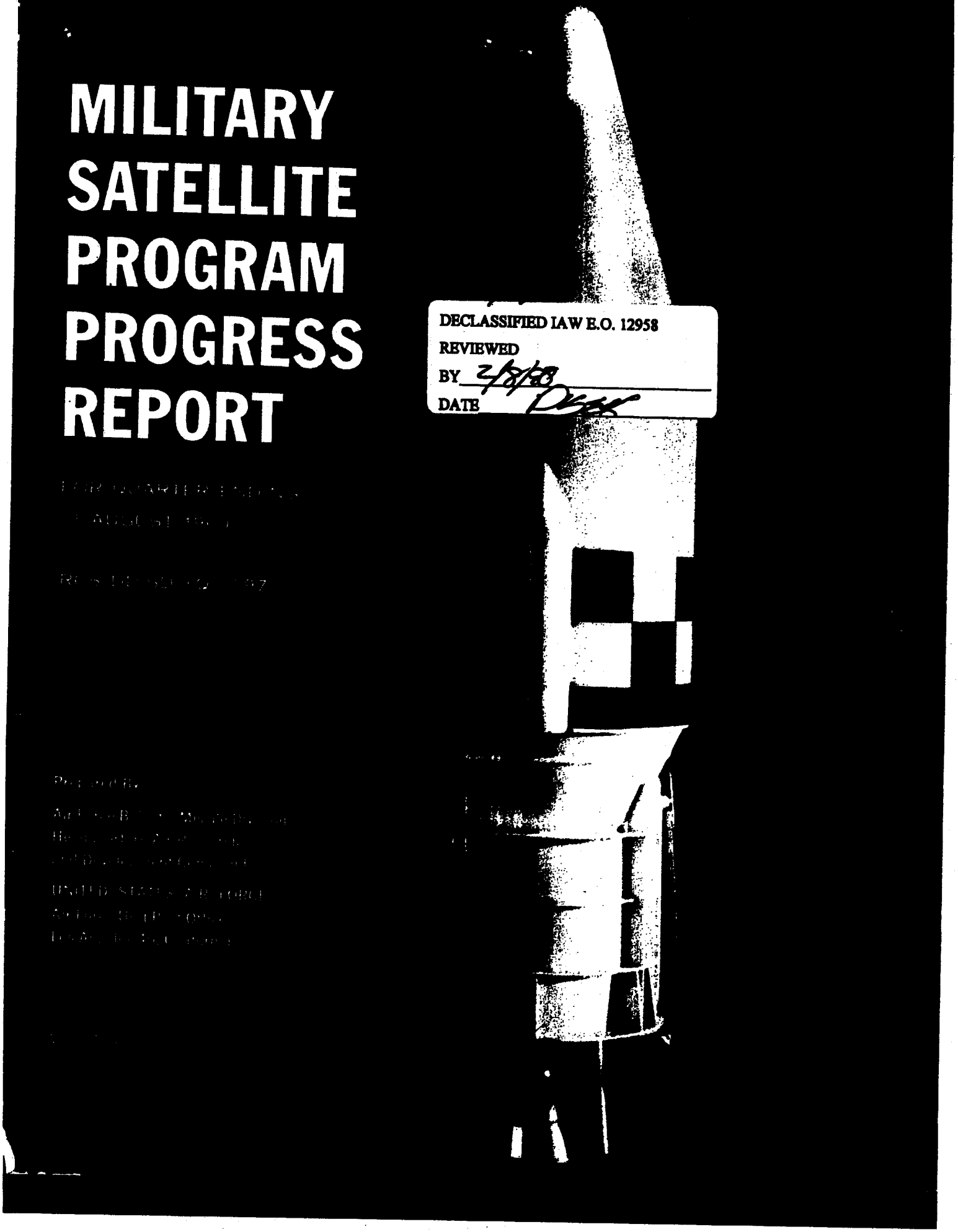
MILITARY SATELLITE PROGRAM PROGRESS REPORT



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MILITARY SATELLITE PROGRAM PROGRESS REPORT

Quarter Ending 31 August 1960

RCS DD-DR&E(Q) 397

WDLPM-4-236 13 September 1960

FOREWORD

During this quarter two DISCOVERER capsules were recovered after extended exposure to the space environment. Recovery of the capsule of DISCOVERER XIII marked the first recovery of an object from extended space flight. Subsequent recovery of the capsule from DISCOVERER XIV was the first recovery of an object from space by an aircraft.

Each system covered in this report is preceded by a concise history of administration, concept and objectives. This will be of assistance to new readers of the report and will make the quarterly report more meaningful in terms of total program objectives.

for O. J. RITLAND
Major General, USAF
Commander

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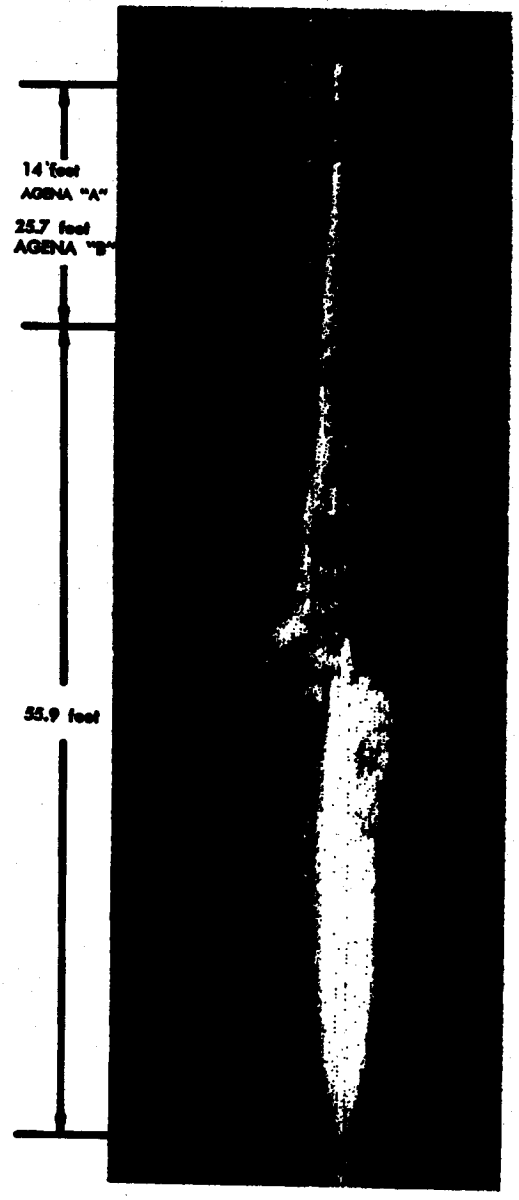
Discoverer



The DISCOVERER Program consists of the design, development and flight testing of 37 two-stage vehicles, using the THOR IRBM 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 Project's 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 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 overall operational control exercised by the Satellite Test Center, Palo Alto, California.

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

SECOND STAGE	AGENA "A"	AGENA "B"	
Weight—			
Inert	1,262	1,328	1,346
Payload equipment	497	887	915
Orbital	1,759	2,215	2,216
Impulse propellants	6,525	12,950	12,950
Other	378	511	511
TOTAL WEIGHT	8,662	15,676	15,722
Engine Model	YLR81-Ba-5	XLR81-Ba-7	XLR81-Ba-9
Thrust-lbs., vac.	15,600	15,600	16,000
Spec. Imp.-sec., vac.	277	277	290
Burn time-sec.	120	240	240
THOR BOOSTER		DM-18	DM-21
Weight—Dry		6,950	6,500
Fuel		33,700	33,700
Oxidizer (LOX)		68,200	68,200
GROSS WEIGHT (lbs.)		108,850	108,400
Engine		MB-3 Block 1	MB-3 Block 2
Thrust, lbs. (S.L.)		152,000	167,000
Spec. Imp., sec. (S.L.)		247.8	248.3
Burn Time, sec.		163	148

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Telemetry ships are positioned as required by the specific mission of each flight. Figures 2 and 3 show a typical launch trajectory from Vandenberg Air Force Base, and figure 3 shows schematically a typical orbit. An additional objective of this program is the development of a controlled re-entry and recovery capability for the payload capsule (Figure 4). 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 aircraft and for sea recovery by Navy surface vessels. The recovery phase of the program has provided advances in re-entry vehicle technology. This information will be used in support of more advanced projects, including the return of a manned satellite from orbit.

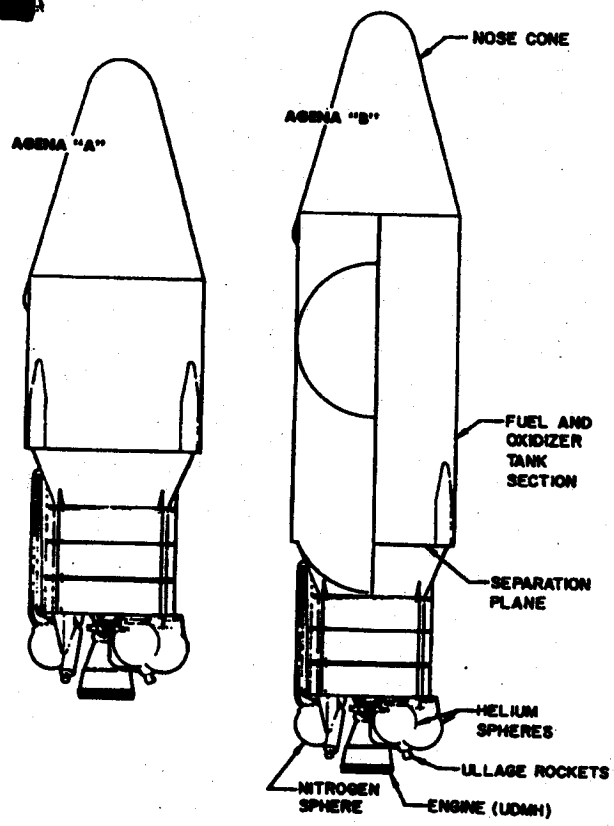
FLIGHT VEHICLE

The three versions of flight test vehicles used in the DISCOVERER Program are defined in the launch schedule shown on page A-5. Specifications for the two THOR configurations and three AGENA configurations used are given on page A-1.

