MILITARY SATELLITE PROGRAM PROGRESS REPORT

FOR QUARTER ENDING

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Prepared By

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UNITED STATES AIR FORCE

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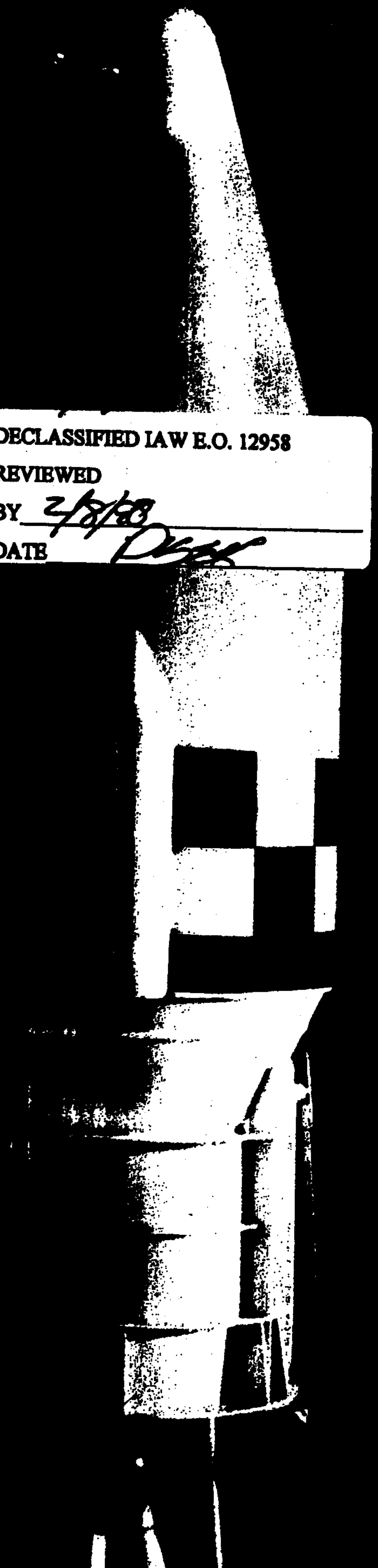

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MILITARY SATELLITE PROGRAM PROGRESS REPORT

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.

O. J. RITLAND
Major General, USAF
Commander

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D i s c o v e r e r

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.

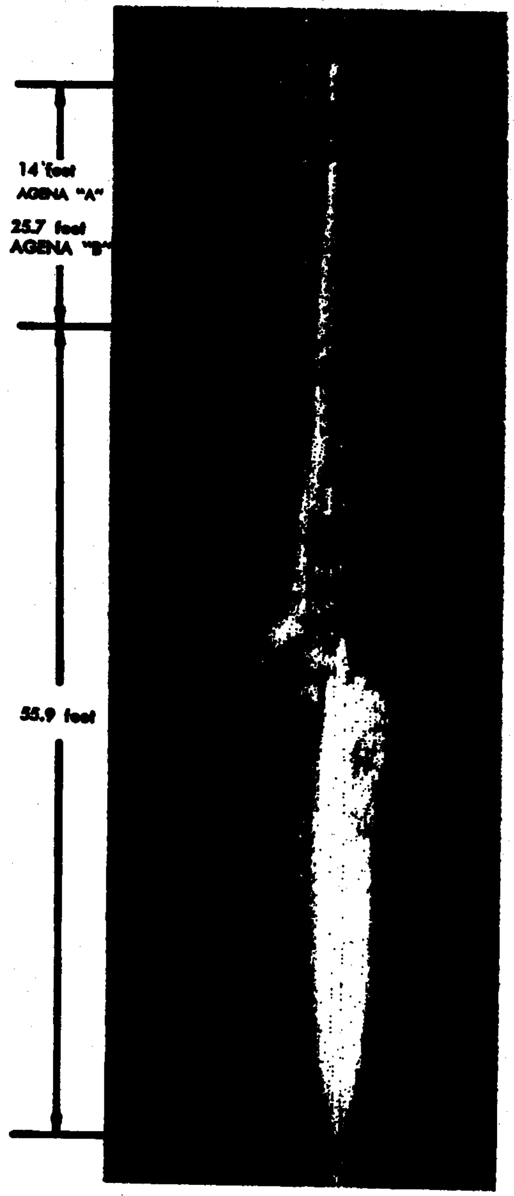
(e) Testing of ground support equipment and development of personnel proficiency.

(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

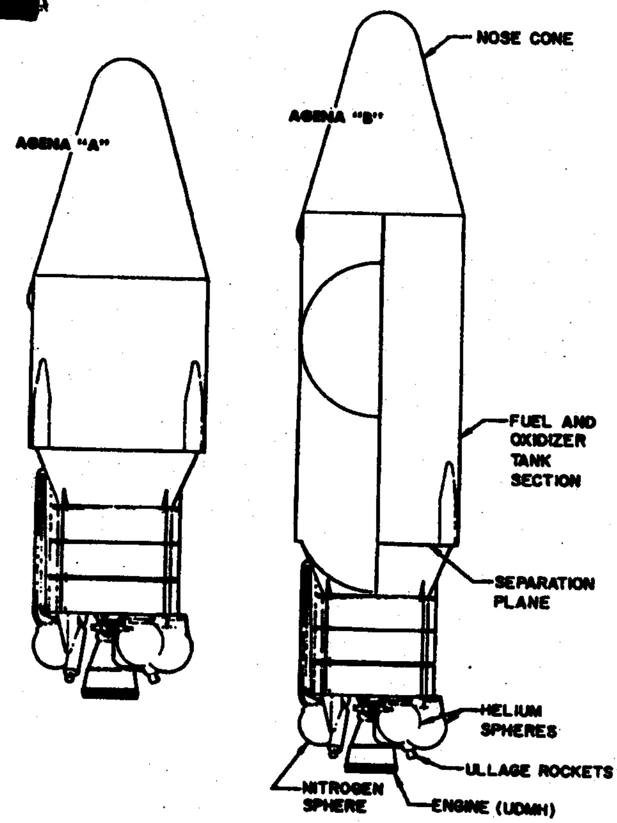
Telemetry ships are positioned as required by the specific mission of each flight. Figures 2 and 3 show a typical launch trajectory from Vandenberg Air Force Base, and figure 3 shows schematically a typical orbit. An additional objective of this program is the development of a controlled re-entry and 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.

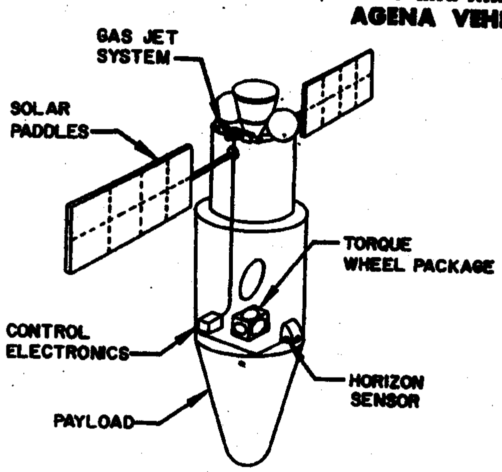
AGENA VEHICLE DEVELOPMENT

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.

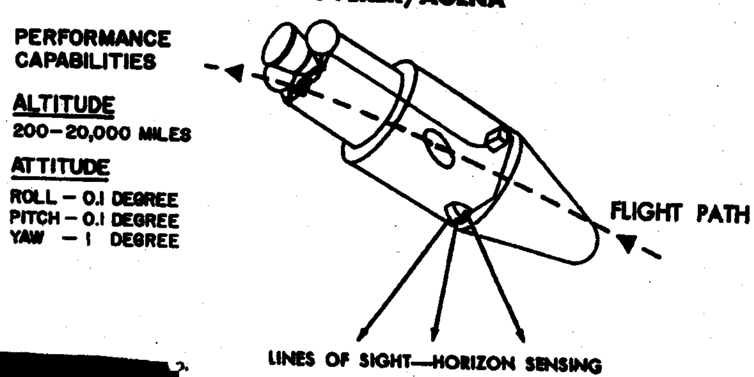


Early AGENA "B" vehicles will use the YLR81-Ba-7 version of this engine. The majority of AGENA "B" vehicles will use the XLR81-Ba-9 engine incorporating a nozzle expansion ratio of 45:1, and providing a further increase in performance capability including engine restart and extended burn-capability.

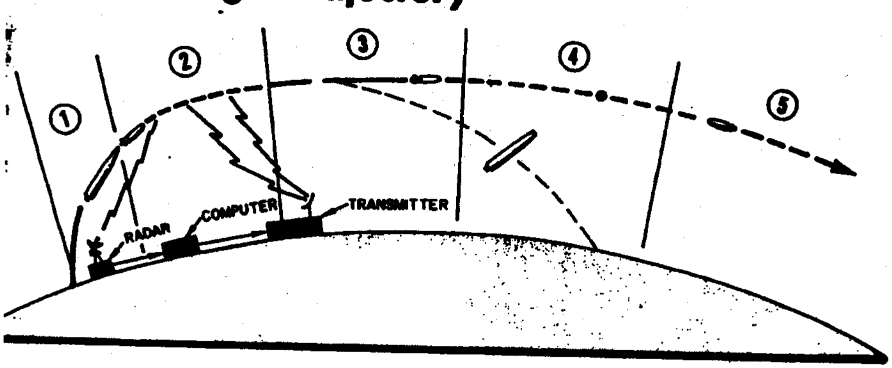
SAMOS and MIDAS AGENA VEHICLE



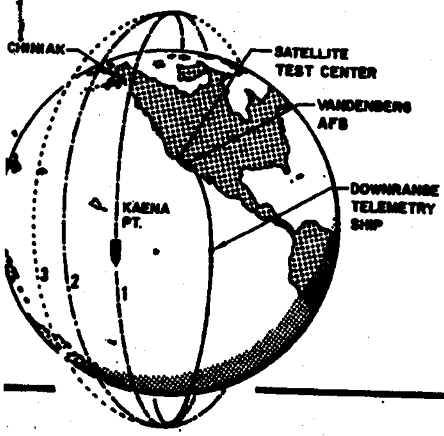
DISCOVERER/AGENA



Powered Flight Trajectory

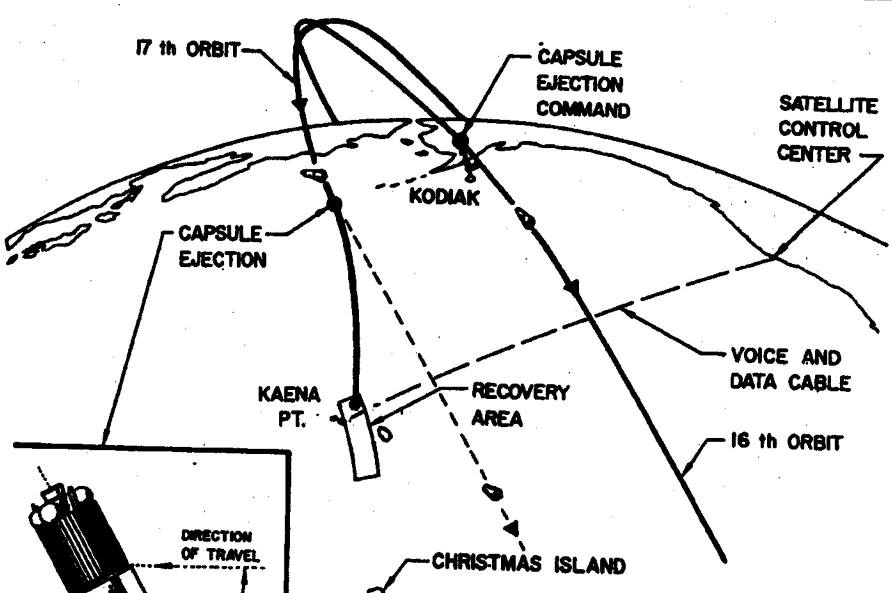


1. **First Stage Powered Flight**—2.5 minutes duration, 78 n.m. downrange, guided by programmed auto pilot.
2. **Coast Period**—2.4 minutes duration, to 380 n.m. downrange; attitude controlled by inertial reference package, horizon scanner, gas reaction jets. Receives AGENA time to fire and velocity 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

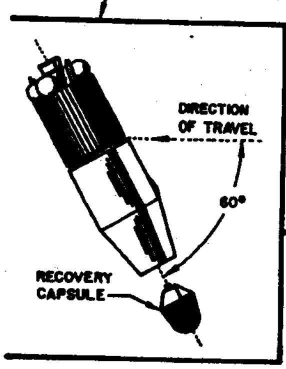
Schematic presentation of orbital trajectory following launch from Vandenberg Air Force Base. Functions performed by each station and a listing of equipment used by each station, is given on page A-4.



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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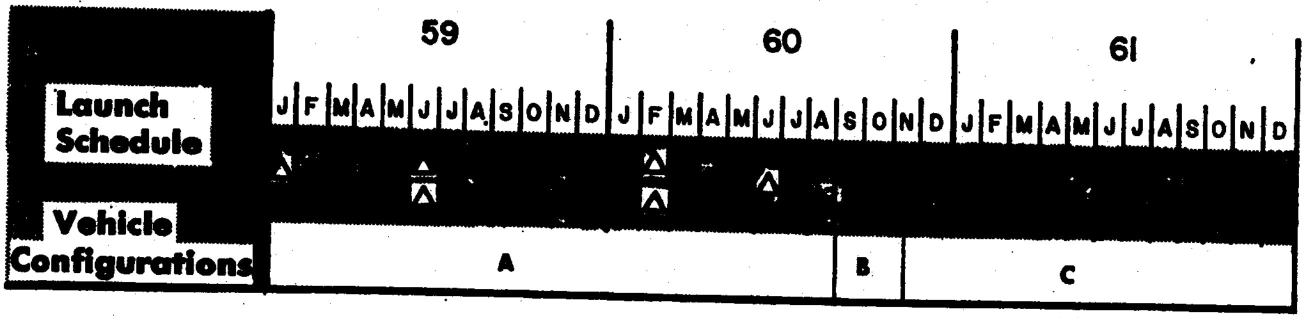
Facility	Equipment*	Flight Function
Satellite Test Center	A	Over-all control, convert tracking stations data to obtain a predicted orbit and generate subsequent ephemerides issue acquisition data to tracking stations for subsequent passes, predict recovery area.
Vandenberg AFB	BCDEFGHIJK	Launch, ascent 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



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.*

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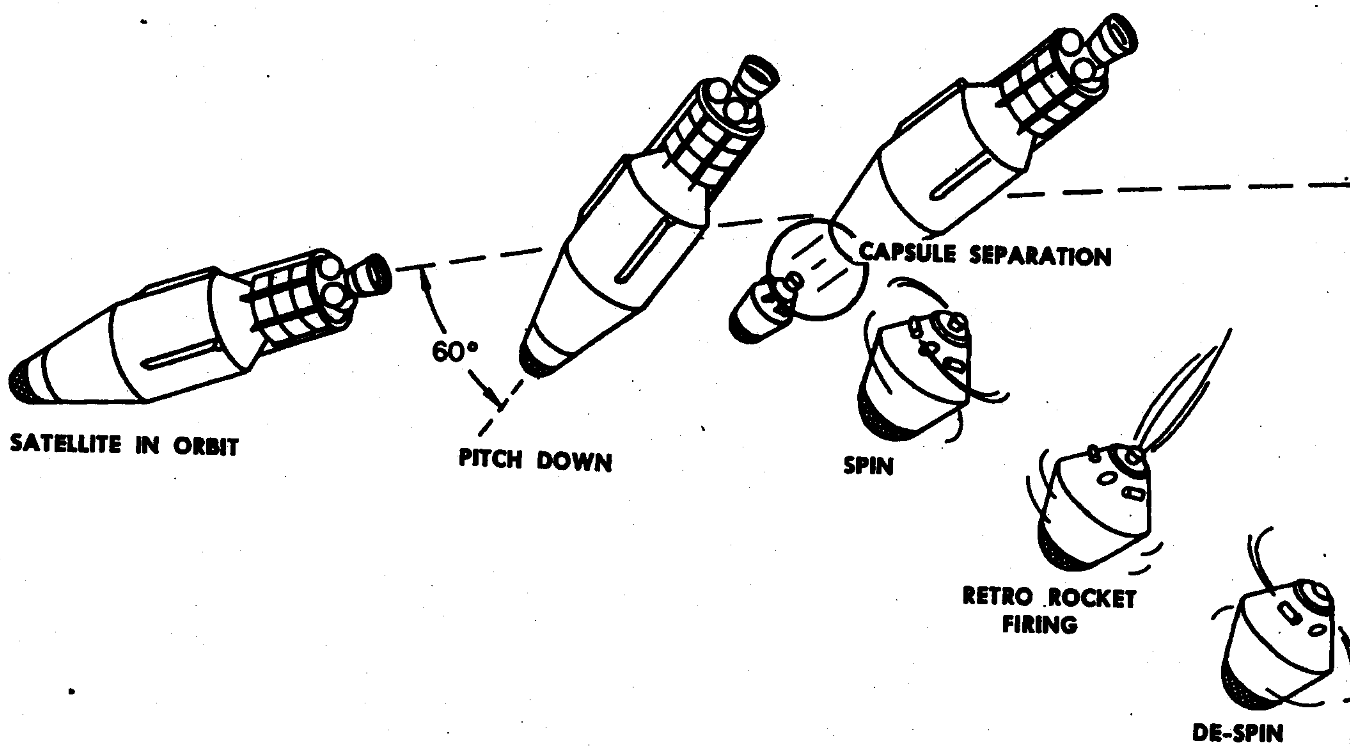
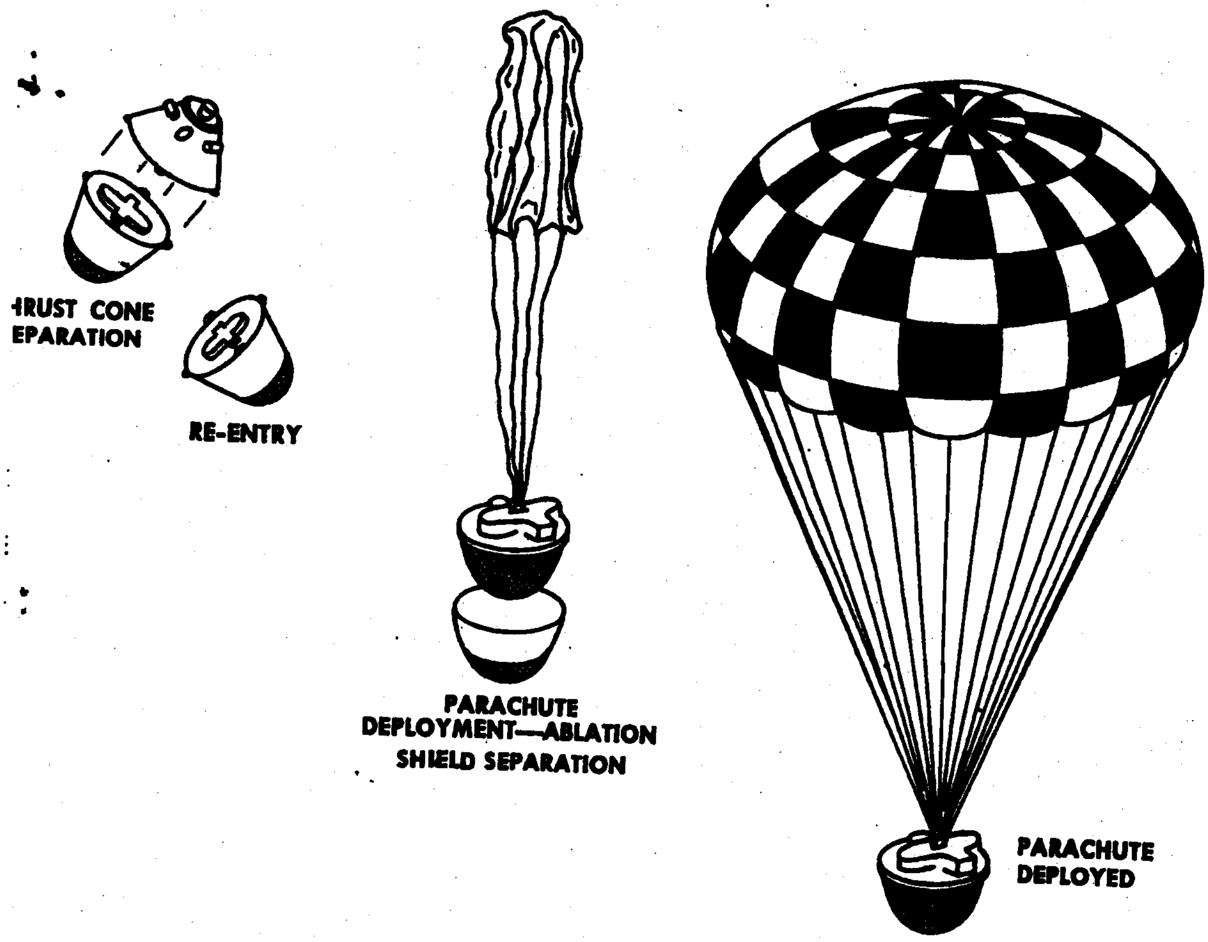
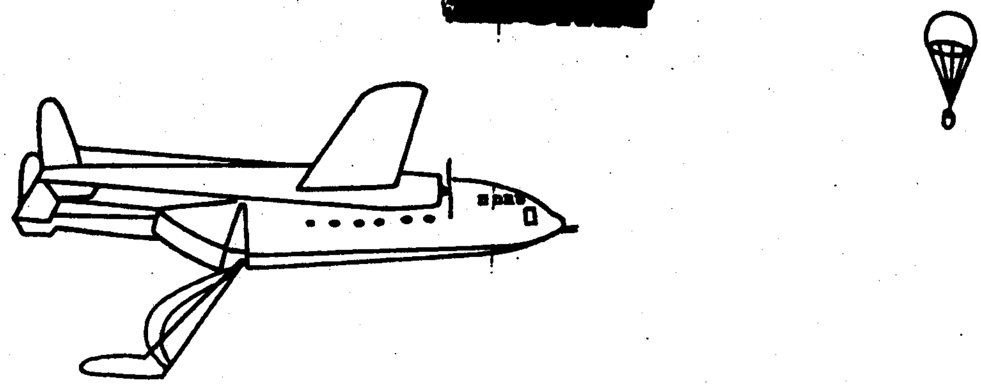


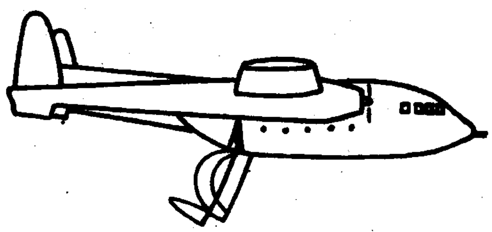
During its seventeenth orbit (approximately 26 and three-quarter hours after launch) the AGENA vehicle pitches nose down and capsule separation occurs. These operations require about a minute and one half. From launch to capsule ejection the satellite has traveled about 444,000 miles in its elliptical 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.

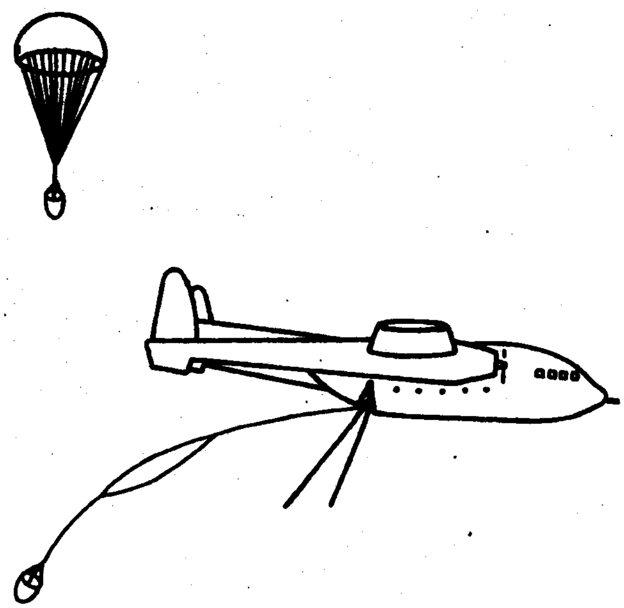
DISCOVERER CAPSULE EJECTION, RE-ENTRY, AND PARACHUTE DEPLOYMENT





DISCOVERER CAPSULE AERIAL RECOVERY

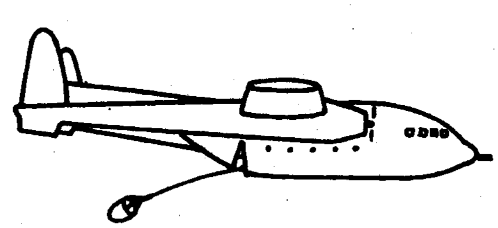




After capsule ejection from the satellite and re-entry into the earth's atmosphere, the parachute deploys. Parachute deployment occurs at an altitude of approximately 55,000 feet. The crews of C-119 aircraft in the recovery zone "home" in on the signals transmitted by the capsule's beacon and determine 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.



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.

