SECRET

V 4-2

CONFIDENTIAL

MONTHLY SUMMARY OF

SPACE

Systems Div...

ACTIVITIES

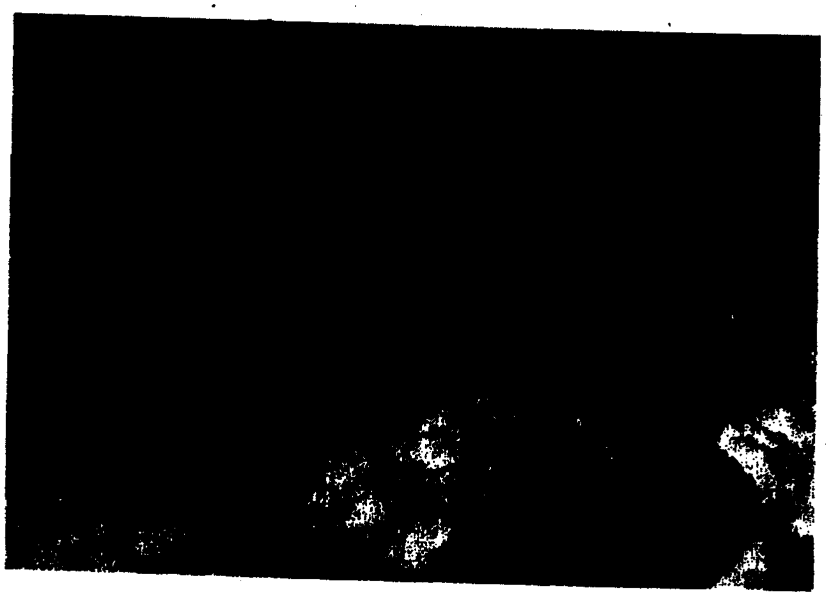
JULY 1961

DOWNGRADED AT ... INTERVALS;
NOT AUTOMATICALLY ... DIR 5200.10

SSLPR-20

SECRET

a foreword to...



SPACE

TABLE OF CONTENTS

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

SSLPR

24 August

Monthly Summary of SPACE SYSTEMS DIVISION ACTIVITIES JULY 1961

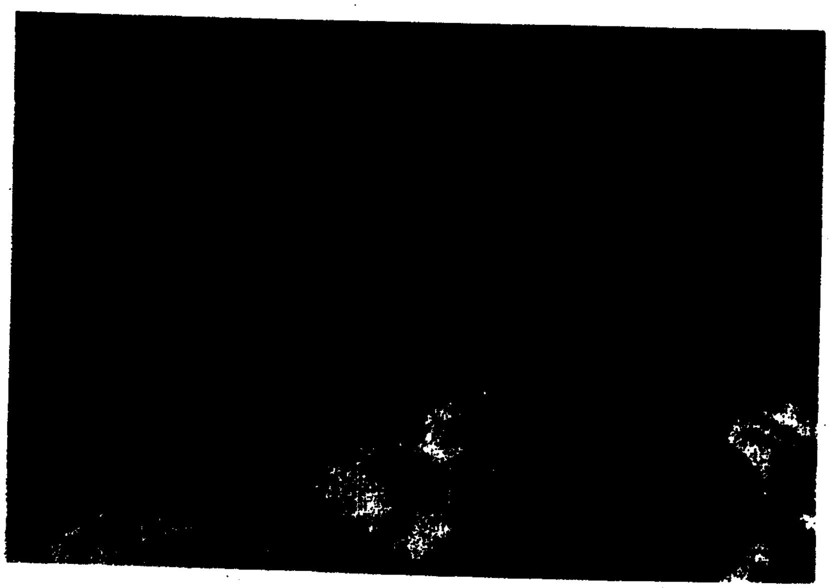
FOREWORD

During July, two space vehicles were launched successfully, contributing significantly to the progress of satellite system programs. DISCOVERER XXVI was placed in orbit on 7 July. Two days later, on its 32nd orbit, the satellite capsule was returned to the atmosphere and aerially recovered. On 12 July, the ATLAS-boosted MIDAS III was placed into a circular 1850 n.m. orbit. Payload data were received. Flight test records which have been reduced indicate that MIDAS III was successful. However, failure of one solar array to extend fully caused a partial power loss. Analysis is underway to determine the cause of this difficulty.

Robert E. Greer
for O. J. RITLAND
Major General, USAF
Commander

SATELLITE

SYSTEMS



DISCOVERER
MIDAS
BIOASTRONAUTICS
BLUE SCOUT
SAINT
VELA HOTEL

SATELLITE SYSTEMS

D
i
s
c
o
v
e
r
e
r

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 booster and the AGENA as the second stage, satellite vehicle. The program was established early in 1958 under direction of the Advanced Research Projects Agency, with technical management assigned to AFBMD. 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 advanced 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.

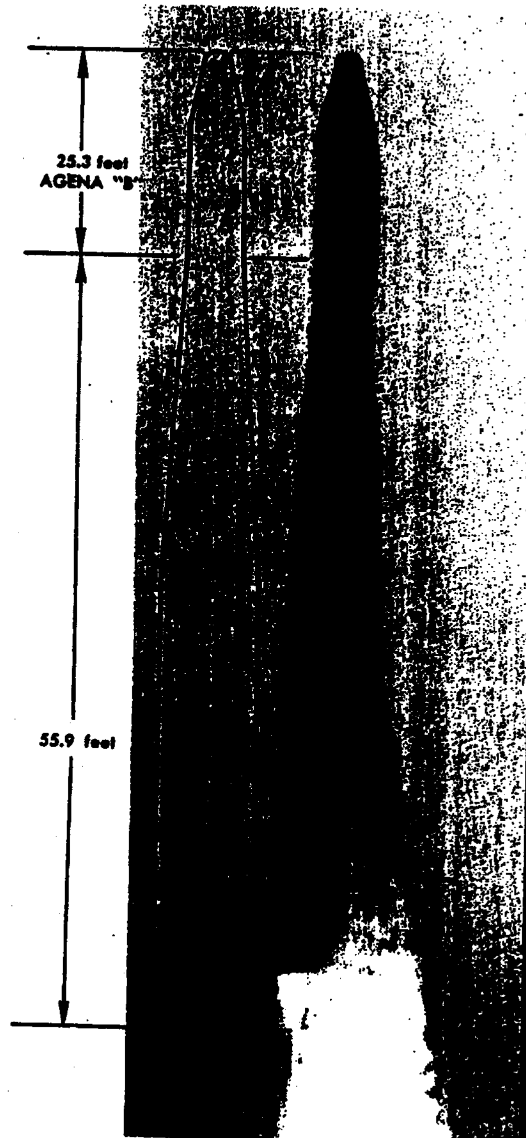
(e) Testing of ground support equipment and development of personnel proficiency.