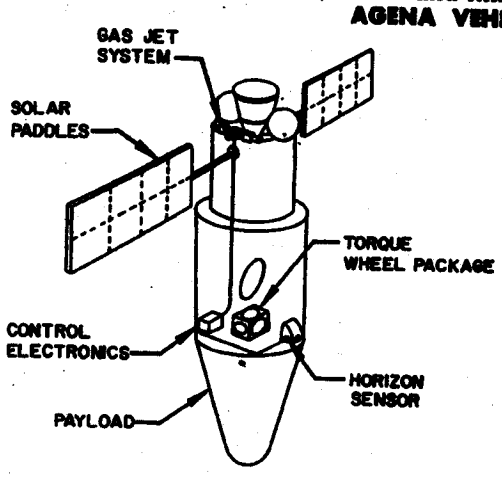
AGENA VEHICLE DEVELOPMENT

The AGENA vehicle was originally designed by the Air Force as the basic satellite vehicle for Advanced Military Reconnaissance Satellite Systems Programs. Basic design was based on use of the ATLAS ICBM as the first stage. ATLAS trajectory characteristics and the stringent eccentricity requirements of the advanced programs led to the selection of a guidance system suited to achieving orbital injection in a horizontal attitude. As a result, an optical inertial system was developed for vehicle guidance and a gas jet system for orbital attitude control. An urgent need for attaining higher altitude orbits resulted in development of the AGENA "B" versions. The YLR81 Ba-5 version of the LR81-Ba-3 engine (Bell Hustler engine developed for B-58 aircraft) is used on AGENA "A" vehicles. The YLR81-Ba-5 version of this engine was developed to provide increased performance through the use of unsymmetrical di-methyl hydrazine (UDMH) fuel instead of JP-4.

Early AGENA "B" vehicles will use the YLR81-Ba-7 version of this engine. The majority of AGENA "B" vehicles will use the XLR81-Ba-9 engine incorporating a nozzle expansion ratio of 45:1, and providing a further increase in performance capability including engine restart and extended burn-capability.



SAMOS and MIDAS AGENA VEHICLE

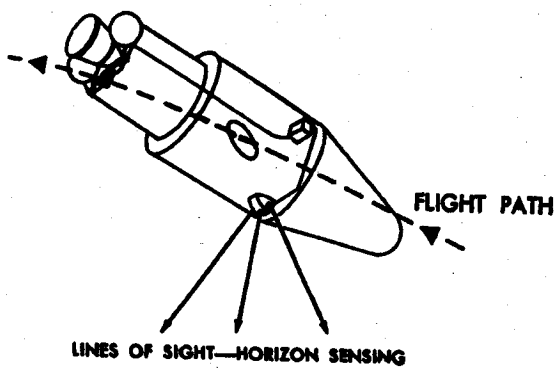


PERFORMANCE CAPABILITIES

ALTITUDE
200–20,000 MILES

ATTITUDE
ROLL – 0.1 DEGREE
PITCH – 0.1 DEGREE
YAW – 1 DEGREE

DISCOVERER/AGENA



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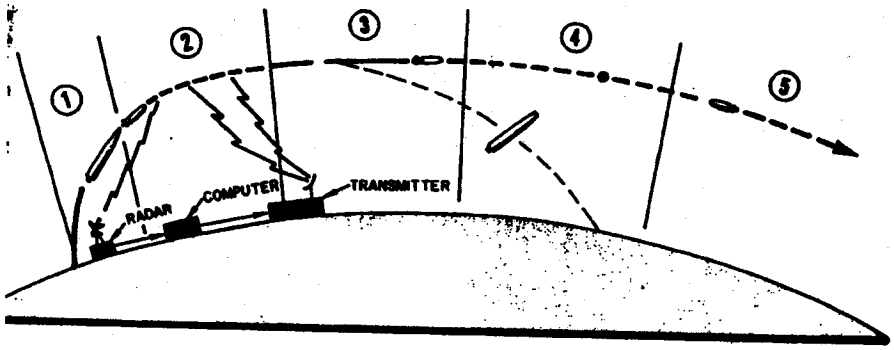
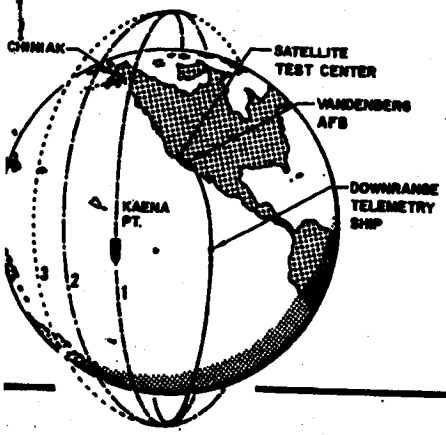
Powered Flight Trajectory

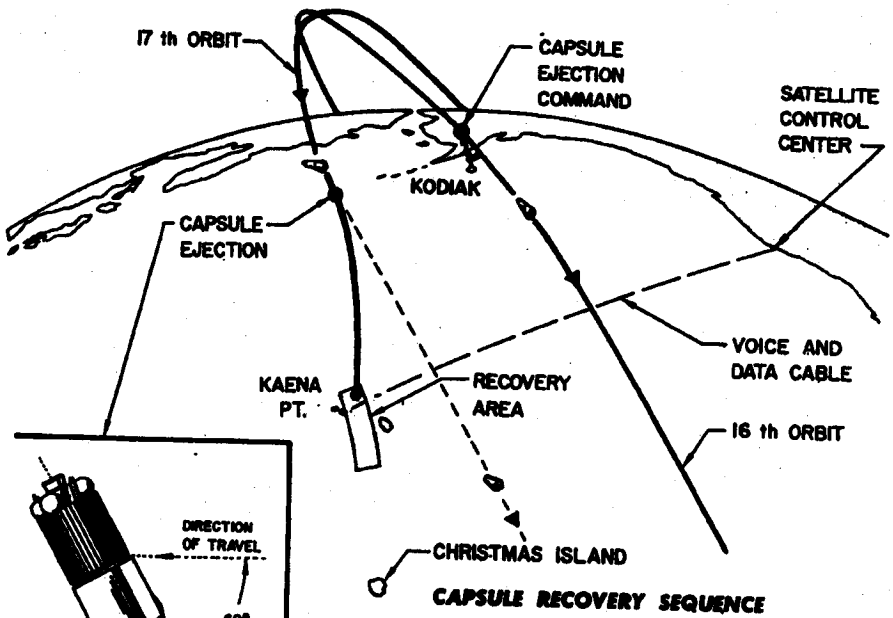


1. First Stage Powered Flight—2.5 minutes duration, 78 n.m. downrange, guided by programmed auto pilot.
2. Coast Period—2.4 minutes duration, to 380 n.m. downrange; attitude controlled by inertial reference package, horizon scanner, gas reaction jets. Receives AGENA time to fire and velocity to be gained commands.
3. Second Stage Powered Flight—2 minutes duration, to 770 n.m. downrange. Guided and controlled by inertial reference package, horizon scanner, gas reaction jets (roll) gimballing engine, yaw and pitch accelerometer—integrated.
4. Vehicle Reorients to Nose Aft—2 minutes duration, to 2,000 n.m. downrange. Guided and attitude controlled by inertial reference package, horizon scanner and gas reaction jets.
5. In-Orbit—Controlled (same as 4).



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.



CAPSULE RECOVERY SEQUENCE

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 command on the 17th orbit, for capsule impact within the predetermined recovery area south of Hawaii. Aircraft and surface vessels are deployed within the area as a recovery force.

Capsule ejection command is sent to the satellite by the Chiniak, Alaska station on the 16th orbit. The vehicle reorients its position (see inset) to permit ejection to occur on a re-entry trajectory on the 17th orbit. The recovery capsule parachute is activated at about 50,000 feet, and the capsule beacon transmits a radio signal for tracking purposes. The recovery force is deployed in the recovery (impact) area.

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Facility	Equipment*	Flight Function
Satellite Test Center	A	Over-all control, convert tracking stations data to obtain a predicted orbit and generate subsequent ephemerides issue acquisition data to tracking stations for subsequent passes, predict recovery area.
Vandenberg AFB	BCDEFGHIJK	Launch, ascent and orbital tracking, telemetry reception, trajectory measurements including time to ignite second stage.
Point Mugu	BCDEFGHIJKL	Ascent tracking and telemetry data reception, transmits command to ignite and shut down AGENA (via guidance computer).
Telemetry Ship (Pvt. Joe E. Mann)	DF	Final stage ascent tracking and telemetry data reception.
Kodiak, Alaska (tracking station)	BDEFGHIJK	Orbital tracking and telemetry data reception, including first pass acquisition, recovery capsule ejection and impact prediction.
Kaena Point, Oahu, Hawaii (tracking station)	BCDEFGHIJK	Orbital tracking and telemetry data reception.
Hickam AFB Oahu, Hawaii		Over-all direction of capsule recovery operations.

