[redacted]

MILITARY SATELLITE PROGRAM

FOR QUARTER ENDING 31 DECEMBER 1958

RCS DD-SD (M) 242

UNCLASSIFIED

Prepared By
Air Force Ballistic Missile Division
Headquarters Air Research And Development Command
UNITED STATES AIR FORCE
Post Office Box 262
Inglewood, California

UNCLASSIFIED

[redacted]

WDPCR - 58 - 10
Copy 44 of 45

[redacted] JUN 1 1958

[redacted]

MILITARY SATELLITE PROGRAM

GLOSSARY

DISCOVERER FLIGHTS

DISCOVERER I:

Scheduled Launch Date: 10 January 1959
Booster: THOR #160, IRBM
Gross Weight: 113,700 lbs
Payload Weight: 70 lbs
Altitude: 220 Statute miles
Payload: Telemetry
Subsystems: Test of Booster/Vehicle Orbital Capability

Second Stage: DISCOVERER Vehicle
On-Orbit Weight: 1,328 lbs
Fuel: JP-4, Inhibited Red Fuming Nitric Acid
Flight Characteristics: Ballistic trajectory to Orbit

DISCOVERER II:

Scheduled Launch Date: 11 February 1959
Booster: THOR #163, IRBM
Gross Weight: 113,802 lbs
Payload Weight: 70 lbs
Altitude: 220 Statute miles
Payload: Telemetry
Subsystems: Test of Booster/Vehicle Orbital Capability

Second Stage: DISCOVERER Vehicle
On-Orbit Weight: 1,328 lbs
Fuel: JP-4, Inhibited Red Fuming Nitric Acid
Flight Characteristics: Ballistic trajectory to Orbit

DISCOVERER III:

Scheduled Launch Date: 18 March 1959
Booster: THOR #170, IRBM
Gross Weight: 114,906 lbs
Altitude: 195 Statute miles
Payload: Mark I biomedical recovery capsule
Subsystems: A, B, C, D, L
Second Stage: DISCOVERER Vehicle

Fuel: Unsymmetrical Di-Methyl Hydrazine/ Inhibited Red Fuming Nitric Acid
On-Orbit Weight: 1,451 lbs
Payload Weight: 195 lbs
Flight Characteristics: Ballistic ascent trajectory with Orbital boost at Apogee

DISCOVERER PROGRAMS

PROGRAM I - ENGINEERING TESTS:

This program will include the demonstration of orbital capability of the DISCOVERER/THOR combination, design concepts, engineering tests of subsystem combinations, orbital stabilization, and the functioning of the tracking and communications system.

PROGRAM II - BIOMEDICAL RECOVERY CAPSULES:

The objectives of the Biomedical Recovery Capsule Program are to recover living specimens from orbital flight and to study the psycho-physiologic response of specimens to conditions of launch, orbit and recovery.

SUBSYSTEMS:

SUBSYSTEM "A": Air Frame
SUBSYSTEM "B": Propulsion
SUBSYSTEM "C": Auxiliary Power
SUBSYSTEM "D": Guidance
SUBSYSTEM "E": Ground/Space Communications
SUBSYSTEM "I": Data Processing
SUBSYSTEM "J": Geophysical
SUBSYSTEM "K": Personnel
SUBSYSTEM "L": Biomedical

PROPULSION:

XLR81-Be-3 — Rocket Engine
Fuel: JP-4
Oxidizer: Inhibited Red Fuming Nitric Acid
263 Sec. Specific Impulse
15,150 lb Thrust

XLR81-Be-5 — Rocket Engine
Fuel: Unsymmetrical Di-Methyl Hydrazine
Oxidizer: Inhibited Red Fuming Nitric Acid
277 Sec. Specific Impulse
15,150 lb Thrust

BIOMEDICAL CAPSULES:

MARK I — 195 lb Recovery Unit (Mice)

MARK II — 279 lb Recovery Unit (Small primate)

SENTRY FLIGHTS

SENTRY program flight schedules and objectives are being realigned, and no approved schedules are available at this time.