(f) Conducting bio-medical experiments, including injection into orbit, re-entry and recovery.

PROGRAM SUMMARY

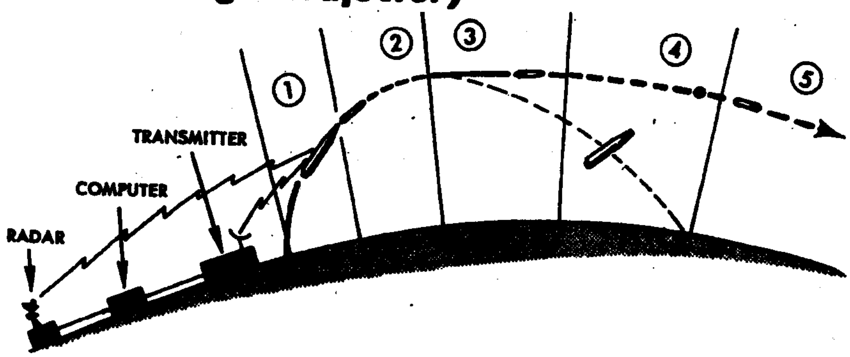
Early launches confirmed vehicle flight and satellite orbit capabilities, developed system reliability, and established ground support, tracking and data acquisition requirements. Later in the program, biomedical and advanced engineering payloads will be flight tested to obtain support data for more 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—	
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

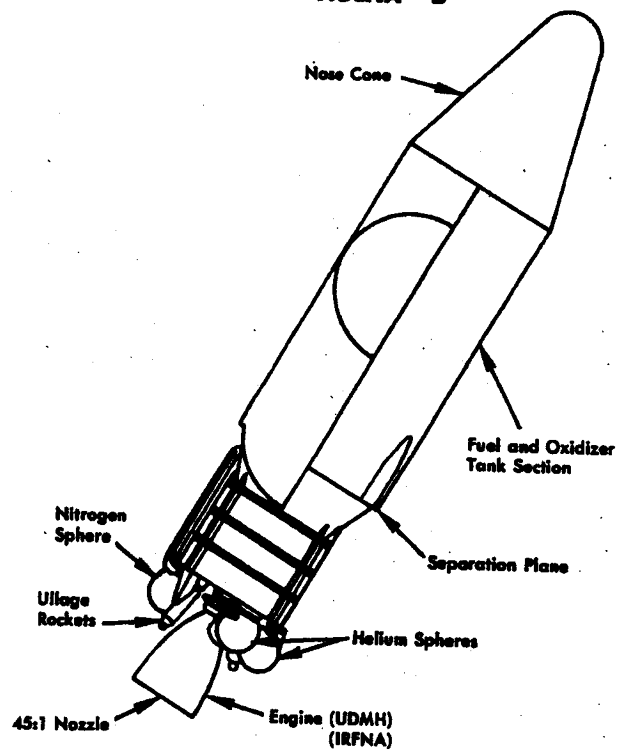
Powered Flight Trajectory



1. **First Stage Powered Flight** — 2.5 minutes duration, 78 n.m. downrange, guided by BTL guidance.
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 Air Force pararescue men and 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.

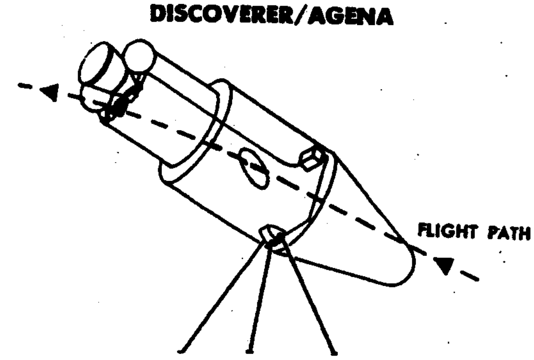
AGENA "B"



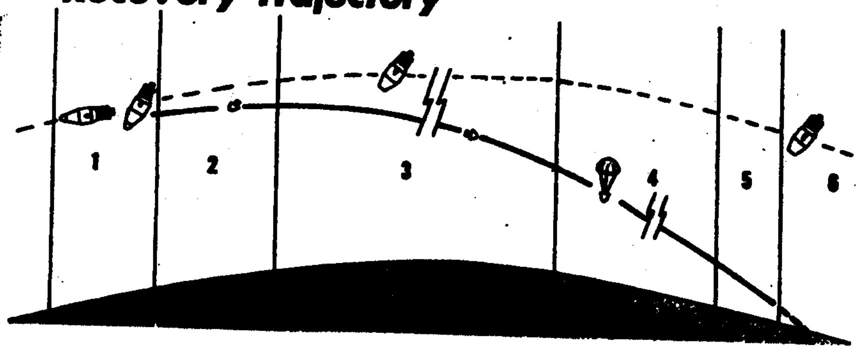
AGENA VEHICLE DEVELOPMENT

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.

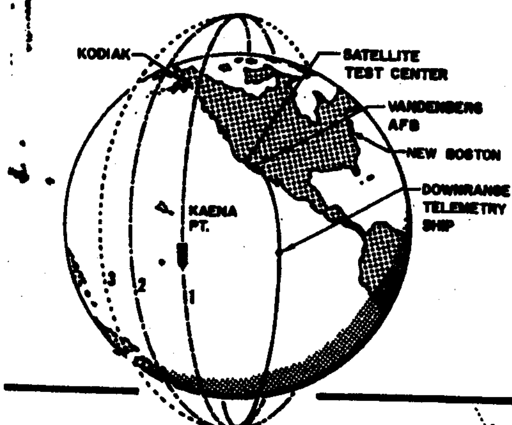
DISCOVERER/AGENA



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**—18 seconds duration, capsule separates, spin gas jets fire, retro rocket fires and de-spin gas jets 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.

