LLISTIC MIS

SPACE

DOWNGRADED AT 12 YEAR INTERVALS: NOT AUTOMATICALLY DECLASSIFIED. DOD DIR 5200.10

GENERAL

- 1. This report was prepared as an in-house prototype of a Space Programs Progress Report which will be prepared for external distribution in the future. This prototype was prepared under a tight deadline with inadequate reference material, and will undoubtedly contain errors of fact. It will not be distributed or released to anyone outside of the Air Force Ballistic Missile Division.
- 2. It is intended to serve as a guide to Space Program Directors in format, style, and presentation planned for future issues. The text, artwork, and illustrations contained in this prototype are planned for use, with corrections, in the full report for external distribution to be produced in late October. Program directors concerned will review all material pertaining to their programs and submit the desired corrections to the Program Reports Branch no later than 2 October 1959.
- 3. Programs not included in this issue due to time considerations will be included in the official issue.
- 4. All offices are invited to comment on any part of this report. This prototype was intended to provide a basis for future improvement, and all suggestions will be appreciated.
- 5. The General Section for official editions will consist of a general statement of progress in the space area.

Robertin

RICHARD D. CURTIN Colonel, USAF Deputy Commander, Military Space Systems

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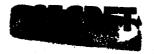
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- 2. SAMOS
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- 7. COMMUNICATIONS SATELLITE
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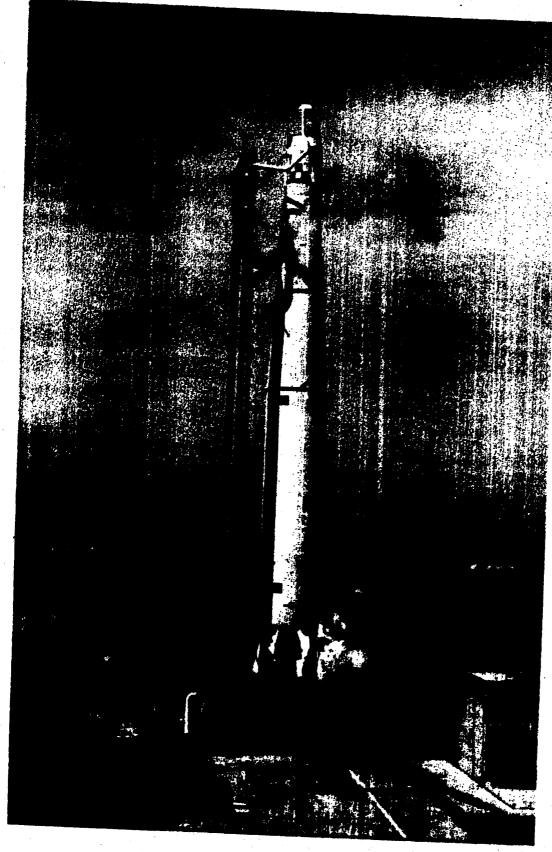
To be included in next month's report.

Inputs needed on items 13 through 18.

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Flight	History
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DISCOVERER No.	Vehicle No.	THOR	Flight Date	
I	1022	163	28 February	Attained orbit annual control
II	1018	170	13 April	Attained orbit successfully. Telemetry received for 514 seconds after lift-off Attained orbit successfully. Recovery capsule ejected on 17st
III	1019	174	3 June	recovered. All objectives except recovery successfully achieved. Launch, ascent, separation, coast and orbital boost successful.
IV	1020	179	25 June	achieve orbit because of premature satellite engine shutdown. same as DISCOVERER III.
v	1029	192	13 August	All objectives successfully
AI	1028	200	19 August	except capsule recovery after ejection on 17th orbit. same as DISCOVERER V.
				- TOO TURKEN V.

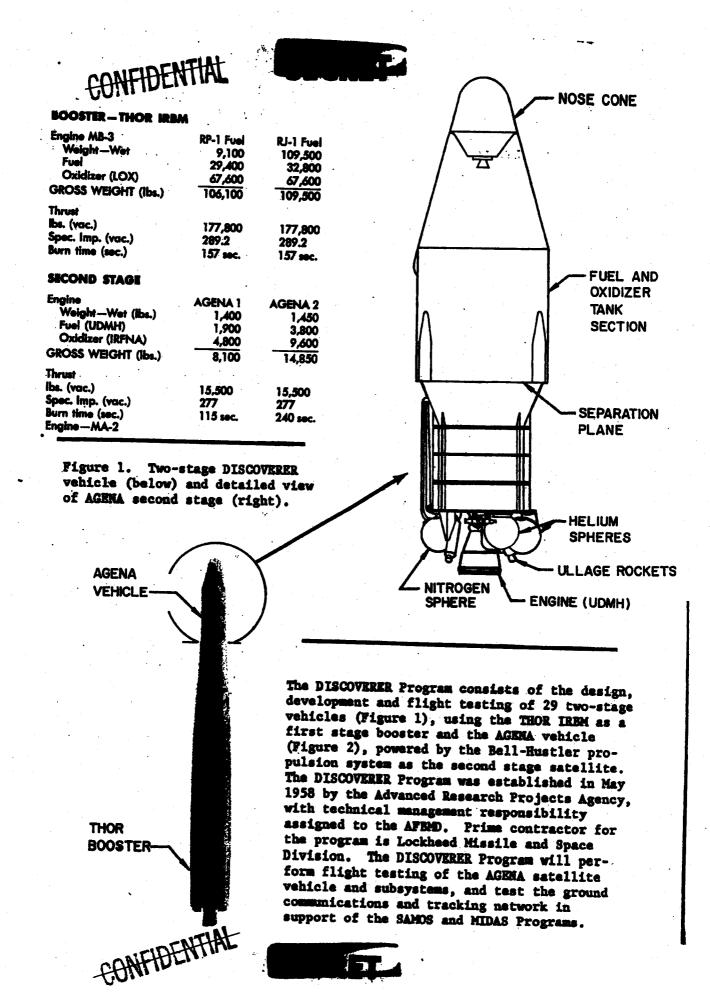
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NOTE TO WDZSD-WDZF: Please update

vehicle and THOR serial numbers.



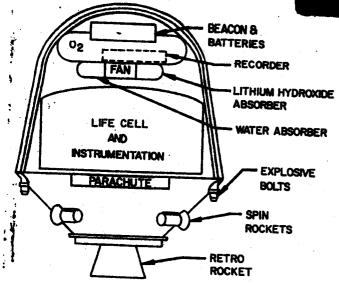
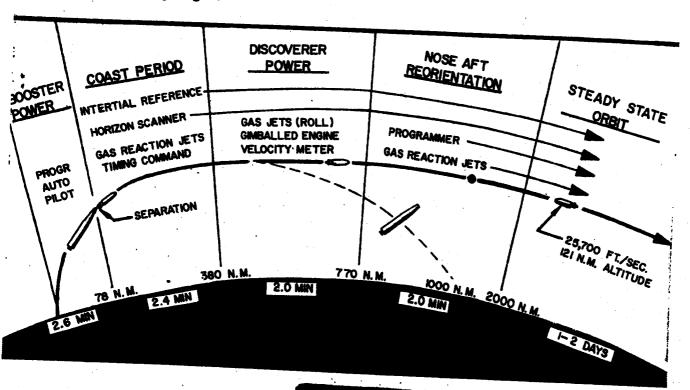


Figure 2. Schematic drawing of typical bio-medical recovery capsule. The Mark I capsule is designed to carry mice and the Mark II to carry small primates.

Figure 3. Typical DISCOVERER trajectory showing booster ellipse, reorientation of satellite to nose aft position, and orbital path at perigee.

Primary objectives include:

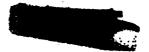
- (a) Flight test of the satellite vehicle airframe, propulsion, guidance and control systems, auxiliary power supply, and telemetry, tracking and command equipment.
- (b) Attaining satellite stabilization in orbit.
- (c) Obtaining satellite internal thermal environment data.
- (d) Testing of techniques 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 (Figure 3).

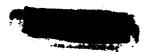




- Payloads may be installed either as a package on the forward equipment rack or distributed throughout the AGENA vehicle. Payload capability is as much dependent upon available space within the vehicle as upon propulsion energy available. Generally, payloads in excess of 1,500 pounds must be integrated throughout the AGENA stage. A program for development of maximum efficiency of the first stages was also underway. The ATLAS ICHM was modified to reduce limitations imposed by trajectory requirements, missile vibration, and static load capability. The external configuration was retained for compatibility with standard ground support equipment, but structural modifications now permit ATLAS to support loads of 11,600 pounds. The dynamic capability to lift the AGENA, considering aerodynamic effects, has also been assured.
- 6. The THOR IRBM had the guidance system removed for the first five DISCOVERER flights. Future developments will result in a configuration known as the DM21. The DM21 will have components not required for booster missions removed and will be powered by a later version of the more efficient MB-3 engine. Also, RJ-1 fuel will be used for space missions, providing longer burning time than RP-1. Coupled with the AGENA having enlarged propellant tanks and single restart capability this booster will have very attractive weight/altitude capabilities.







