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MONTHLY SUMMARY OF

SPACE

Systems Divi

ACTIVITIES

EXEMPTED FROM DECLASSIFICATION IAW E.O. 12958

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JUNE 1961

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a foreword to...

SPACE

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HEADQUARTERS
SPACE SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
Air Force Unit Post Office, Los Angeles 45, California

DCLPS

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

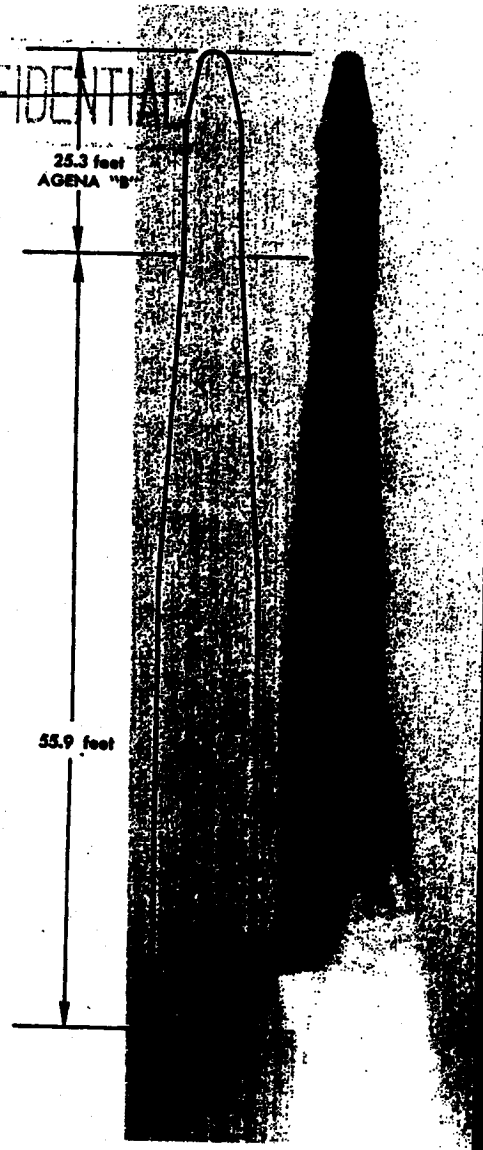
SECRET

SATELLITE
SYSTEMS

DISCOVERER
MIDAS
BIOASTRONAUTICS
BLUE SCOUT
SAINT
VELA HOTEL

Discoverer

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.

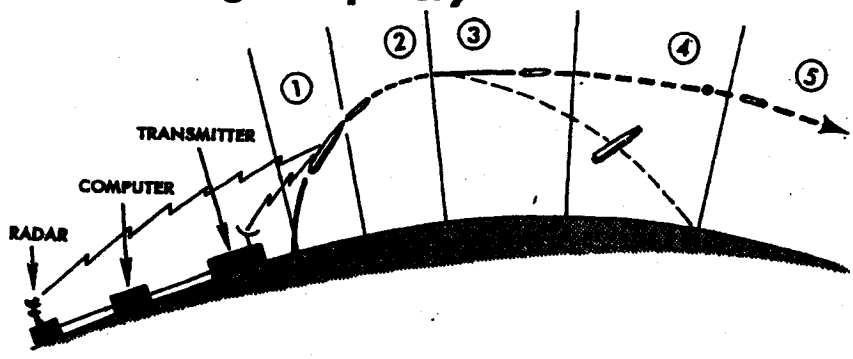
PROGRAM SUMMARY

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.

SECOND STAGE	AGENA "B"
Weight—	
Inert	1,346
Payload equipment	915
Orbital	2,261
Impulse propellants	12,950
Other	511
TOTAL WEIGHT	15,722
Engine Model	XLR81-Ba-9
Thrust-lbs., vac.	16,000
Spec. Imp.-sec., vac.	290
Burn time-sec.	240
BOOSTER	DM-21
Weight—Dry	6,500
Fuel	33,700
Oxidizer (LOX)	68,200
GROSS WEIGHT (lbs.)	108,400
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 gimballing the engine and roll by gas reaction jets. Engine shutdown 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).

