocket fires and de-spin rockets fire. Retro rocket and thrust cone separate from re-entry capsule.
3. **Re-entry**—8 minutes duration, recovery capsule re-enters the earth's atmosphere. Parachute cover is ejected and ablation shell separated from capsule.
4. **Descent to Recovery Altitude**—18 minutes duration. Reefed parachute is deployed and chaff (to aid in radar tracking) is ejected. Capsule descends from 55,000 feet to 14,000 feet.
5. **Air Recovery**—6 minutes duration, capsule descends from 14,000 feet to 1,500 feet during which time air recovery is attempted.
6. **Sea Recovery**—Capsule impacts in the sea, surface forces attempt recovery.

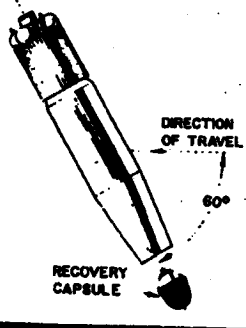


### Orbital Trajectory

*Schematic presentation of orbital trajectory following launch from Vandenberg Air Force Base. Functions performed by each station and a listing of equipment used by each station, is given on page 4.*

### RECOVERY CAPABILITY

*This objective was added to the program after the first launch achieved vehicle flight and orbit objectives successfully. It includes the orientation of the satellite vehicle to permit a recoverable capsule to be ejected from the nose section of the AGENA vehicle. Ejection is programmed to occur on a selected orbit, for capsule impact within the predetermined recovery area near Hawaii. Aircraft and surface vessels are deployed within the area as a recovery force.*

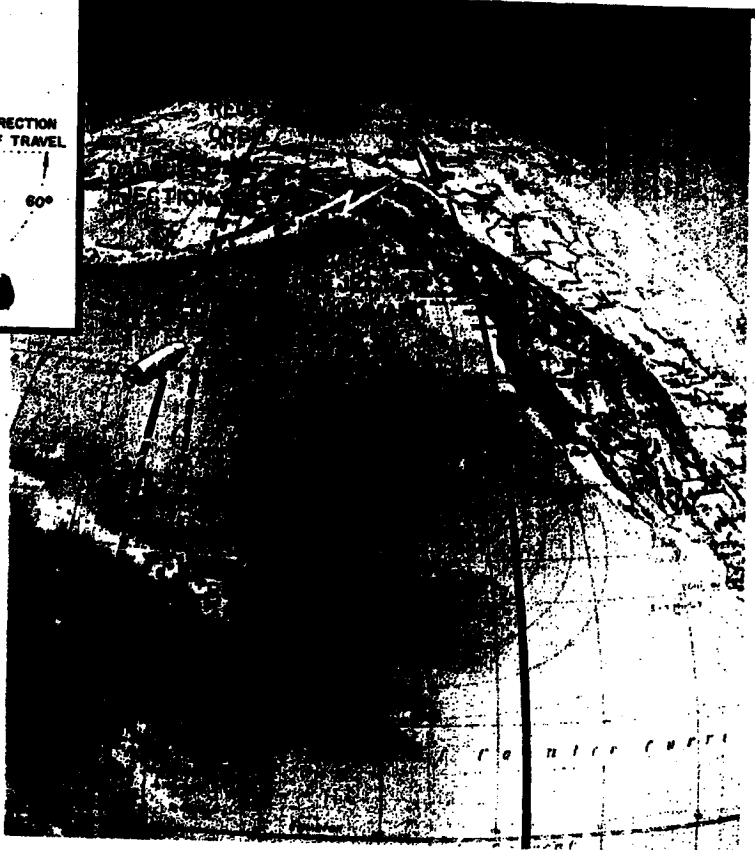


### CAPSULE RECOVERY SEQUENCE

• The desired orbit for capsule ejection is selected after the vehicle is on orbit based on satellite performance, longitudinal location of the orbit, recovery force status, and weather in the potential recovery area. A command is sent to the vehicle prior to the selected recovery pass which initiates the recovery sequence. This command may be sent from any of the primary tracking stations listed on page A-4.

• The ejection sequence includes a pitch down maneuver, capsule separation, spin-up, retro-rocket firing, de-spin and re-entry. Following parachute deployment the aerial recovery force converges on the descending capsule and snags the parachute. The capsule contains a radio beacon and reflective chaff which is dispersed to aid in tracking.

• The recovery force consists of C-119, RC-121, WVII and JC-54 aircraft supplemented by 2 or 3 surface vessels that receive and record telemetry data. If it is necessary to retrieve the capsule from the sea, these ships are available.



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Facility	Equipment*	Flight Function
Satellite Test Center	ABCD	Over-all control, orbit computations and predictions, acquisition data for tracking stations, prediction of recovery area.
†Vandenberg AFB Tracking Station	BDEFGHIJ	Ascent and orbital tracking, telemetry reception, trajectory measurements, command transmission.
Downrange Telemetry Ship	BGIJ	Telemetry reception and tracking during ascent and orbit injection.
†New Hampshire Tracking Station	BDFGHIJ	Orbit tracking, telemetry reception, commands to satellite.
†Kodiak Tracking Station	BDFGHIJ	Orbit tracking, telemetry reception, initial acquisition on pass 1, monitor events in recovery sequence.
†Hawaiian Tracking Station	BDFGHIJ	Orbit tracking, telemetry reception and transmission of commands to satellite.
Hickam AFB Oahu, Hawaii	D	Over-all direction of capsule recovery operations.
Tern Island	BGHJ	Recovery capsule tracking.

†Primary Tracking Stations (have command capability)

**\*Equipment**

- A. General Purpose Computer(s) and Support Equipment
- B. Data Conversion Equipment
- C. Master Timing Equipment
- D. Control and Display Equipment
- E. BTL Tracking Station (DISCOVERER ascent only)

- F. VERLORT
- G. VHF FM/FM Telemetry Station
- H. VHF Direction Finding Equipment
- I. Doppler Equipment
- J. VHF Telemetry Antenna

NOTE: In addition to equipment listed, all stations have inter- and intra-station communications equipment and checkout equipment.

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**Launch Schedule**

VEHICLE CONFIGURATIONS	A	●	J	1959
		★	F	
			M	
		★	A	
			M	
		●●	J	
			J	
		★★	A	
			S	
			O	
	★★	N		
		D		
		J	1960	
	●●	F		
		M		
	★	A		
		M		
	●	J		
		J		
	ⓇⓇ	A		
	★	S		
	●	O		
	Ⓡ	N		
	Ⓡ★	D		
		J	1961	
★★	F			
●	M			
★	A			
	M			
●Ⓡ	J			
3	J			
3	A			
2	S			
2	O			
1	N			
1	D			
	J	1962		
1	F			
	M			
	A			

- ★ Attained orbit successfully.
- Ⓡ Attained orbit and capsule recovered.
- Failed to attain orbit.

**VEHICLE CONFIGURATIONS**

A. THOR—DM-18/AGENA "A"

B. THOR—DM-21/AGENA "B"  
MB-3 Block 1/XLR81-Ba-7

C. THOR—DM-21/AGENA "B"  
MB-3 Block 2/XLR81-Ba-9

**Flight History**

DISCOVERER No.	DM-21 No.	AGENA No.	Flight Date	Remarks
<b>DISCOVERER FLIGHTS 0 THRU XX ARE ON PAGE A-6</b>				
XXI	261	1102	18 February	Attained orbit successfully. Non-recoverable, radio-metric data gathering MIDAS support flight.
XXII	300	1105	30 March	Launch, ascent, separation, coast and orbital stage ignition normal. Orbital velocity was not attained because of an AGENA hydraulic malfunction.
XXIII	307	1106	8 April	Attained orbit successfully. Loss of control gas prevented proper positioning of the satellite for capsule re-entry. Capsule was ejected into new orbit on re-entry pass.
XXIV	302	1108	8 June	Failed to attain orbit because of a second stage malfunction.
XXV	303	1107	16 June	Attained orbit successfully. Capsule recovered from the ocean after two days on orbit. All objectives achieved.

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Flight History (continued)

DISCOVERER No.	DM-21 No.	AGENA No.	Flight Date	Remarks
0	160	1019	21 January 1959	<i>AGENA destroyed by malfunction on pad. THOR refurbished for use on flight XII.</i>
I	163	1022	28 February	<i>Attained orbit successfully. Telemetry received for 514 seconds after lift-off.</i>
II	170	1018	13 April	<i>Attained orbit successfully. Recovery capsule ejected on 17th orbit was not recovered. All objectives except recovery successfully achieved.</i>
III	174	1020	3 June	<i>Launch, ascent, separation, coast and orbital boost successful. Failed to achieve orbit because of low performance of satellite engine.</i>
IV	179	1023	25 June	<i>Same as DISCOVERER III.</i>
V	192	1029	13 August	<i>All objectives successfully achieved except capsule recovery after ejection on 17th orbit.</i>
VI	200	1028	19 August	<i>Same as DISCOVERER V.</i>
VII	206	1051	7 November	<i>Attained orbit successfully. Lack of 400-cycle power prevented stabilization on orbit and recovery.</i>
VIII	212	1050	20 November	<i>Attained orbit successfully. Malfunction prevented AGENA engine shutdown at desired orbital velocity. Recovery capsule ejected but not recovered.</i>
IX	218	1052	4 February 1960	<i>THOR shut down prematurely. Umbilical cord mast did not retract. Quick disconnect failed, causing loss of helium pressure.</i>
X	223	1054	19 February	<i>THOR destroyed at T plus 56 sec. by Range Safety Officer. Severe pitch oscillations caused by booster autopilot malfunction.</i>
XI	234	1055	15 April	<i>Attained orbit successfully. Recovery capsule ejected on 17th orbit was not recovered. All objectives except recovery successfully achieved.</i>
XII	160	1053	29 June	<i>Launch, ascent, separation, coast and orbital stage ignition were successful. Failed to achieve orbit because of AGENA attitude during orbital stage boost.</i>
XIII	231	1057	10 August	<i>Attained orbit successfully. Recovery capsule ejected on 17th orbit. Capsule was recovered after a water impact with negligible damage. All objectives except the airborne recovery were successfully achieved.</i>
XIV	237	1056	18 August	<i>Attained orbit successfully. Recovery capsule ejected on 17th orbit and was successfully recovered by the airborne force. All objectives successfully achieved.</i>
XV	246	1058	13 September	<i>Attained orbit successfully. Ejection and recovery sequence completed. Capsule impact occurred south of the recovery forces; located but lost prior to being retrieved.</i>
XVI	253	1061	26 October	<i>Launch and ascent normal. AGENA failed to separate from booster and failed to attain orbit.</i>
XVII	297	1062	12 November	<i>Attained orbit successfully. Recovery capsule ejected on 31st orbit and aerial recovery was accomplished. All objectives were successfully achieved.</i>
XVIII	296	1103	7 December	<i>Attained orbit successfully. Recovery capsule ejected on 48th orbit and aerial recovery was accomplished. All objectives were successfully achieved.</i>
XIX	258	1101	20 December	<i>Attained orbit successfully. Non-recoverable, radio-metric data gathering MIDAS support flight.</i>
XX	298	1104	17 February	<i>Attained orbit successfully. Capsule did not re-enter due to on-orbit malfunction.</i>

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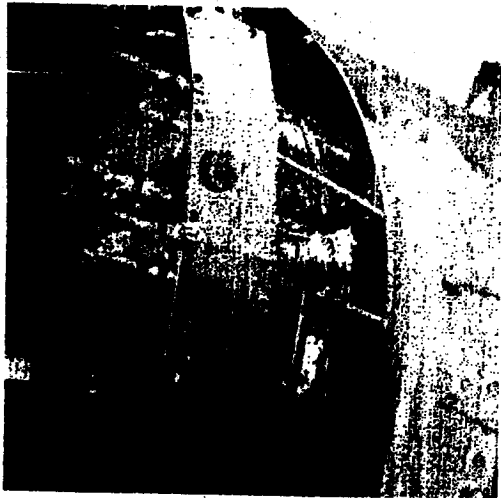


Figure 1 — Attitude control valve heating element installation on DISCOVERER XXV. Attitude control difficulty on DISCOVERER XXIII was attributed to sluggish or sticking valves resulting from extremely low temperatures encountered while on orbit.

### Monthly Progress — DISCOVERER

#### Flight Test Progress

- Two DISCOVERER satellites were launched from Vandenberg Air Force Base in June. The first, DISCOVERER XXIV, did not orbit. The second, DISCOVERER XXV, was injected into a near-nominal orbit and its capsule was successfully returned from space and recovered after two days on orbit. (U)

- DISCOVERER XXIV was launched from Vandenberg Air Force Base at 1416 PDT on 8 June. THOR performance was nominal throughout the boost phase. However, telemetry results indicate a small fire may have started in the AGENA aft equipment area at or shortly after liftoff. This was indicated by a constant increase in the aft equipment area temperature from liftoff until a loss of telemetry occurred at T plus 147 seconds. At T plus 77 seconds a sharp rise in battery current occurred and

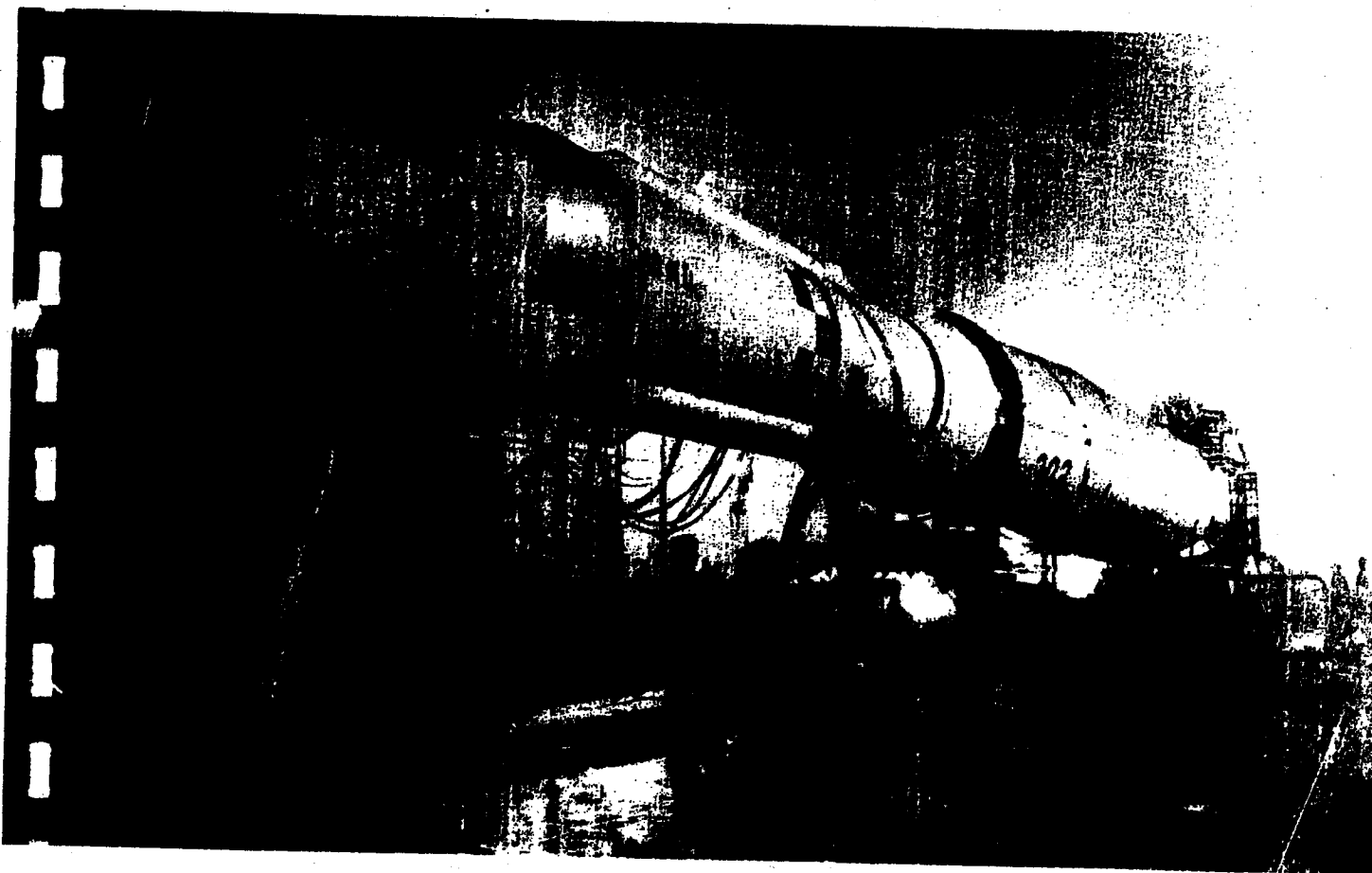


Figure 2 — AGENA 1107 and THOR 303 prior to their launch as DISCOVERER XXV on 16 June.

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**DISCOVERER XXV LAUNCH**



all voltages showed disturbances of approximately ten seconds duration. Other data indicates that separation did occur but that the AGENA vehicle did not develop sufficient thrust for orbital boost. Failure to orbit is attributed to damage resulting from the fire. ~~(C)~~

• The source of the DISCOVERER XXIV fire is unknown but seepage of unsymmetrical di-methyl hydrazine (fuel) from a plumbing leak or quick-disconnect spillage is suspected. Remedial action for subsequent flights includes more stringent propellant leak detection, adding a manual fuel leak check of the AGENA vehicle during the countdown and the addition of a "scupper" near the propellant quick-disconnect to catch spillage when the line is pulled away. A purge system to replace the atmosphere in the aft equipment area is currently under consideration for early incorporation. ~~(C)~~

**DISCOVERER XXV**

• DISCOVERER XXV was launched from Vandenberg Air Force Base at 1603 PDT on 16 June and was successfully injected into a near-polar orbit. The ascent was normal with all events occurring essentially as planned. On orbit the satellite was oriented and stabilized as programmed. The thermostatically controlled electric heaters installed to correct the sticky attitude control valve malfunction due to low temperature operation encountered on DISCOVERER XXIII performed successfully. Since this system requires electrical power, investigations are being conducted in an attempt to find a passive method of solving this low temperature valve operation problem. Table I shows the predicted and attained orbital parameters. ~~(C)~~

Event	Programmed	Actual
Apogee, statute miles	292	256
Perigee, statute miles	147	140
Period, minutes	91.6	90.9
Eccentricity	0.017	0.0138
Inclination Angle, degrees	81.8	82.1

TABLE I. COMPARISON OF PROGRAMMED AND ACTUAL ORBITAL PARAMETERS FOR DISCOVERER XXV.

**Capsule Recovery**

• As planned, capsule recovery was initiated on the 33rd pass (two days on orbit) at 1800 PDT on 18 June. All events occurred as programmed and the capsule descent followed a nominal trajectory. However, the impact area was incorrectly calculated which positioned the recovery aircraft

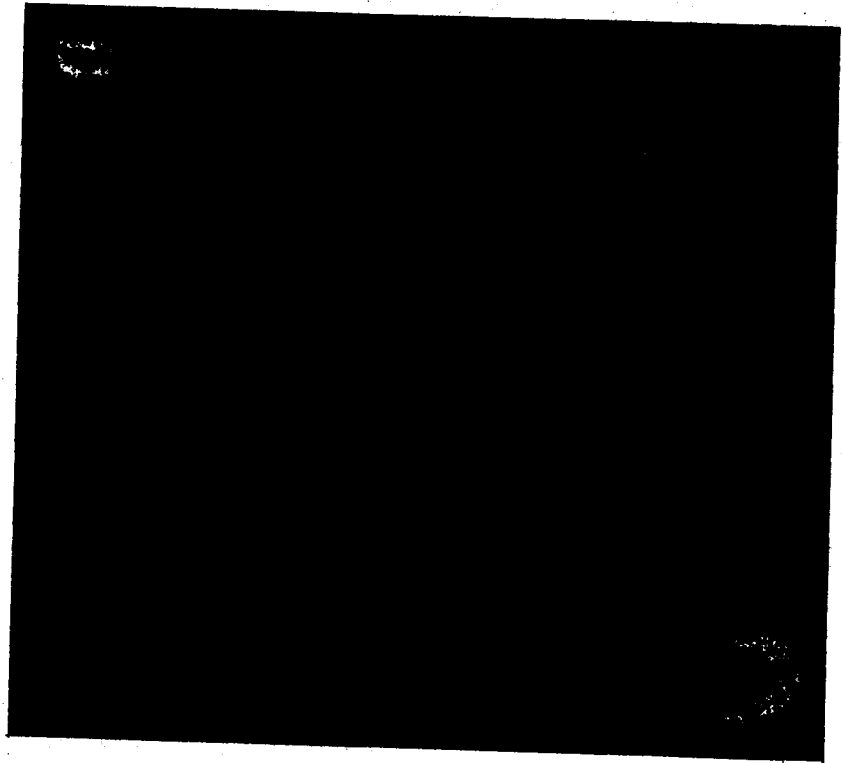
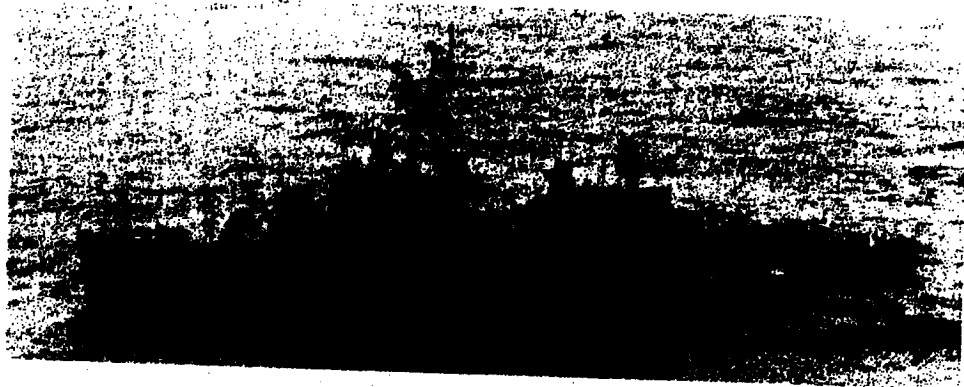


Figure 3 - Three-man Air Force para-rescue team with life rafts and capsule (above) capsule safely aboard the raft (left) and pick-up the morning of 19 June.



out of range to effect an aerial recovery. The capsule was located electronically and ultimately sighted by a recovery aircraft at 1845 PST. An Air Force para-rescue team was deployed and by 2046 PST the capsule was safely aboard their raft. The capsule and the rescue team were picked up by a Navy destroyer the next morning. The capsule was taken to Hawaii by the destroyer and flown to the mainland for evaluation. —(C)—

**Space Research Experiments**

• A number of space environment experiments were conducted successfully during the DISCOVERER XXV operation. An emulsion block, dosimeters, and discs of gold, nickel, titanium, cadmium, magnesium, bismuth, iron, and yttrium were recovered with the capsule and are currently being compared with

identical samples retained on earth to determine the effects of space radiation on these elements. (U)

• Two atmospheric density gages, two micrometeorite detectors, a cosmic ray monitor and twelve temperature probes were carried on DISCOVERER XXV and telemetered data from these instruments are being analyzed. Temperatures in the 25 degree Fahrenheit range were recorded and the detectors recorded evidence of micrometeorite impacts. No satisfactory data were received from the atmospheric density gages. —(C)—

**Future Flights**

• The launch of DISCOVERER XXVI is scheduled for early July. It will also carry samples and instruments for further space environment research. DISCOVERER XXVII will be launched later in July. (C)

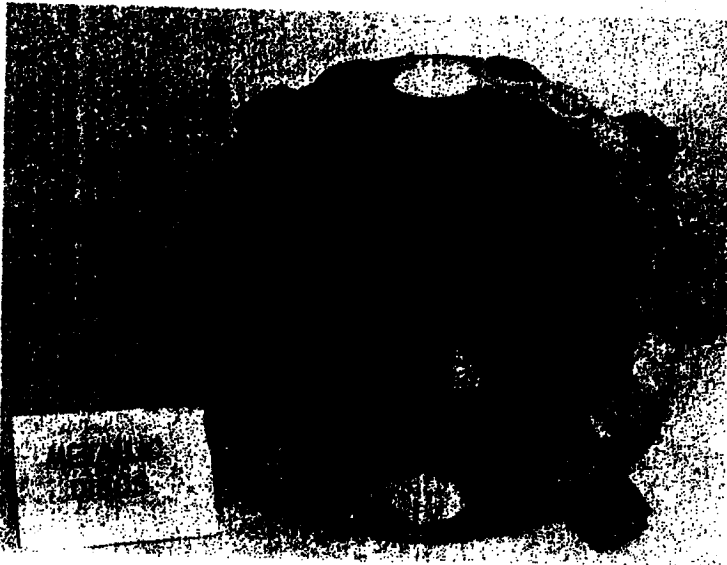
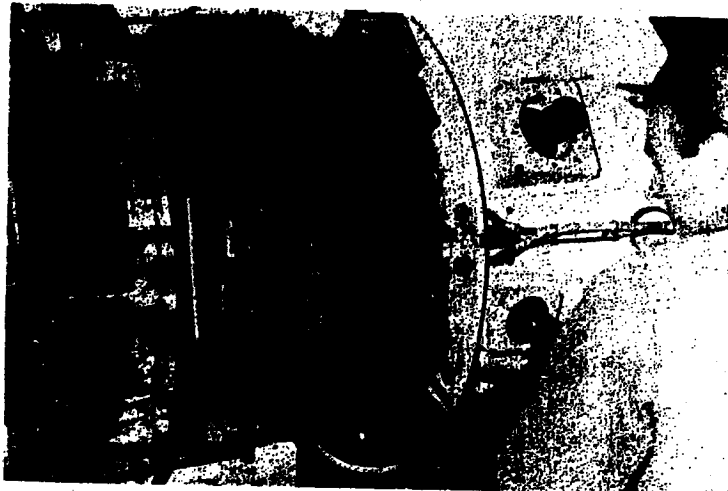


Figure 4 — Samples of titanium, cadmium, magnesium, nickel, yttrium, gold, bismuth and iron mounted on the DISCOVERER XXV capsule. The atomic structure of these samples is being compared with identical samples retained on earth to determine the effects of space radiation on these elements.

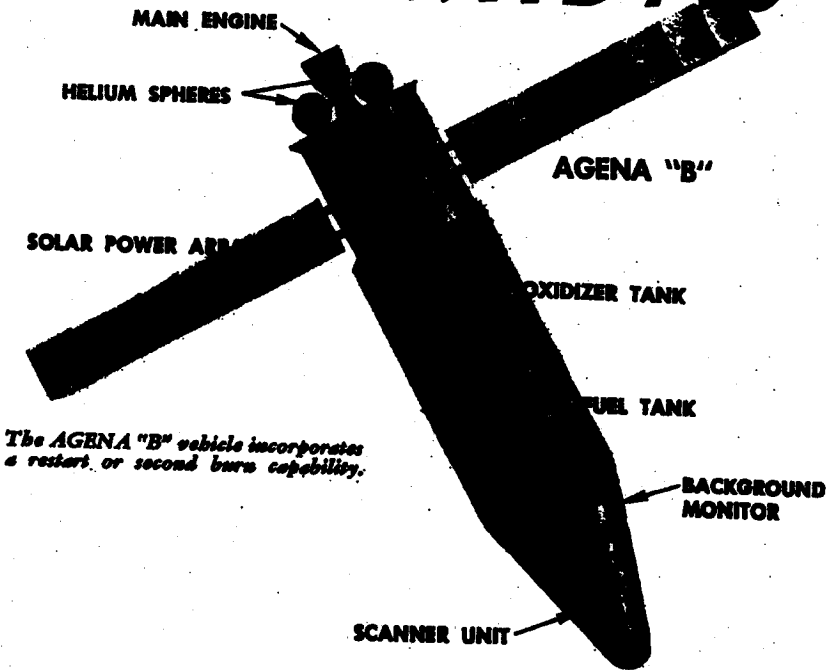
Figure 5 — Technicians installing the module which replaced the rear access door on DISCOVERER XXV and carried space research experiments furnished by the Air Force Geophysical Research Directorate.