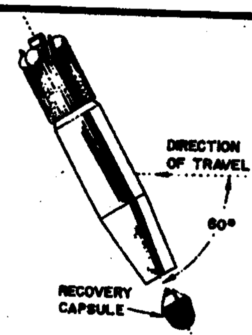


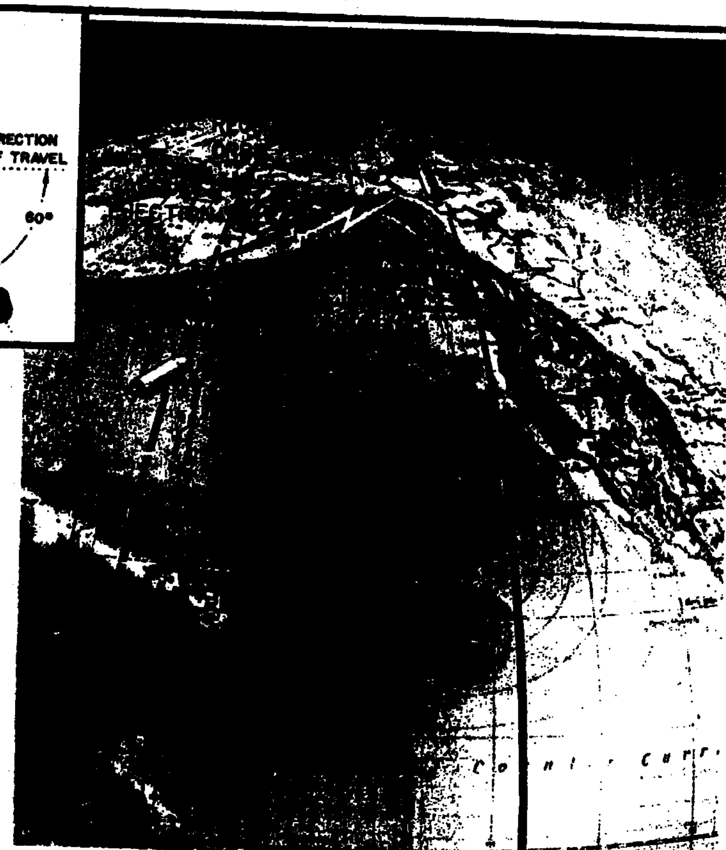
Orbital Trajectory

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 A-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, 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.*

GROUND SUPPORT FACILITIES

Facility	Equipment*	Flight Function
Satellite Test Center	ABCD	Orbital control, orbit computations and predictions, acquisition data for tracking stations, prediction of recovery area.
†Vandenberg AFB Tracking Station	BDEFGHI	Ascent and orbital tracking, telemetry reception, trajectory measurements, command transmission.
Downrange Telemetry Ship	BFHI	Telemetry reception and tracking during ascent and orbit injection.
†New Hampshire Tracking Station	BDEFGHI	Orbit tracking, telemetry reception, commands to satellite.
†Kodiak Tracking Station	BDEFGHI	Orbit tracking, telemetry reception, initial acquisition on pass 1, monitor events in recovery sequence.
†Hawaiian Tracking Station	BDEFGHI	Orbit tracking, telemetry reception and transmission of commands to satellite.
Hickam AFB Oahu, Hawaii	D	Over-all direction of capsule recovery operations.
Tern Island	BFGI	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. VERLORT
- F. VHF FM/FM Telemetry Station
- G. VHF Direction Finding Equipment
- H. Doppler Equipment
- I. VHF Telemetry Antenna

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

Flight History

DISCOVERER No.	DM-21 No.	AGENA No.	Flight Date	Remarks

DISCOVERER FLIGHTS 0 THRU XX ARE ON PAGE A-6

DISCOVERER No.	DM-21 No.	AGENA No.	Flight Date	Remarks
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.*
XXVI	308	1109	7 July	*Attained orbit successfully. Capsule was ejected on the 32nd orbit and aerial recovery was accomplished. All objectives achieved.*
XXVII	322	1110	21 July	*Failed to attain orbit because of severe booster pitch oscillation.*

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.*

Monthly Progress — DISCOVERER

Flight Test Progress

DISCOVERER XXVI Flight

• DISCOVERER XXVI was launched from Vandenberg Air Force Base at 1629 PDT on 7 July and was injected into a near-nominal orbit. All events during launch, boost, separation, coast, AGENA burn and orbital injection occurred as planned except for a longer than normal AGENA burn time. This is attributed to an error in the accelerometer-integrator system. Table I shows the predicted and attained orbital parameters. (C)

Event	Programmed	Actual
Apogee, statute miles	293.6	505.5
Perigee, statute miles	147.4	142.8
Period, minutes	91.6	95.02
Eccentricity	0.0175	0.0421
Inclination Angle, degrees	81.5°	82.9°

Table I. Comparison of Programmed and Actual Orbital Parameters for DISCOVERER XXVI

• All subsystems operated satisfactorily throughout the orbital flight. The thermostatically controlled electric heaters installed on the control valves performed successfully. As planned, capsule recovery

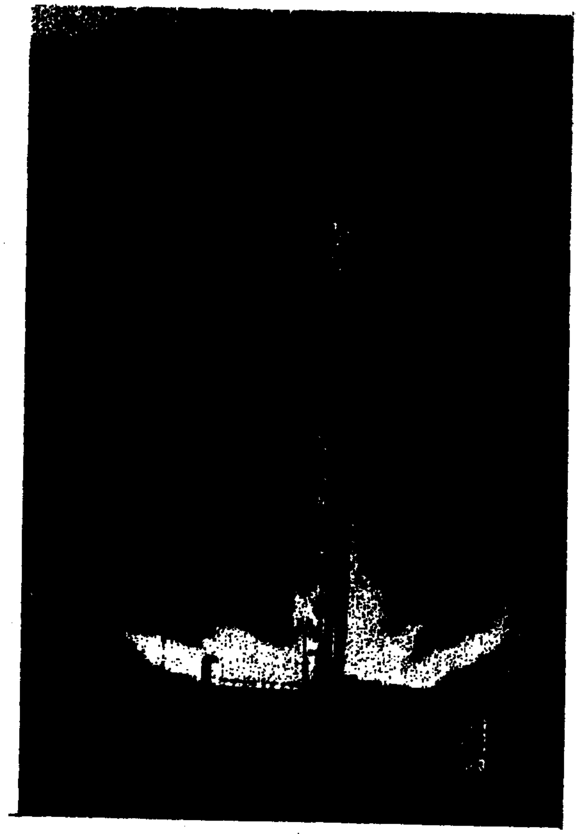


Figure 1. Launch of DISCOVERER XXVI on 7 July from Vandenberg Air Force Base.