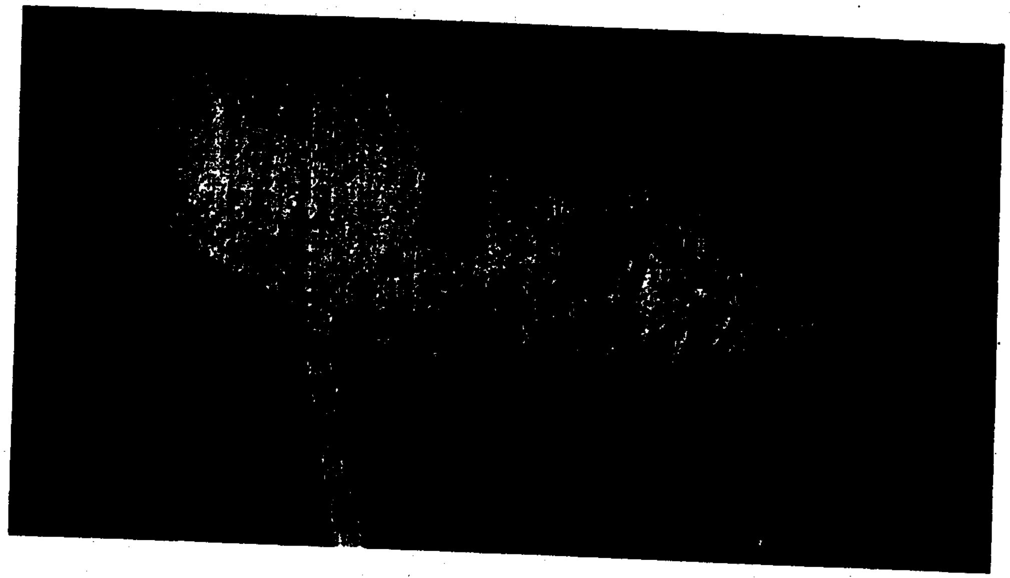
(1) DISCOVERER XIII was launched from Vandenberg AFB at 13:38 PDT, on 10 August and was successfully injected into polar orbit. THOR booster trajectory was slightly high and west but was well within tolerance. Second stage separation was successfully accomplished as was transmission of Commands 5 (time-to-fire 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



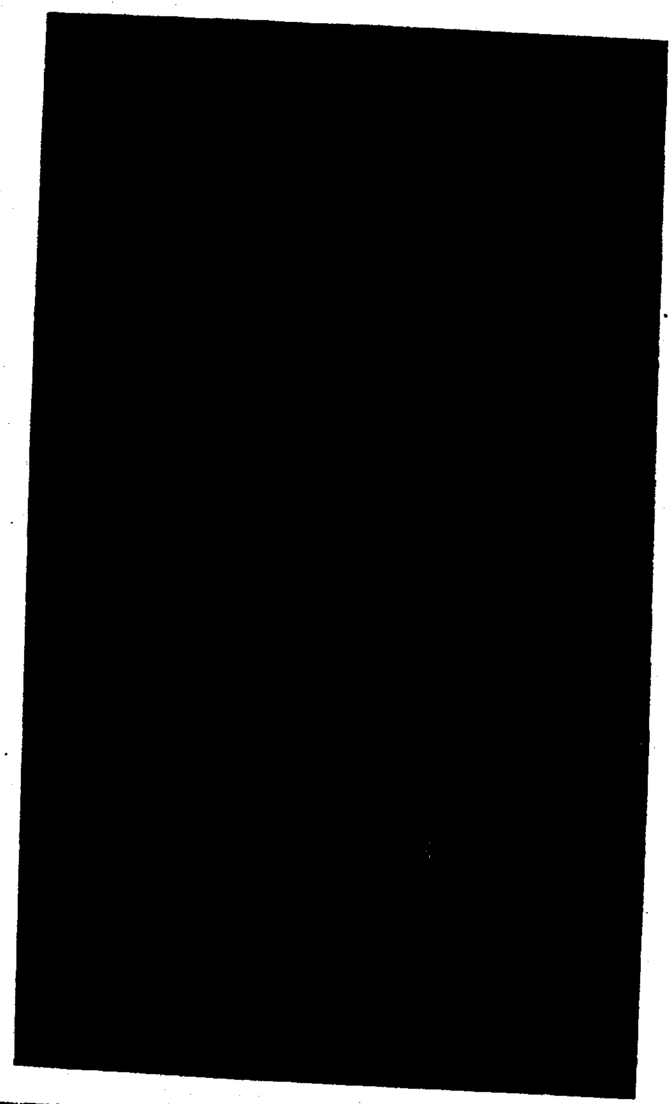


Figure 1. Assembly and Erection of DISCOVERER XIII flight test vehicle. Top view on opposite page shows final checkout procedure for second stage AGENA vehicle. Center and bottom views show AGENA being mated with THOR booster. Above, DISCOVERER XIII during pre-dawn countdown on 10 August. The blanket 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.

[redacted]

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

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

(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.

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.

(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.

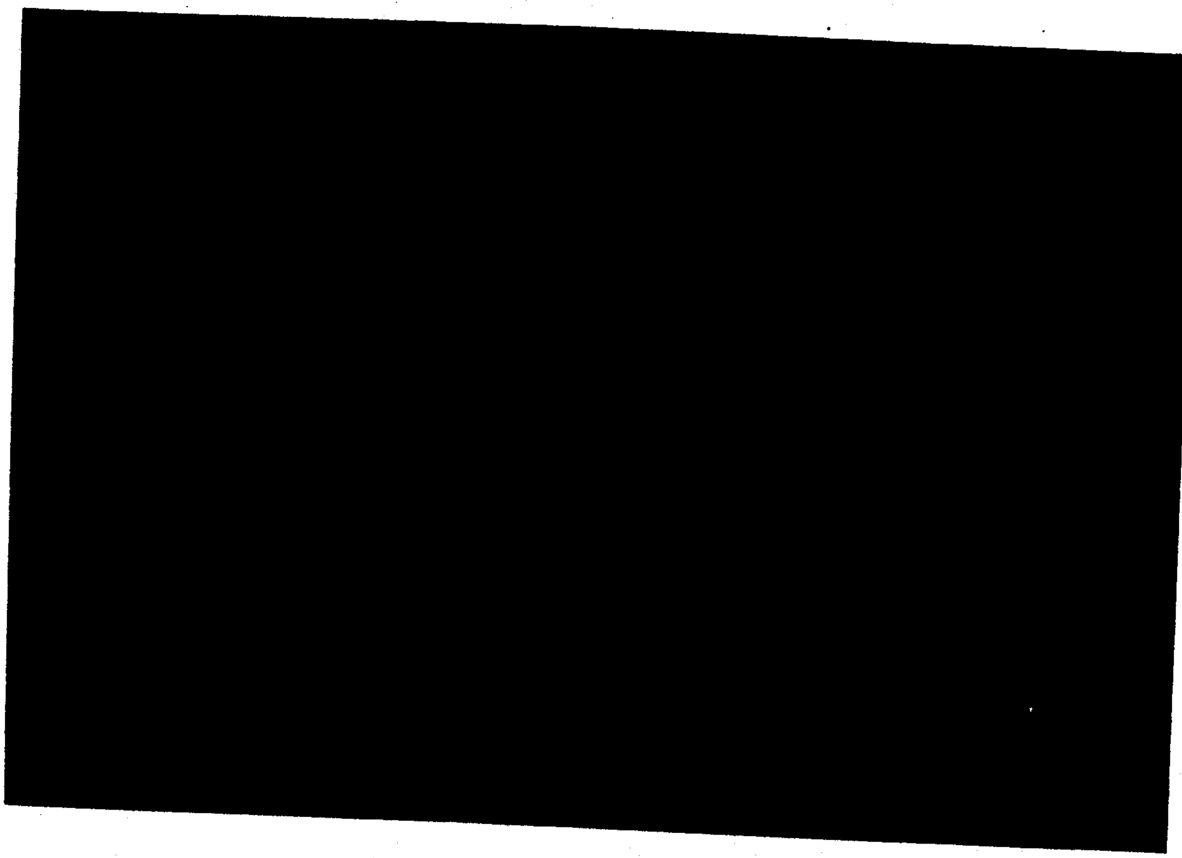
(4) Testing of the XLR-81Ba-9 engine (with 45:1 area ratio nozzle) continued at Arnold Engineering Development Center. An engine start and restart firing series, with the engine mounted in a modified test stand to permit gimballing, was completed in June. This series covered operation in a temperature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



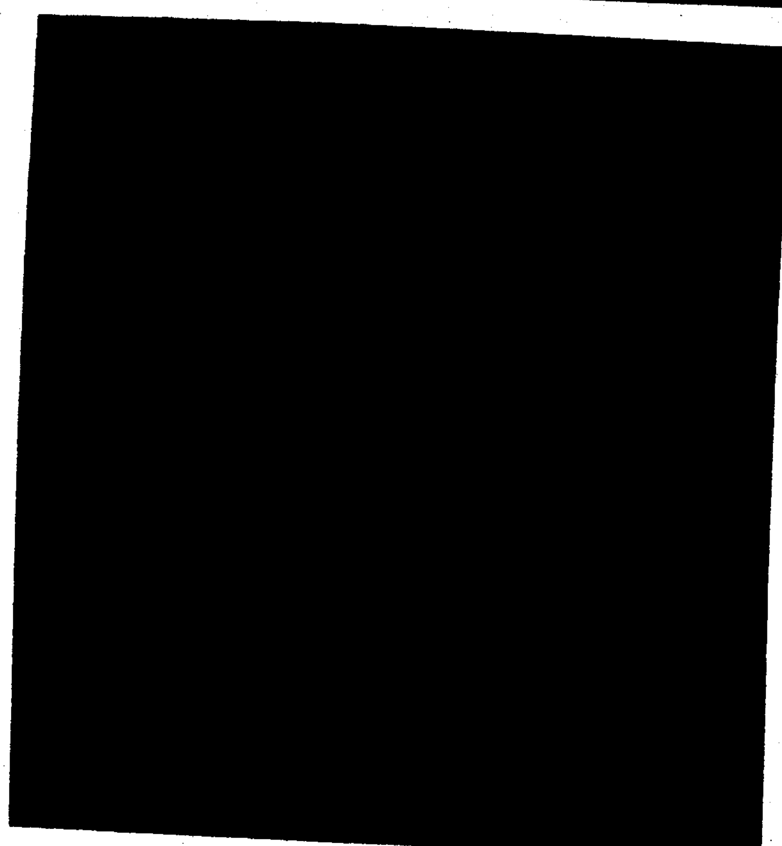


Figure 2. Frogman jumps from helicopter (above) to effect recovery of DISCOVERER XIII capsule shown floating in lower right corner of photo. Capsule being reeled-in by helicopter winch (right) and frogman being returned (top photo, opposite page). Capsule prior to removal from helicopter aboard the "Haiti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

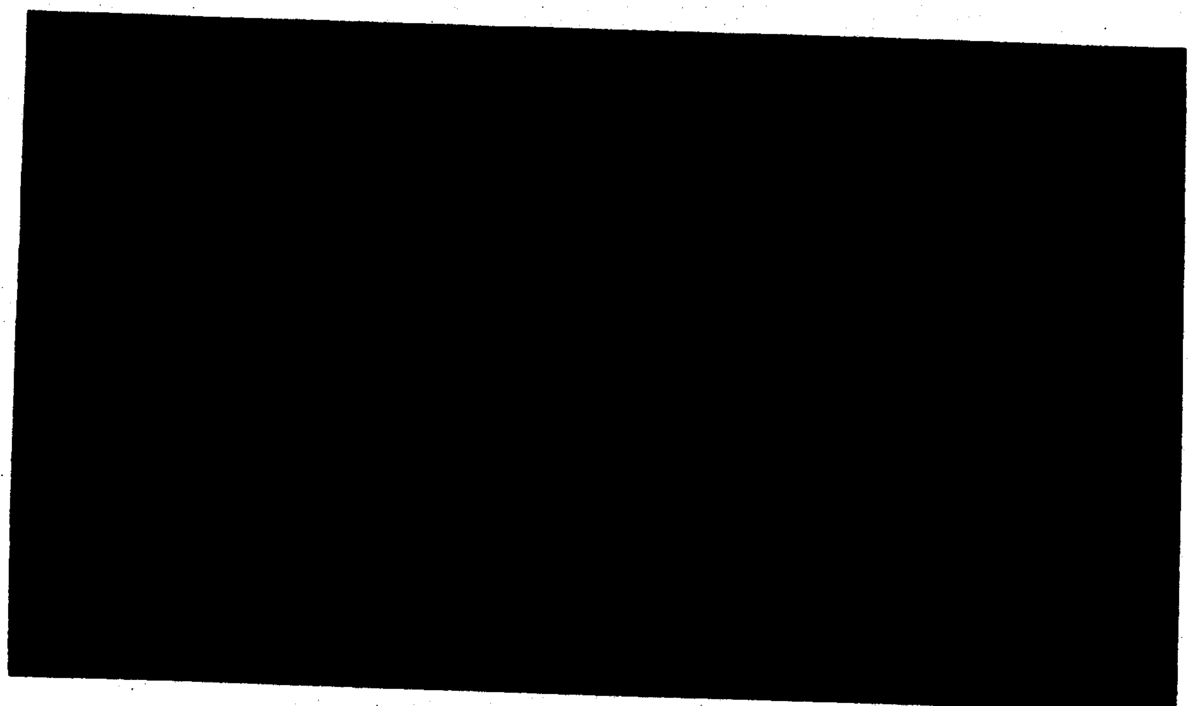
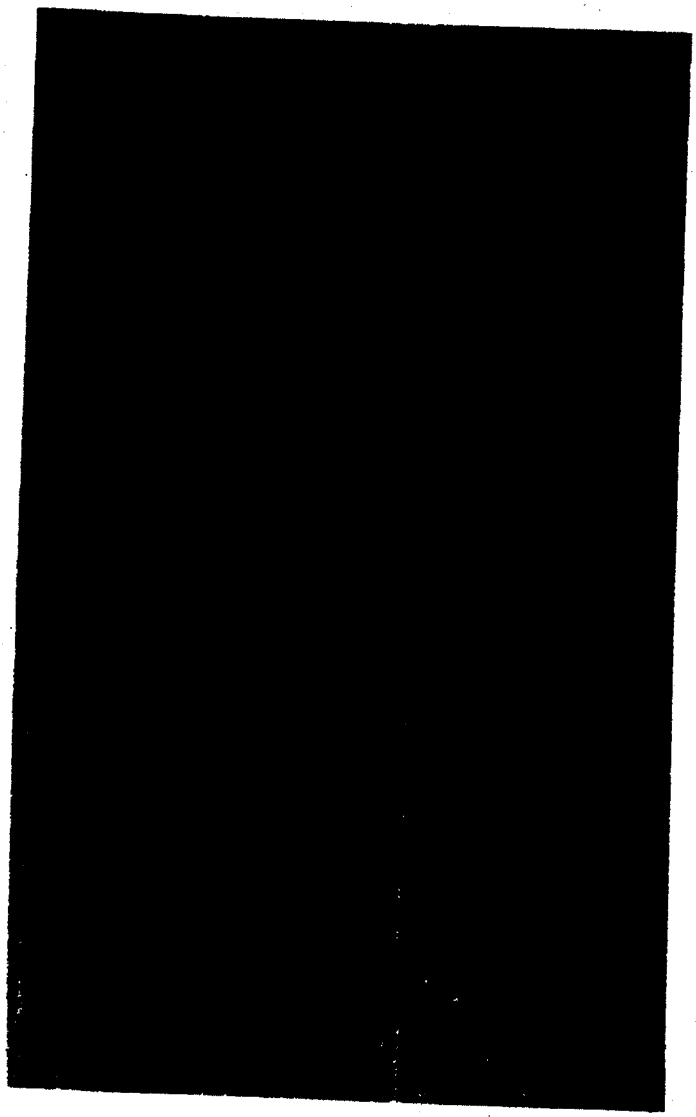


Figure 3.
Recovering the Capsule—
DISCOVERER XIV

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.*



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.

b. Recovery System Component Test Program

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

(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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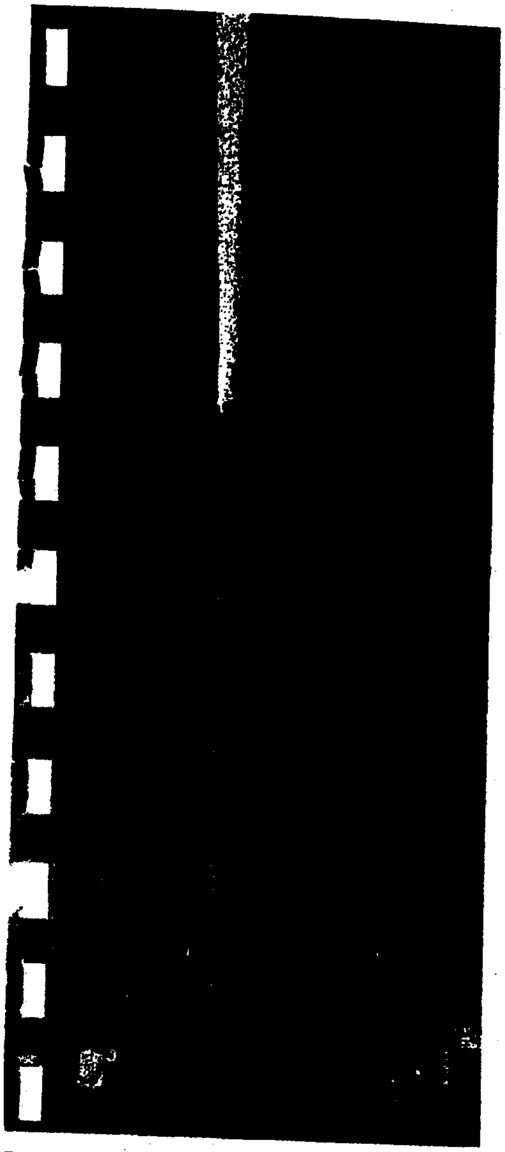
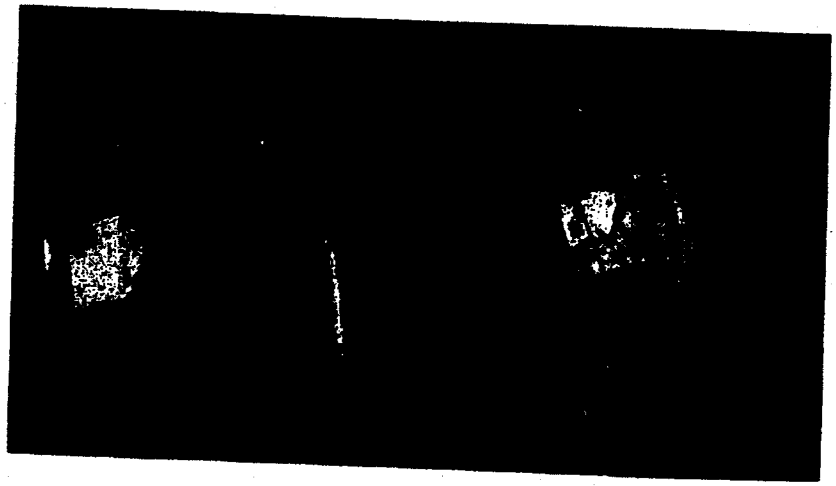
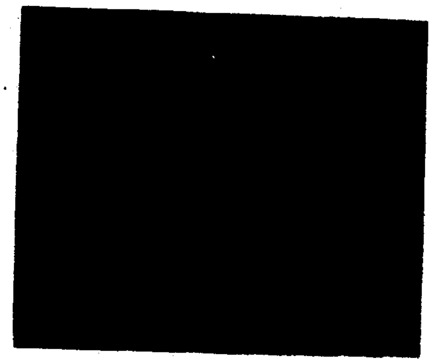
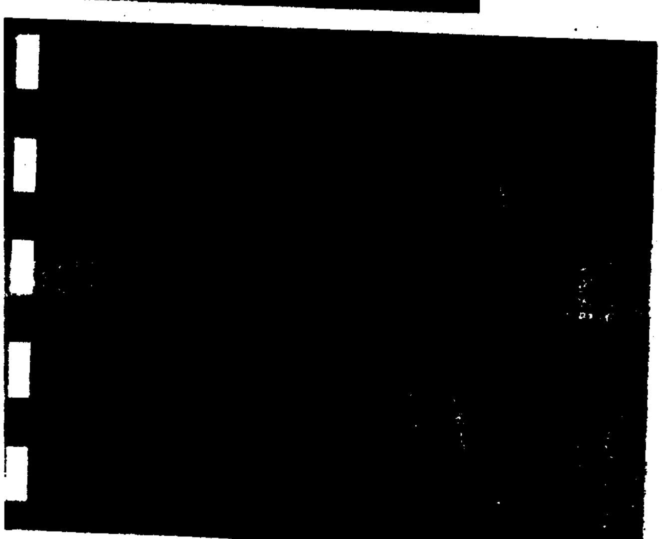








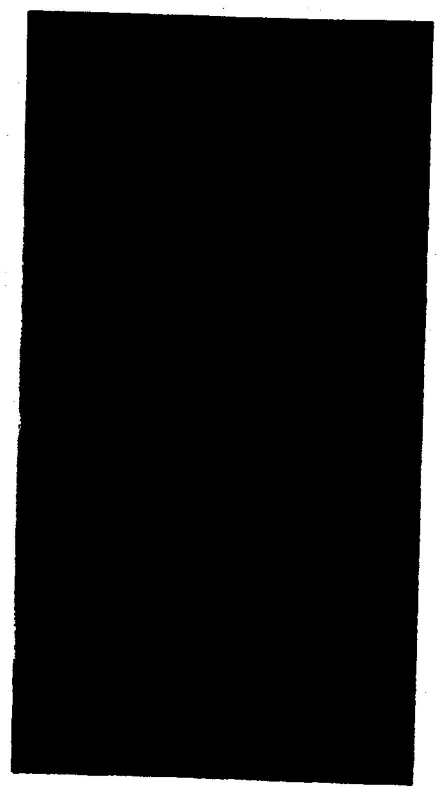


Figure 4. Test capsule (left) suspended from the balloon that will carry it to 100,000 feet altitude. Closeup (above) of test capsule and telemetry equipment which provides flight data and through which the release command is received. The ablative shield which protects the capsule from the heat generated 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.

[redacted]

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.

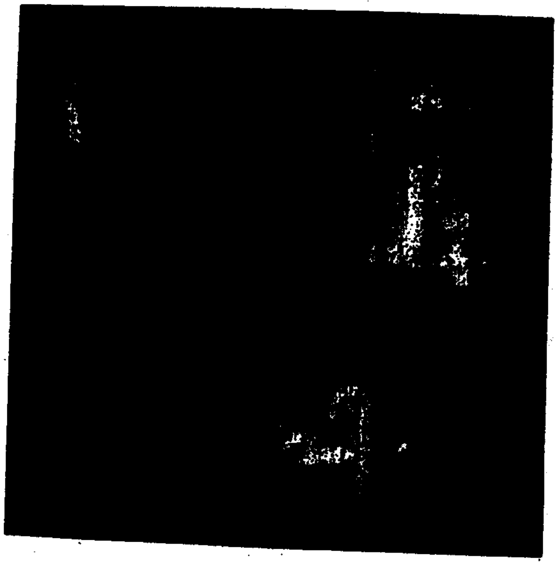


Figure 5. The Advanced Biomedical Capsule mockup (below) with a model of the 50-pound chimpanzee and the seat partially installed. Specimen-recording and telemetry equipment are mounted on the top of the capsule. Forward end of the mockup (left) showing oxygen spheres, blowers, and coolant equipment.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

[redacted]

Samos

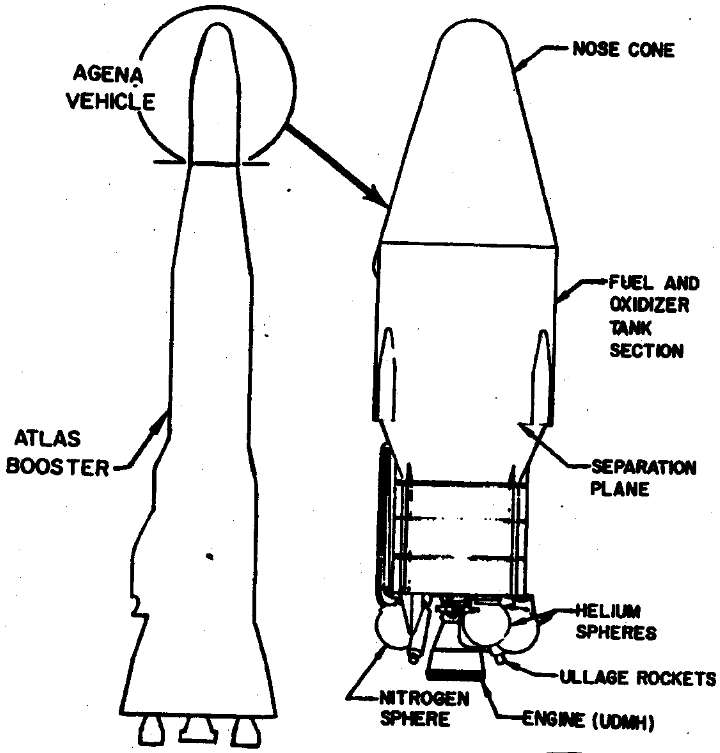
BOOSTER—ATLAS ICBM

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

Figure 1.

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



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.

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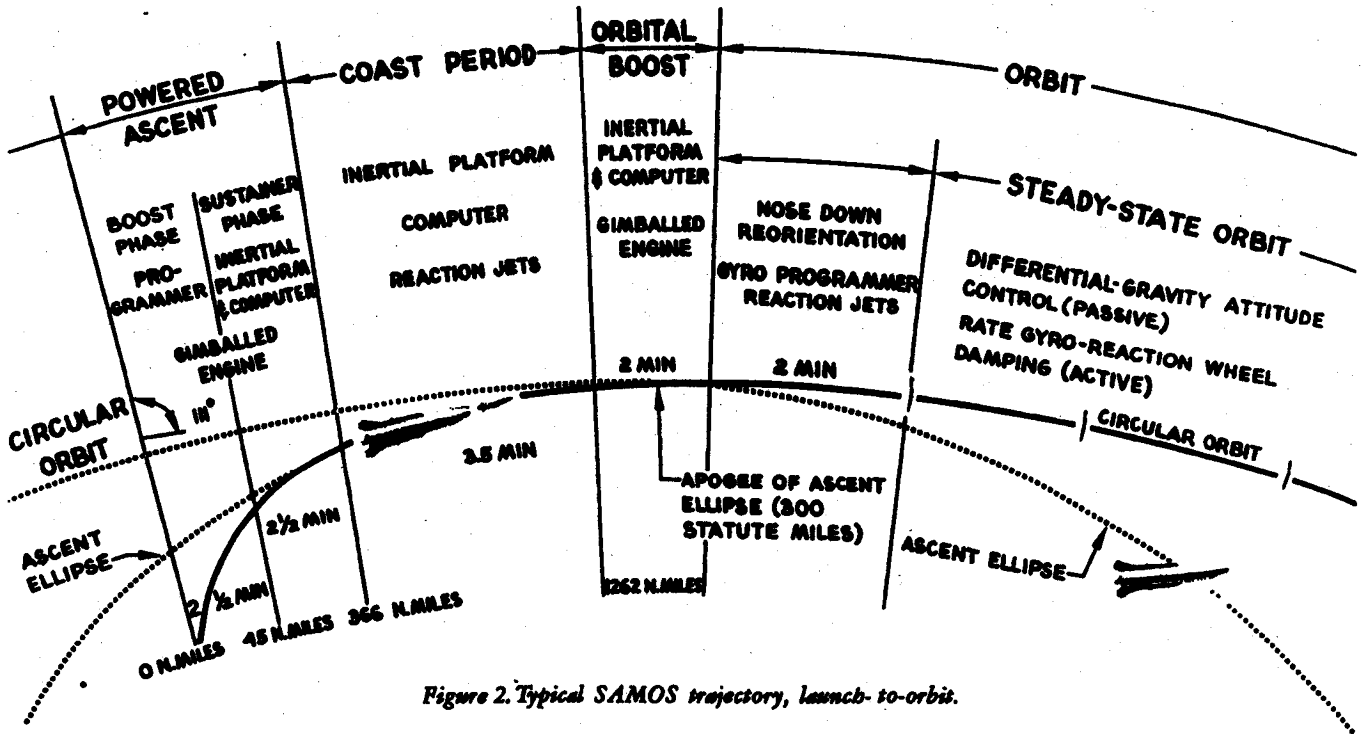

Figure 2. Typical SAMOS trajectory, launch- to-orbit.

Ferret Reconnaissance . . .