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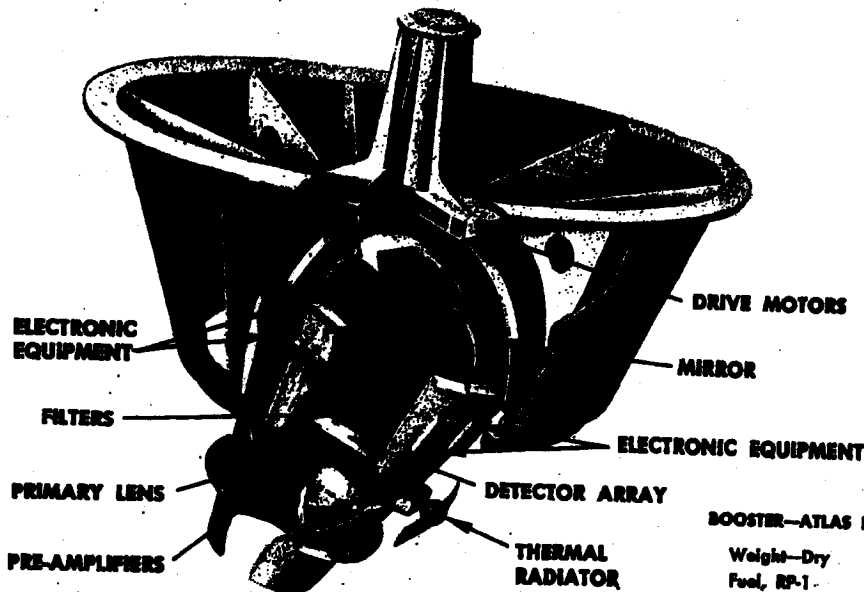
# MIDAS

SECOND STAGE		AGENA "B"
Weight— Insert		1,763
Payload equipment		1,641
Orbital		3,404
Impulse Propellants Fuel (UDMH) Oxidizer (IRFNA)		12,950
Other		758
<b>GROSS WEIGHT (lbs.)</b>		<b>17,112</b>
Engine	XL881-8a-9	
Thrust, lbs. (vac.)		16,000
Spec. Imp., sec. (vac.)		290
Burn Time, sec.		240
Restart Provisions		Yes

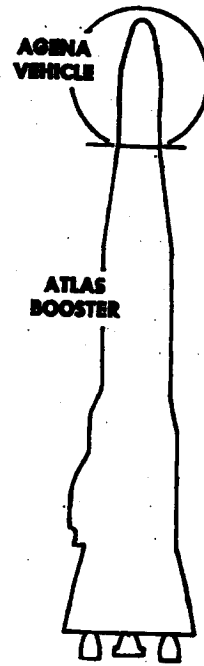


## MIDAS Infrared Detection Payload

*Payload Operation: Incident radiation passes through the primary lens, then is reflected by the mirror which brings the energy into sharp focus on the detector array. The filter is located in front of the detector array to exclude unwanted radiation. Preamplifiers are mounted in back of the detectors.*



BOOSTER—ATLAS ICBM	
Weight—Dry	15,100
Fuel, RP-1	74,900
Oxidizer (LOX)	172,300
<b>GROSS WEIGHT (lbs.)</b>	<b>262,300</b>
Engine—MA-2	
Thrust (lbs. vac.) Boost	346,200
Sustainer	79,700
Spec. Imp. (sec. vac.) Boost	286
Sustainer	310



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## PROGRAM HISTORY

The MIDAS Program was included in Weapon System 117L when WS 117L was transferred to the Advanced Research Projects Agency. ARPA subsequently separated WS 117L into the DISCOVERER, SAMOS and MIDAS Programs, with the MIDAS objectives based on an infrared early warning system. The MIDAS (Missile Defense Alarm System) Program was directed by ARPA Order No. 38, dated 5 November 1958 until transferred to the Air Force on 17 November 1959. The Air Force directed that the program be continued under the technical guidance of the ARPA Order and approved the MIDAS R&D Development plan dated 15 January 1960. This plan was a "minimum essential" program directed toward the satellite vehicle and proof of the feasibility of infrared detection capabilities. It provided for ten test launches, two from the Atlantic Missile Range and eight from the Pacific Missile Range. Subsequent authorization was obtained to utilize two DISCOVERER flights (designated RM-1 and RM-2) to carry background radiometers in support of MIDAS.

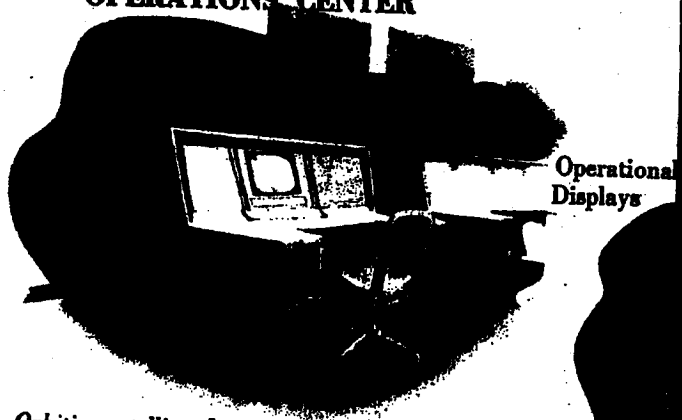
A program of complete system development, including the ground environment of MIDAS, has been submitted to the Department of the Air Force and has been approved in principle and objective. The launch schedule of that program, 31 March 1961 MIDAS R&D Development Plan, is shown on page B-5. Authorization has been received to initiate action implementing the plan with reconsideration for approval to be accomplished subsequent to a successful test launch in 1961.

## TECHNICAL HISTORY

The MIDAS infrared early warning payload is engineered to use a standard launch vehicle configuration. This consists of an ATLAS missile as the first stage and the AGENA vehicle, powered by a Bell Aircraft rocket engine as the second, orbiting stage. The final configuration payload weight will be approximately 1,000 pounds.

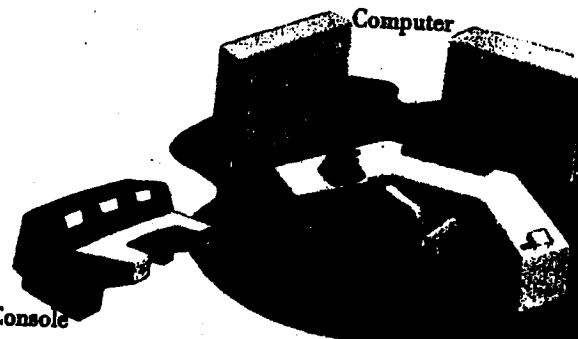
The first two R&D flights used the AGENA "A" and ATLAS "D" vehicle programmed to place the payload in a circular 261 nautical mile orbit. Subsequent R&D flights will utilize the ATLAS "D"/AGENA "B" configuration which will be programmed to place the payload in a circular 2,000 nautical mile polar orbit.

## OPERATIONS CENTER



Operational Displays

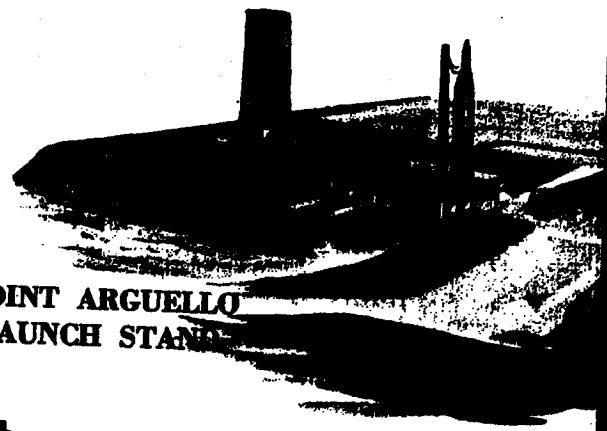
*Orbiting satellites detect infrared radiation emitted by ICBM's in powered flight. Data is telemetered instantaneously to Midas Control Center via far north Readout Stations. Decoded data reveal approximately the number of missiles launched and launch location, direction of travel and burning characteristics. This data is graphically displayed on the control consoles and operational displays at the Operations Center. The Tracking and Control Center monitors and controls the status of the orbital network and the ground environment. The Point Arguello stands are used to launch the MIDAS satellites into polar orbits.*



Control Console

Computer

## TRACKING AND CONTROL



POINT ARGUELLO  
LAUNCH STAND



**SECRET**

Satellite Vehicle

*Eight MIDAS Satellites -- four each in two orthogonal polar orbital planes -- at 2,000 n.m. altitude*

Donnell

Antenna

READOUT STATION

Electronic Equipment

CENTER

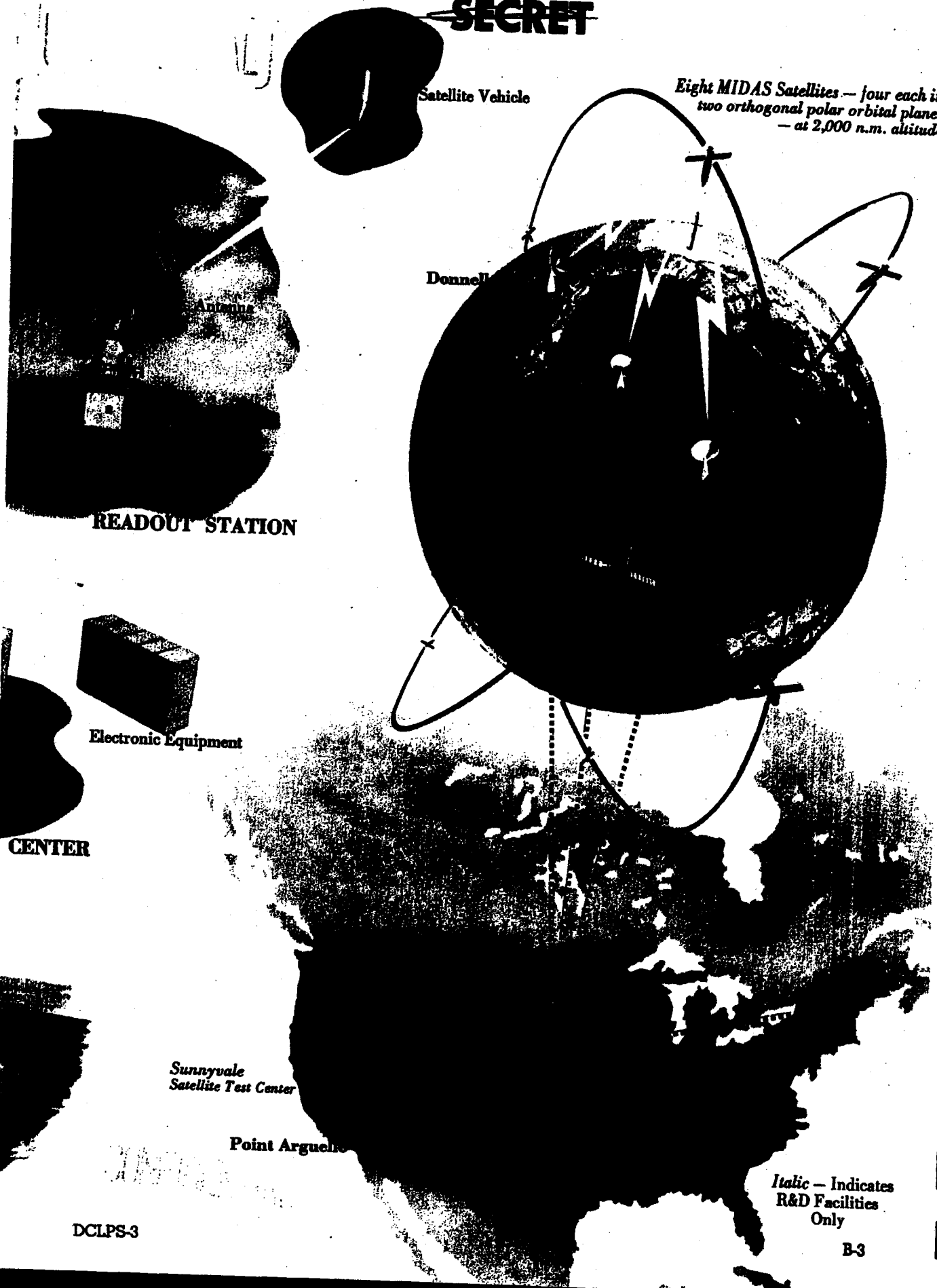
*Sunnyvale  
Satellite Test Center*

Point Arguello

*Italic -- Indicates  
R&D Facilities  
Only*

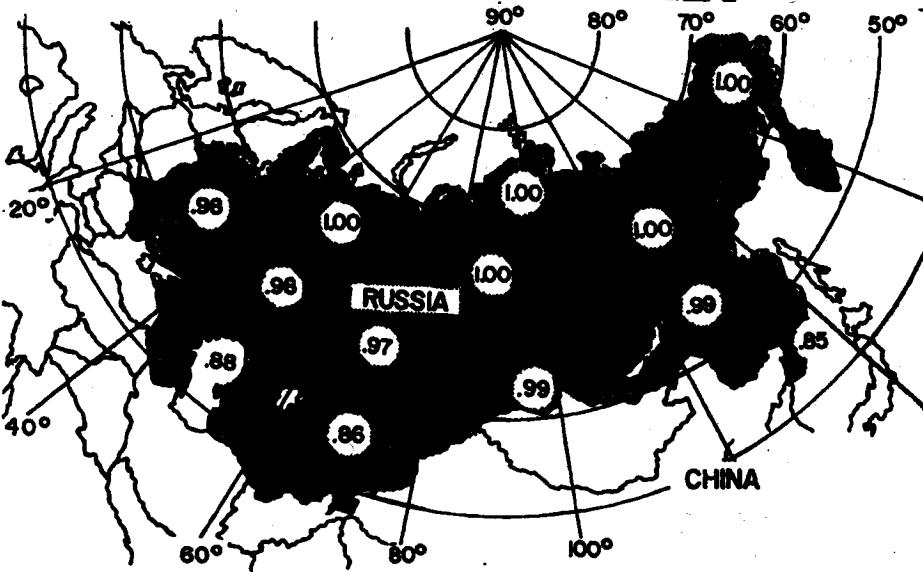
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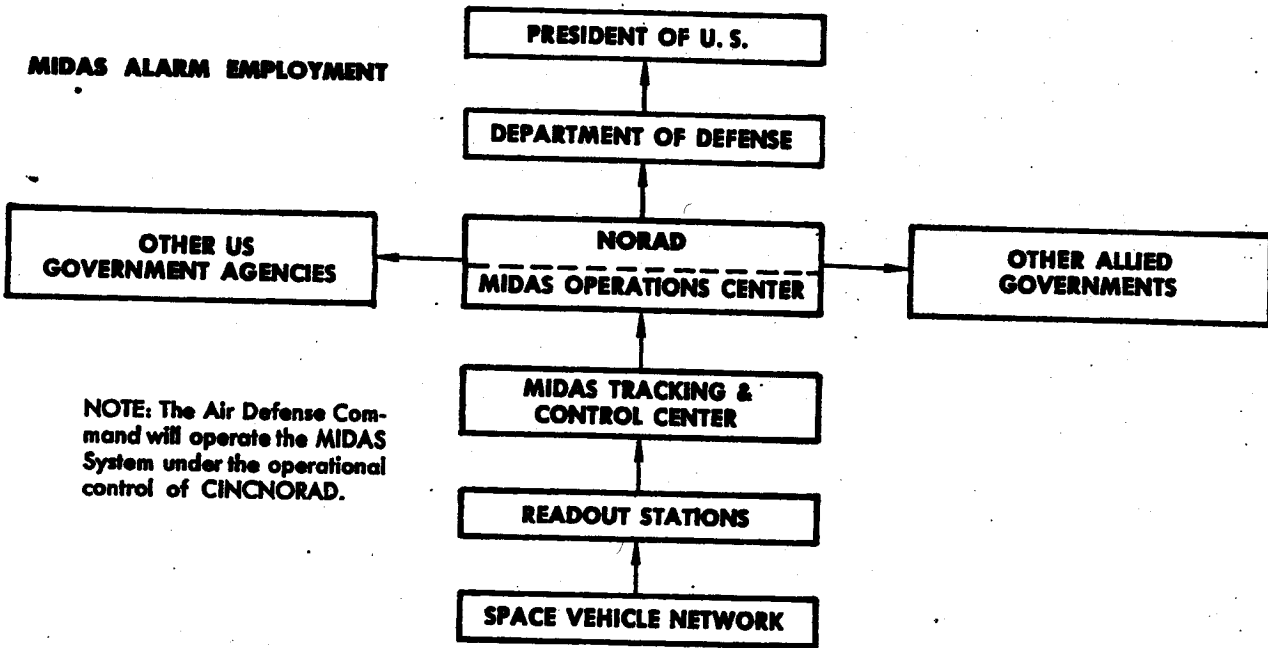
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Probabilities of less than 1.00 on this map indicate the probability of at least one MIDAS satellite detecting an ICBM launch. Probabilities of 1.00 indicate that more than one MIDAS satellite will always be in position to detect an ICBM launch. These figures are based on geometric considerations of the family of satellites and ground readout station locations. Darker areas indicate most probable Russian ICBM launch site locations.

**MIDAS ALARM EMPLOYMENT**



NOTE: The Air Defense Command will operate the MIDAS System under the operational control of CINCNORAD.

**CONCEPT**

The MIDAS system is designed to provide continuous infrared coverage of the Soviet Union. Surveillance will be conducted by eight satellite vehicles in accurately positioned orbits. The area under surveillance must be in line-of-sight view of the scanning satellite. The system is designed to accomplish instantaneous readout of acquired data by at least one of three strategically located readout stations. The readout

stations transmit the data directly to the MIDAS Tracking and Control Center where it is processed. It is then displayed and evaluated in the MIDAS Operations Center. If an attack is determined to be underway, the intelligence is communicated to a central Department of Defense Command Post for relay to the President and all national retaliatory and defense agencies.

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**Launch Schedule**

ATLAS		J	1960	
	●	F		
		M		
		A		
	"D" / AGENA	★		M
		J		
		J		
		A		
		S		
		O		
	"A"	★		N
	◆	★		D
ATLAS		J	1961	
		F		
		M		
		A		
		M		
		J		
	1	J		
	1	A		
	1	S		
		O		
		N		
		D		
ATLAS	1	J	1962	
		F		
	1	M		
	1	A		
	"D" / AGENA	1		M
		J		
		J		
		A		
	1	S		
	1	O		
	"B"	1		N
		1		D
ATLAS	1	J	1963	
		F		
		M		
	2	A		
	2	M		
	3	J		
		J		
		A		
		S		
	1	O		
	1	N		
	1	D		

**Flight History**

MIDAS No.	Launch Date	ATLAS No.	AGENA No.	Remarks
I	26 February	29D	1008	<i>Did not attain orbit because of a failure during ATLAS/AGENA separation.</i>
II	24 May	45D	1007	<i>Highly successful. Performance with respect to programmed orbital parameters was outstanding. Useful infrared data were observed and recorded.</i>
RM-1	20 December	DISCOVERER	Vehicle	<i>Despite satellite oscillations, sufficient data were obtained for evaluation of payload operation. Information obtained in the 2.7- micron region agrees with data obtained from balloon-borne radiometric equipment. Data in the 4.3- micron region is somewhat higher than had been anticipated from theoretical studies.</i>
RM-2	18 February	DISCOVERER	Vehicle	<i>All channels functioned properly and valid data were obtained on six stable orbits. Data confirmed previous radiometric measurements.</i>

- ◆ DISCOVERER vehicles carrying MIDAS radiometric payloads
- ★ Attained orbit successfully
- Failed to attain orbit

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# MIDAS GROUND SUPPORT FACILITIES

Facility	Equipment*	Flight Function
Satellite Test Center	ABCDEP	Operations control, orbit computations and predictions, initiation of commands to satellite (via tracking stations), process payload data.
Vandenberg AFB Tracking Station	ABCEFGHIJKLMP	Ascent and orbital tracking; telemetry reception; trajectory computations; command transmission; reception recording and processing of payload data.
Downrange Telemetry Ships	GHIJNO	Tracking and data reception during ascent. (Three ships are available for this function. Equipment is typical.)
Hawaiian Tracking Station	BEFGHJ	Orbital tracking, telemetry reception, payload data reception.
AMR	HJ	Orbital data reception.
New Hampshire Station	ABCEFGHIJKLM	Orbital tracking; telemetry reception; command transmission; reception, recording and transmission of payload data.
African Tracking Station	BEGJ	Telemetry reception and recording during second burn.
North Pacific Station	BCEHKMP	Satellite and payload data reception, command transmission.
Kodiak Tracking Station	FJ	Orbital tracking.
Mugu Tracking Station	BEFGJ	Tracking and telemetry reception.

- NOTES:**
- (1) In addition to equipment listed, all stations have inter- and intra-station communications equipment and checkout equipment.
  - (2) Equipment listed is either presently available or planned and approved for procurement.

## \*Equipment

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>A. General Purpose Computer(s) and Support Equipment</li> <li>B. Data Conversion Equipment</li> <li>C. PICE</li> <li>D. Master Timing Equipment</li> <li>E. Control and Display Equipment</li> <li>F. VERLORT</li> <li>G. VHF FM/FM Telemetry Station</li> <li>H. PAM FM Ground Station</li> </ul> | <ul style="list-style-type: none"> <li>I. Doppler Equipment</li> <li>J. VHF Telemetry Antenna</li> <li>K. UHF Tracking and Data Acquisition Equipment (60 foot F&amp;D Antenna)</li> <li>L. UHF Angle Tracker</li> <li>M. UHF Command Transmitter</li> <li>N. APL Doppler Equipment</li> <li>O. SPQ-2 Radar</li> <li>P. Midas Payload Evaluation and Command Equipment</li> </ul> |
|---|---|

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**Monthly Progress -- MIDAS**

**Flight Test Progress**

• Tests consisting of compatibility checks of the payload and communication and control equipment simulated flight, radio-frequency interference tests and system checks have been performed on the MIDAS III vehicle at Pt Arguello Complex 1, Pad No. 2. Three delays have been encountered. The first delay was caused by an AGENA vehicle problem. Analysis of DISCOVERER XXIII flight data indicated that attitude control valve temperatures lower than valve design operating temperatures were a possible cause of erratic operation of the attitude control valves which resulted in a rapid expendi-

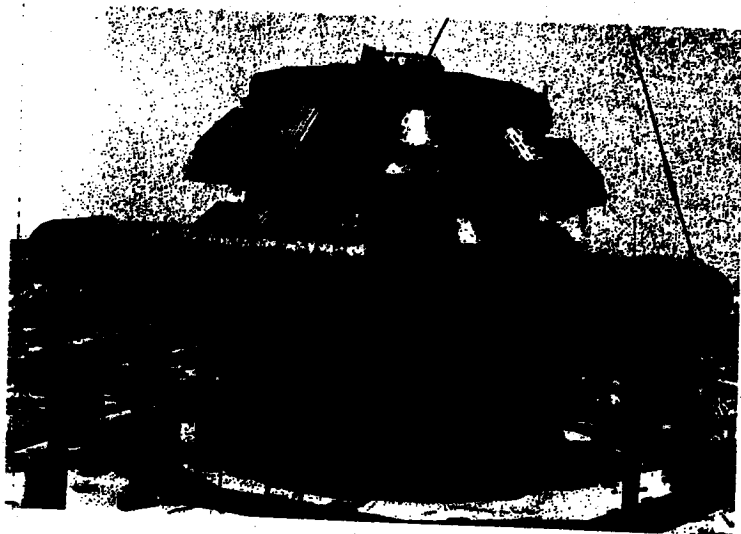
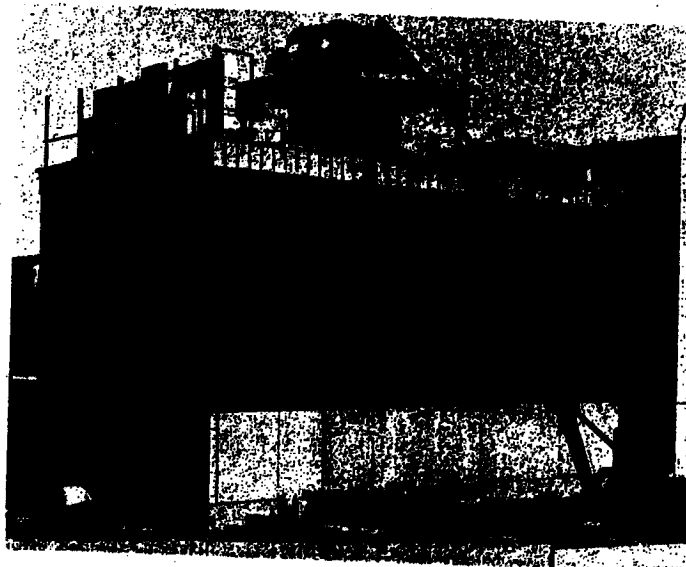
ture of control gas. To eliminate a possible cause of the low valve temperatures a modification was incorporated providing thermal insulation between the valve attachment bolts and the vehicle structure. The second delay was caused by the necessity to replace the defective liquid oxygen pressure regulator on the ATLAS booster. A third delay was caused by an intermittent electrical short in the infrared detection system. The present launch is scheduled for 2 July. ~~IC~~

**Technical Progress**

**Boosters**

• A decision has been made by the Space Systems Division that the guidance systems on the ATLAS

*The test chamber for the High Vacuum Orbital Simulator during installation at Lockheed, Sunnyvale. The test chamber, which has an inside diameter of 18 feet, is designed to simulate the space environment. The vacuum obtainable with a MIDAS test specimen will be  $1 \times 10^{-5}$  mm Hg. Redundancy has been incorporated into the vacuum system to enable one-year continuous operation. The test chamber will provide a temperature range from plus 500 degrees Fahrenheit to minus 300 degrees Fahrenheit. The behavior of the MIDAS payload in the test chamber will be controlled, observed and recorded by an Automatic Programming and Data System called APADS.*



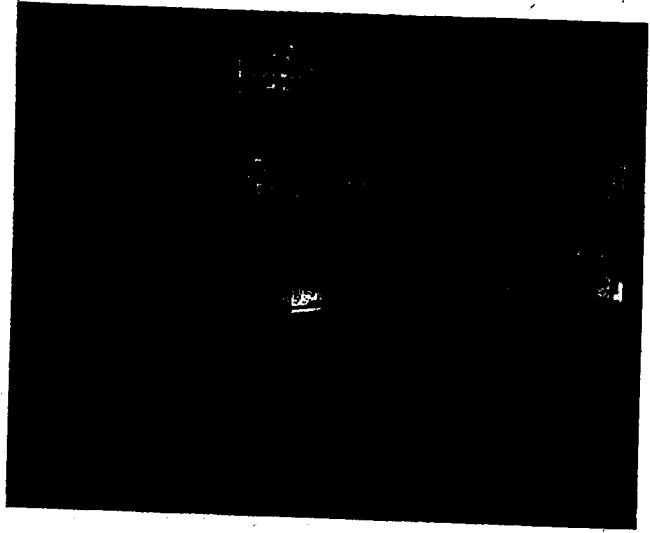
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*New Boston, New Hampshire MIDAS Tracking Station. The 60-foot tracking antenna is on the left (above). The Data Acquisition and Processing Building is the large building in the center. Two radomes and vans containing monitoring consoles are shown in the left hand photograph. The photos on the opposite page show various consoles at the station. The antenna control console (top) positions 60-foot parabolic antenna and monitors the data transmission. An Air Force technician (center) is shown manning one of the antenna controlled consoles at the New Boston station. The lower console monitors satellite acquisition and tracking and MIDAS payload control and readout functions.*

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boosters for the MIDAS launches should be modified to incorporate an improved model gyro. Since the improved gyro has not been produced in sufficient quantity to supply all ATLAS modification requirements, a potential problem is apparent. (S)

### Second Stage Vehicles

- The AGENA vehicle for the MIDAS IV launch is scheduled for acceptance by the Space Systems Division at the Systems Test Complex on 5 July. This vehicle is scheduled for shipment to Vandenberg Air Force Base after completing a flushing operation at Santa Cruz Test Base. The launch of MIDAS IV is presently scheduled for late August. (C)

### Infrared Scanners

- Acceptance testing of the Series III service test model payload was completed in June at Aerojet-General Corporation. The test data are currently being evaluated. Acceptance testing of subassemblies for the first Series III flyable payload has also been completed. Fabrication and assembly of this flight payload is in progress with delivery to Lockheed scheduled for mid-August. A Series III payload will be flown on MIDAS VI. (U)

### Background Radiometer Flights

- Data from the U-2 infrared background measurement flights is being reduced by Baird-Atomic and the results will be published following completion of the data reduction. This infrared background data will be used to refine the design of the payload scanner unit. (U)

### System Development

- A conceptual description of a data processing configuration for MIDAS has been published as a result of a study performed by Lincoln Laboratory. Lockheed Missiles and Space Company is examining the Lincoln Laboratory report and will direct formal comments to the Air Force Space Systems Division. (U)

### Facilities



- Information has been received from the Alaskan Air Command that modifications to the MIDAS technical facilities at Donnelly Flats will begin on 15 July. Completion for occupancy is scheduled for 15 September, with final completion of the air conditioning system scheduled for 15 November. However, an interim air conditioning system will function until the final completion date. (U)

- Final design plans and specifications for the MIDAS Technical Support Building at the New Hampshire tracking and telemetry station were turned over to the Corps of Engineers for construction contract action on 23 June. (U)

- A review conference on preliminary design plans for the Otumwa, Iowa, tracking and control center facilities was held on 27 and 28 June. The architect/engineer is proceeding on preparation of final design plans. On 14 June a predesign conference was held at Omaha, Nebraska, to discuss the rehabilitation of the base support facilities at Otumwa. A review of preliminary design plans is scheduled for 30 August. (U)

- Construction contract bids for Point Arguello Launch Complex No. 2 were opened on 26 June and the contract awarded to Paul Hardeman, Inc. on 27 June. This complex will accommodate launchings of Series IV MIDAS vehicles. This complex will be similar to Launch Complex No. 1, but will have AGE consoles incorporating the latest improvements. At present the complex will consist of two launch stands with a third stand to be constructed upon approval and receipt of funds from Hq USAF.