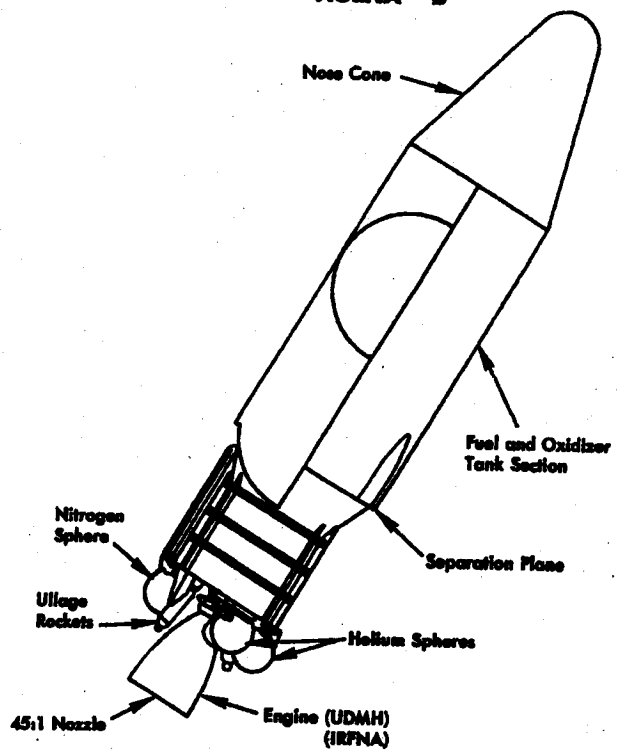
Telemetry ships are positioned as required by the specific mission of each flight. Illustrations on the opposite page show a typical launch trajectory from Vandenberg Air Force Base and a typical orbit. An additional objective of this program is the development of a controlled re-entry and recovery capability 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 VEHICLE DEVELOPMENT

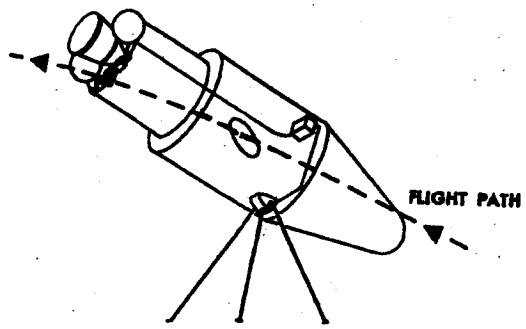
The AGENA vehicle was originally designed as a basic satellite vehicle for Military Space Programs.

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.

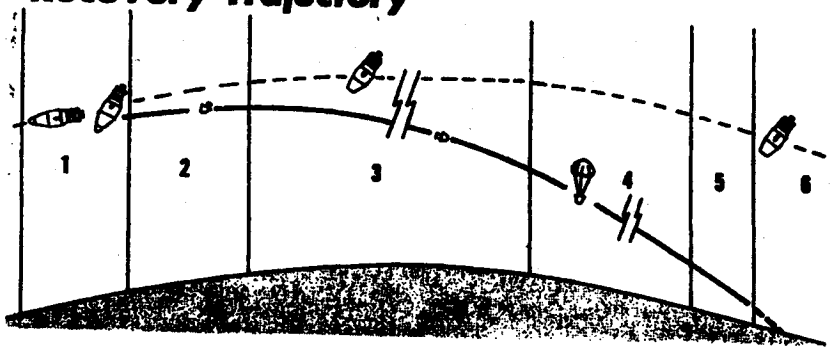
AGENA "B"



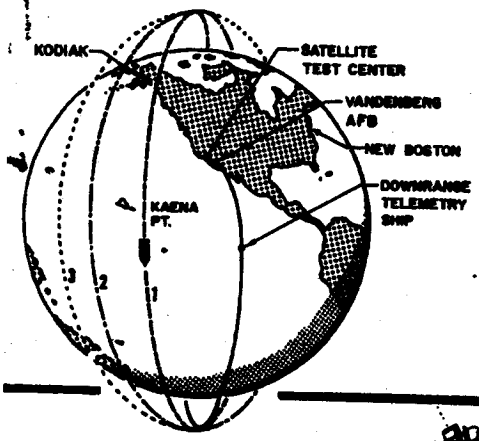
DISCOVERER/AGENA



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.