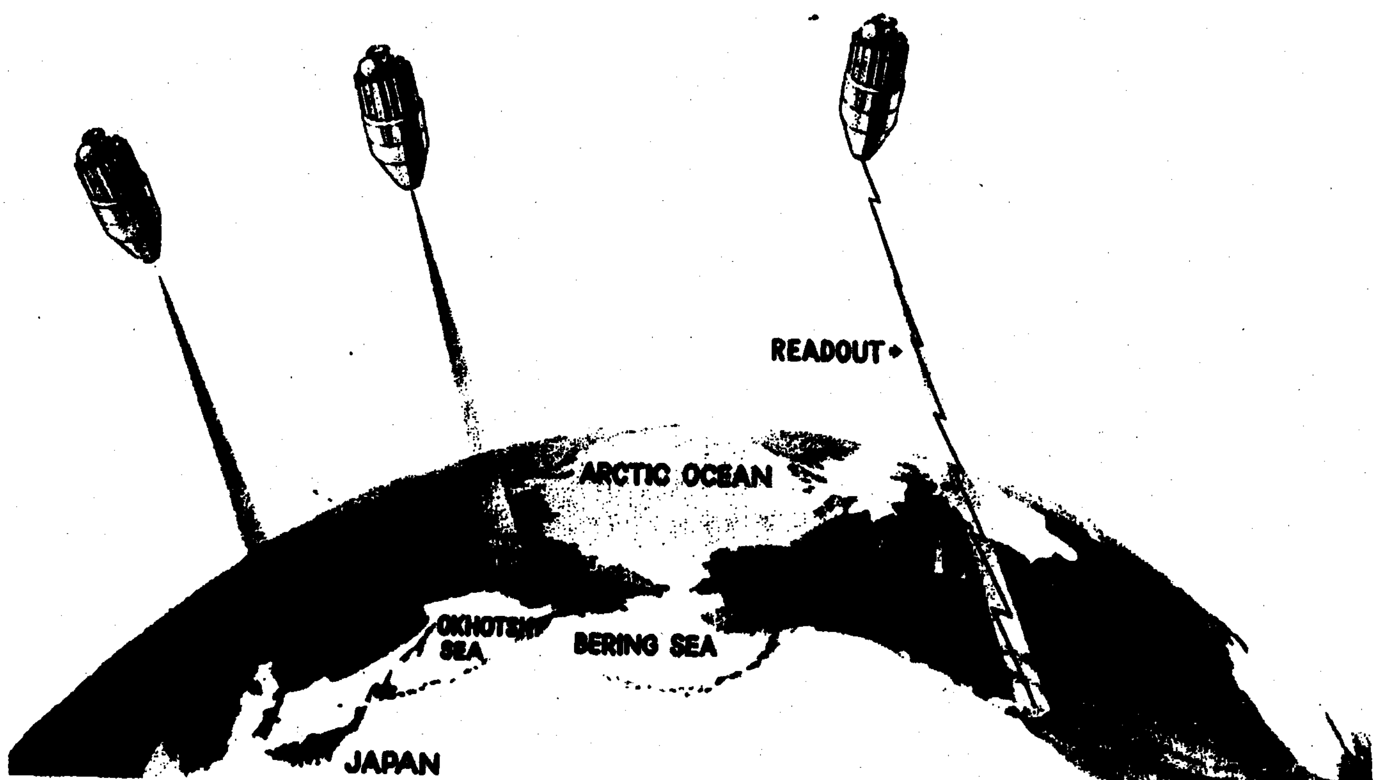

Figure 4. The Ferret reconnaissance system will gather data from electronic emissions over areas of interest.

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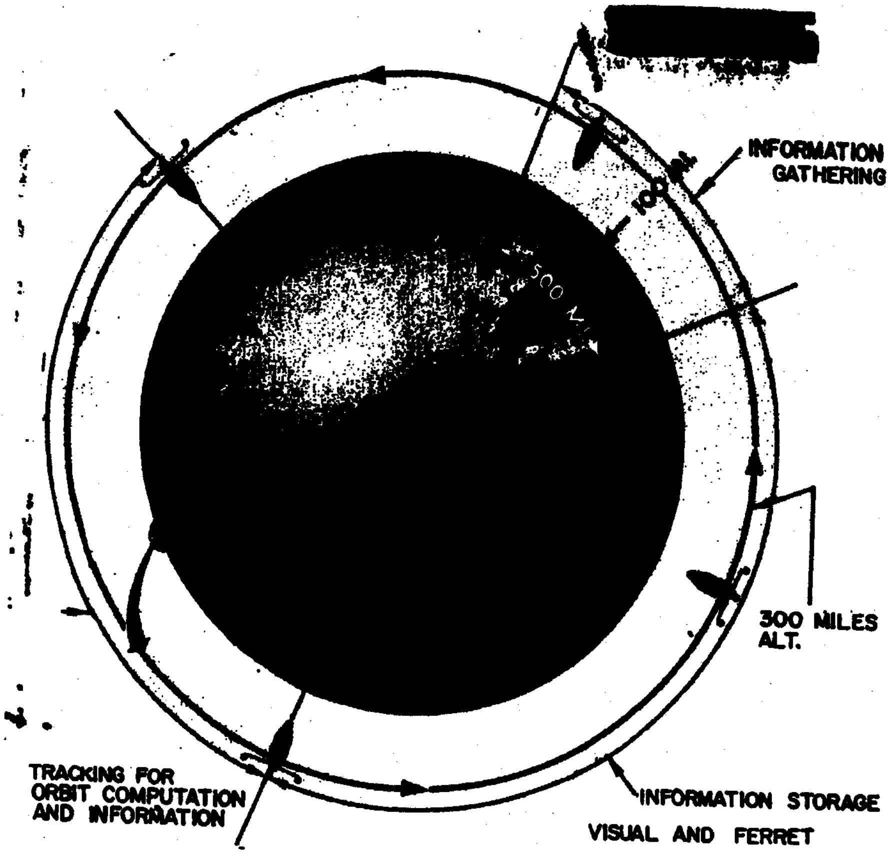

Figure 3.
Schematic of SAMOS system in operational orbit. When the satellite is over the area of interest the sensing equipment is turned on (Information gathering). When it leaves the area of interest the sensing equipment is turned off and the sensing data is processed (Information storage). When the vehicle comes within range of a ground receiving station, the data will be read-out upon command for processing and transmitted to using agencies. This process is continuously repeated during the useful lifetime of the vehicle.

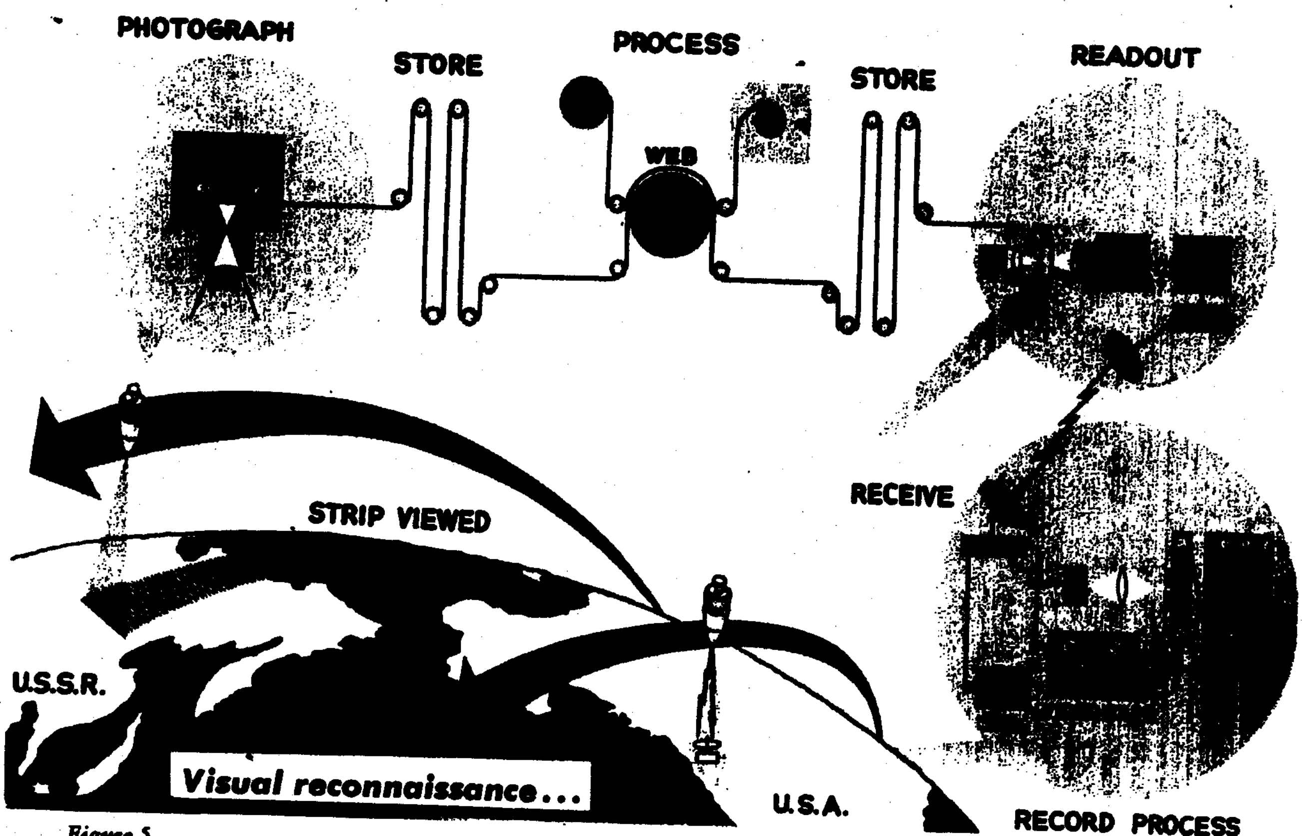

Figure 5.
The initial visual reconnaissance program will use conventional photo techniques with automatic film processing and TV-type electronic image readout to ground stations thru a data link. Ground electronics will reconvert the signal into photo image form, with a capability of resolving objects 20 feet in length.

[redacted]

Figure 6. SAMOS concept, showing reception of commands and transmission of data between satellite and ground station; and subsystem functions (schematic).

For economical testing of components a dual-capability visual and ferret payload will be flown on the first 3 flights. On later flights only a visual or ferret system payload will be carried. These payloads will be housed in the AGENA vehicle (Figure 1).

Data collected by the visual payloads will be electronically transmitted in the readout system or physically recovered in the recovery system. Ferret data will be transmitted electronically. These systems are composed of the AGENA vehicle, ATLAS booster, launch facilities, tracking facilities, and a communications and data processing network. The recovery system will include a re-entry capsule and a recovery force.

CONCEPT

ATLAS Series D missiles launched from VAFB will boost the AGENA vehicle into polar orbits. Injection into near-circular orbits (Figure 2) will be accomplished by the AGENA vehicle rocket engine. A self-contained guidance system using a horizon reference scanner will provide attitude stabilization. As the satellite travels in an orbit essentially fixed in space the earth rotates inside the orbit (Figure 3). Each successive orbit is displaced laterally approximately 23½ degrees at the equator, permitting one vehicle to observe the entire earth in a time period dependent upon the width of the area under surveillance. Early versions will have a useful life of approximately ten days. The readout systems will have a useful life of four months with a design objective in certain configurations of one year; recovery systems will have a useful life of fifteen to thirty days.

TECHNICAL DESCRIPTION

Visual Program—Four versions (E-1, E-2, E-5 and E-6) of visual payloads are being developed. The E-1 payload is a photo component test payload which is combined with the F-1 ferret payload. The E-2 photographic payload, under development by Eastman Kodak Company, includes a camera, film processor, and electronic readout equipment. The E-5 recoverable system designed by Lockheed will retain the exposed film and the 66-inch focal length camera developed by Itek Corporation. The E-6 payload is a medium resolution, general area coverage, photographic recoverable subsystem being developed as an alternate to the E-5. The E-6 is now in the source selection phase.

Ferret Program—Ferret payloads are being developed on a progressively more advanced basis from R&D (F-1) to advanced systems (F-4). Although only the F-1 and F-2 are included in the flight test schedule. The F-2 all-digital, general coverage payload will use superheterodyne scanning receivers in conjunction with directional antennas, an analog to digital converter and tape recorders (for storage). A programmer will be used to control read-in over areas of interest and readout over tracking stations. The F-3 payload will use similar receivers with stop-scan capability and controllable antennas added. Recording of the actual signal intercepted (rather than the digital representation) will be possible with a bandwidth up to 6mc. A complex programmer will permit satellite search of a given area or frequency range.

[redacted]

[redacted]

[redacted]	60	61	62
	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D
	[redacted]	[redacted]	[redacted]
VEHICLE CONFIGURATIONS	ATLAS "D"/AGENA "A"	ATLAS "D"/AGENA "B"	

SAMOS Launch Schedule

[redacted]

A. BRIEF OF PROGRESS

The AGENA "A" vehicle for the first SAMOS flight completed system tests at Vandenberg Air Force Base on 17 August. The ATLAS booster flight readiness firing was successfully completed on 23 August. The launch of this vehicle is now scheduled for 4 October. The two remaining AGENA "A" vehicles are in the modification and checkout phases in the systems test area. The premating of major components for the first AGENA "B" vehicle was completed on 23 August. Delivery of the XLR-81Ba-9 engine was made in mid-August.

Checkout and testing of the E-1 and F-1 first flight payloads is proceeding on schedule at Vandenberg Air Force Base. Final assembly of the E-2 payload for the fourth SAMOS flight was completed during August. A thermal model of the E-5 payload was completed during August, with delivery programmed for early September. A mid-February 1961 date has been established for delivery of the first E-5 flight payload.

Installation of the E-1 operating console, the second set of visual reconnaissance ground reconstruction electronics equipment and two primary record cameras in the Vandenberg Air Force Base data acquisition and processing building was completed in July. Installation of the UHF equipment and the Model 1604 computer at this station have also been completed. Delivery of the Programmable Integrated Control Equipment, to be used on the third and subsequent SAMOS flights, is scheduled for September.

Construction of all facilities for the first SAMOS flight is complete, and support equipment checkout is proceeding at a rate compatible with the scheduled launch date. The SAMOS laboratory building at Vandenberg Air Force Base was accepted on 18 July. The construction contract for the Point Arguello diesel generator building was awarded on 29 August.

[redacted]

B. TOPICAL SUMMARY

1. Technical Status

a. Second Stage Vehicles

The AGENA "A" vehicle for the first SAMOS flight successfully completed systems testing on 17 August. On-stand date was rescheduled from 19 August to 2 September. Launch is now scheduled for 4 October.

(1) The second stage vehicle for the first SAMOS flight has completed system testing at Vandenberg Air Force Base. The tests were successfully concluded on 17 August following a simulated launch. Late delivery of airborne communications equipment and the requirement for a full-scale RF interference check (because of the DISCOVERER XII horizon scanner problem) resulted in rescheduling the on-stand date from 19 August to 2 September. This revised date is compatible with the requirement of not installing the AGENA until after completion of the ATLAS booster Flight Readiness Firing (FRF). The ATLAS FRF was successfully completed on 23 August. Launch of the first SAMOS flight is now scheduled for 4 October. This date will permit the telemetry ship Pvt. Joe E. Mann to return on station, following its support of the DISCOVERER recovery operation.

The two remaining SAMOS AGENA "A" vehicles are approximately six to eight weeks behind schedule. Schedule recovery appears unlikely.

(2) The two remaining SAMOS AGENA "A" dual payload satellites are proceeding through modification and checkout in the systems test area. These vehicles are approximately six to eight weeks behind schedule. This slip resulted from late delivery of communications equipment, the 30-day strike at Lockheed and the need for engineering changes in the systems test area. These changes will decrease the time required for the

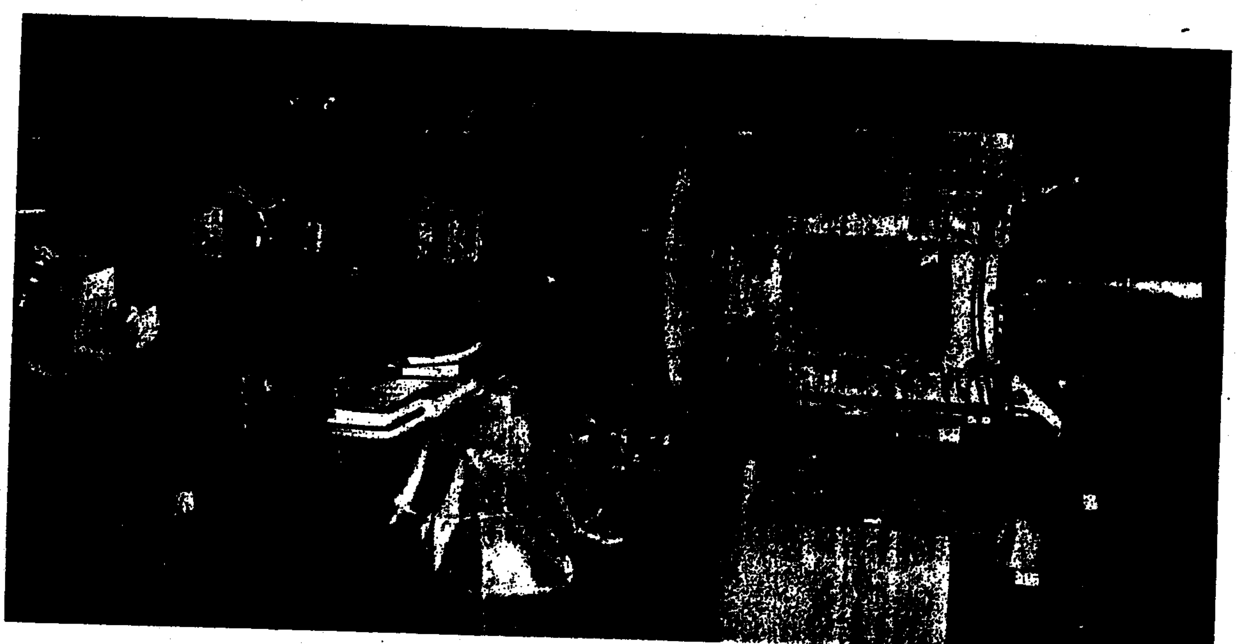

Figure 7. The AGENA "A" vehicle for the first SAMOS flight undergoing auxiliary power subsystem checkout at Vandenberg Air Force Base. The test fixture on the far left is used in checking the satellite's inertial reference unit. The inertial reference unit and the horizon scanner provide the attitude reference for the AGENA flight control system.

[redacted]

missile assembly building phase of prelaunch operations. No airborne communications equipment delinquencies exist at this time, but previous delays have made schedule recovery unlikely.

Because of the attitude control problem experienced on the second MIDAS flight, the orbital program for the first three SAMOS satellites will be changed. The change assures completion of tank pressurization venting prior to shutting off the flight control system pneumatics.

(3) Because of the attitude control problem experienced on the second MIDAS flight, the first three SAMOS satellites will maintain a horizontal, nose forward position throughout most of the first orbit. Re-orientation to the nose-down position will be initiated by stored commands as the satellite comes within range of the tracking staton at Kodiak, Alaska, on its first orbital pass. This change assures completion of tank pressurization venting prior to shutting off the flight control system pneumatics. The forces created by the continuation of venting after switching from the flight control to the attitude damping system were believed to have been a major factor in the loss of attitude control. The AGENA "B" vehicles will incorporate a full-time attitude control system and will not require the modifications being made on the AGENA "A" vehicles.

The first AGENA "B" vehicle has entered the final assembly phase of manufacture.

(4) The stacking of major components for the first AGENA "B" (single-payload) vehicle was completed on 23 August. The vehicle has now entered the final assembly phase of manufacture. The XLR-81Ba-9 engine (45:1 area nozzle ratio) was received in mid-August. Delivery has also been made of the guidance and control system inertial reference package and its associated electronic items.

b. Visual Reconnaissance Systems

Visual Reconnaissance Systems payloads are being developed in a minimum number of configurations to attain readout and recovery mission objectives. The design and purpose of each configuration is as follows:

Readout:

E-1—Component Test Payloads

E-2—Steerable Reconnaissance Payload (with 20-foot ground resolution)

Recovery:

E-5—High Resolution, Steerable Recoverable Payload (with 5-foot ground resolution)

E-6—Medium Resolution, General Area Coverage, Recoverable Payload (with a ground resolution of 10 feet or more).

Checkout of the E-1 is proceeding on schedule.

(1) Checkout and testing of the E-1 payload continues to proceed on schedule at Vandenberg Air Force Base.

E-2 thermal mockup environmental tests were successfully conducted in July.

(2) Environmental tests of the E-2 thermal mockup conducted in July indicate that successful control of critical components can be achieved under both hot and cold orbital conditions.

E-2 payload final assembly completed in August. Delivery to be made in late September.

(3) Final assembly of the E-2 payload for the fourth SAMOS flight was completed during August. Subsequent functional testing of the completed payload has resulted in modifications to the processor web feed system. Eastman Kodak is expending maximum effort to incorporate these

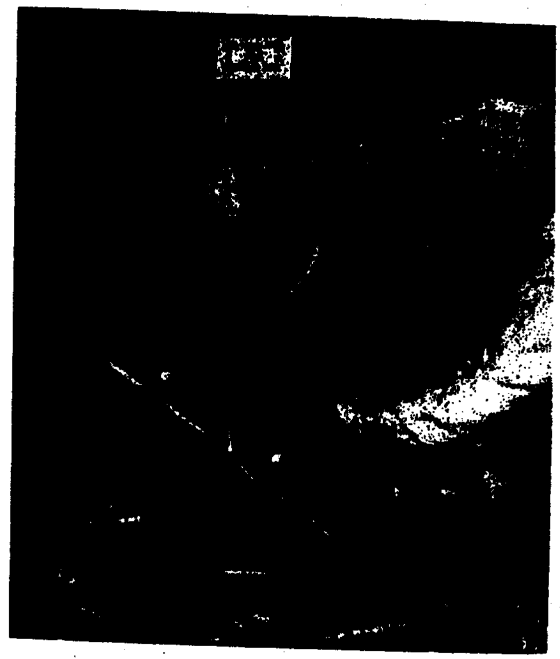

Figure 9. E-1 payload for the first SAMOS flight showing a technician installing pre-exposed, pre-developed film prior to testing the payload read-out phase of operation.

Figure 8. Stacking, or premating of the major components of the AGENA "B" vehicle for the fourth SAMOS flight. This vehicle has twice as much propellant capacity as previous vehicles and will be flown carrying an E-2 payload. Following this operation, the AGENA structural assemblies are mounted horizontally in a stand for installation of the engine and other flight hardware components.

[redacted]

E-5 thermal model completed in August. First E-5 flight payload scheduled for mid-February 1961 delivery.

(4) Design releases for the full-scale test models of the E-5 recovery capsule were completed in August and fabrication of the initial test articles is progressing satisfactorily. A thermal model of the E-5 payload, for testing in the high altitude temperature simulator, was completed during August. Delivery of this thermal model is programmed for early September. A mid-February 1961 date has been established for delivery of the first E-5 flight payload.

Wind tunnel tests of the E-5 recovery capsule are essentially complete.

(5) Wind tunnel tests for the purpose of confirming the E-5 recovery capsule basic aerodynamic configurations are essentially complete. The force oscillation tests at Langley Field, to determine dynamic stability characteristics in the 2.3–5 Mach range, were completed on 10 August. Tests in the transonic range are scheduled to begin in early September.

Two tests to determine the E-5 capsule drag and oscillation characteristics during retrieval have been conducted. Neither test was completed.

(6) Two Recovery Equipment Test Unit (RETU) tests have been conducted at Edwards Air Force Base. These tests determined the E-5 capsule drag and oscillation characteristics during retrieval into the recovery aircraft. Because the RETU was lost during the deployment phase, neither test was completed. Some data were obtained and are currently being evaluated.

Test results of the stability and rate of descent characteristics of a single main parachute versus a clustered main chute configuration are still being evaluated.

(7) Test results of the stability and rate of descent characteristics of a single main parachute versus a clustered main chute configuration are still being evaluated. Based on visual observation of tests completed to date at El Centro, California, the single chute system appears more desirable from the stability standpoint. Structural integrity tests of the E-5 stabilization chute were initiated late in August.

c. Ferret Reconnaissance System

Ferret Reconnaissance System payloads are being developed in a minimum number of configurations. The designation and purpose of each configuration is as follows:

F-1—Component Test Payloads

F-2—Digital General Coverage Payloads

F-3—Specific Mission Payloads—Analog Signal Recording

(1) Checkout and testing of the F-1 payload is proceeding on schedule at Vandenberg Air Force Base.

Assembly of components for the initial F-2 payloads continues on schedule.

(2) The testing and assembly of components for the initial F-2 payloads continues on schedule.

d. Ground Support Equipment

The vacuum test chamber was delivered to Vandenberg Air Force Base in June.

(1) Functional tests of the electronics portion of the vacuum test chamber (used for leak testing E-1 and E-2 payloads) were completed by the contractor and the chamber was delivered to Vandenberg Air Force Base in June. This completed the delivery of major items of E-1 payload ground support equipment for the Vandenberg Air Force Base missile assembly building.

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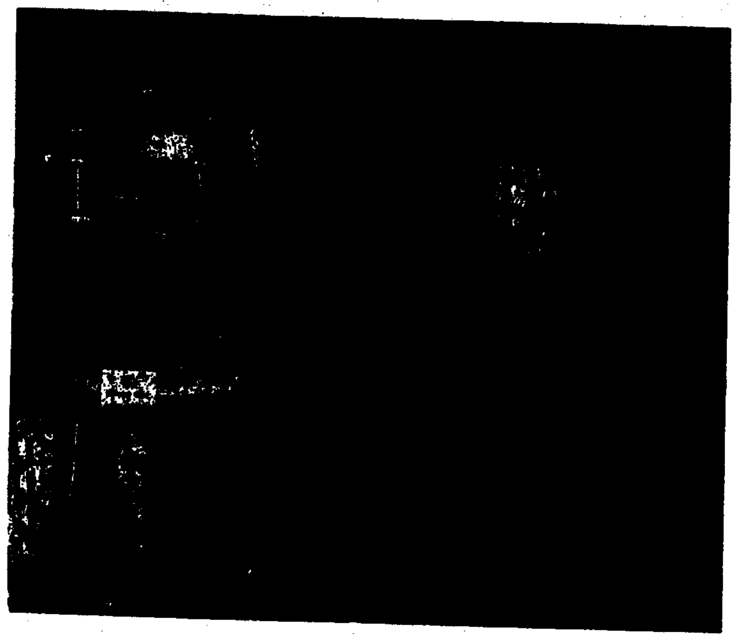


Figure 10. Adjusting the checkout console signal generator during functional testing of the F-1 payload. These tests consist of checking payload readout against calibrated inputs. The telemetry monitoring equipment is in the left-hand section of the console.

Installation of UHF equipment at Vandenberg Air Force Base is complete and systems integration has started.

(3) Installation of the E-1 operating console, the second set of visual reconnaissance ground reconstruction electronics equipment, and two primary record cameras in the Vandenberg Air Force Base data acquisition and processing building was completed in July. Installation of the UHF equipment required for initial SAMOS operations at the Vandenberg AFB tracking and acquisition station is complete, and the equipment is undergoing systems integration. Also completed during July was the installation of the Model 1604 computer.

Delivery of PICE to Vandenberg Air Force Base scheduled for September.

(4) Assembly and checkout of the Programmable Integrated Control Equipment (PICE) to be available for the third and subsequent SAMOS flights, are progressing at the contractor's facility. Functional checkout and compatibility tests of set No. 1 are now in progress. Delivery to the Vandenberg AFB tracking and acquisition station is scheduled for September. Set No. 2, scheduled for delivery to the satellite test center 60 days after completion of set No. 1, is in final assembly.

F-2 checkout console completed in June.

(5) The first F-2 checkout console was completed in June and compatibility tests, using a service test model F-2 payload, are in progress.

Telemetry data monitoring equipment delivered in June.

(6) A major portion of the telemetry data monitoring equipment was delivered to Airborne Instruments Laboratory on 15 June. This equipment will be incorporated into the F-2 evaluation and command complex for the Vandenberg AFB and New Boston tracking and acquisition stations.

F-1 console delivered.