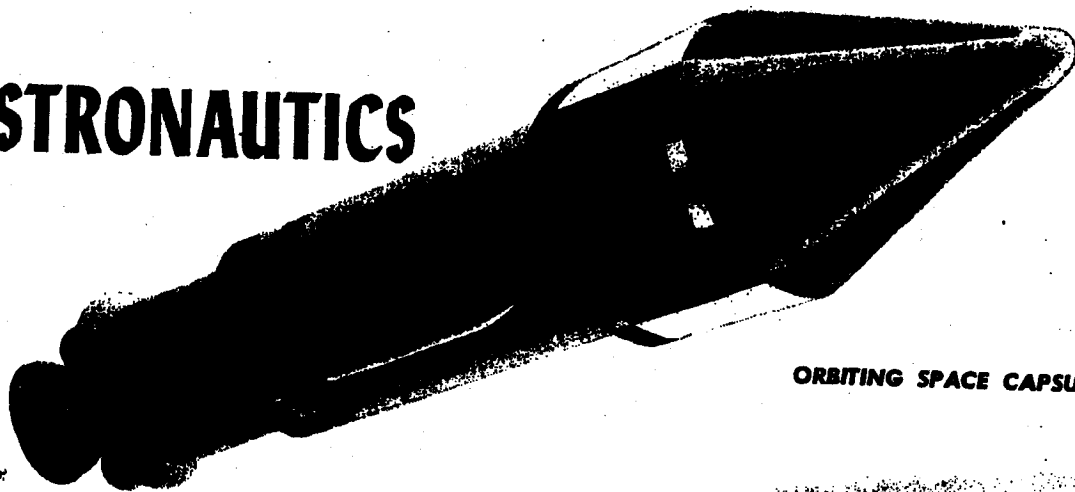
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# BIOASTRONAUTICS



ORBITING SPACE CAPSULE



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### Program History

The BIOASTRONAUTICS Office was established in May 1958 and charged with the biotechnical supervision of the early military "Man-in-Space" Program and the Bioastronautics aspects of the DISCOVERER Program. NASA was subsequently assigned the "Man-in-Space" responsibility in the fall of 1958. The development and fabrication of suitable Biomedical Recovery Capsules for the DISCOVERER Program has continued without interruption.

On 13 May 1959, a MARK I biomedical capsule was successfully flown without specimens. The flight telemetry demonstrated successful operation of the Bioastronautic subsystem as an engineering concept. Although re-entry was successful, recovery was not accomplished. A second MARK I capsule was launched on DISCOVERER IV on 25 June 1959 with four mice aboard. Although orbit and recovery were not achieved, 600 seconds of telemetry showed the animals to be in good condition throughout the flight.

Subsequent DISCOVERER efforts culminated in preparation of a MARK II capsule suitable for a small primate. Launch and recovery of a small primate from orbit awaits approval of an "Abbreviated Space Systems Development Plan, Biomedical Program" submitted to Hq AFSC in November 1960.

Applied Research contracts for the design and development of advanced biocapsule hardware include photosynthetic oxygen production, super-critical gas storage, radiation shielding and bio-instrumentation. All components are scheduled to be flown in subsequent advanced space biocapsule programs.

An Advanced Biomedical Capsule has successfully completed the mockup phase of development. The capsule is designed to carry a fifty pound chimpanzee to altitudes of about 25,000 n.m. to thoroughly explore and assess the radiation hazards of the inner and outer Van Allen Belts. In addition, long-

term weightlessness effects will be investigated. On 7 November 1960, Space Systems Division approved continued development of the advanced capsule in support of eventual manned military space systems.

### Program Concept

The complete exploration of space, including limits to manned operational space systems, requires a determination of the biological effects of the space environment. The Space Systems Division is continuing its aggressive research and development program in this technical area to insure that sufficient bioastronautics knowledge will be available during the 1963-1965 time period. Present deficiencies in reaching these goals are: capsule development, life support system design, biological instrumentation and determination of space flight stresses (long term weightlessness, operational experience in the radiation belts, and isolation). Neither Project MERCURY with its short duration, low altitude orbit, nor DYNASOAR with its low altitude suborbital flight will provide data concerning the key problems of long term weightlessness and Van Allen Belt radiation, Knowledge which is crucial to manned operational space systems.

The current BIOASTRONAUTICS Program is furnishing a limited amount of data from actual ballistic and orbital flights. Experiments include those made on a space-available basis aboard scheduled ICBM and DISCOVERER Program flights. The Bioastronautics Orbital Space System (BOSS), when approved as an Air Force system, will not be limited by piggyback or space-available restrictions. Data obtained from these tests will be available for correlation with those obtained from laboratory experiments. The results will be of supplemental significance to the DYNASOAR Program and Project MERCURY and will be necessary to the success of future manned military missions such as SMART.

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## Monthly Progress — BIOASTRONAUTICS

### *Small Primate Unrestrained (Project SPURT)*

- The second Engineering Design Review of the Project SPURT capsule was conducted by Space Systems Division representatives at the General Electric Company, Philadelphia facilities on 6 June. The design and fabrication is satisfactory. The replacement of the nylon mesh between the animal and the camera with a wire screen will be required. Consideration will also be given to replacing the foam rubber lining within the animal cell with matted felt to reduce the "G" load time on the animal. ~~(C)~~
- An eighty-hour simulation test of the capsular life support function was performed between 6 and 10 June. During the first few hours of the test, a noticeable build-up of carbon monoxide was noted (up to 67 parts per million). This was later traced to

its origin, the interior paint coating of the capsule. The interior paint will be eliminated in the flight item. The small squirrel monkey used for the test died approximately three hours before the end of the test of causes unrelated to the satisfactory capsular life support function. The test will be repeated beginning on 12 July. ~~(C)~~

- Flight item fabrication is now in progress with a piggyback flight aboard an ATLAS ICBM tentatively scheduled for late in August. ~~(C)~~

### *Passenger Pods*

- Because of basic problems with the ATLAS E booster, the Systems Office has postponed the Passenger Pod Program for sixty days. This slippage affects the two Bioastronautics Passenger Pods which were described in the March and April reports. ~~(C)~~

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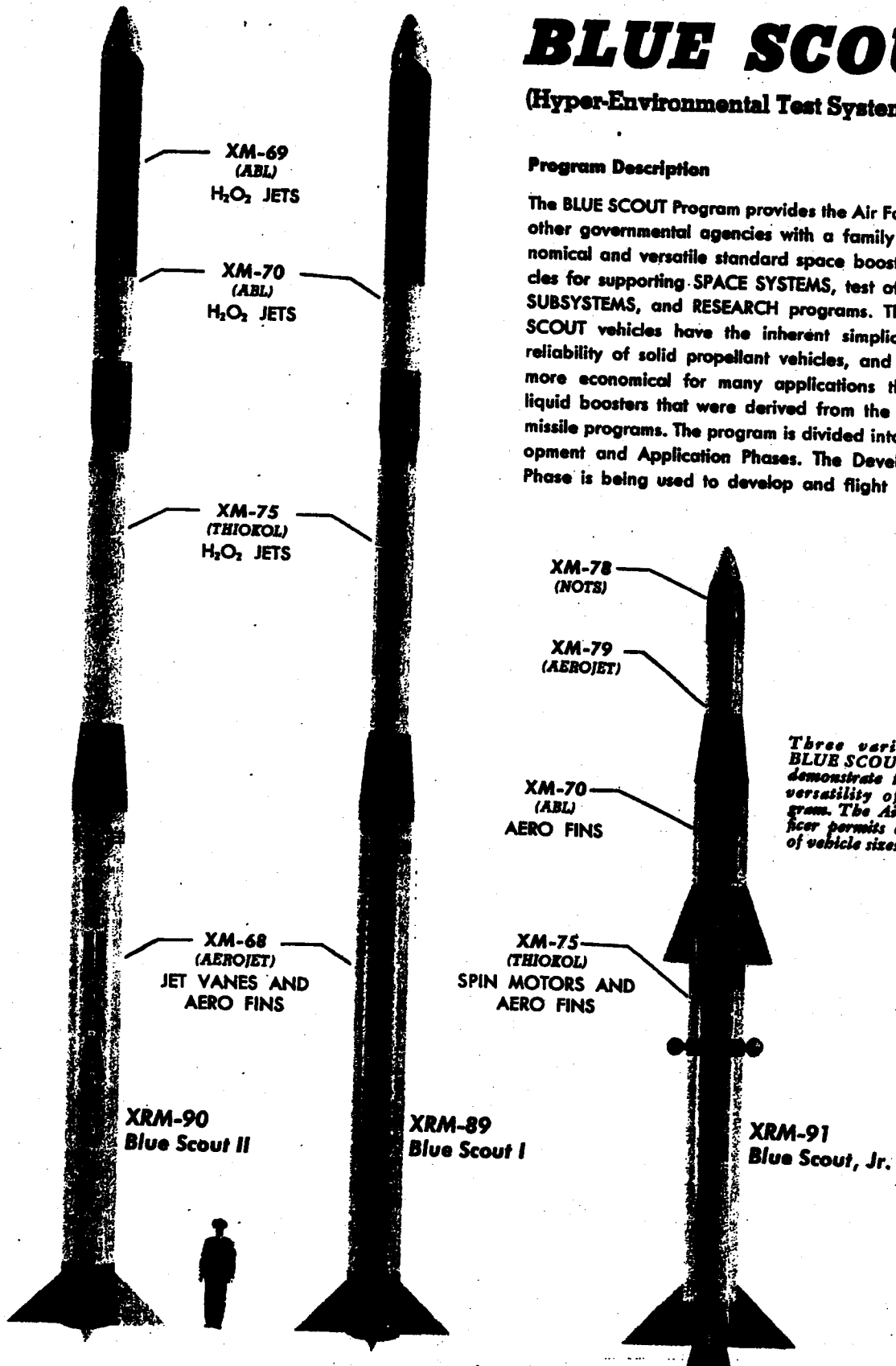
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# BLUE SCOUT

(Hyper-Environmental Test System)

## Program Description

The BLUE SCOUT Program provides the Air Force and other governmental agencies with a family of economical and versatile standard space booster vehicles for supporting SPACE SYSTEMS, test of SPACE SUBSYSTEMS, and RESEARCH programs. The BLUE SCOUT vehicles have the inherent simplicity and reliability of solid propellant vehicles, and are far more economical for many applications than the liquid boosters that were derived from the ballistic missile programs. The program is divided into Development and Application Phases. The Development Phase is being used to develop and flight test the



*Three variations of BLUE SCOUT vehicles demonstrate the mission versatility of the program. The Air Force officer permits comparison of vehicle sizes.*

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solid propellant vehicles, to train AIR FORCE PERSONNEL in processing launch of the vehicles, and to accomplish BLUE SCOUT Program objectives. The Application Phase will support programs such as SAMOS, SAINT, BAMBI, ASSET, TRANSIT, and PROBES. The vehicle receipt, assembly, payload mating, checkout and launch will be accomplished by Air Force military personnel during the Application Phase.

**Performance**

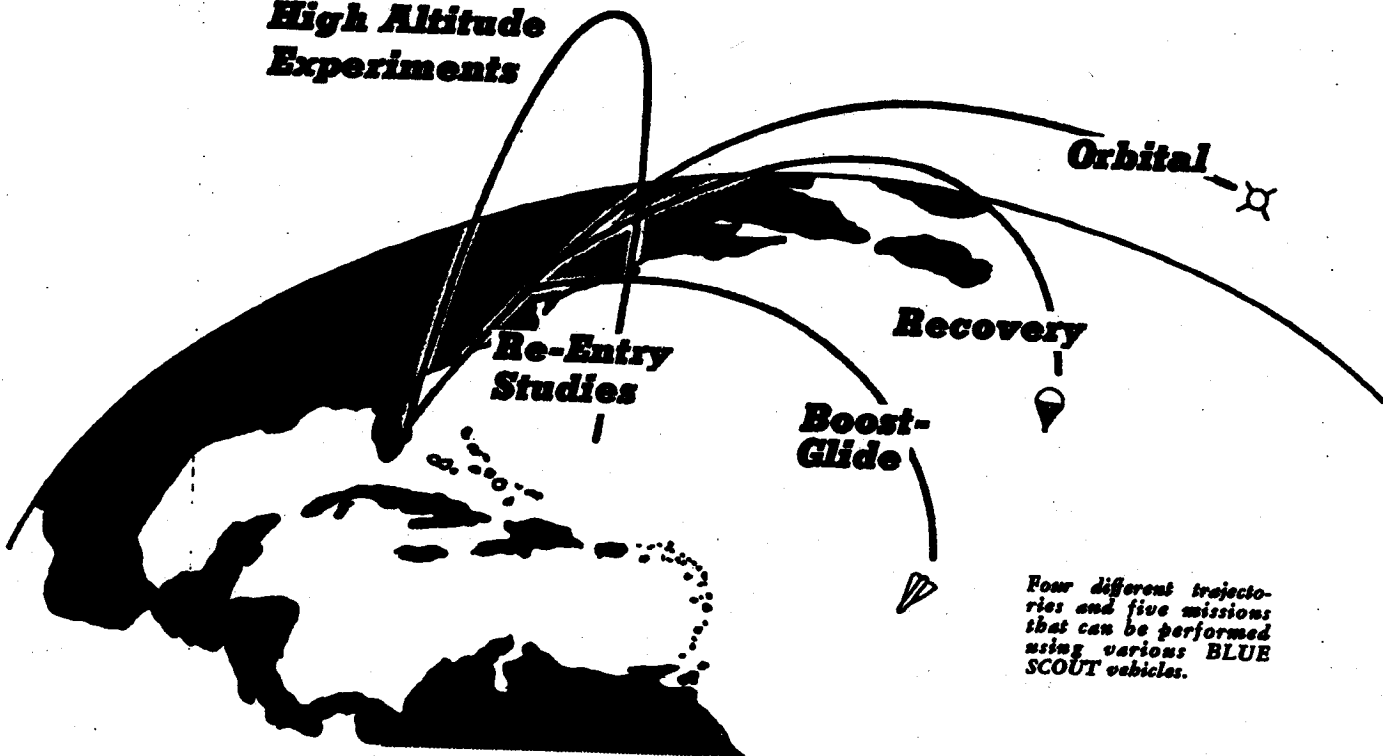
The BLUE SCOUT vehicles have a performance capability which permits them to: (1) place a 200-pound payload into a 400 nautical mile circular orbit, (2) boost a 200-pound payload to 4,000 nautical miles on a probe trajectory, (3) boost a 25-pound payload to 75,000 nautical miles on a probe trajectory, (4) place a 400-pound payload into a boost-glide trajectory at a velocity of 20,500 feet per second at 250,000 feet altitude. Besides ORBITAL FLIGHTS, PROBES, and BOOST-GLIDE trajectories, the vehicle can boost payloads into trajectories and downward booster HIGH-SPEED RE-ENTRY profiles, data RECOVERY capability and ATTITUDE STABILIZED final stage (and payload) are also provided.

**Program Management**

**Development Phase:** An abbreviated Development Plan, covering the Development Phase only, was approved on 9 January 1959. This plan gave Space Systems Division management responsibility. In June 1959, Aeronutronic Division of the Ford Motor Company was chosen through normal competitive bidding as the Payload, Test and Systems Integration Contractor. The procurement of vehicle components and associated support equipment, modified to meet BLUE SCOUT requirements, is being made through NASA, rather than direct procurement from the SCOUT contractors. Atlantic Missile Range launch complex 18 and an existing assembly building are being used for the Development Phase of the program. The 6555th Test Wing (Dev) manages the Development Test program at the Atlantic Missile Range and provides the Air Force personnel who are being trained to assume the vehicle processing, launch and evaluation tasks. An all-military operational capability will be developed from this group.

**Application Phase:** Space Systems Division will have the responsibility for providing BLUE SCOUT booster support to the Air Force and other government agencies for SPACE SYSTEMS, test of SPACE

**High Altitude Experiments**



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**SUBSYSTEMS, and SPACE RESEARCH** flight operations. This responsibility will include the coordination and establishment of agreements of responsibilities with payload agencies, both government and contractor, for the integration of the payloads and boosters; the monitoring of flight operation plans, objectives, schedules, accomplishment, and results; the funding action for the booster support; the planning for launch facilities and launch personnel; the procurement of booster vehicles and other equipment; and the over-all coordination required for execution of the BLUE SCOUT booster support program.

#### **Missions**

The Application Phase missions for the BLUE SCOUT Program, some of which are firm while others are in the planning stage, are as follows:

**SAINT:** Two BLUE SCOUT vehicles required, first launch from Atlantic Missile Range January, 1963.

**ASSET:** A requirement from Aeronautical Systems Division for seven BLUE SCOUT vehicles to be used in investigations of the aerodynamic and thermodynamic properties of boost-guide vehicles. The first launch is scheduled from Atlantic Missile Range in mid-1962 with a three-month launch interval.

**BAMBI:** Four BLUE SCOUT vehicles required, first launch from Pacific Missile Range in mid-1962, interval between launches of three months.

**TRANSIT:** Six BLUE SCOUT vehicles required, first launch from Pacific Missile Range in mid-1962, interval between launches of three months.

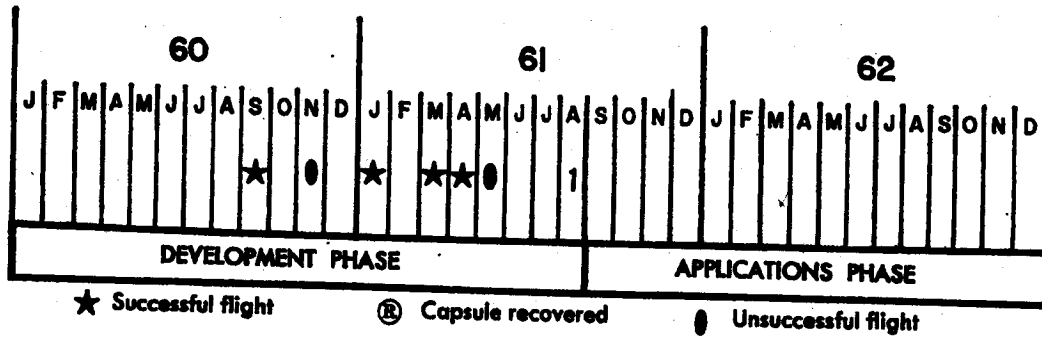
**MISS:** Sixteen BLUE SCOUT vehicles required, first launch from Pacific Missile Range in mid-1962, interval between first four launches of two months, with four month intervals between subsequent launches. (The MISS program provides data for SAMOS operations.)

**PROBES PROGRAM:** A requirement from the Office of Aerospace Research for thirty BLUE SCOUT vehicles indicated FY62 funding will support approximately fifteen BLUE SCOUT vehicles. A requirement of approximately fifteen BLUE SCOUT vehicles per year for the period 1962-1970 is expected.

**BEANSTALK:** This program is under the management of Electronics Systems Division. Present information indicates that ten BLUE SCOUT JUNIOR vehicles will be furnished to Electronics Systems Division for launch operations from Pacific Missile Range during 1962.

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**Launch Schedule**



**Flight History**

Blue Scout	Launch Date	Type of Flight*	Type Designation	Remarks
D1	21 September	A	XRM-91	<i>Telemetry was lost prior to fourth stage burnout. All of the primary (vehicle) objectives were accomplished; none of the secondary (payload) objectives were achieved.</i>
D2	8 November	A	XRM-91	<i>A second stage motor failure occurred at T plus 60 seconds. The vehicle impacted approximately 240 n.m. downrange.</i>
D3	7 January	A&C	XRM-89	<i>The 392-pound payload was launched successfully. The recovery capsule survived re-entry but was not recovered. All other primary objectives were achieved as were the majority of secondary objectives.</i>
D4	3 March	A	XRM-90	<i>The 172-pound payload was launched successfully. The test was completely successful. All primary and secondary objectives were achieved. Valuable payload experiment data were obtained.</i>
D5	12 April	A&C	XRM-90	<i>The 365-pound payload was launched on a probe trajectory. Seven of the eleven primary test objectives were accomplished and one was partially achieved.</i>
D6	9 May	A&C	XRM-89	<i>Indications are that a control motor power lead became disconnected during second stage burning and caused the vehicle to veer left from the programmed trajectory. At T plus 81 seconds range safety action was taken.</i>

**\*Type of Flight**

- |                               |              |                 |
|-------------------------------|--------------|-----------------|
| A — High Altitude Experiments | C — Recovery | E — Boost-Glide |
| B — Re-Entry Study            | D — Orbital  |                 |

**Monthly Progress - BLUE SCOUT**

**Program Administration**

• Headquarters AFSC and USAF were briefed regarding the Meteorological Information Satellite System (MISS) on 20-21 June. The MISS Program proposes using BLUE SCOUT vehicles to place a 150 pound MISS payload into a 400-nautical mile orbit. (S)

• Representatives from the Space Systems Division and other AFSC Divisions and Centers attended the annual Office of Aerospace Research Probes Program Review Committee in Washington, D. C. on 13-16 June. It was established that a small amount of FY-61 funds would be available for procurement of long leadtime BLUE SCOUT components and for sounding rockets. The Hq USAF representative stated that FY-62 funds for nine BLUE SCOUT and four BLUE SCOUT Junior vehicles seemed assured. Funds for this procurement are expected by mid-July. The area of mutual responsibility for the management of the CY-62 Probes Program, as contained in the Schriever/Hooks Memorandum of Understanding, was reviewed and verified as follows:

1. Requirements for research probes will continue to be managed by the Office of Aerospace Research (OAR). Payloads and funds for BLUE SCOUT procurement for OAR experiments will also be furnished by OAR.

2. AFSC (SSD) will manage requirements for other than research probes generated by AFSC; will also develop, procure, integrate and launch the BLUE SCOUT vehicles; and track the probes. (U)

• The 6565th Test Wing (Dev) at Vandenberg Air Force Base has been requested to prepare a plan for launching twelve to sixteen BLUE SCOUT vehicles per year from the Pacific Missile Range for a five-year period, with the first launch occurring early in 1962. Assistance in establishing the required launch capability can be obtained from the 6555th Test Wing (Dev) at the Atlantic Missile Range. Programs which have indicated a requirement for west coast BLUE SCOUT booster support are MISS, TRANSIT, BAMBI, BEANSTALK, and the Probes Program. (C)

**Flight Test Progress**

• The launch of the seventh BLUE SCOUT vehicle (D-8) is scheduled for 25 July. This guided four-stage XRM-92 vehicle will be launched from the Atlantic Missile Range and will place a 150-pound payload into a 300-nautical mile circular orbit with a 32.5

degree inclination angle. The launch preparation schedule is given in Table I. The payload which will check out airborne and ground-based units of the world-wide MERCURY tracking network, will contain S-band and C-band radar beacons, a Minitrack system beacon, command equipment for controlling the payload equipment during flight, and telemetry equipment for obtaining data on payload equipment operation and for assisting in the control and tracking of the satellite. In addition to the payload objectives, the vehicle objectives are as follows:

1. Evaluate the guidance and control system.
2. Investigate the temperature and vibration environment within the vehicle.
3. Verify motor performance.
4. Demonstrate stage separation of the Air Force Scout.
5. Verify the adequacy of Pad 18B for use in launching guided BLUE SCOUT vehicles.
6. Demonstrate the compatibility of the vehicle and Aerospace Ground Equipment.
7. Develop a military capability for assembly, checkout and launch of the Air Force Scout vehicle. (U)

Event	Date
Receive Payload at AMR	3 July
Vehicle telemetry checked	9 July
Spin balance payload and mate payload carrier to the vehicle	11 July
Combined systems check complete	14 July
System Run	15 July
Installation on Pad 18B	18 July
Dry Run	21 July
Launch Ready	25 July

TABLE I. FLIGHT D-8 MILESTONE SCHEDULE

• The BLUE SCOUT Junior vehicle O-1 is being processed on a non-interference basis with vehicle D-8 at the Atlantic Missile Range. Launch preparation and documentation will be accomplished entirely by Air Force personnel of the 6555th Test Wing (Dev) and AFSWC, respectively. The launch of this vehicle with an AFSWC payload is scheduled for mid-August. (U)

• Representatives from all participating government agencies and major contractors attended the D-6 post flight analysis held on 6 June. Approximately five seconds after second stage ignition on 9 May, a loss of vehicle control along the yaw axis



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resulted in a flight path deviation which required destruct action to be taken. Analysis of the problem indicates a break in signal continuity between poppet valve electronics and the hydrogen peroxide valve coils and/or telemetry leads on the peroxide (control) motors. The most likely cause was a control harness failure in the transition section between the first and second stage motors. The exact point of failure within the harness cannot be determined. It was concluded that the control malfunction was not due to any inherent shortcomings of the control system or any of the components. Except for increased quality control for the harness, no required or recommended action was taken relative to this malfunction. (U)

• In reviewing the second stage destruct system malfunction, which occurred during the D-6 flight, the Atlantic Missile Range Flight Safety System Committee was unable to definitely establish the cause of the malfunction. It was hypothesized that an interruption of electrical current prevented the second stage squibs from firing. Detonation of the third stage shaped charge could have destroyed the

second stage safe/arm electrical leads before sufficient current had been applied to ignite the second stage squib. Recommendations were made to route all destruct system wiring down the instrumentation tunnels away from the shaped charge installation and to install limiting resistors in each destruct system safe/arm unit to balance the current supplied to each stage. This modification is being accomplished on all future launch vehicles. (U)

#### *Facilities*

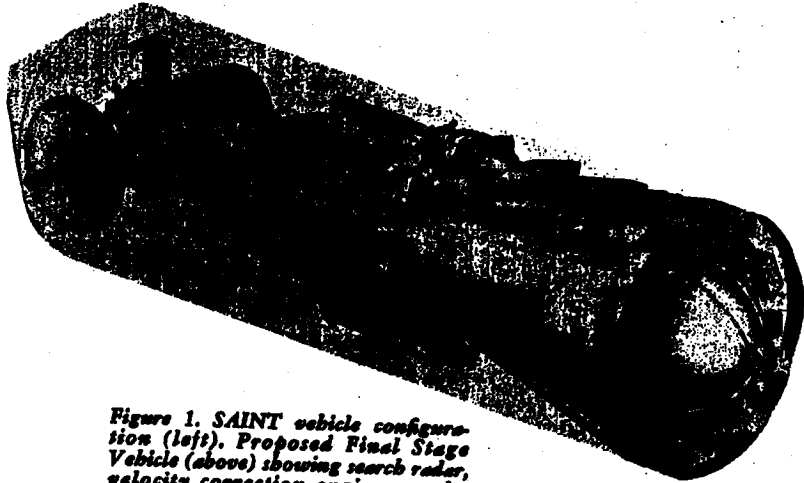
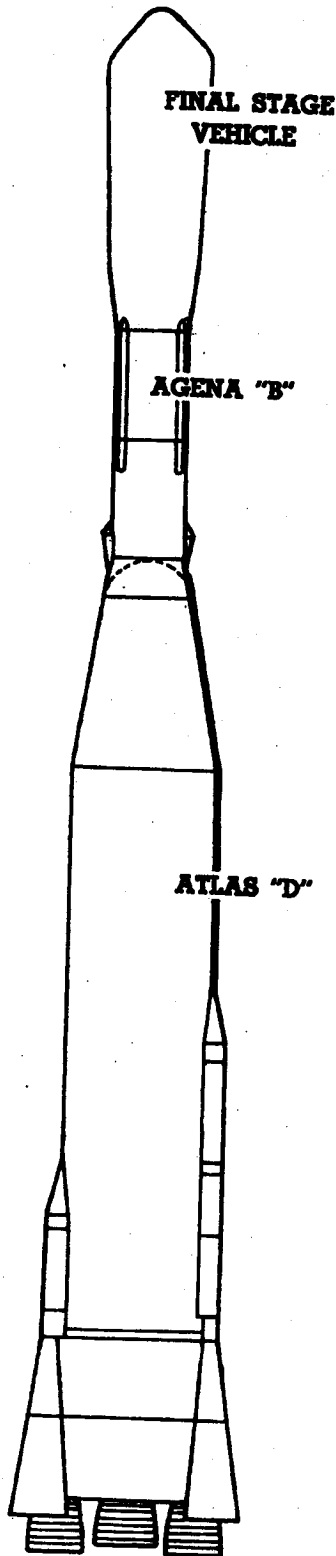
• Design effort has been temporarily deferred on the facilities for support of the follow-on program. Amended construction project justification data (Form 161) reflecting minimum facility requirements were forwarded in April to Hqs USAF for review. Immediate release of funds is required for the construction of BLUE SCOUT facilities at the Atlantic Missile Range. Further delay will result in the facilities becoming the limiting factor for AMR operations. Informal information indicates that funds for this purpose will be released in July. (U)

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# SAINT



*Figure 1. SAINT vehicle configuration (left). Proposed Final Stage Vehicle (above) showing search radar, velocity correction engine nozzle, control-gas storage spheres, and attitude control jets.*

The SAINT (Satellite Inspector System for Space Defense) Program has been established to develop and demonstrate feasibility of a co-orbital satellite inspector system capable of rendezvousing with and inspecting suspected hostile satellites and assessing their mission.