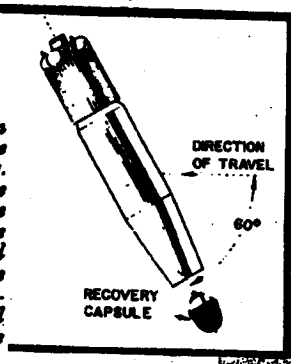


Orbital Trajectory

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 orbits, 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, WV11 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.

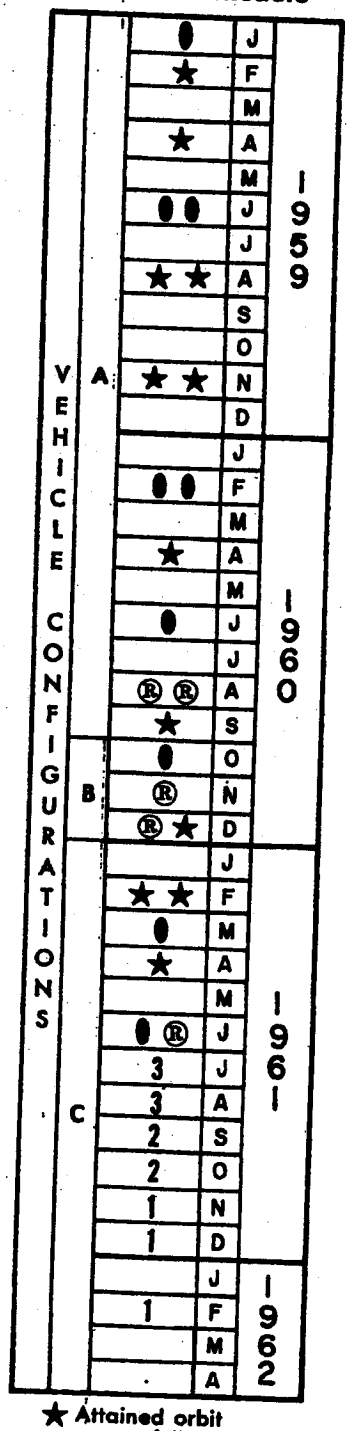
†Primary Tracking Stations (have command capability)

*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.

Launch Schedule



★ Attained orbit successfully.

Ⓡ Attained orbit and capsule recovered.

● Failed to attain orbit.

Flight History

DISCOVERER No.	DM-21 No.	AGENA No.	Flight Date	Remarks
				DISCOVERER FLIGHTS 0 THRU XX ARE ON PAGE A-6
XXI	261	1102	18 February	*Attained orbit successfully. Non-recoverable, radiometric 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.*

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 (continued)

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

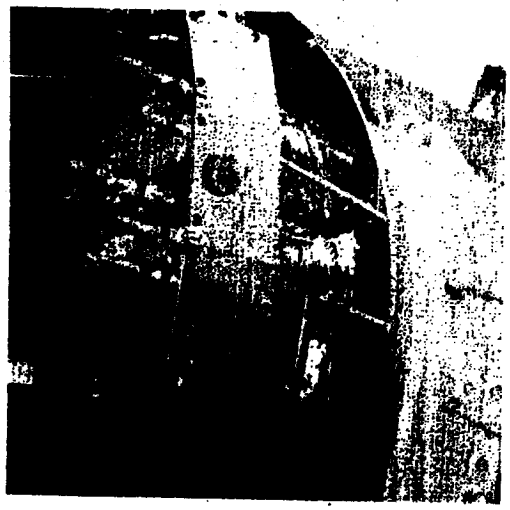


Figure 1 — Attitude control valve heating element installation on DISCOVERER XXV. Attitude control difficulty on DISCOVERER XXIII was attributed to sluggish or sticking valves resulting from extremely low temperatures encountered while on orbit.