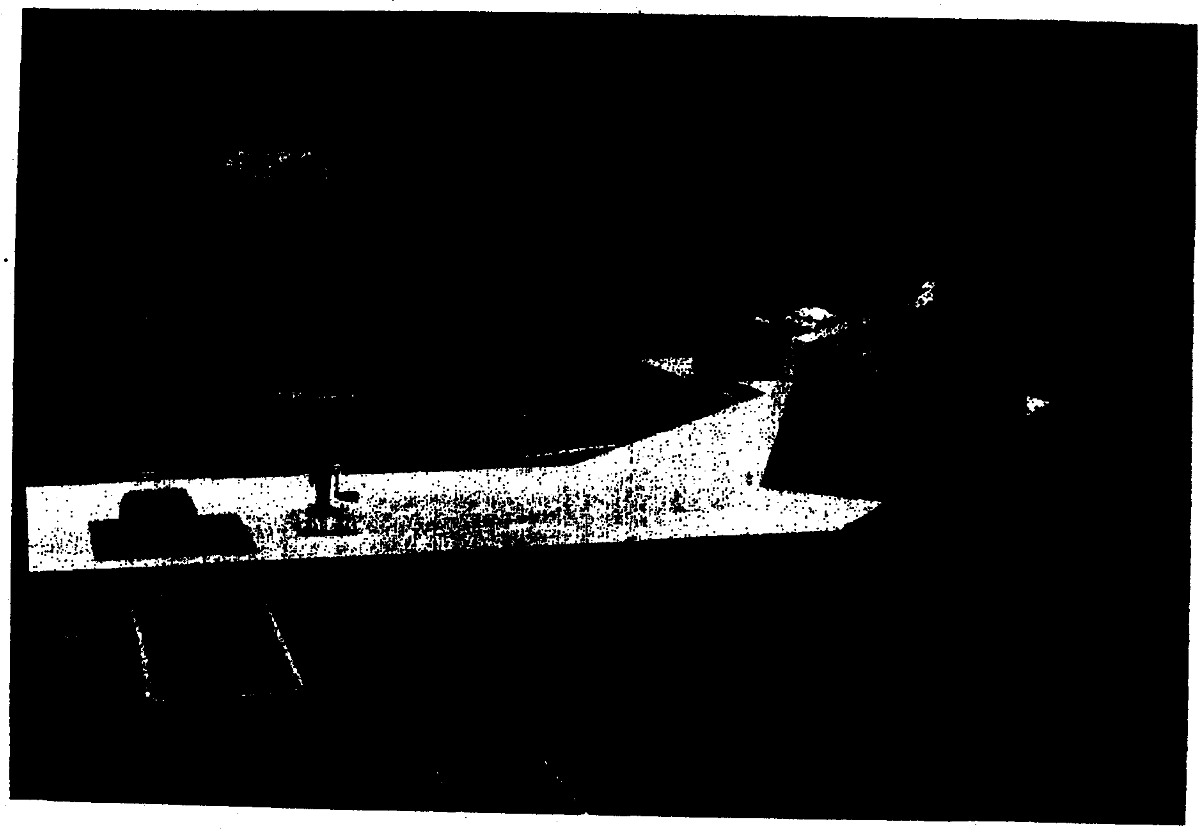
(7) The F-1 operating console was delivered to Vandenberg AFB in July.

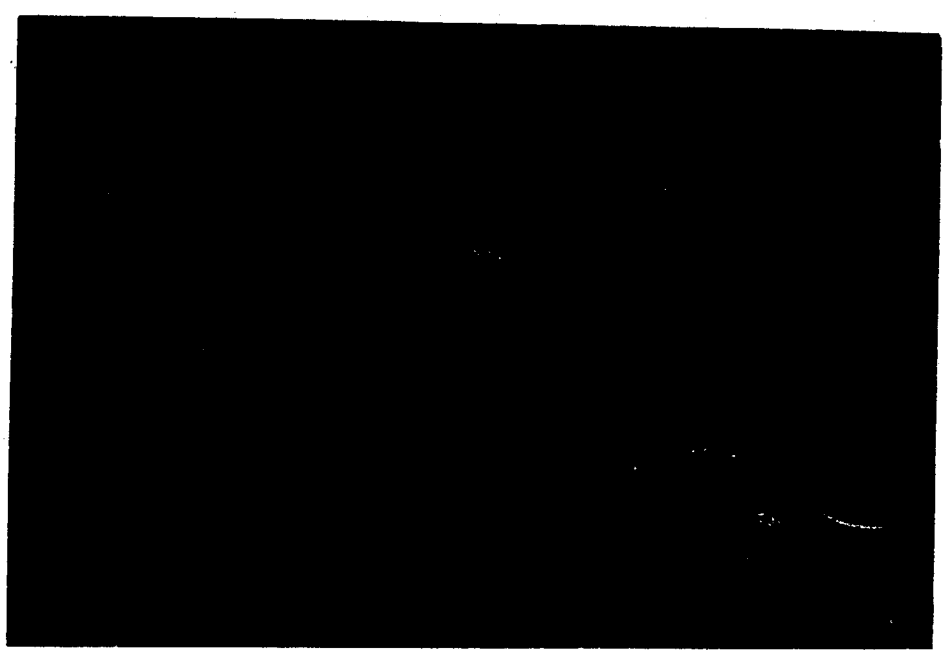
2. Facilities

Modification designed for the New Boston data acquisition and processing building.

a. A change in concepts of computer type and configuration has necessitated the design of a modification to the New Boston data acquisition and processing building. This modification is scheduled for completion in time to support the first SAMOS launch.

[redacted]





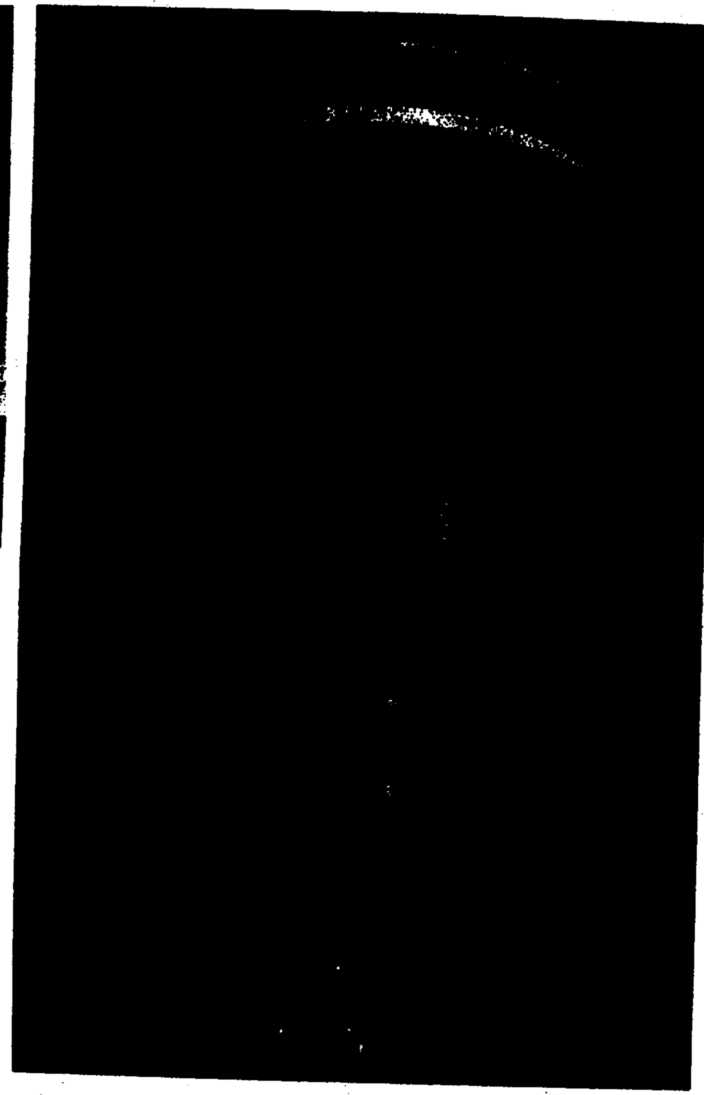


Figure 11. Model 1604 computer (opposite page, upper) installation in the Vandenberg Air Force Base data acquisition and processing building. This high speed computer is well adapted to the real time operations required in satellite programs. Aerial view (opposite page, lower) of the Vandenberg Air Force Base tracking and data acquisition station. The TLM-18 telemetry antenna is in the upper left of the picture. To the right of it is the VHF telemetry building. The data acquisition and processing building is the large building in the center of the site. The 60-foot tracking and data acquisition antenna is in the lower right corner. UHF angle tracking antenna and control building (above) at Vandenberg. The 60-foot antenna is in the background. Closeup (right) of the 60-foot UHF tracking and data antenna with the UHF telemetry building shown behind the antenna. Angle tracker console (below) with equipment racks in the background. This equipment is undergoing systems integration tests.

[redacted]

Offutt Air Force Base interim data processing facility construction cancelled.

b. The construction contract for the interim data processing facility at Offutt Air Force Base was ordered cancelled by the Office of Secretary of Defense in June. Pending redirection of the program, no further action will be taken on either the interim or final facility.

Construction is complete on all facilities required for the first SAMOS flight.

c. Construction of all facilities required for the first SAMOS flight is complete, and installation and checkout of equipment are progressing at a rate compatible with the scheduled launch date. Systems testing of the Pad 1 complex at Point Arguello was completed late in July.

SAMOS laboratory building accepted on 18 July.

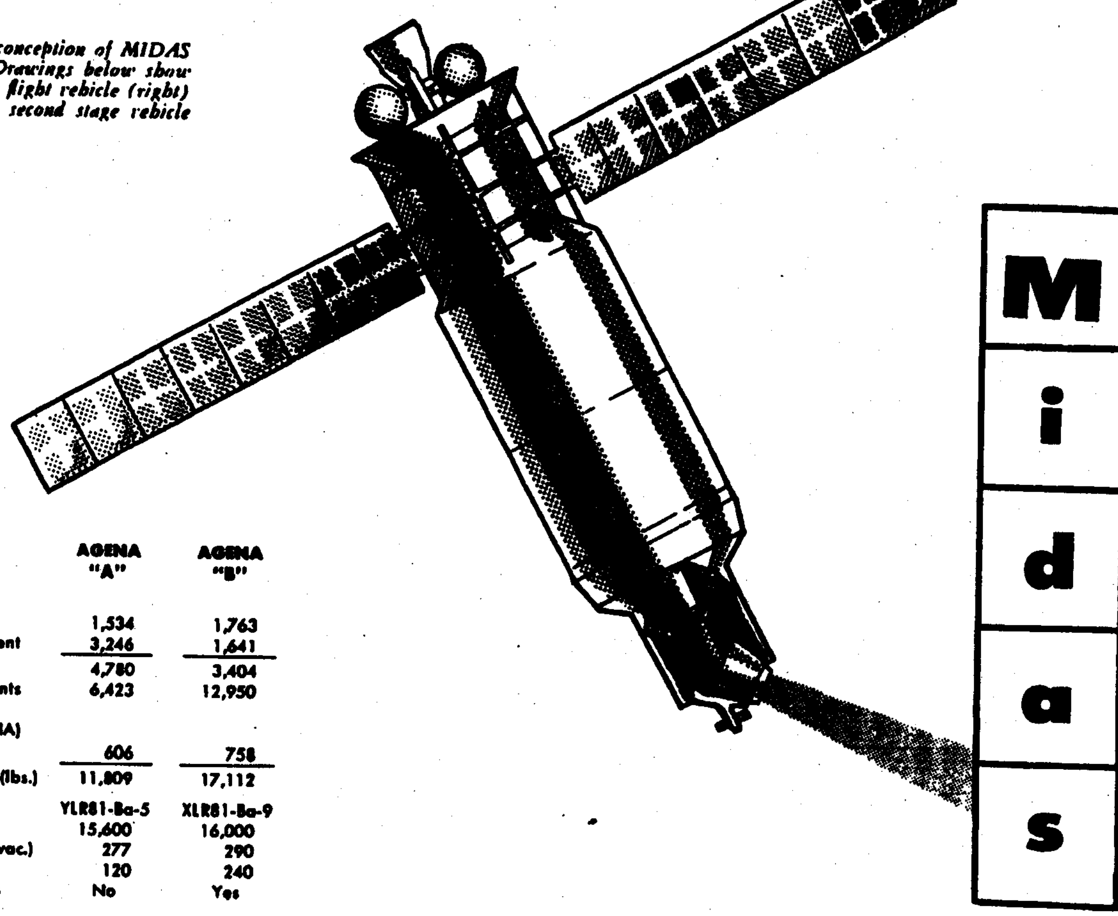
d. The SAMOS laboratory building at Vandenberg AFB was completed and accepted on 18 July, with minor deficiencies remaining to be corrected. Design of the Vandenberg AFB helium unloading and storage facility has been initiated with final design review scheduled for 9 September.

Construction contract awarded for Point Arguello diesel generator building.

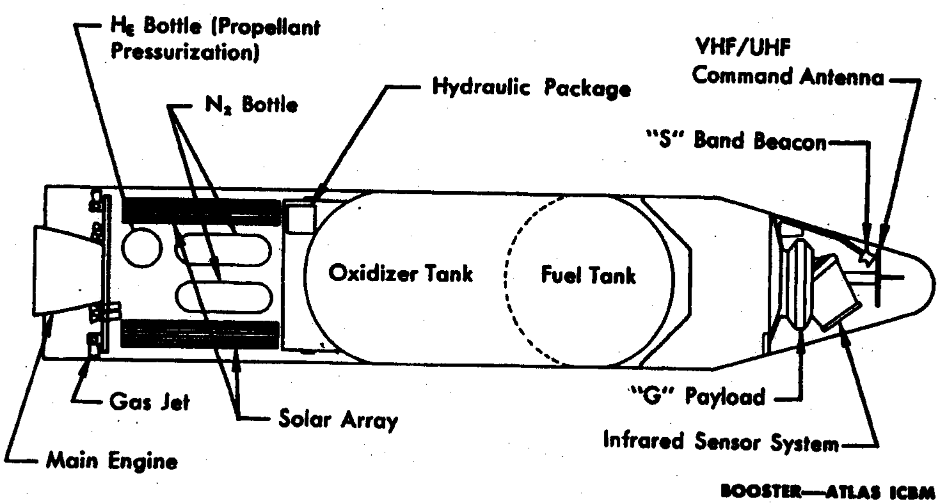
e. Bid openings for the Point Arguello diesel generator building were held on 26 July. A total of twelve bids ranging from $184,000 to $249,000 were received. The construction contract was awarded on 29 August.

[redacted]

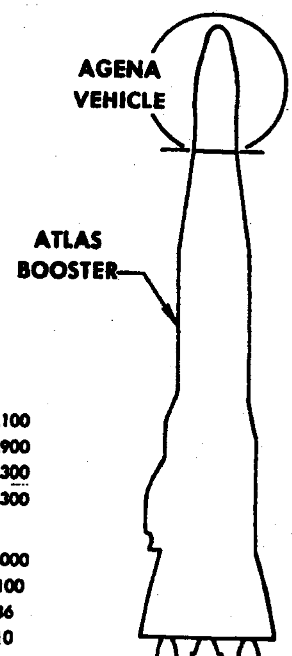
Figure 1. Artist's conception of MIDAS satellite (right). Drawings below show complete two-stage flight vehicle (right) and AGENA "B" second stage vehicle (left).



SECOND STAGE	AGENA "A"	AGENA "B"
Weight—		
Inert	1,534	1,763
Payload equipment	3,246	1,641
Orbital	4,780	3,404
Impulse Propellants	6,423	12,950
Fuel (UDMH)		
Oxidizer (IRFNA)		
Other	606	758
GROSS WEIGHT (lbs.)	11,809	17,112
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
Restart Provisions	No	Yes



MIDAS, Configuration II, AGENA "B" Satellite



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

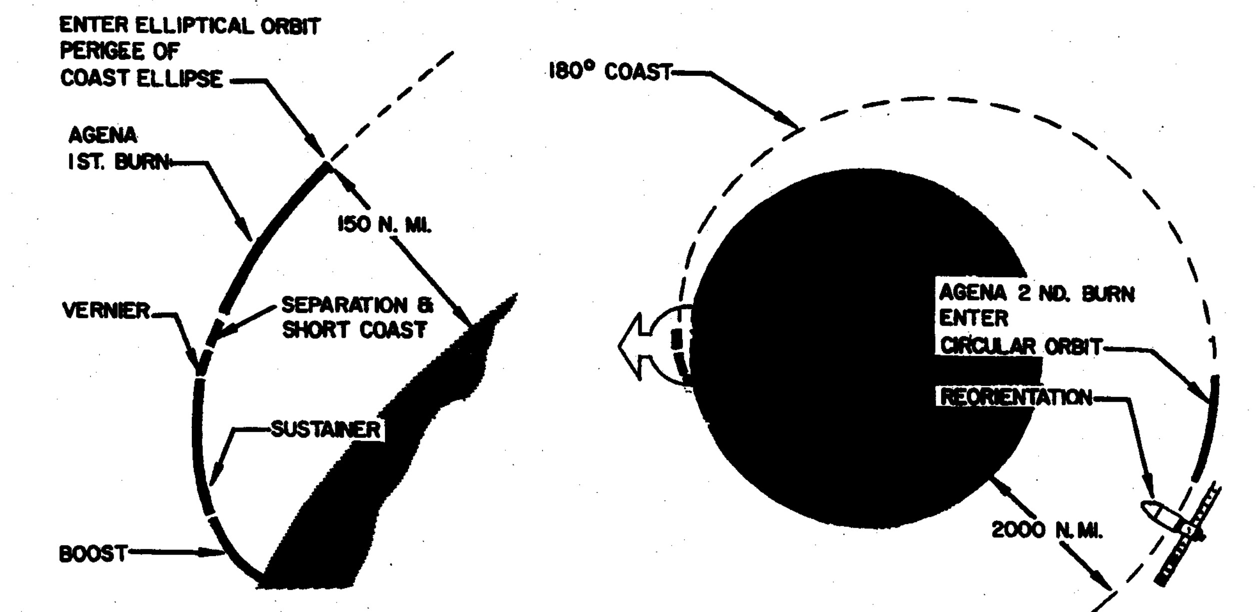


Figure 2.
Launch-to-orbit trajectory for flights 3 and subsequent. From boost through separation guidance and control is provided by the ATLAS radio inertial system. The AGENA inertial guidance system, with horizon scanner, provides attitude, velocity and directional control to establish the orbit and vehicle orientation.

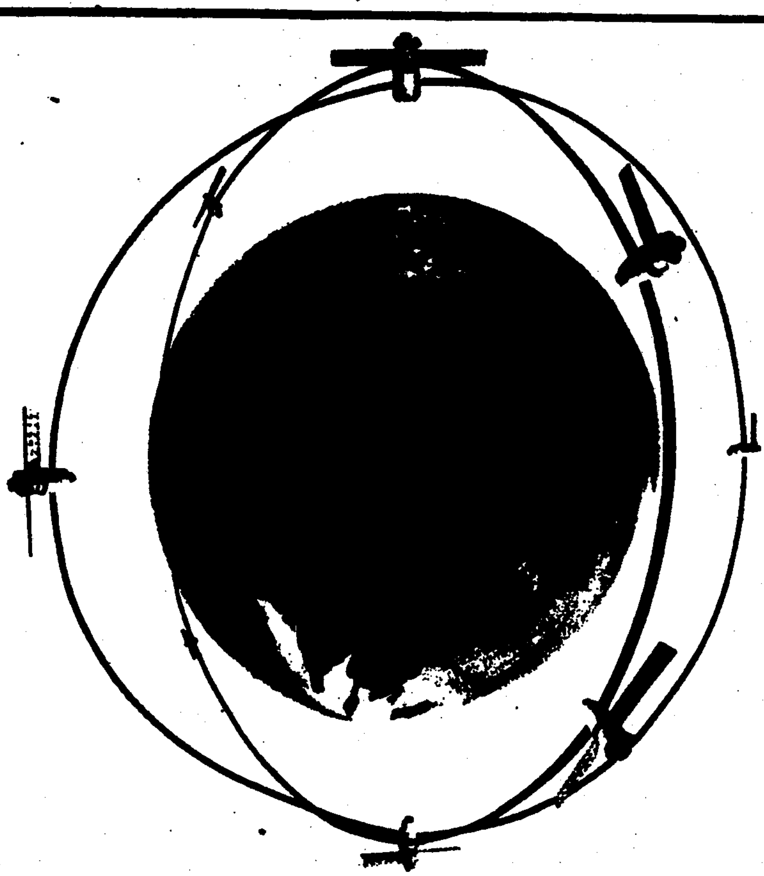


Figure 3.
Proposed MIDAS system. Four satellites spaced equidistant in each of two orthogonal planes at 2,000 n.m. altitude. Provides maximum coverage of USSR with minimum number of satellites.

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 reconnaissance 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. A ten launch development plan for MIDAS (WS-239A) has been approved. Additional authorization has been obtained to utilize two DISCOVERER flights (designated RM-1 and RM-2) to carry background radiometers in support of MIDAS.

CONDITIONS:
2,000 n.m. altitude
Two orthogonal polar orbital planes, four equi-spaced satellites in each plane.
Readout Stations
United Kingdom
North Atlantic
North Pacific

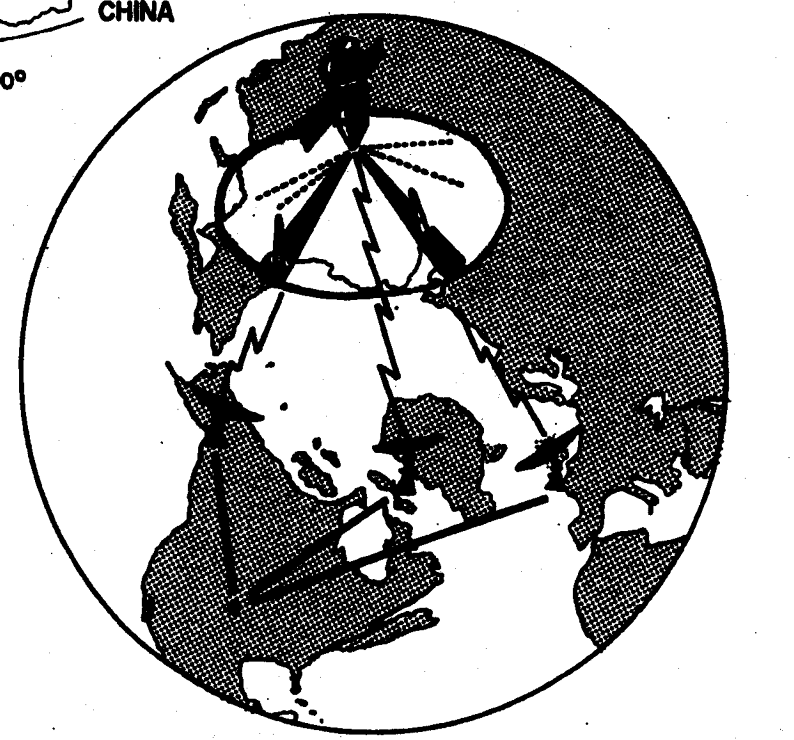


Figure 4.
Orbiting satellites detect infrared radiation emitted by Soviet ICBM's in powered flight. Data telemetered instantaneously to MIDAS Control Center via far-north readout stations. Decoded data reveal approximately the number of missiles launched and launch location, direction of travel and burning characteristics. Probabilities of less than 1.00 on the above map indicate the probability of at least one MIDAS satellite detecting an ICBM launch. Probabilities of 1.00 indicate that more than one MIDAS satellite will always be in position to detect an ICBM launch. These figures are based on geometric considerations of the family of satellites and ground readout station locations.

TECHNICAL HISTORY

The MIDAS infrared reconnaissance 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 (Figure 1). The final configuration payload weight will be approximately 1,000 pounds.

The first two of the ten 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.

MIDAS I, launched in February 1960, did not attain orbit because of a failure during ATLAS/AGENA separation.

MIDAS II, launched in May 1960, was highly successful. Performance with respect to programmed orbital parameters was outstanding. Useful infrared data were observed and recorded.

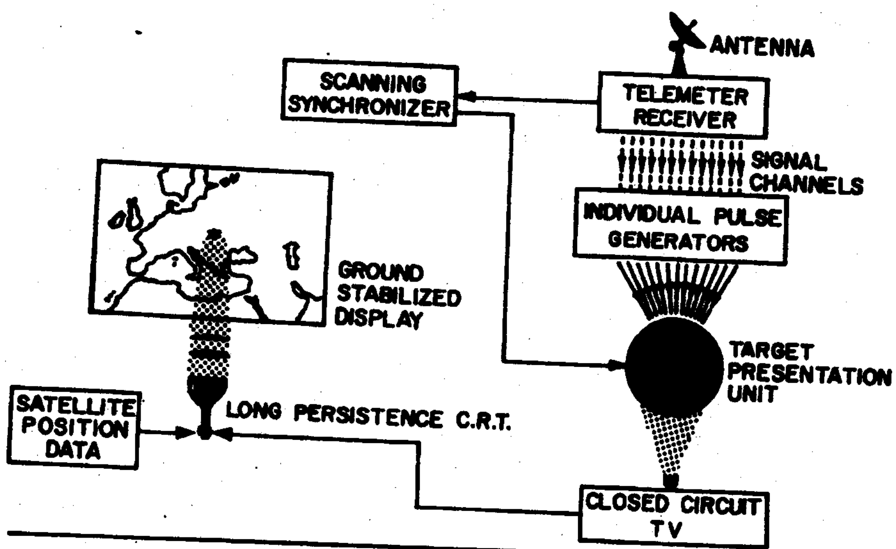
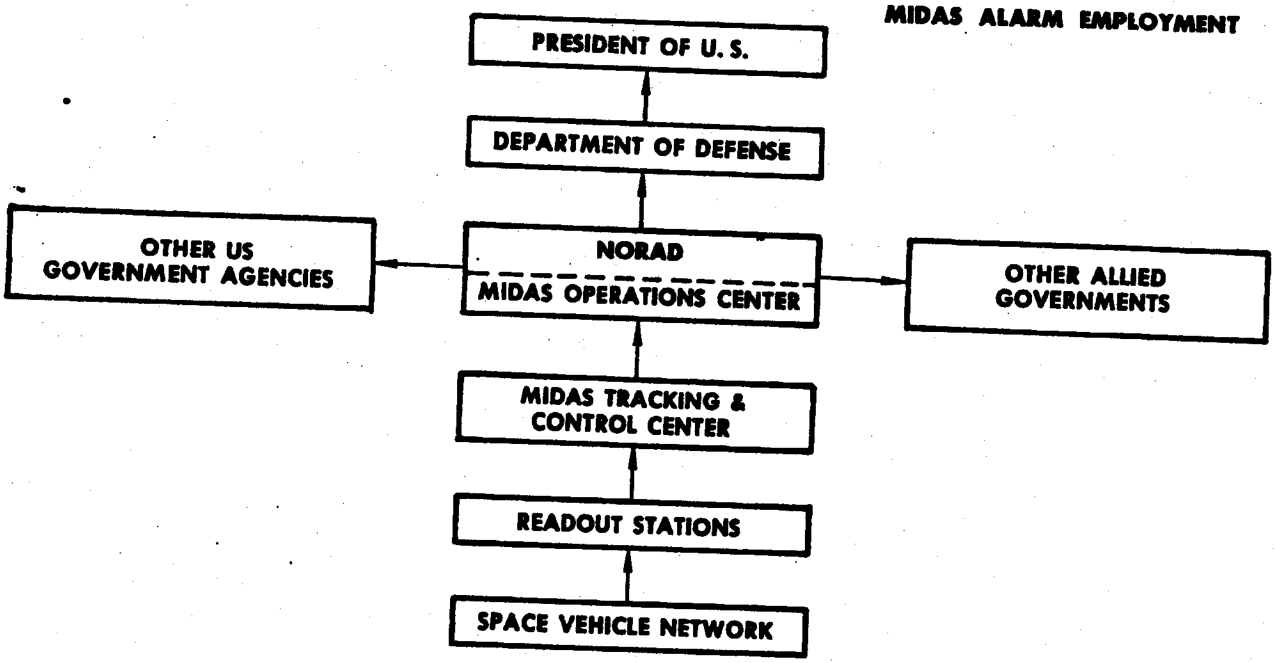


Figure 5.
Simplified version of ground presentation system (left) for display of infrared reconnaissance data. The data is displayed on a TV monitor with a map overlay. The chart below shows data flow from the readout stations to decision-making agencies. The MIDAS Control Center, or other using agencies having a correlated ground stabilized display, can determine when an actual attack has been launched.

MIDAS ALARM EMPLOYMENT



CONCEPT

The MIDAS system is designed to provide continuous infrared reconnaissance of the Soviet Union. Surveillance will be conducted by eight satellite vehicles in accurately positioned orbits (Figure 3). The area under surveillance must be in line-of-sight view of the scanning satellite. Mission capabilities are shown in Figure 4. The system is designed to accomplish instantaneous readout of acquired data by at least one of three strategically located readout stations. The readout stations transmit the data directly to the MIDAS Tracking and Control Center where it is processed. It is then displayed and evaluated in the MIDAS Operations Center (Figure 5). 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.

[redacted]

	60	61	62
	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D
[redacted]	[redacted]	[redacted]	[redacted]
VEHICLE CONFIGURATIONS	ATLAS "D"/AGENA "A"	ATLAS "D"/AGENA "B"	

MIDAS Launch Schedule

[redacted]

A. BRIEF OF PROGRESS

In July the Air Force Ballistic Missile Committee authorized two MIDAS flights, designated RM-1 and RM-2, using THOR/AGENA "B" vehicles from the DISCOVERER Program. These flights will carry a background radiometer rather than an infrared missile detection payload. The vehicles are scheduled to be launched in November and December.

Assembly of the AGENA "B" vehicle for the third MIDAS flight is proceeding on schedule. This will be the first MIDAS vehicle to utilize the full dual-burn capability of the AGENA engine. A definitive contract for the advanced infrared detection payload being developed by Aerojet-General is expected to be completed in September.

A government-to-government agreement is being drafted for the United Kingdom readout station in anticipation of approval of the MIDAS operational program. Authorization has been granted to proceed with establishment of the Southeast Africa station. Construction of the Donnelly Flats, Alaska, technical facilities is proceeding on schedule; construction of the support facilities will be delayed approximately two months.

[redacted]

B. TOPICAL SUMMARY

1. *Flights*

The Air Force Ballistic Missile Committee has authorized two additional MIDAS flights. A background radiometer will be carried by THOR/AGENA "B" vehicles currently in the DISCOVERER Program.

a. In July, the Air Force Ballistic Missile Committee authorized two additional MIDAS flights, designated RM-1 and RM-2, to be conducted using THOR-boosted AGENA "B" vehicles currently in the DISCOVERER Program. A background radiometer will be carried rather than an infrared missile detection payload. These flights will provide infrared background measurements for a wide variety of conditions, as may exist between arctic and tropical regions. They will assist in determining the magnitude of background radiance in the 2.7 and 4.3 micron absorption range and in establishing the spatial and spectral background characteristics which must be known for current as well as future MIDAS requirements.

The launches are scheduled for November and December.

b. The payloads for these flights are scheduled for delivery to Vandenberg Air Force Base in late September and October. The AGENA "B" vehicles will be available on approximately the same schedule. The launches are scheduled for November and December.

Re-ignition of the AGENA engine following initial shutdown has been proposed for the second flight.

c. It is proposed that the RM-2 flight include the first operational use of the AGENA vehicles restart capability. Although this would not be a full-scale dual-burn flight, the engine would be re-ignited following initial shutdown.

2. *Technical Status*

a. Second Stage Vehicles

Assembly of the AGENA "B" for the third MIDAS flight is on schedule.

(1) Assembly of the AGENA "B" vehicle for the third MIDAS flight is proceeding on schedule. The vehicle was delivered to the systems test area on 8 August. This will be the first MIDAS vehicle to utilize the full dual-burn capability of the AGENA engine.

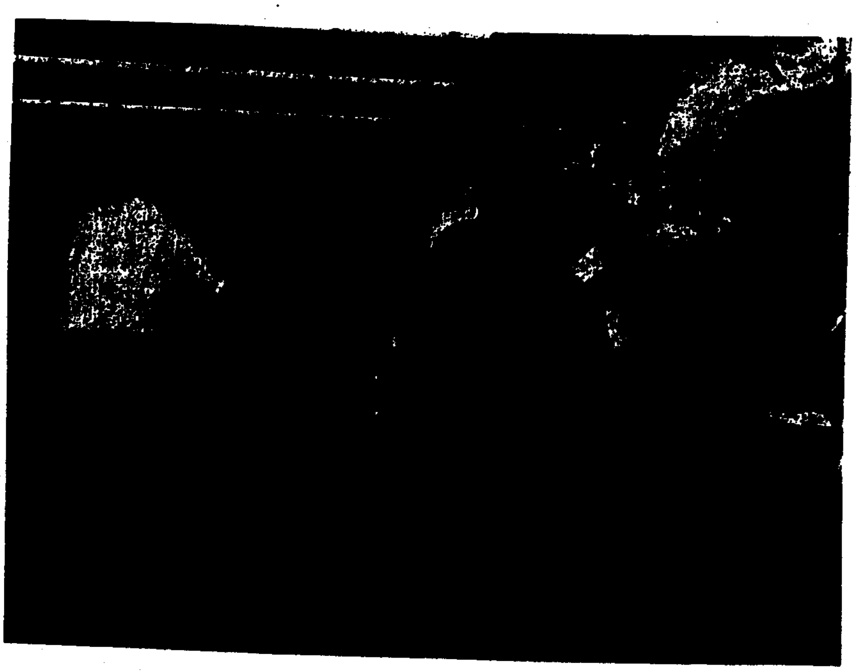


Figure 6. Engine functional checks being performed on the third MIDAS satellite vehicle. The refrasil heat shield, designed to protect the aft equipment rack extension from the hot exhaust gases, can be seen surrounding the engine nozzle. One arm of the solar auxiliary power array will fold into the well on the left side of the vehicle.

[redacted]

Fourth MIDAS AGENA vehicle due to be completed on 10 October.

(2) Assembly of the AGENA vehicle for the fourth MIDAS flight is scheduled for completion on 10 October. It is anticipated that assembly of this vehicle will be completed on schedule.

Solar auxiliary power array completes 1000 hours of continuous cycling.

(3) The electromechanical equipment for positioning the solar auxiliary power array has successfully completed approximately 1000 hours of continuous cycling.

b. Infrared Scanner Units

Infrared scanner units for flights 3, 4, and 5 are being manufactured by Baird-Atomic, Inc., and for flights 6, 7 and 8 by Aerojet-General Corporation.

Delivery of initial flight infrared scanner unit is scheduled for 6 October.

(1) Production and organizational changes directed toward achieving the desired production quality and delivery rate have been instituted at Baird-Atomic, Inc. A re-evaluation of their delivery schedule has established 6 October as the delivery date for the initial flight unit.

Ground readout units are programmed for delivery on 8 and 22 September.

(2) The delivery dates for the two Baird-Atomic, Inc., ground readout units have been established as 8 and 22 September. These schedule slippages, caused by delays during systems tests, will have no effect on flight schedules.

Aerojet is developing a service test model of an advanced infrared detection payload.

(3) Aerojet-General is developing a service test model of an advanced infrared detection payload for use on later MIDAS flights. A detailed reliability test program is being developed for this payload. In addition to developing the service test model of this payload, Aerojet is now contracted to procure long-leadtime items for the flight payloads. A definitive contract for this payload is expected to be completed in September.

3. *Facilities*

Facility design criteria for the East Atlantic station are scheduled for completion in October.

a. A government-to-government agreement is being drafted for the United Kingdom Readout Station in anticipation of approval of the MIDAS operational program. Facility design criteria for this station are scheduled for completion in October. Design will be initiated by the Third Air Force following receipt of criteria and approval to proceed from Hq USAF and USAFE.

Authorization was granted in August to proceed with establishment of the Southeast Africa station.

b. Responsibility for Southeast Africa Station site selection, construction, and operation was assigned to the Atlantic Missile Range in June. The design criteria were completed by AFBMD and supplied to AMR during August. Also during August, the AMR siting team selected the location and authorization was granted to proceed with the establishment of this station. The station's primary function will be to record AGENA "B" second-burn performance data. A portable van installation will be used to support the February MIDAS flight.

Construction of the North Pacific station technical facilities is on schedule; support facilities are two months behind schedule.

c. Construction of the Donnelly Flats, Alaska, technical facilities is proceeding on schedule. Because of last year's prolonged steel strike and the late thaw this spring, construction of the support facilities at Fort Greely, Alaska, will be delayed approximately two months. Completion is now scheduled for December.

[redacted]

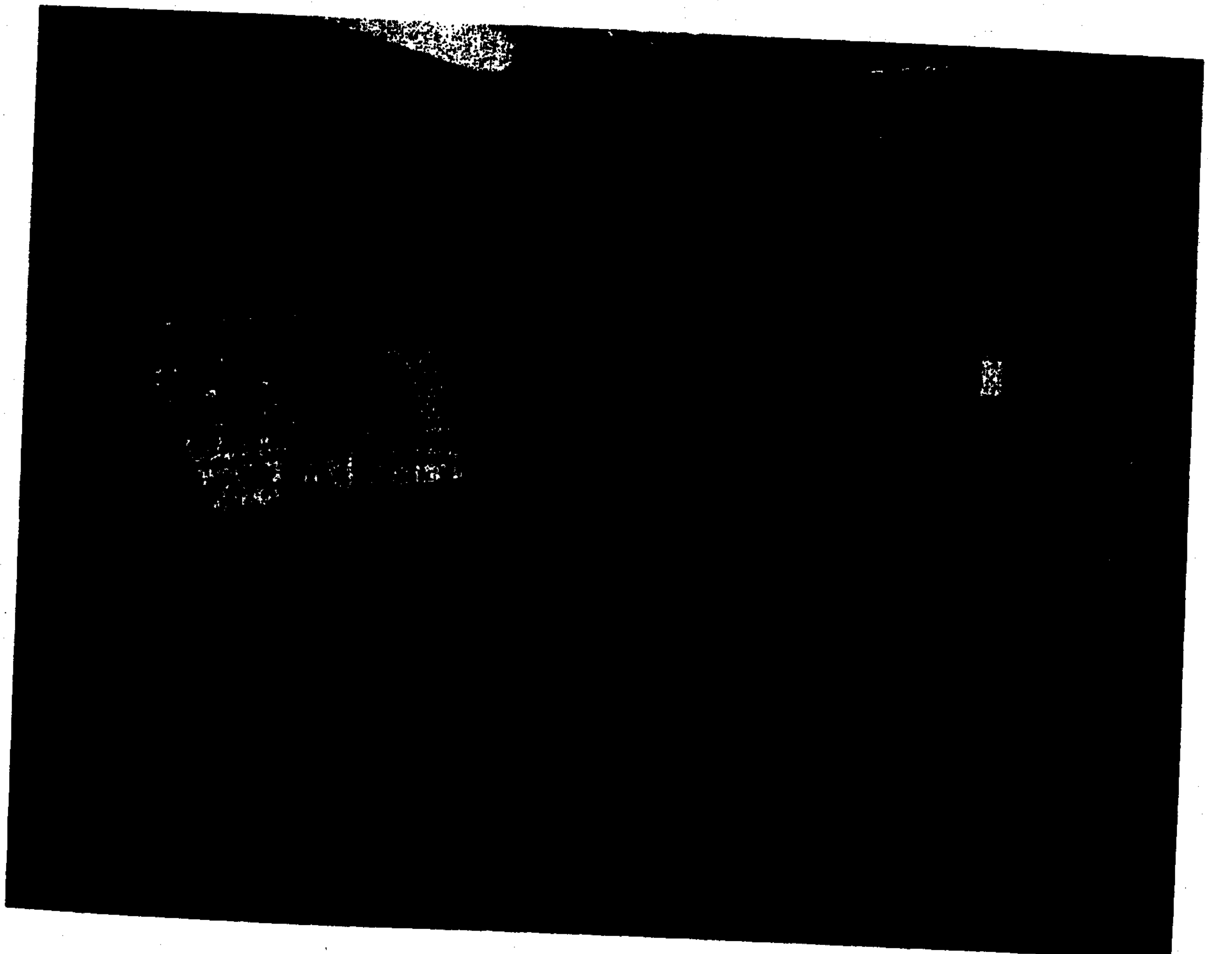


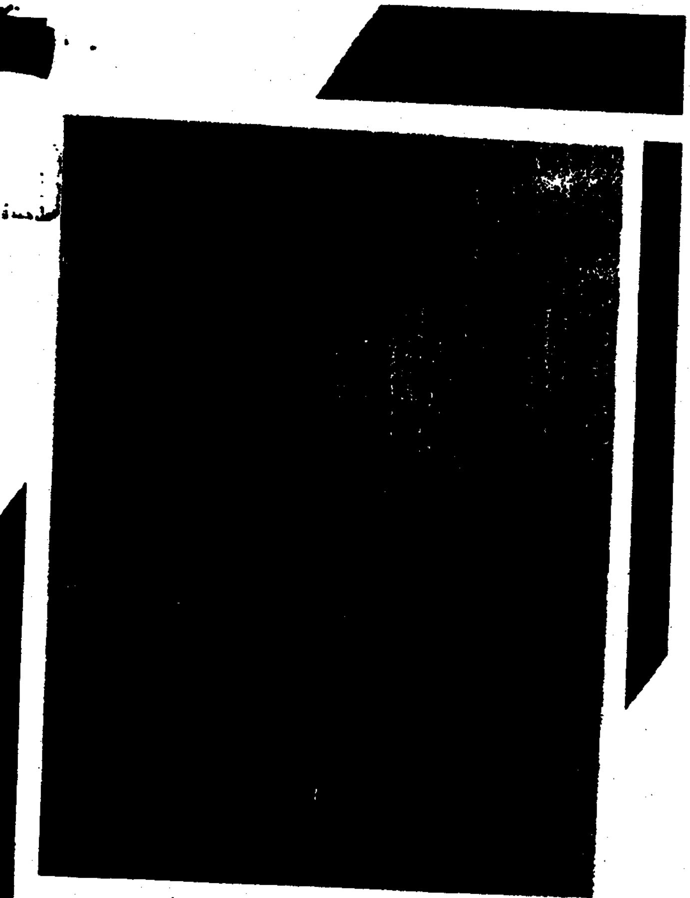
Figure 7. MIDAS ground presentation equipment installed in the Satellite Test Center. The ground presentation console is in the foreground. Readout tapes from the second MIDAS flight (launched 24 May) were processed through this unit.

[redacted]

DISTRIBUTION

Headquarters, USAF	20
Air Research and Development Command	5
Strategic Air Command	1
Air Defense Command	14
6555 Test Wing — Development	2
6594 Test Wing — Satellite	5
San Bernardino Air Materiel Area	1
AF Command and Control Development Division	1
Air Force Ballistic Missile Division	15

MILITARY SATELLITE PROGRAM PROGRESS REPORT



FOR QUARTER ENDING
30 NOVEMBER 1960
RCS DD-DR&E (Q) 397

Prepared By
Air Force Ballistic Missile Division
Headquarters Air Research
and Development Command

UNITED STATES AIR FORCE
Air Force Unit Post Office
Los Angeles 45, California

WDLPR-4-254

[redacted]

HEADQUARTERS
AIR FORCE BALLISTIC MISSILE DIVISION (ARDC)
UNITED STATES AIR FORCE
Air Force Unit Post Office
Los Angeles 45, California

WDLPR-4

10 December 1960

MILITARY SATELLITE PROGRAM PROGRESS REPORT

QUARTER ENDING 30 NOVEMBER

RCS DD-DR&E(Q) 397

FOREWORD

During this quarter the capsule of DISCOVERER XVII was recovered following a two-day exposure to the space environment. This was the second recovery of an object from space by an aircraft. This was also the first successful flight test of the AGENA "B" vehicle. The progress being made in preparation for the Radiometric Measurement flights and the MIDAS III flight are reported in the MIDAS Section. Photographs showing the construction progress at Donnelly Flats and Fort Greely, Alaska, are included.

The programs covered in this report are preceded by a concise history of administration, concept, objectives, and flight schedules. 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.

O. J. RITLAND
Major General, USAF
Commander

[redacted]

[redacted]

The DISCOVERER Program consists of the design, development and flight testing of 37 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 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.

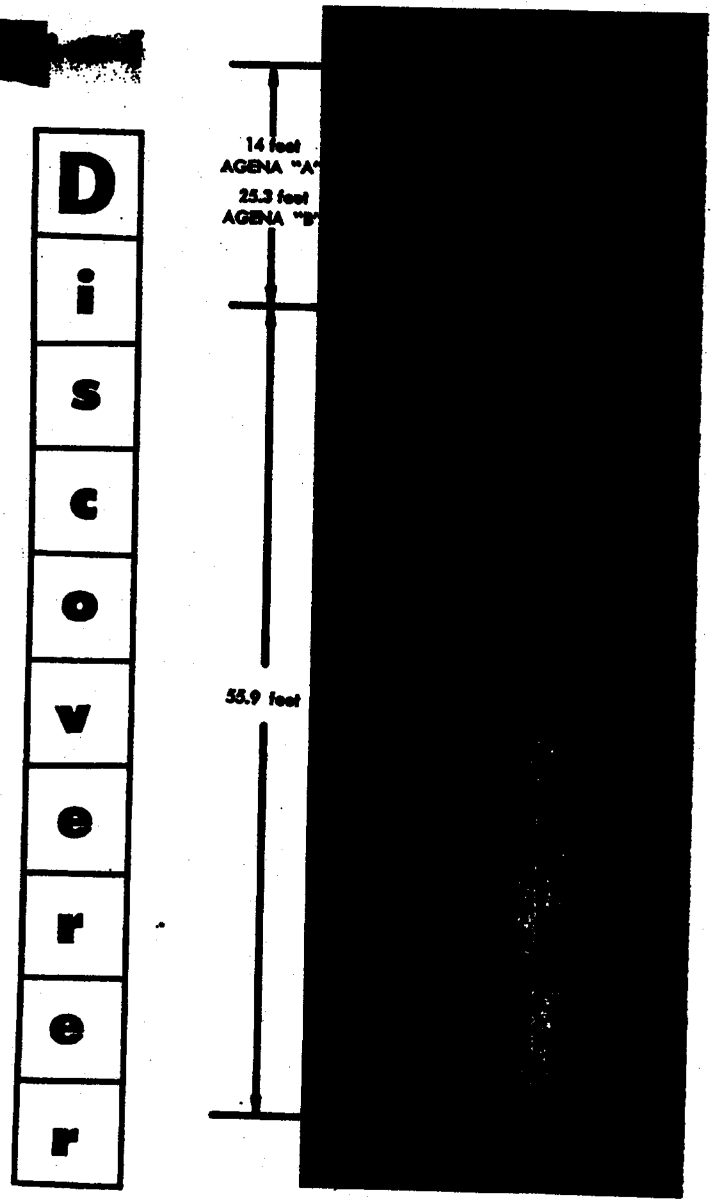
(e) Testing of ground support equipment and development of personnel proficiency.

(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, Sunnyvale, California

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



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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	169,000
Spec. Imp., sec. (S.L.)		247.8	248.3
Burn Time, sec.		163	148

[redacted]

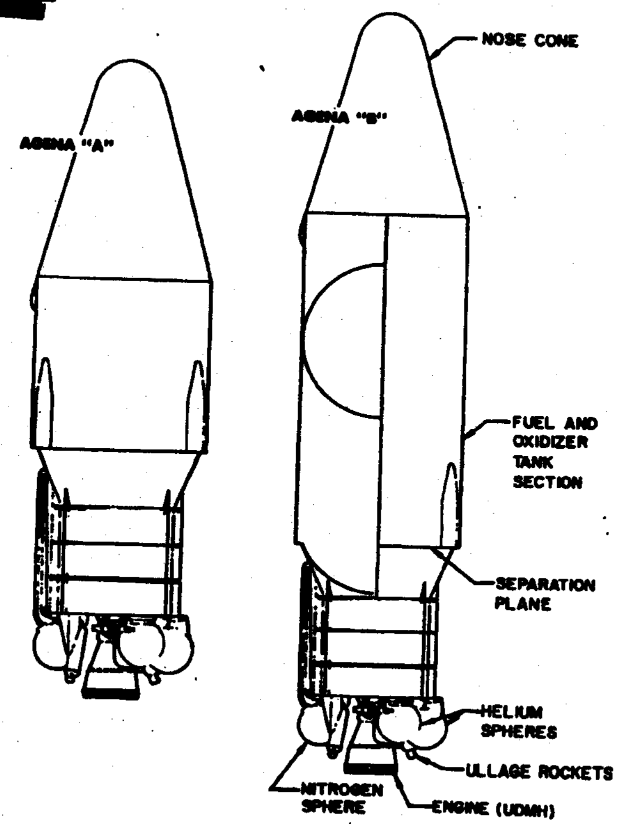
Telemetry ships are positioned as required by the specific mission of each flight. Figures 2 and 3 show a typical launch trajectory from Vandenberg Air Force Base, and figure 3 shows schematically a typical orbit. An additional objective of this program is the development of a controlled re-entry and 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 5. Specifications for the two THOR configurations and three AGENA configurations used are given on page 1.

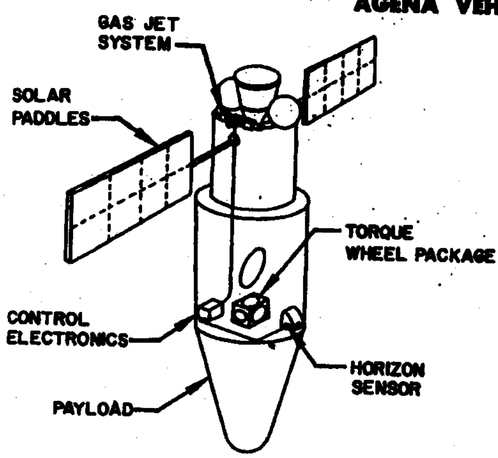
AGENA VEHICLE DEVELOPMENT

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 stabilization system suited to achieving orbital injection in a horizontal attitude. As a result, an optical inertial system was developed for vehicle stabilization 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



DISCOVERER/AGENA

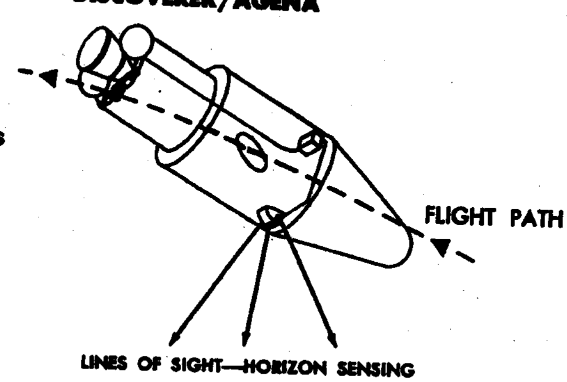
PERFORMANCE CAPABILITIES

ALTITUDE

200—20,000 MILES

ATTITUDE

ROLL — 0.1 DEGREE
PITCH — 0.1 DEGREE
YAW — 1 DEGREE



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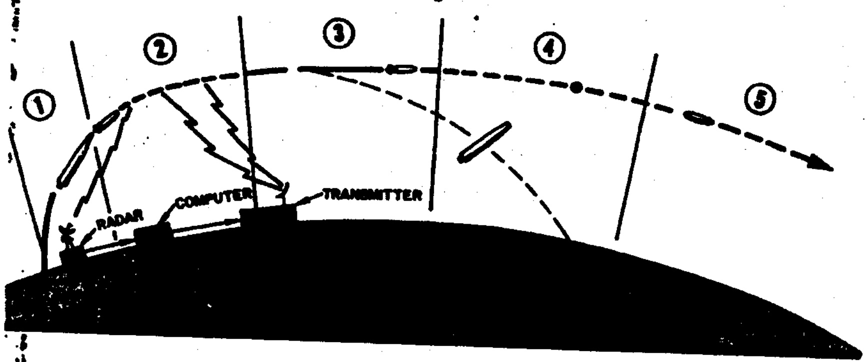
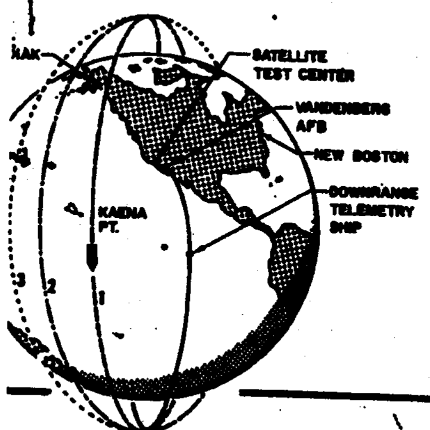
Powered Flight Trajectory

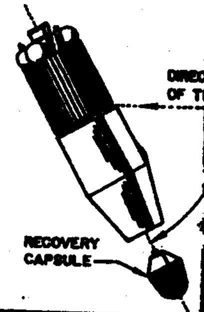


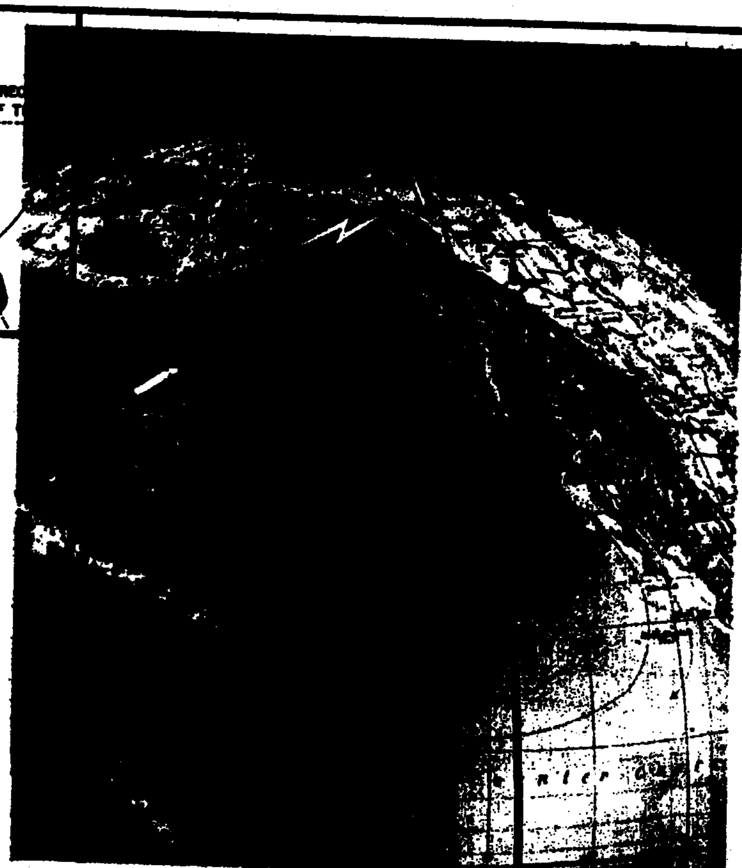
1. **First Stage Powered Flight—2.5 minutes duration, 78 n.m. downrange, guided by programmed auto pilot.**
2. **Coast Period—2.4 minutes duration, to 380 n.m. downrange, attitude controlled by inertial reference package, horizon scanner, gas reaction jets. Receives AGENA time to fire and velocity to be gained commands.**
3. **Second Stage Powered Flight—4 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 4.





CAPSULE RECOVERY SEQUENCE

Capsule ejection command is sent to the satellite by the Kodiak, Alaska station. The vehicle reorients its position (see inset) to permit ejection to occur on a re-entry trajectory on the recovery 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.

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 recovery orbit, for capsule impact within the predetermined recovery area near Hawaii. Aircraft and surface vessels are deployed within the area as a recovery force.

GROUND SUPPORT FACILITIES

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.
Mugu Tracking Station	BDEFGHI	Ascent tracking, telemetry reception, computation and transmission of ignition and shutdown corrections.
Downrange Telemetry Ship	BGIJK	Telemetry reception and tracking during ascent and early part of first orbit.
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		Over-all direction of capsule recovery operations.

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

Equipment

A. General Purpose Computer(s) and Support Equipment
B. Data Conversion Equipment
C. Master Timing Equipment
D. Control and Display Equipment
E. Guidance and Command Equipment (DISCOVERER ascent only)
F. VERLORT
G. VHF FM/FM Telemetry Station
H. VHF Direction Finding Equipment
I. Doppler Equipment
J. VHF Telemetry Antenna
K. APL Doppler Equipment

LAUNCH SCHEDULE

Configuration	Launches	Month	Year
A	⬮	J	1959
A	★	F	1959
A		M	1959
A	★	A	1959
A		M	1959
A	⬮ ⬮	J	1959
A		J	1959
A	★ ★	A	1959
A		S	1959
A		O	1959
A	★ ★	N	1959
A		D	1959
A		J	1960
A	⬮ ⬮	F	1960
A		M	1960
A	★	A	1960
A		M	1960
A	⬮	J	1960
A		J	1960
A	® ®	A	1960
A	★	S	1960
B	⬮	O	1960
B	®	N	1960
B	2	D	1960
C	2	J	1961
C	1	F	1961
C	1	M	1961
C	2	A	1961
C	2	M	1961
C	2	J	1961
C	2	J	1961
C	2	A	1961
C	2	S	1961
C	1	O	1961
C		N	1961
C		D	1961

FLIGHT HISTORY

DISCOVERER No.	THOR 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.*

★ Attained orbit successfully.

® Capsule recovered.

⬮ Failed to attain orbit.

VEHICLE CONFIGURATIONS

A. THOR—DM-18/AGENA "A"

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

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

[redacted]

A. BRIEF OF PROGRESS

DISCOVERER XVII was launched from Vandenberg Air Force Base on 12 November. After orbiting the earth for nearly 51 hours, the capsule was snatched from the air by an Air Force C-119J recovery aircraft. This was the second flight of an AGENA "B" vehicle. Biomedical, internal satellite pressure, and optical tracking light experiments were carried on this flight. Preliminary results indicate that all were successful.

Because of a timer malfunction which prevent separation, DISCOVERER XVI, the first flight test of an AGENA "B" vehicle, failed to attain orbit on 26 October. DISCOVERER was launched on 13 September and the capsule was ejected as scheduled. Because of a depletion of control gas, the capsule impacted approximately 1,000 miles south of the predicted impact point. Severe weather in the area prevented recovering the capsule from the sea.

Two successful tests of the Mark II capsule were completed during the quarter. In the first test the primate was in a simulated space environment for 42 hours; nearly 29 hours of simulated orbital conditions were logged during the second test.

Extensive test firings of the XLR-81Ba-9 engine continued throughout the report period. One thrust chamber assembly has completed 2,600 seconds of operation.

A tracking station is being built on Tern Island for use in tracking the re-entry vehicles during recovery operations.

B. TOPICAL SUMMARY

1. Flights

a. DISCOVERER XVII

(1) DISCOVERER XVII Flight

DISCOVERER XVII was successfully launched from VAFB on 12 November.

(a) DISCOVERER XVII was launched from Vandenberg Air Force Base at 1242 PST on 12 November. An attempt to launch on the previous day was cancelled because of propellant loading and umbilical problems. The ascent was satisfactory except that the injection altitude was slightly low and the period of the satellite orbit was approximately 2½ minutes longer than planned. The extended satellite period had little effect on satellite operation or the recovery, except to make the alternate (thirty-first) pass more desirable for recovery operations than the nominal (thirty-second) pass.

First AGENA "B" orbited; first capsule recovered after two days in orbit.

(b) This was the first AGENA "B" satellite to be orbited and the second AGENA "B" to be launched. This was also the first attempt to recover a capsule after two days in orbit, all other attempts were made after one day. The recovery was also a "perfect" catch — the first caught at the predicted impact point.

After 51 hours in orbit, the capsule was ejected and recovered.

(c) Recovery forces were deployed in the predicted impact area at 1400 PST on 14 November. At 1431, after nearly 51 hours in orbit, the capsule in DISCOVERER XVII was ejected over Alaska. Satellite attitude at ejection was two degrees left and fifty-nine degrees down, which is close to the optimum position. Capsule spin, retro-thrust, and de-spin were near nominal. Initial acquisition of the capsule beacon transmitter signal was made by one of the C119J aircraft in the recovery force at 1434 PST. Nine minutes later the descending parachute and capsule were sighted by Pelican II. During the first pass the grappling hooks struck the parachute but did not snag it. The second pass was successful. The capsule was undamaged, except for some scorching of the cover by aerodynamic heating at re-entry.

(2) DISCOVERER XVII Experiments

Successful biomedical tests conducted.

(a) Several biomedical experiments were carried on DISCOVERER XVII and the data obtained are expected to provide important information on the space environment. Only preliminary results are available, but indications are that all experiments were successful.

Internal satellite recorded gas density.

(b) A densiometer mounted in the forward equipment compartment of the satellite revealed a greater density of gases in the compartment than was expected. Some differential gas pressure between the vacuum conditions of space and the interior of the satellite was expected. This would be caused by the outgassing of paint, insulation and other materials together with the fact that in near-vacuum conditions gases cease to flow and are lost only by random escape of separate molecules. However, the unexpectedly high differential pressure discovered in DISCOVERER XVII could have a significant effect on the design of future space vehicles. Because of this increased density, densiometers will be carried on several future DISCOVERER flights to provide additional data and verify these initial findings.

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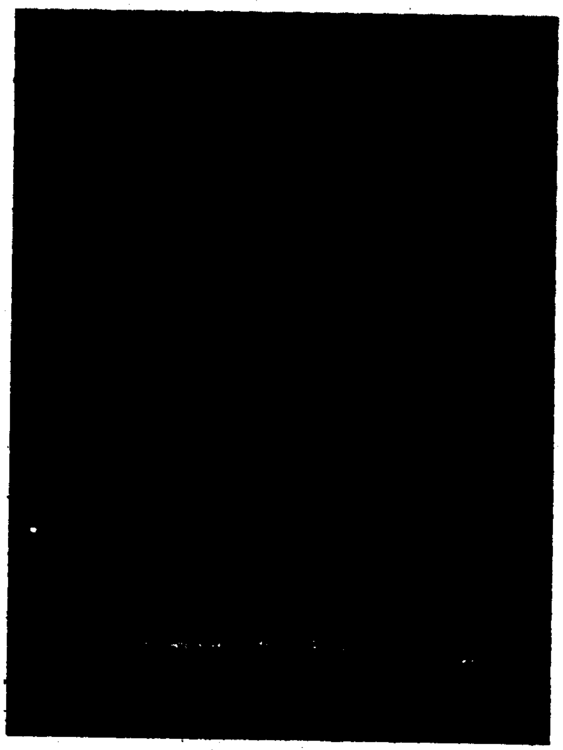


Figure 1. DISCOVERER XVII following ignition (below); during thrust buildup (above) and on its way for a trip that will carry the capsule in space for two days and travel a distance of a million miles before it is safely returned to earth. The launch took place from Complex 75-3 at Vandenberg Air Force Base on 12 November. This was the second launch of an AGENA "B" vehicle.

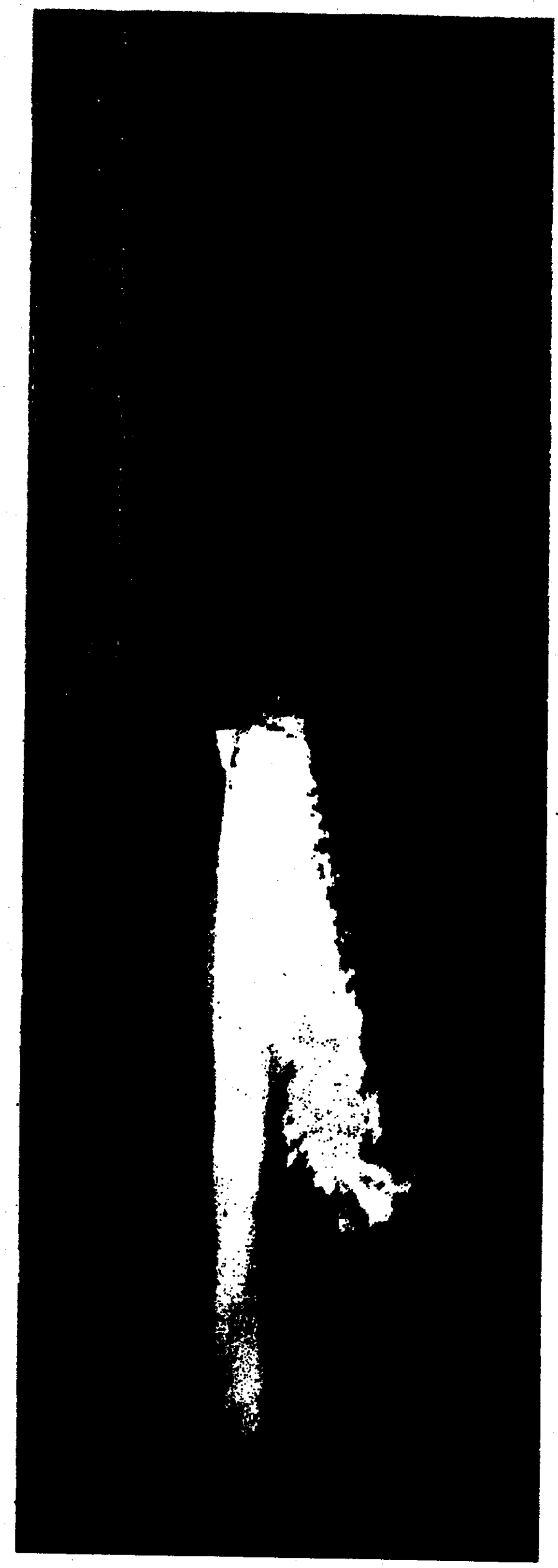


Figure 2. Photograph taken from the rear of Pelican II during recovery operations. The pickup gear trailing from the aircraft struck the parachute (note tear in canopy) but did not snag it.

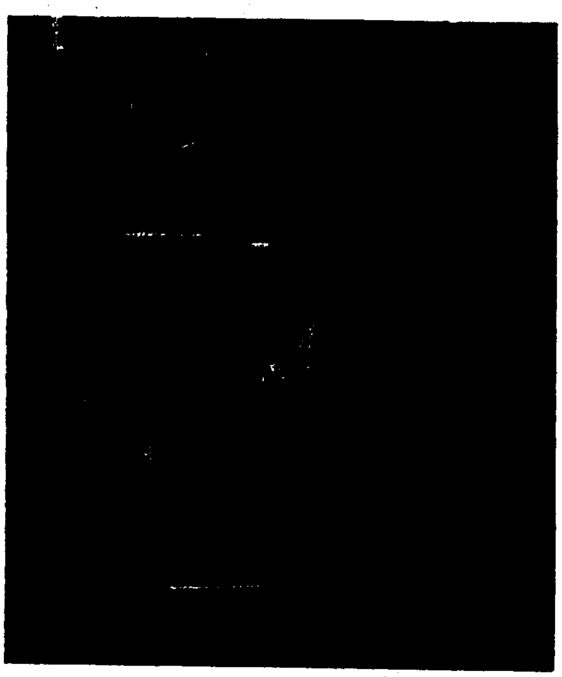


Figure 3. The tense period during which the winch operator reels in the capsule. From the time the grappling hooks snare the parachute until the capsule is safely aboard requires approximately one-half hour.

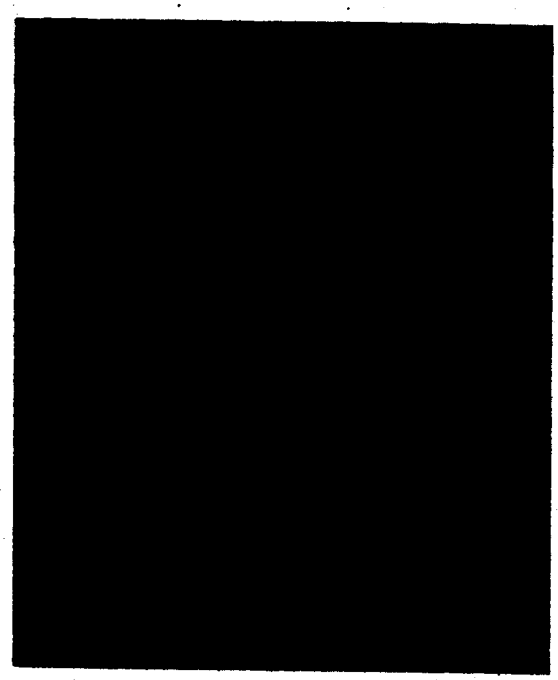


Figure 4. The parachute and capsule about to be pulled aboard Pelican II. The flashing light and beacon transmitter were still operating when the capsule was safely aboard. Another recovery aircraft is visible on the left of the capsule.

[redacted]

Tracking lights operated and were photographed by six ground stations.

(c) As part of an extensive program being carried out by the Air Force and several governmental agencies for development of superprecise tracking systems, tracking lights were carried aboard the DISCOVERER XVII satellite. The lights were photographed against a star background by optical tracking equipment in the Netherlands West Indies, Japan, India, Iran, Florida, and New Mexico. The data from this and other DISCOVERER flights employing the tracking lights will be used to develop a very precise earth-space positioning system against which other tracking devices (radar) can be calibrated.

b. DISCOVERER XVI

DISCOVERER XVI launched on 26 October.

(1) DISCOVERER XVI was launched from Vandenberg Air Force Base at 1226 PDT on 26 October. DISCOVERER XVI was the first vehicle to carry an AGENA "B" second stage. Countdown was normal and DM-21 performance was satisfactory except that the vernier engines did not operate after main engine cutoff. Normally, the vernier engines burn nine seconds longer to damp out any attitude errors induced during main engine thrust decay.

Did not attain orbit because of unsuccessful separation.

(2) Following cutoff of the DM-21 main and vernier engines, the AGENA Subsystem D timer is programmed to initiate a series of events which should result in injecting the satellite into its planned orbit. These events include firing explosive separation bolts, activating satellite control and stabilization equipment, firing the retro-rockets on the adapter, firing ullage rockets, initiating AGENA engine firing and reorientation events. A failure in the timer prevented successful separation of the THOR and AGENA and the satellite plunged into the ocean 660 nautical miles downrange.

Computer modified to prevent recurrence.

(3) Telemetry data reveal that the signal initiating separation was not sent by the sequence timer. A malfunction within the computer rendered the sequence timer inoperative. The computer has been modified to prevent a recurrence of this problem.

c. DISCOVERER XV

DISCOVERER XV successfully launched on 13 September.

(1) DISCOVERER XV was launched from Vandenberg Air Force Base at 1515 PDT on 13 September and was successfully injected into polar orbit. THOR booster trajectory was satisfactory; AGENA performance was nominal.

Capsule ejected; impacts south of recovery area.

(2) Data received on the first pass over Kodiak and Hawaii indicated that the satellite was stable and in correct attitude but that control gas consumption was excessive. The capsule was ejected on the 17th orbit but, because of a loss of control gas, the pitch-down prior to ejection was not accomplished. As a result, the capsule impacted about 1,000 miles south of the impact point predicted prior to capsule ejection.

Severe weather prevents recovery.

(3) The capsule descent was tracked by the Hawaiian tracking station until re-entry; a computer run of this data resulted in a revised impact point prediction. Aircraft and the recovery ship "Dalton Victory" were dispatched to the impact area. The first aircraft to reach the area

aluminum dye were dropped to mark the area. On the morning 15 September, a Coast Guard amphibian arrived but did not land because of rough seas. Because of deteriorating weather and sea conditions, a plan to drop parachutists and a raft was abandoned. The aircraft lost sight of the capsule which was then listing and riding low in the water. The capsule was not seen again although the search continued throughout 15 and 16 September.

Radiometric measurement flight ready for December launch.

d. Radiometric Measurement Flights

DISCOVERER XIX, which is undergoing subsystem tests in the missile assembly building at Vandenberg Air Force Base, is scheduled for launch in December. This vehicle will carry a radiometer designed to gather background infrared radiation data for the MIDAS Program. Another radiometric measurement flight is scheduled for early next year. These two satellites will not carry recoverable capsules.

2. *Technical Status*

a. MARK II Capsule Tests

Successful 65-hour simulated orbital flight completed by primate.

(1) A complete successful orbital simulated test of the Mark II biomedical capsule with a live female Rhesus monkey passenger was conducted late in October. The monkey was put in the life cell of the capsule at Vandenberg Air Force Base during a simulated launch countdown. The sealed capsule was then flown to Sunnyvale and placed in the high altitude temperature simulator. The primate was dependent upon the life cell for its existence throughout the 65-hour period. This is twenty percent longer than required by project specifications. The 42 hours the capsule was in the chamber is the longest time in the United States space programs history an animal has been confined under orbital conditions.

MARK II capsule can support primate.

(2) The primate emerged from the life cell in an exceptionally vigorous condition. She lost about a half-pound in weight, as expected and exhibited very mild effects of exposure to carbon monoxide. The results demonstrated that the capsule can sustain a primate in satisfactory condition for a longer period than required by present DISCOVERER flight objectives.

Second successful MARK II test completed.

(3) A full duration test was conducted beginning 7 November simulating a one-day mission with a live monkey in the life cell of a Mark II biomedical capsule. This test was successful in sustaining the animal in a healthy condition under simulated orbital conditions. On 8 November, after nearly 29 hours in a simulated space environment the capsule was removed from the chamber and, shortly after midnight, the animal was removed from the capsule in good condition. During the test, the nitrogen level in the capsule atmosphere increased above normal because of minor leaks around an electrical connector. However, the leaks did not result in stopping the operations.

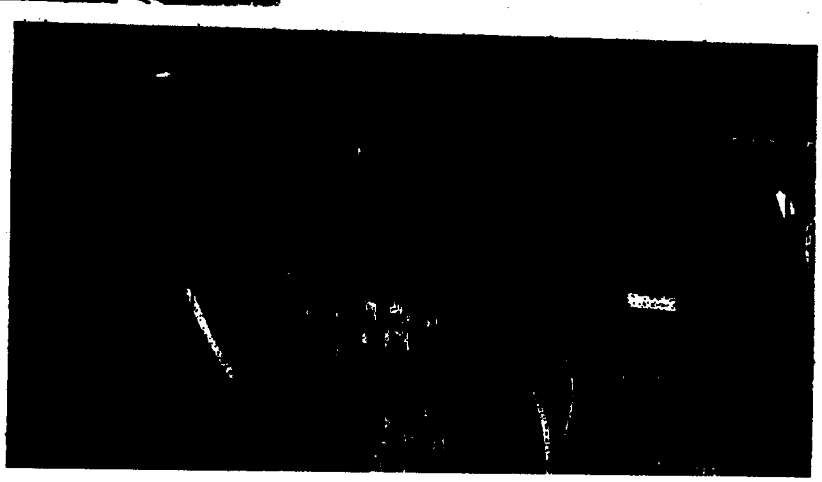
Closed cycle air regeneration.

(4) The life cell uses a closed cycle ducted air regeneration system pressurized to approximately one-half atmosphere. During normal operation, the cell atmosphere contains a mixture of oxygen, carbon dioxide and water vapor. Some carbon monoxide is also present. The mixture is regenerated by the chemical action of lithium

[redacted]

Figure 5. Device (left) used in training monkeys for space flights. When the red light on top of the trainer (arrow) flashes, the monkey pulls the lever. The primate is conditioned to respond to the light signal in order to avoid a mild shock. Performance of this psychomotor task provides scientists with information about how well man will be able to perform his duties as pilot of a spacecraft. Center photograph shows the biomedical capsule after its arrival from Vandenberg Air Force Base during the simulated orbital test. The equipment in the right foreground cools the interior of the capsule. Bottom view shows the rear of the capsule (center), encased in its ablative shell, prior to insertion into the high altitude temperature simulation chamber. Some of the recorders and other instruments which will monitor and record pressure and temperatures within the chamber and the condition of the primate are shown.

A scientist (opposite page) checking the readings of the air within the capsule. All impurities (carbon dioxide, water vapor, etc.), are removed by the self-contained air regeneration system. Lower photo shows the removal of the sealing cover from the life cell. The feet of the monkey are visible (arrow). Photo (upper right) shows the primate following her removal from the life cell. During this test she spent 65 hours in the cell, 42 of them under orbital conditions. Rhesus monkeys are used in these tests because of the enormous amounts of information available from previous experimentation with this species.



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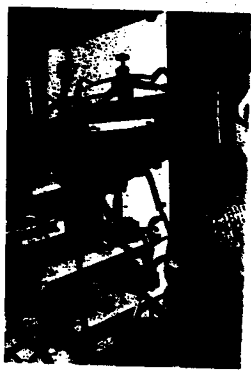

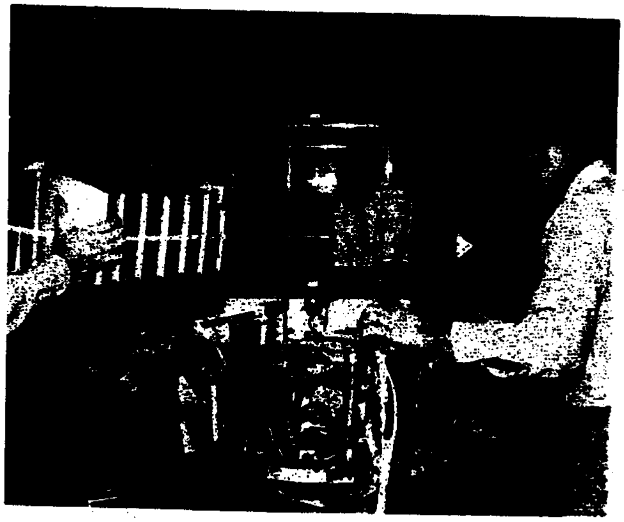

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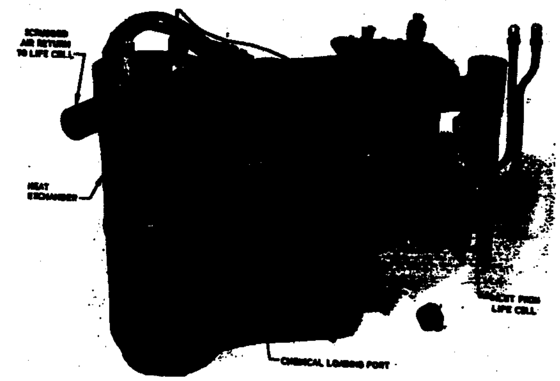


Figure 6. The air conditioner assembly from the life cell, with major parts labeled. The air returns from the life cell, passes through a chemical filter, over a coil in the heat exchanger and returns to the cell.

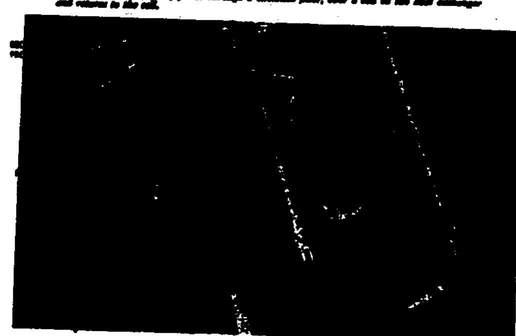


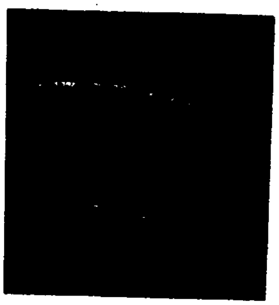
Figure 7. The life cell with all parts to show the feeder from which the primate receives pieces of paraffin-covered apple, the fan which circulates the air, the camera which photographs the primate every three seconds, and the film camera. Water from the water bottle flows thru the heat exchanger to cool recirculated air. The programmer monitors the life cell operation.

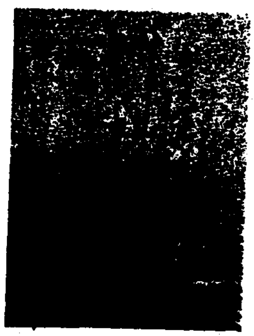
[redacted]

[redacted]

[redacted]

Figure 8. Recovery operations which will permit picking DISCOVERER capsules from the water if they should impact some distance from the recovery force. Frogmen with life raft (left) being dropped from C-54 aircraft. Frogmen in large raft with capsule in one [illegible] rubber raft. [illegible] the [illegible] which will allow a C-119 recovery aircraft to snatch the capsule from the sea. Frogmen are shown [illegible] [illegible] [illegible] [illegible] which [illegible] [illegible] and capsule location. C-119 [illegible] which the [illegible] to [illegible] capsule recovery. [illegible] of raft [illegible] the [illegible] and [illegible] during pickup attempt.





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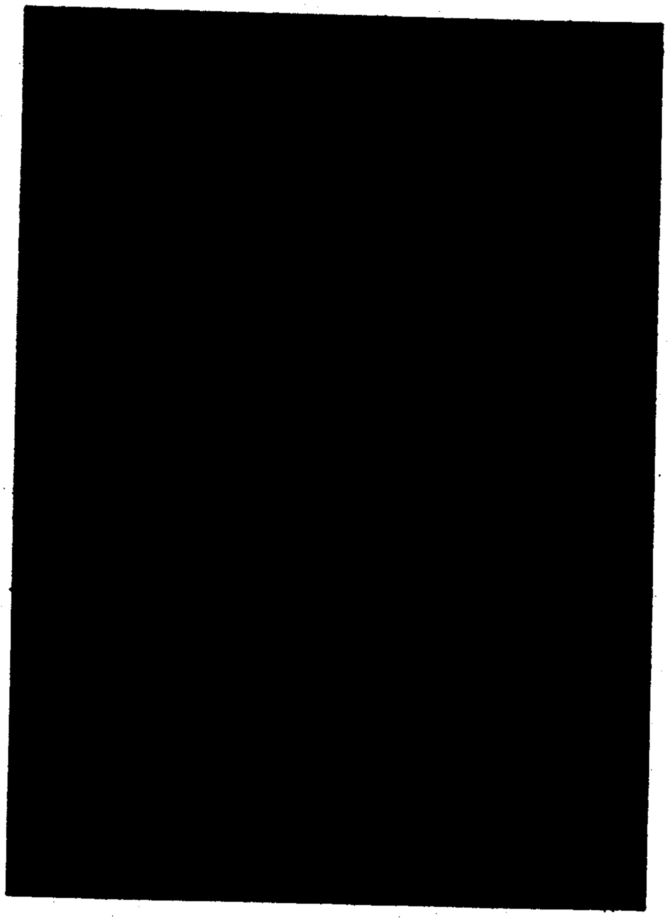

Figure 9. Photo showing smoke bomb in the distance, capsule at the end of the rope, and the snag hook midway between the capsule and the aircraft. Lower photo shows the capsule being pulled aboard the C-119 recovery aircraft.

[redacted]

hydroxide, lithium chloride and activated charcoal. Pure oxygen is introduced into the system by a pressure regulated valve.

b. Balloon Drop Tests

Balloon drop tests continue.

A two-stage parachute development program is currently being conducted. This program includes high altitude balloon drop tests to evaluate system operation and select a radar reflective parachute pattern compatible with the APS-95 radar.

c. Capsule Ablative Shell

Phenolic nylon used in new capsule ablative shell.

The capsule ablative shell used on DISCOVERER XVII was constructed of phenolic nylon. Since this material exhibits certain advantages over the previous shell, it will be used on subsequent flights. During qualification tests, under low pressure and high temperature conditions, this material was found to crack circumferentially on the ojive and conical skirt section. The development program initiated to correct this condition, resulted in the machining of stress relieving grooves in the ojive of the shell. This configuration has successfully passed qualification tests in the high altitude test chamber with only minor cracks occurring. Extensive tests have indicated that minor cracks, as experienced in the stress relieved shells, do not materially degrade the structural and ablative integrity of the shell. Other manufacturing techniques are being studied in an effort to eliminate this minor cracking.

d. XLR-81Ba-9 Engine Development

Preliminary Flight Rating Test completed.

(1) In September the XLR-81Ba-9 engine (serial No. 307) was fitted with a new thrust chamber and subjected to a full duration calibration run. The 240 second firing was completed without appreciable nozzle throat erosion, using a titanium uncooled extension which had previously completed a five day humidity test. The nozzle extension was in excellent condition following the firing. This test completed the Preliminary Flight Rating Test for this engine.

Thrust chamber assembly completes 2,600 seconds of operation.

(2) During October, the XLR-81Ba-9 engine (serial No. 306) completed the final start-stop test in the Preliminary Flight Rating Test program satisfactorily. Upon completion of component functional checks the engine was shipped to Bell Aircraft for use in the reliability program which began on 25 October. In November, several additional tests were completed in the reliability program using engine serial No. 306. A new thrust chamber was installed for these tests. The previous chamber was removed after 2,600 seconds of operation so that statistical data can be gathered on more than one thrust chamber.

3. *Facilities*

Tern Island station to track capsules during re-entry.

A tracking station is being built for installation on Tern Island which is located approximately 500 miles northwest of Hawaii. The station will be used for automatic tracking and data acquisition of re-entry vehicles during recovery operations. The installation, which is scheduled to be operational by mid-December, will consist of a tracking and data van and a communications and control van. The equipment includes an automatic tracking quadhelix antenna, ground timing sys-

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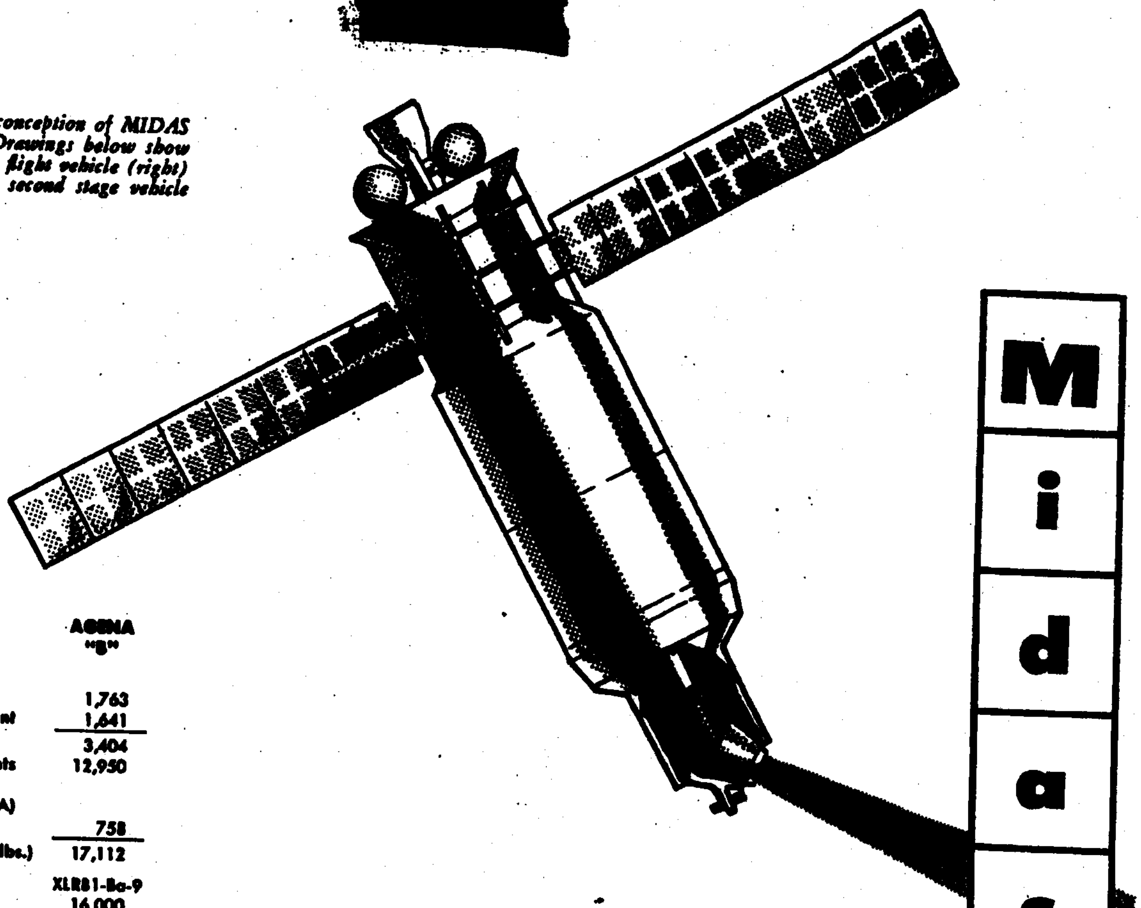
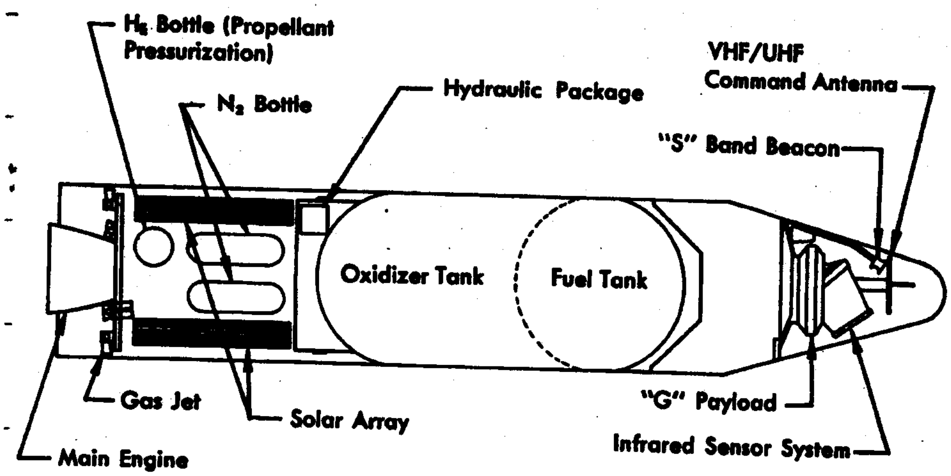
Figure 1. Artist's conception of MIDAS satellite (right). Drawings below show complete two-stage flight vehicle (right) and AGENA "B" second stage vehicle (left).

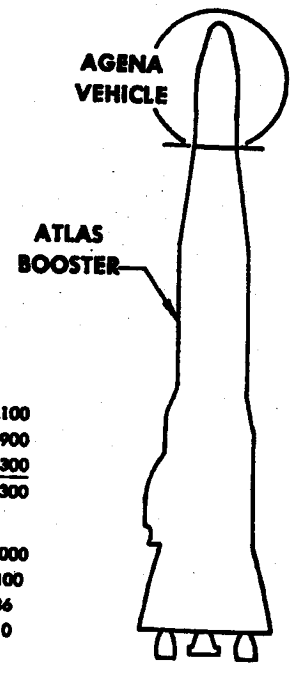


MIDAS

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



MIDAS, Configuration II, AGENA "B" Satellite



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

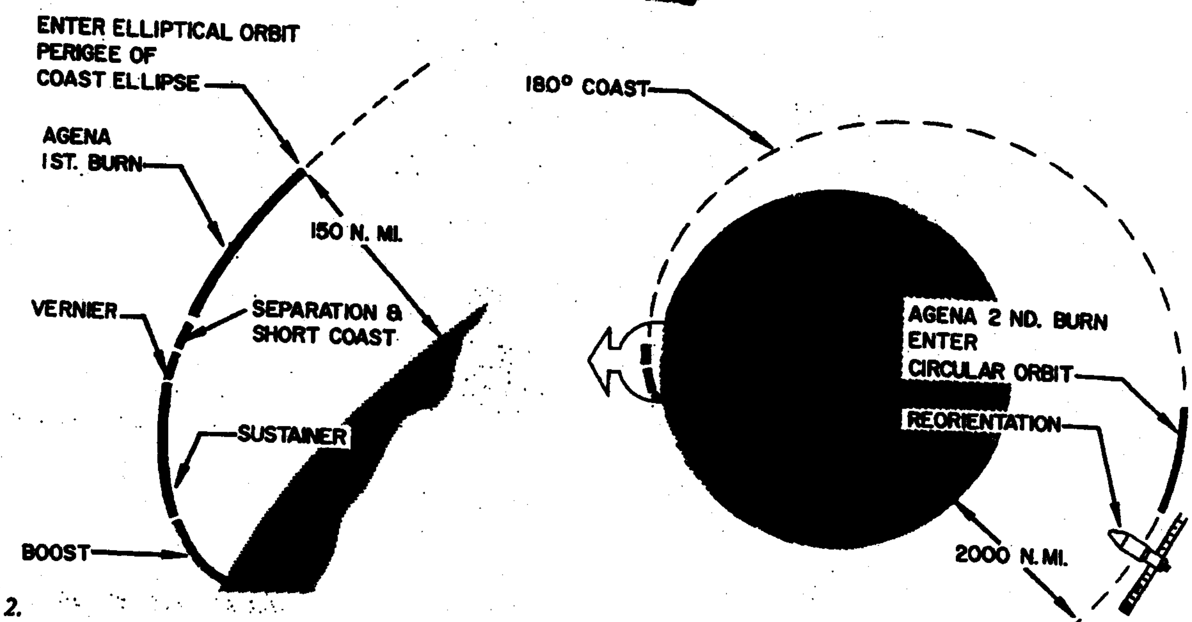


Figure 2.
Launch-to-orbit trajectory for flights 3 and subsequent. From boost through separation, guidance and control is provided by the ATLAS radio inertial system. The AGENA inertial guidance system, with horizon scanner, provides attitude, velocity and directional control to establish the orbit and vehicle orientation.

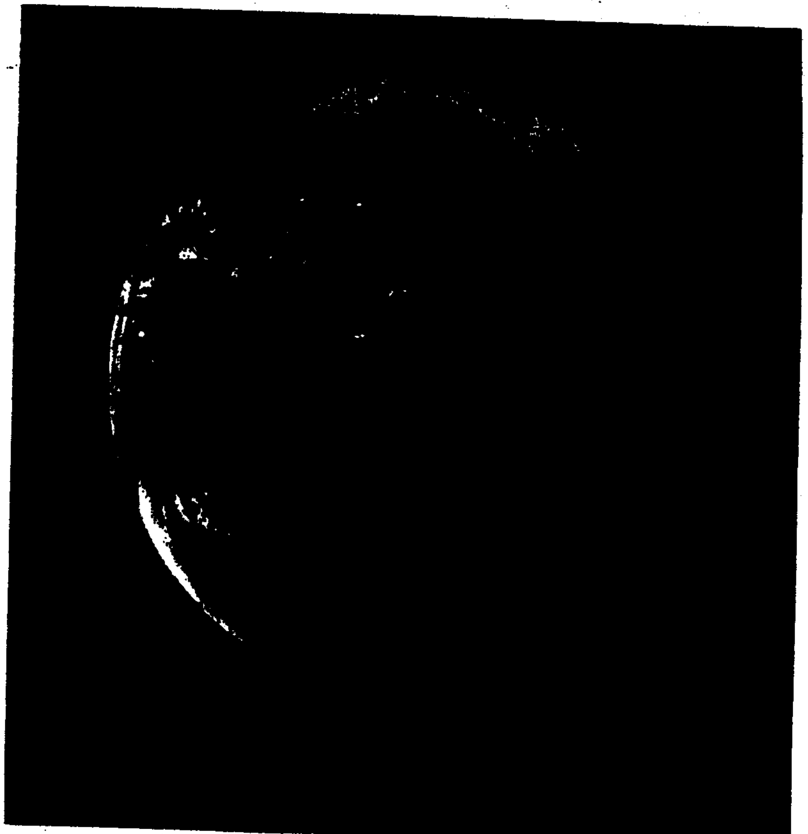


Figure 3.
Proposed MIDAS system. Four satellites spaced equidistant in each of two orthogonal planes at 2,000 n.m. altitude. Provides maximum coverage of USSR with minimum number of satellites.

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. A ten launch development plan for MIDAS (WS-239A) has been approved. Additional authorization has been obtained to utilize two DISCOVERER flights (designated RM-1 and RM-2) to carry background radiometers in support of MIDAS.

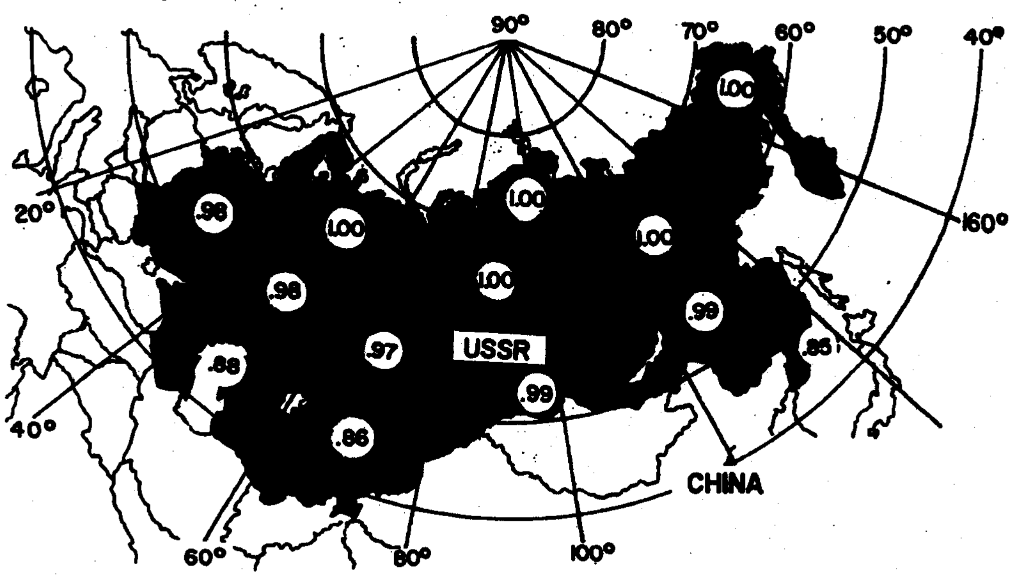
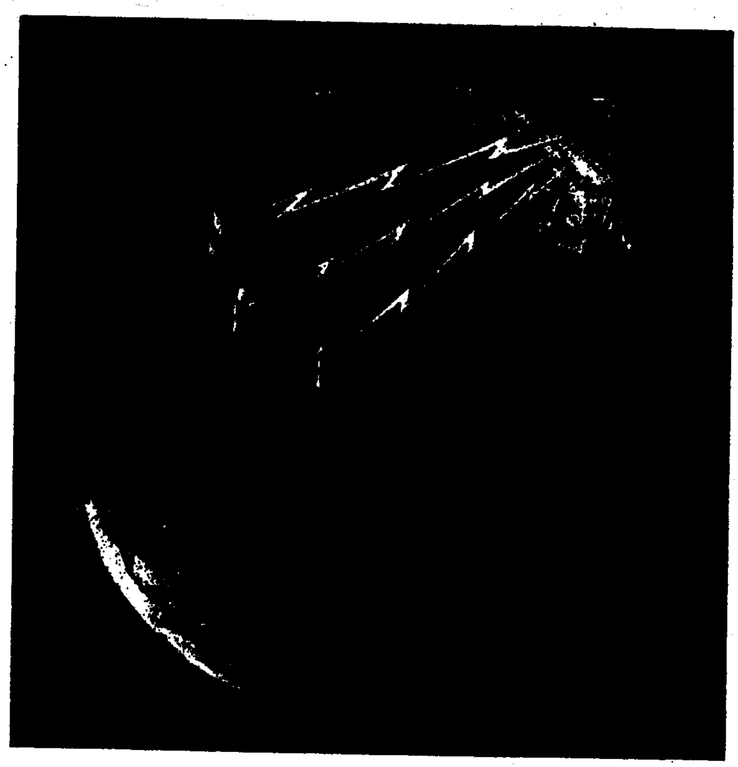


Figure 4.
Orbiting satellites detect infrared radiation emitted by Soviet ICBM's in powered flight. Data telemetered instantaneously to MIDAS Control Center via far north readout stations. Decoded data reveal approximately the number of missiles launched and launch location, direction of travel and burning characteristics. Probabilities of less than 1.00 on the above map indicate the probability of at least one MIDAS satellite detecting an ICBM launch. Probabilities of 1.00 indicate that more than one MIDAS satellite will always be in position to detect an ICBM launch. These figures are based on geometric considerations of the family of satellites and ground readout station locations.



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 (Figure 1). The final configuration payload weight will be approximately 1,000 pounds.

The first two of the ten 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.

MIDAS I, launched in February 1960, did not attain orbit because of a failure during ATLAS/AGENA separation.

MIDAS II, launched in May 1960, was highly successful. Performance with respect to programmed orbital parameters was outstanding. Useful infrared data were observed and recorded.

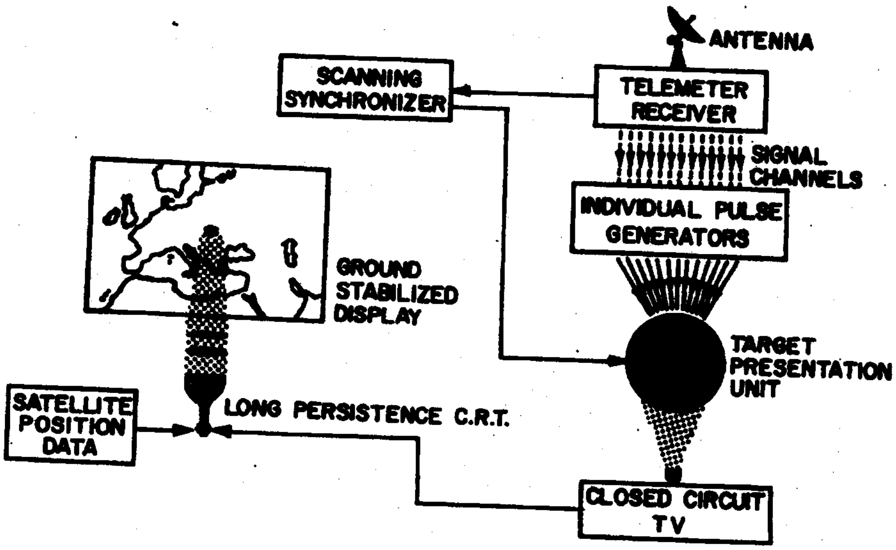
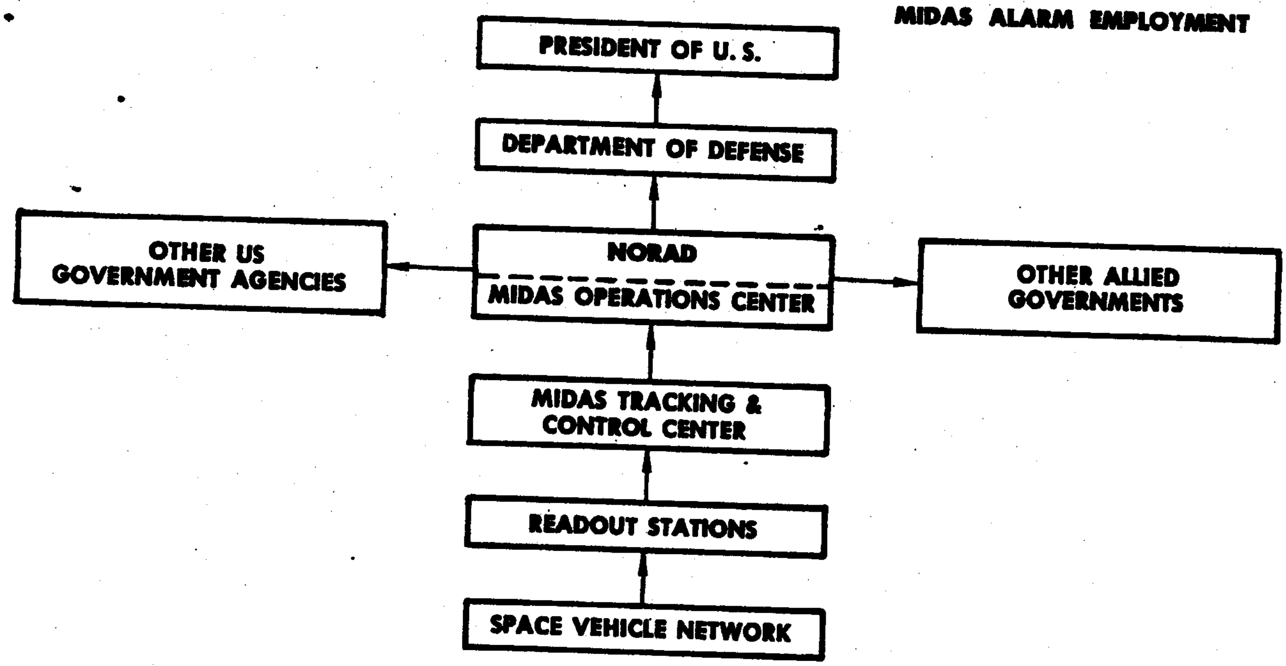


Figure 5.
Simplified version of ground presentation system (left) for display of infrared warning data. The data is displayed on a TV monitor with a map overlay. The chart below shows data flow from the readout stations to decision-making agencies. The MIDAS Control Center, or other using agencies having a correlated ground stabilized display, can determine when an actual attack has been launched.

MIDAS ALARM EMPLOYMENT



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 (Figure 3). The area under surveillance must be in line-of-sight view of the scanning satellite. Mission capabilities are shown in Figure 4. The system is designed to accomplish instantaneous readout of acquired data by at least one of three strategically located readout stations. The readout stations transmit the data directly to the MIDAS Tracking and Control Center where it is processed. It is then displayed and evaluated in the MIDAS Operations Center (Figure 5). 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.

[redacted]

[redacted]	60	61	62
	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D
[redacted]	[redacted]	[redacted]	[redacted]
VEHICLE CONFIGURATIONS	ATLAS "D"/AGENA "A"	ATLAS "D"/AGENA "B"	

MIDAS Launch Schedule

MIDAS GROUND SUPPORT FACILITIES

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

NOTES: (1) In addition to equipment listed, all stations have inter- and intra-station communications equipment and checkout equipment.

(2) Equipment listed is either presently available or planned and approved for procurement.

**Equipment*

- A. General Purpose Computer(s) and Support Equipment
- B. Data Conversion Equipment
- C. PICE
- D. Master Timing Equipment
- E. Control and Display Equipment
- F. VERLORT
- G. VHF FM/FM Telemetry Station
- H. PAM FM Ground Station
- I. Doppler Equipment
- J. VHF Telemetry Antenna
- K. UHF Tracking and Data Acquisition Equipment (60 foot F&D Antenna)
- L. UHF Angle Tracker
- M. UHF Command Transmitter
- N. APL Doppler Equipment
- O. SPQ-2 Radar
- P. Midas Payload Evaluation and Command Equipment

[redacted]

A. BRIEF OF PROGRESS

A preliminary version of a revised MIDAS Operational System Description has been completed. The MIDAS Development Plan will be resubmitted to the Secretary of the Air Force in the very near future.

Delivery of the AGENA "B" vehicle for the third MIDAS flight from the system test phase of manufacturing. The radiometer for the RM-1 flight (DISCOVERER XIX) was delivered to Vandenberg Air Force Base on 18 November. This flight is presently scheduled for 15 December.

A comprehensive program has been initiated to determine the sensitivity of selected components to high energy proton radiation and to determine the qualitative characteristics of the Van Allen radiation at MIDAS flight altitudes.

The payload for the third MIDAS flight has successfully completed the high altitude temperature simulation chamber test program. The payload for the fourth MIDAS flight is scheduled for December.

Component compatibility tests were conducted in October with the full-scale model of the solar auxiliary power array. The current generated exceeded expectations.

The Baird-Atomic ground infrared data display equipment is currently being installed in the Satellite Test Center. A second ground presentation unit is scheduled for delivery in December.

A detailed evaluation of launch pad requirements for the MIDAS operational phase was completed in September. The study indicated the need for a three-pad launch complex. Final acceptance of the Donnelly Flats, Alaska, facilities was accomplished on 29 September. A government-to-government agreement has not yet been accomplished for the United Kingdom station. Delay of approval of entry into the Union of South Africa is causing the construction completion date to slip day-for-day. Construction of the New Boston facilities is proceeding toward a 30 December completion date.

[redacted]

B. TOPICAL SUMMARY

1. *Program Administration*

Preliminary version of Operation System Description completed.

a. A preliminary version of a revised MIDAS Operational System Description has been completed. This document presents a description of the complete operational system as presently conceived incorporating the refinements and progress of the past year's R&D efforts. Following review by AFBMD, the final version will be prepared and distributed to those agencies with the need to know for decision, planning and programming for this forthcoming space system.

Development Plan to be resubmitted.

b. A proposed MIDAS Development Plan dated 24 October was presented to the Air Force Ballistic Missile Committee on 4 November. The revised plan (1) incorporates additional test launches, (2) is system oriented, i.e. includes necessary ground support elements, (3) provides back up developments in critical engineering and technical areas, and (4) provides for long lead time improvements, capabilities and reliability. Guidance has been received from the Secretary of the Air Force approving in principle but recommending a revised presentation of the Development Plan. The Development Plan will be resubmitted to the Secretary of the Air Force in the very near future.

Encouraging progress made in System data analysis by Lincoln Laboratories.

c. Representatives of AFBMD visited the Lincoln Laboratory to review progress on MIDAS System Analysis effort. Encouraging progress is being made in system data analyses; in efforts to tape and then perform computer studies of data from the impending MIDAS III, IV, and V launches; in special studies on remote station data system configurations; and data display systems. A series of reports, beginning in November, will detail the results of the Lincoln efforts and give their recommended courses of action. Such technical consultation and services have proven of great value to the guidance and direction of the R&D efforts.

2. *Flights*

Delivery of AGENA "B" delayed.

a. Delivery of the AGENA "B" vehicle for the third MIDAS flight from the system test phase of manufacturing has been delayed because of continued component difficulties. A small number of modifications remain to be accomplished. An intensive schedule recovery program has been developed which calls for completing the systems test activity on 22 December and for shipment from the Santa Cruz Test Base on 13 January. This Santa Cruz completion date represents a slippage of two days from the last scheduled delivery date and AFBMD has established a series of system test readiness meetings with the prime and associate contractors and supporting ARDC elements. This group is constantly watching the effect of Technical Difficulties on the ability to meet scheduled launch dates. Every effort is being made to assure the highest possible probability of success of each test series.

Radiometer for RM-1 delivered to VAFB on 18 November.

b. The radiometer for the RM-1 flight (DISCOVERER XIX) was delivered to Vandenberg Air Force Base on 18 November. The radiometer entered systems testing for compatibility with the satellite vehicle on 29 November. This radiometric measurement flight is presently scheduled for 15 December. A second flight is scheduled for early in 1961. The purpose of these flights is to gather background infrared radiation data.

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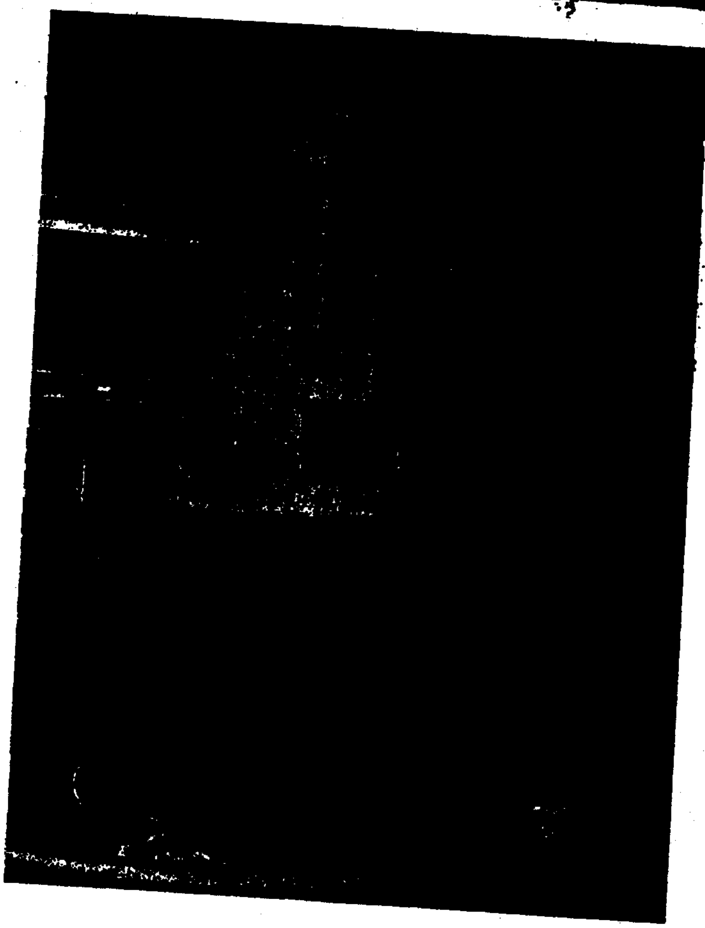

Figure 6. The radiometer (left) which will be carried on the RM-1 flight installed in the payload section of the AGENA satellite. The entire assembly is about to be placed in the high altitude temperature simulation chamber. The lens of the radiometer which will measure background radiation can be seen through the popout window. The sensing element is mounted behind the lens. A background radiometer (below) of the type to be carried on DISCOVERER flights RM-1 and RM-2. The primary function of these flights will be to provide background radiation data for use in future MIDAS flights. The nitrogen spheres are part of the nitrogen-gas cooling system which cools the sensitive element of the radiometer.

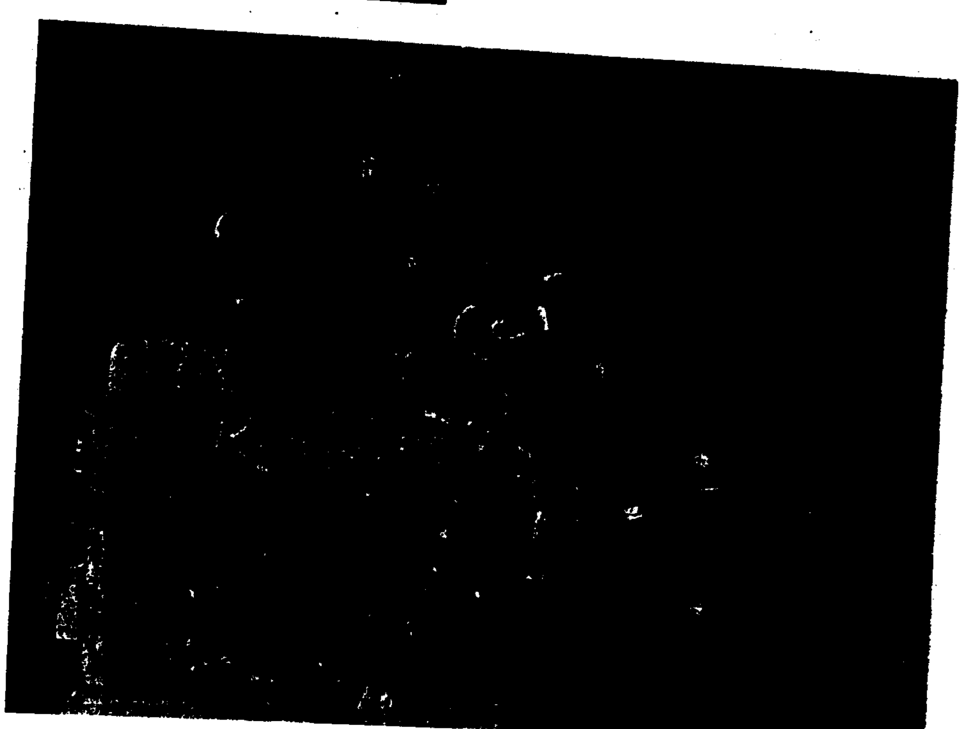

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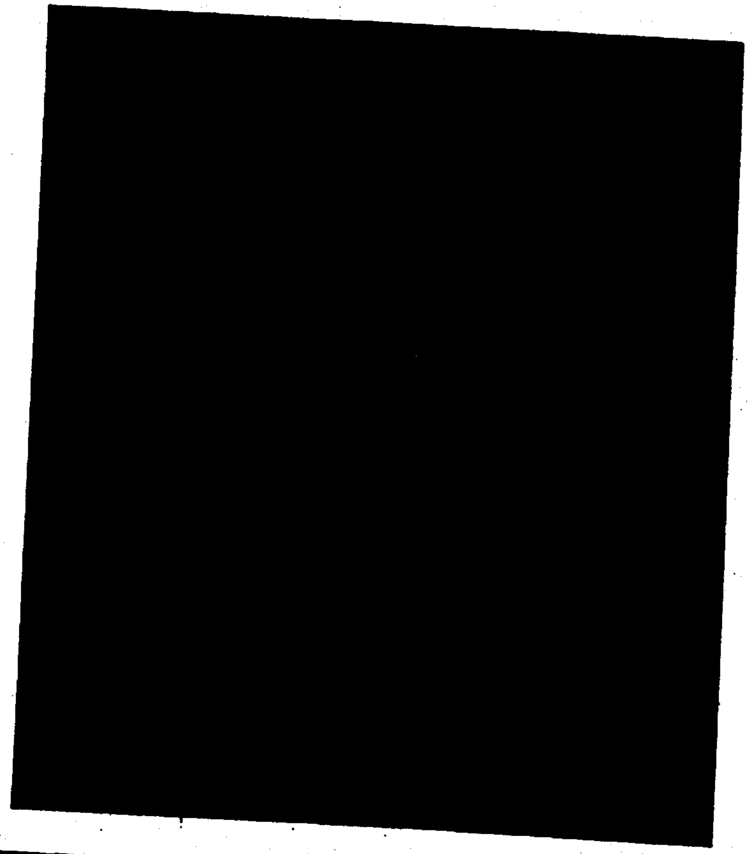
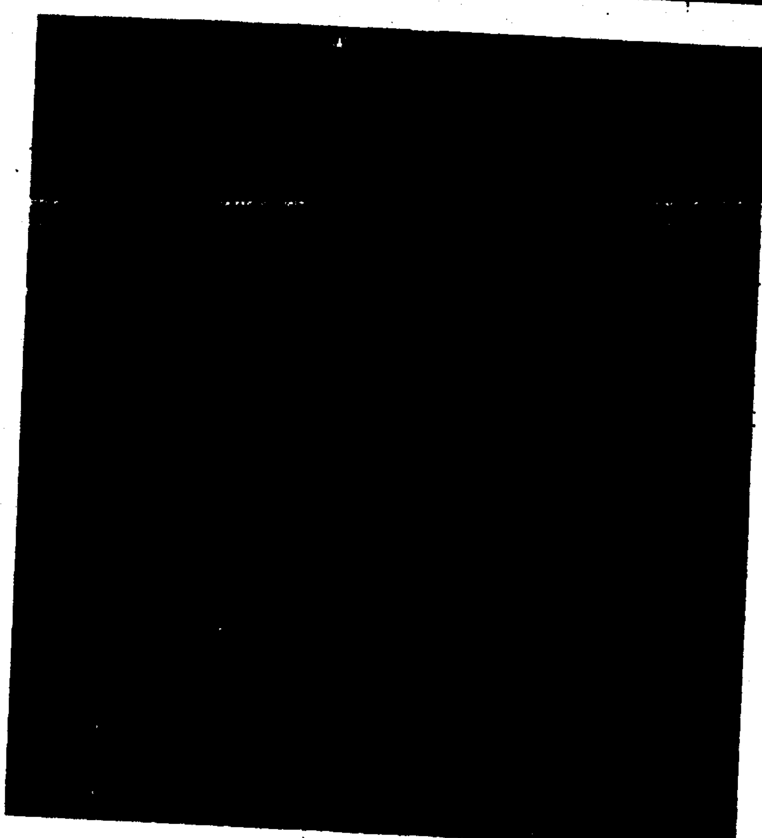
Figure 7. The second Baird-Atomic, Inc., infrared payload (right), which will be carried on MIDAS V, is shown in the collimator prior to optical checkout. The unit in front of the lens is the pre-amplifier and the tube projecting behind the lens is the telemetry antenna mount. The various units on the telescope assembly contain the post-amplifiers, the D.C. power supply, the radiometer pre-amplifier, and regulator assembly. The initial Baird-Atomic payload (below), which will be carried on MIDAS IV, is being instrumented by a Lockheed technical prior to being installed in the high altitude temperature simulation chamber. This flight, scheduled for February, will be the first launch of the ATLAS "D"/AGENA "B" vehicle.





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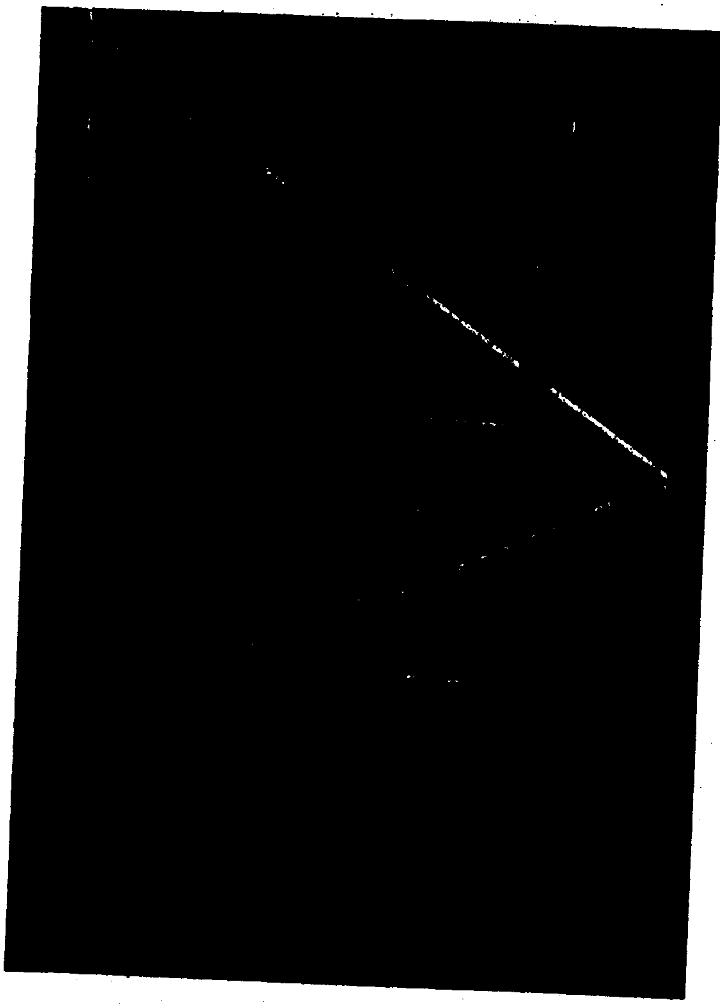
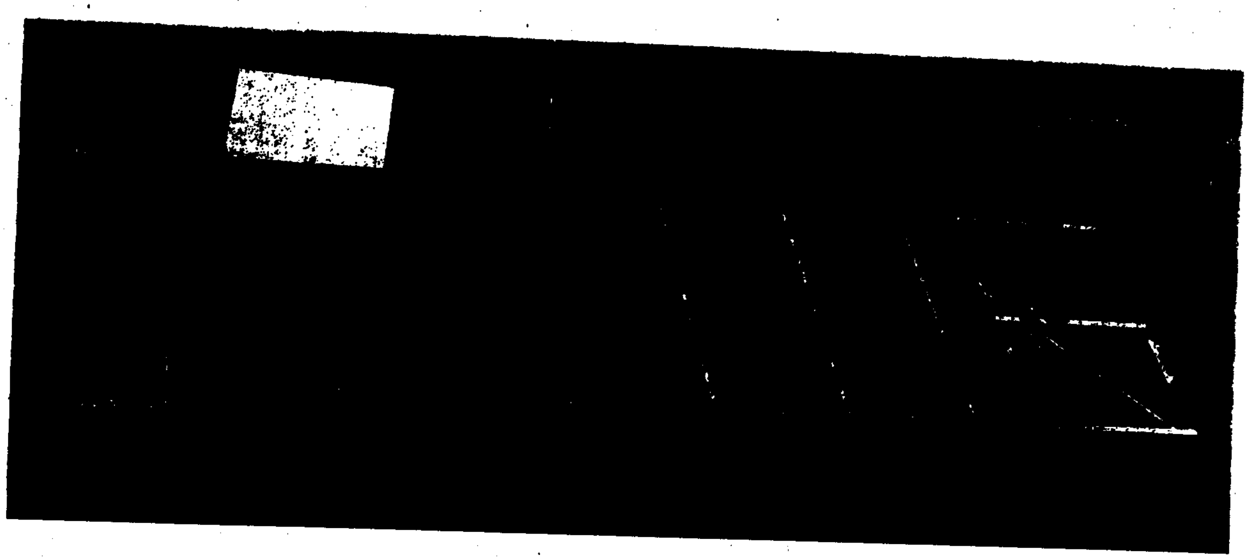


Figure 8.
Operational tests of the solar auxiliary power array. For the tests, a special fixture holds the array; in space the array will be experiencing zero gravity and the light weight framework will provide sufficient support. The close up shows the sun position sensor which adjusts the array to permit maximum sun exposure for the solar cells.



3. *Technical Status*

a. Van Allen Radiation Study

Comprehensive study of Van Allen radiation initiated.

(1) As a result of recent investigations by Space Technology Laboratories on the significance of the high energy Van Allen protons, and their potential effect on long-life satellites, special instrumentation is being developed to be carried on SERIES II MIDAS flights. Contrary to the present theory that the damage cross section is inversely proportional to energy, evidence has been found that solar photovoltaic cells may be degraded at a much higher rate by high energy protons, e.g., 700 MEV. A comprehensive program has been initiated to determine the sensitivity of selected components to high energy proton radiation and to determine the qualitative characteristics of the Van Allen radiation at MIDAS flight altitudes.

Instrumentation to measure proton radiation to be carried on MIDAS III and IV.

(2) Instrumentation will be carried on MIDAS III and IV to measure proton radiation in the Van Allen belt. Since the lower Van Allen region extends from 1200 to 2400 nautical miles above the surface of the earth the MIDAS satellites, orbiting at 2,000 nautical miles, will be functioning in the belt. The instrumentation will have its own telemetry and will be concerned primarily with radiation above the 100 mev range. The instrumentation will include means of measuring the proton radiation flux. It will also include photovoltaic cells, similar to those used in the solar auxiliary power array, which will be exposed to Van Allen belt radiation to investigate the effect of radiation damage on cell efficiency.

b. Second Stage Vehicles

AGENA "B" for fourth MIDAS flight delivered.

(1) The AGENA "B" vehicle for the fourth MIDAS flight was delivered to systems test area on 25 November. This represents a one-week schedule slippage. It is anticipated that this time will be recovered during the systems test phase. The horizon sensor is scheduled for delivery on 28 November. The sensor will be installed in the satellite during the system test phase.

Fifth MIDAS satellite is on schedule.

(2) The fifth MIDAS satellite is currently in final assembly and is on schedule. It will be delivered to systems test on 6 December. The design of the Development Test Vehicle for MIDAS Series III (MIDAS VI) has been released and is in the early-fabrication stage, on schedule.

Heat shield hot firing test completed.

(3) The first hot firing test of the MIDAS heat shield has been completed at Arnold Engineering Development Center. The shield was designed to eliminate the thermal problem that developed at the interface of the aft equipment rack and the radiantly cooled nozzle extension of those MIDAS vehicles which have an extended aft equipment rack to accommodate the solar array. Preliminary examination of the data indicates that the temperature within the aft equipment rack will be well within the thermal limits established for this area.

Transmitter to be installed in satellite for MIDAS III, IV and V.

(4) Authorization has been obtained for installation of a 400-mc transmitter in the satellite vehicles for MIDAS III, IV, and V. This transmitter, which will have its own battery pack and antenna, will provide approximately a 20-milliwatt signal for antenna acquisition and automatic tracking by the mobile ground station located in South

Figure 9.
Aerial view (above) of the Donnelly Flats, Alaska, technical facilities. The three radome structures can be seen in the background. The corrugated steel storage buildings are in the left foreground, the next building houses the diesel powered generators, next is the heated vehicle storage building and last is the data acquisition and processing building. One radome site (left) showing the radome support structure and the support equipment building. The support for the radar antenna is shown in the lower photo. On the opposite page is an interior view showing the three large diesel driven generators which provide power for this important tracking station. The lower photo shows the heated vehicle storage building with the data acquisition and processing building in the background.

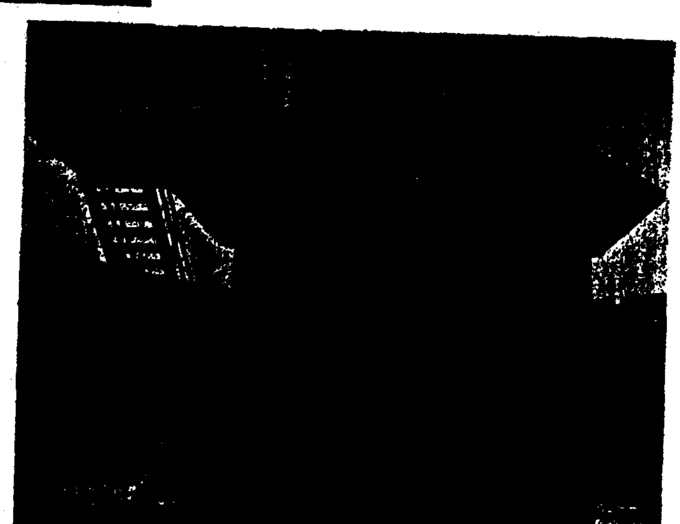
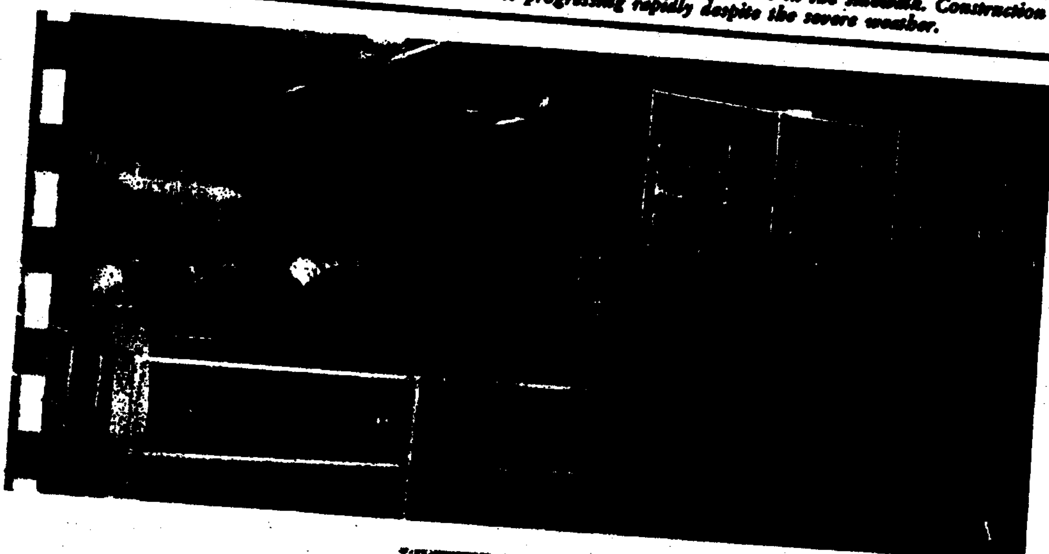


Figure 10. The completed combination dormitory and dining hall at the Ft. Greely, Alaska, support facilities. Note the cylinder head vehicle heaters in the sidewalk. Construction of both technical and support facilities is progressing rapidly despite the severe weather.



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Africa. This station will provide a minimum interim capability for second burn telemetry data readout, which is a mandatory requirement. Establishment of this interim capability was made necessary because of the inability to obtain right-of-entry to establish the Atlantic Missile Range station 13 capability in Southeast Africa.

Manufacture of proton radiation package on schedule.

(5) Manufacture of the instrumentation package which will measure proton radiation in the Van Allen belt is on schedule. This package is scheduled for installation in the MIDAS III satellite vehicle on 15 December.

c. Infrared Scanners

Infrared scanner units for MIDAS flights III, IV and V are being manufactured by Baird-Atomic, Inc., and for flights VI, VII and VIII by Aerojet-General Corporation.

Flight three payload completes test.

(1) The payload for the third MIDAS flight has satisfactorily completed the test program conducted in the high altitude-temperature simulation chamber. The payload for the fourth MIDAS flight is scheduled for delivery in December.

Infrared detector delivery problems continue.

(2) The infrared detectors to be used on the service test model of Aerojet-General's advanced infrared payload configuration are being provided on a competitive basis by Infrared Industries and Electronic Corporation of America. Delivery of detectors from both contractors continues to be a problem. Aerojet has assigned a resident representative to follow and expedite the program.

Advanced configuration cost contract negotiated.

(3) A cost contract has been negotiated for seven payloads of the advanced configuration being developed for MIDAS flights 6, 7 and 8. Five are programmed as flight articles and spares and two for life testing in the accelerated reliability program.

January delivery of engineering model.

(4) An engineering model of the Aerojet-General advanced scanner will be delivered in January.

Evaluation of proposed system completed.

(5) The technical and engineering evaluation of the proposed all-electronic infrared scanner system has been completed. The results of this evaluation have been very encouraging. A final decision is pending on whether to proceed with the development effort on this system.

d. Solar Auxiliary Power Array

Power array compatibility tests conducted.

Component compatibility tests were conducted in October with the full-scale model of the solar auxiliary power array. The full array, including stepping motors, was operated by exposure to sunlight and refrigerated batteries were used to simulate orbital temperature conditions. The performance of the array was entirely satisfactory and the current generated exceeded expectations.

e. Ground Support Equipment

Installation of data display equipment started.

(1) Delivery of the initial Baird-Atomic ground infrared data display equipment originally scheduled for 15 October was made during November. This equipment will be used in support of MIDAS [illegible]

[redacted]

affect the scheduled activation date. Some revision of the integration activity will be required; however, this will not affect the MIDAS launch schedule. A second ground presentation unit, for installation at Vandenberg Air Force Base, is scheduled for delivery in December. Delays in delivering the second unit of ground support equipment, however, will cause some slippage in the Vandenberg Air Force Base tracking station activation date for support of MIDAS flights.

Sixty-foot antenna transferred to AFBMD.

(2) Arrangements were completed on 18 October for the transfer of responsibility for the 60-foot automatic tracking and telemetry antenna at Eglin Air Force Base to AFBMD for relocation near Pretoria, South Africa, and eventual transfer to AFMTC for AMR station 13.

Modification approach agreed on.

(3) On 19 October, an agreement was reached on the technical approach to be used in modifying the Vandenberg Air Force Base 60-foot antenna. These modifications will comply with the requirements of the MIDAS, SAMOS, and ADVENT Programs.

PICE peripherical equipment provisioning a problem.

(4) The provisioning of data handling equipment (PICE peripherical equipment) for the New Boston station is currently a problem. Solutions are under investigation to enable the New Boston station to support MIDAS operations on schedule.

4. Facilities

Launch pad requirements evaluation completed.

a. A detailed evaluation of launch pad requirements for the MIDAS operational phase was completed in September. This study indicated the need for a three-pad launch complex during the establishment of the operational network, and a requirement for from two-to-three pads for maintaining the MIDAS satellite network once the buildup phase has been completed.

North Pacific technical facilities accepted.

b. Final acceptance of North Pacific station technical facilities at Donnelly Flats, Alaska, was accomplished on 29 September. Completion of all support facilities at Fort Greely, Alaska, is scheduled during December. The Donnelly Dome microwave relay station is scheduled for completion on 15 December.

Government-to-government approval pending.

c. Design criteria for the United Kingdom station was reviewed on 3 and 4 November. Final revisions are to be completed and submitted to AFBMD by 15 December. The Third Air Force is proceeding with necessary preliminary actions prior to initiating design. Upon receipt of design criteria from AFBMD, the Third Air Force will start the design. The government-to-government agreement has not yet been accomplished.

Union of South Africa approval delayed.

d. Delay of approval of entry into the Union of South Africa has caused the station construction completion date to slip day-for-day. The government-to-government agreement for this station is still pending.

Construction on schedule.

e. Construction of facilities at the New Boston, New Hampshire station is proceeding on schedule toward a 30 December completion date.

DISTRIBUTION

Headquarters USAF	21
Headquarters ARDC	5
Strategic Air Command	1
Air Defense Command	14
6555 Test Wing (Development)	2
6594 Test Wing (Satellite)	5
San Bernardino Air Materiel Area	1
Air Force Command and Control Development Division	1
Air Force Ballistic Missile Division	15