### Program Objectives

1. Design, fabricate, and demonstrate feasibility of a prototype vehicle capable of co-orbital rendezvous with another satellite at 400 nautical miles with a capability of inspecting and identifying the unknown satellite.
2. Study and define a SAINT vehicle which could be used as an ultimate defense vehicle having a capability of rendezvous up to 1,000 nautical miles with necessary orbit changes.
3. Develop and fabricate those long lead type items required for the ultimate defense system including a capability of negating hostile systems.

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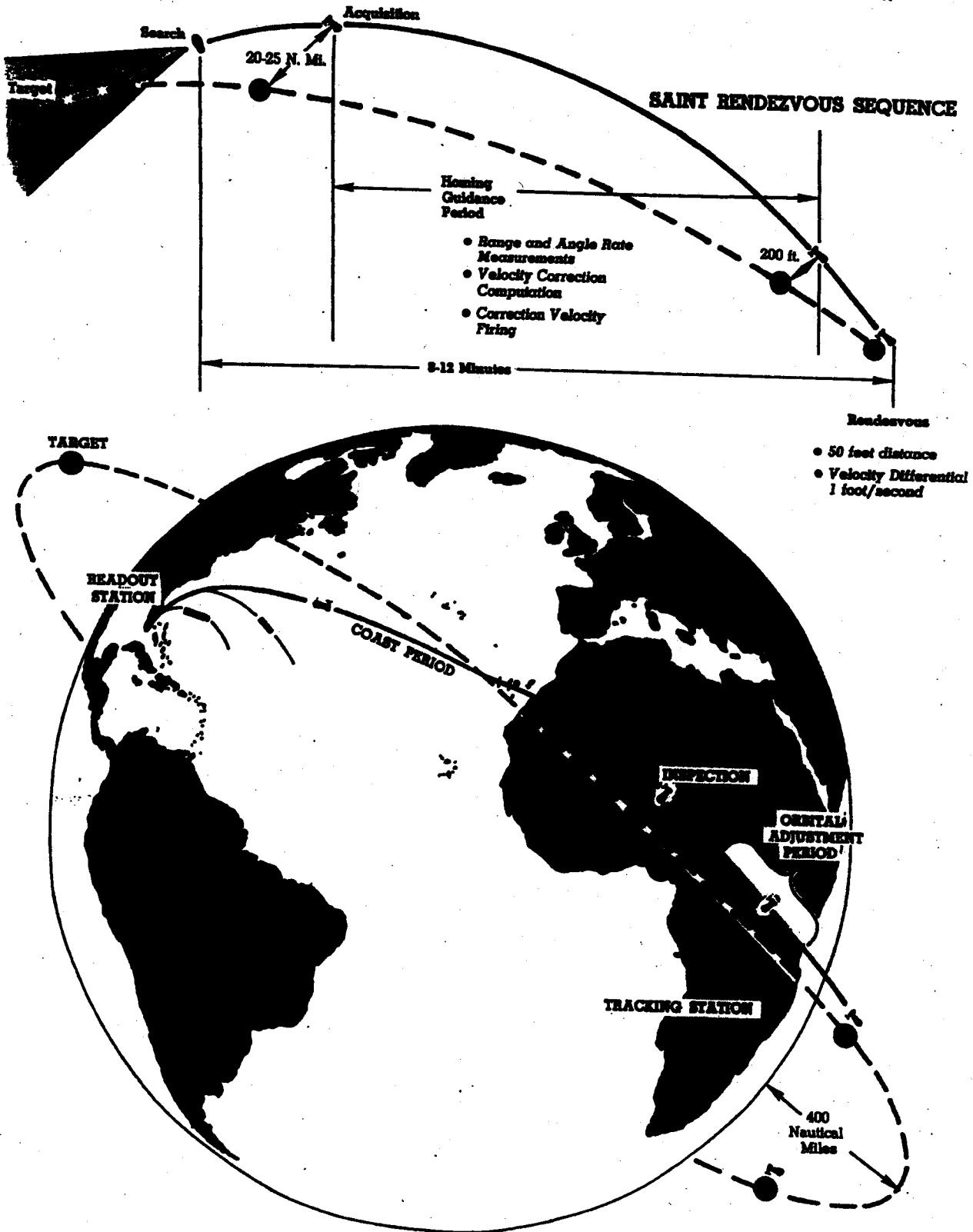


Figure 2. SAINT Program feasibility demonstration flight and rendezvous sequence.

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**Program History**

Initial studies were conducted by industry in 1958 under SR187. Studies were continued in 1959 by the Radio Corporation of America under ARPA contract and Space Technology Laboratories under Space Systems Division management. The STL study was completed 21 December 1959 and the RCA study 31 January 1960, both indicating SAINT would be a feasible system of practical value to the Department of Defense. Subsequently, the following actions have been taken:

1. AF System Development Requirement No. 18 published .....21 April 1960
2. AFBMC approval of SAINT Development Plan .....15 July 1960
3. Department of Defense approval of Development Plan .....25 August 1960
4. Air Force Development Directive No. 412 .....17 October 1960
5. Assigned Systems No. 621A..31 October 1960
6. RCA chosen as Final Stage Vehicle and payload contractor...25 November 1960
7. Contract agreement with RCA 27 January 1961
8. Contract with RCA.....17 March 1961

**Concept**

**Philosophy** — The philosophy for development of the prototype vehicle calls for a step-by-step development program with a conservative choice of subsystems and emphasis upon reliability. Ground tests will provide assurance of component capability and reliability before flight.

**Over-all System** — Unidentified orbiting objects will be acquired, catalogued, and the ephemeris accurately determined through the facilities of the Space Detection and Tracking System (SPADATS) utilizing available acquisition and tracking equipments. (It is anticipated that, for the ultimate operational system, the capabilities of SPADATS will be expanded to provide additional information such as target size, configuration and stability in orbit, possibly within 12 hours after detection.) This information will be relayed to a Defense Command Control Center which will determine if inspection is necessary. Should inspection be deemed necessary, the ephemeris information will be used to compute data which will be inserted into the guidance system of a SAINT vehicle. The vehicle will be launched into an appropriate position at a time which enables the final stage vehicle to go into orbit with the unknown satellite and inspect it at close range. This inspection data will be stored

in the payload for transmission upon command to ground stations. After reception by the ground stations the data will be processed, displayed and evaluated, to determine the mission and intent of the unknown satellite.

**Vehicle** — The SAINT system as presently envisioned, consists of three stages including an active "Final Stage" or rendezvous vehicle. Early configurations of the SAINT vehicle will consist of a Series "D" ATLAS booster, AGENA "B" second stage, and a SAINT final stage vehicle. This configuration is shown in Figure 1. Later final stage vehicles having increased maneuvering capability and additional sensors would be boosted with the ATLAS/CENTAUR. The final stage vehicle (Figure 1) will include a radar seeker, launch and homing guidance system, attitude control, maneuvering propulsion and a payload. The payload will include television cameras and various other sensors to determine the nature of the target satellite and its functional purpose. In addition the payload will have a storage and communications capability.

**Feasibility Demonstration** — Four flights launched from the Atlantic Missile Range, are planned for the feasibility demonstration. The first flight is scheduled in March 1963 with the subsequent flights scheduled at three month intervals. The feasibility demonstration configuration of the SAINT vehicle will consist of a Series "D" ATLAS booster, AGENA "B" second stage and a SAINT final stage vehicle. The demonstration final stage vehicle weighs approximately 2,400 pounds. In this demonstration (Figure 2), the final stage vehicle will be programmed to rendezvous with an existing satellite if one is available in a three hundred to five hundred mile easterly orbit. If such a satellite is not available, a target satellite will be placed in a 400 nautical mile, 28.8 degree inclination circular orbit by a BLUE SCOUT booster. Rendezvous will be accomplished while under surveillance of a Southeast Africa station and a TV image of the target, in addition to the telemetered data of final stage vehicle performance, will be transmitted to the ground station. The image and data will also be stored and read out on command as the vehicle passes over the Air Force Missile Test Center. For the purpose of the feasibility demonstration rendezvous is defined as a closing of the final stage vehicle with the target satellite to within 50 feet and a relative velocity of less than one-foot per second. Station keeping will be maintained for one orbital period.

**Future Development** — Continued study toward definition of an ultimate operational system is being pursued simultaneously with the other phases of the program. This effort will distinguish certain long lead type items on which development action must be initiated and provide further refinements to the system. Included are extension of the maneuvering capability of the vehicle into 1,000 nautical mile orbits with the necessary station keeping and inspections of multiple targets as well as more exotic sensor capability. For example, a sensor capable of detecting a nuclear warhead is most desirable. Effort is currently underway to proceed with the development of such a sensor.

**Program Management**

Space Systems Division management of this program is based upon the associate contractor structure

composed of a First Stage contractor, Second Stage contractor, Final Stage Vehicle contractor, and Systems Engineering and Technical Supervision contractor (Aerospace Corporation). Military support is provided by the Space Detection and Tracking System through the Air Force Command and Control Development Division, and by the 6594th and 6555th Missile Test Wings.

**Facilities**

The demonstration program will utilize existing launch, tracking and data reduction facilities insofar as possible. However, some additional ground support equipment will be required at the Air Force Missile Test Center and at the Southeast Africa tracking site.

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**Monthly Progress — SAINT**

**Program Administration**

• The Requests for Proposal for the SAINT target were forwarded to prospective contractors on 14 June. The completed proposals are to be returned to the Space Systems Division on 14 July. A SAINT Target Evaluation Board has been established and will convene between 17 and 21 July to choose the contractor who will design and fabricate the SAINT target. (U)

• A work statement defining the ATLAS D booster required for the SAINT Program has been finalized and coordinated with the Aerospace Corporation and General Dynamics Astronautics. General Dynamics Astronautics has been requested to submit a proposal for the fabrication and delivery of the SAINT boosters. The work statement for the AGENA B vehicle required to support the SAINT Program will be finalized before 21 August. The first booster and second stage vehicle are scheduled for delivery in December 1962 and will be launched in March 1963. ~~(S)~~

• The fourth Technical Direction Meeting was held at the Radio Corporation of America, Burlington, Massachusetts facility on 16 June. Based on an RCA study, it was decided that the search and track

radar scan angle will be increased from the present  $\pm 15^\circ$  to  $\pm 20^\circ$  to meet the SAINT requirements. (S)

• At the third Management Meeting held on 17 June the current configuration of the Final Stage Vehicle was reviewed. The forward portion of the final stage vehicle will use semi-monocoque construction and the aft portion will use a truss structure. The requirement to mount the search and track radar on a non-cantilever type support for increased rigidity made this configuration necessary. The semi-monocoque construction allows many of the final stage vehicle components to be installed on the outside of the structure. This design feature will permit radiative cooling to be utilized to control the temperature of these final stage vehicle components. The truss type structure on the aft portion of the final stage vehicle will provide a growth capability for additional sensors and components as required. ~~(S)~~

• The final stage vehicle contractor (Radio Corporation of America, Burlington, Massachusetts) has established sub-contracts with Minneapolis Honeywell to design and fabricate the inertial Measurement unit and the digital computer. Westinghouse has been selected by RCA to design and fabricate the search and track radar. Aerojet-General has been selected to design and fabricate the main propulsion unit and the force control unit. Other major subcontracts are scheduled to be finalized in the near future. ~~(S)~~

# VELA HOTEL

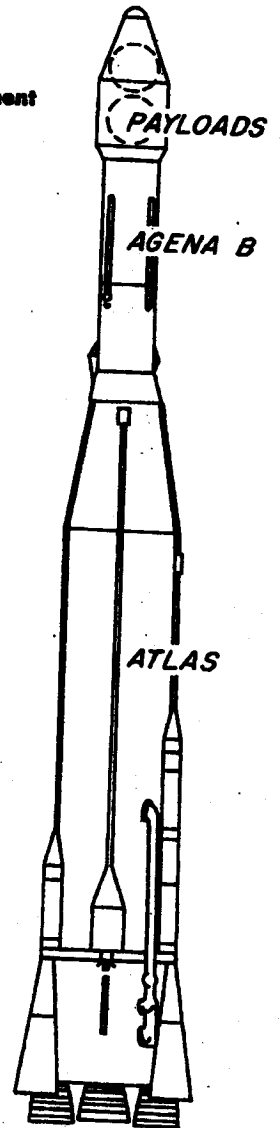
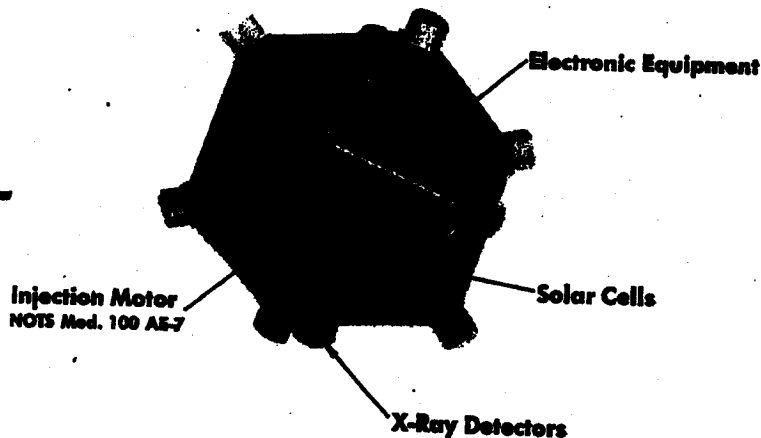


Figure 1. VELA HOTEL vehicle configuration (right). Artist's concept of payload showing solar cells, X-ray detectors and injection motor.

## Program Objectives

The objective of the VELA HOTEL Project is to conduct a research and development program including experiments and prototype testing to gain information which will lead to the definition of an operational space-based system for high altitude nuclear detonation detection.

## Program History

The Panofsky Panel on High Altitude Detection, reporting to the President's Scientific Advisory Committee, made several recommendations with respect to research and development work which should be accomplished in order to increase basic understanding of the physical mechanisms involved. The Department of Defense agreed to assume over-all responsibility with Atomic Energy Commission support in the high-altitude detection area. Further, it was agreed that the AEC would undertake laboratory development of the nuclear detection instrumentation and that the portion of the effort concerning measurements of natural radiations in space should be implemented jointly by the DOD and the NASA. Within the Department of Defense, the Advanced Research Projects Agency was assigned the management responsibility for Project VELA on 2 September 1959. On 18 September 1959, ARPA issued Order Number 102-60 to AFSC for a study and evaluation of the technical and operational factors associated with the detection of high-altitude nuclear detonations. The initial results were used in October 1959 to provide the State Department with supporting technical data for the United States delegation at the Geneva conference. Amendment No. 1 to the original ARPA Order directed AFSC to extend and refine the original study. It was subsequently requested that a joint working group including AFSC, AEC and NASA representatives, chaired by AFSC, be established. The mission of the Technical Working Group was to recommend a research and

development program which would investigate the concept of nuclear detonation detection from satellites. To facilitate conducting the work involved, the Joint Working Group formed subcommittees for payload, space boosters, and communications and control.

## Program Concept

On 21 June 1961, the Secretary of Defense approved and funded the VELA HOTEL Program. The program will consist of five launches from the Atlantic Missile Range, beginning in April 1963 and extending through April 1964. The launch vehicle for the VELA HOTEL Program will be an ATLAS D/AGENA B. Each vehicle will place two spacecraft into a single highly elliptical orbit. The instrumentation aboard the spacecraft will be furnished by the AEC and will consist of X-ray,

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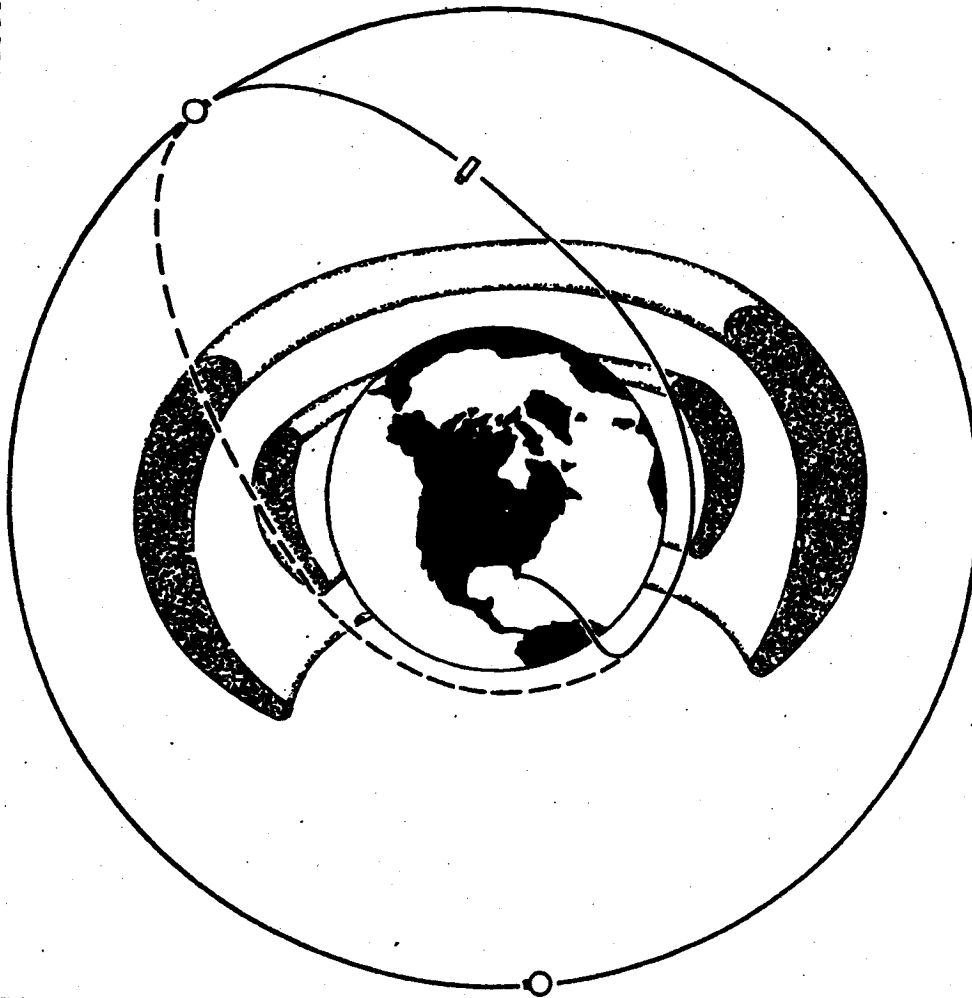


Figure 2. VELA HOTEL trajectory showing the elliptical transfer orbit which has a 200 n.m. perigee and a 50,000 n.m. apogee. On the first orbit one payload will be ejected, on the next orbit, the second payload will be fired and placed into orbit approximately 140 degrees behind the first payload.

gamma ray, and neutron detectors and Geiger-Mueller tubes. Each spacecraft will contain a propulsion unit capable of transferring the spacecraft into a minimum circular orbit of 50,000 nautical miles. The propulsion unit of one spacecraft will be fired at first apogee and the second spacecraft will be transferred at a later apogee such that the spacecraft will initially be 140° apart in orbit. The spacecraft will be designed to have an operating life of six months with redundant telemetry transmission capabilities in range of 75,000 nautical miles.

The vehicle will be launched from the Atlantic Missile Range at an azimuth of approximately 110°. After AGENA B separation from the ATLAS D, the AGENA B will program through two burns with final cutoff over Australia. A spin-table on the AGENA B will then spin and separate the tandem payloads. The two spacecraft will then separate such that at apogee they will be several miles apart. The previously described transfer sequence will then be initiated;

Simultaneous tracking of the two spacecraft will be carried out by the SSD world wide tracking net. Data will be collected at Sunnyvale Satellite Test Center, punched on tape and shipped to the AEC at Albuquerque, New Mexico for reduction and analysis.

In addition to the major high-altitude portion of the VELA HOTEL Program, several Discoverer piggy-back low altitude polar orbit flights are being accomplished which will obtain background radiation data below the Van Allen belts. These flights as proposed will carry Lawrence Radiation Laboratory experiments consisting of X-ray, gamma ray and neutron detectors, PENG (proton-electron-neutron-gamma ray) detectors and solid state spectrometers.

The first of these launches will occur in early August 1961. The AEC is also initiating, as a separate but related project, a piggy-back flight program aboard Rangers (Lunar probes), NASA Scouts and Mariners (Venus probes).

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## **Monthly Progress – VELA HOTEL**

### ***Program Administration***

- The ARPA Order approving VELA HOTEL was received by the Space Systems Division on 29 June. Requests for proposal for the spacecraft contract was released to contractors on 3 July and a pre-proposal briefing will be given on 20 July. (U)
- The proposed launch date for the VELA HOTEL/ DISCOVERER Piggyback flight is 31 August. This vehicle will carry Lawrence Radiation Laboratory experiments consisting of a scintillator X-ray detector and a solid state spectrometer X-ray detector. (U)



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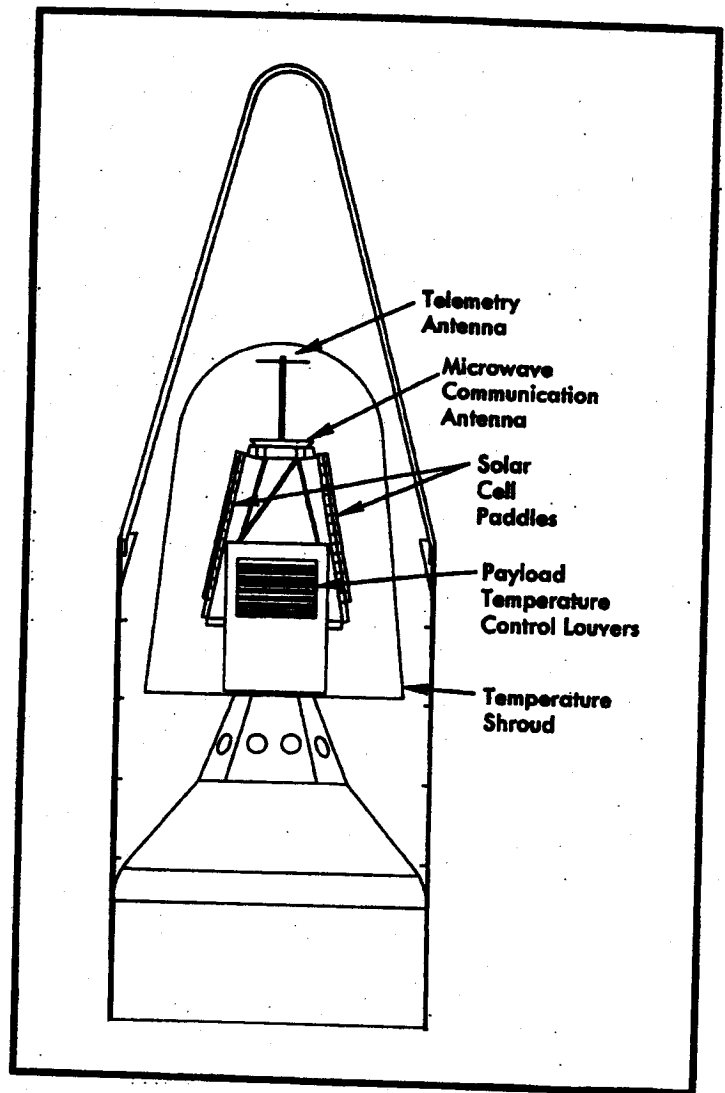
# ADVENT

The ADVENT Program will investigate the feasibility of using satellites in synchronous orbit as instantaneous repeaters for microwave radio communications. A satellite vehicle station in synchronous equatorial orbit will remain in a fixed position relative to any point on the surface of the earth. Active communications equipment contained in this satellite will receive, amplify and instantaneously retransmit any message beamed in its direction.

## PROGRAM HISTORY

The Research and Development program for active communication satellites was initiated by ARPA in January 1959. Following early research and development, a three-phased development program (STEER, TACKLE and DECREE) was initiated in May 1959 by Amendment No. 1 to ARPA Order No. 54. Phase I (STEER) was given priority in order to demonstrate the feasibility of providing an early UHF communications capability for positive control of the SAC strike forces. Space Systems Division (SSD) was given responsibility for the design, development, and flight testing of the complete system, including launch, satellite tracking and control, and necessary support facilities and ground equipment. Aeronautical Systems Division (ASD) and the U.S. Army Signal Research and Development Laboratory (USASRD) were delegated responsibility for the development of the communications subsystem for Phase I and Phases II and III, respectively.

*Figure 1. Proposed satellite with jettisonable fairing mounted on CENTAUR second stage.*



In April 1960, Amendment No. 5 to ARPA Order No. 54 reoriented the program. The research and development effort previously directed toward providing a ground-to-satellite-to-aircraft UHF communications capability for the SAC strike forces was cancelled. A single integrated ADVENT Program for the development of a 24-hour microwave communications satellite replaced the former STEER, TACKLE and DECREE Programs.

On 15 September 1960, the Secretary of Defense transferred over-all management responsibility for the ADVENT Program from ARPA to the Department of the Army. The development responsibilities of SSD and USASRD were retained essentially status quo. The Army was given responsibility for funding and for over-all systems engineering to provide guidance and a basis upon which detailed design data can be evolved by SSD and USASRD.