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

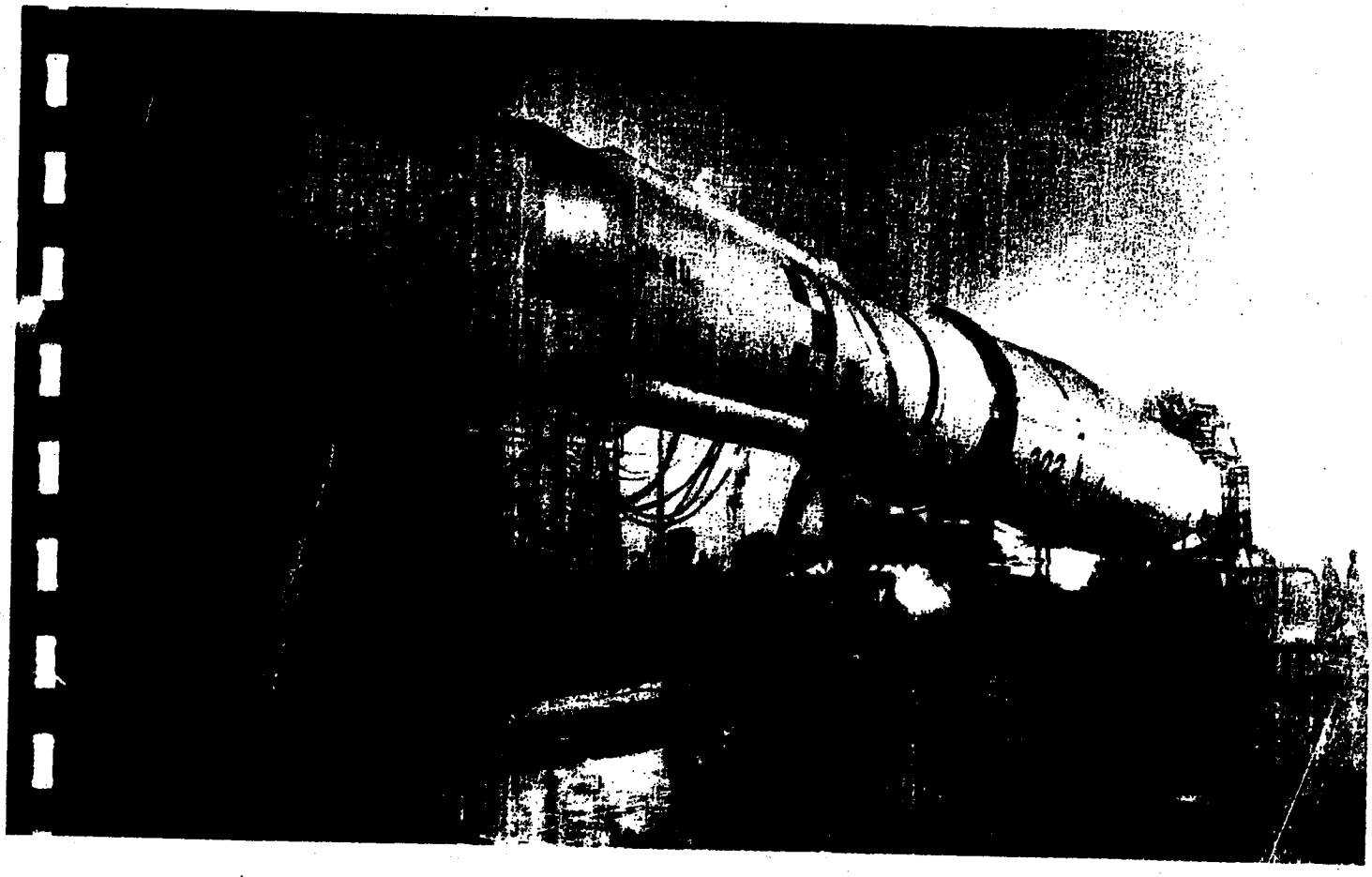


Figure 2 — AGENA 1107 and THOR 303 prior to their launch as DISCOVERER XXV on 16 June.

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

DISCOVERER XXV RECOVERY

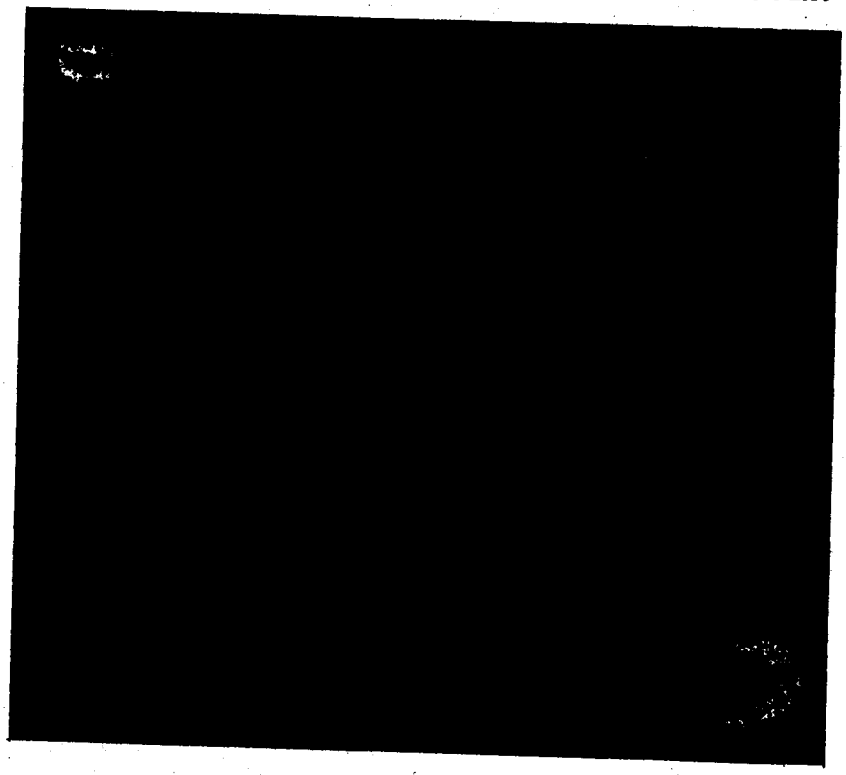
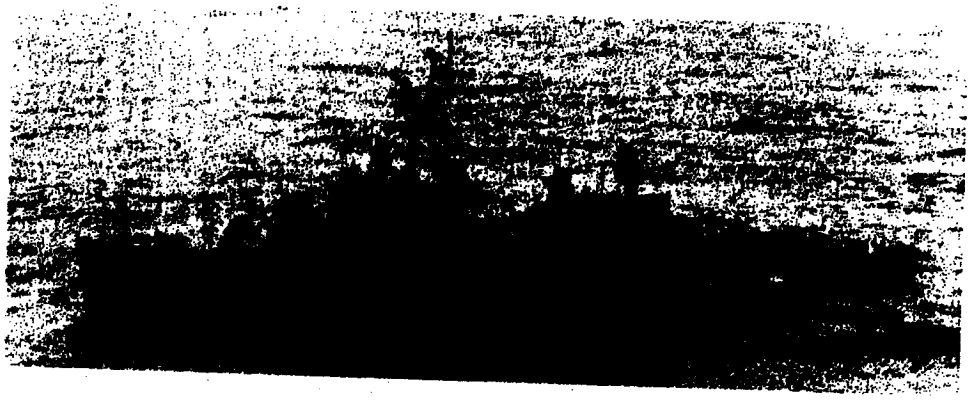


Figure 3 — Three-man Air Force para-rescue team with life rafts and capsule (above) capsule safely aboard the raft (left) and pick-up the morning of 19 June.



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)

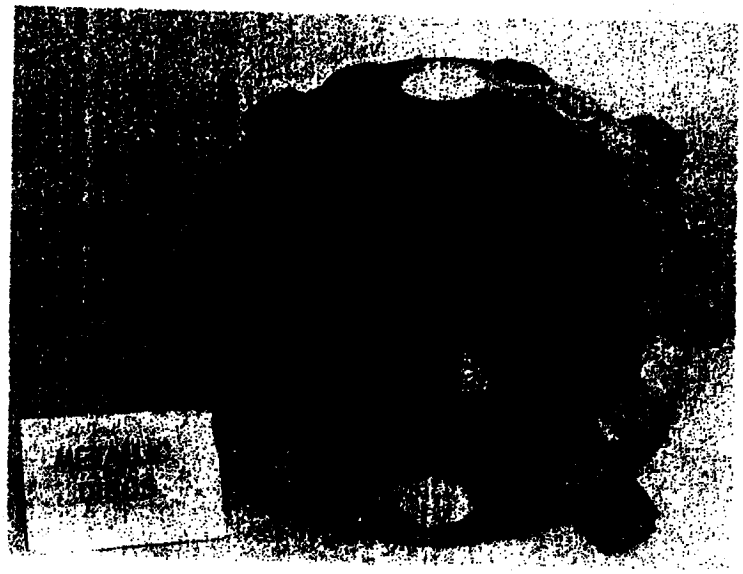


Figure 4 — Samples of titanium, cadmium, magnesium, nickel, yttrium, gold, bismuth and iron mounted on the DISCOVERER XXV capsule. The atomic structure of these samples is being compared with identical samples retained on earth to determine the effects of space radiation on these elements.