*Equipment

A. 2 UNIVAC 1103-A digital computers
B. VERLORT (Modified Mod II) radar
C. TLM-18 self-tracking telemetering antenna
D. Tri-helix antenna
E. Doppler range detection equipment
F. Telemetry tape recording equipment
G. Telemetry decommutators for real time data presentation
H. Plot boards for radar and TLM-18 tracking data
I. Conversion equipment for teletype transmission of radar, TLM-18 and doppler tracking data in binary format
J. Acquisition programmer for pre-acquisition direction of antennas
K. Ground command to satellite transmission equipment
L. Guidance computer

GROUND SUPPORT FACILITIES

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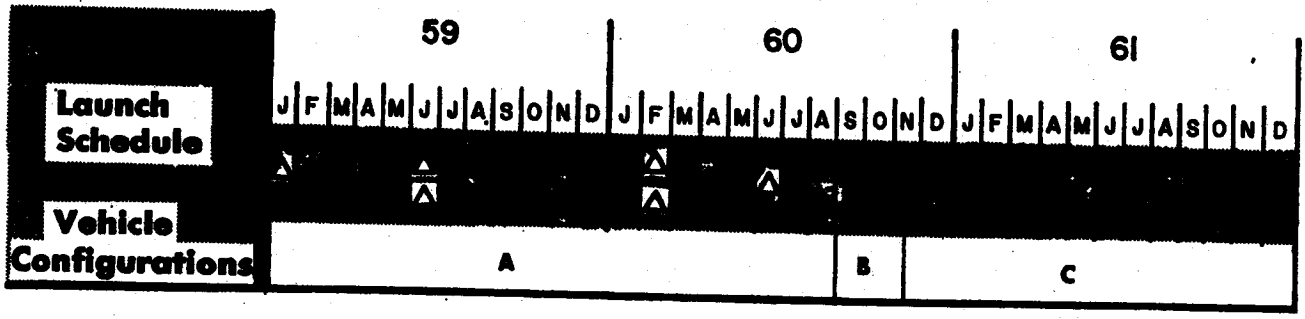


A. THOR—DM-18 / AGENA "A"

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

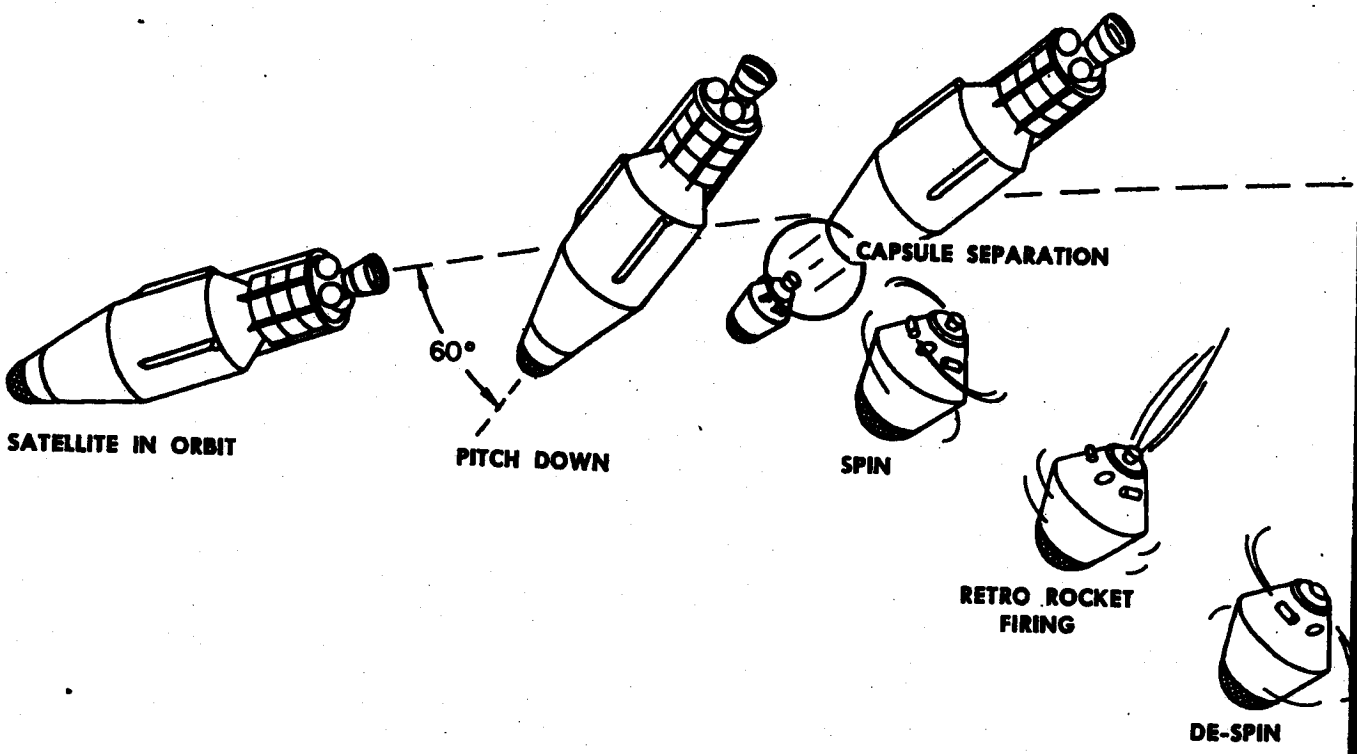
C. THOR—DM-21 / AGENA "B"
MB-3 Block 2 / XLR81-Ba-9

● Attained orbit successfully.

△ Failed to attain orbit.

Flight History

DISCOVERER No.	AGENA No.	THOR No.	Flight Date	Remarks
0	1019	160	21 January 1959	*AGENA destroyed by malfunction on pad. THOR refurbished for use on flight XII.*
I	1022	163	28 February	*Attained orbit successfully. Telemetry received for 514 seconds after lift-off.*
II	1018	170	13 April	*Attained orbit successfully. Recovery capsule ejected on 17th orbit was not recovered. All objectives except recovery successfully achieved.*
III	1020	174	3 June	*Launch, ascent, separation, coast and orbital boost successful. Failed to achieve orbit because of low performance of satellite engine.*
IV	1023	179	25 June	*Same as DISCOVERER III.*
V	1029	192	13 August	*All objectives successfully achieved except capsule recovery after ejection on 17th orbit.*
VI	1028	200	19 August	*Same as DISCOVERER V.*
VII	1051	206	7 November	*Attained orbit successfully. Lack of 400-cycle power prevented stabilization on orbit and recovery.*
VIII	1050	212	20 November	*Attained orbit successfully. Malfunction prevented AGENA engine shutdown at desired orbital velocity. Recovery capsule ejected but not recovered.*
IX	1052	218	4 February 1960	*THOR shut down prematurely. Umbilical cord mast did not retract. Quick disconnect failed, causing loss of helium pressure.*
X	1054	223	19 February	*THOR destroyed at T plus 56 sec. by Range Safety Officer.*
XI	1055	234	15 April	*Attained orbit successfully. Recovery capsule ejected on 17th orbit was not recovered. All objectives except recovery successfully achieved.*
XII	1053	160	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	1057	231	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	1056	237	18 August	*Attained orbit successfully. Recovery capsule ejected on the 17th orbit and was successfully recovered by the airborne force. All objectives successfully achieved.*



During its seventeenth orbit (approximately 26 and three-quarter hours after launch) the AGENA vehicle pitches nose down and capsule separation occurs. These operations require about a minute and one half. From launch to capsule ejection the satellite has traveled about 444,000 miles in its elliptical orbit around the earth. The "cold gas" spin system operates, the retro rocket fires and the "cold gas" de-spin system operates. Next the thrust cone separates. The thrust cone contains the spin/de-spin system gas spheres, squib operated valves, manifolds, and exhaust jets; the retro-rocket; the rocket programmer; and the S-band beacon transmitter. The capsule then free falls in much the same position as when it was ejected. Upon re-entry the capsule re-orients itself so that the ablation shield absorbs the intense heat of re-entry. After the two and one-half minute period of re-entry the parachute compartment cover is ejected and the chute unfolds. At this time the ablation shield, having served its purpose, is separated from the capsule. The parachute is deployed at approximately 55,000 feet and the capsule, sending out a signal on which the recovery aircraft "home," descends toward the earth it left only the day before. On recovery, the weight of the capsule is approximately one-third what it was at the time of separation. Items that are no longer needed are ejected to reduce the capsule weight and permit recovery.

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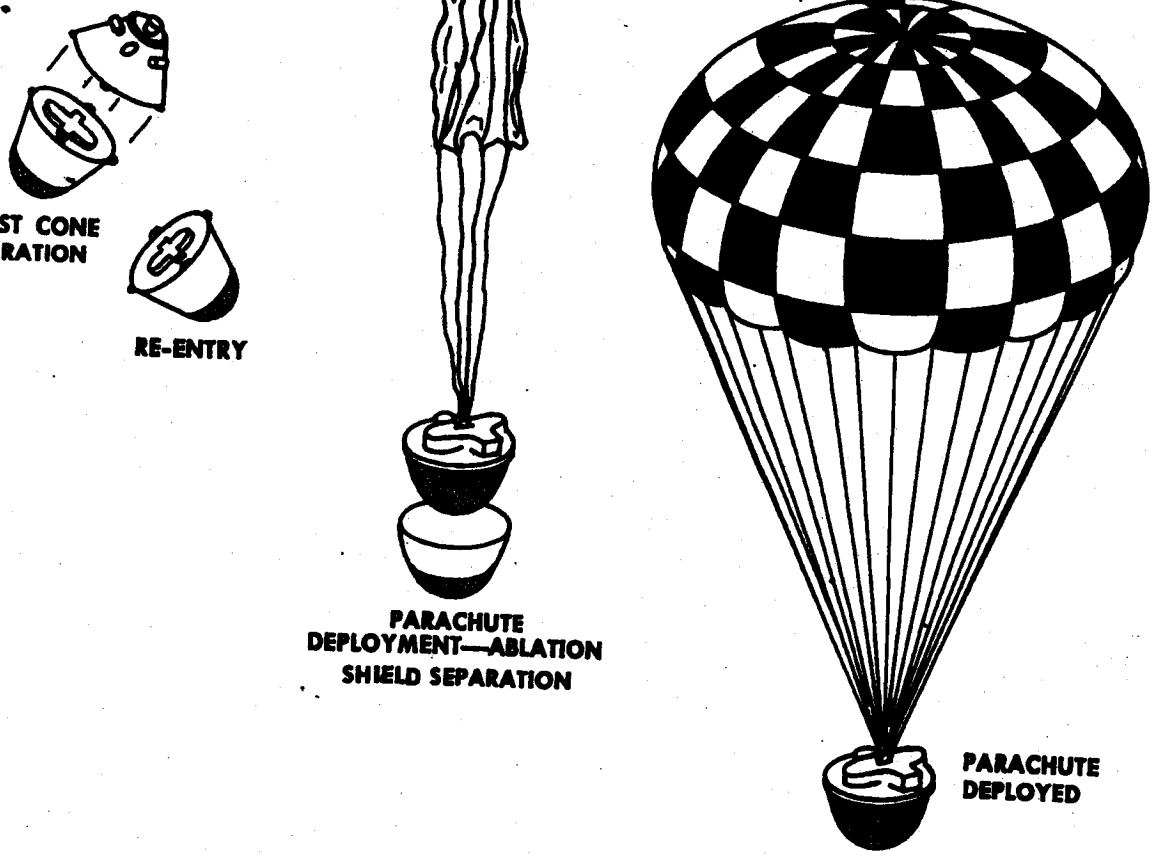
DISCOVERER CAPSULE EJECTION, RE-ENTRY, AND PARACHUTE DEPLOYMENT



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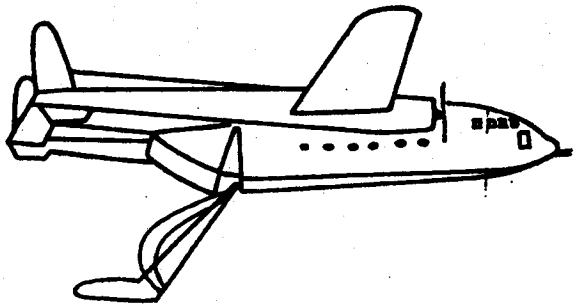
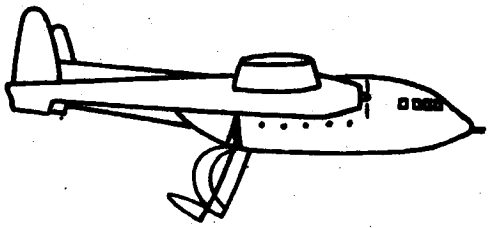


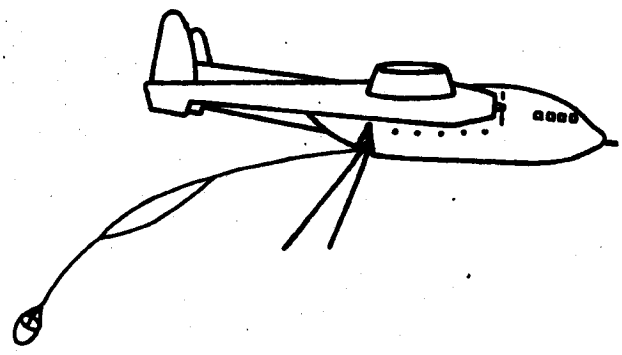
DISCOVERER CAPSULE AERIAL RECOVERY

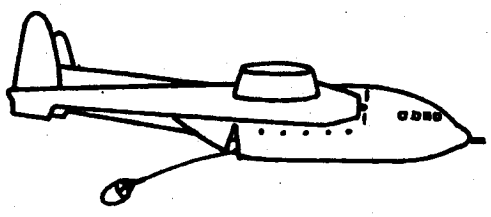


After capsule ejection from the satellite and re-entry into the earth's atmosphere, the parachute deploys. Parachute deployment occurs at an altitude of approximately 55,000 feet. The crews of C-119 aircraft in the recovery zone "home" in on the signals transmitted by the capsule's beacon and determine their intercept course. They have between 20 and 30 minutes from the time of parachute opening until it impacts into the sea to effect recovery.

The sequence on this page shows contact being made (top center), the aircraft making a pass on the falling capsule (above), the hook of the recovery gear snagging the nylon canopy (above right), and the capsule being hauled into the recovery aircraft. From the time the chute is snagged until it is safely aboard requires from 15 to 20 minutes. If the aircraft cannot effect recovery, surface vessels in the impact area attempt to recover the capsule from the sea. A flashing lite, dye markers, and the transmitter aid them in their search.

Recovery of the DISCOVERER XIV capsule by the Hawaiian based recovery force was the first time in history a man-made object returning from a sustained period in space was recovered by an aircraft.





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A. BRIEF OF PROGRESS

DISCOVERERs XIII and XIV were launched into polar orbits on the 10th and 18th of August, respectively. After orbiting the earth for over 26 hours both capsules were recovered. DISCOVERER XIII was recovered from the sea and DISCOVERER XIV was snatched from the air by an Air Force C-119. These events marked the first time in history man-made objects which had been in orbit around the earth were returned and recovered.

The assembly of AGENA vehicles continues on schedule. Only two AGENA "A" satellites remain to be flown. One of these will carry a biomedical capsule. Two AGENA "B" vehicles are undergoing subsystem checks at Vandenberg Air Force Base following Air Force acceptance. The first XLR-81Ba-9 engine for use in later AGENA "B" vehicles has successfully completed acceptance tests.

Throughout the quarter extensive recovery system component system drop tests were conducted at Holloman Air Force Base, New Mexico. The capsules containing diagnostic payloads were carried by balloons to 100,000 feet altitude and released. They then went through a normal ejection sequence while the payload transmitted valuable data to the ground station. A full-scale mockup of a biomedical capsule designed to maintain a chimpanzee in orbit for two days was completed in June.

Van type telemetry readout and recording equipment has been installed on Christmas Island to monitor all orbital passes within range of the station and record all telemetry data during re-entry. The installation of equipment for a DISCOVERER ground station at the New Boston, New Hampshire, facility was completed and checked out during August.

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B. TOPICAL SUMMARY

1. *Flights*

a. DISCOVERER XII

DISCOVERER XII was launched on 29 June from Pad 4 at Vandenberg Air Force Base. The satellite vehicle failed to attain orbit.

(1) DISCOVERER XII was launched at 2300 hours, GMT, on 29 June from Pad 4 of Complex 75-3, Vandenberg Air Force Base. The countdown proceeded satisfactorily with minor technical holds because of ground support equipment problems. The major hold was caused by weather. The launch, first stage trajectory, engine cutoff, and separation were normal. AGENA engine ignition, thrust and engine cutoff were also normal. However, the satellite failed to achieve orbit. Telemetry data indicate that the AGENA vehicle was in a pitch down attitude during engine operation causing the vehicle to reenter the atmosphere. Subsequent investigation has isolated the cause of the improper pitch attitude to the horizon scanner.

RF interference from the satellite telemetry transmitter caused improper operation of the horizon scanner on the DISCOVERER XII flight.

(2) The cause of improper horizon scanner operation during the DISCOVERER XII flight was found to be RF interference from the satellite telemetry transmitter. A modification was incorporated to correct this condition. Subsequent testing revealed no RF interference with the scanner at any frequency or transmitter power level.

b. DISCOVERER XIII

DISCOVERER XIII launched into polar orbit on 10 August. Performance of THOR booster and AGENA vehicle was very satisfactory.

(1) DISCOVERER XIII was launched from Vandenberg AFB at 13:38 PDT, on 10 August and was successfully injected into polar orbit. THOR booster trajectory was slightly high and west but was well within tolerance. Second stage separation was successfully accomplished as was transmission of Commands 5 (time-to-fire correction) and 6 (velocity-to-be-gained correction). AGENA performance was very close to nominal. Re-orientation of the satellite into a nose aft attitude was accomplished after burnout. Table I lists nominal and actual orbital parameters.

PARAMETER	NOMINAL	ACTUAL
Apogee, Statute Miles	408	429
Perigee, Statute Miles	140	155
Eccentricity	0.0323	0.0326
Period, Minimum	93.5	94.1
Inclination Angle, Degree	81.69	82.67
Injection Altitude, Statute Miles	140	156
Injection Angle, Minimum	0	+0.08
Injection Velocity, ft/sec		25,852

TABLE I. DISCOVERER XIII Orbital Parameters

The recovery sequence was initiated, the capsule survived re-entry, and the parachute deployed successfully.

(2) The recovery sequence was automatically initiated by the satellite programmer 26 hours, 37 minutes after launch. This event occurred within range of the Kodiak, Alaska, tracking station as DISCOVERER XIII passed southward toward Hawaii on its 17th orbit. Telemetry received by

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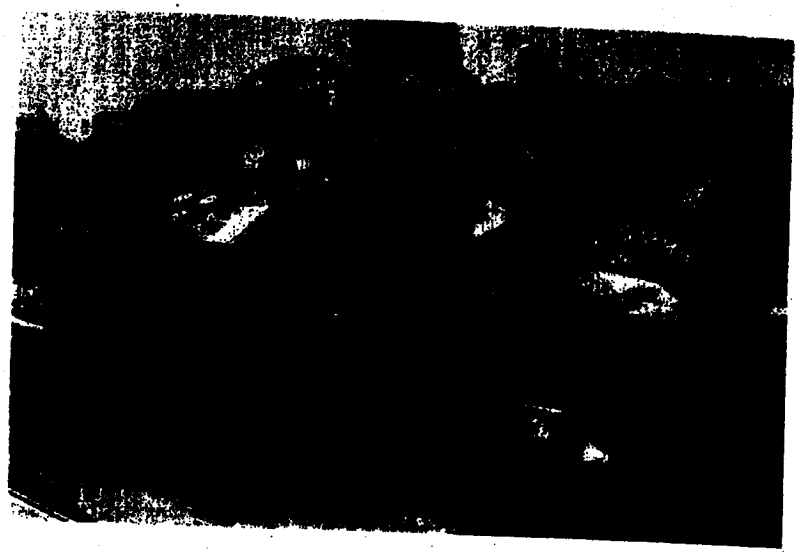

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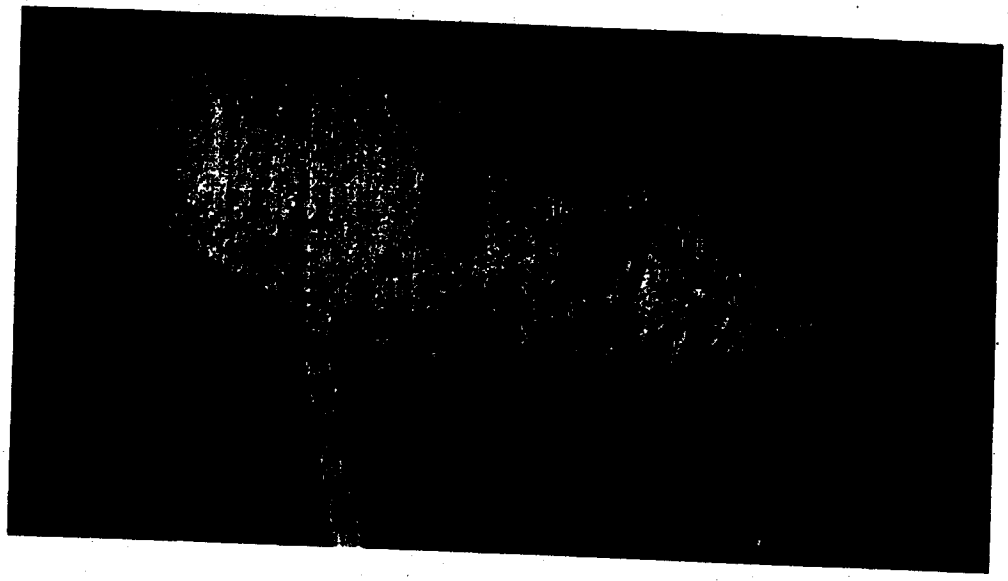

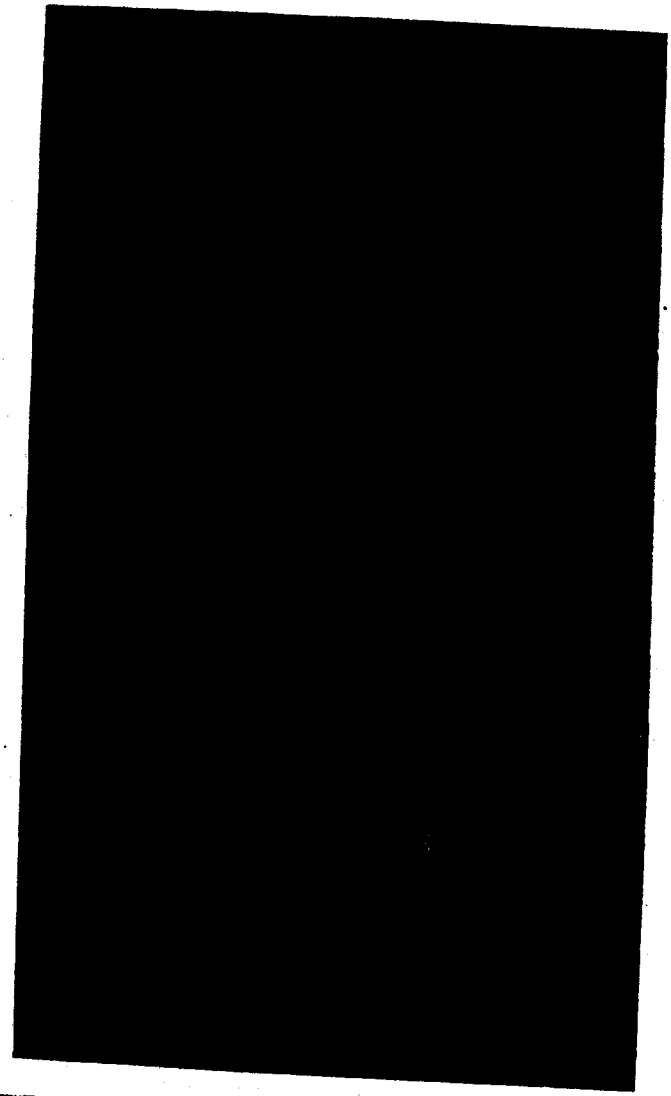

Figure 1. Assembly and Erection of DISCOVERER XIII flight test vehicle. Top view on opposite page shows final checkout procedure for second stage AGENA vehicle. Center and bottom views show AGENA being mated with THOR booster. Above, DISCOVERER XIII during pre-dawn countdown on 10 August. The blanket surrounding the nose cone air conditions the capsule electronics during countdown to prevent overheating. The black dome protruding from the blanket is part of the ablative shield which surrounds and protects the capsule during re-entry. Right, DISCOVERER XIII erected on pad alongside umbilical tower prior to launch. Service and electrical lines are connected.

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Kodiak from the satellite and the capsule confirmed that satellite pitch-down, capsule ejection, spin, retro rocket firing, capsule de-spin and thrust cone ejection were accomplished. Minutes later the Hawaiian tracking station acquired the telemetry signal and determined that ablative shield ejection and parachute deployment had occurred.

Aircraft could not attempt recovery. Capsule rescued from sea by frogman from recovery ship helicopter.

(3) All aircraft and ships of the recovery force within range acquired the capsule's RF beacon and began homing on the signal. No aircraft was able to attempt recovery, but one plane did observe the capsule impacting in the sea. A helicopter from the "Haiti Victory," one of the recovery ships, was sent to retrieve the capsule. The capsule was flown to Hawaii by helicopter, transferred to an Air Force plane, and delivered to Washington, D.C. After being viewed by President Eisenhower, the capsule was placed on public display by the Air Force. This historic object, the first man-made object recovered after a sustained period of orbit, will become part of the Smithsonian Institute's collection of space vehicles.

DISCOVERER XIII carried a diagnostic payload which transmitted data about capsule environment and recovery sequence events.

(4) DISCOVERER XIII carried a diagnostic payload in addition to the normal recovery equipment. The payload contained instrumentation to determine capsule environment and the functioning of separation and recovery sequence events. A five channel telemetry system was installed to transmit the data obtained to the ground stations. To assure receipt of all data, a tape recorder was provided to record the real time events and capsule performance during the telemetry "blackout" period which occurs when the capsule re-enters the atmosphere. After a two-minute time delay, these stored data were transmitted to the ground stations. The high speed of re-entry induces ionization over the skin of the capsule which effectively blocks telemetry transmission. An S-band transponder was also provided to aid in tracking the capsule from ejection through recovery.

c. DISCOVERER XIV

DISCOVERER XIV was delayed on 18 August because the DISCOVERER XIII vehicle was passing through the projected flight area.

(1) DISCOVERER XIV was launched at 1257 PDT on 18 August into a polar orbit from Vandenberg AFB. The launch was delayed approximately 15 minutes because the still orbiting DISCOVERER XIII satellite was passing through the projected flight area. THOR booster performance was near nominal. Separation, transmission of Commands 5 and 6, and orbital boost were accomplished as planned. Nominal and actual orbital parameters are given in Table II.

PARAMETER	NOMINAL	ACTUAL
Apogee, Statute Miles	428	500
Perigee, Statute Miles	118	111
Eccentricity	0.037	0.046
Period, Minimum	93.4	94.5
Inclination Angle, Degree	79.6	79.6
Injection, Altitude Statute Miles	118	118
Injection Angle, Minimum	0	−0.22
Injection Velocity, ft/sec		26,150

TABLE II. DISCOVERER XIV Orbital Parameters

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AGENA vehicle was in an abnormal attitude during its first orbit but stabilized on subsequent passes.

The capsule was ejected on the 17th orbit. The crew of a C-119 sighted the capsule and on their third pass snagged the parachute and safely reeled the capsule aboard.

(2) On the first pass over Kodiak, telemetry data indicated an abnormal satellite attitude, stop indications by the horizon scanner and excessive control gas consumption. The satellite stabilized in its proper attitude on subsequent passes and orbited as planned.

(3) While on its 17th orbit the satellite programmer automatically initiated the recovery sequence. The capsule re-entered the atmosphere and its parachute was deployed. A C-119, one of the airborne recovery force, homed on the CW beacon signal and visually sighted the capsule. On the third pass, 1609 PDT, the hooks on the special air-recovery gear snagged the nylon canopy. The chute and capsule were carefully reeled in and at 1623 PDT were safely aboard the aircraft. The capsule is presently being analyzed at the contractor's facility.

2. *Technical Status*

a. Second Stage Vehicles

One of the two remaining AGENA "A" vehicles is ready for launch.

(1) Only two DISCOVERER AGENA "A" vehicles remain to be flown. DISCOVERER XV is now at Vandenberg Air Force Base in preparation for a September launch. The remaining vehicle is at Sunnyvale for modifications incorporating the improvements from the latest flight tests.

Three AGENA "B" vehicles have been accepted by the Air Force; two of these have been delivered to Vandenberg Air Force Base.

(2) Two AGENA "B" satellites were delivered to Vandenberg Air Force Base during August and are currently undergoing subsystem checks in the missile assembly building. An additional AGENA "B" has been accepted by the Air Force and is awaiting shipment to Vandenberg. Three vehicles have completed their test firings at Santa Cruz Test Base and are being readied for Air Force acceptance inspections.

XLR-81Ba-9 engine nozzle coating and modified fuel injector tests continue.

(3) Evaluation and testing of nozzle coatings in an effort to reduce XLR-81Ba-9 engine throat erosion continued during June. The test results using a modified fuel injector have been encouraging. Tests of this injector will continue.

An XLR-81Ba-9 engine start and restart firing series was completed in June.

(4) Testing of the XLR-81Ba-9 engine (with 45:1 area ratio nozzle) continued at Arnold Engineering Development Center. An engine start and restart firing series, with the engine mounted in a modified test stand to permit gimballing, was completed in June. This series covered operation in a temperature range of from 120 to −55 degrees F.

Phase two of the Preliminary Flight Rating Tests was initiated during August.

(5) Phase two of the Preliminary Flight Rating Tests (PFRT) on the XLR-81Ba-9 engine (serial number 306) was initiated during August. After being retrofitted with flight configuration components, the engine was installed on the Bell Test Center vertical test stand for initiation of start-stop and malfunction tests. A 30-second restart firing was accomplished, but test data indicated a 2.75 percent shift in the power level. The engine was torn down for examination. Tests of this engine are expected to resume early in September.