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Project MERCURY (Man-In-Space) represents the transitional threshold between this nations' cumulative achievements in space research and the beginning of actual space travel by man. The primary program objective is to place a manned satellite into orbit about the earth, and to effect a controlled re-entry and successful recovery of the man and capsule (See Figure 1). Manned and unmanned ICBM trajectory and partial orbit flights, and unmanned orbiting flights will be used to verify the effectiveness and reliability of an extensive research program prior to manned orbital flights (See Figure 2). The program will be conducted over a period of nearly two years, with the initial R&D flight test scheduled for September 1959. During this time all advances in the state-of-the-art will be immediately and carefully integrated into the program to assure that the final flight will represent the ultimate sophistication in vehicle reliability and

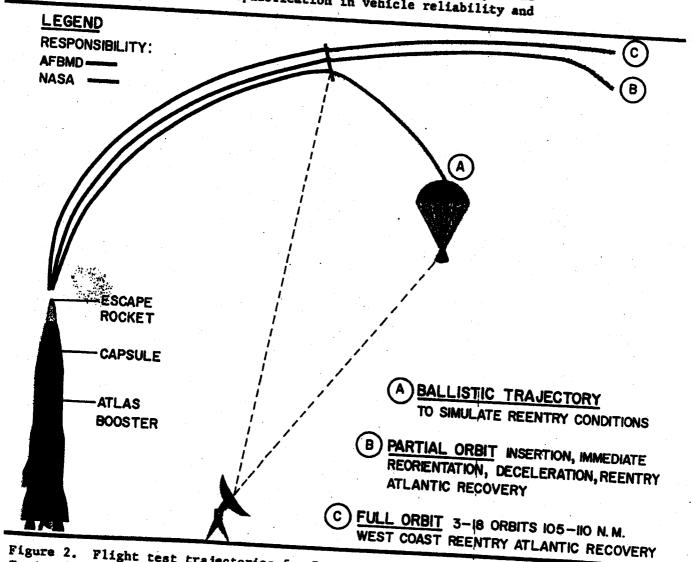
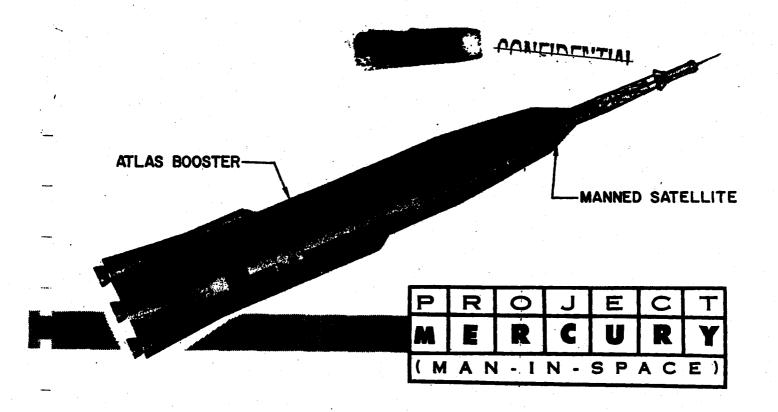
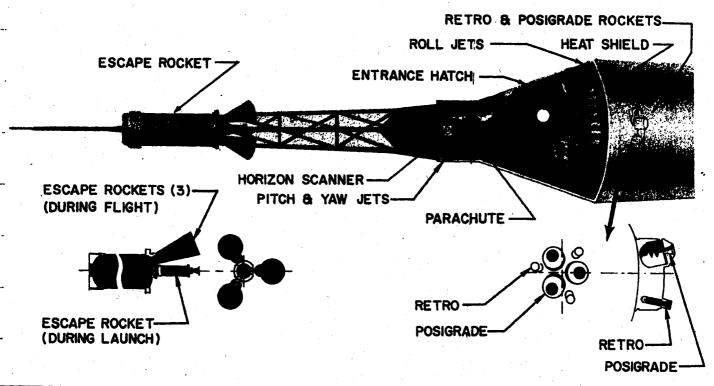


Figure 2. Flight test trajectories for Project MERCURY, defining specific objectives. Trajectory C represents the path of the final (manned) flight. The point at which AFBMD and NASA responsibility is divided represents injection into orbit.





WEIGHT AT SEPARATION ORBITAL ALTITUDE ORBITAL CYCLES

APPROX. 2413 LBS. 105-120 MILES (n) 3-18

ORBIT INCLINATION HEAT SHIELD RECOVERY 33 DEGREES
ABLATIVE OR SINK
AIR B/OR WATER OR LAND

Figure 1. Complete vehicle (top view) with satellite installed on ATLAS booster. Manned satellite (bottom view) showing pilots' flight position, and detail views of retro and posigrade rockets and pilot safety system escape rockets.





TABLE 1

PROJECT MERCURY NASA Responsibility Booster-Capsule integration Capsule Ground support Recovery Flights **Flights** 1 and 2 3 - 10 Laboratory Flight Capsules Capsules (McDonnell) Re-entry

Manned-unmanned flights
Launch from AMR
Earth track 33°N/33°S/Lat.
3-18 orbits
Orbit capability 28 hours
Orbit weight 2500 lbs.
Orbit altitude 105-115 n.m.
Automatic pilot safety equipment with manual backup.

heating,

dynamics, recovery

AFBMD Responsibility Booster ATLAS "D" Modified New guidance antennae Thin skinned tanks Shifted tank bulkheads Light weight thrust structure Capsule separation machanism Interface electrical connections LOX dome protection Abort-sensing system Detects dangerous variations in tank pressures, guidance, thrust

power, attitude.

escape capability.

Pilot initiated

Integrated countdown - including pilot insertion and capsule countdown.

AMR launch Stand 14 - adapted for pilot and capsule.

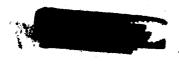
GE ground guidance equipment modified to provide: (a) real time data, (b) additional discrete command signals during powered flight.

Launch azimuth:

(a) Ballistic trajectory - 1080

Launch

(b) Orbital trajectory - - 072





space knowledge. The total program accomplishment is under the direction of NASA. The primary responsibility of the Air Force Ballistic Missile Division consists of: (a) providing ten ATIAS boosters modified in accordance with program objectives and pilot safety factors, and (b) determination of trajectories, and launching and control of vehicles up to and including injection into orbit. The division of responsibilities for this program is given in Table 1. Specific details of AFBMD support

ATLAS MODIFICATION PROGRAM - Modifications to the ATLAS Series D ICBM are necessary to: (a) permit mating of the Man-In-Space capsule to the missile, (b) to achieve a flight which will place the capsule in orbit, and (c) to provide two-way safety features between the missile and ground and also between the missile and the capsule to permit pilot escape if deemed necessary at any time, including on the launch pad. Capsule adaptation and orbit attainment modifications include: provision of booster-to-capsule interface and electrical connections, shielding and insulation of LOX dome, modifications to control system and guidance computer system, and reorientation or redesign of airborne antennae. Limited AFBMD technical assistance is required in capsule design to affect an efficient coordination of efforts during development of the two stages. Modifications providing pilot safety factors include: an abort sensing system which warns the pilot of a vehicle malfunction of a catastrophy causing nature, permits the pilot to abort the booster engine, and to initiate a capsule ejection system; and provision of a ground system for the automatic transmission of control signals if the vehicle is determined to be headed toward a non-recoverable orbit or an impossible re-entry condition. Every possible factor relating to pilot safety is being considered, including malfunction at the pad and physiological stresses on the pilot at all times during the flight.

LAUNCHING PROGRAM - The Air Force Ballistic Missile Division will establish a flight trajectory for each flight mission, including re-entry environment for those flights which contain orbiting requirements. The feasibility of providing additional real time trajectory data on the powered and injection phases of the flights from the ground guidance system are being studied.

GURRENT MONTHS! PROGRESS - During this reporting period, a test
management structure was agreed upon designating AFRMD as Launch
Director and NASA as Operation Director for all Project MERCURY flights.
Responsibility for all DOD-MERCURY support efforts was assigned to Major
General D. Yates by the Office of the Secretary of Defense. The initial
R&D flight is scheduled for 8 September 1959. Recent slippages have been
caused by the capsule not being ready. Basic design of a transistorized
approach to the malfunction sensing-abort initiating system has been agreed
upon, with a magnetic-amplifier back-up approach being considered.

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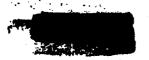


TABLE 2

PROJECT MERCURY

AFBMD Responsibility
in support of
PROJECT MERCURY
NASA HS-36
includes:

Design, engineering studies Equipment modification Hardware fabrication

Launch support Trajectory data Missile allocation

Flight scheduling

Provide ten (10) ATLAS boosters.

Modify boosters for NASA preliminary research and manned orbital flight and safety objectives.

Launch, control and define trajectories of booster-capsule vehicle up to, and including, injection into orbit.





being achieved by long range planning and maximum integration with other programs. Use of the basic four-stage, solid propellant, SCOUT vehicle developed by NASA and modified to achieve Program 609A objectives will effect an economy in vehicle development. Necessary modifications include provisions for stabilizing the fourth stage without spin and use of the vehicle in less than the full four-stage configuration. Close integration with the current ballistic missile program will effect an economy by permitting tests and experiments to be conducted on regularly scheduled ballistic missile test flights whenever possible without delaying schedules. Economy in the operational phase will be exercised by the use of this low-cost vehicle as a standard flight test platform to perform scientific and military experimental research in support of all Air Force facilities. RELIABILITY will be obtained by the ten-vehicle R&D flight test program, at least two prior flights of the basic SCOUT, and maximum use of knowledge gained in prior Air Force ballistic missile flight testing. VERSATILITY will be achieved by designing a vehicle capable of being readily adapted to a wide range of payload variations, and capable of being flown in several configurations of four stages or less. This VERSATILITY results in the following flight capabilities: (a) vertical launch with high speed re-entry, (b) boost-glide trajectory, (c) ballistic missile trajectory, including payload recovery, and (d) full orbit up to 5,000 miles.

PROGRAM MANAGEMENT - An abbreviated development plan, covering the R&D phase only, was prepared by Headquarters USAF and approved on 9 January 1959. A firm assignment of \$8,180,000 was made for accomplishment of this portion of the program only. A letter was issued assigning management responsibility to AFRMD, with a strong emphasis placed on the importance of integrating the program as closely as possible with the conduct of scientific and military research experiments on regularly scheduled ballistic missile flight tests (Piggyback Program). In June 1959, Aeronutronic Division of the Ford Moter Company was chosen through normal competitive bidding as the Payload, Test, and Systems Integration Contractor. Arrangements have been made for the procurement of vehicle components and associated

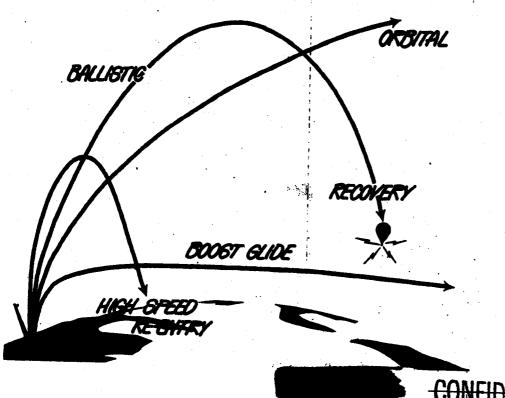
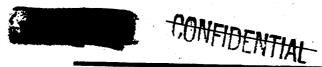


Figure 2

Four different trajectories possible using different arrangements of Project 609A stages.



PROJECT 609A Space Environment Test System PAYLOAD PROGRAM DESCRIPTION - The Hyper-Environment BUIDANCE Research Program (609A) is divided into R&D and Operational phases. The R&D phase will be used ALTAIR to develop and flight test vehicles capable of ANTAREScarrying payloads to altitudes of 200 to 5,000 miles. The Operational phase will use this standardised vehicle to permit the economical performance of flight test experiments in support of scientific research and advanced military space system programs. CASTOR ECONOMY - RELIABILITY - VERSATILITY - In this order of emphasis are the three significant guides to program accomplishment ECONOMY is PAYLOAD Propulsion **GUIDANCE** NASA SCOUT ALTAIR-Stage Engine 1. ALGOL Aerojet ANTARES. Senior 2. CASTOR Thickol Sergeant 3. ANTARES ABL X-254 4. ALTAIR ABL x-248 CASTOR PAYLOAD AO" DIA: 31.0 DIA. ALTAIR GUIDANCE ANTARES STAGES 1, 2, 3, 4 STAGES 1,2,3 (ALTERNATE) HEIGHT - 72' 7" HEIGHT- 68' 10"

Figure 1. Four possible variations of Project 609A vehicle demonstrate mission-versatility of program.

HEIGHT

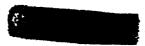
WEIGHT - 12,960 LBS

STAGES 3,4

SPIN STABILIZED



WEIGHT - 35,475 LBS.



WEIGHT - 34,925 LBS

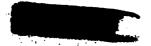


support equipment, modified to meet Program 609A requirements, through NASA, rather than through their SCOUT Program contractors. Atlantic Missile Range facilities consisting of Launch Pad 18A, its tower, and half of the blockhouse will be made available to the Air Force for this program. Availability, procured through NASA, will follow completion of the current VANGUARD Program. A division has been established within the 6555th Guided Missiles Group at AMR to supply Air Force technicians to participate in the assembly, checkout and launch operations of the R&D phase under the direction of the Payload and Test Contractor. An all-military operational capability will be developed from within this group.

CURRENT STATUS - All contractual arrangements have been made for the accomplishment of the entire program. System studies are being conducted which will establish specifications for vehicle component modifications, delivery dates, quantities of hardware required for the test program, and test site support requirements. A survey of the detailed experimental requirements of all participating ARDC Centers is being used to determine vehicle configurations and capabilities required and to permit integration of as many of these experiments as possible into the R&D flight tests. Arrangements have been made with the Directorate of Laboratories at WADC to furnish technical support as required. Although primary design and engineering for the basic MASA SCOUT vehicle has been essentially completed no tests or fabrication specifically for the 609A program has been started at this time,

FUTURE SCHEDULES - On 1 September 1959 the Payload and Test Contractor will submit a detailed test plan specifying launch dates, describing the objectives, configuration, and trajectory for each test flight, and furnishing detailed support schedules. The first vehicle is to be delivered in January 1960. The first payloads, complete with experiment instrumentation, will be delivered in February. Test site preparations are scheduled for completion in February. Flight tests are scheduled to begin in March 1960 and continue into October. The operational readiness date is October 1960.







CONGEPT - The TIROS Program is managed and receives technical direction from the National Aeronautics and Space Administration. The program is a joint effort with the Army Signal Corps supplying the payload and the AFBMD providing:

- a. The launch vehicle
- b. Integration of the payload into the launch vehicle
- c. Communications to the tracking and data handling agencies during the launch.
- d. Launching and placing the payload into the desired orbit, including determination of orbital injection conditions.
- e. Preparation of a report covering the launching phase and the orbital injection conditions.

TECHNICAL STATUS - The vehicle chosen for this project was the THOR/ABLE three-stage vehicle used previously for the Lunar probes. This vehicle uses a THOR IRBM minus the guidance system as as the first stage, an aerojet AJ-10-104 liquid-fueled second stage, and the Allegheny Ballistic Laboratories solid fueld third stage. This configuration provides ample boost to place the desired 270 pound payload into a 380 nautical mile circular orbit. The orbit will have an inclination angle of 53.9 degrees. Payload function is gathering and transmitting synoptic weather information. Design of all stages and interfaces of the vehicle have been completed. Production is on schedule for the planned 2 December 1959 launch date. A very small, lightweight transponder has been designed, manufactured, and delivered to satisfy the NASA requirement for verification of orbital injection conditions. The original NASA payload constraint of the 30° North parallel point of verticality which required a "dogleg" in the second stage burning portion of the trajectory has been removed. Final shaping of a new and much more efficient trajectory is being accomplished.

PROBLEM AREAS - No problems have been encountered.



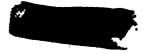




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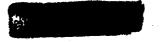
1.	ADVANCED	COMMUNICATIONS	SYSTEMS	STIDY

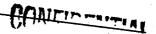
- 2. Geo-Astrophysical Program Study
- 3. Manned Satellite Intercept and Inspection
- 4. Bio-Medical Studies

Items 2, 3 and 4 require inputs to WDPCR for inclusion in next month's report.

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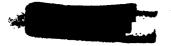


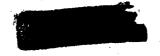




navigational and propulsion systems will be required. This study was funded with \$285,000 in Fiscal Year 1959. In addition to three funded contractors, one contractor has undertaken the study on a voluntary basis. Contractors' final reports are due at AFBMD in February 1960.

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ADVANCED SYSTEMS STUDIES

- 1. The Advanced Systems Studies Division has several space studies in progress. The purpose of these studies is to determine the military missions and mode of operation in space. For the purpose of study, space has been divided into three borad areas; earth orbital, lunar, interplanetary. Studies in the lunar and interplanetary area are being managed and directed at AFBMD: There are two studies in the Lunar area: SR 192 (U) Strategic Lunar System, and SR 183 (U) Lunar Observatory. There is one study in the interplanetary area: SR 182 (U) Strategic Interplanetary System.
- 2. The objective of SR 192 is to determine a military posture in the lunar area which is defined as the surface of the moon and the area in its surrounding gravitational field. This is a broad conceptual type study which will examine all facets of military operations such as offensive, defensive, and supporting systems. This study was funded with\$600,000 in Fiscal Year 1959 and final reports from the contractors are due at AFBMD by February 1960. In addition to the three funded contractors working on this study, there are three voluntary contractors. Consequently, the total effort being applied is estimated as equivalent to one million dollars.
- 3. An obvious military requirement in the lunar area will be a surveilance and intelligence collection system. Therefore, SR 183 (U) Lunar Observatory was initiated to examine this problem. The objective of this study requirement is to determine a sound and logical approach for establishing a manned intelligence observatory on the moon from which the entire earth and its surrounding area can be kept under continuous surveillance. All earth orbital systems can be monitored and enemy activities in space and on the lunar surface can also be watched. All possible types of sensors and their probable ranges will be examined. This study will also include the means of logistically supporting the lunar base. This study was funded with \$420,000 in Fiscal Year 1959. Three contractors were funded and three additional contractors are performing the study on a voluntary basis. Consequently, it is estimated that this study has the equivalent of a \$500,000 to \$600,000 effort being applied to it.
- 4. The interplanetary area is being studied under SR 192 (U) Strategic Interplanetary System. The objective of this study is to determine the possible military missions and the type of equipment necessary for operations in the interplanetary area. This area is being studies separately from the lunar area because the operational problems involved appear to be somewhat different, the distances are much greater; our present knowledge of the area is limited, therefore, special types of



Telemetry ships are positioned as required by the specific mission of each flight. Figures 4 and 5 show a typical launch trajectory from Vandenberg Air Force Base, and Figure 6 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 7). 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 and Air Force 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. The program launch schedule is given in Table 1, and a history of DISCOVERER flights is given in Table 2.



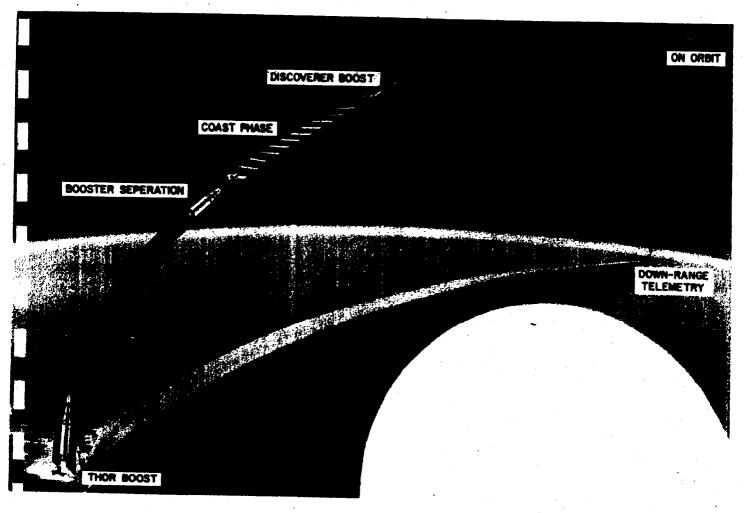
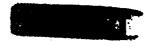


Figure 4. Typical DISCOVERER trajectory (above) from launching at Vandenberg AFB to orbit. Typical satellite orbital path around the earth (right).

Barly tests confirmed vehicle flight and satellite orbit capabilities, developed system reliability and predictability, and established ground support, tracking, and data acquisition requirements. Subsequent flights are planned to acquire scientific data for design of advanced military reconnaissance payload components. Typical data gathering objectives include: cosmic and atomic radiation, magnetic field, total electron density, auroral radiation, micrometeorite measurement, Lyman alpha from space (or stars), solar radiation, and atmosphere density (drag) and composition. A world-wide network of control, tracking, and data acquisition stations has been established. Overall operational control is exercised by the Control Center in Palo Alto, California. Blockhouse and launch operations are performed at the Vandenberg Air Force Base Control Center.







MONTHLY PROGRESS - Progress in the DISCOVERER Program during the month of August provided a high degree of confidence in the design and performance of the vehicle, payload and ground support components; and in the effectiveness of management and testing techniques employed. All objectives except capsule re-entry were achieved in the flights of DISCOVERER V on 13 August and DISCOVERER VI on 19 August. Vehicle performances, including the orbits attained, were very close to prelaunch predictions. Both satellites carried a capsule to be ejected on the 17th orbit for re-entry and recovery south of the Hawaiian Islands. Telemetry data indicate that capsule separation occurred as planned, but neither unit was detected by the recovery forces. Battery failure due to unexpected low temperatures is suspected as the cause of failure.

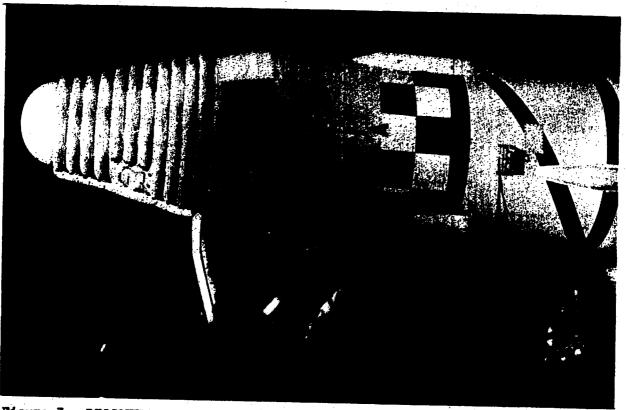
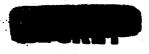


Figure 7. DISCOVERER V prior to erection on launch pad (above) and during launch preparations (top left).



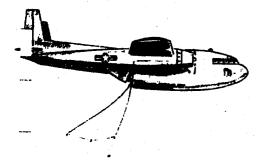
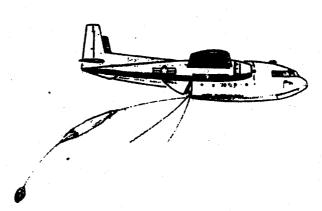
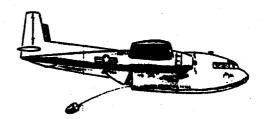




Figure 6. Air recovery technique for DISCOVERER payloads. After the capsule is ejected from the orbiting satellite it is placed on a re-entry trajectory by the - retro-rocket. At approximately 55,000 feet the parachute opens and recovery beacon starts to __ transmit. C-119 aircraft use directional finders to "home" on the recovery beacon signal to determine their intercept run. When visual contact is made the C-119s air snatch the capsule. If aircraft do not ... effect recovery surface ships in the impact area take over. Capsule recovery is the responsibility of an Hawaiian based recovery force.



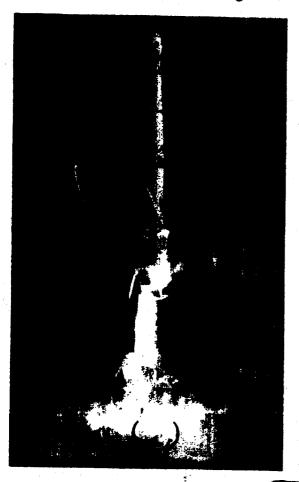


injection and vehicle reorientation to an engine-forward attitude occurred substantially as planned. Interference from other radar operations resulted in poor tracking at the Vandenberg and Point Mugu stations. Radar tracking and telemetry reception was excellent at all other stations during satellite lifetime except for intermittent difficulty with the relay command system on passes 15, 16 and 17. Except for failure to recover the capsule, all objectives were attained.

RECOVERY OPERATIONS ...

- a. Gause of Failure Since capsule recovery was the only unsuccessful objective of the past three flights, an investigation is being conducted to determine the cause or causes of failure. Present information indicates that capsule temperatures were lower than anticipated, causing failure of the battery which triggers the parachute action sequence. The vehicle was designed to maintain a temperature of approximately 70 degrees farenheit; however, some data show capsule temperatures as low as 20 degrees farenheit.
- b. Tracking Reports On both flights the Kodiak tracking station report the recoverable capsule to be in the satellite when it passed out of range on the 17th orbit. Also on both flights, Hawaii reported that ejection of the capsule had occurred before the vehicle came within radar range. The intended point of capsule separation is between the radar range of the two stations. DISCOVERER V data received from temperature sensors in the forward section of the satellite indicated that a marked temperature rise occurred between Kodiak and Hawaii, establishing that the capsule retro-rocket fired. A similar temperature rise was not noted on DISCOVERER VI, but the retro-rocket could have fired without affecting the temperature sensors.
- c. Recovery Forces During both flights the recovery forces were deployed properly in relation to the expected impact point. DISCOVERER V orbital calculations resulted in a shift of the impact point 88 nautical miles to the north. Only the aircraft forces were able to redeploy completely prior to the expected time of parachute descent. At and after the expected time of parachute opening, scattered radar and acquisition beacon contacts were reported by the Hawaiian station, one of the ships, and one of the aircraft, but none of these contacts were ascertained to be the descending capsule. Difficulty with the DISCOVERER VI radar command timer adjust system moved the predicted impact point 360 nautical miles south. Only the RC121 aircraft were able to reach the jarea in time. No signals

DISCOVERER V - After five launch cancellations on previous days, caused primarily by unfavorable weather, the final countdown began at 0800, 13 August, and the vehicle was launched at 1200 PDT from Vandenberg Air Force Base. The first stage THOR boost and resulting coast trajectories were slightly higher than anticipated and the launch azimuth was about one-tenth of a degree east of that planned. Performance of the AGENA propulsion system was slightly below nominal. The AGENA vehicle was placed into an orbit closely approximating the planned orbit. The nose aft reorientation of the satellite vehicle occurred as planned, after burnout of the second stage AGENA propulsion system. During the entire active life of the vehicle all ground stations reported excellent tracking and data acquisition when the satellite was within range. At one



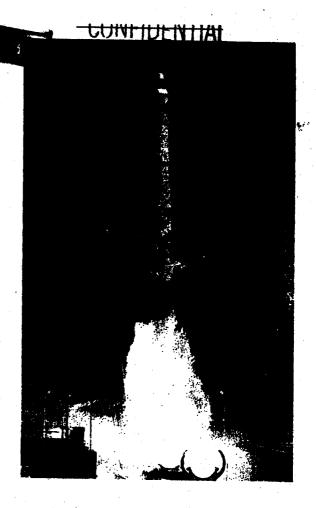
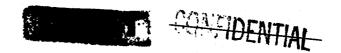


Figure 8. DISCOVERER V (above) at liftoff from Vandenberg Air Force Base launch pad. DISCOVERER VI (left) during launch (note that white paint has been removed from nose cone).

time all four stations were tracking the vehicle simultaneously, demonstrating a radar range in excess of 1,000 miles. Except for failure to recover the capsule all primary and secondary objectives were achieved.

DISCOVERER VI - Launching occurred at 1225 FDT, 19 August, from Vandenberg Air Force Base. The first stage boost trajectory was about 5.4 degrees west of the planned 170 degrees and, as on four of the five previous flights, the boost and resulting coast trajectories were slightly high. Separation, coast, orbital



SIGNIFICANCE OF LAUNCHES - The signal successes achieved by the flight tests of DISCOVERERS V and VI provides reassurance to: (a) the validity of the basic design and engineering used in program development and, (b) the validity of progressive and continuing test procedures and resultant modifications. The former is emphasized by the reliability with which predicted performance parameters have been attained so early in a program which was planned to be a gradual development from the simple to the complex. The latter is a demonstration of the value of flexible scheduling in accordance with current requirements. The slight delay in the launching of DISCOVERERS V and VI to permit a thorough evaluation of the slightly less than nominal performances of DISCOVERERS III and IV proved well spent in the light of this months successes. This is the largest, most advanced, true satellite vehicle ever launched by the United States, and the only fully guided and stabilized satellite.

FUTURE PLANS ...

- a. Two flight vehicles are at Vandenberg Air Force Base undergoing pre-launch checking. Launch of DISCOVERER VII is scheduled tentatively and the pre-launch checking.
- b. Vehicle 1055 was successfully hot fired at Santa Gruz Test Base on 20 August, and vehicle 1053 was installed in test stand No. 2 on 18 August. Instrumentation hookup and mechanical preparation for hot firing are in progress. Vehicle 1056 is scheduled for hot firing on 21 September. Vehicle 1057 arrived at SCTB on 21 August and is undergoing receiving inspection.
- c. Vehicle 1058 is undergoing engine thrust alignment at the Modification and Checkout Center in Palo Alto, California.





BOOSTER-ATLAS ICEM SECOND STAGE-Engine -- MA-2 Engine AGENA 2 Weight—Wet 15,101 Weight-Wet (lbs.) 1,450 Fuel, RP-1 74,900 Fuel (UDMH) 3,800 Oxidizer (LOX) 172,300 Oxidizer (IRFNA) 9,600 GROSS WEIGHT (lbs.) 262,820 GROSS WEIGHT (Ibs.) 14,850 Thrust Thrust lbs. (vac.) Boost 360,600 lbs. (vac.) 15,500 lbs. (vac.) Sustainer 56,730 Spec. Imp. (vac.) 277 Spec. Imp. (sec.) Burn time (sec.) 240 sec. (vac.) Boost 286 Engine -- MA-2 (vac.) Sustainer 310 NOSE CONE AGENA VEHICLE

FUEL AND

OXIDIZER

SEPARATION

PLANE

HELIUM SPHERES

ENGINE (UDMH) .

MITROGEN

SPHERE

ULLAGE ROCKETS

TANK SECTION

CIF

ATLAS

BOOSTER-

AGENA 1 1,400

1,900 4,800 8,100

15,500 277 115 sec.

SAMOS PROGRAM HISTORY -SAMOS Program was included in Weapon System 117L when WS 117L was transferred to the Advanced Research Projects Agency in May 1958. ARPA subsequently separated WS 117L into the DISCOVERER, SAMOS, MIDAS Programs with the SAMOS objectives based on a visual and ferret reconnaissance system.

PROGRAM MISSION - The primary mission of the SAMOS advanced reconnaissance system is to provide continuous visual, electronic (and other) surveillance of the USSR and satellite nations. Efforts include development of hardware to permit:

CANCIDENTIA

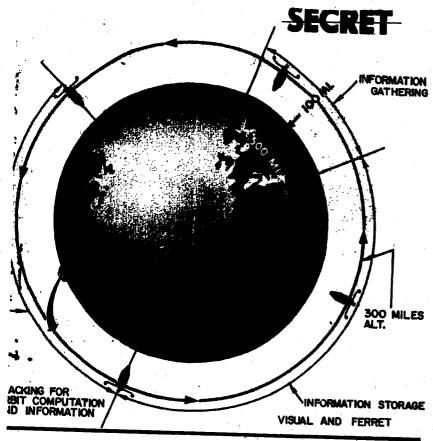


Figure 3. Schematic of SAMOS system in operational orbit. When the satellite is over unfriendly territory the sensing equipment is turned on (Information gathering). When it leaves unfriendly territory the sensing equipment is turned off and the sensing data is processed (Information storage). When the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

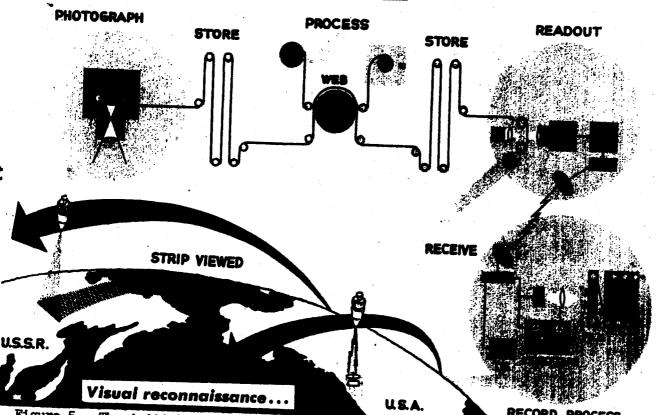


Figure 5. The initial visual reconnaissance program will use conventional photo techniques with automatic film processing and TV-type electronic image readout to ground stations thru a data link. Ground electronics will reconvert the signal into photo image form, with a capability of resolving objects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

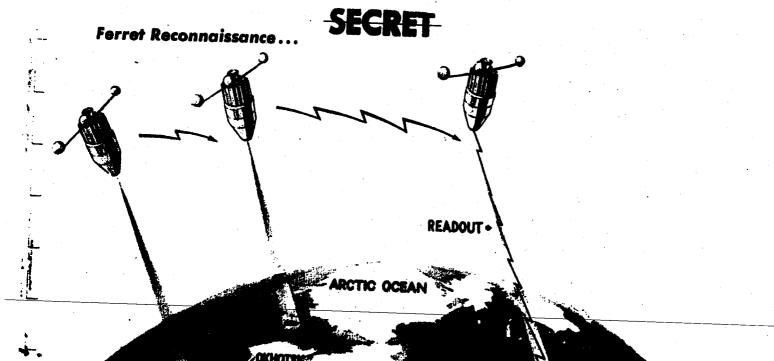
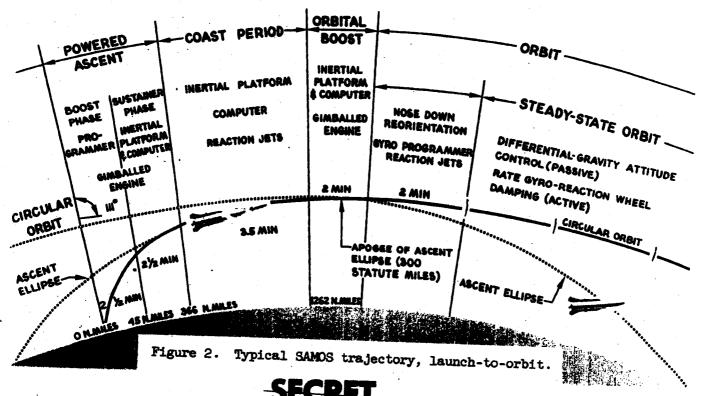


Figure 4. The Ferret reconnaissance system will gather data from radiations in the region of the electromagnetic spectrum between 30 to 40,000 mc/sec. This data will be stored, filtered, indexed, and reconverted into an appropriate electrical signal for transmission to ground. The System also includes ground-based equipment for inflight calibration and vehicle equipment adjustment, evaluation of equipment performance, and data decoding.

BERING SEA

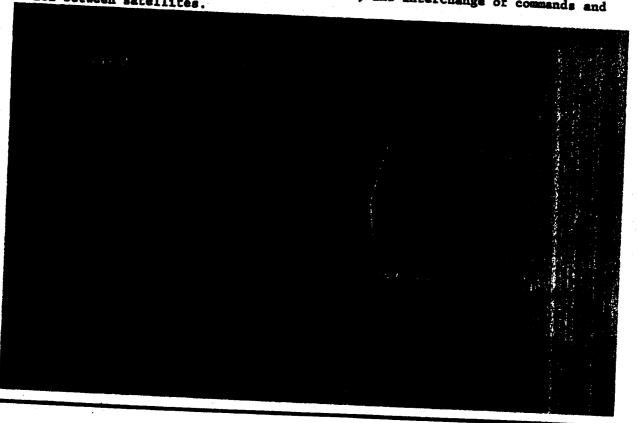
JAPAN





- PONCHDENTIAL

Figure 6. MIDAS relay concept, showing reception of commands and transmission of data between satellite and ground station; and interchange of commands and data between satellites.



- a. Terrain and mapping photographic coverage.
- b. Determination of characteristics of enemy electronic emissions.
- c. Verification of known targets, detection of unknown targets.
- d. Location and evaluation of defenses.
- e. Evaluation of military and industrial strength.
- f. Assessment of high-yield weapons damage.
- g. Reconnoitering of troop movements.
- h. Location of naval forces throughout the world.
- 1. World-wide weather and cloud-cover data.

The reconnaissance equipment will be housed in the AGENA satellite vehicle (Figure 1), and successfully flight tested in the DISCOVERER Program. During the Development phase a dual-capability visual and ferret payload will be developed for economical test of components. In the operational phase each satellite vehicle will carry only the visual or the ferret payload. The system is composed of the satellite vehicle, ICBM booster, launch facilities, tracking facilities, and a communications and data processing network.



SIMULATED PHOTOGRAPHY FROM SATELLITE VEHICLE

36 INCH LENS

SCALE - 1:60,000

1 MILE

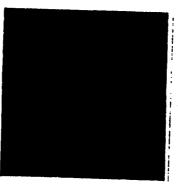
LENS - 36" FOCAL LENGTH ALTITUDE-300 STATUTE MILES FILM - EASTMAN F5740-6 EXPOSURE- 1/100 SEC. AT F/2.8 CONTRAST RANGE - 4:1



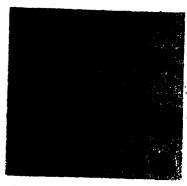
1:528,000

CONTACT PRINT **ILLUSTRATING** SCALE OF IMAGE 100 MILES

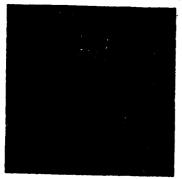
17 MILES



9 X ENLARGEMENT



300 X ENLARGEMENT



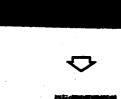
SIMULATED PHOTOGRAPHY FROM SATELLITE VEHICLE

E INCH LENS

SCALE - 1:60,000

1 MILE

LENS - 6" FOCAL LENGTH ALTITUDE-300 STATUTE MILES FILM - BASTMAN F5740-6 EXPOSURE- 1/100 SEC. AT F/2.8 CONTRAST RANGE - 4:1

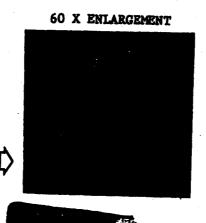


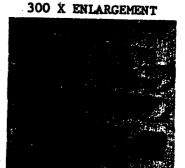


CONTACT PRINT ILLUSTRATING SCALE OF IMAGE

100 MILES

1:3,168,000 CONFIDENTIAL





FILM IMAGE READOUT - 6 INCH LENS







ORIGINAL SCENE

FILM IMAGE IN SATELLITE

IMAGE RECORDED ON GROUND

CONCEPT - In the operational SAMOS Program AGENA satellite vehicles will be boosted into polar orbits from Vandenberg Air Force Rase by Series D ATLAS missiles (Figure 2). Injection into near-circular orbits, or varying altitudes, will be accomplished by the AGENA (Bell-Hustler) power plant. The satellite will be stabilized in attitude by a satellite-contained guidance system utilizing a horizon reference scanner. As the satellite continues in an orbit essentially fixed in space, completing an orbit in about 90 minutes, the earth rotates inside the orbit (Figure 3). As a result, each successive orbit will be displaced approximately 22½ degrees at the equator, permitting a single vehicle to observe the entire earth versions will have a useful life in the order of ten to thirty days. Later versions are expected to exceed one year of useful life.

TECHNICAL HISTORY -

- a. Visual Program The development of the payload camera, inflight film processor, and readout data link were undertaken by Eastman Kodak Company. Cameras with 36, 20, and 6 inch focal length lenses have been developed and the first flyable visual reconnaissance package has been assembled. This package includes automatic film processing equipment, film transport and take-up, and temperature controls.
- phases. The F-l payload was assembled using a maximum of off-the-shelf components for early availability. The F-2 payload is being designed for maximum performance. The F-l payload has undergone extensive flight testing, mounted in an aircraft, over U.S. radars. The results have been excellent.





PROGRAM PROGRESS DURING AUGUST

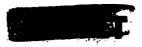
a. <u>Visual Reconnaissance</u>

- (1) Component testing and final assembly of the Visual Reconnaissance (E-1) prototype payload were completed and final acceptance testing is scheduled to begin in September. The B-2 Engineering Model Payload readout equipment was assembled, tested and operated successfully as a complete system. This system was connected to the ground reconstruction electronics, via the data link simulator, and a final reassembled film record was obtained. Fabrication of the first flyable E-2 Prototype Payload is 50 percent complete.
- (2) E-1/E-2 Ground System Operating Equipment, Assembly of the prototype ground reconstruction electronics equipment (GRE) was completed and auxiliary GRE equipment is undergoing test and modification. The E-1/E-2 proto-acceptance tests. The prototype primary record processor is complete and acceptance tests are underway.
- (3) Final versions of the subsystem specifications for all E-1 airborne and ground equipment were completed by the contractor and will be submitted to AFBMD.

b. Ferret Reconnaissance

- (1) The Ferret (F-1) Reconnaissance vehicle equipment (Figure 7) to be flown with the E-1 payload was completely assembled, aligned and checked out. Final systems test with the ground checkout equipment are nearing completion. Testing of bands 1 and 2 antennas was completed and testing of band 3 antenna
- (2) Fabrication of the F-2A Prototype Payload assembly and sub-assemblies is complete except for bands 1 and 2 receivers, and the power and control unit testing has been started. Component fabrication of the F-2 pro-of components is 40 percent complete. Final assembly of the service test model (Figure 8) console was completed on 21 August and system testing is 50 percent complete. Work on the F-2B and F-3 Prototype Payloads is progressing satisfactorily in relation to all schedules for the F-1 portion of the program.
- (3) Inhibit action tests were continued on the first service test model F-1 payload. Results of band 1 tests are being evaluated and band 2 tests are in progress. The second service test model was tested in the high altitude temperature simulator. Test results are being analyzed to determine the most desirable range of skin temperatures for optimum equipment temperature on orbit. The proper temperature can then be obtained by design of skin coatings.

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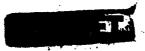




- c. <u>Communications</u> Checkout of the first command package prototype for the Command Decoder-Sequencer Programmer was completed. Three of the planned five or six memory units were complete, and a fourth is 70 percent complete. Unit 1 of the clock package has undergone successful bench checkout, temperature test, and operational test in the high altitude temperature simulator chamber. The intermediate storage unit mockup is complete and ready for checkout.
- d. <u>Facilities Construction</u> Excellent progress is being made at the New Boston Tracking and Data Acquisition Station. The walls of the UHF Receiver Building are up, the Angle Tracker Building is nearly complete, and work has begun on the Data Acquisition and Processing Building.

e. <u>Technical Studies</u>

- (1) A study of the possible use of a wide angle lens for cloud photography on the E-1 Payload indicated a high degree of feasibility. The capability of photographing a 300-mile wide swath (with a ground resolution of 400 feet) could be incorporated in the first flyable E-1 components test
- (2) More advanced electronic reconnaissance systems, capable of providing answers to specific intelligence requirements, are being developed under the F-4 Program. Development continued on the parameter selector, intrapulse f-m detector, the improved pulse width shaper, and the multifrequency sequential signal detector.
- (3) An operational analysis was made of the ratio of readout to readin time to determine what percent of time over potential enemy territory could be usefully recorded without overtaxing readout capabilitites. The use of Vandenberg AFB, Ottumwa, and New Boston for readouts would permit approximately a 75 percent readout to readin ratio.
- (4) Reliability requirements for the auxiliary power specifications were written, and a detailed study of the specifications for the proportional



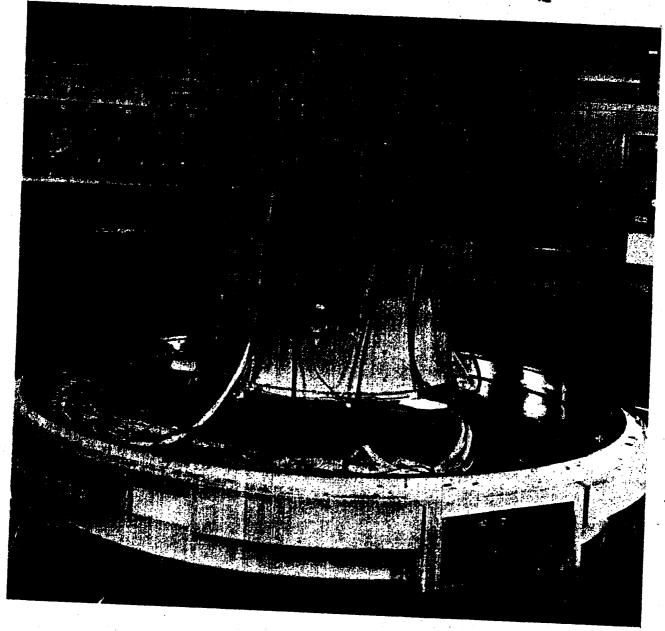


Figure 7. Ferret (F-1) psyload Service Test Model prior to environmental testing in the high altitude temperature simulator. The coupler for checking out the antenna is shown mounted on the antenna structure.



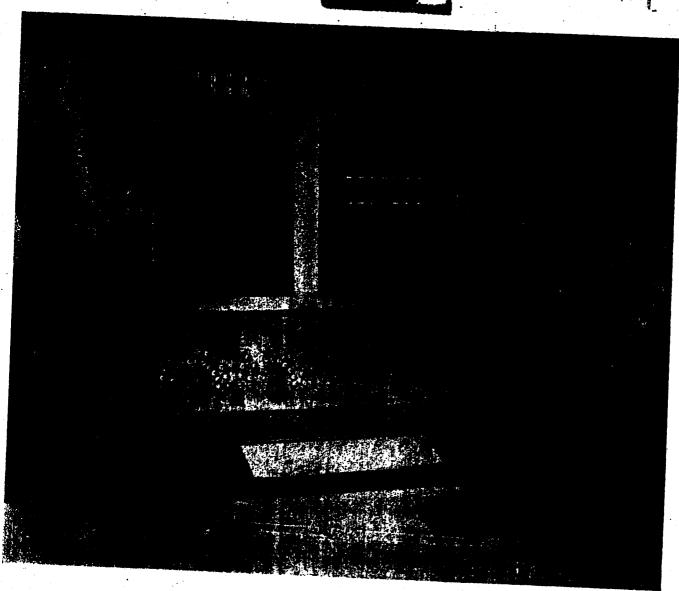
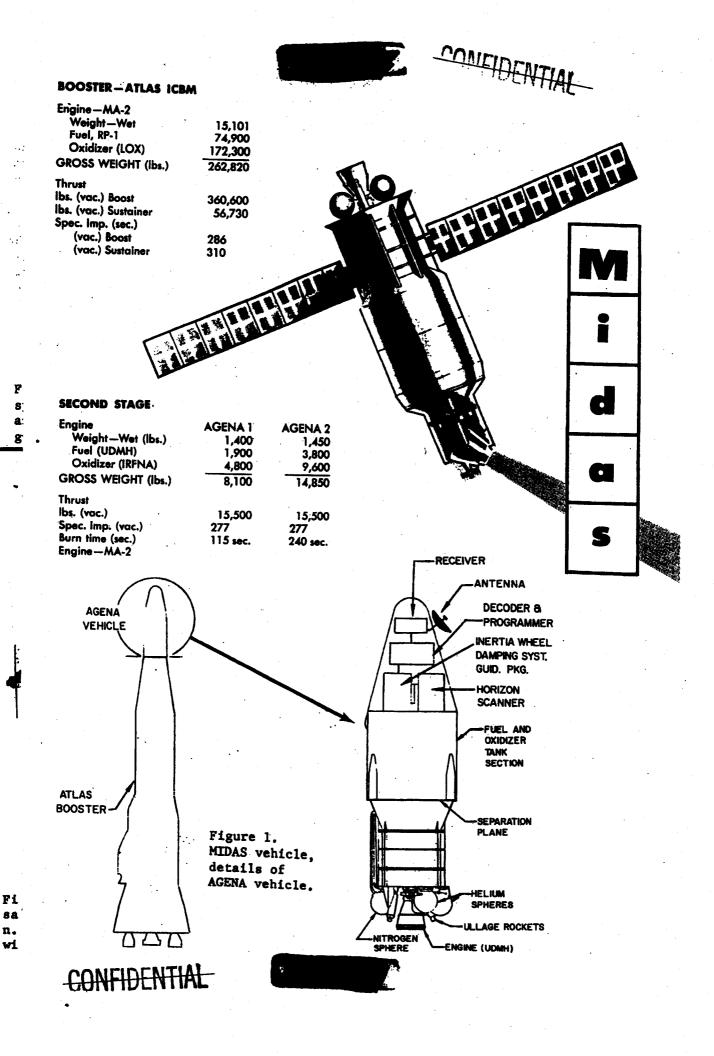
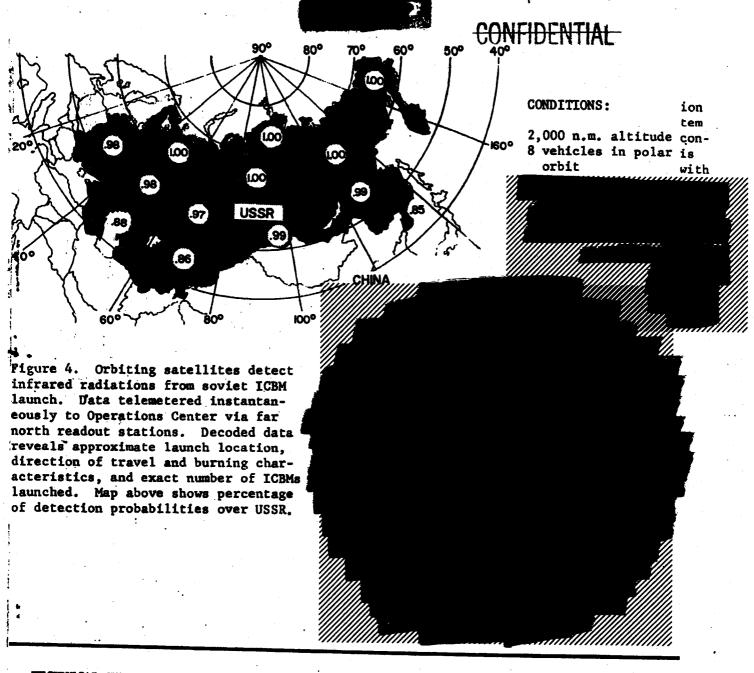


Figure 8. Mockup of the Ferret (F-2) command console panel configuration.

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TECHNICAL HISTORY - The original WS 117L program encompassed a Military Satellite reconnaissance system gathering infrared, ferret, and visual intelligence through interchangeable payloads engineered to utilize a standard booster/satellite vehicle configuration. This configuration consists of a "D" Series ATLAS missile as the first stage and the AGENA vehicle, powered by the Bell-Hustler rocket engine, as the second, orbiting stage. Refinements to the AGENA vehicle will be made as a result of the DISCOVERER flight test program. The program for development of the infrared payload has progressed to the assembly of the first flight article, installation in the AGENA vehicle, and initiation of checkout operations. A silicon-barrier solar auxiliary power unit has been developed, fabricated, and will be flight tested on the first two flights. The third major component of the payload, the communications package, has also been designed, fabricated, and tested. The total payload weight has been determined to be 1,014 pounds. The ATLAS/AGENA configuration with single restart capability and large propellant tanks can place a payload of 1,500 pounds on 2,000 nautical mile altitude polar orbit (See Figure 2).

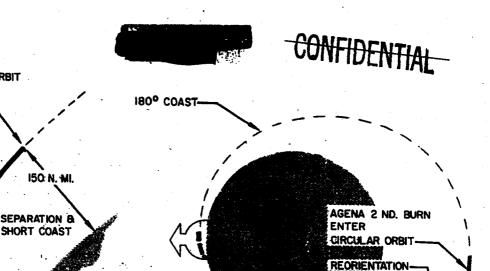
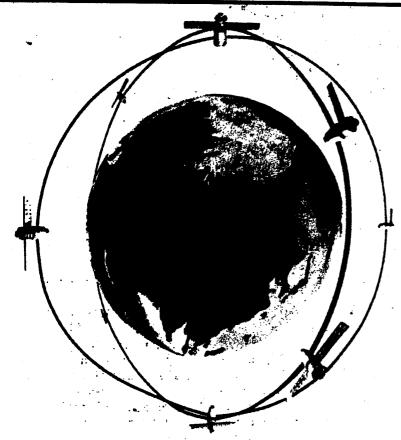


Figure 2. Launch-to-orbit trajectory. Optimum ATLAS boost guided by radio inertial system. AGENA ascent (coast, burn, coast, second burn) provides attitude reference and governs velocity magnitude and direction by horizon scanner monitored inertial guidance system. Orbital attitude maintained by reaction wheel and gas jets.



SUSTAINER

ENTER ELLIPTICAL ORBIT

PERIGEE OF

VERNIER.

AGENA IST. BURN-

COAST ELLIPSE

Figure 3. Proposed MIDAS system. Four equidistant satellites in each of two orthogonal planes at 2000 n.m. altitude. Provides maximum goverage of USSR with minimum number of satellites.

MIDAS PROGRAM HISTORY - The Air Force initiated studies toward the use of infrared sensing equipment aboard satellite vehicles for missile detection early in 1956. The studies were undertaken as part of Weapon System 117L by the Lockheed Missile and Space Division. In May of 1958 the programs encompassed by WS 117L were transferred to the newly established Advanced Research Projects Agency. After several reorientations the programs formerly included in WS 117L were separated into the DISCOVERER, SENTRY and MIDAS programs. The MIDAS (Missile Defense Alarm System) Program was directed by ARPA Order 38-59 dated 5 November 1958. Prime contractor is the Lockheed Missile and Space Division. Development activities now underway will lead to the first flight of a ten-flight R&D program starting late in 1959, with operational buildup commencing in July 1961. An established and reliable system is programmed for January 1962.

2000 N. MI.



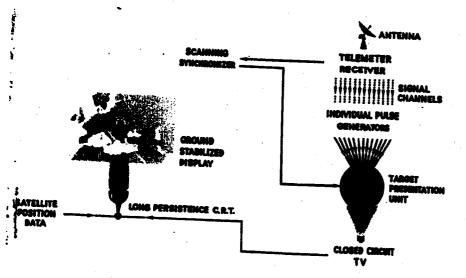
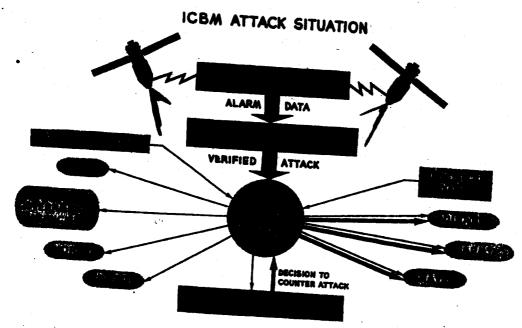


Figure 5. Simplified version of ground presentation system for display of infrared reconnaissance data. The data is displayed on a TV monitor with a map overlay. The chart below shows data flow from the readout stations to decision-making agencies. The Control Center determines when a signal is an actual attack. The decision to counterattack is made by the president, with all affected agencies reacting as planned.



CONCEPT - The MIDAS Program system is designed to provide continuous infrared reconnaissance of the Soviet Union. Surveillance will be conducted by the accurate positioning of eight satellite vehicles in orbit as shown in Figure 3. The area under surveillance must be in line-of-sight view of the scanning satellite, while nitude of infrared radiation. The MIDAS System scanning sensitivity and magnitude of infrared radiation. The MIDAS System is designed to accomplish instantaneous readout of acquired data by at least one of three strategically located Control Center where it is processed, displayed, and evaluated (Figure 5). If an attack is determined to be underway, the intelligence is communicated to a central retaliatory and defense agencies. The decision to counterattack is made by the president of the United States, with retaliatory Forces reacting only in response assessment. MIDAS mission capabilities are shown in Figure 4.



PROGRAM PROGRESS DURING AUGUST

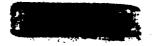
- a. A reliability study of the first vehicle (Figure 6) has been initiated and weight factors have been completed in detail. On 24 August the infrared scanner payload package was mated with the first flight vehicle and alignment was accomplished successfully. Modification and checkout of this vehicle is now 80 percent complete, with delivery to Santa Cruz Test Base (Figure 14) scheduled for 4 September. Work on subsequent flight vehicle continues essentially on schedule, with the second vehicle scheduled to enter modification and checkout on 22 September.
- b. Work statements for infrared reconnaissance situation display consoles (Figures 7 through 11) have been submitted to subcontractors for bids. Six units of two types are requested for delivery by September 1960. Display consoles will be used to monitor data as it is transmitted; and summary display consoles, having all the features of the data display units, will have the additional capability of evaluating and summarizing incoming data for display. These units will replace the analog display systems developed during the early stages of the program, permitting the entire system to be dirven digitally by means of the computed equipment. These consoles will meet the later developmental and early operational system requirements.

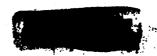


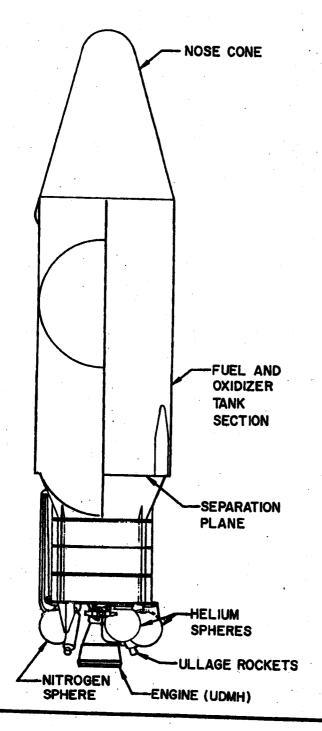
Figure 6. First Flight Test Vehicle, 80 percent complete.

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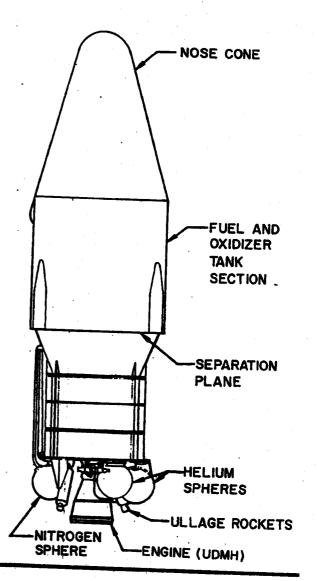








AGENA



AGENA 2

 Weight - Wet (1bs)
 1,450

 Fuel (UDMH)
 3,800

 Oxidizer (IRFNA)
 9,600

 GROSS WEIGHT (1bs)
 14,850

CONFIDENTIAL

AGENA 1

Weight - Wet (1bs) Fuel (UDMH)	1,400
Oxidizer (IRFNA)	1,900 4,800
GROSS WEIGHT (1bs)	8,100



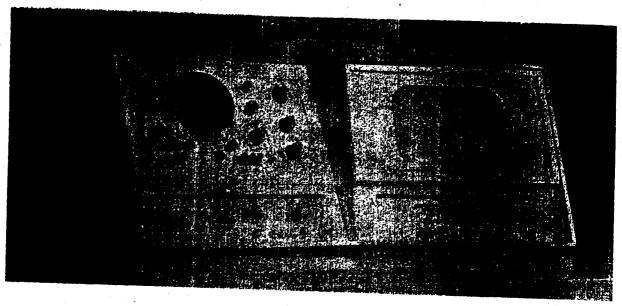


Figure 9. Ground Display Console, with television monitor on left and "A" scope on right.

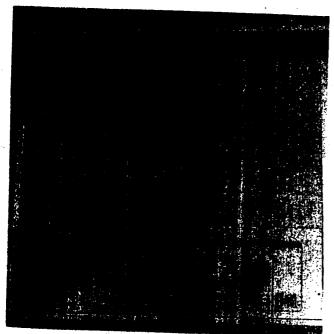


Figure 10. GROUND DISPLAY "A" SCOPE-monitors 7 of the 8 encoder outputs, the condition of the 27 signal channels, and the index signals. Key voltages, etc., and the detector cell bias, preamplifier and amplifier voltages, etc., will be monitored at the console.

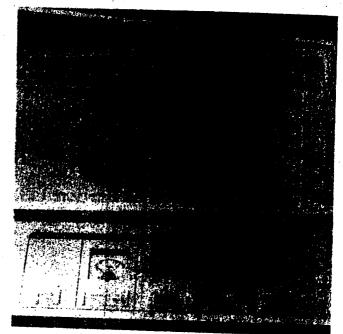
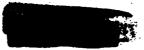


Figure 11. TELEVISION MONITORING CONSOLE which includes the monitoring screen, TV adjustments, command control activating switches and presentation time adjustments. The TV image consists of moving "asterisks" of light. Scaled maps placed over the screen are used to determine the position and movement of satellite detected targets.





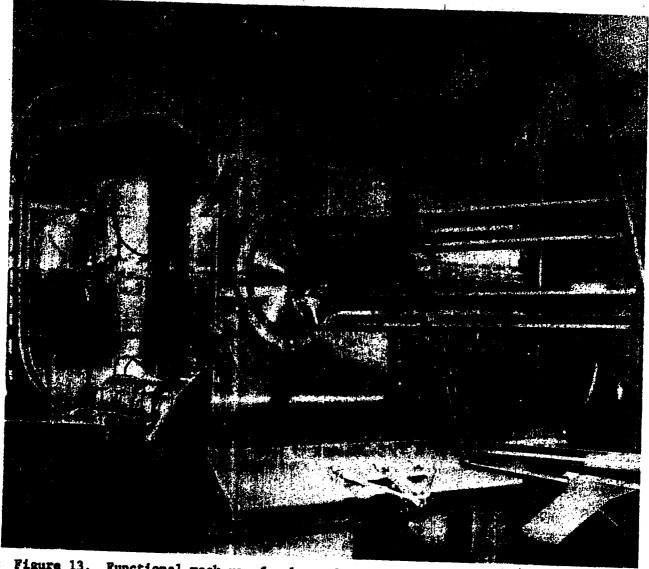
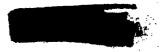


Figure 13. Functional mock-up of solar collector assembly for MIDAS flights 3 and 4, showing solar array extension and orientation systems.

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c. After the new high-precision gears were installed on the azimuth drive, the first scanner unit (Aerojet-General) was tested (Figure 12) and the desired constant rate of rotation obtained. Development work at Infrared Industries, Inc. has been extended to include an investigation of the performance of lead sulfide detectors at temperatures down to -80 degrees C. The investigation was initiated because of the low temperatures obtainable through use of passive cooling techniques.

d. The timer-period display for the vehicle command control console and panel were reviewed. It has been recommended that a direct digital period display be substituted for the proposed frequency display and that the step command counting system be controlled by step command control rather than by a separate control.





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WDPCR-74





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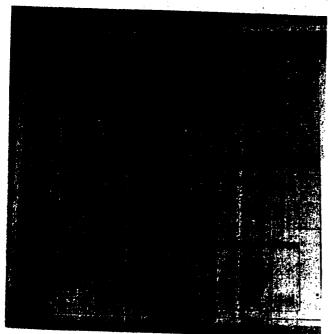
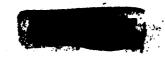


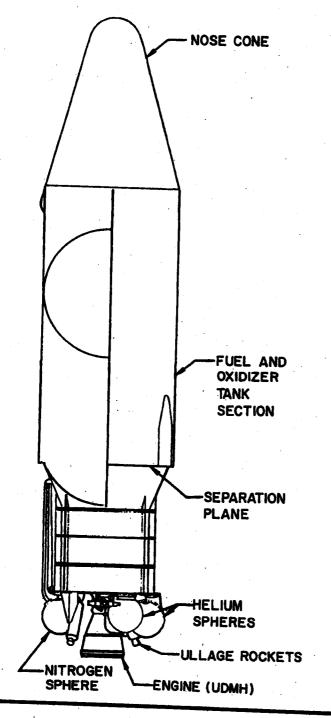
Figure 10. GROUND DISPLAY "A" SCOPE-monitors 7 of the 8 encoder outputs, the condition of the 27 signal channels, and the index signals. Key voltages, etc., and the detector cell bias, preamplifier and amplifier voltages, etc., will be monitored at the console.



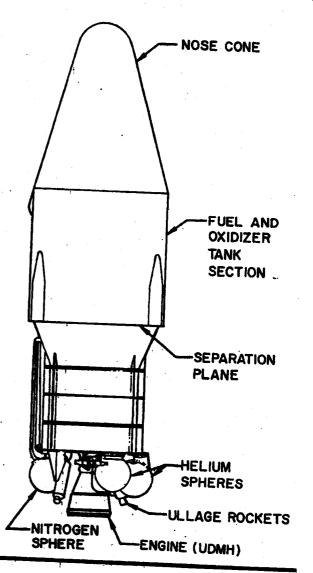
Figure 11. TELEVISION MONITORING CONSOLE which includes the monitoring screen, TV adjustments, command control activating switches and presentation time adjustments. The TV image consists of moving "asterisks" of light. Scaled maps placed over the screen are used to determine the position and movement of satellite detected targets.







AGENA



AGENA 2

Weight - Wet (1bs) 1,450
Fuel (UDMH) 3,800
Oxidizer (IRFNA) 9,600
GROSS WEIGHT (1bs) 14,850

CONFIDENTIAL

AGENA 1

Weight - Wet (1bs) 1,400
Fuel (UDMH) 1,900
Oxidizer (IRFNA) 4,800
GROSS WEIGHT (1bs) 8,100

- **4.** 35



PROGRAM PROGRESS DURING AUGUST

- a. A reliability study of the first vehicle (Figure 6) has been initiated and weight factors have been completed in detail. On 24 August the infrared scanner psyload package was mated with the first flight vehicle and alignment was accomplished successfully. Modification and checkout of this vehicle is now 80 percent complete, with delivery to Santa Cruz Test Base (Figure 14) scheduled for 4 September. Work on subsequent flight vehicle continues essentially on schedule, with the second vehicle scheduled to enter modification and checkout on 22 September.
- b. Work statements for infrared reconnaissance situation display consoles (Figures 7 through 11) have been submitted to subcontractors for bids. Six units of two types are requested for delivery by September 1960. Display consoles will be used to monitor data as it is transmitted; and summary display consoles, having all the features of the data display units, will have the additional capability of evaluating and summarizing incoming data for display. These units will replace the analog display systems developed during the early stages of the program, permitting the entire system to be dirven digitally by means of the computed equipment. These consoles will meet the later developmental and early operational system



Figure 6. First Flight Test Vehicle, 80 percent complete.

WDPCR-74