**PROGRAM OBJECTIVES**

The primary ADVENT objective is to demonstrate the feasibility of achieving a military system for microwave communications (surface-to-surface) employing satellite repeaters in 24-hour equatorial orbit. The feasibility of placing a satellite in predetermined

position in a 19,300 nautical mile equatorial orbit must be demonstrated. The feasibility of being able to stabilize the satellite, control its attitude and orbit, and keep it on station within the required tolerances must also be demonstrated. The satellite must be capable of providing broad band communications on a real time basis at microwave frequencies. The Program Plan is based upon the design of a single configuration of a final stage vehicle compatible with launching by either AGENA "B" or CENTAUR second stage boosters.

The ADVENT Program will consist of the following flight tests, launched from the Atlantic Missile Range:

**Phase One.** Three ATLAS/AGENA "B" flights, nominal 5,600 nautical mile orbits, beginning March 1962.

**Phase Two.** Two flight tests, using payload space on NASA ATLAS/CENTAUR research and development flights numbers 9 and 10, April and June 1963.

**Phase Three.** Five ATLAS/CENTAUR flights launched into 19,300 nautical mile equatorial orbits, beginning July 1963.

**Launch Schedule**

	62												63												64					
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
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<b>Funded By</b>	ARMY												NASA												ARMY					
<b>Vehicle Configuration</b>	ATLAS/AGENA "B"												ATLAS/CENTAUR																	

**Monthly Progress — ADVENT**

**Program Administration**

• On 13 June, a Management Survey Team from Hq Space Systems Division and Hq Ballistic Systems Division initiated a detailed investigation of the General Electric Missile and Space Vehicle Department (GE/MSVD) management of the Final Stage Vehicle contract. An independent technical survey was also made by a team of Aerospace Corporation and technical consultant personnel. These surveys were completed on 23 June. (U)

**Technical Progress**

**Booster Vehicles**

• The initial tests of the Lockheed Wind Tunnel Test Program at the NASA Ames Research Center were completed on 15 June. Preliminary data reduction is now in progress. Arrangements were made to continue the wind tunnel testing in the NASA Langley eight-foot tunnel starting early in September. These tests will consider effects in the transonic region. (U)

• Atlantic Missile Range Launch Pad 12 proposed tower structure modifications are being studied because of the recently established requirement for

two ten-foot diameter antennas to be attached to the gantry for pre-launch checkout of the Bendix equipment. A requirement for additional weather protection for upper tower levels is also being evaluated. (U)

• The NASA CENTAUR Engine Development Plan was reviewed with representatives of Marshall Space Flight Center and Aerospace Corporation. Additional requirements for testing and facilities in support of ADVENT were formulated and forwarded to NASA. (U)

• General Dynamics-Astronautics has forwarded a proposal to Space Systems Division adding additional instrumentation on the interstage section, forward of the liquid oxygen tank. The instrumentation will be utilized to gain additional data on the stress loads applied to the ATLAS booster. The interstage area has been a cause of concern on several previous space launches. (C)

• General Dynamics-Astronautics forwarded to the Space Systems Division a series of proposed modifications to the NASA CENTAUR which would improve the potential payload capability and bring it within the requirements established for ADVENT.



Figure 1— Forward section of ADVENT Phase I nose fairing (right) and aft section (left) during assembly at LMSC facilities. This fairing will become part of AGENA vehicle 1501.

Aerospace Corporation is currently reviewing these proposals. General Dynamics is also preparing a proposal which defines the maximum capabilities of the NASA CENTAUR vehicle for ADVENT. The proposal should be completed in July. (U)

#### *Final Stage Vehicle*

- Representatives from the Space Systems Division, Aerospace, and GE-MSVD attended the technical interchange meeting on the final stage vehicle main propulsion subsystem at Marquardt on 1 June. The meeting included a review of the previous two months' development effort, component status, and system problem areas. Marquardt has received most of the component parts for the propulsion system and is starting an extensive test and evaluation program on these components. (U)
- The Space Systems Division has directed GE-MSVD to restore some of the effort that was deleted or reduced due to funding restrictions during the second quarter of FY-61. Work on the liquid flywheel and the non-mechanical infrared sensor has been resumed. (U)
- The 24 May Airborne/Ground Station Tracking Telemetry and Command Interface Meeting revealed that a critical area existed on delivery schedules of TTC ground equipment to be used for in-house testing at General Electric. It was determined that this area would become even more critical unless General Electric could accept the use of the CDC-160A computer in this ground equipment. A meeting was scheduled for 1 June to resolve this question. At the 1 June meeting, General Electric and Philco were advised to proceed with the CDC-160A approach. (U)

#### *Tracking, Telemetry and Command*

- Re-start capability for the code generating subsystem is technically feasible. GE-MSVD's logic diagram for its implementation is basically sound. GE is being instructed to so proceed. (U)

- A study of the over-all antenna modifications at Kaena Point has indicated that in addition to feed and drive modifications, some other items will have to be replaced because of wear and tear of the antenna. Lockheed representatives stated that this work could be performed under their enlarged Kaena Point maintenance proposal which has been submitted to Space Systems Division. Excessive difficulty would be encountered in attempting the feed and drive modifications and antenna refurbishing during one down time period, with three subcontractors performing the three phases of work. It was agreed that one contractor, Philco Western Development Laboratories, should perform all the work required and report to one single source. (U)

- A preliminary study was begun to determine the capability of the Control Data Corporation CDC-160A computer to handle tracking, telemetry and command requirements. The initial report indicates that the computer will meet the memory and processing time requirements. Further evaluation will be made in early July when Philco has completed their data and command flow charts. (U)

- Personnel manning levels and the level of competence for engineering maintenance and operation of the ADVENT tracking, telemetry and command station equipment has been reviewed. A letter recommending changes to the USASEDL proposed manpower requirements for Fort Dix and Camp Roberts is being prepared. The Space Systems Division is presently negotiating with Lockheed along the same lines for operation at Kaena Point and the Satellite Test Center. Consolidated recommendations will be presented to USAAMA upon completion of negotiations. (U)

- A meeting of Aerospace and Rand personnel was held to discuss the estimated jamming capability of the USSR and the planned ADVENT anti-jamming mode. Results indicate the method now under study is appropriate. (U)

**Project**

**ANNA**

**Second Stage -- ABLESTAR (AJ-10-104)**

Thrust (vacuum)	7900 pounds
Specific impulse (vacuum)	277 seconds
Burning time	296 seconds
Propellant	IWFNA UDMH

**First Stage -- DM-21A**

Thrust (sea level)	182,000 pounds
Specific impulse (sea level)	247 seconds
Burning time	163 seconds
Propellant	Liquid Oxygen RP-1

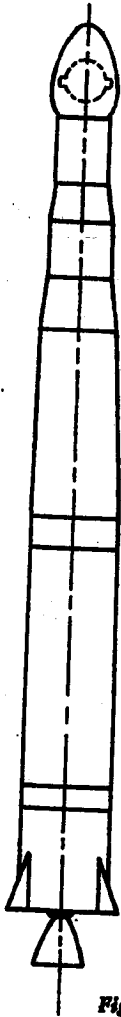


Figure 1. Two stage ANNA vehicle.

**Program Description**

Project ANNA is the tri-service geodetic satellite program. The program is designed to satisfy the primary military (Army, Navy, Air Force) and scientific (NASA) requirements in geodesy. The Navy has over-all program management responsibility and is also responsible for satellite system management. The Space Systems Division (SSD) was assigned the responsibility for booster system management, which includes providing the booster vehicles, integrating payloads to the vehicles, and being responsible for flight operations from launch through attainment of orbit. On 4 April 1961, the Navy officially directed the Space Systems Division to proceed with plans for launching the first ANNA satellite on 5 December using the THOR Ablestar (Figure 1) vehicle previously purchased for TRANSIT 5A.

**Payload Description**

The ANNA payload (Figure 2) is a 36-inch diameter sphere with a bank of solar cells encircling the package at the equator. The satellite contains an Air Force High-Intensity Pulsed Gas Discharge Lamp for optical measurements, a Navy (TRANSIT) doppler beacon for doppler measurements, and an Army SECOR Transponder for radio ranging data. The basic payload structure is the same as the TRANSIT Navigational Satellite. The payload weight is 325 pounds. The payload contains high magnetic permeability rods which will reduce the satellite spin to zero by hysteresis damping after a few days on orbit.

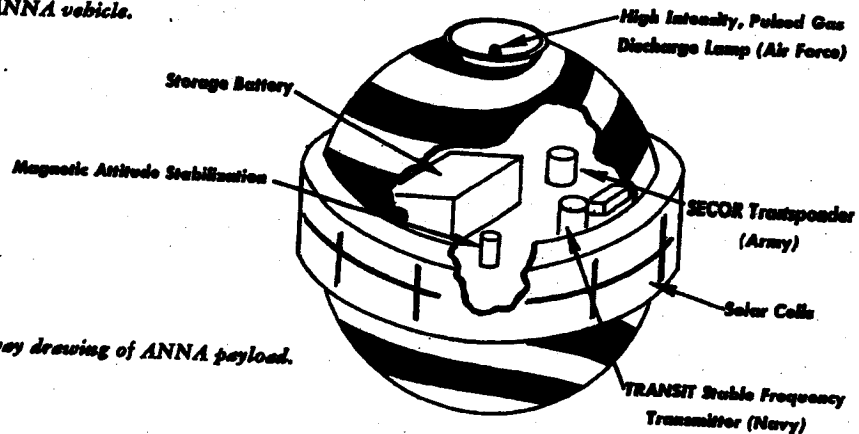


Figure 2. Cutaway drawing of ANNA payload.

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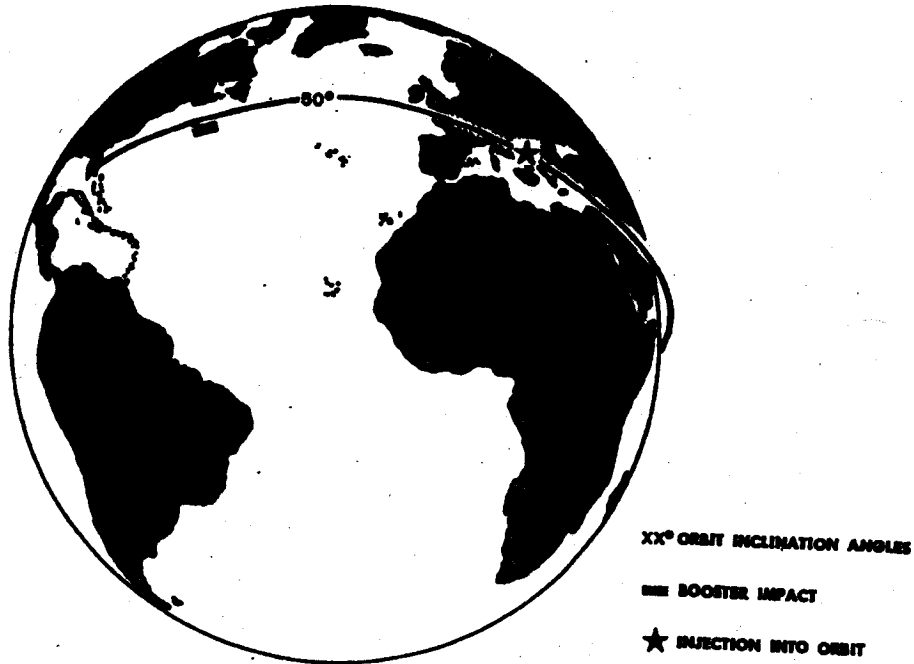


Figure 3. ANNA launch trajectory (50° orbit inclination angle) showing flight path, booster impact area, and orbital injection point.

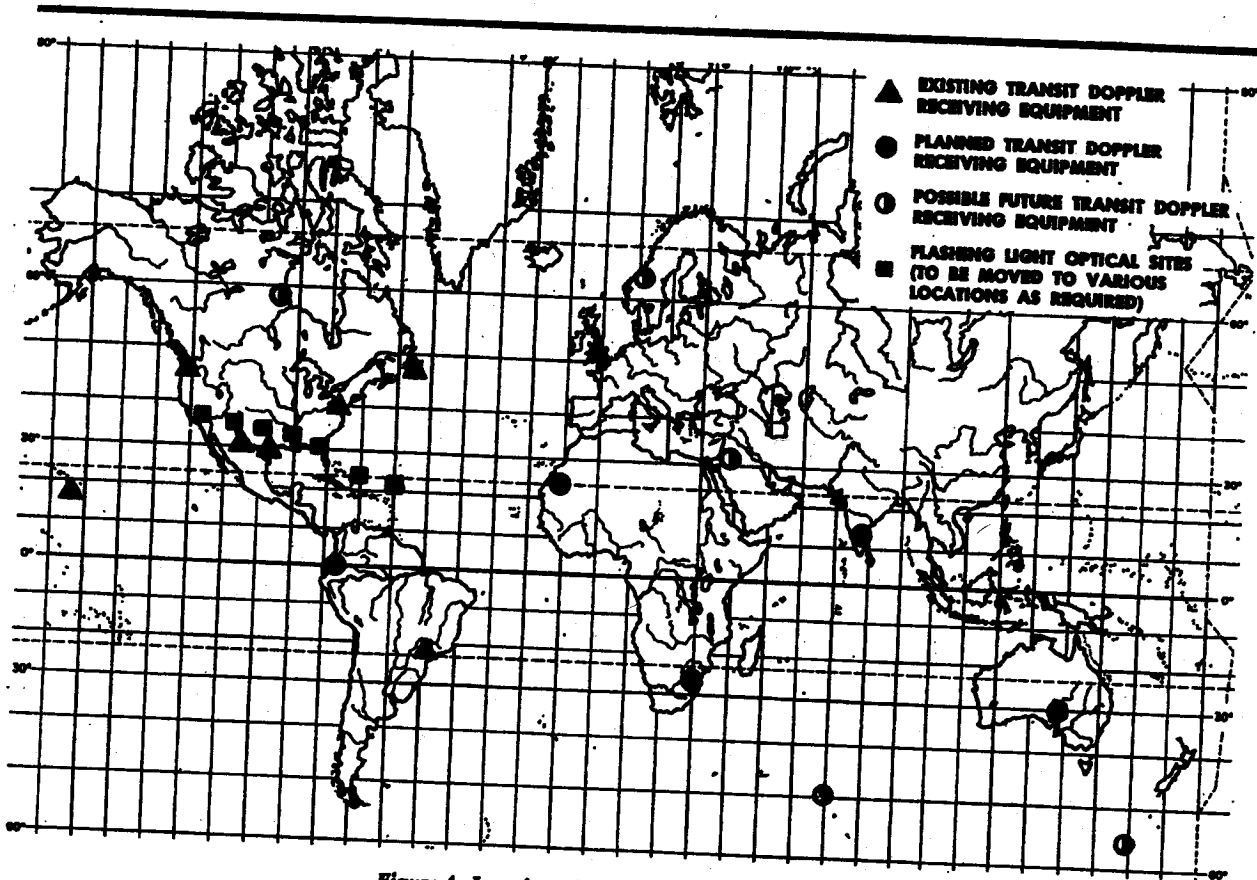


Figure 4. Location of ANNA tracking stations.

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### Program Objectives

The Objectives of the ANNA Program are to:

1. Relate the major datums to each other and to the earth's center of mass.
2. Determine the structure of the earth's gravitational potential.

The vehicle will be launched from the Atlantic Missile Range in a northeasterly direction and will achieve a 600 nautical mile orbit with an inclination angle of 50°. Figure 3 shows the vehicle's trajectory.

### Orbital Performance

Achievement of program objectives is dependent on tracking the satellite using the three measurement techniques: optical, radio doppler and radio ranging. Since a high degree of accuracy is required, the different types of observation will provide independent measurements for cross-checking. Two basic approaches to the application of the satellite for geodetic purposes will be utilized.

1. The *orbital method* requires extremely precise determination of the satellite orbit, including minor variations from the Keplerian Ellipse, and then uses this information as a "measuring rod" for connecting the various datums over which it passes.

2. The *inter-visible method* uses the satellite as a point of simultaneous observation from known and unknown data. It does not require precise knowledge of the satellite ephemeris but it does require simultaneous sightings from several locations.

The expected accuracy in determination of the absolute geocentric variance of station positions is approximately 20 to 200 feet.

### Ground Support and Tracking Stations

In regard to satellite tracking, each of the services is providing a system of tracking stations corresponding to its component in the satellite; i.e., the Air Force is providing for optical tracking, the Navy is providing for doppler ground support facilities, and the Army is providing ground facilities for the radio ranging.

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# DYNA SOAR



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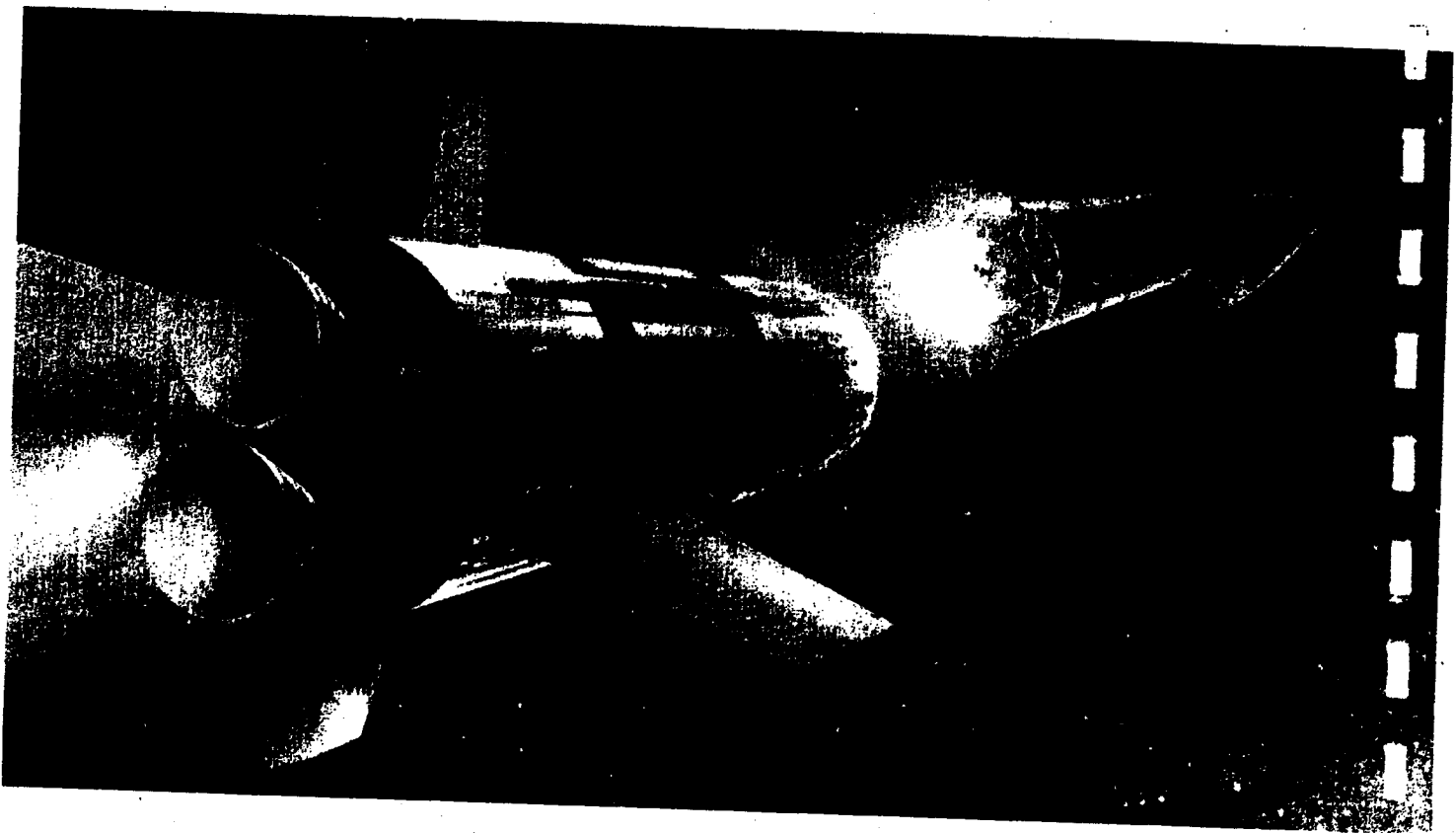
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**Program History**—Competition for the DYNA SOAR study contract was initiated in 1958 and resulted in the Boeing Airplane Company and the Martin Company being awarded the follow-on contract to more fully define their proposed approaches. In November 1959, following review and evaluation of the Boeing/Martin detailed studies by a Source Selection Board, it was announced that Boeing had been selected as the glider and system integration prime contractor, with Martin furnishing modified TITAN ICBM's for booster support. The conceptual phase of DYNA SOAR concluded with a study program requirement known as Phase Alpha. The objective of this study was to reaffirm proposed glider design. In April 1960, Phase Alpha was completed and results were presented to the Department of Defense. On 9 May, formal approval of the DYNA SOAR Step I Program was received by AFBMD/BMC from WADD/ASC.

During the period covering program go-ahead to the end of CY 1960, efforts on the program were concentrated on design refinements to TITAN I and possible increased booster performance to accomplish program objectives. Studies on booster capabilities revealed many favorable factors on cost, time and expanded objectives by use of the XSM-68B (TITAN II) as the booster. Results of these studies were presented to Headquarters USAF and the Department of Defense. Headquarters USAF directed

use of TITAN II as the SYSTEM 620 DYNA SOAR Step I Booster. Formal direction to use TITAN II was received by AFBMD/BMC from WADD/ASC on 13 January 1961. Effective April 1961, the symbols for AFBMD/BMC and WADD were redesignated SSD and ASD, respectively.

**Program Objectives**—The DYNA SOAR Program will explore the possibilities of manned flight in the hypersonic and orbital realms. The program will proceed in three major steps from a research and test phase to an operational military system. In Step I, a full scale, minimum sized manned glider will be developed. A modified version of the TITAN II ICBM will boost the glider into hypersonic flight at velocities up to 22,000 ft/sec and permit conventional landing at a predetermined site. In Step II the glider will be tested, using a more powerful booster to achieve orbital velocities. This phase may be expanded into an interim operational weapon system providing all-weather reconnaissance and satellite interceptor capabilities. The objectives of Step II are to test vehicle performance between 22,000 ft/sec and orbital velocities; and to gather re-entry data from various orbits; and to test military equipment and man-machine relationships. Step III will provide an operational weapon system with a vehicle that will operate primarily in a hypersonic glide, be able to maneuver within the atmosphere, and be able to make a conventional landing at a predetermined



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site. The capability of DYNA SOAR type systems to perform these programmed missions appears attractive as a result of studies made to date. The missions under study are: reconnaissance (manned and unmanned); air and space defense; strategic bombardment and logistics support. Manned and unmanned versions are being considered where applicable.

**Flight Program** — Step I includes twenty air-launched, manned flights with the glider being dropped from a B-52. Sixteen booster-launched flights will follow; flights 1 and 2 are designated as unmanned flights. If all significant flight objectives are achieved, the third flight will be manned. Flights 3 and 4 have been programmed as backup flights in the event that flights 1 and/or 2 do not achieve program objectives. The frequency is five launches at two-month intervals and eleven launches at six-week intervals. The range from Wendover AFB, Utah, to Edwards AFB is adequately instrumented for the tracking and telemetry required during the air-launched tests of the DYNA SOAR glider. Instrumentation sites for the AMR launches will be located at Cape Canaveral, San Salvador, Mayaguana, Antigua, Santa Lucia, and Fortaleza. Instrumentation, tracking, and recovery ships will be provided to supply additional support for the AMR launches. Landing facilities will be provided at Fortaleza, Brazil; Santa Lucia, Lesser Antilles; and Mayaguana, Bahama Islands.

**Program Responsibilities** — Steps I and II of the DYNA SOAR Program are to be conducted by the USAF with NASA participation. USAF will provide program management and technical direction, with ASD having responsibility for over-all system management.

SSD is responsible for the booster, and its Aerospace Ground Equipment (AGE), special airborne systems, and booster requirements of the launch complex. ASD will have responsibility for glider, glider AGE, and subsystem development. NASA will provide technical support in the design and operation of the glider in obtaining basic aeronautical and space design information.

**Technical Approach** — Space Systems Division technical approach to meet the objectives of the program are:

1. Modifying a TITAN II ICBM by adding stabilizing fins; strengthening the holddown and skirt area, intertank and interstage sections; redesigning the guidance bay; incorporating a malfunction detection system.
2. Modifying the XLR 87-AJ-5 and XLR 91-AJ-5 rocket engines to obtain structural compatibility with the modified booster; include malfunction detection system shutdown and fail safe systems.
3. Modification of an AMR launch pad.
4. Provide an integrated launch countdown.



AGE — GLIDER SEPARATION

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**Monthly Progress — DYNA SOAR**

**Program Administration**

- Aerospace Ground Equipment to support the auxiliary systems functional test stand has been released for fabrication. Release of this equipment at this time will allow the AGE design to parallel the airborne equipment engineering. (U)
- Studies are continuing with the objective of recommending the optimum booster for consideration in connection with accelerating the orbital phase of DYNA SOAR. It is expected that these studies will be combined with system studies being made by the DYNA SOAR System Program Office and presented to higher headquarters. (U)
- As a result of a Space Systems Division/Aerospace Corporation study of the DYNA SOAR booster ionization problem, a SHF telemetry transmitter has

been recommended for installation in the second stage. It is believed that a VHF transmitter would be "blacked out" due to shock and plume ionization during staging and the last portions of boost. Loss of telemetry data is considered to be unacceptable during these times. Study on the use of SHF is continuing. (U)

- Pulse code modulated (PCM) telemetry with high level inputs is also recommended for the DYNA SOAR booster. PCM telemetry is scheduled for use on TITAN II. High level in lieu of low level inputs will be necessary due to the noise problems. (U)
- A Program Element Breakdown (PEB) which orients hardware and functional subject areas of the DYNA SOAR Program was revised by the System Program Office, Wright-Patterson Air Force Base. The new PEB is intended for system-wide use for the System Package Program, Contractor Program Plans, Statement of Work, Program Evaluation Review Techniques (PERT), cost estimation and reporting, scheduling, and optionally internal files system. Efforts are continuing to further refine the program element breakdown as experience is gained in implementation of the existing PEB. (U)

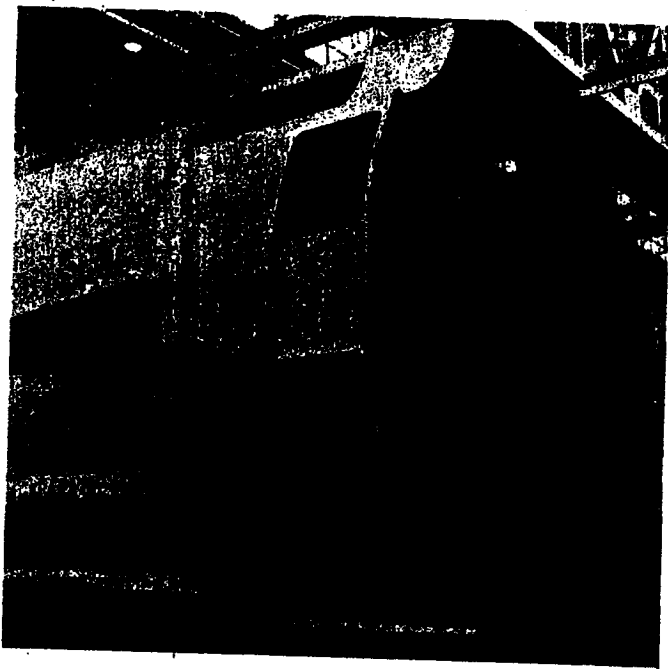


Figure 1 — Engine compartment mockup (left) of the two-stage TITAN II booster which will be used to boost the DYNA SOAR glider. The pitch and yaw fins (below) will be installed in the concave portion of the engine compartment fairing.