First flight configuration XLR-81Ba-9 engine completes acceptance testing.

(6) The first XLR-81Ba-9 engine (serial number 316) delivered with flight configuration hardware, has successfully completed acceptance testing. One engine (serial number 317) has been hot fired but operation was unstable and the power level dropped. Analysis disclosed that the

[redacted]

Figure 2. Frogman jumps from helicopter (above) to effect recovery of DISCOVERER XIII capsule shown floating in lower right corner of photo. Capsule being reeled-in by helicopter winch (right) and frogman being returned (top photo, opposite page). Capsule prior to removal from helicopter aboard the "Haiti Victory," one of the recovery force ships (bottom photo, opposite page).

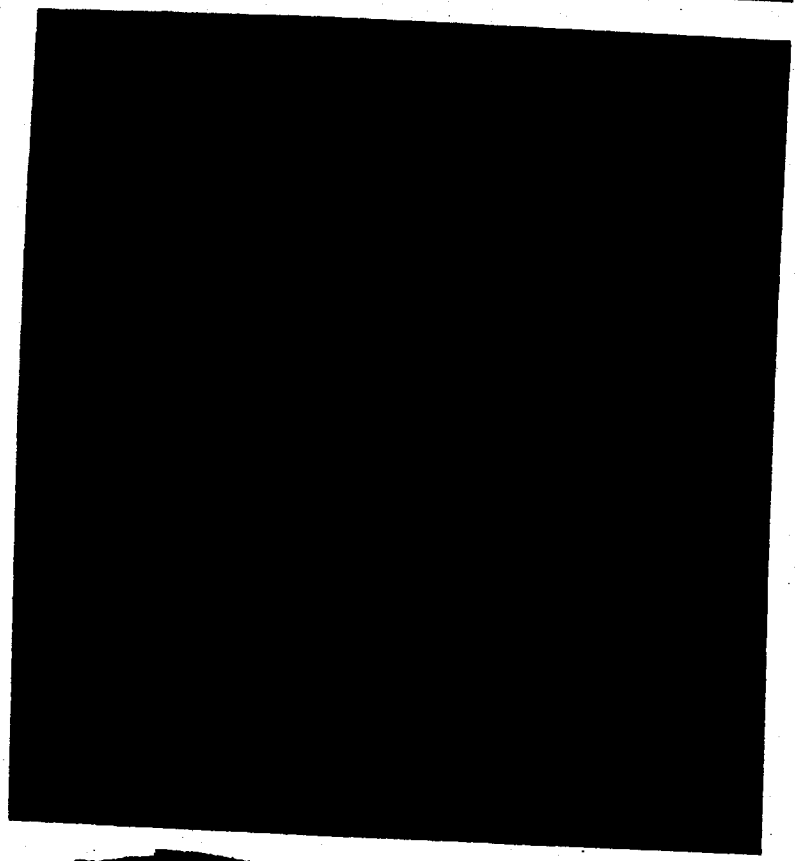

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Figure 3.
Recovering the Capsule—
DISCOVERER XIV

Right—*Air Force C-119 patrols in recovery area north of Hawaii with capsule recovery gear extended.*

Below—*View of capsule and parachute from inside C-119 fuselage. This photo was taken on the second of two unsuccessful recovery passes.*

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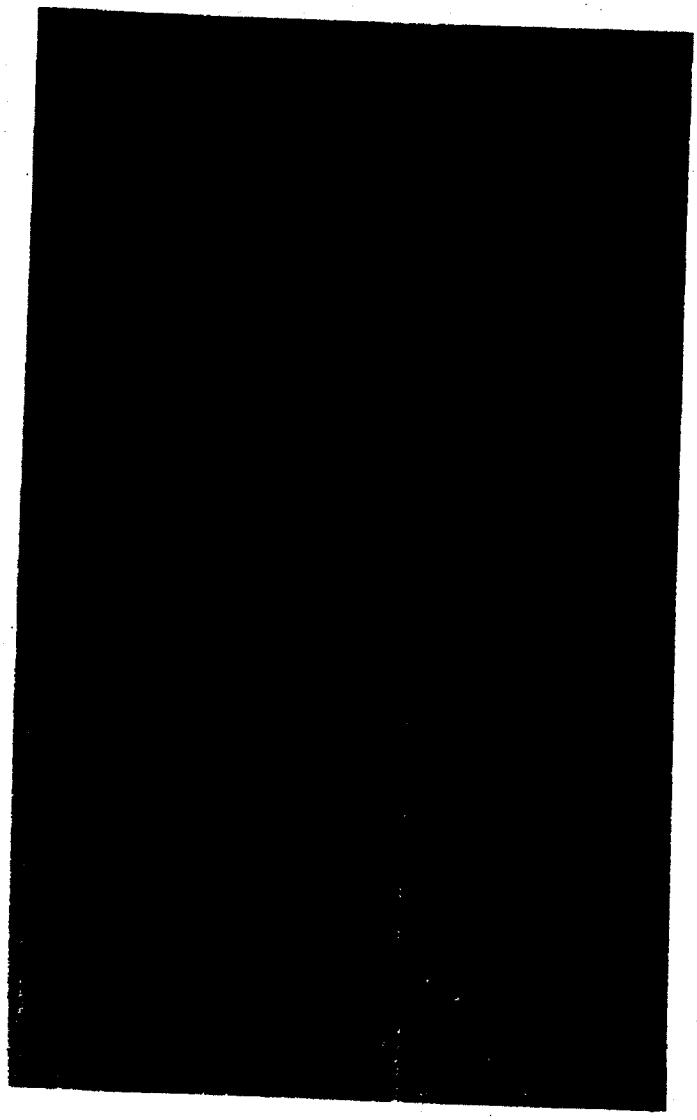

Left—Recovery harness snares capsule and parachute. Photo taken from within C-119 on third pass.

Below—Capsule being reeled toward aircraft by members of recovery crew.

[redacted]

gas generator venturis required re-sizing and that the oxidizer filter was improperly installed. This engine is now being prepared for final acceptance testing.

"Cold-gas" spin/de-spin system incorporated into DISCOVERER payloads.

b. Recovery System Component Test Program

(1) Extensive examination of the results of DISCOVERER flights I through XI indicated the possibility of tumbling and/or precession of the capsule upon separation from the AGENA vehicle because one or more of the spin/de-spin rockets failed to fire properly. To correct this condition a "cold gas" spin/de-spin system has been incorporated into the DISCOVERER payloads. The "cold gas" system contains two separate subsystems each supplying a maximum of 195 pounds thrust, with a firing duration of 0.8 seconds. Each system contains a gas sphere (containing a nitrogen and freon gas mixture), a manifold, a squib operated valve, and exhaust jets.

Drop tests of the parachute and retrofiring systems have been conducted at Holloman Air Force Base.

(2) Drop tests of DISCOVERER capsules continued throughout the quarter at Holloman Air Force Base, New Mexico. Originally scheduled for nine drops, the test series was extended to permit testing of the capsule parachute system and the retrofiring system. "Cold gas" system tests were initiated on 23 June. The third and fourth successful balloon drops of the recovery system series (second and third successful dynamic tests of the "cold gas" spin system) were made at Holloman AFB on 23 and 27 July. The retro rocket and spin/de-spin systems functioned satisfactorily. During the tests chaff was dispensed from the pilot chute deployment bag and did not contact the main chute, indicating that the prior interference problem has been solved.

Capsule is carried to 100,000 feet altitude, released upon ground command, and proceeds thru the normal recovery sequence.

(3) For each of the drop tests, the capsule is carried to 100,000 feet altitude. On command from the ground, the capsule is released. During the retrofiring system drop, the ejection programmer within the capsule fires the spin system, the retro rocket, and the de-spin system in the normal ejection sequence. Parachute deployment is also controlled by the ejection programmer. These capsules are fully instrumented to monitor capsule performance and contain telemetry equipment to transmit the data obtained. In the parachute deployment test the Mach and dynamic loading conditions encountered in actual recoveries are experienced.

Mark IV capsule drop tests conducted in August.

(4) The drop test programs continued at Holloman AFB with two test attempts on 4 August. The first balloon burst at 30,000 feet, before the planned drop of the Mark IV capsule; however, the equipment was recovered successfully. On the second the capsule was dropped and parachute deployment was satisfactory. The purpose of these tests was to determine if the new parachute cover would release properly during capsule deceleration. The Mark IV capsule is similar to the recently recovered capsules but contains an improved programmer and other modified components.

c. Biomedical Capsules

A full-scale mockup was prepared as part of the Advanced Biomedical Capsule Study.

The Advanced Biomedical Capsule Study was completed on 17 June. This study indicated the feasibility of developing a capsule capable of maintaining a chimpanzee in orbit for two days. The capsule would be integrated with the SAMOS recovery vehicle. A final report, preliminary drawings and a full-scale mockup have been prepared as part of the study.