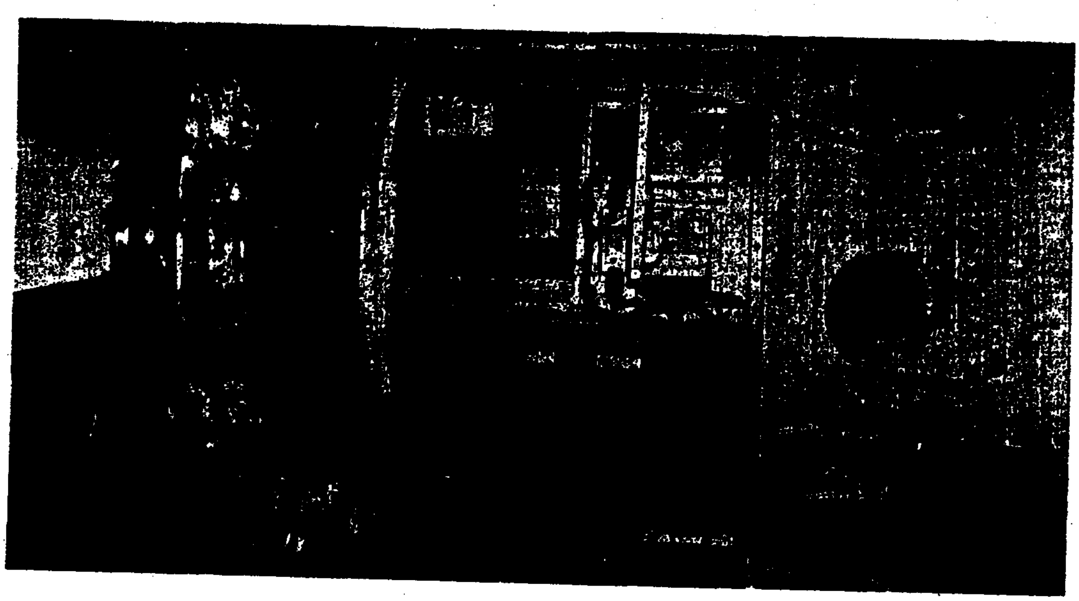
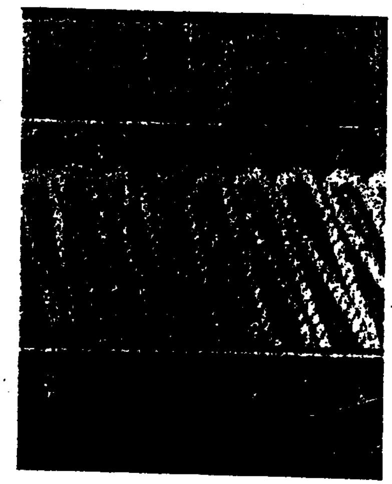


Figure 2. Discoverer XXVI AGENA B vehicle showing the space research instruments furnished by the Geophysical Research Directorate (center). The new "scuppers" are visible on the right of the experiment packages. They are part of a system for draining propellant slippage at liftoff. The rectangular box on the lower left is the attitude control valve heating element installation. These modifications corrected problems that had occurred on previous flights.



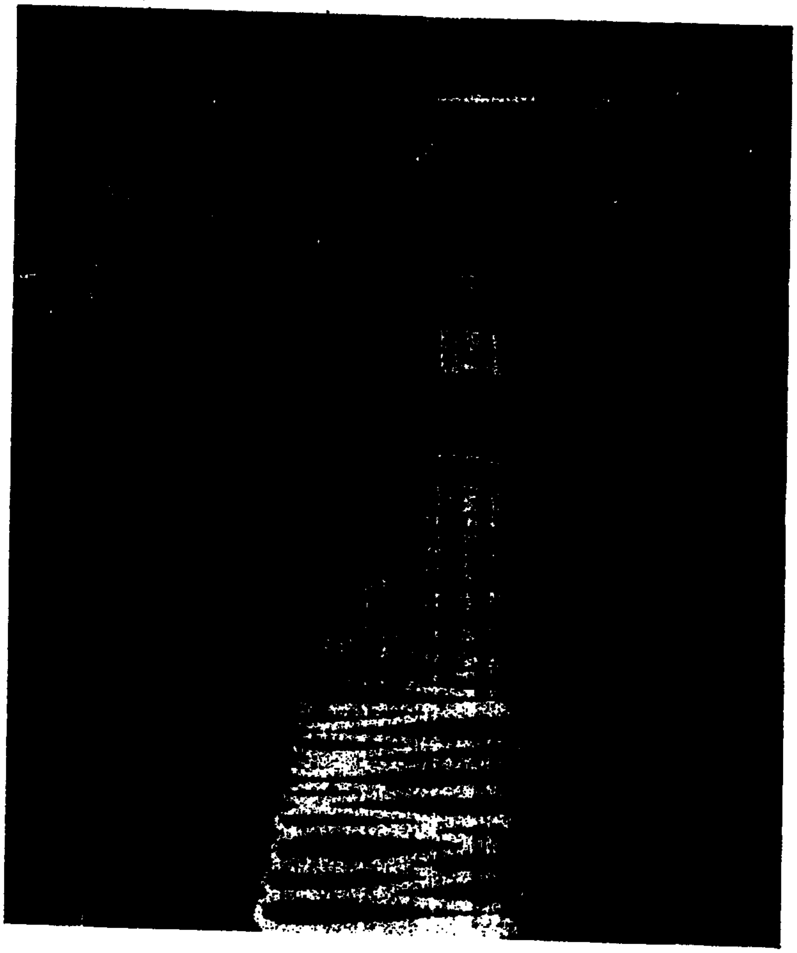
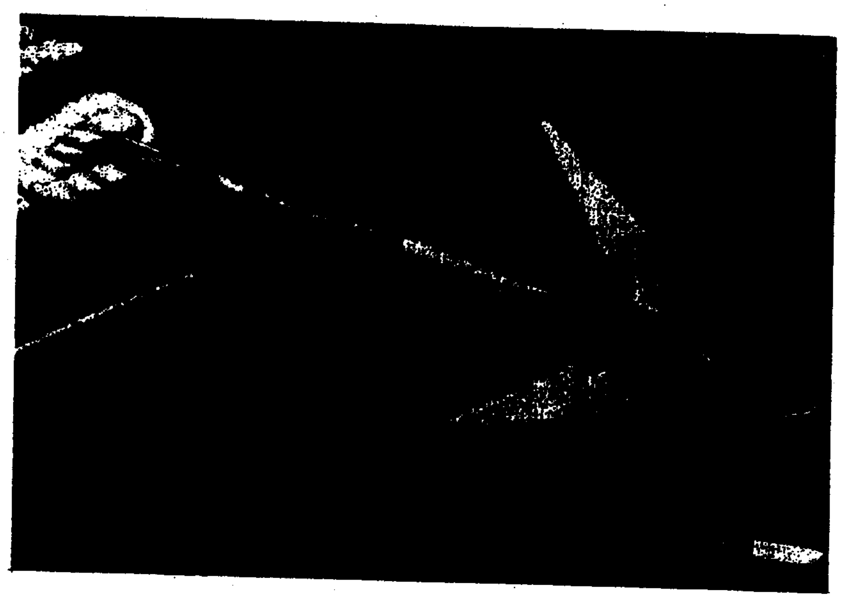


Figure 3. Recovery force airman (left) tying shock cord into the trough of the recovery aircraft. Cord from the winch reel is tied in zig-zag fashion to the trough. The insert (above) provides a close-up of the ties. When the parachute is caught, the string ties break and help cushion the shock. The hook which snares the parachute of the descending capsule is shown below.