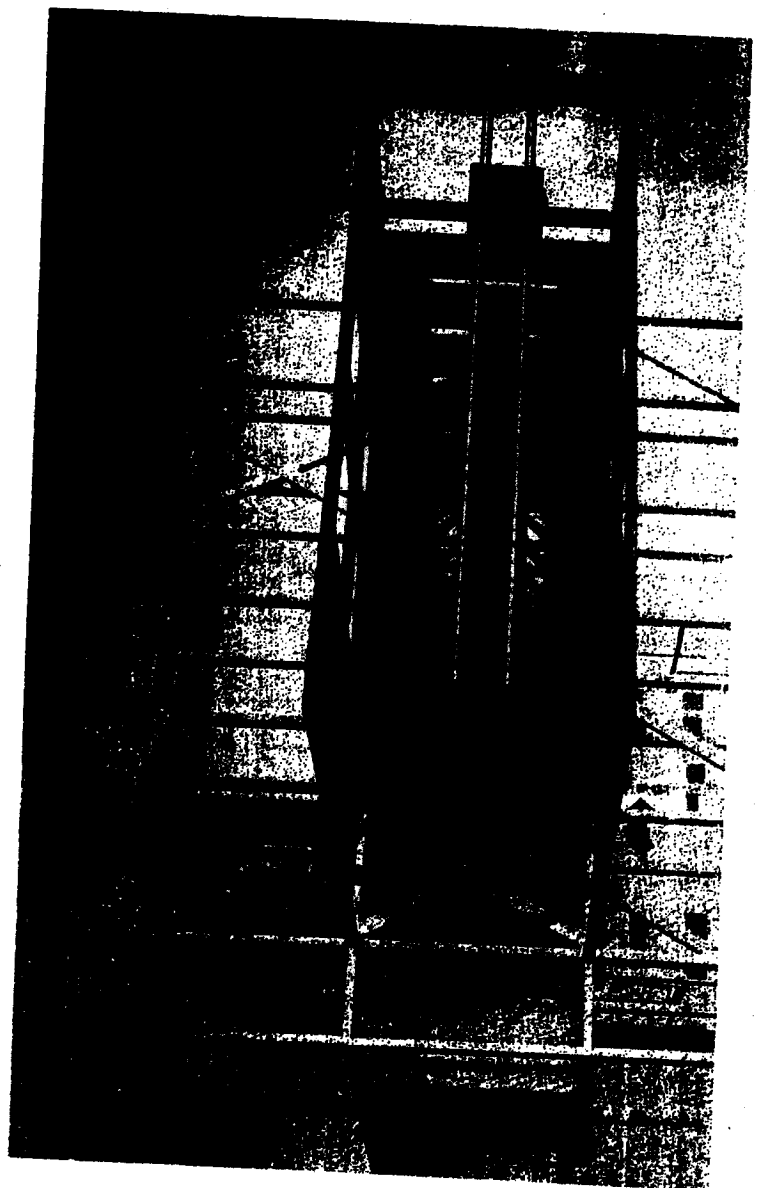


- A review of the System Description of DYNA SOAR (D2-6909-2) was conducted on 19 and 20 June at the DYNA SOAR System Program Office. Government and industrial program participants acted upon recommendations to refine further the System Description as a reference document to define configuration pending publication of detailed model specifications. This document will be a key reference document in preparation for the 11 September system mock-up. (U)

- On 29 June, the definitized contract was distributed covering The Martin Company effort through the period ending 30 September. (U)

- Design criteria for the addition to the Vertical Test Cell at Martin-Baltimore have been reviewed and approved. The Vertical Test Cell will be used for functional testing of the booster as well as compatibility and vibrational testing of the complete air vehicle (booster and glider). (U)

**Figure 2 - Model of the Martin-Baltimore Vertical Test Cell as it exists (left) and with additions (right) to accommodate the complete DYNA SOAR air vehicle. The glider is visible in lower right photograph.**



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# MERCURY

Project MERCURY represents the transitional threshold between this nation's cumulative achievements in space research and the beginning of actual space travel by man. The primary program objective is to place a manned satellite into orbit about the earth, and to effect a controlled re-entry and successful recovery of the man and capsule. Unmanned ballistic trajectory and unmanned orbital flights will be used to verify the effectiveness and reliability of an extensive research program prior to manned orbital flights. The program will be conducted over a period of approximately four years. The initial R & D flight test was accomplished successfully in September 1959. The total program accomplishment is under the direction of NASA. The primary responsibility of Space Systems Division to date consists of: (a) providing 15 ATLAS boosters modified in accordance with program objectives and pilot safety factors, and (b) determination of trajectories and the launching and control of vehicles through injection into orbit.

Major contractors participating in the Space Systems Division portion of this program include: Aerospace Corporation, systems engineering and technical direction; Convair-Astronautics, modified ATLAS boosters; GE/Burroughs, ATLAS guidance equipment; and Rocketdyne, engines. All of these companies also participate in launch operations, special studies and engineering efforts peculiar to Project MERCURY requirements.

*The MERCURY astronomical symbol (♿) with the "R" for Reliability will be attached to those components and missile end items which have been selected and accepted for use in boosters identified for Project MERCURY.*

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K-1

**General Sequence of Events for MA-4 Flight (Orbital)**

Following the initial hold-down, the vehicle will lift-off Atlantic Missile Range Stand 14. Upon a General Electric ground guidance command the booster engine will shut down and staging will occur. Twenty seconds after booster staging, the pylon ring separation explosive bolts fire, the pylon clamp ring is separated, and the escape rocket is fired separating the pylon from the capsule. The sustainer engine accelerates the capsule to the predetermined velocity. The sustainer and vernier engines will shut down upon ground guidance command and the capsule separation explosive bolts will fire. The postgrade rockets will fire and separate capsule from the booster. After five seconds of damping the capsule initiates a 180° yaw maneuver and pitches to a 34° blunt-end-forward attitude. The capsule will maintain a 34° attitude throughout its orbit. At a specified time the Automatic Stabilization and Control System is commanded from the ground to start the orientation mode. If the capsule is in the proper attitude the retro-rockets fire. Sixty seconds after retro-fire the retro and post-grade package will be jettisoned and the capsule will assume a re-entry attitude. When the capsule has descended to 21,000 feet, the drogue parachute is deployed. At 10,000 feet, the drogue parachute and antenna fairing will be jettisoned and the main parachute deployed. At impact the parachute is jettisoned and the recovery aids are deployed.

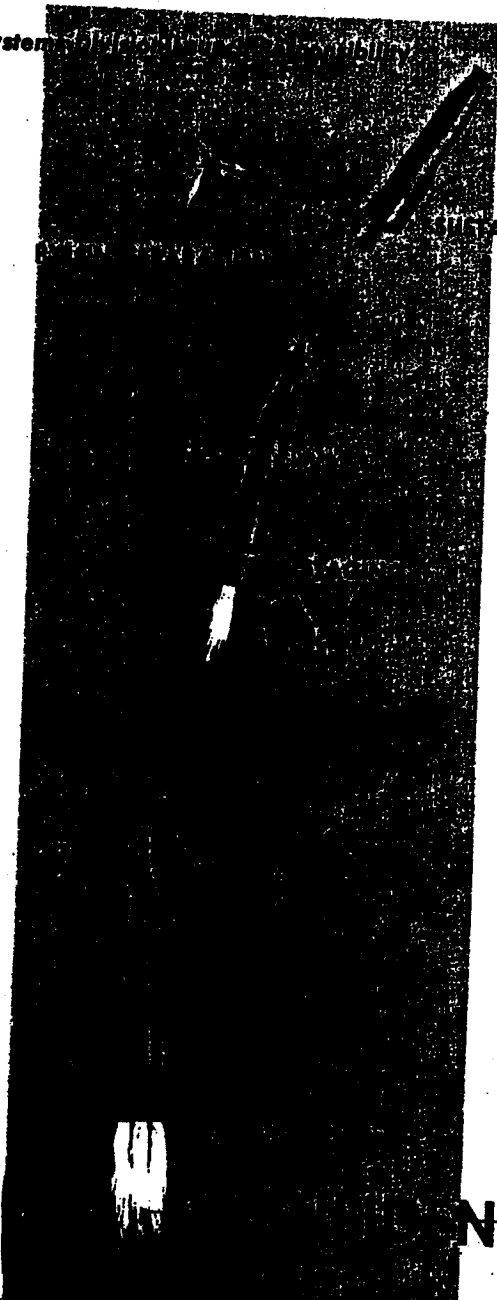
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**Space Systems  
MERCURY Support**

- Fifteen modified ATLAS
- Launch complex and
- Systems development
- Studies and technical
- Safety program

**Trajectory Outline**

Space Systems

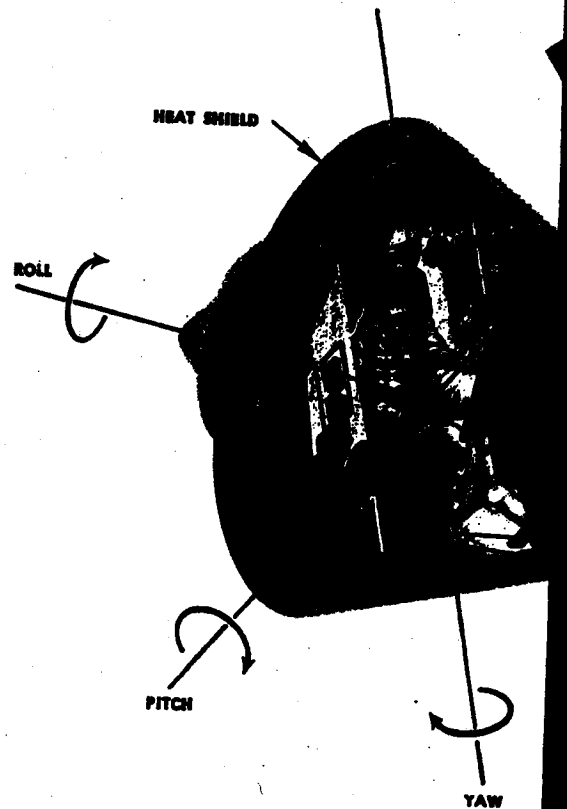


**CAPSULE SEPARATION**

**ROTATION**

**ORB**

**SUSTAINER ENGINE CUTOFF**



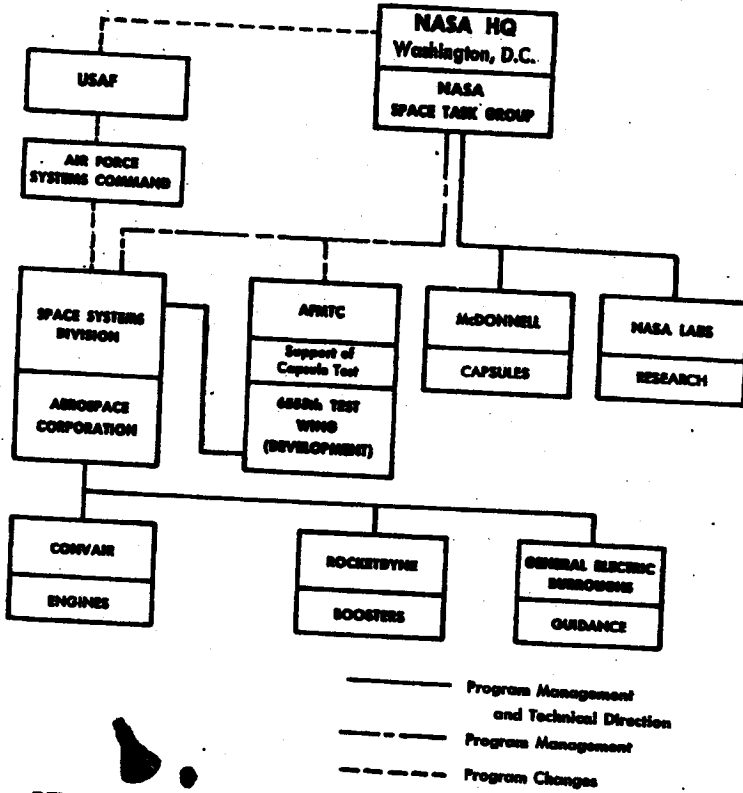
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Division  
of Functions  
S "D" boosters  
support thru orbital insertion  
assistance



of MA-4 Flight

ATTITUDE

RETRO ROCKETS FIRE

RE-ENTRY

RETRO and POSIGRADE  
ROCKETS JETTISONED

DROGUE PARACHUTE OPENS

MAIN PARACHUTE DEPLOYED

IMPACT

NORMAL ORBITAL FLIGHT

MAIN INSTRUMENT PANEL

MAIN PARACHUTE

DROGUE PARACHUTE

PERISCOPE

HORIZON SCANNER

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K-3

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## Launch Schedule

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## Flight History

MERCURY Flight	Launch Date	ATLAS No.	Remarks
Big Joe 1	9 September	10D	<i>Flight test objectives were achieved to such a high degree that a second, similar flight was cancelled. The capsule was recovered intact.</i>
MA-1	29 July	50D	<i>After one minute of normal flight guidance, rate, track lock, and telemetry were lost and the vehicle was destroyed. The exact cause of the malfunction has not been determined.</i>
MA-2	21 February	67D	<i>Test analyses have been completed and all booster and capsule test objectives were achieved.</i>
MA-3	25 April	100D	<i>Vehicle destroyed after 43 seconds of flight by the Range Safety Officer. Programmed pitch and roll functions failed to occur and Range Safety criteria were violated. Investigations to determine the cause of programmer failure have resulted in changes to the autopilot system of the MA-4 and subsequent boosters.</i>

- ★ Successful flight
- Unsuccessful flight



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**Monthly Progress — Project MERCURY**

**Flight Test Progress**

**MA-4 Flight**

• The launch of MA-4 is still scheduled for early August. The Space Systems Division Factory Roll-Out Inspection Team accepted the results of the composite testing of ATLAS 88D on 30 June. This booster, scheduled to support the MA-4 launch, incorporates the engineering changes to the autopilot and Abort Sensing and Implementation Systems recommended by the ATLAS 100D (MA-3) investigation board. Delivery of the booster to the Atlantic Missile Range is estimated for 13 July. —(C)—

• Flight objectives for the MA-4 mission remain as reported in the April "Space Systems Division

Activities" Report. The sequence of events for the MA-4 flight (orbital) are shown on page K-2 of this report. (U)

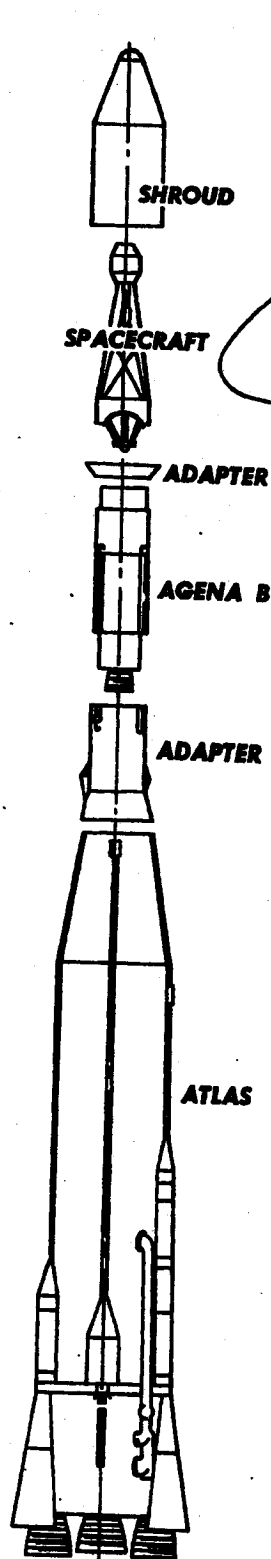
**Technical Progress**

• The decision to proceed with a test program for incorporation of baffled injectors on the MA-5 engine system is still pending resolution of the anomalies encountered during the MA-3 baffled injector engine test program. The baffled injector test program was proposed in an effort to reduce the possibility of rough combustion following engine ignition. Space Systems Division has requested Rocketdyne Division of North American Aviation to submit a proposal on the test and production program for review and presentation to the NASA Space Task Group. —(C)—

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# RANGER - NASA AGENA "B"



*RANGER vehicle showing ATLAS, AGENA B, and Spacecraft. Represented above are the lunar and earth satellite flights. The dotted line indicates Space Systems Division responsibility and the "\*" indicates the spacecraft injection point.*

**Program Responsibilities** - The RANGER-NASA AGENA "B" Program is the over-all responsibility of Headquarters NASA. The responsibility for the spacecraft has been assigned to Jet Propulsion Laboratory (JPL) for interplanetary investigations and Goddard Space Flight Center (GSFC) for the earth satellite programs. The booster system was delegated to Marshall Space Flight Center (MSFC) who in turn assigned Space Systems Division the responsibility and authority for the over-all accomplishment of the booster program.

Under NASA Order No. S4601-G the Air Force is supporting the NASA AGENA "B" Program. This will permit NASA to take full advantage of the technical and operational background and experience developed by the Air Force in space booster projects; permit contractors to discharge their contractual obligations with NASA and USAF utilizing already established management relationships, insofar as practicable; and provide NASA the benefits of contract administration services and procedures already established for USAF programs employing the same basic vehicles as those scheduled for this program.

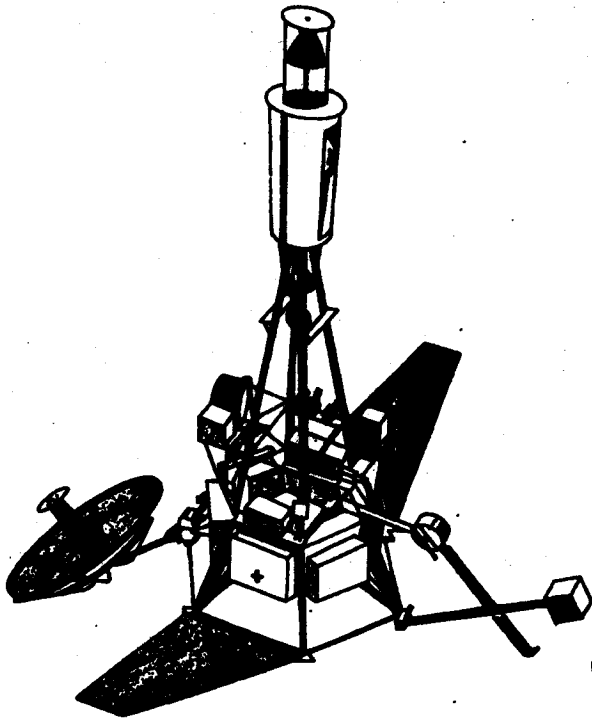
The ATLAS and THOR first stage boosters were allocated to NASA for the missions planned through 1964. Contractual action was initiated with General Electric (GE) and Bell Telephone Laboratories (BTL) for the guidance systems necessary for the respective boosters.

Letter contract AF 04(647)-592 was awarded to Lockheed Missiles and Space Division (LMSD) for procurement of nine AGENA "B" second stage boosters. This contract also includes modification to Stand 12 at AMR; conversion of the Polaris static test stand at Santa Cruz Test Base; and procurement of Aerospace Ground Equipment to checkout, handle, and launch the AGENA "B" booster.

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**RANGER Program**



The ATLAS/AGENA "B" booster system will include the standard ATLAS "D" first stage booster with GE Mod III G guidance system. The second stage will be a modified AGENA B second stage booster similar to those used in several Air Force space programs. The only major change to be incorporated for these missions is the capability to separate the RANGER spacecraft and fire a retro rocket to prevent the AGENA "B" from hitting the moon. Lunar impact of the AGENA "B" is not desired due to its unsterile condition.

The RANGER Program will be the initial launch by NASA of the Air Force developed AGENA "B" second stage. Maximum effort is being given toward using the same components that have been flown on the Air Force missions.

**Scientific Satellite Program**

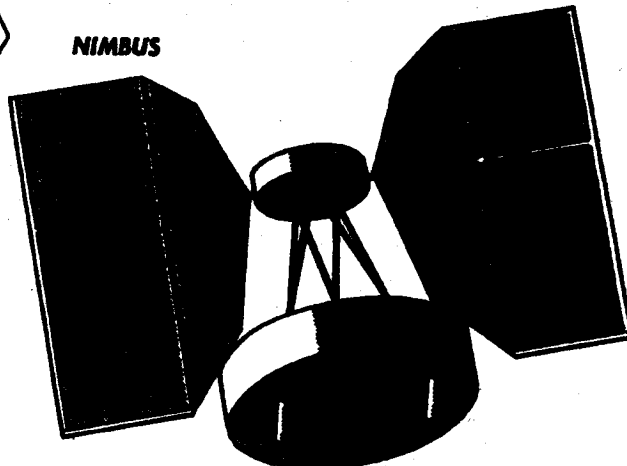
**Lunar Test Missions**

The RANGER Program is a series of five deep space probes to be launched from the Atlantic Missile Range (AMR) on the ATLAS/AGENA B boosters system. Jet Propulsion Laboratories (JPL) under contract from the National Aeronautics and Space Administration (NASA) is responsible for the missions and providing the spacecraft hardware. The mission of the first two RANGER launches will be an interplanetary investigation in support of the follow-on lunar impact mission. The orbit will be highly elliptical near escape velocity and have an apogee of approximately 625,000 miles. The spacecraft is planned for one orbit with approximately a 50 day period.

**Lunar Impact Missions**

The remaining three launches will impact the surface of the moon and transmit scientific information back to the earth. Experiments are designed to measure seismographic disturbances, temperature changes and impact acceleration. These Ranger spacecrafts will also have the capability of accomplishing a mid-course maneuver to correct for minor errors in the trajectory.

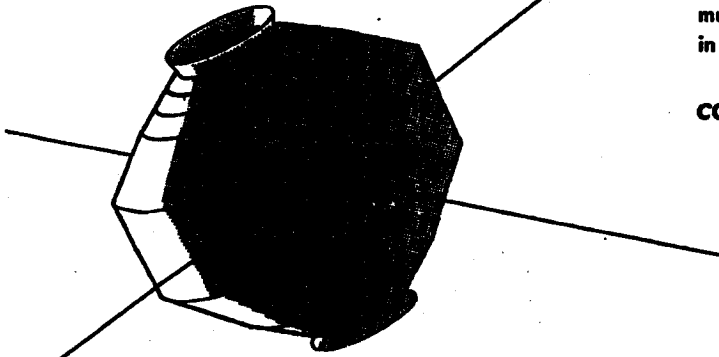
**NIMBUS**



NIMBUS is a 650 pound earth oriented stabilized satellite to be placed in a "high noon" circular orbit at 600 miles altitude. This satellite is intended to serve as a platform for experiments designed to explore the meteorological process of the earth's atmosphere. Experiments include full picture coverage of the clouds over the entire earth, electromagnetic radiation maps of the earth, and the atmosphere around the earth and other experiments to determine the effect of the sun on the atmosphere.

A total of five NIMBUS satellites will be put into orbit by the THOR/AGENA B booster from Vandenberg Air Force Base. The first launch is scheduled for June 1962 with subsequent launches every six months. The booster system will be the same as used on Topside Sounder and the Communication Satellite with slight modification to accept the larger payload.

**TOPSIDE SOUNDER SATELLITE MISSION (S-27)**



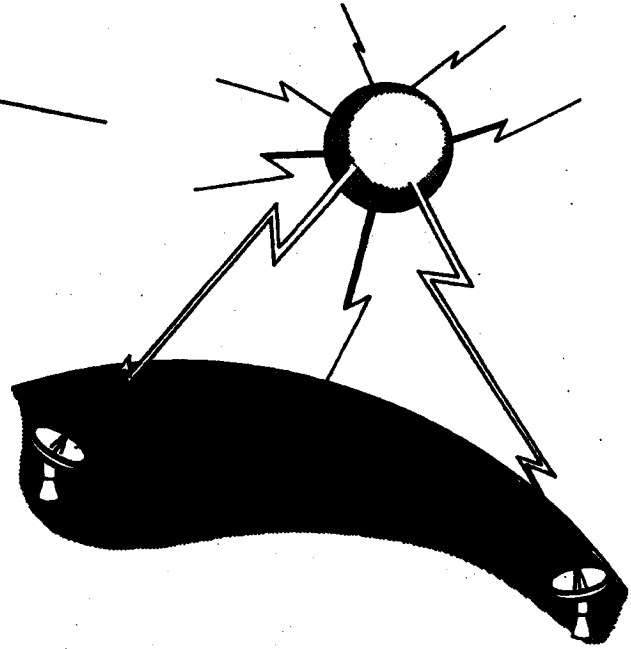
The primary objective of the S-27 Satellite is the examination of the structure of the ionosphere from above in a manner similar to that now being done by ground-based ionospheric sounders. In particular the objective is to obtain information about the ionosphere in the region above the F layer maximum. Other objectives are to measure the cosmic noise level and determine the plasma frequency at the altitude of the satellite.

The Topside Sounder (S-27) will be launched on board a THOR/AGENA "B" booster system from Vandenberg Air Force Base into a 540 n.m. circular orbit. This will be the first Pacific Missile Range launch in this program; however, it will be similar to previous Air Force THOR/AGENA B launches from Vandenberg Air Force Base.

The THOR/AGENA "B" booster system will be composed of the standard DM-21 THOR booster with Bell Telephone Laboratory guidance systems and AGENA "B" second stage similar to the one used

in the RANGER launches from Atlantic Missile Range. Minor modifications will be made to the AGENA to make it compatible to the mission; however, maximum use will be made of the experience developed in the RANGER Program.

**COMMUNICATION SATELLITE MISSION (A-12)**



The primary objective of Project Echo A-12 is the demonstration of a spacecraft deployment and rigidization technique applicable to passive communications satellites. Development of the spacecraft will be undertaken by the Langley Research Center. The Communication Satellite (A-12) will be launched into a 650 n.m. orbit aboard the THOR/AGENA "B" booster. The shroud which surrounds and protects the Communication Satellite will be the same general shape as the S-27 except the length is reduced to accommodate the shorter space craft.

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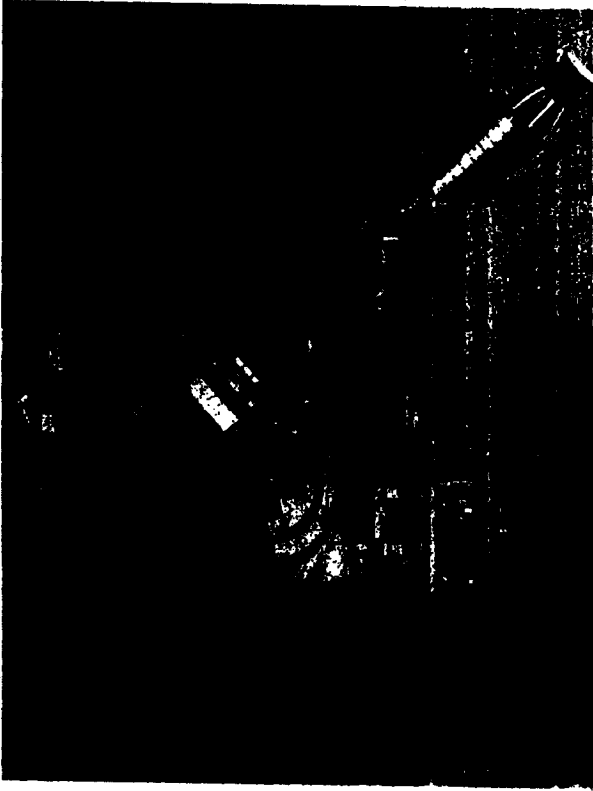
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MISSION																							

**LEGEND**

- ① LUNAR TEST VEHICLE (ATLAS)      ● COMMUNICATION SATELLITE (THOR)
- ① LUNAR IMPACT (ATLAS)            \* METEOROLOGICAL SATELLITE (THOR)
- SCIENTIFIC SATELLITE (THOR)    \* BACKUP VEHICLE (THOR)

Note: Lunar flights will be launched from the Atlantic Missile Range; all others will be made from Vandenberg Air Force Base.