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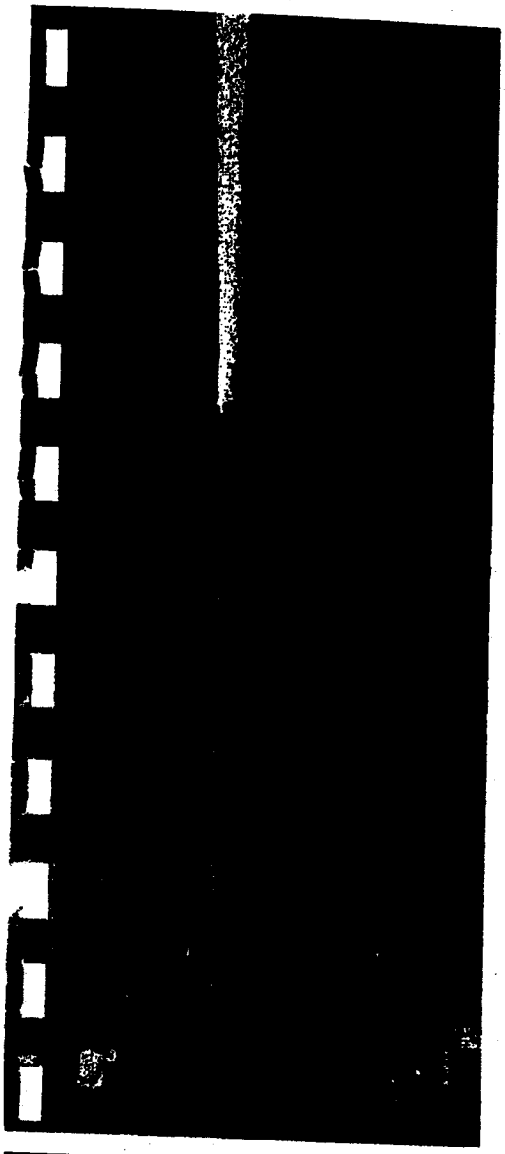


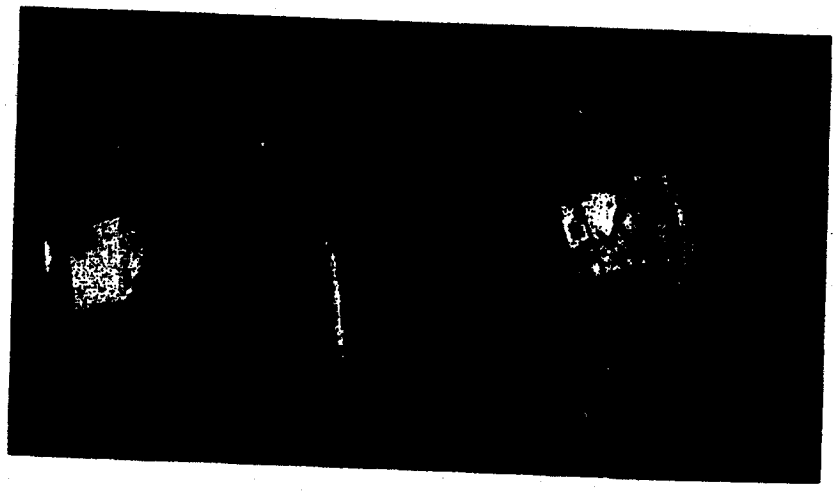
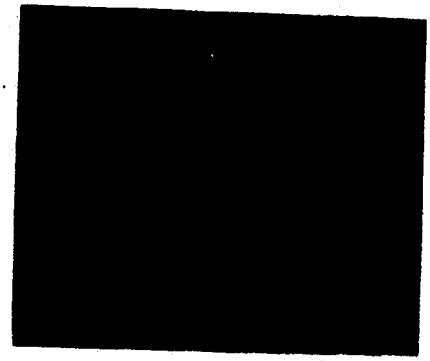
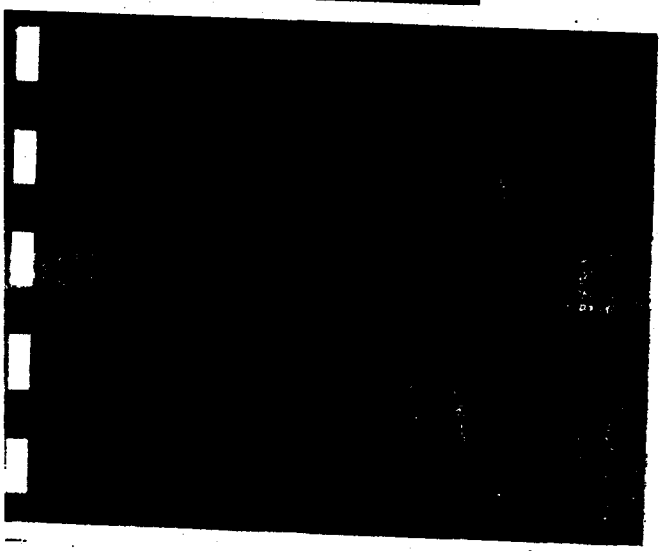
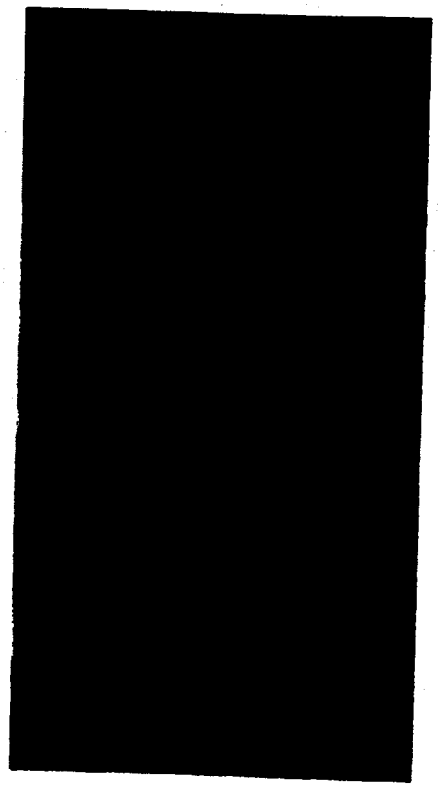


Figure 4. Test capsule (left) suspended from the balloon that will carry it to 100,000 feet altitude. Closeup (above) of test capsule and telemetry equipment which provides flight data and through which the release command is received. The ablative shield which protects the capsule from the heat generated during high speed re-entry into the atmosphere is shown. The external surface of the shield peels off under the intense heat of friction, thus dissipating the heat and protecting the capsule. The capsule and parachute are contained within this shield. Aerial view (right) of the capsule during descent over New Mexico. The parachute deployed at approximately 55,000 feet altitude. Capsule immediately after impact (lower right). Closeup of the capsule and parachute (lower left). An impact at sea would cause little damage to the capsule structure.







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3. *Facilities*

Telemetry readout and recording equipment has been installed on Christmas Island. An additional ship and five telemetry equipped aircraft supported the recent DISCOVERER flights.

a. In June, a van type telemetry readout and recording installation was established on Christmas Island to provide monitoring and recording facilities downrange from Hawaii. The equipment at this station monitored all orbital passes within the range of the station and recorded all telemetry from the diagnostic payload and from the AGENA vehicle. During the recovery pass, this installation extended the telemetry reception on coverage south of the equator. For DISCOVERER XIII and XIV flights an additional ship and five telemetry equipped aircraft were dispersed between Hawaii and Christmas Island to increase telemetry coverage south of Hawaii.

Vandenberg Air Force Base data acquisition and processing building air conditioning modificaton completed.

b. Acceptance of the air conditioning system modification for the Vandenberg Air Force Base data acquisition and processing building was made in August following successful completion of an equipment test run.

DISCOVERER ground station equipment installed and checked out at New Boston on 17 August.

c. Installation of a DISCOVERER ground station at the New Boston, New Hampshire, facility was completed and checked out on 17 August. Installation of equipment was started in July. The station has the capability for Verlort radar tracking, command and telemetry reception. Consturuction of support facilities is on schedule.

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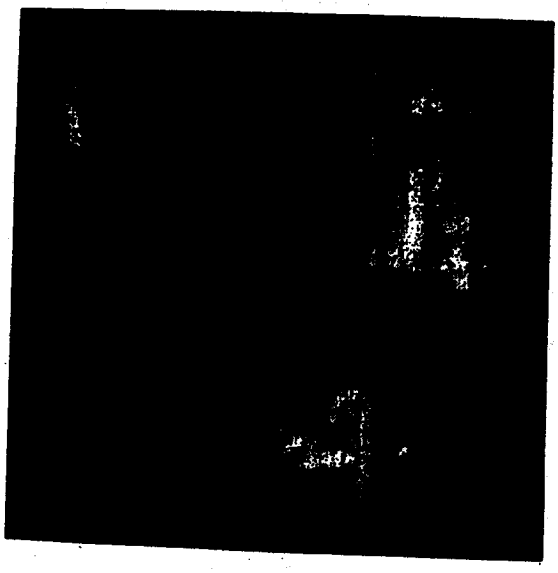

Figure 5. The Advanced Biomedical Capsule mockup (below) with a model of the 50-pound chimpanzee and the seat partially installed. Specimen-recording and telemetry equipment are mounted on the top of the capsule. Forward end of the mockup (left) showing oxygen spheres, blowers, and coolant equipment. This mockup was constructed as part of the Advanced Biomedical Capsule Study.