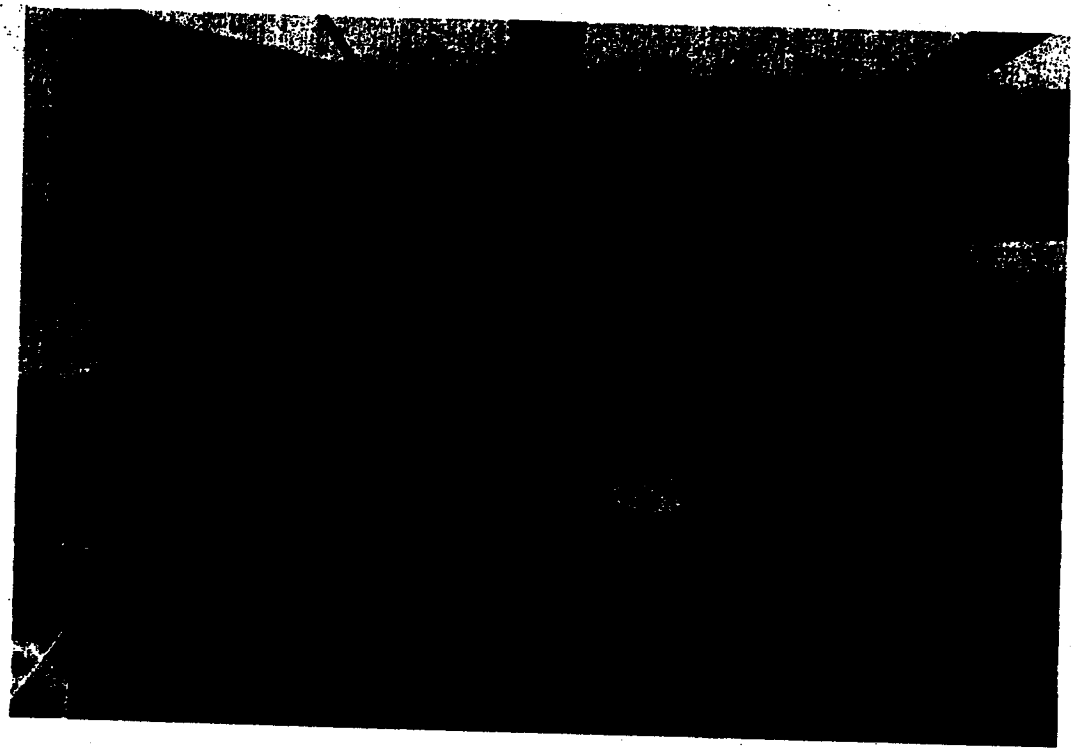
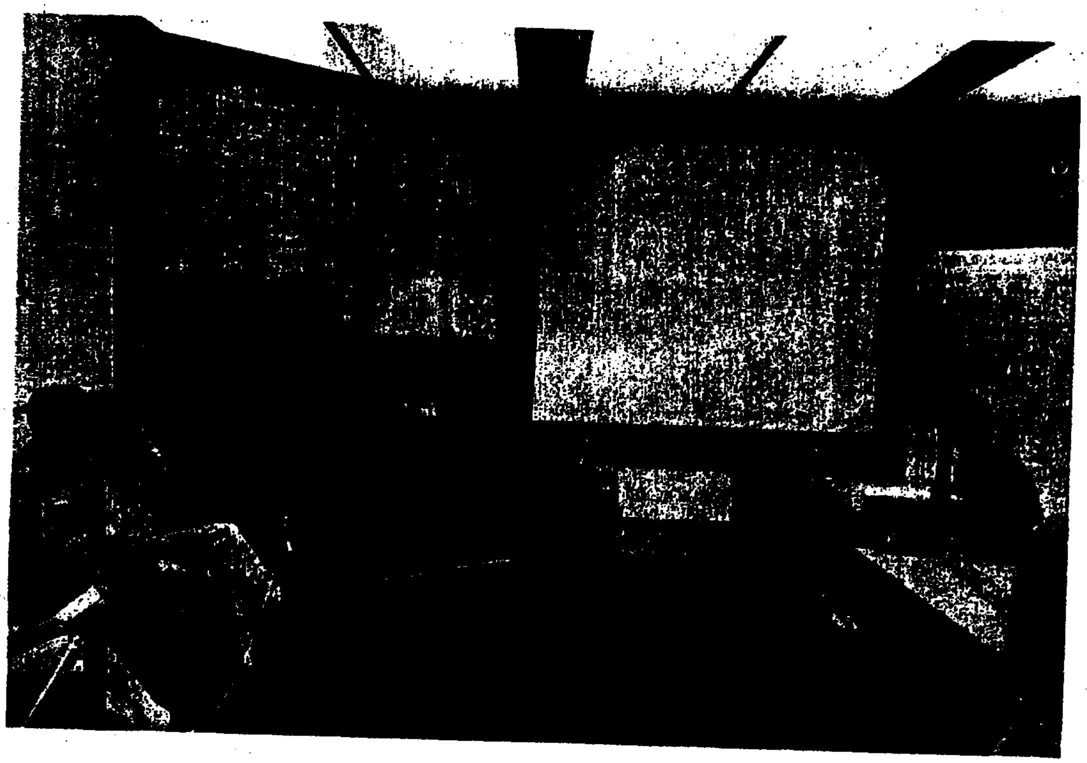
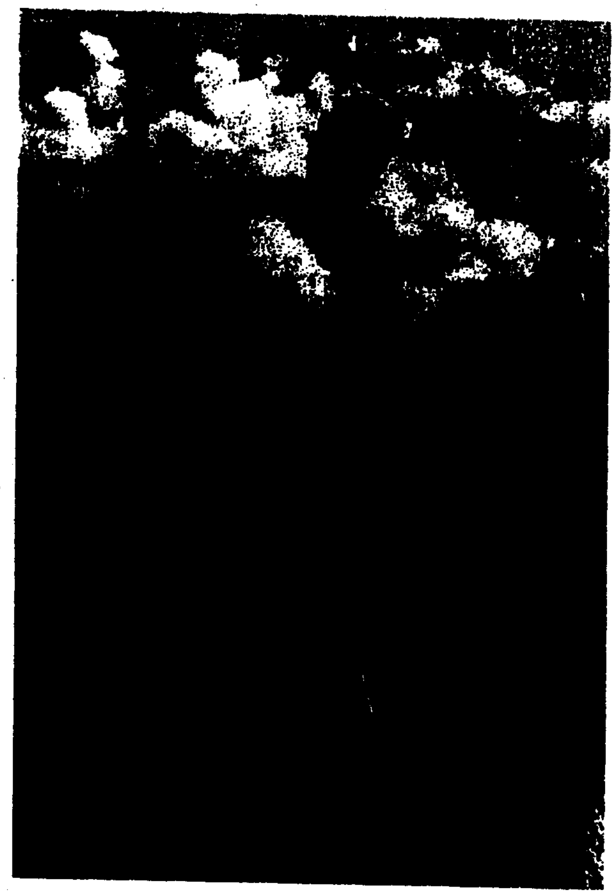
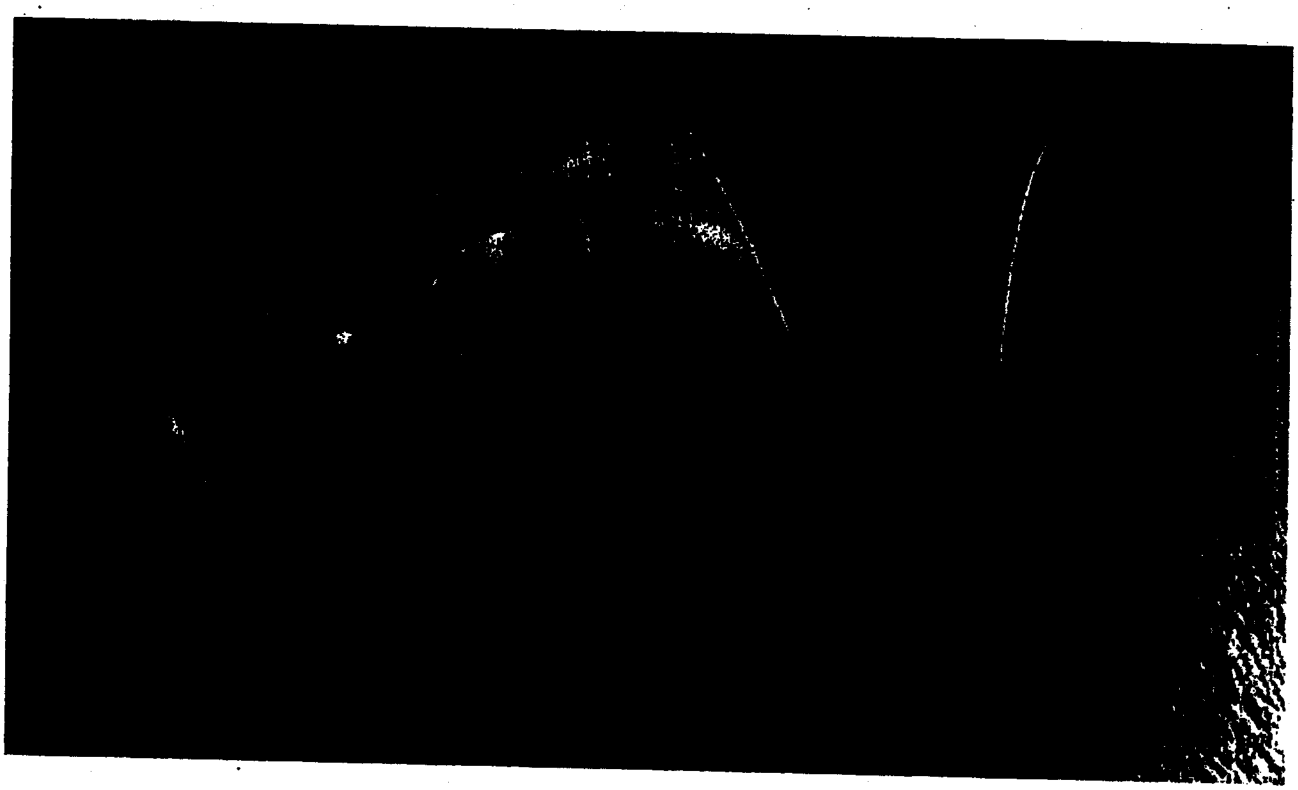


Figure 4. Views of the Hawaiian Control Center during recovery operations which resulted in the air-recovery of the DISCOVERER XXVI capsule. Prior to the start of the recovery operation, the predicted capsule impact point is determined. Then the aerial and sea forces are deployed and controlled from this center. All reports of contact are recorded on the glass charts, left. Reports of bearings taken on the descending capsule by the recovery craft, Tern Island and Kaena Point are projected on the screen, center.



DISCOVERER XXVI CAPSULE RECOVERY





was initiated on the 32nd pass (two days on orbit) at 1905 PDT on 9 July. All events occurred as programmed and the capsule followed the predicted descent trajectory. The capsule was sighted northwest of Hawaii and aerial recovery was accomplished. This was the fourth DISCOVERER capsule recovered by the airborne forces, two other capsules have been recovered from the sea. Following capsule ejection, the AGENA satellite reoriented to its normal "on-orbit" attitude and operated satisfactorily for the remainder of its battery life. (C)

DISCOVERER XXVI Experiments

- As part of the continuing program designed to measure the space environment and determine radiation effects on various materials, nearly 45 pounds of instruments and specimens were carried on the DISCOVERER XXVI satellite vehicle and its capsule. The capsule carried "poker chip" samples of iron, nickel, ytterium, titanium, magnesium, lead and bismuth. Some of the samples were returned to the Air Force Geophysical Research Directorate for evaluation and the remainder are being analyzed by Lockheed scientists. Three canisters were also recovered with the DISCOVERER XXVI capsule. One contained various dosimeters and was returned to the Air Force Special Weapons Center. Another contained inert biological materials (cellulose products) and was transmitted to the Space Systems Division for analysis. Various metal and film samples were included in the third canister to provide information on the effects of space radiation on photographic materials. Analysis of the specimens is in process. (S)

- The non-recoverable Geophysical Research Directorate equipment, which was mounted on the module that replaces the engine access door, included two atmospheric density gages, two micrometeorite detectors, a cosmic ray monitor and temperature probes. During the flight, data from these instruments were telemetered to tracking stations via the AGENA telemetry system. The information was sent to the Geophysical Research Directorate for reduction and analysis. Inspection of the raw data indicated that all instruments operated satisfactorily and the data obtained appeared to be valid. (U)