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### Monthly Progress — RANGER PROGRAM

#### Lunar Test Missions — Flight Test Progress

- The tests on the RA-1 AGENA B in the Lockheed Missiles and Space Company missile assembly building at the Atlantic Missile Range have been completed. During the test period an advanced version of the horizon sensor was installed. This modification has been incorporated in all AGENA B vehicles using a horizon sensor. On 15 June, the AGENA B vehicle was mated to ATLAS 111D on Pad 12. (U)

- Late delivery of ATLAS airborne guidance equipment could introduce some delay. The use of non-flight components has permitted some preliminary vehicle tests to be satisfactorily completed. Any significant tests must await the installation of actual flight equipment. (U)

Figure 1 — RANGER I spacecraft without solar paddles during checkout. This spacecraft was mated with the AGENA vehicle on 30 June.

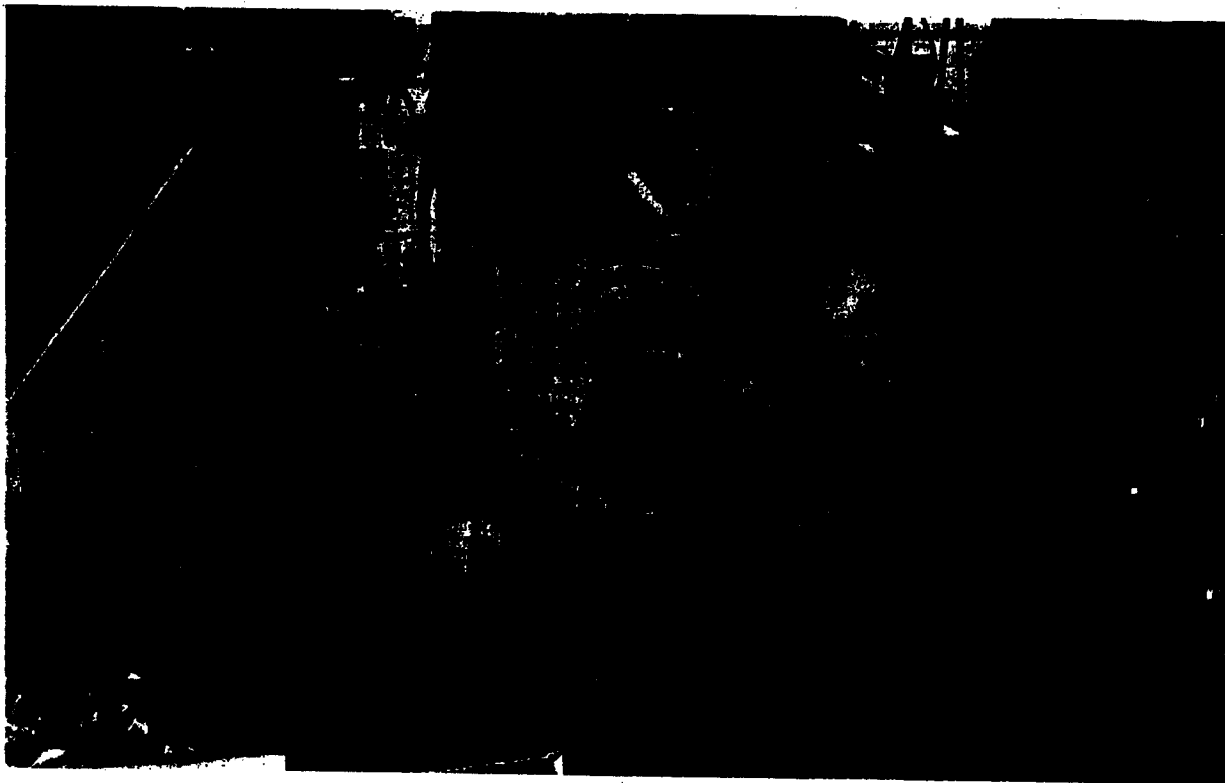


Figure 2 — Final checkout of the AGENA B vehicle in Hangar E at the Atlantic Missile Range. Following completion of these checks, the vehicle was moved to the launch pad.

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- The RANGER I spacecraft was mated to the AGENA B vehicle on 30 June. The Joint Flight Acceptance Test (J-FACT) is scheduled for 13 July and the Flight Readiness Demonstration will be conducted on 18 July. (C)

- The AGENA B vehicle to be used for the second RANGER flight has completed its preliminary system tests. Shipment to the Atlantic Missile Range is scheduled for August. (U)

**Lunar Impact Missions — Technical Progress**

- The first Lunar Impact AGENA B vehicle has completed final assembly and has entered subsystem testing. Several additional tests will be conducted to verify vehicle readiness for this mission. (U)

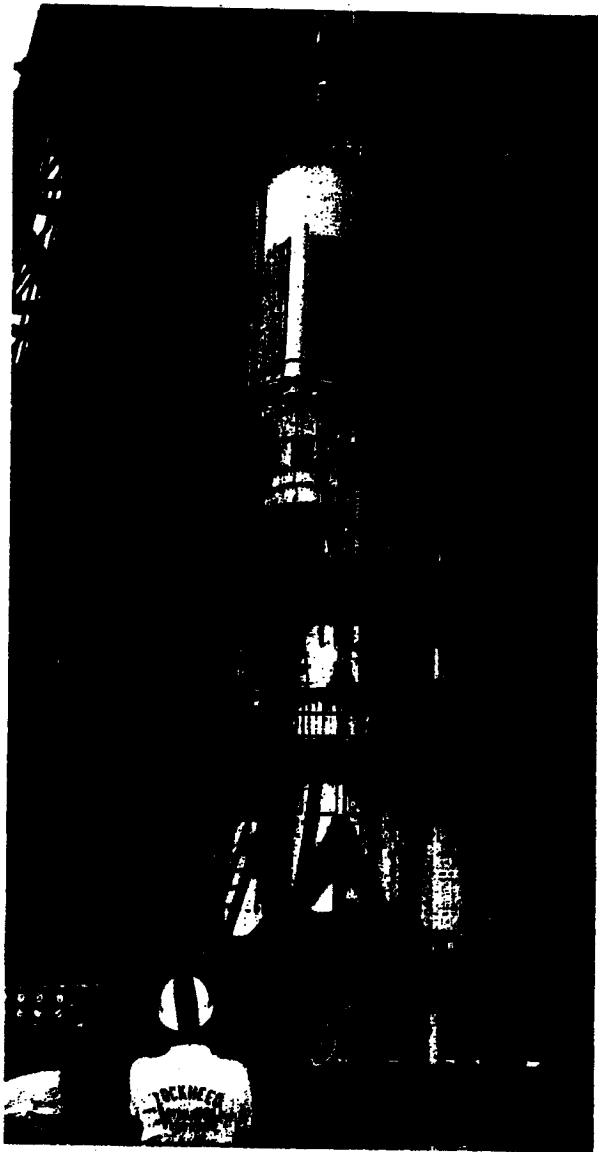


Figure 3 — Mating the AGENA B vehicle with ATLAS 111D on Pad 12. These vehicles comprise the booster system for RANGER I which is scheduled for launch late in July.



**A. THIRD STAGE—X-248 (Allegany Ballistic Lab.)**

Thrust at altitude	3130 pounds
Specific impulse (vac)	250 seconds
Total impulse	116,400 lbs/sec
Burning Time	37.5 seconds
Propellant	Solid

**B. SECOND STAGE—AJ10-42 (Aerojet-General)**

Thrust at altitude	7700 pounds
Specific impulse (vac)	271 seconds
Total impulse (min)	870,000 lbs/sec
Burning time	115 seconds
Propellant	Liquid

**C. FIRST STAGE—THOR IRBM**

Thrust (s.l.)	131,500 pounds
Specific impulse (s.l.)	248 seconds
Specific impulse (vac)	287 seconds
Burning time	158 seconds
Propellant	Liquid

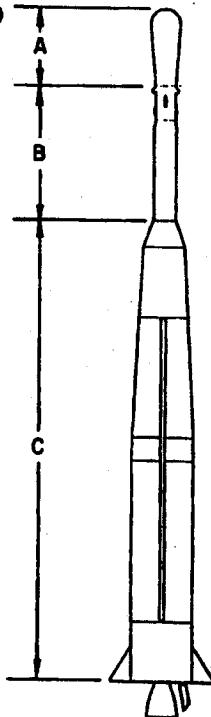
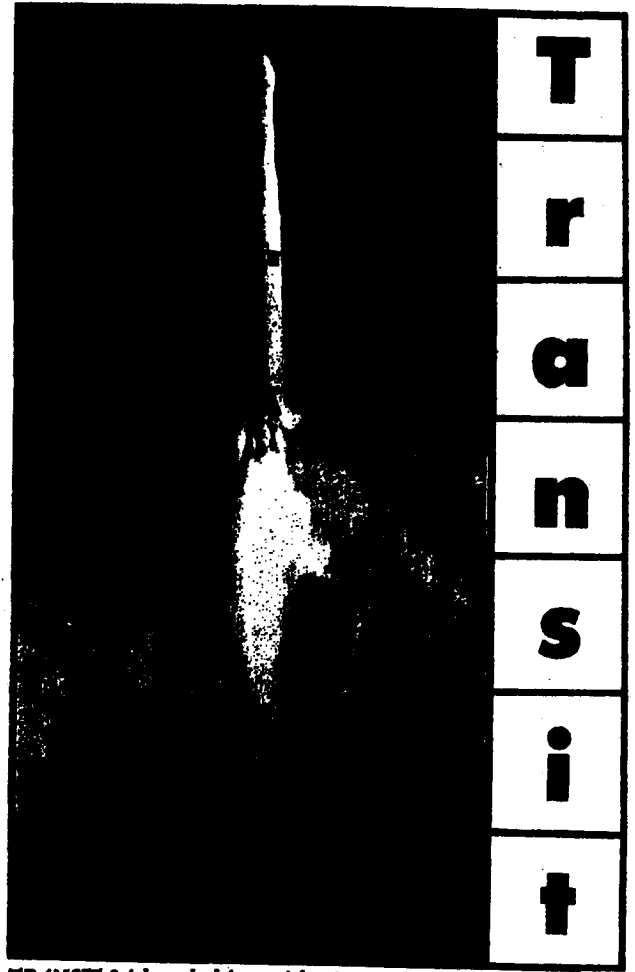


Figure 1. TRANSIT IA three stage flight vehicle.

The TRANSIT Program consists of the flight testing of eight vehicles to place 200-350-pound satellite payloads into circular orbits of 400 to 500 nautical miles. The program is designed to provide extremely accurate, world-wide, all-weather navigational information for use by aircraft, surface and subsurface vessels, particularly in relation to POLARIS missile firings. The ARPA Order for TRANSIT IA was initiated in September 1958 and amended in April 1959 to



TRANSIT 3A launched from Atlantic Missile Range

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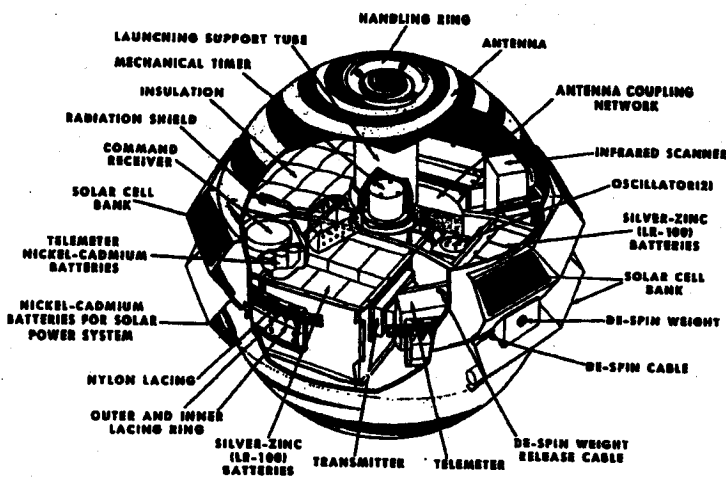


Figure 2. Cut-away drawing of TRANSIT IA payload (NAV 1).

add TRANSIT 1B, 2A and 2B flights. The TRANSIT 3A and 3B flights were initiated by a Navy MIPR, dated 18 May 1960. Because of the successful TRANSIT 2A launch and excellent payload performance the Navy elected to launch TRANSIT 3A rather than 2B. TRANSIT 2B was scheduled to carry the same type payload as was carried on the 2A flight. Subsequently, the Navy initiated requests for TRANSIT 4A, 4B, 5A and 5B.

The program was originally authorized by ARPA Order No. 97-60, which assigned AFBMD responsibility for providing the booster vehicles, integrating payloads to the vehicles, and flight operations from launch through attainment of orbit. The TRANSIT project was transferred to the Navy on 9 May 1960. The Navy has now assumed both the administrative and technical responsibility for the TRANSIT program. Payload tracking responsibility has been assigned to the USN Bureau of Weapons. Applied Physics Laboratory is the payload contractor.



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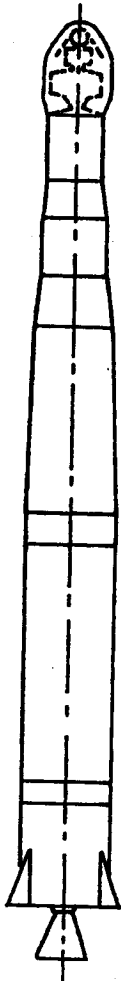


Figure 3. Two stage vehicle used for TRANSIT 1B and subsequent flights.

**SECOND STAGE — ABLESTAR (AJ10-104)**

Thrust (vacuum)	7900 pounds
Specific impulse (vacuum)	277 seconds
Burning time	296 seconds
Propellant	IRFNA UDMH

**FIRST STAGE — THOR IRBM**

Thrust (sea level)	152,000 pounds
Specific impulse (sea level)	247 seconds
Burning time	163 seconds
Propellant	Liquid Oxygen RP-1

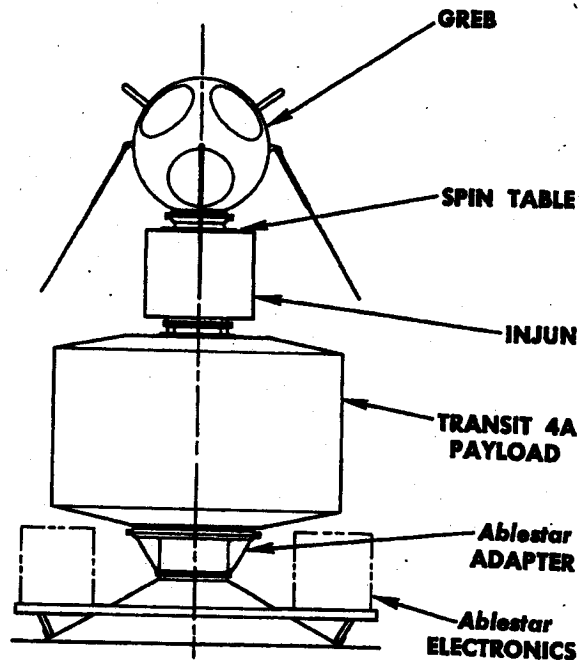


Figure 4. Payload arrangement for TRANSIT 4A flight.

**Program Objectives**

1. Provide accurate navigational reference information for POLARIS launches.
2. Precise determination of satellite position by measuring the doppler shift of satellite transmitted radio signals.
3. Investigate the refractive effect of the ionosphere on radio transmissions.
4. Acquire additional geodetic and geographical data by precision tracking of the orbiting satellite.

**Flight Vehicles** TRANSIT 1A was a three stage vehicle as shown in Figure 1. TRANSIT 1B and subsequent vehicles are two stage vehicles as shown in Figure 3.

**Launch Plans** All vehicles will be launched from Complex 17 at the Atlantic Missile Range. Launch azimuth will vary between 45.5° and 140° for each flight.

**Payload Description** The TRANSIT 4A payload is shown in Figure 4. The payload consists of three separate assemblies and has a total weight of 300 pounds. The TRANSIT payload (175 lbs) is the next step in the Navy Program to develop an operational navigation system. The payload is a short cylindrical shape as opposed to the spherical shape of all the previous payloads. The new shape is close to that which is proposed for the operational system payloads. The TRANSIT 4A payload is the first satellite to contain a Radioactive Isotope Power Supply (a SNAP Power Supply). This radioactive supply provides power for the operation of several satellite systems. The second satellite, the INJUN payload, (40 lbs) is under the cognizance of Dr. Van Allen of the State University of Iowa. It will perform radiation measurements. The third satellite (55 lbs) is a Naval Research Laboratory GREB with detectors to study solar emissions. There is also 30 pounds of interconnecting structure consisting of a spin table to spin the GREB, springs to separate the payloads, and supporting brackets for the launch phase.

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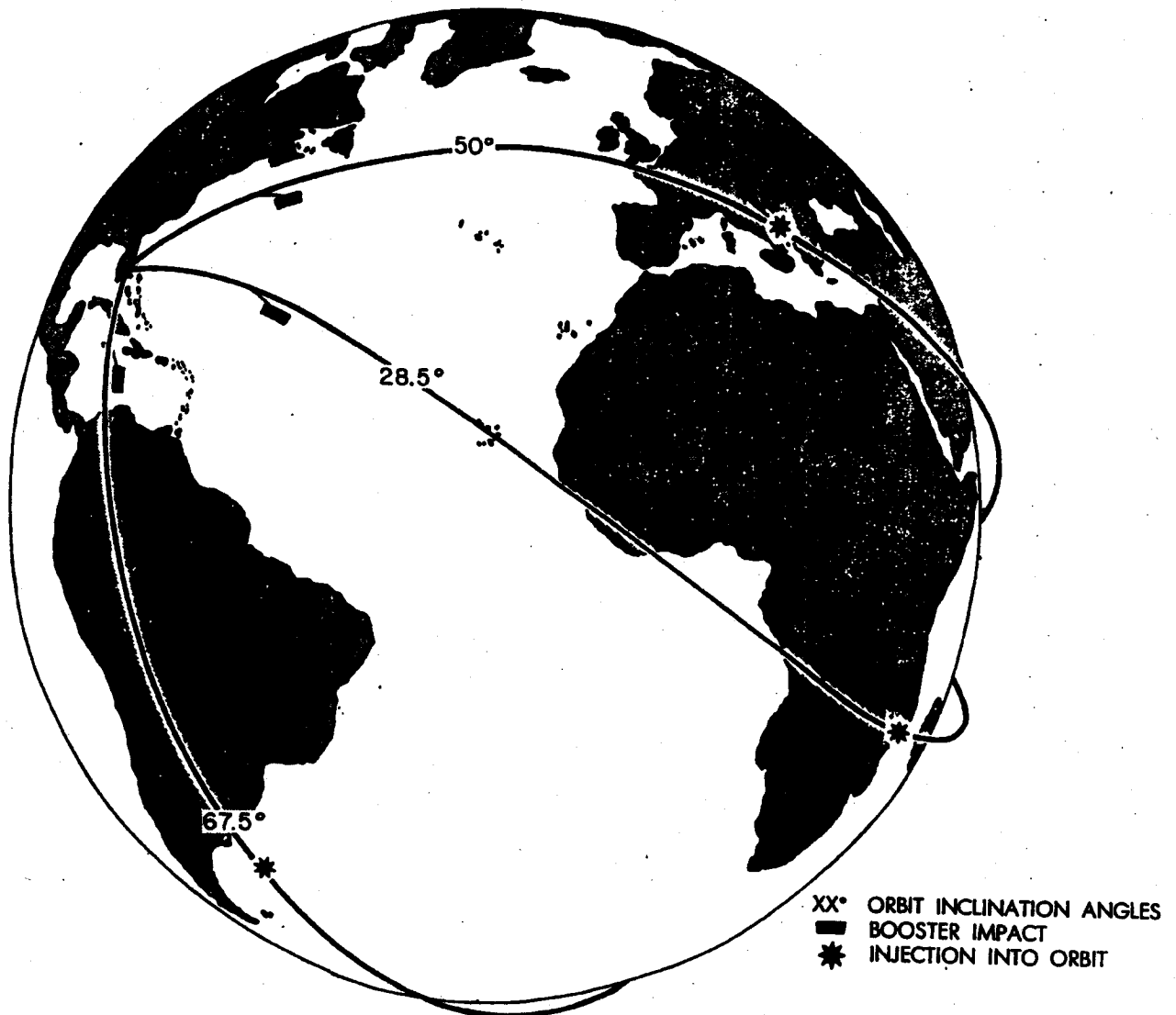


Figure 5. Typical TRANSIT launch trajectories showing flight path, booster impact areas, and orbital injection points.

**Orbital Performance** Achievement of program objectives is based primarily on measuring the doppler shift of satellite transmitted radio signals. During the first three months of flight, the four transmitters will be operated to obtain experimental confirmation of the theoretical mathematical relationship between the frequency and the refractive index of the ionosphere. Studies have shown that refraction effects on the doppler shift can be eliminated by using the transmission from two satellites. After four months of tracking the satellite by measuring the doppler shift of the satellite radio signal, the exact position of the satellite at any point in the orbit should be known. Using known orbital positions, ships and aircraft can then use satellite signals to make analogous computations to establish accurate position.

**Ground Support and Tracking Stations** The Navy Bureau of Weapons payload contractor provides a system of payload tracking stations which obtain information for precise orbit determination. These stations are located in Maryland, Texas, New Mexico, Newfoundland and Brazil. First and second stage tracking and telemetry, and second stage guidance will be provided by the facilities of the Atlantic Missile Range. A mobile downrange tracking station at Punta Arenas, Chile, will receive telemetry data and tracking information during the last portion of the second stage Ablestar coast, re-ignition and second burn, payload spin-up and payload injection periods. This station was located in Erding, Germany, for the TRANSIT 1B flight, Punta Arenas, Chile, for the TRANSIT 2A and 3A and Pretoria, Union of South Africa for TRANSIT 3B.

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## Launch Schedule

59					60					61					62																									
J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J					
TRANSIT FLIGHT NUMBER																																								
1A					1B					2A					3A					3B					4A					4B										
●					★	★				○					★					★					1											1				
A					A					B					B					C					B					B										
ORBIT INCLINATION ANGLES      A. 50°    B. 67.5    C. 28.5																																								

★ Attained orbit successfully

○ Failed to attain orbit

## Flight History

TRANSIT No.	Launch Date	Thor No.	Ablestar No.	Remarks
1A	17 September	136	—	The three-stage vehicle was launched from Stand 17A at the Atlantic Missile Range. The payload was not injected into orbit, because the third stage motor failed to ignite.
1B	13 April	257	002	The Thor Ablestar boosted satellite was launched from Stand 17B at AMR. The satellite was placed into orbit. The Ablestar second stage (on its first flight test) fired, shut off, coasted, and then restarted in space.
2A	22 June	281	003	A dual payload, consisting of TRANSIT 2A plus GREB (which studied solar emissions), was placed in orbit by the Thor Ablestar vehicle. A propellant slosh problem, discovered in the second stage, has been corrected.
3A	30 November	283	006	TRANSIT 3A failed to achieve orbit when the first stage Thor shut down prematurely, after a failure in the main engine cutoff circuitry. Staging occurred and the second stage performed nominally until it was cut off and destroyed by Range Safety.
3B	21 February	313	007	TRANSIT 3B was launched with only partial success. The Ablestar stage failed to restart in space and the payloads did not separate. Although no definite cause has yet been determined, the counting device in the Ablestar programmer is considered the most probable cause of malfunction.
4A	28 June	315	008	TRANSIT 4A was launched, with great success, into an orbit with a perigee of approximately 460 n.m. and an apogee of approximately 540 n.m. The payload consists of three separate satellites: the TRANSIT 4A, containing the first radioactive power supply to be used in space; INJUN, which studies radiation in the lower Van Allen and auroral zones; and GREB, which studies solar X-Ray emissions.

**Monthly Progress - TRANSIT**

**Program Administration**

• A TRANSIT Systems Coordination Meeting will be held on 13 - 14 July at the Space Systems Division. At this time, all aspects of the TRANSIT 4A flight will be discussed as well as those of the TRANSIT 4B flight scheduled for August. Because of booster system and payload technical difficulties, the launch of the TRANSIT 4B has been rescheduled to the week of 28 August. This represents a one-week delay. (C)

**Flight Test Progress**

**TRANSIT 4A Test Objectives (C)**

• The objectives of the TRANSIT 4A flight were as follows:

1. Demonstrate satisfactory operation of the payload equipment during the launch phase, subsequent spindown operation and long-term operation while in orbit.
2. Demonstrate satisfactory operation and potential lifetime for the solar cell power supply.
3. Demonstrate the capability of accurate navigation from a single doppler curve with its limits imposed by present inadequate knowledge of geodesy ionospheric refraction and present instrumentation.
4. Demonstrate satisfactory operation on satellite-borne injection memory equipment.

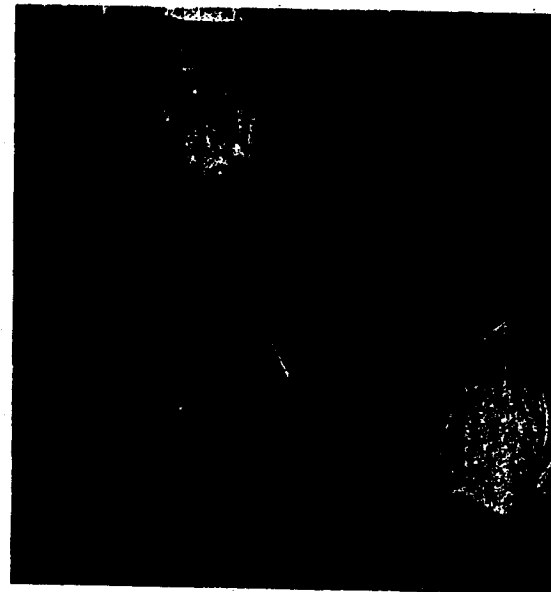
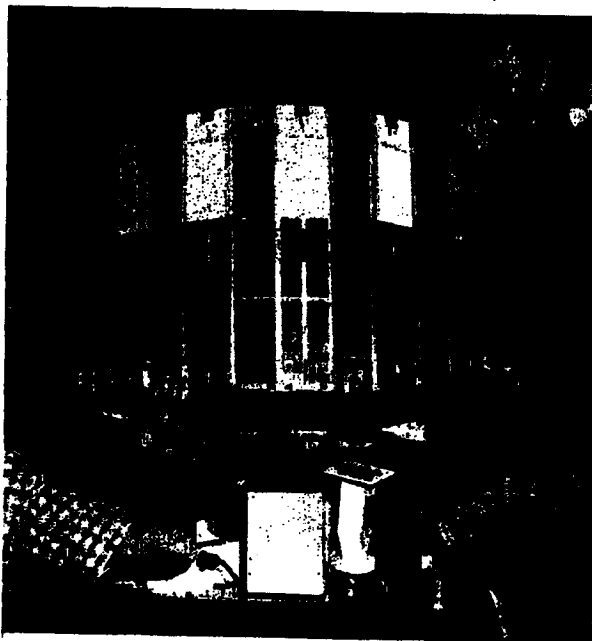
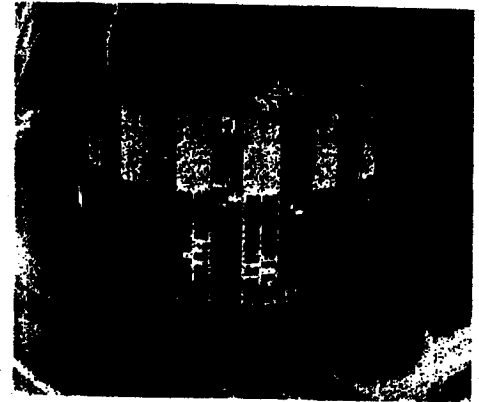


Figure 6 - Installing the Radioactive Isotope Power Supply on the TRANSIT 4A payload (top), monitoring the radiation from the small nuclear power plant (above) and mating the complete package with the Ablestar second stage.

