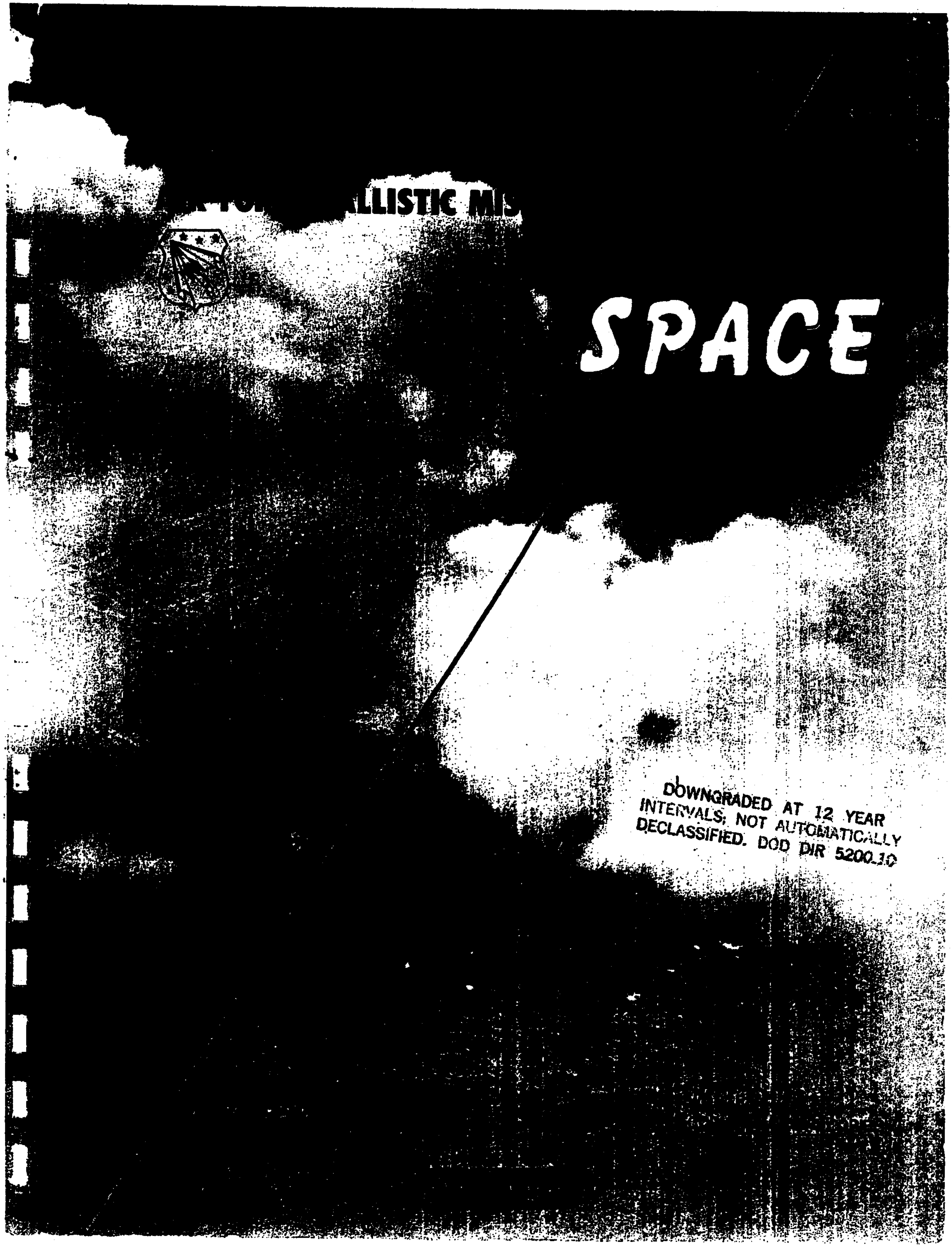

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SPACE

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.

R D Curtin

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

WDPCR-74

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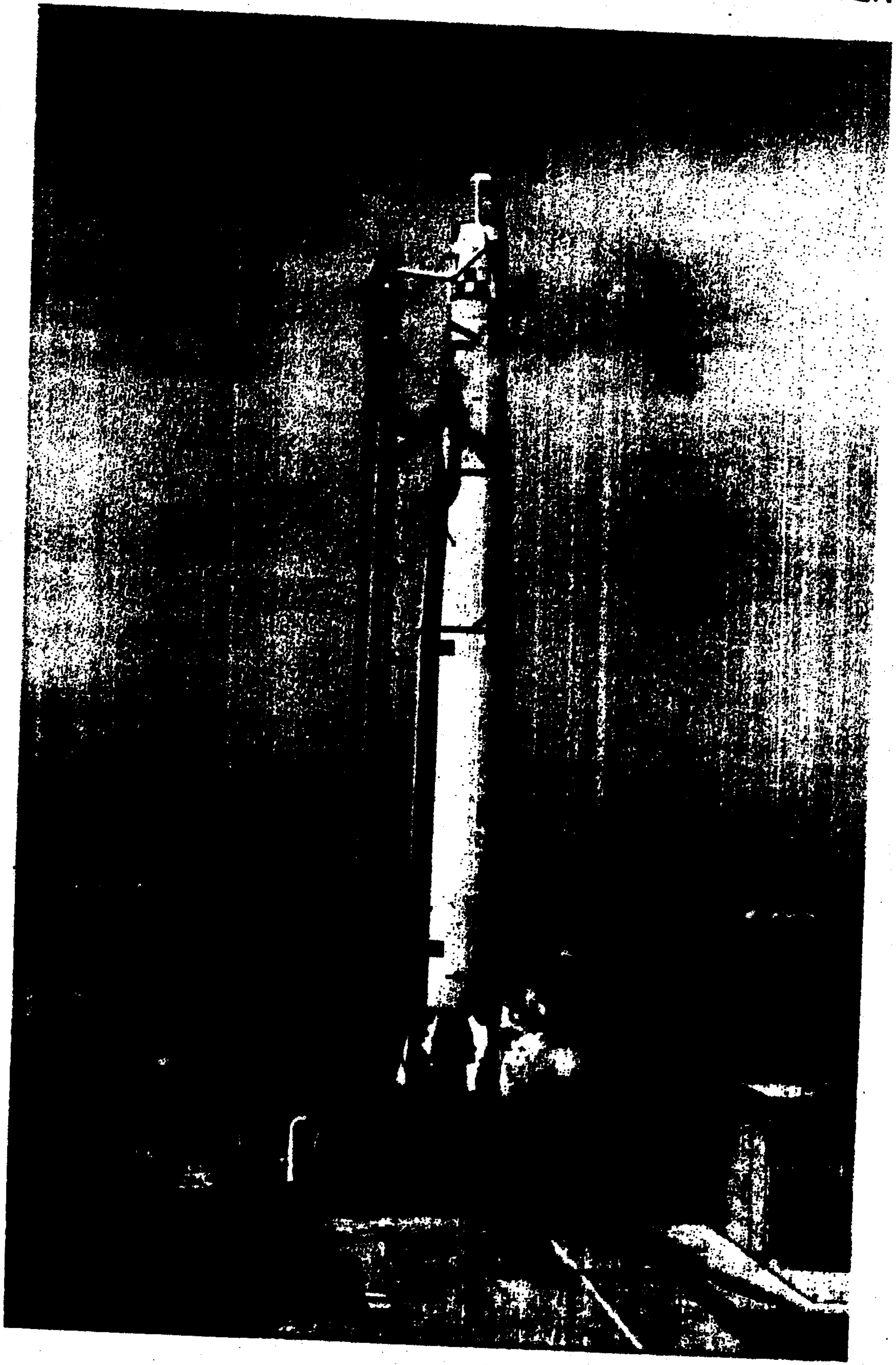
To be included in next month's report.

Inputs needed on items 13 through 18.



Discoverer

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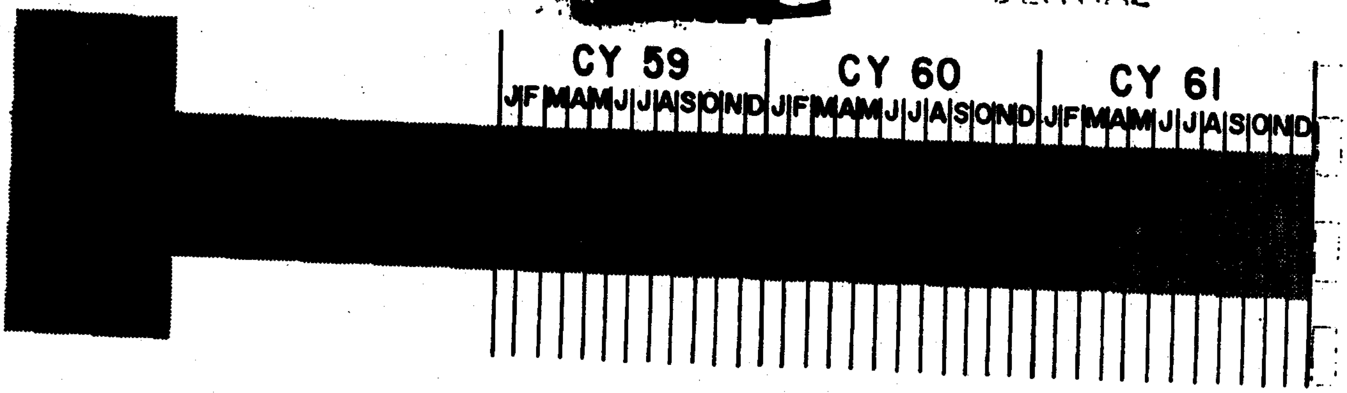
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Flight History

DISCOVERER No.	Vehicle No.	THOR No.	Flight Date 1959	Remarks
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	1019	174	3 June	Launch, ascent, separation, coast and orbital boost successful. Failed to achieve orbit because of premature satellite engine shutdown.
IV	1020	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.

Actual launched

VII	1025	1051	206		
VIII	1028	1050	212		
IX	1051	1052	218		
X	1050	1054	223		
XI	1052	1055	231	234	
XII	1054	1053	234	160	originally used for 1st try 1.21-59
XIII	1055	1057	237	231	
XIV	1053	1056	241	237	
XV	1056	1058	246		
XVI	1057	1061	253		
XVII	1058	1062	258	297	
XVIII	1061	1103	261	296	

NOTE TO WDZSD-WDZF: Please update vehicle and THOR serial numbers.

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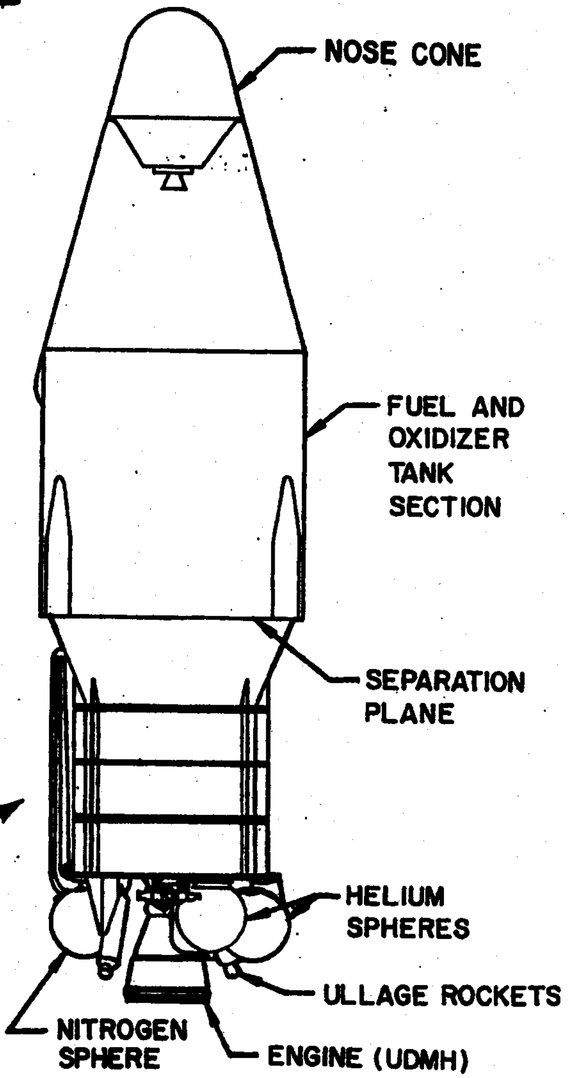
BOOSTER—THOR IRBM

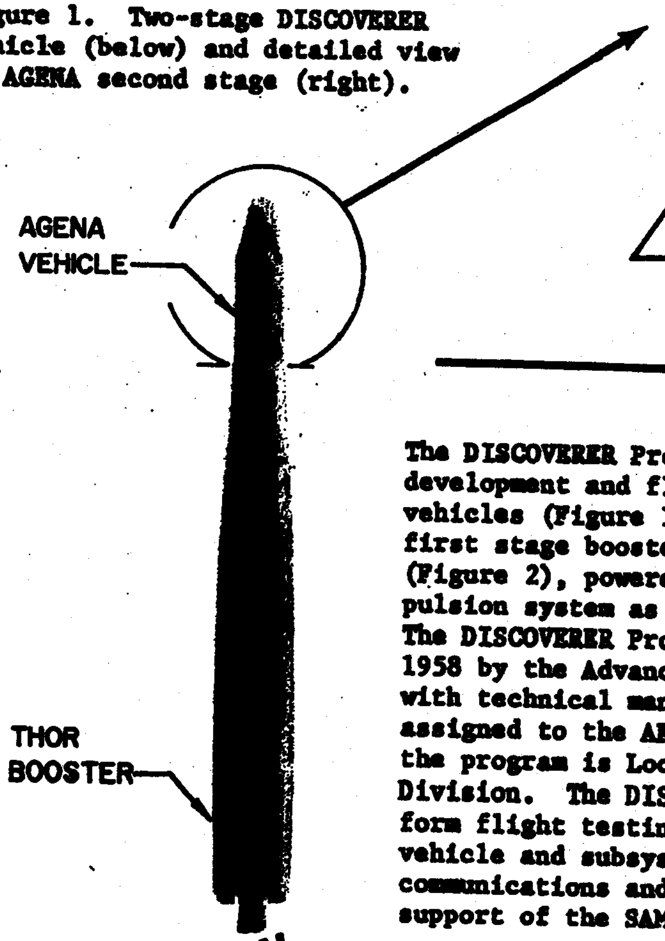
Engine MB-3	RP-1 Fuel	RJ-1 Fuel
Weight—Wet	9,100	109,500
Fuel	29,400	32,800
Oxidizer (LOX)	67,600	67,600
GROSS WEIGHT (lbs.)	106,100	109,500
Thrust		
lbs. (vac.)	177,800	177,800
Spec. Imp. (vac.)	289.2	289.2
Burn time (sec.)	157 sec.	157 sec.

SECOND STAGE

Engine	AGENA 1	AGENA 2
Weight—Wet (lbs.)	1,400	1,450
Fuel (UDMH)	1,900	3,800
Oxidizer (IRFNA)	4,800	9,600
GROSS WEIGHT (lbs.)	8,100	14,850
Thrust		
lbs. (vac.)	15,500	15,500
Spec. Imp. (vac.)	277	277
Burn time (sec.)	115 sec.	240 sec.
Engine—MA-2		

Figure 1. Two-stage DISCOVERER vehicle (below) and detailed view of AGENA second stage (right).





The DISCOVERER Program consists of the design, development and flight testing of 29 two-stage vehicles (Figure 1), using the THOR IRBM as a first stage booster and the AGENA vehicle (Figure 2), powered by the Bell-Hustler propulsion system as the second stage satellite. The DISCOVERER Program was established in May 1958 by the Advanced Research Projects Agency, with technical management responsibility assigned to the AFBMD. Prime contractor for the program is Lockheed Missile and Space Division. The DISCOVERER Program will perform flight testing of the AGENA satellite vehicle and subsystems, and test the ground communications and tracking network in support of the SAMOS and MIDAS Programs.

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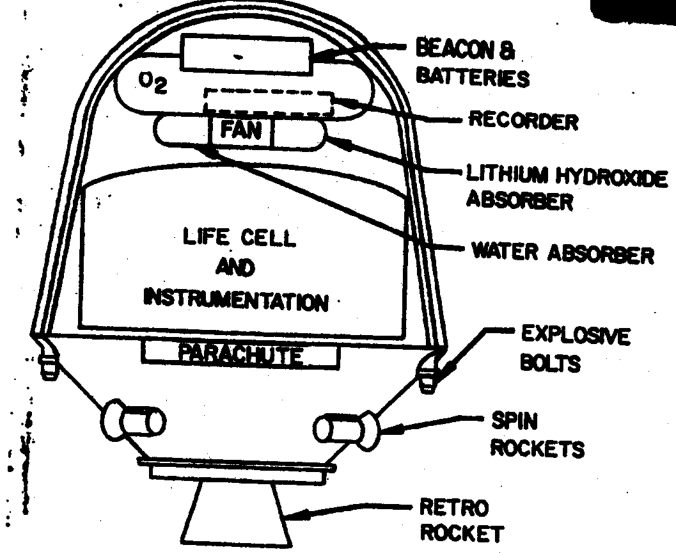


Figure 2. Schematic drawing of typical bio-medical recovery capsule. The Mark I capsule is designed to carry mice and the Mark II to carry small primates.

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.

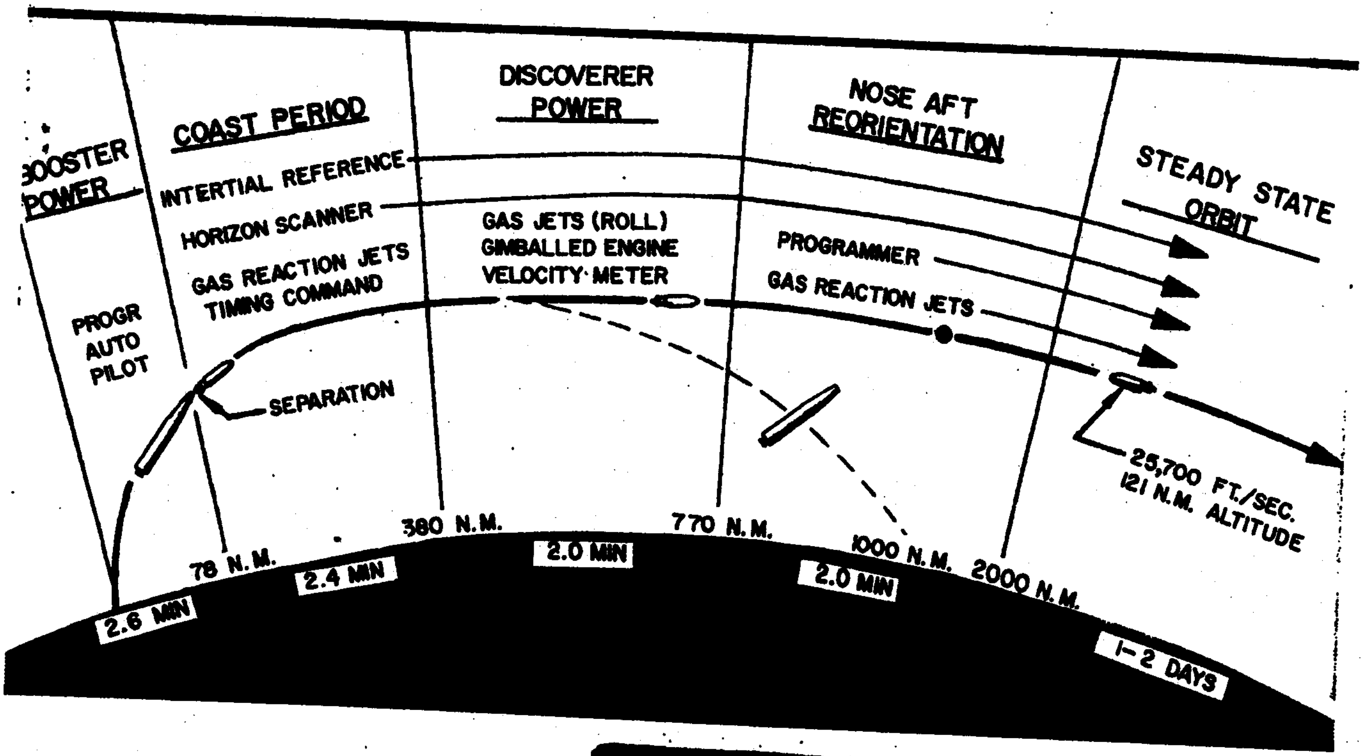
(c) Obtaining satellite internal thermal environment data.

(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).

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



5. 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 ICBM 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

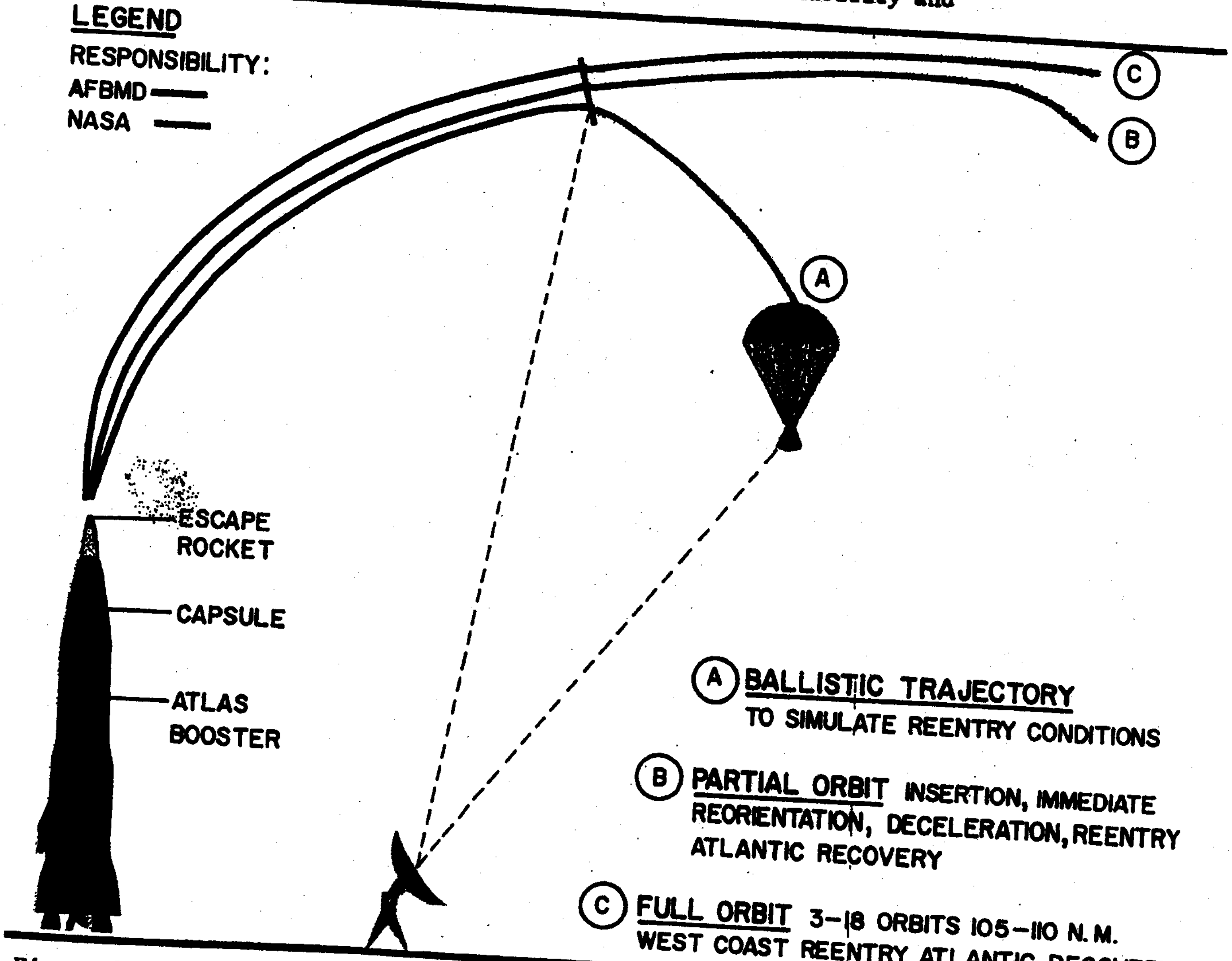

Figure 2. Flight test trajectories for Project MERCURY, defining specific objectives. Trajectory C represents the path of the final (manned) flight. The point at which AFBMD and NASA responsibility is divided represents injection into orbit.

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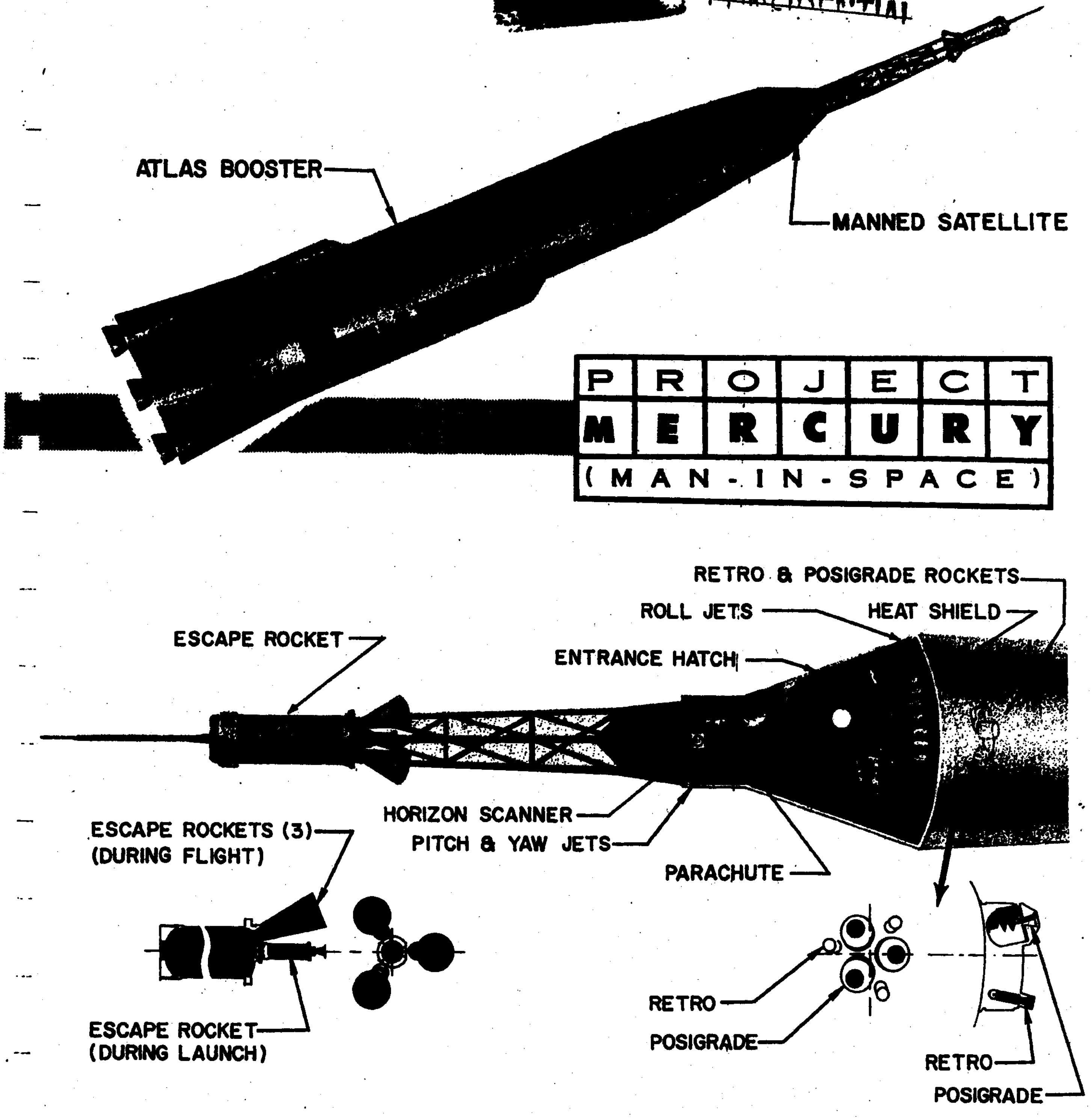

WEIGHT AT SEPARATION	APPROX. 2413 LBS.	ORBIT INCLINATION	33 DEGREES
ORBITAL ALTITUDE	105-120 MILES (n)	HEAT SHIELD	ABLATIVE OR SINK
ORBITAL CYCLES	3-18	RECOVERY	AIR &/OR WATER OR LAND

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.

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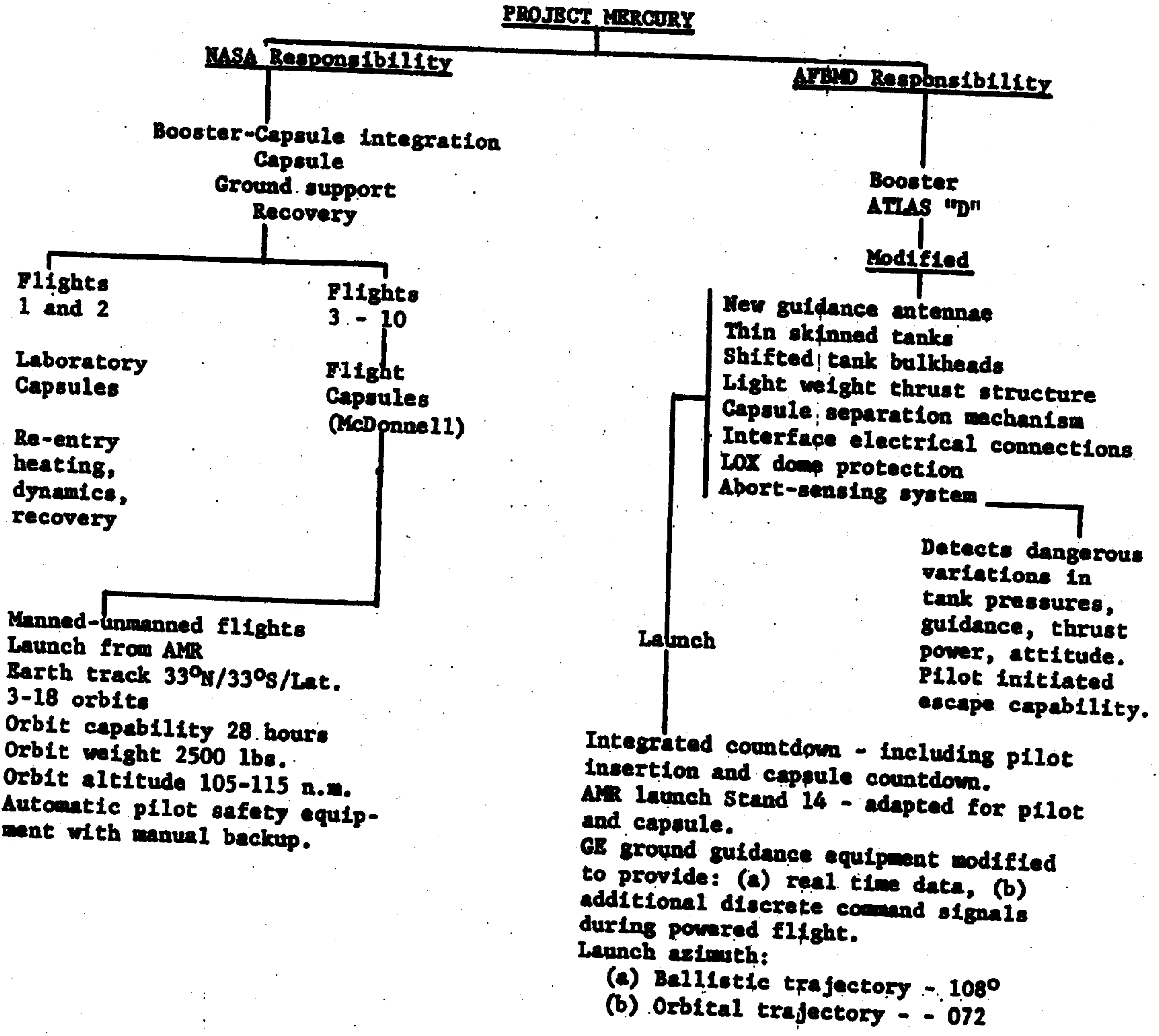
TABLE 1



PROJECT MERCURY

NASA Responsibility

Booster-Capsule integration
Capsule
Ground support
Recovery

- Flights 1 and 2
  - Laboratory Capsules
  - Re-entry heating, dynamics, recovery
- Flights 3 - 10
  - Flight Capsules (McDonnell)
    - 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.

AFBMD Responsibility

Booster
ATLAS "D"

Modified

- New guidance antennae
- Thin skinned tanks
- Shifted tank bulkheads
- Light weight thrust structure
- Capsule separation mechanism
- Interface electrical connections
- LOX dome protection
- Abort-sensing system
  - Detects dangerous variations in tank pressures, guidance, thrust power, attitude. Pilot initiated escape capability.

Launch

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 - 108°
(b) Orbital trajectory - - 072

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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 ATLAS 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 are given in Table 2.

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.

CURRENT MONTHS' PROGRESS - During this reporting period, a test management structure was agreed upon designating AFBMD 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	Launch support
Equipment modification	Trajectory data
Hardware fabrication	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.

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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 AFBMD, 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 Motor 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

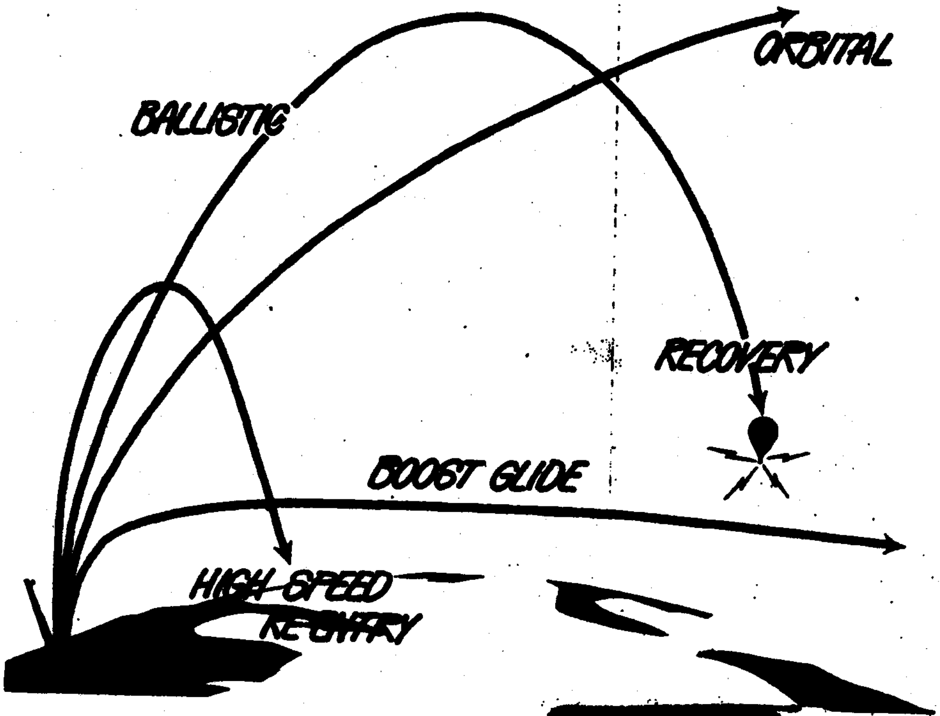

Figure 2

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

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PROJECT 609A

Space Environment Test System

PROGRAM DESCRIPTION - The Hyper-Environment Research Program (609A) is divided into R&D and Operational phases. The R&D phase will be used to develop and flight test vehicles capable of carrying payloads to altitudes of 200 to 5,000 miles. The Operational phase will use this standardized vehicle to permit the economical performance of flight test experiments in support of scientific research and advanced military space system programs.

ECONOMY - RELIABILITY - VERSATILITY - In this order of emphasis are the three significant guides to program accomplishment ECONOMY is

Propulsion

NASA SCOUT Stage	Engine
1. ALGOL	Aerojet Senior
2. CASTOR	Thiokol Sergeant
3. ANTARES	ABL X-254
4. ALTAIR	ABL x-248

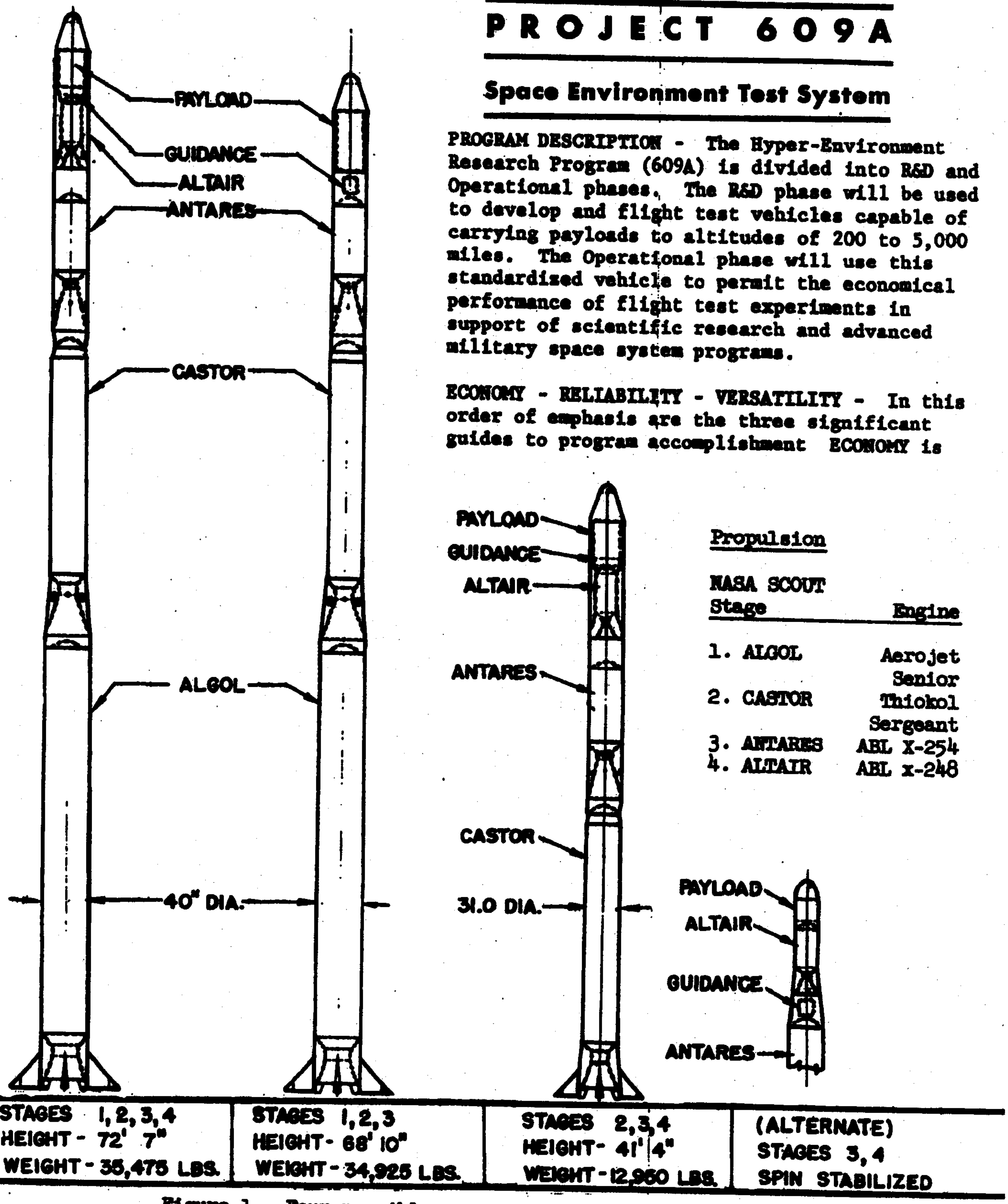

Figure 1. Four possible variations of Project 609A vehicle demonstrate mission-versatility of program.

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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 NASA 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.

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TIROS

CONCEPT - 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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[redacted] ~~CONFIDENTIAL~~

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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

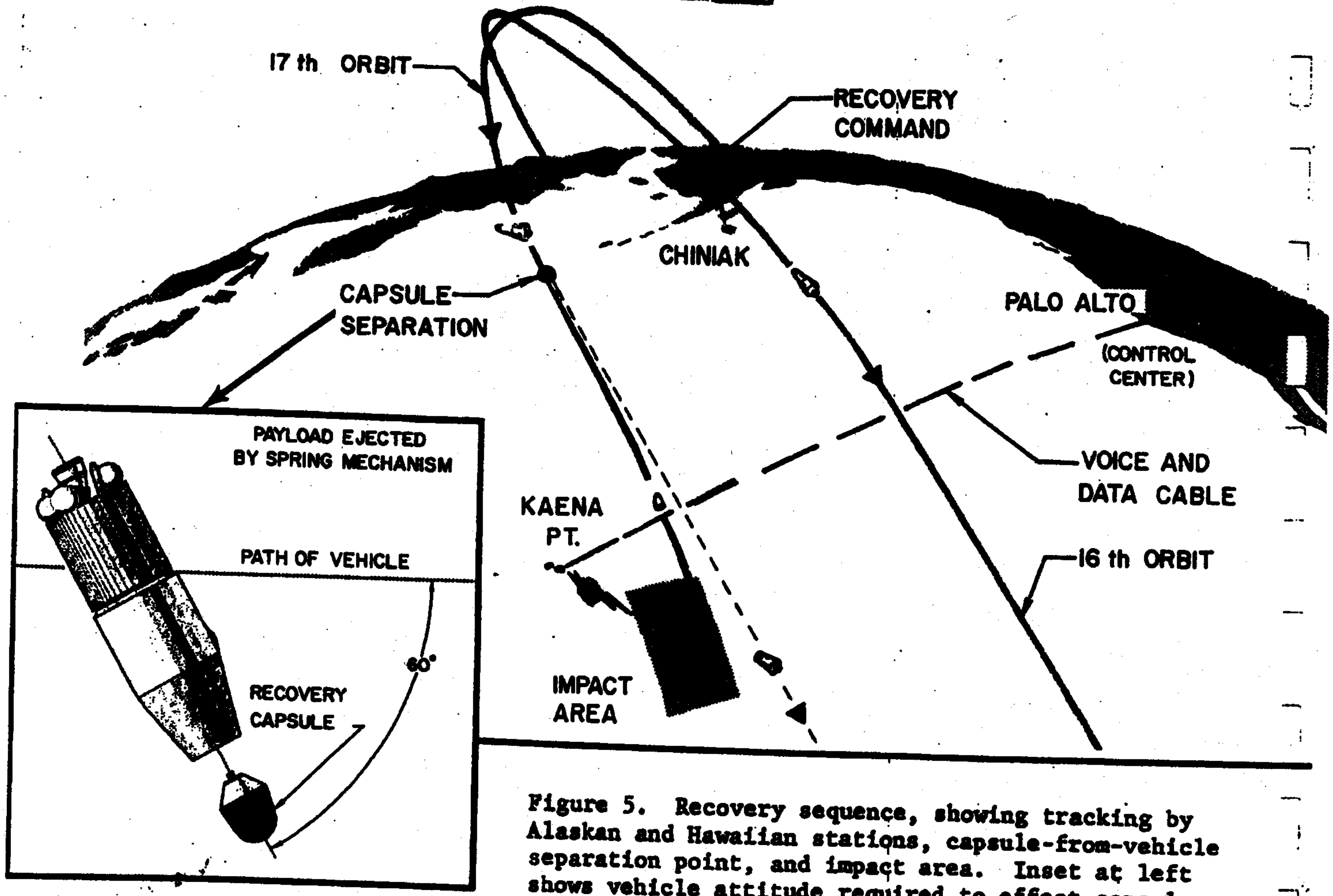

Figure 5. Recovery sequence, showing tracking by Alaskan and Hawaiian stations, capsule-from-vehicle separation point, and impact area. Inset at left shows vehicle attitude required to effect capsule re-entry following ejection.

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.

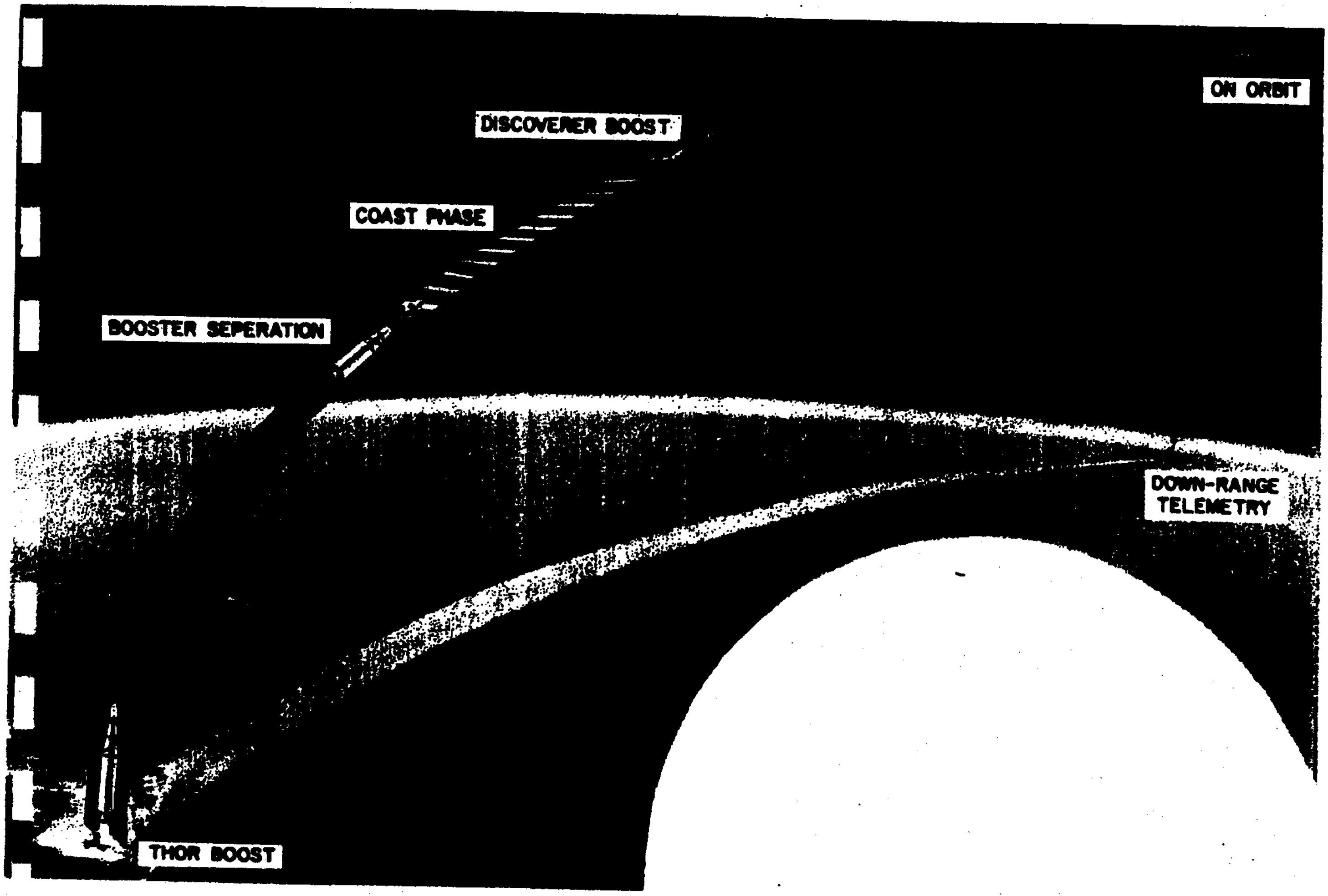

Figure 4. Typical DISCOVERER trajectory (above) from launching at Vandenberg AFB to orbit. Typical satellite orbital path around the earth (right).

Early 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.