DISCOVERER XXVII Launch

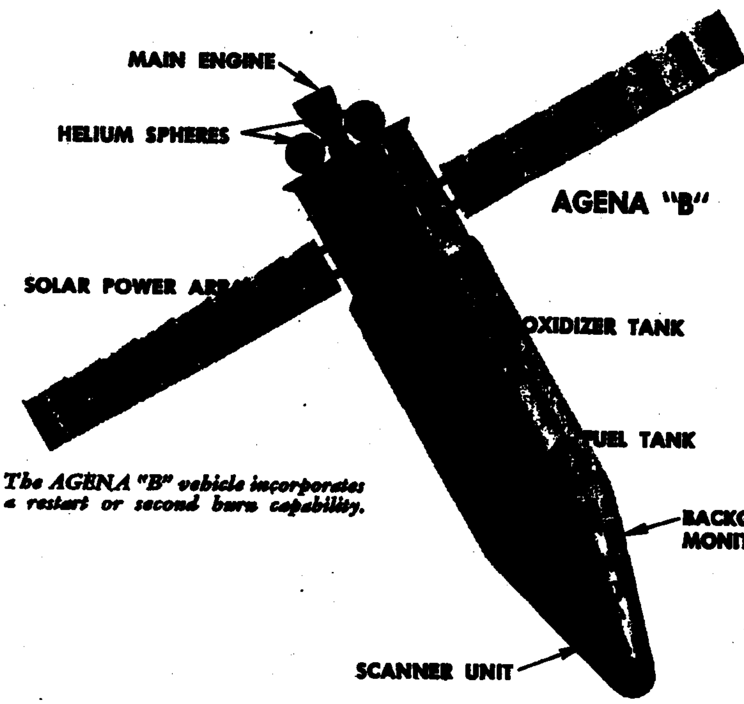
- DISCOVERER XXVII was launched from Vandenberg Air Force Base at 1535 PDT on 21 July. A DM-21 booster pitch oscillation, evident immediately after launch, became severe after approximately one minute of flight. The vehicle apparently broke up at this time. A destruct command was sent at T + 95.1 seconds. Three minutes after launch the DISCOVERER satellite S-band beacon signal was lost and approximately two and one-quarter minutes later, booster telemetry was lost. The DISCOVERER satellite reached an altitude of only 35,000 feet and impacted twelve to fifteen miles downrange. Ships from the Pacific Missile Range located main parts of the DM-21 booster, but were unable to recover the parts connected with the failure. (C)

Future Flights

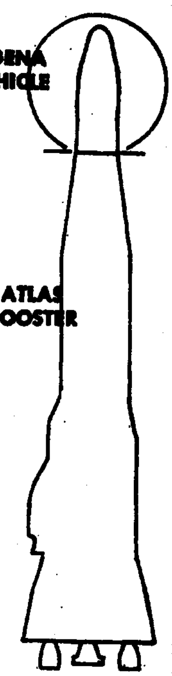
- The next three DISCOVERER satellites will carry recoverable capsules with recovery planned after between one to four days in orbit. (C)

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

MIDAS



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



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	356,000
	Sustainer	82,100
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. 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.

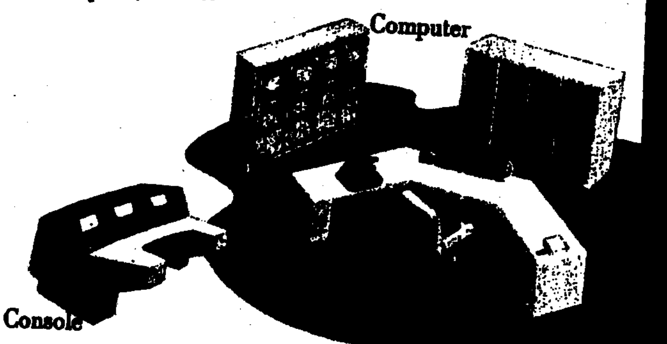
TECHNICAL HISTORY

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.

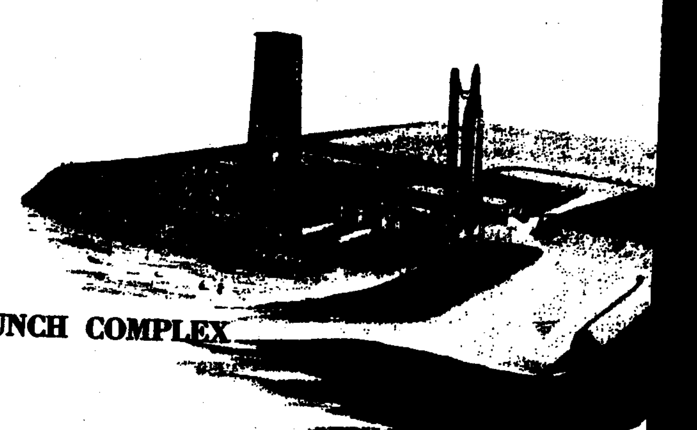
The first two R&D flights used the AGENA "A" and ATLAS "D" vehicle programmed to place the payload in a circular 261 nautical mile orbit. Subsequent R&D flights utilize the ATLAS "D"/AGENA "B" configuration programmed to place the payload in a circular 2,000 nautical mile polar orbit.