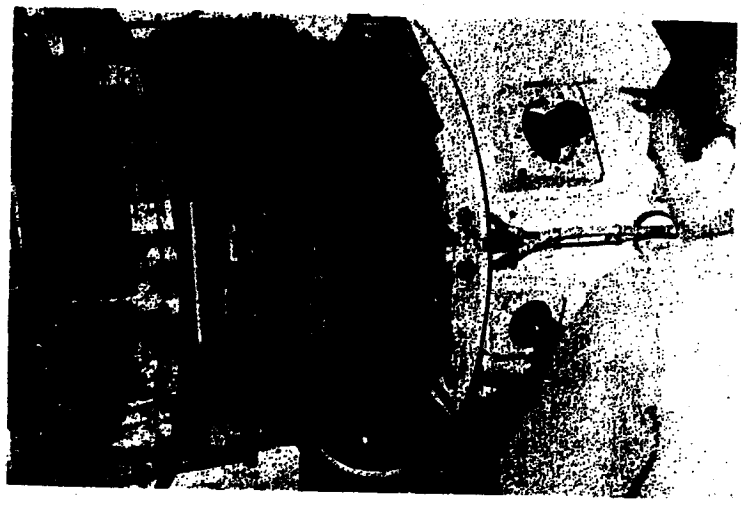
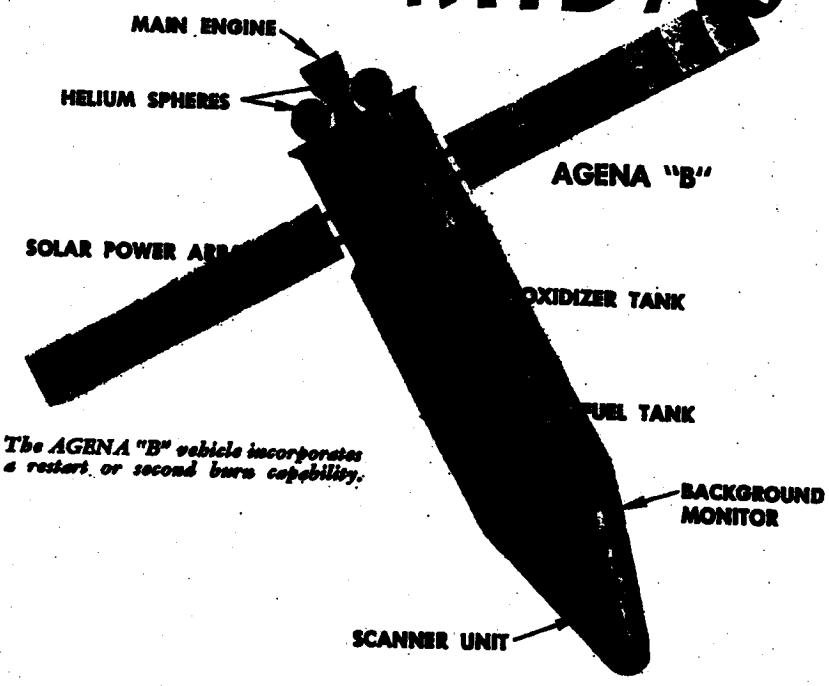


Figure 5 — Technicians installing the module which replaced the rear access door on DISCOVERER XXV and carried space research experiments furnished by the Air Force Geophysical Research Directorate.

MIDAS

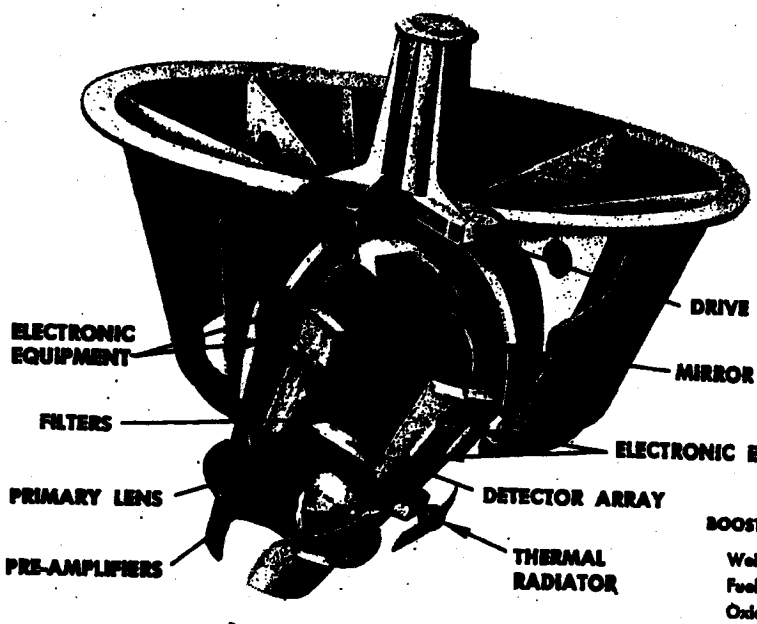
SECOND STAGE	AGENA "B"
Weight—	
Inert	1,763
Payload equipment	1,641
Orbital	3,404
Impulse Propellants	12,950
Fuel (UDMH)	
Oxidizer (IRFNA)	
Other	758
GROSS WEIGHT (lbs.)	17,112
Engine	XLR81-Ba-9
Thrust, lbs. (vac.)	16,000
Spec. Imp., sec. (vac.)	290
Burn Time, sec.	240
Restart Provisions	Yes

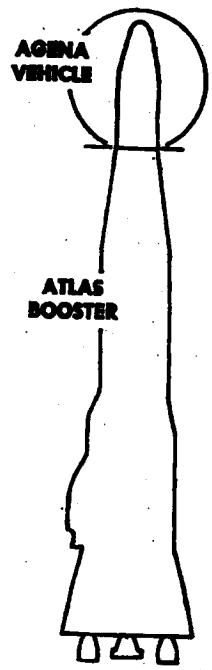


The AGENA "B" vehicle incorporates a restart or second burn capability.

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
GROSS WEIGHT (lbs.)		262,300
Engine—MA-2		
Thrust (lbs. vac.)	Boost	346,200
	Sustainer	79,700
Spec. Imp. (sec. vac.)	Boost	286
	Sustainer	310

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.

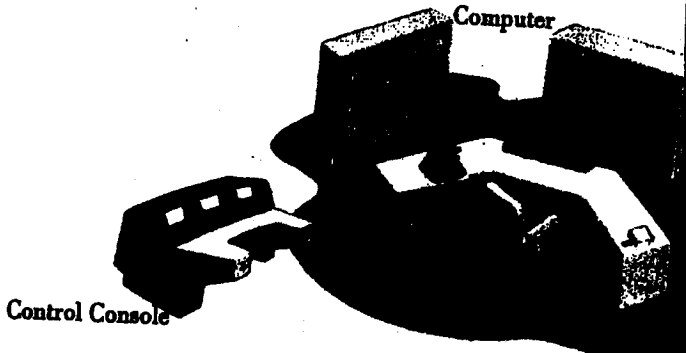
TECHNICAL HISTORY

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.

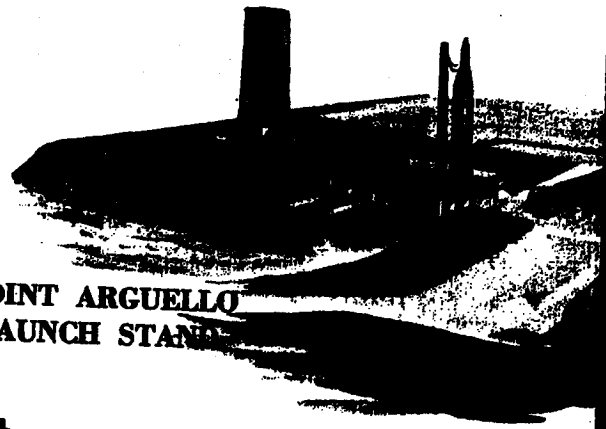
The first two R&D flights used the AGENA "A" and ATLAS "D" vehicle programmed to place the payload in a circular 261 nautical mile orbit. Subsequent R&D flights will utilize the ATLAS "D"/AGENA "B" configuration which will be programmed to place the payload in a circular 2,000 nautical mile polar orbit.

OPERATIONS CENTER

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.



TRACKING AND CONTROL



POINT ARGUELLO
LAUNCH STAND

SECRET