SENTRY PROGRAMS

VISUAL RECONNAISSANCE

SUBSYSTEMS:

SUBSYSTEM "A": Air Frame
SUBSYSTEM "B": Propulsion
SUBSYSTEM "C": Auxiliary Power
SUBSYSTEM "D": Guidance
SUBSYSTEM "E": Visual
SUBSYSTEM "F": Ferret
SUBSYSTEM "E": Ground/Space Communications
SUBSYSTEM "I": Data Processing
SUBSYSTEM "J": Geophysical
SUBSYSTEM "K": Personnel

FERRET RECONNAISSANCE

BOOSTER:

ATLAS ICBM

SENTRY PROPULSION:

BELL AIRCRAFT XLR81-Be-5 Engine
277 Sec. Specific Impulse
15,150 lb thrust
Fuel: Unsymmetrical Di-Methyl Hydrazine
Oxidizer: Inhibited Red Fuming Nitric Acid

MIDAS FLIGHTS

The MIDAS program is undergoing realignment, and flight schedules are not available.

[redacted]

[redacted]

[redacted]

AIR FORCE BALLISTIC MISSILE DIVISION
HEADQUARTERS
AIR RESEARCH AND DEVELOPMENT COMMAND
Post Office Box 262
Inglewood, California

WDPCR

9 January 1959

MILITARY SATELLITE PROGRAM PROGRESS REPORT
Quarter Ending 31 December 1959
RCS DD-SD(M) 242

FOREWORD

This is the first report submitted since reorientation of the Military Satellite program by the Advanced Research Projects Agency in November, 1958. The new program objectives for the SENTRY and MIDAS programs have not yet been approved, so specific progress toward approved objectives cannot be reported at this time. Development plans are now being written for the reoriented programs for submission to the Advanced Research Projects Agency and the Air Staff.

B. A. SCHRIEVER
Major General, USAF
Commander

[redacted]

WDPCR-58-10

[redacted]

[redacted]

I. DISCOVERER PROJECT

A. DISCOVERER FLIGHTS

1. DISCOVERER FLIGHT I

The first launch is now scheduled for 13 January 1959.

Difficulties with the facilities checkout and operation caused postponement of the first flight, but are now being corrected.

The first flight payload will consist of telemetry.

The first DISCOVERER flight was rescheduled from December to 13 January 1959. Flight operation crews are taking advantage of this additional time for further intensive training.

Difficulties were encountered with the checkout of the THOR booster on the launch pad and the operation of blockhouse launch control and monitoring equipment. The booster checkout delay was caused by minor discrepancies in the booster and booster checkout equipment. Discrepancies were found in the guidance system checkout console for the DISCOVERER vehicle. An alternate procedure for the DISCOVERER guidance system checkout has been devised and system checkouts are continuing.

The first flight will carry a payload consisting of telemetry to provide data on performance of the booster and the orbit vehicle, and data concerning the space environment.

2. DISCOVERER FLIGHT II

DISCOVERER II is scheduled for launch on 11 February 1959. Flight configuration and objectives are the same as DISCOVERER I.

The second DISCOVERER launch is scheduled for 11 February 1959. The configuration, payload, and flight objectives are essentially the same as for the first flight. The first two flights will employ JP-4 fuel for satellite propulsion, with inhibited red fuming nitric acid as the oxidizer.

[redacted]

[redacted]

[redacted]

B. FACILITIES AND SITES

1. LAUNCH

All equipment for the first two flights is in place.

All vehicle checkout and ground support equipment required for the first two flights is in place at Vandenberg Air Force Base and checked out.

2. TRACKING

The ground station network is ready for the first flight.

The DISCOVERER ground station network is ready for the first flight. The interim Control Center at Palo Alto, including the interlocking computer, are operationally ready. All tracking stations are ready and interstation communication links, voice and teletype, are fully installed. The computer program, including provision for orbital tracking data from Space Track stations, was satisfactorily checked out. