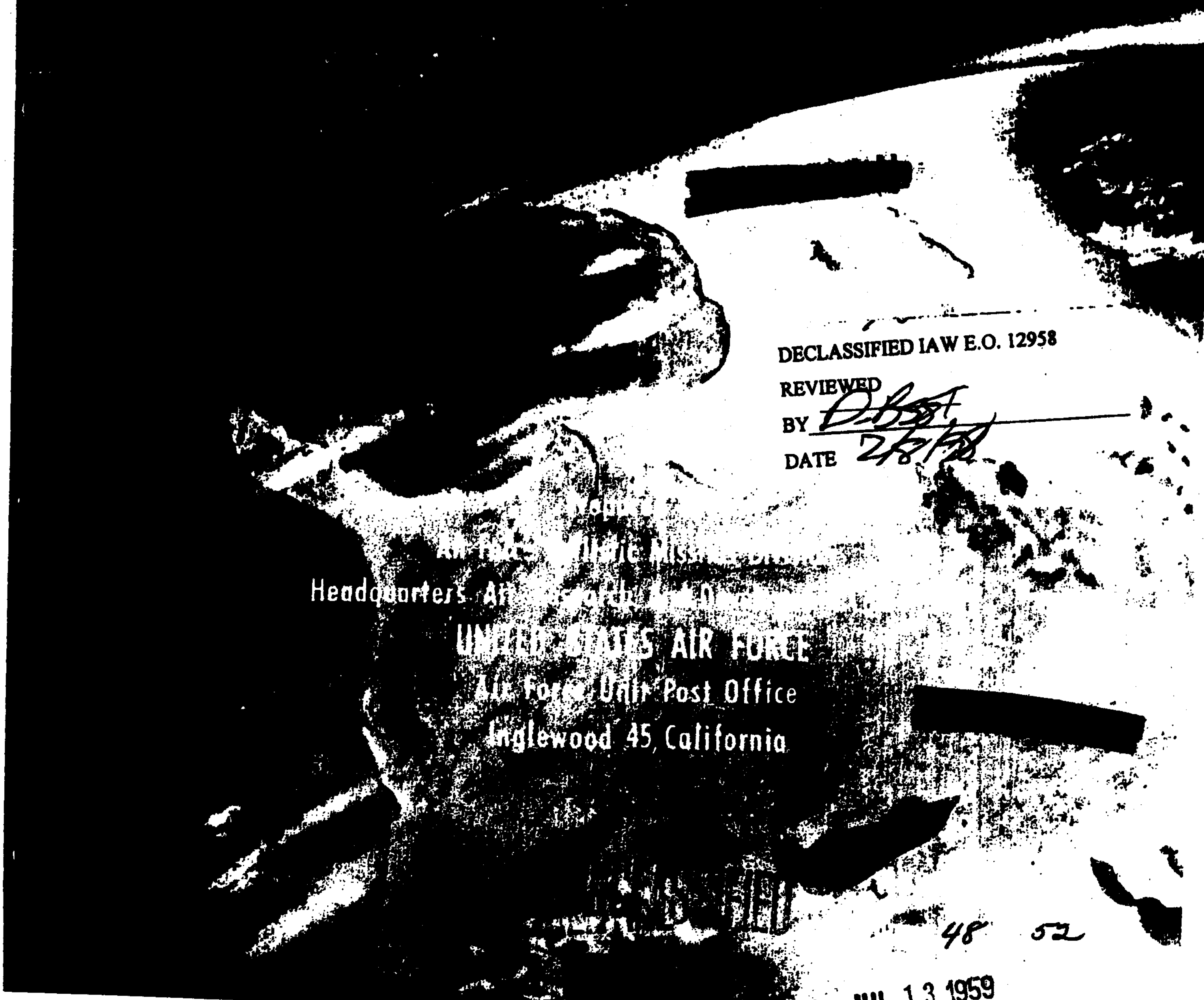
MILITARY SATELLITE PROGRAM

FOR QUARTER ENDING 30 JUNE, 1959

RCS DD-SD (M) 242



[redacted]

DECLASSIFIED IAW E.O. 12958

REVIEWED
BY D. Best
DATE 2/8/98

[illegible]

Air Force [illegible] Missi[illegible] Di[illegible]

Headquarters Air [illegible]

UNITED STATES AIR FORCE

Air Force Unit Post Office

Inglewood 45, California

[redacted]

48 52

JUL 13 1959

[redacted] [redacted]

AIR FORCE BALLISTIC MISSILE DIVISION
HEADQUARTERS
AIR RESEARCH AND DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
Air Force Unit Post Office
Los Angeles 45, California

WDPCR

8 July 1959

MILITARY SATELLITE PROGRAM PROGRESS REPORT
Quarter Ending 30 June 1959
RDC DD-SD(M) 242

FOREWORD

During the final quarter of Fiscal Year 1959, all phases of DISCOVERER, SENTRY and MIDAS programs continued to be essentially on schedule. Major problems encountered were in definition and approval of program objectives and funding.

The DISCOVERER Program successfully launched vehicles II, III and IV. Only DISCOVERER II attained orbit; however DISCOVERER III and IV flights experienced successful launch, ascent, separation, coast and orbital boost results.

Reorientation of the SENTRY Program resulted in definition of Visual (photographic) and Ferret (electronic) reconnaissance objectives and addition of a dual (Visual-Ferret) payload for initial development flights.

Detailed planning of MIDAS Phase I is proceeding satisfactorily, and manufacturing has been started in some areas. Approval and funding of Phase II is urgently needed for orderly program accomplishment.

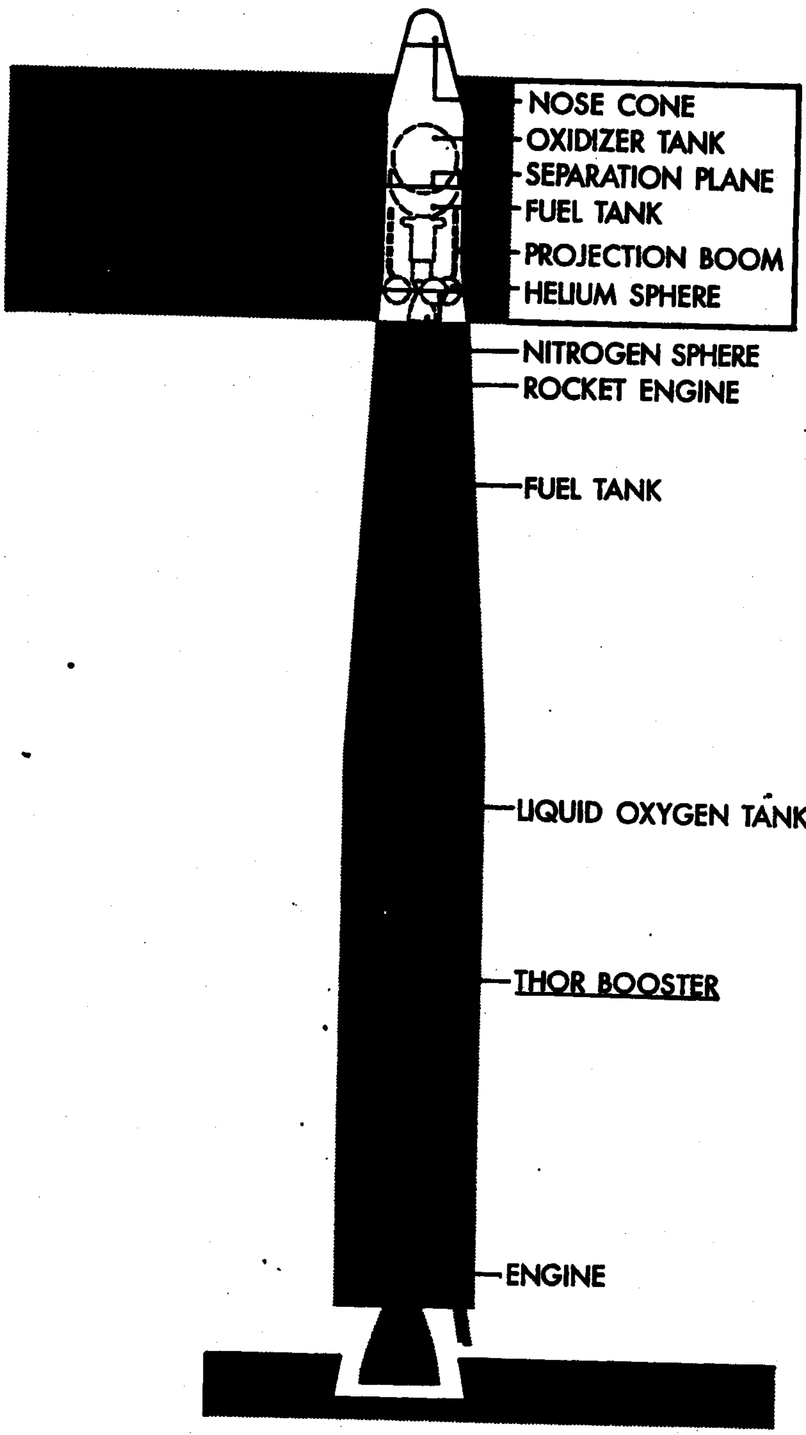
H. L. Evans
for O. J. RITLAND
Brig. Gen., USAF
Commander

WDPCR-5

[redacted]

[redacted]

[redacted] [redacted]



BOOSTER: *THOR IRBM*
SECOND STAGE: *DISCOVERER vehicle*
Propulsion: XLR81-Ba-5 engine
Specific Impulse: 277 lbs./sec.
Thrust: 15,150 lbs.
Fuel: Unsymmetrical Di-Methyl Hydrazine
Oxidizer: Inhibited Red Fuming Nitric Acid

DISCOVERER

Engineering Tests—of design concepts, subsystem combinations, orbital stabilization, tracking and communication system functions; and demonstration or orbital capabilities.

Biomedical Recovery Capsule—to recover living specimens from orbital flight and to study their physio-psychological response to conditions of launch, orbit and recovery.

[redacted] [redacted]

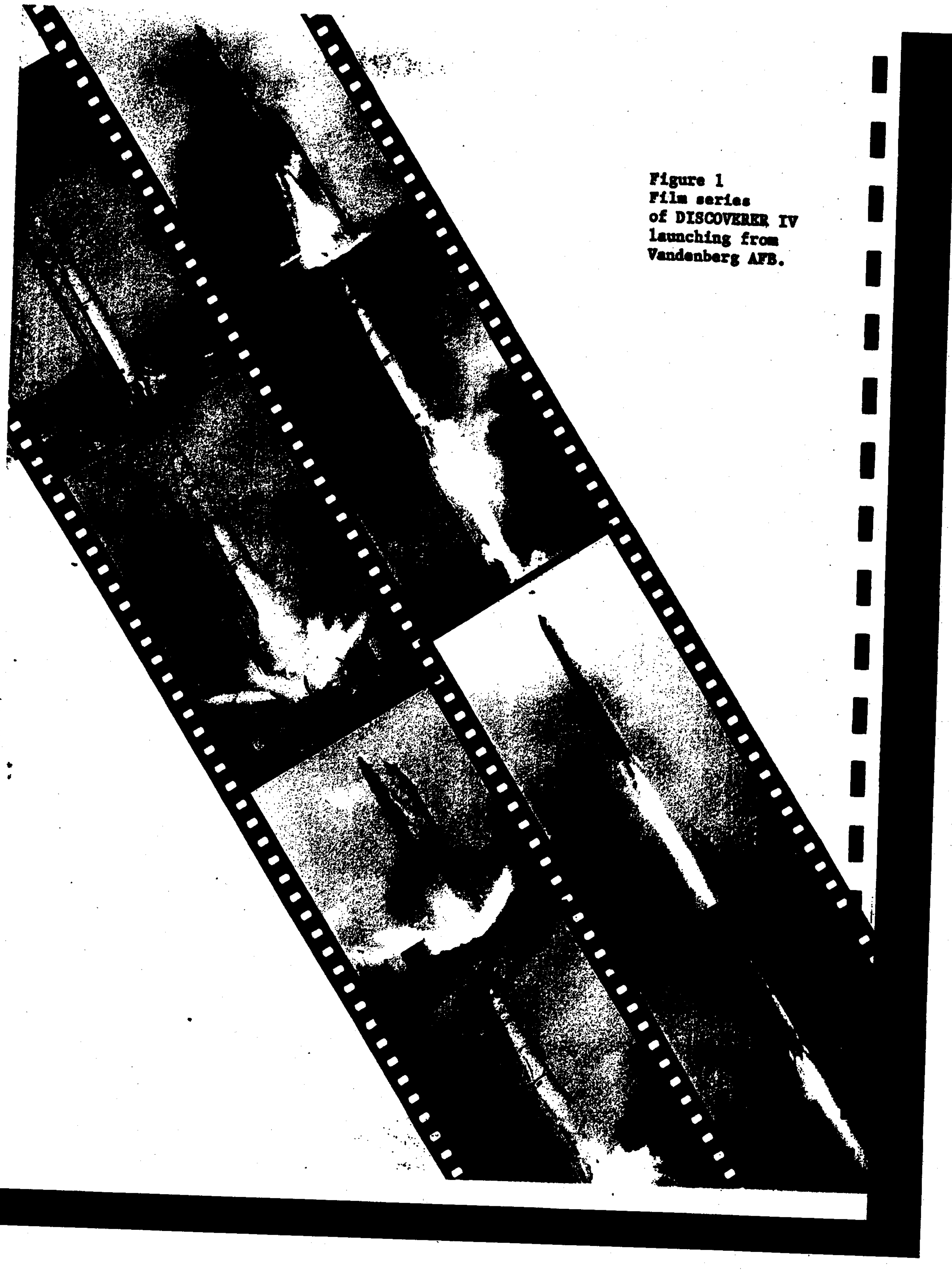


Figure 1
Film series
of DISCOVERER IV
launching from
Vandenberg AFB.

[redacted] [redacted]

DISCOVERER PROGRAM

I. GENERAL

DISCOVERER II successfully achieved circular polar orbit on 13 April.

On 13 April 1959, DISCOVERER II was successfully injected into orbit approximately 6 minutes after being launched from Vandenberg AFB. The 1,858 lb. DISCOVERER II vehicle, containing 6,352 lbs. of propellants, separated from the THOR booster and coasted to near-apogee altitude where rocket engine ignition occurred and required orbital velocity was attained. The satellite required 90.43 minutes to complete an almost circular orbit of the earth with an apogee of 215.7 and a perigee of 157.6 statute miles.

Orbit stabilization, re-entry orientation, ejection and re-entry were successful.

Immediately after engine burnout the satellite stabilization and guidance system operated a series of small gas jets which caused the vehicle to turn in a horizontal plane until an engine-forward position was attained. This positioning was in preparation for a period during the seventeenth orbit when the satellite nose was tilted 60 degrees downward to permit ejection to cause re-entry of the 197 lb. recoverable capsule payload. Telemetered data show that control and ejection equipment operated as planned.

Ground-command error made control of impact in planned recovery area impossible; re-entry visually observed.

However, a reset error, introduced into the satellite timer by ground command on the second pass, made it impossible to adjust capsule ejection to permit impact within the planned recovery area; and the automatic ejection program took effect. Based on the known orbit characteristics and the predicted time of automatic ejection occurrance, it was calculated that the capsule would impact near the arctic circle. A "space watch" was alerted and, at the predicted time and in the predicted area, observers on the Norwegian islands of Spitzbergen saw

[redacted]

[redacted]

[redacted]

caused the postponements. Launch, ascent, separation, coast, and orbital boost were accomplished as planned. Premature satellite engine shut-down resulted in failure to achieve required orbital velocity, and impact occurred approximately 30 degrees south of the equator.

Premature shut-down may have been caused by fuel exhaustion.

Indications are that fuel exhaustion was the cause of premature shut-down, since fuel for additional burning should have been present in the tanks at the time of shut-down. Records of propellant loading and a check of quantities remaining in the ground storage tanks, confirm that the vehicle was fully loaded with both propellants used when it was launched.

DISCOVERER IV successfully launched on 25 June, but failed to achieve orbit.

DISCOVERER IV was launched on 25 June from Vandenberg AFB with launch, ascent, separation, coast, and orbit boost successfully accomplished. However, the vehicle failed to achieve orbit. A detailed review of DISCOVERER III and IV flight records is being made since neither vehicle achieved orbit, in spite of successful systems and component operation. Launch of DISCOVERER V on 1 July has been postponed until this review has been completed. DISCOVERER IV was the first vehicle to be launched from Vandenberg AFB stand 75-3-5.

II. TECHNICAL STATUS

Improved timer program accelerated to include installation in DISCOVERER III.

The Fairchild timer installed in DISCOVERER III (see Section I.) provides improved flexibility in the range and manner of changing timing periods by ground command. Plans call for the installation of a timer automatic reset device to prevent timer errors from accumulating during periods when the satellite is beyond tracking station range.

Successful data obtained from "Mechanical Mice" on DISCOVERER II flight.

Extensive testing of the Biomedical Recovery Capsules is being conducted. "Mechanical Mice" (multi-vibrators emitting a pulse similar to the heartbeat of live

[redacted]

changes. The animal was then flown to Sunnyvale for installation in a Bemco chamber, modified to permit the animal to rest in a horizontal position.

Successful retrodynamics test conducted on 5 May.

High altitude retrodynamics tests of the capsule were conducted on 5 May. The capsule was carried by balloon to 90,000 feet and dropped. Capsule retro and spin rockets fired as planned, and tracking data indicates trajectory well within tolerances.

Engine relay box tests completed.

Testing of the engine relay box, which began after the DISCOVERER I flight, has been completed. Belief that this component may have been a cause of premature engine shut-down has been disproven.

Changes being made to increase weight capabilities.

Douglas Aircraft Co. has reduced the weight of the THOR by removing equipment and brackets installed in the operational missile but not required when used as a satellite booster vehicle. Douglas also plans to change from RP-1 to RJ-1 fuel as soon as static tests can be conducted. RJ-1 fuel has the same chemical properties but has greater density than RP-1, permitting additional weight capability of approximately 50 lbs. The range safety officer at Vandenberg AFB has approved a change in DISCOVERER launch azimuth from 182.8 to 175 degrees providing increased weight capability of 26 lbs.

III. PROBLEMS ENCOUNTERED

Flight testing halted temporarily to permit review of all data.

DISCOVERER IV flight data indicate booster and satellite vehicle performance within specifications. However, since orbit was not achieved, flight testing has been halted temporarily to permit a review of all available data.

Flight order changed to accommodate Mark II capsule testing program.

Because of difficulties encountered, testing of the Mark II capsule cannot be completed before the first flight scheduled to carry a primate. As a result, the scheduled launch dates of flights 7 and 8 have been reversed.

[redacted]

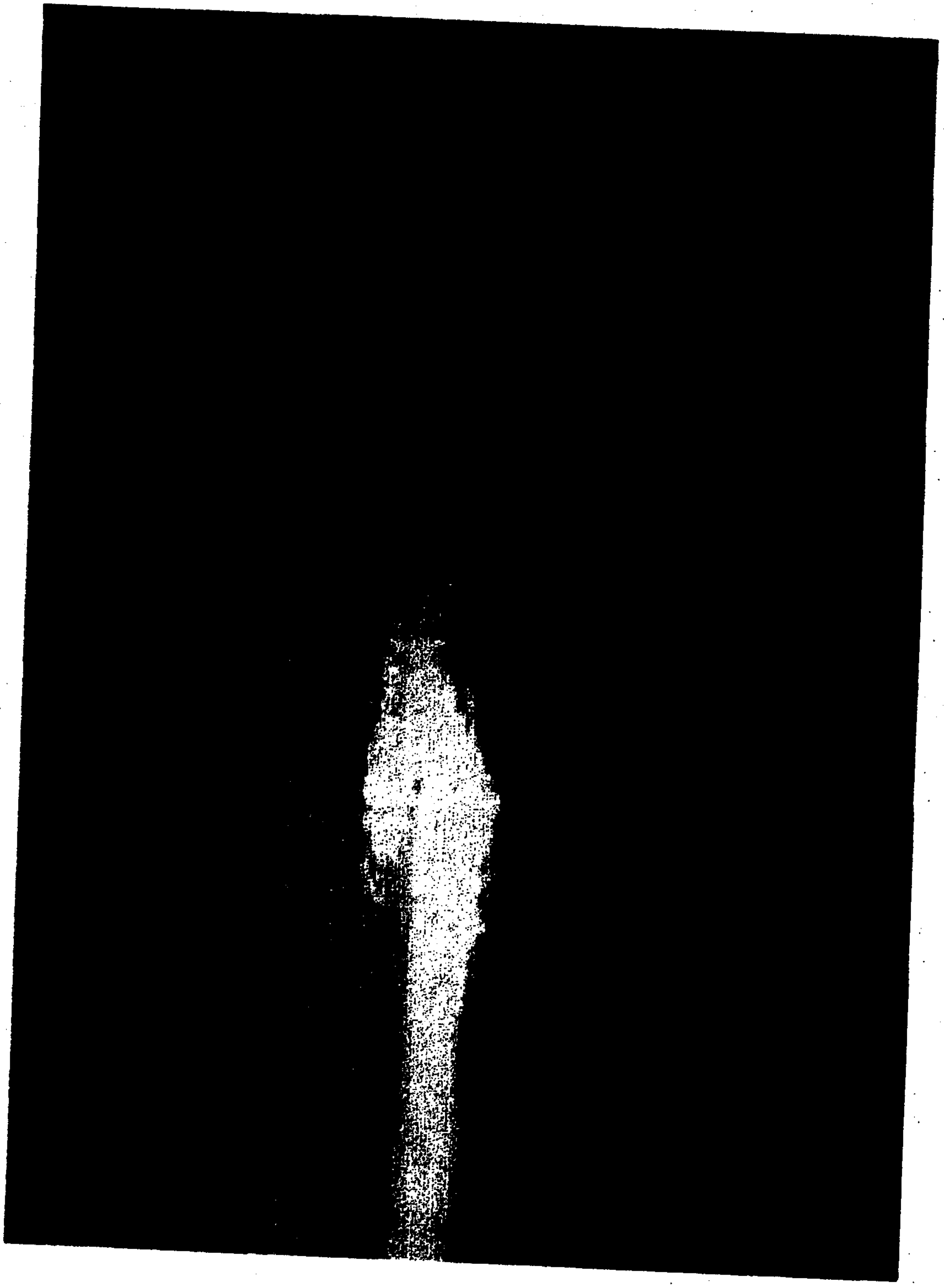


Figure 2
DISCOVERER III flight at lift-off.

[redacted]

[redacted] [redacted]

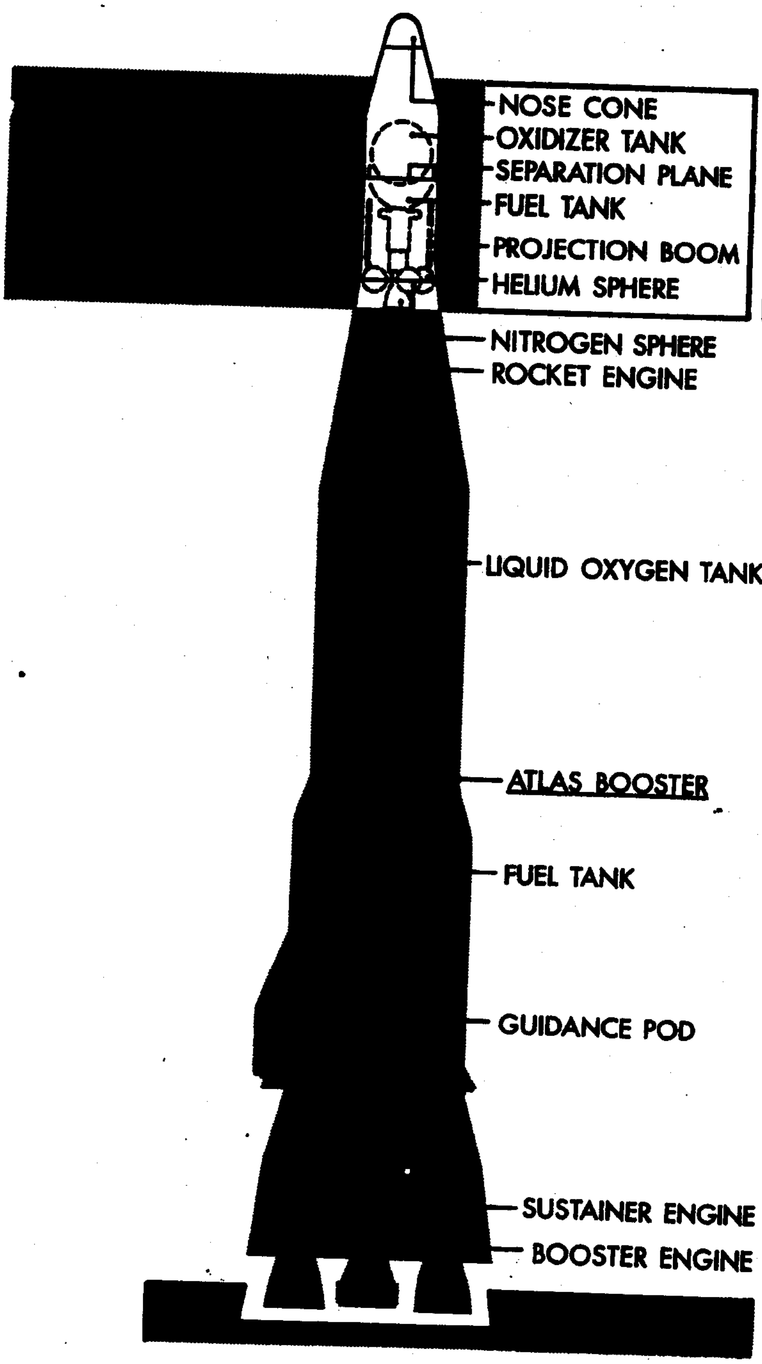
Life cell being sealed to chassis.

Life cell placed in altitude chamber prior to test.

Observing life cell in altitude chamber during test.

[redacted] [redacted]

[redacted] [redacted]



BOOSTER: *ATLAS ICBM SM65-D*
SECOND STAGE: *SENTRY vehicle*
Propulsion: XLR81-Ba-5 engine
Specific Impulse: 277 lbs./sec.
Thrust: 15,150 lbs.
Fuel: Unsymmetrical Di-Methyl Hydrazine
Oxidizer: Inhibited Red Fuming Nitric Acid

SENTRY

VISUAL (Photographic Reconnaissance) – airborne equipment to collect, process and store high resolution photographic information and convert stored images into video signals for transmission to ground. Ground equipment to receive data link output signal and convert into photographic form.

FERRET (Electronic Reconnaissance) – airborne equipment to collect radiation data from [redacted]lectromagnetic spectrum region; store, filter and reconvert into electrical signals for transmission to ground. Ground equipment for in-flight calibration and adjustment of airborne equipment, engineering evaluation of equipment performance, decoding of reconnaissance data, and time and vehicle position for further data processing.

[redacted] [redacted]

[redacted] [redacted]

SENTRY PROGRAM

I. GENERAL

Reoriented SENTRY program defines objectives as visual (photo) and ferret (electronic) reconnaissance.

Reorientation of the SENTRY program, including revisions to the Development Plan in September 1958, December 1958, and January 1959 was resolved in May 1959 when final approval and funding were received. The reoriented program calls for the use of polar-orbiting satellites capable of performing visual (photographic) and ferret (electronic) reconnaissance functions of a military intelligence nature. Infrared reconnaissance requirements have been deleted. A dual (visual and ferret) payload will be used on the initial development flights to test equipment. When in orbit, the visual, then the ferret equipment, will be checked out for satisfactory operation, prior to jettisoning of the ferret payload. The visual payload will then be permitted to operate without interference and will have a useful life of 10 to 15 days, depending upon which power supply is used.

New requirements for visual payload include recovery capability and use of wide-band data link.

The reoriented visual reconnaissance program included development of the controlled re-entry of a recoverable photographic payload to provide a back-up of the electronic readout of this data over a ground-space link. Recovery capability requirement was deleted by ARPA on 24 June. A wide-band data link will be used for the visual payload ground-space communications. This link includes a payload camera, using strip film, which is automatically developed while in orbit, by a special processor housed in a chamber which closely controls temperature, pressure and humidity. On ground station command, readout of the developed negative is accomplished by electronic

[redacted] [redacted]

[redacted]

feasible to provide early availability. The F-2 payload is capable of receiving real-time commands and includes extensive use of transistors to reduce power consumption and weight.

F-3 program includes two versions of advanced payload.

The program for the most advanced payload calls for two versions, designated F-3A and F-3B. Payload F-3A capabilities include:

1. Increased receiver frequency coverage.

2. 100 kc band-width analog recording.

[redacted]

Payload F-3B capabilities include:

1. Increased receiver frequency coverage.

2. Capability of using 6Mc analog recorder.

[redacted]

Program requires extensive ground data handling network.

The SENTRY program requires an extensive ground data handling network, including several tracking and acquisition stations

[redacted]

Included on the capsule are an acquisition beacon, recorder, and telemetry system to relay information on acceleration, temperature, ablation, etc., during re-entry.

Recovery capsule orbital attitude controlling devices being studied.

Use of a reaction wheel for controlling recovery capsule orbital attitude was being studied. Preliminary specifications for the pitch motor were determined and limit cycle operation was studied on an analog computer. Three-axis control by means of reaction wheels in pitch and roll, with a constant-momentum wheel coupling roll and yaw, was also being considered. In addition, an alternate method of control involving low-impulse reaction jets was under consideration.

Ferret (F-1) payload development and fabrication proceeding satisfactorily.

The antenna for the F-1 payload has been redesigned, as required by the dual-payload configuration, to provide a 1.5 inch aperture through which the visual payload (E-1) will photograph prior to jettison of the F-1 equipment. Corrections required by tests of the redesigned antenna have been made. Acceptance testing of three sets of deliverable signal antennas was successfully completed. Eight prototype power converters were delivered to Airborne Instruments Laboratory (AIL), representing a major milestone in equipment development.

Use of nuclear APU being investigated extensively.

An accelerated investigation is continuing in the feasibility of using one of several possible Systems for Nuclear Auxiliary Power (SNAP) developed by the AEC. Investigation includes consideration of the weight, active life, development schedule, reliability and potential hazard of the SNAP unit selected.

III. <u>PROBLEMS ENCOUNTERED</u>

Recovery requirement deferred; funding decreased.

On 24 June ARPA directed the deferral of activity in the recovery capability requirement. Accompanying this deferral was a reduction in 1960 Fiscal Year and being prepared for the parachute and air recovery system are now being held in abeyance. Basic work statements for the high-resolution photographic mission were prepared and submitted to possible subcontractors.

Ferret payload work proceeding on schedule.

The second article of the F-1 prototype vehicle equipment was checked out completely, using the prototype subsystems checkout console. Qualification testing of the F-1 payload will be conducted with these units in July. Two antenna assemblies have been completed for the F-2 payload. Assembly drawings for the F-2 payload data handling unit and ground data handling equipment have been released for fabrication. A contract for design and fabrication of digital display equipment relating to the evaluation and command console was awarded to Raytheon Manufacturing Corporation. The contract for the payload telemetry display equipment was awarded to Consolidated Avionics.

F-3 payload plans being formulated.

Both ground and satellite equipment specifications have been given to AIL for the F-3, 100 kc, analog recorder. Detailed planning to incorporate the recorder in the payload was started. Other techniques for obtaining technical intelligence data have reached the detailed planning stage.

Control equipment being developed for tracking stations.

A study into the requirements for data obtained and required by tracking stations has resulted in the start of development of the Programmable Integrated Control Equipment (PICE) system. This equipment, installed at tracking stations, will accept and store all incoming data and make portions of the data available instantaneously, as needed, to the other data handling equipment in the tracking station or at the control center. Specifications for this equipment are complete.

[redacted]

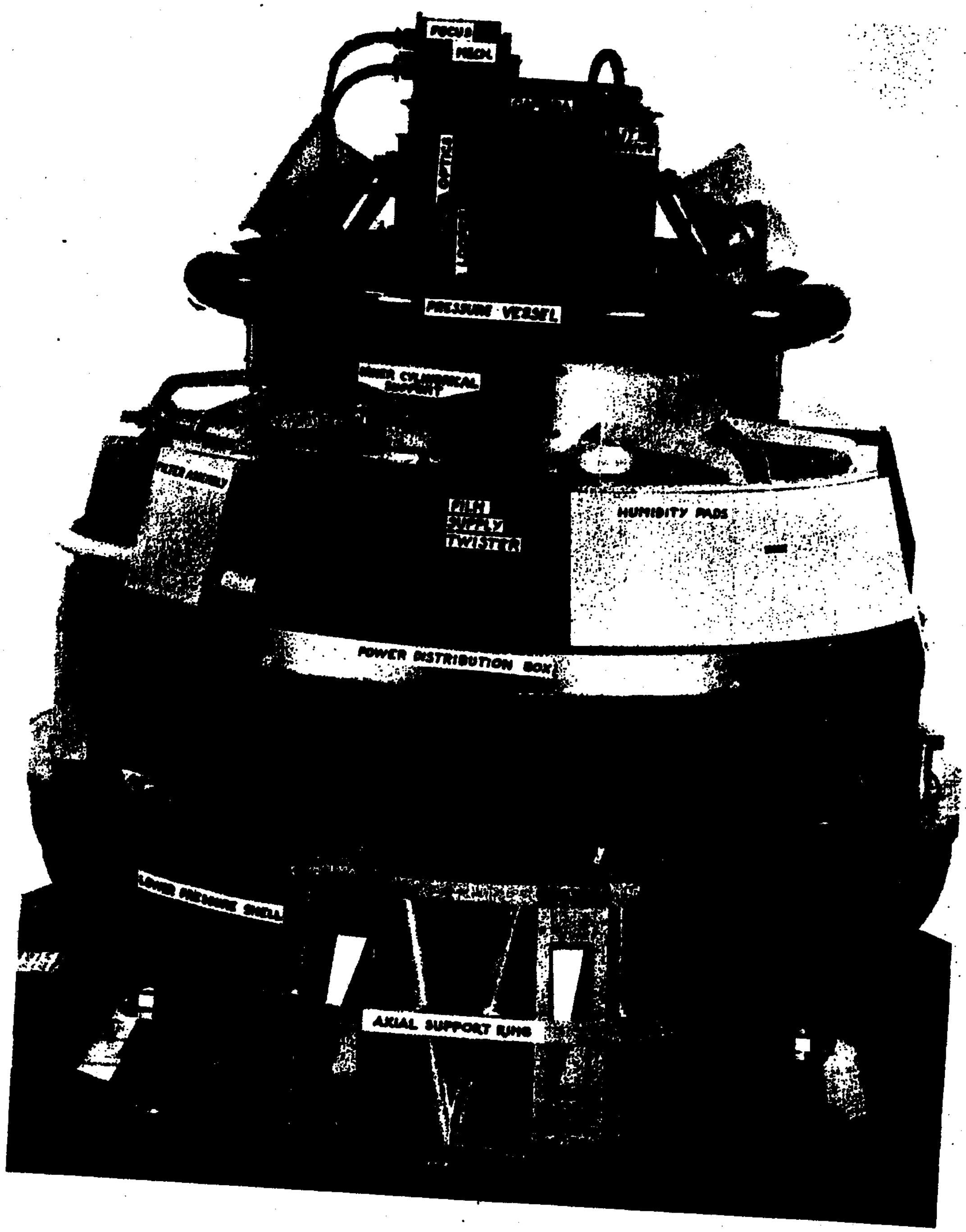


Figure 4
Mock-up of SENTRY (E-2) Visual Reconnaissance Package.

[redacted]

[redacted]

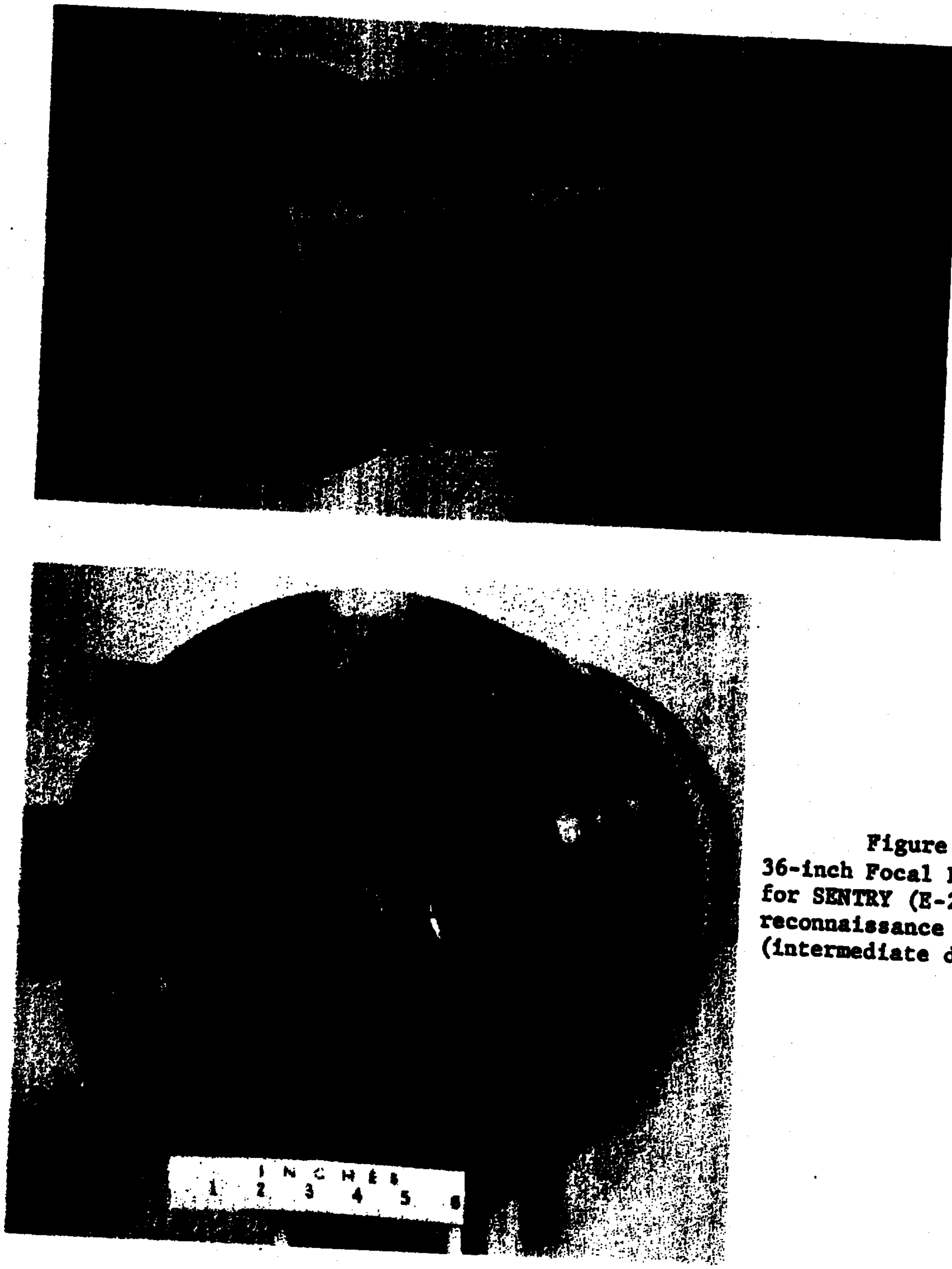
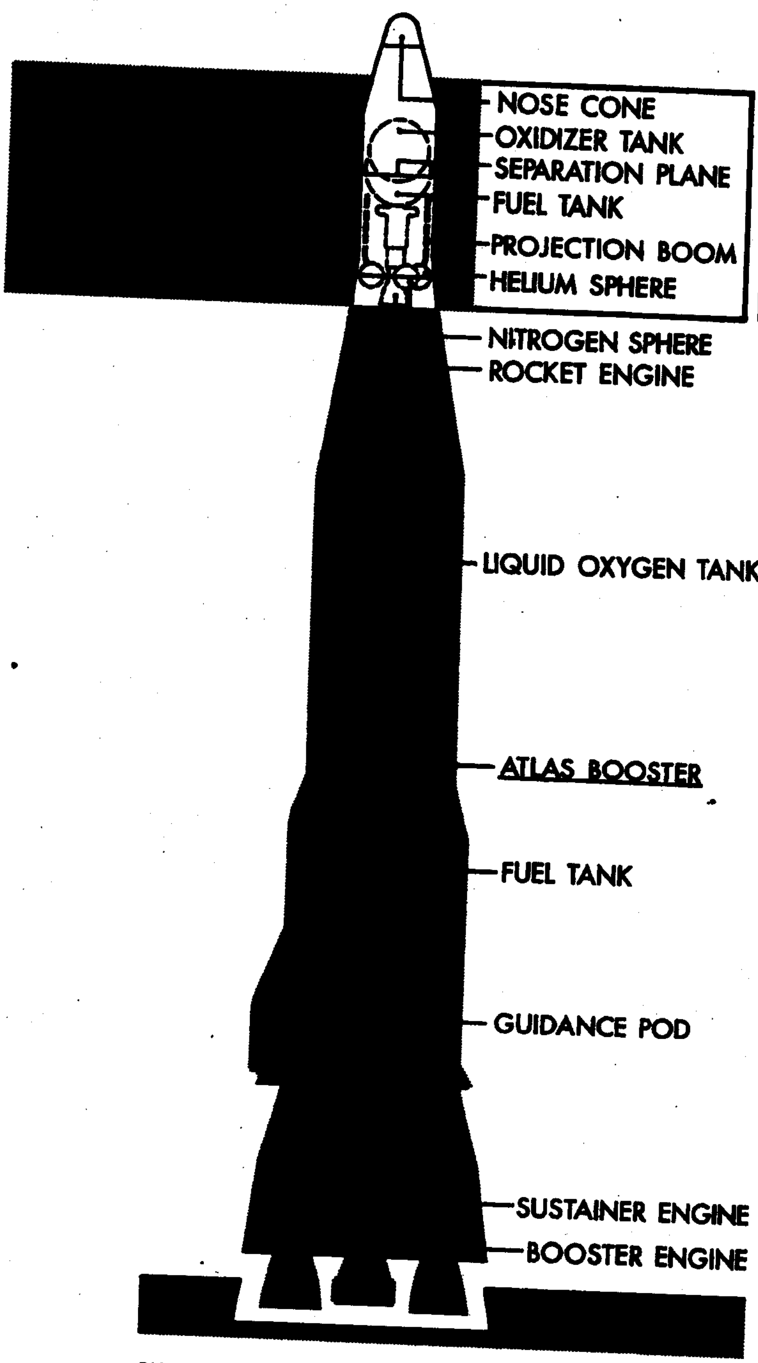


Figure 6
36-inch Focal Length lens for SENTRY (E-2) visual reconnaissance package (intermediate design).

[redacted]

[redacted]



BOOSTER: *ATLAS ICBM SM65-D*
SECOND STAGE: *MIDAS vehicle*
Propulsion: XLR81-Ba-5 engine
Specific Impulse: 277 lbs./sec.
Thrust: 15,150 lbs.
Fuel: Unsymmetrical Di-Methyl Hydrazine
Oxidizer: Inhibited Red Fuming Nitric Acid

PHASE I—Four flights, starting December 1959, from Atlantic Missile Range. Nominal launch azimuth of 108° with mean orbital altitude of 250-350 statute miles.

Flight 1—Primary objectives are to test and evaluate: infrared reconnaissance payload, orbital vehicle and adapter system, booster system, ground handling, checkout and launch systems [redacted] hicle subsystems and communications, and ground tracking and command systems.

Flight 2—Will continue the testing and evaluation of infrared reconnaissance system components, techniques and system operation, solar cell performance, and other basic systems required to demonstrate orbital capacity.

[redacted]

MIDAS

[redacted] [redacted]

MIDAS PROGRAM

I. GENERAL

Ground configuration and detailed plans for MIDAS Phase I being developed.

The MIDAS Phase I program involves four ATLAS boosted, low-latitude (107 degrees launch azimuth), low-altitude (300 to 700 mile) flights from the Atlantic Missile Range (AMR) with first flight scheduled for December 1959. Initial Phase I flights will use the following facilities:

1. Atlantic Missile Range - Launch and read-out of data from satellite in orbit.

2. AMR Down-Range Stations - Tracking during ascent and through orbit injection; read-out of exit telemetry data.

3. Development Control Center (Palo Alto/Sunnyvale) - Operations control; ground presentation in real time and analysis of infrared data.

4. Vandenberg AFB - Tracking; ground presentation of infrared data in real time, satellite interim timer command, infrared scanner command.

5. Kaena Point, Hawaii - Tracking; infrared data read-out, satellite interim timer command, infrared scanner command.

Targets, launched from AMR, White Sands Proving Ground, Point Mugu and Vandenberg AFB, will be observed by the orbiting satellites.

II. TECHNICAL STATUS

Authorization given for Bell Aircraft Corp. to proceed with design and development of a restart engine.

A simulated altitude testing program with a modified Bell XLR81-Ba-5 rocket engine was successfully completed in April 1959. Bell Aircraft Corp. was then authorized to proceed with the design and development of a restart engine. A review of the engine modification mock-up was held at the Bell facilities in mid-June.

[redacted]

[redacted]

Additional balloon flights requested to support infrared background measurements program.

Requirements were evaluated for additional balloon flights for measuring infrared background at sites other than the Minnesota area. Lockheed has requested three additional flights in the southern part of the United States. This program will yield data on backgrounds which contain scattered thunderstorm activity.

III. PROBLEMS ENCOUNTERED

Launch stand and booster availability conflict exists between NASA and MIDAS programs.

The launch stand and booster availability conflict between the NASA (Man-in-Space) Program and MIDAS Phase I flights remains unresolved.

AMR tracking station capability doubted. Manual tracking being studied.

Discussions regarding use of the RADC down-range tracking facility at AMR revealed a doubt as to the ability of this facility to track the satellite in the presence of stronger reflections from the booster. The possibility of using manual tracking, if separation occurs close enough to the station for the equipment to distinguish between the two objects, is being studied.

Indefinite Phase II approval and funding are hampering orderly program accomplishment.

Uncertain and indefinite Phase II approval and funding are becoming detrimental to orderly program accomplishment. This problem became particularly acute on 1 July when contracting should have started for all phases. The immediate approval of Phase II is urgently needed.

IV. WORK SCHEDULES

First MIDAS satellite shipped to Modification Center.

The first MIDAS satellite was shipped from Sunnyvale to the Modification and Check-out Center at Palo Alto on 25 June.

[redacted]

[redacted]

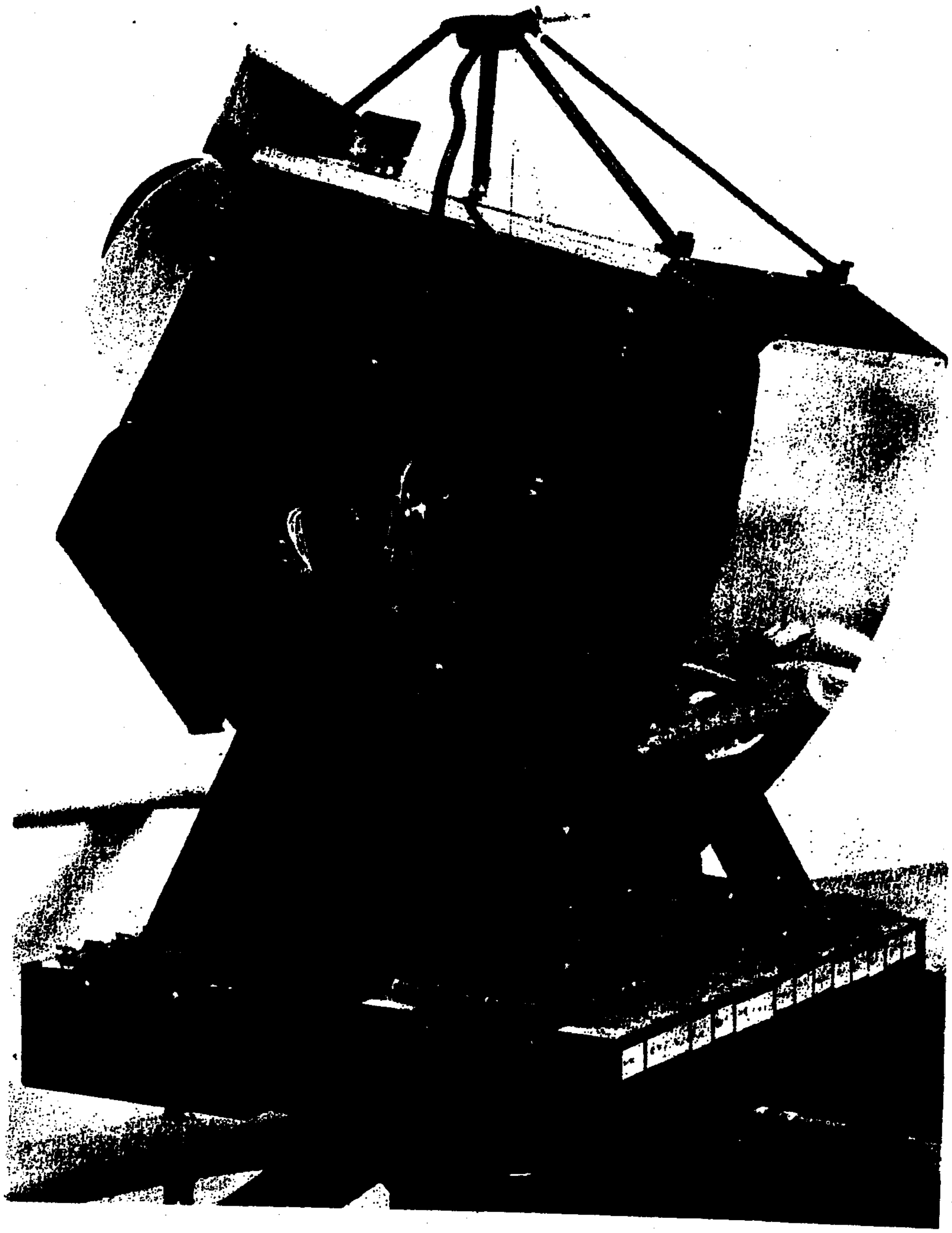


Figure 7
Infrared scanner for first MIDAS) Phase I flight.

[redacted]

[redacted]

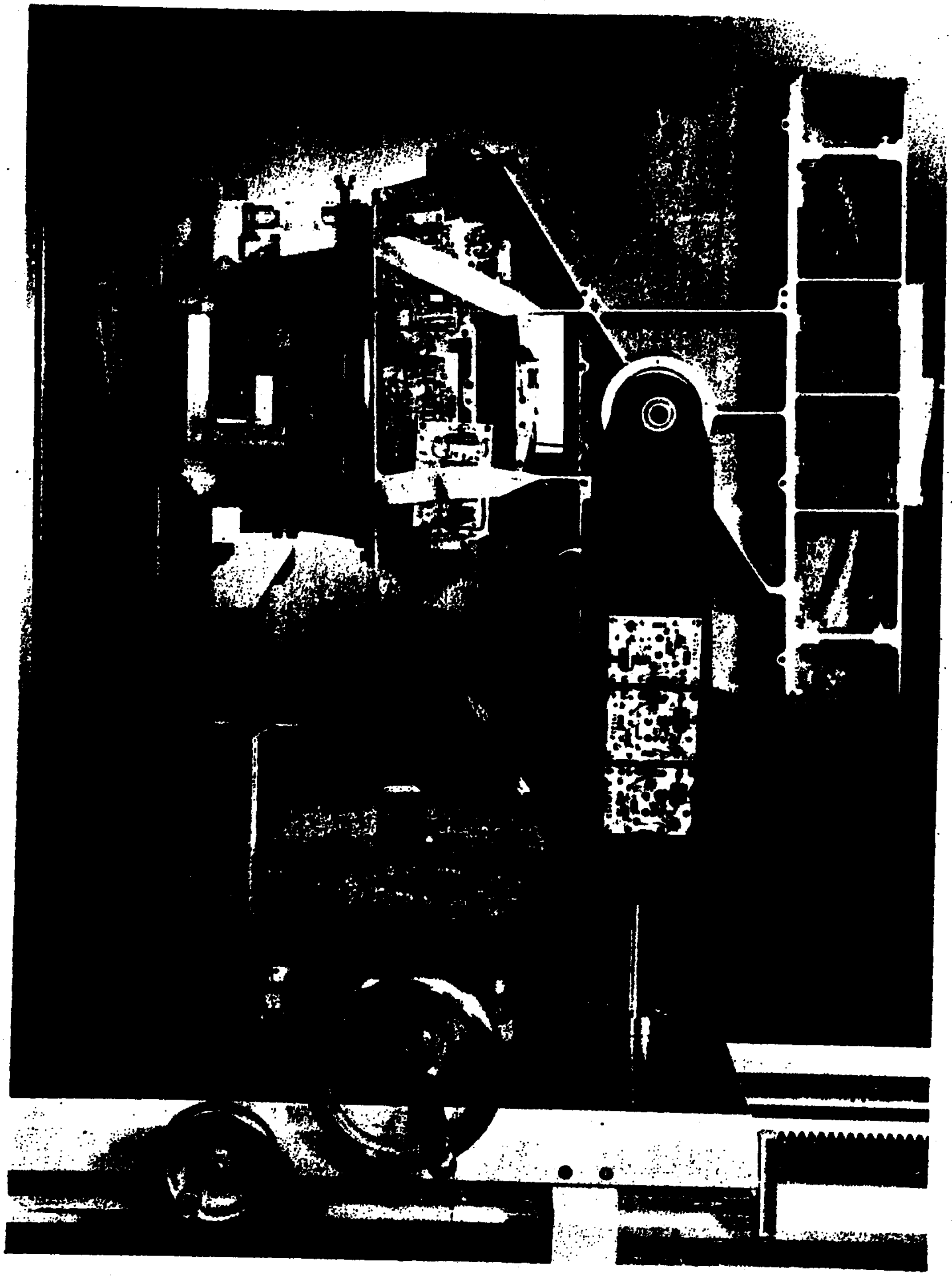


Figure 9
Infrared scanner for first MIDAS (Phase I) flight undergoing Collimator testing.

[redacted]

[redacted] [redacted]

DISTRIBUTION

Advanced Research Projects Agency	6
Headquarters, United States Air Force	12
Commander, Air Research & Development Command	2
Commander-in-Chief, Strategic Air Command	1
Commander, Air Force Cambridge Research Center	1
Commander, Rome Air Development Center	2
Commander, Wright Air Development Center	1
Air Force Ballistic Missile Division (HQ ARDC)	18
Ballistic Missiles Center (HQ AMC)	3
Assistant CINCSAC (SAC MIKE)	2
Air University Library	1

[redacted]

[redacted]