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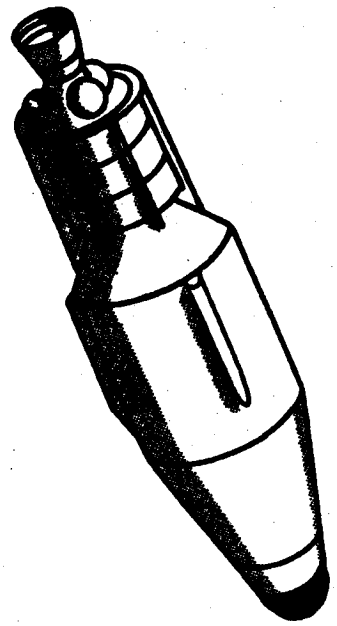
BOOSTER—ATLAS ICBM

Weight—Wet	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

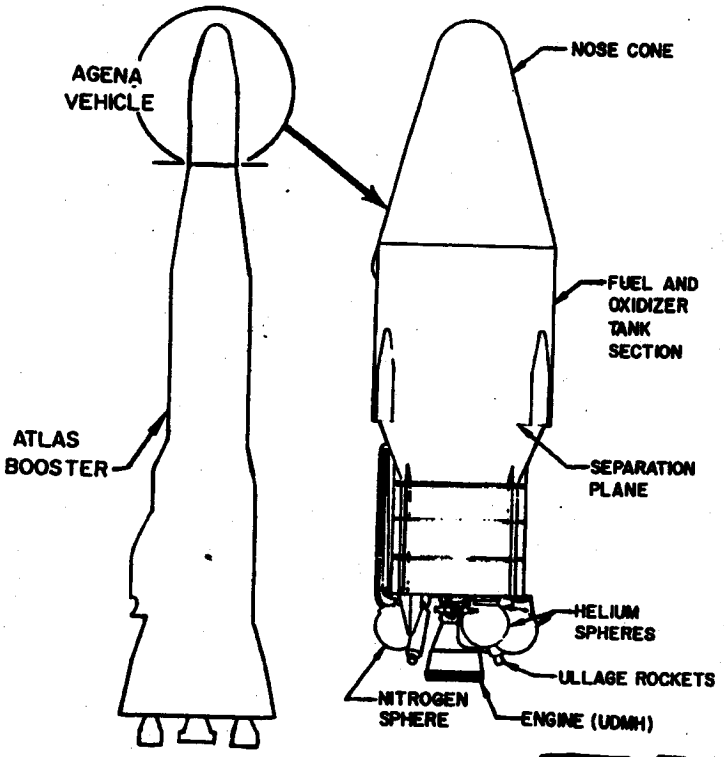
SECOND STAGE	AGENA "A"	AGENA "B"
Weight—		
Inert	1,508	1,695
Payload equipment	2,605	3,058
Orbital	4,113	4,753
Impulse Propellants	6,492	12,950
Fuel (UDMH)		
Oxidizer (IRFNA)		
Other	606	718
GROSS WEIGHT (lbs.)	11,211	18,421
Engine	YLR81-Ba-5	XLR81-Ba-9
Thrust, lbs. (vac.)	15,600	16,000
Spec. Imp., sec. (vac.)	277	290
Burn Time, sec.	120	240



SAMOS

Figure 1.

Artists' concept of SAMOS satellite. Line drawing of complete flight vehicle (right) and detailed view of basic AGENA upper stage (left).



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PROGRAM HISTORY

The SAMOS Program was included in Weapon System 117L when WS 117L was transferred to the Advanced Research Projects Agency early in 1958. ARPA separated WS 117L into the DISCOVERER, SAMOS and MIDAS programs with the SAMOS objectives based on a visual and ferret reconnaissance system. On 17 November 1959 responsibility for this program was transferred from ARPA to the Air Force by the Secretary of Defense. The program was realigned on 11 August 1960 to emphasize visual reconnaissance over ferret and physical recovery of data over electronic readout.

PROGRAM MISSION

The primary mission of the SAMOS advanced reconnaissance system is to provide visual and electronic coverage of the USSR and its allied nations. Efforts include development of hardware to permit:

a. Verification of known targets, detection of unknown targets.

b. Location and evaluation of defenses.

c. Evaluation of military and industrial strength.

d. Assessment of high-yield weapons damage.

e. Reconnoitering of troop movements.

f. Location of naval forces throughout the world.

g. Determination of characteristics of enemy electronic emissions.

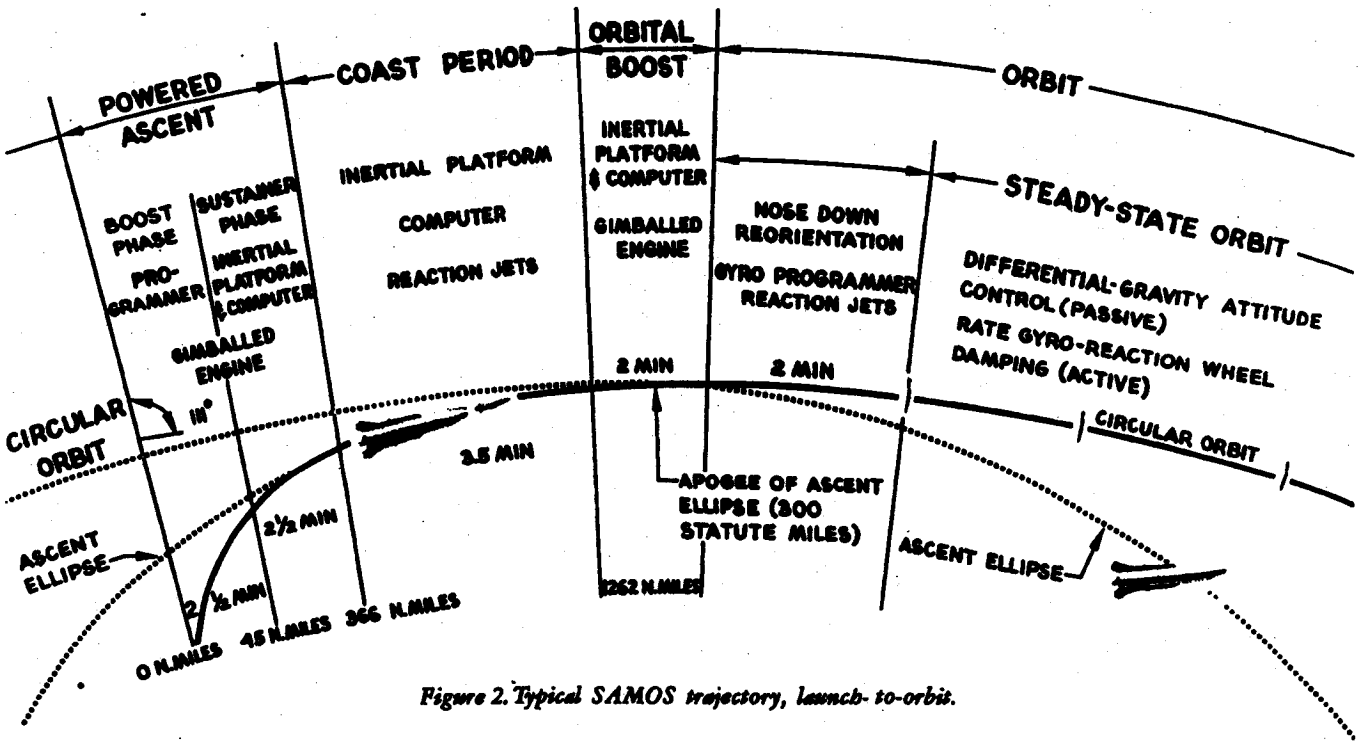

Figure 2. Typical SAMOS trajectory, launch- to-orbit.

- **Ferret Reconnaissance...**

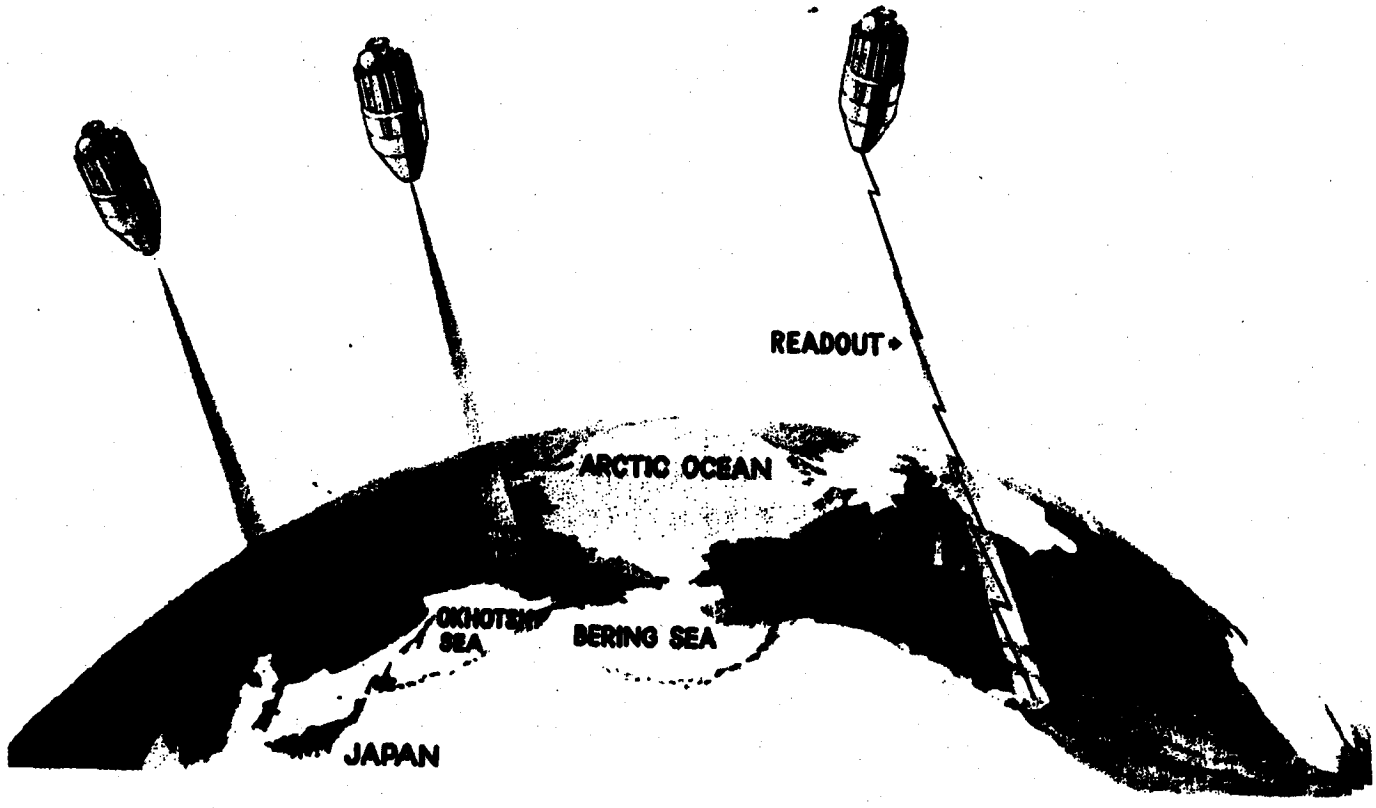

Figure 4. The Ferret reconnaissance system will gather data from electronic emissions over areas of interest.