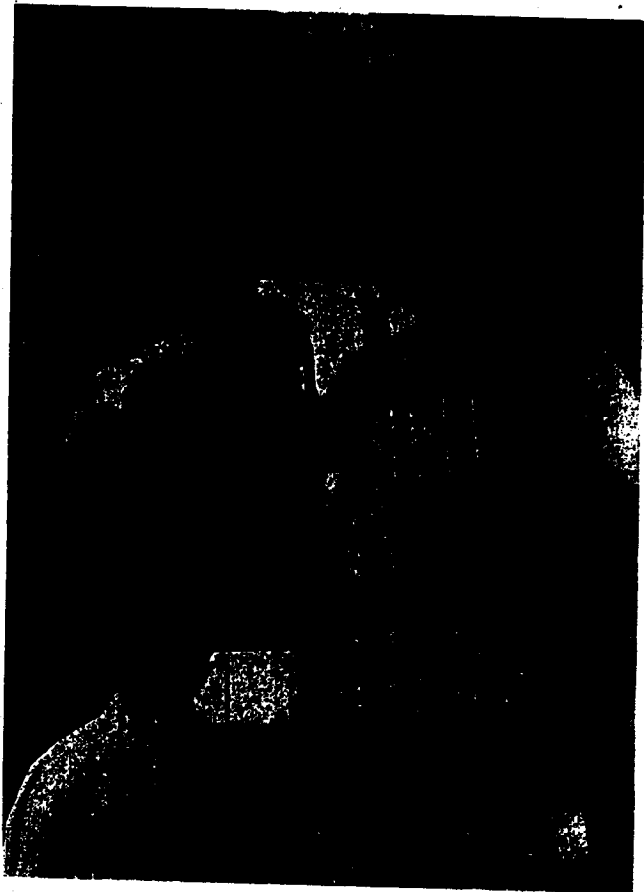
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INSTALLING THE INJUN



ATTACHING THE GREB



PLACING THE FAIRING  
OVER THE THREE SATELLITES

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5. Continue experiments to determine accurately the shape of the earth and its force field when data becomes available from different tracking stations at widely dispersed locations.

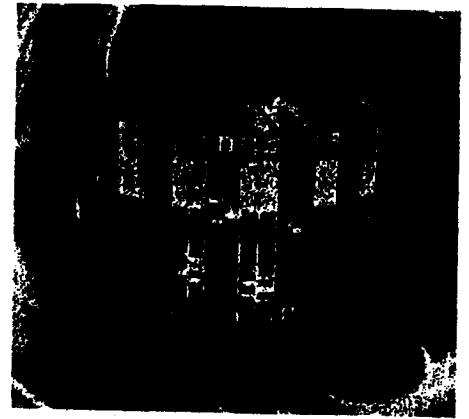
6. Demonstrate satisfactory injection of the payload into the required orbit (500 nautical mile circular  $\pm 100$  nautical miles).

#### **TRANSIT 4A Flight**

- Two holds occurred during the countdown. The first was at T-12 minutes and required the resetting of the THOR fuel pressure regulator. A range safety difficulty (AZUSA problem) at T-13 seconds caused the countdown to be recycled to T-8 minutes. The count proceeded with no further holds and the TRANSIT 4A vehicle was launched from Stand 17B at 2323 EST on 28 June. A one-day launch delay had been incurred because severe local thunderstorms at the Atlantic Missile Range prevented the installation of the payload. The launch had been scheduled for 14 June but a failure of the flight programmer and a spare flight programmer caused the launch to be canceled and rescheduled for two weeks later. ~~(C)~~
- THOR performance during the flight was excellent. The Ablestar performed extremely well during the first burn period. Second burn occurred as programmed and the three satellites were injected into orbit. The orbit has a perigee of approximately 470 nautical miles and an apogee of 530 nautical miles with a period of 104 minutes. (U)
- This launch was the first in which three satellites were placed into orbit by a single launch vehicle. Also, the TRANSIT 4A payload was the first satellite to contain a radioactive power supply. The small SNAP (System for Nuclear Auxiliary Power) reactor furnishes approximately  $2\frac{1}{2}$  watts of power. (U)
- The only problems that were encountered during this major space achievement were the failure of the payload-contractor spin table to separate the GREB from the INJUN and the failure of the FPS-16 radars to track the second stage C-Band Beacon. The latter problem is currently under investigation by the Space Systems Division. ~~(C)~~

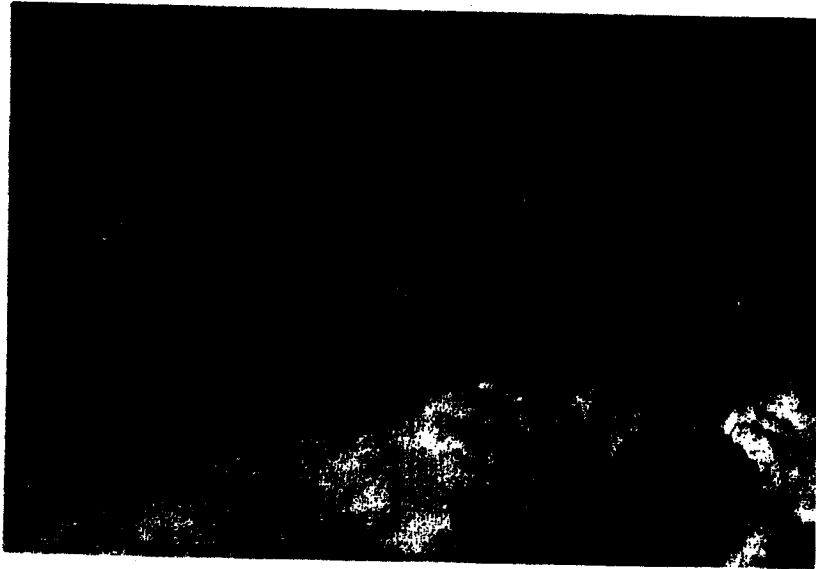
**LAUNCH OF  
TRANSIT 4A  
ON 28 JUNE**

DCLPS-3



# **SPACE**

## **BOOSTERS**



**EXISTING OR PROGRAMMED  
STAGES**

**SPACE BOOSTERS**

~~SECRET~~

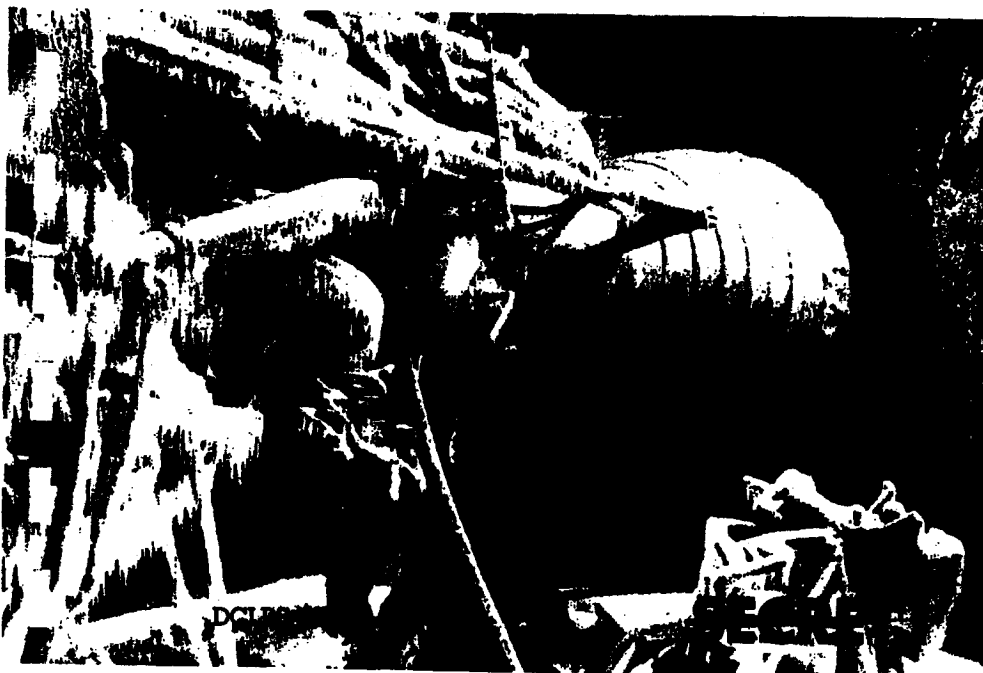
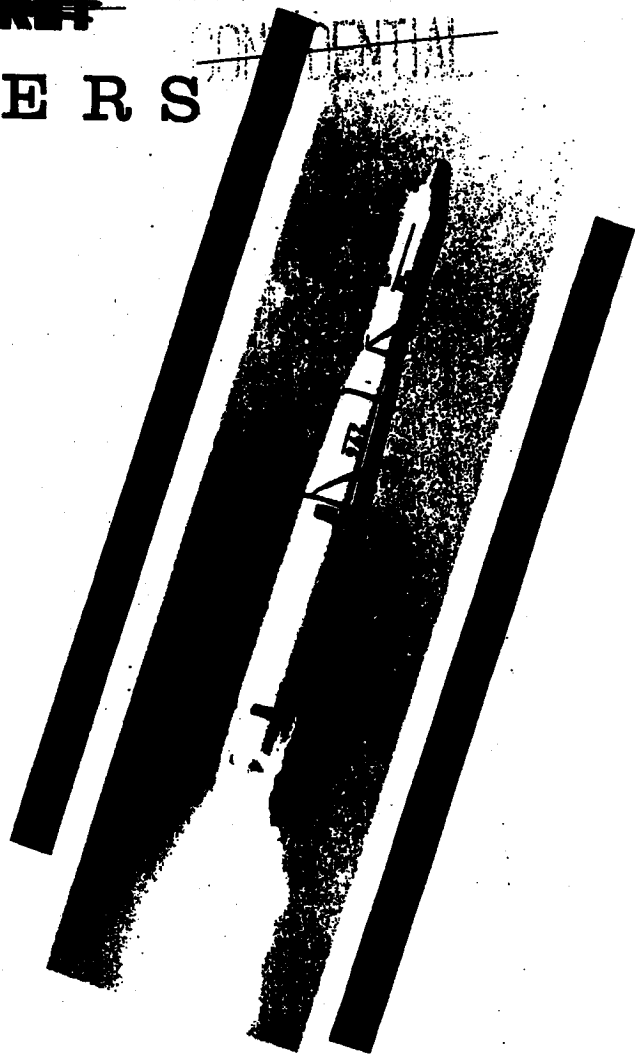
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# Space Program BOOSTERS

● The primary pacing factor in the accomplishment of space missions has been, and for some time will continue to be, the availability of Air Force ballistic missiles and upper stages to boost the payload vehicle. Space flight planning requires close examination of all technological areas wherein advances provide increases in booster and mission capability. This, in turn, has required that space schedules be sufficiently flexible to incorporate rapidly those advances in the state-of-the-art which increase the potential for reliable and predictable space research.

● Because of the wide range of its activities, The Air Force Space Systems Division has accumulated a broad base of experience in booster selection for space missions. Experience in ballistic missile R&D programs and in development of upper stage vehicles have provided much information. Research programs in the propellant and materials areas also are providing new capability for space research. The number and variety of boosters available permit the selection of a combination of stages tailored to provide specific capabilities for specific missions.

● The following pages describe briefly the booster vehicles currently being used by The Air Force Space Systems Division to support military and civilian space programs. Nominal performance data is given to permit nominal comparisons of vehicle capabilities. Specific qualifications are made where necessary for clarity.



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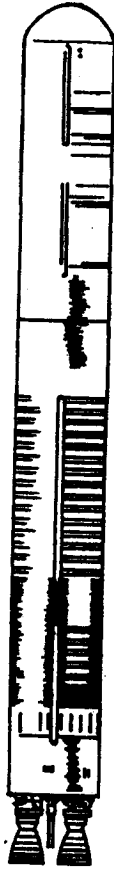
DM-19/AJ10-118/  
ABL X248-A5



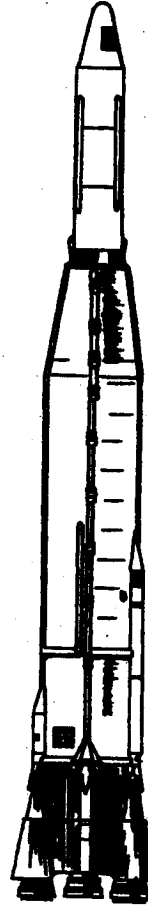
DM-21/Ablestar



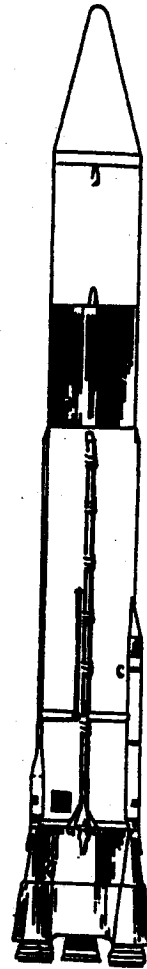
DM-21/AGENA B



TITAN II



ATLAS D/AGENA B



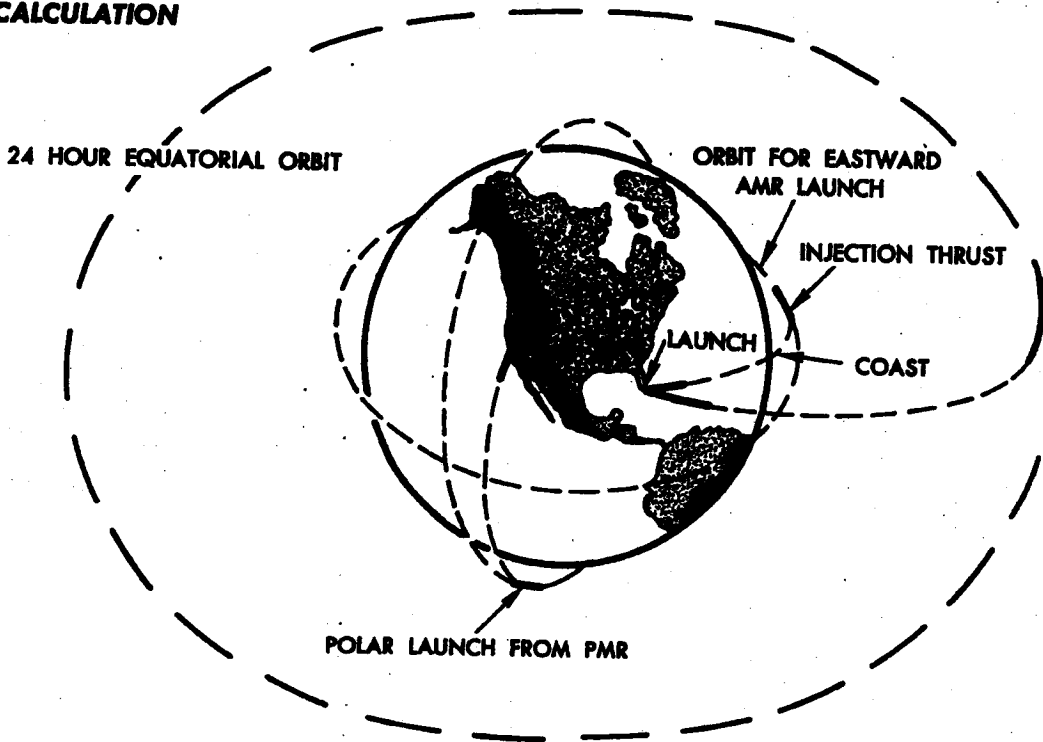
ATLAS D/CENTAUR

## Program Vehicle Combinations

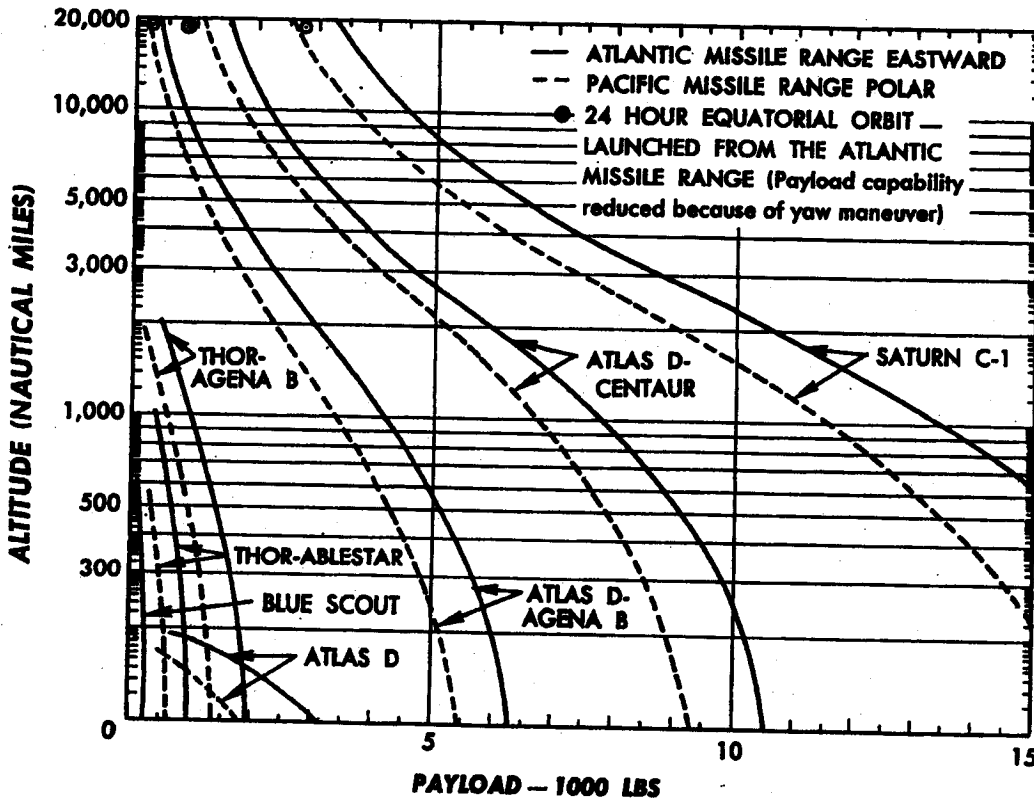
ABLE -1, -3 and -4.	A	M	R	DISCOVERER (1 thru 15)	A	H	NASA AGENA "B"...	E	K	
ABLE -4 and -5.....	E	M	R	DISCOVERER (16 thru 19)	C	J		C	K	
ADVENT (Phase One) .		E	K	DISCOVERER (20 and subs)	C	K	NASA Delta .....	B	L	R
ADVENT (Phase Two) .		E	P	DYNA SOAR .....	F	G	SAINT .....	E	K	
ADVENT (Phase Three)		E	O	MERCURY .....		E	TIROS .....	A	L	R
ANNA .....		D	N	MIDAS (I and II).....	E	H	TRANSIT 1A .....	A	L	R
BAMBI .....		E	P	MIDAS (III and subs)...	E	K	TRANSIT 1B thru 5B ..	D	N	J
COURIER .....		D	N				VELA HOTEL.....	D	J	

NOTE: Light type indicates completed programs      Bold type indicates active programs

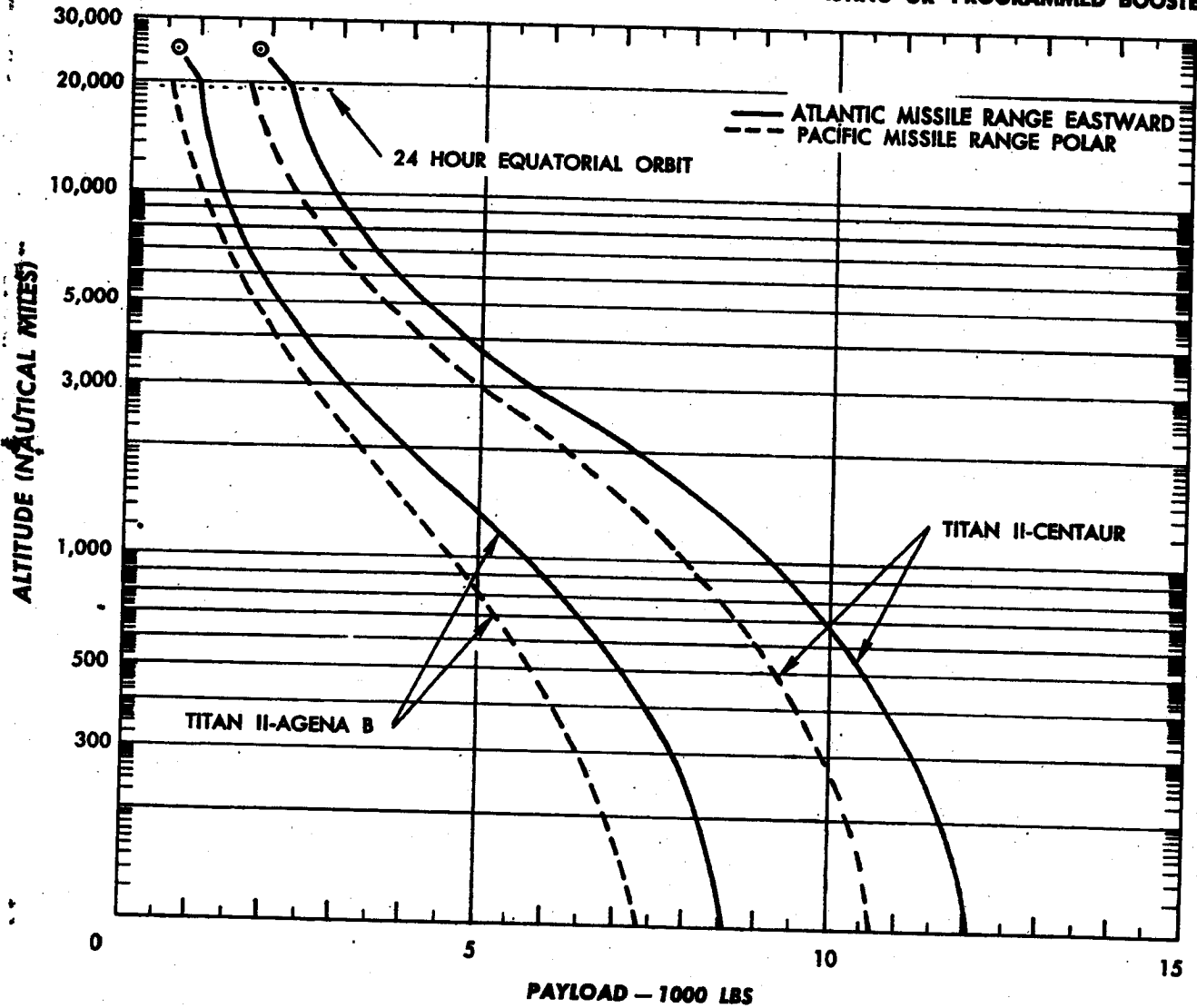
**LAUNCH CAPABILITIES  
CALCULATION**



**Performance Summary - EXISTING OR PROGRAMMED BOOSTERS**



Performance Summary — POSSIBLE COMBINATIONS OF EXISTING OR PROGRAMMED BOOSTERS



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# ~~SECRET~~ Specifications

## BOOSTERS

### THOR — Douglas Aircraft Company

	A	B	C	D
	DM-18	DM-19	DM-21	DM-21A
Weight — dry	7,846	7,204	6,590	6,870
Fuel — RP-1/RJ-1*	31,500	31,500	33,500*	31,500
Oxidizer — Liquid Oxygen	68,000	68,000	68,000	68,000
Total	<u>107,346</u>	<u>106,704</u>	<u>108,090</u>	<u>106,370</u>
Height — feet	61.3	65.1	55.9	60.4
Engine — Rocketdyne Division of North American Aviation	MB-3 Block I	MB-3 Block I	MB-3 Block II	MB-3 Block I
Thrust — lbs. (sea level)	152,000	152,000	169,000	152,000
Spec. Impulse — lb.-sec/lb. (sea level)	247.0	247	250	247
Burn Time — seconds	160	160	149	160
Guidance — Bell Telephone Laboratories series 400 or autopilot only.				

(27) (31) (87) (4) (4) (100) (10) (10) (100) (5) (7) (72)

### ATLAS — General Dynamics-Astronautics

	E
	Series D
Weight — dry	15,100
Fuel — RP-1	74,900
Oxidizer — Liquid Oxygen	172,300
Total	<u>262,300</u>
Height — feet	69
Engine — Rocketdyne Division of North American Aviation	MA-5
Thrust — lbs. (sea level)	309,000
Booster	57,000
Sustainer	2,000
Vernier	251
Specific Impulse — lb.-sec/lb. (sea level)	214.7
Booster	
Sustainer	
Guidance — Radio Mod II/III — General Electric (radar), Burroughs (computer)	

(9) (12) (75)

### TITAN II — The Martin Company

	F	G
	FIRST STAGE	SECOND STAGE
Weight — dry	12,231	5,375
Fuel — N <sub>2</sub> H <sub>4</sub> /UDMH	83,713	20,200
Oxidizer — N <sub>2</sub> O <sub>4</sub>	161,632	37,702
Total	<u>257,576</u>	<u>63,714</u>
Height — feet (combined first and second stage)	90	
Engine — Aerojet-General Corporation	XLR87AJ-5	XLR91AJ-5
Thrust — lbs.	430,000 (sea level)	100,000 (vacuum)
Specific Impulse — lb.-sec/lb.	258 (sea level)	314 (vacuum)
Burn Time — seconds	146.3	181.9
Guidance — Radio Mod III — General Electric (radar), Burroughs (computer)		

## UPPER STAGES

### R ABL X248-9 Allegany Ballistics Laboratory

Weight — wet	60
Propellant — Solid	459
Total	<u>519</u>
Height — feet	
Engine	
Thrust — lbs. (vacuum)	2,750
Specific Impulse — lb.-sec/lb. (vacuum)	254
Burn Time — seconds	42.1

(8) (10) (80)

~~SECRET~~

# Existing or Programmed Stages

## SATELLITE VEHICLES

### AGENA — Lockheed Missiles and Space Company

	<b>L</b> YLR-81 Ba-5	<b>J</b> XLR-81 Ba-7	<b>K</b> XLR-81 Ba-9 <sup>②</sup>
① Weight — inert	1,262	1,328	1,346
Fuel — UDMH			
Oxidizer — IRFNA			
② Total	8,165	14,789	14,807
Height — feet	14	19.5	21
Engine			
Thrust — lbs. (vacuum)	15,600	15,600	16,000
Specific Impulse — lb.-sec/lb. (vacuum)	277	277	290
Burn Time — seconds	120	240 <sup>④</sup>	240 <sup>④</sup>
	⑫ ⑰ ⑦①	③ ④ ⑦⑤	③ ④ ⑦⑤

### ABLE Series — Aerojet-General Spacecraft Division

	<b>L</b> AJ10-42 (and -118)	<b>M</b> AJ10-101 (and -101A)	<b>N</b> AJ10-104 (Ablestar)
Weight — wet	1,247	848	1,297
Fuel — UDMH	875	869	2,247
Oxidizer — IRFNA	2,500	2,461	6,227
Total	4,622	4,178	9,771
Height — feet	18	16	15
Engine			
Thrust — lbs. (vacuum)	7,670	7,720	7,900
Specific Impulse — lb.-sec/lb. (vacuum)	267	268	277
Burn Time — seconds		113	296
	⑨ ① ⑬ ⑥⑨	④ ② ④ ①①①	④ ② ⑤ ⑧①

### CENTAUR — General Dynamics-Astronautics

	<b>P</b>	<b>C</b>
Weight — dry	2,891 <sup>⑤</sup>	
Fuel — Hydrogen	—	
Oxidizer — Liquid Oxygen	—	
Total	32,000	
Height — feet	45.5	
Engines (Two) — Pratt & Whitney	RL10A-3	
Thrust — lbs. (vacuum) (15,000 each)	30,000	
Minimum Specific Impulse — lb.-sec/lb. (vacuum)	420	
Burn Time — seconds	370	

CENTAUR modifications necessary to meet ADVENT mission are being determined

#### NOTES:

- ① Payload weight not included. Does include controls, guidance, APU and residual propellants.
- ② Does not include THOR adapter (225 lbs.) or ATLAS adapter (315 lbs.)
- ③ Single restart capability
- ④ Dual burn capability
- ⑤ Changes in payload weight affect fuel and oxidizer weights, but not total weight.

- Number of successful flights.
- Not tested because of first stage failure.
- ⬡ Number of launches attempted.
- ◯ Percentage of success.

**DISTRIBUTION**

Department of the Air Force	10	Air Defense Command	1
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