CONTROL AND DISPLAY FACILITY

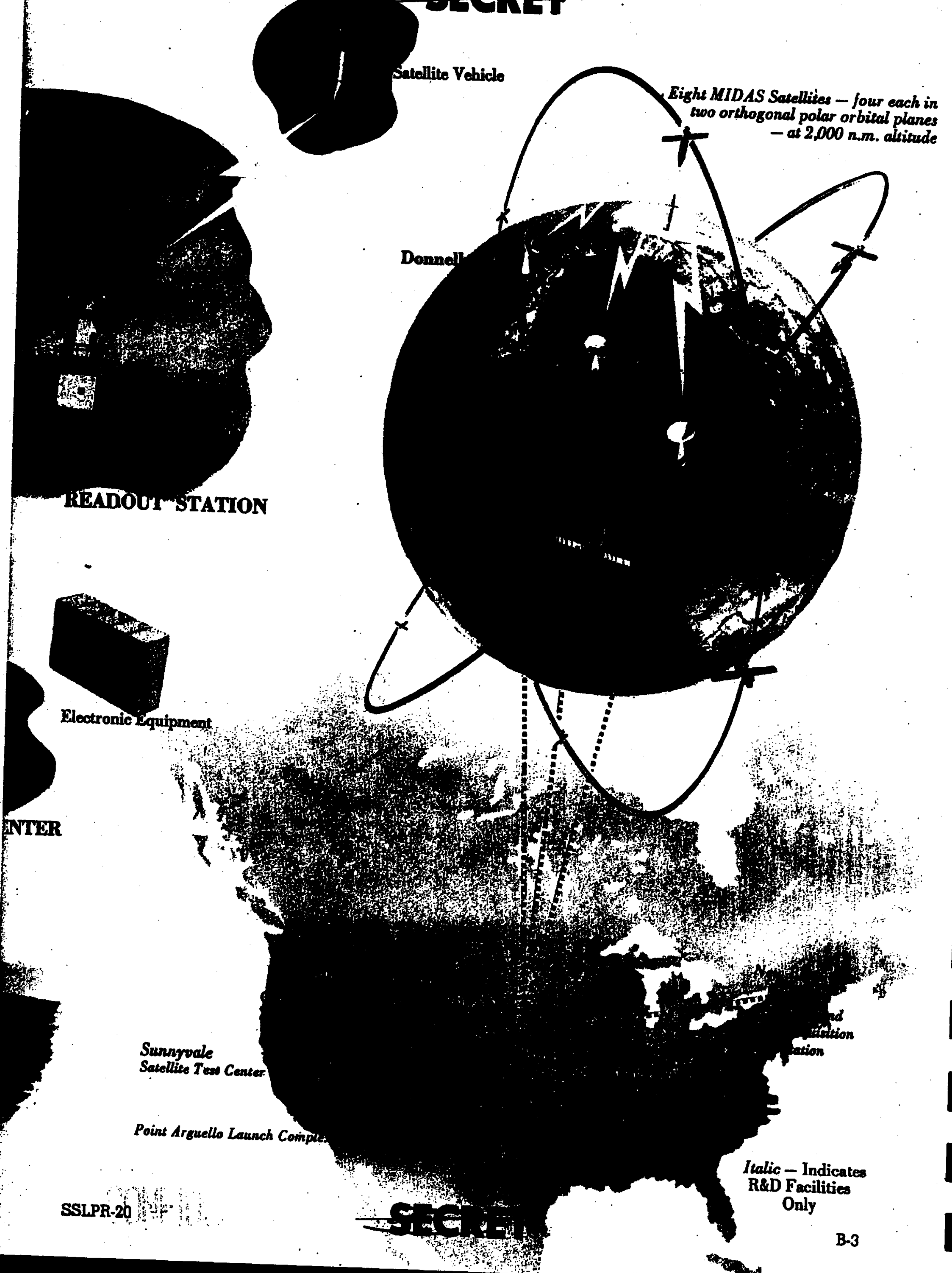
Orbiting satellites detect infrared radiation emitted by ICBM's in powered flight. Data is telemetered instantaneously to Midas Tracking and Control Center via far north Readout Stations. Decoded data reveal approximately the number of missiles launched and launch location, direction of travel and burning characteristics. This data is displayed in near real time on the control consoles and operational displays at the Control and Display Facility. 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 R&D satellites into polar orbits.



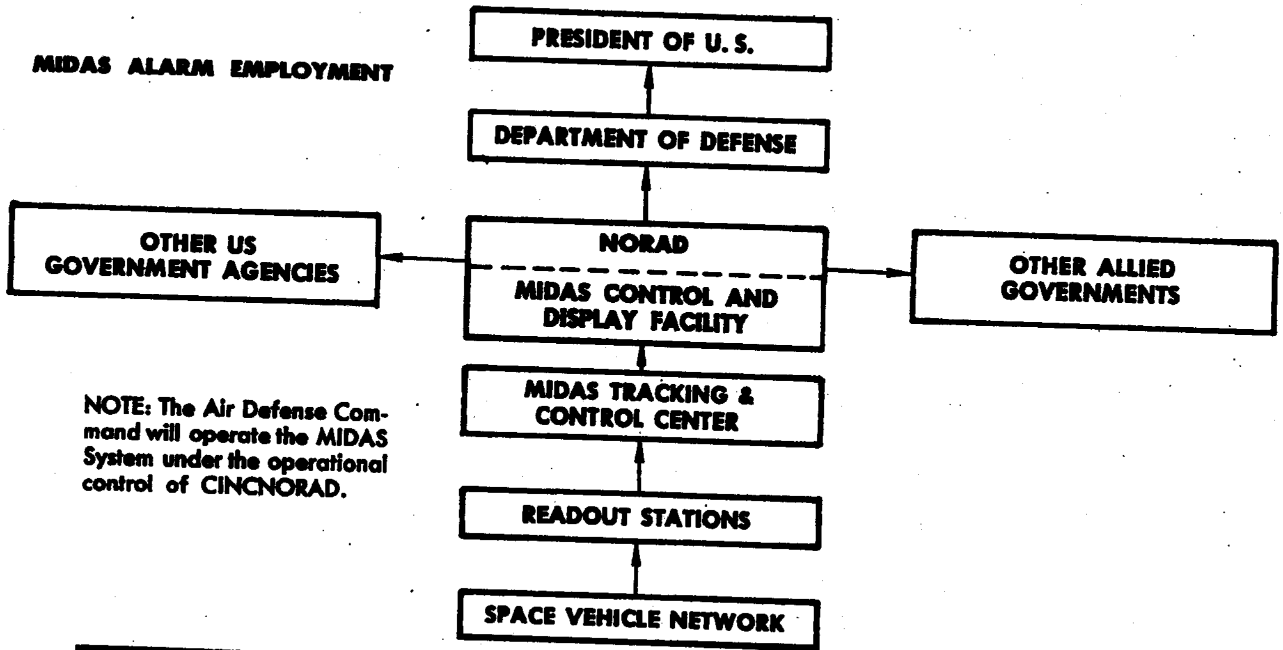
TRACKING AND CONTROL C



LAUNCH COMPLEX


Satellite Vehicle
Eight MIDAS Satellites — four each in two orthogonal polar orbital planes — at 2,000 n.m. altitude
Donnell
READOUT STATION
Electronic Equipment
NTER
Sunnyvale Satellite Test Center
Point Arguello Launch Comple
Italic — Indicates R&D Facilities Only

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 Control and Display Facility. 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.

Flight History

MIDAS No.	Launch Date	ATLAS No.	AGENA No.	Remarks
I	26 February	29D	1008	*Did not attain orbit because of a failure during ATLAS/AGENA separation.*
II	24 May	45D	1007	*Highly successful. Performance with respect to programmed orbital parameters was outstanding. Useful infrared data were observed and recorded.*
RM-1	20 December	DISCOVERER Vehicle		*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.*
RM-2	18 February	DISCOVERER Vehicle		*All channels functioned properly and valid data were obtained on six stable orbits. Data confirmed previous radiometric measurements.*
III	12 July	97D	1201	*Extremely successful. Second firing of the second stage occurred as programmed. AGENA B vehicle was stabilized in an 1850 nautical mile circular orbit with an eccentricity of 0.0039. Operation of the payload and data link was excellent. Because of an electrical power loss, apparently caused by the failure of one solar array panel to extend, data acquired subsequent to pass five was limited to Van Allen belt radiation information. Inability to properly control power consumption by appropriate and timely vehicle command programming resulted in nearly complete power deterioration within the succeeding several orbits. Van Allen radiation measurements will be obtained during the anticipated 60-90 day battery life of the High Energy Proton Damage Experiment (HEPDEX) package.*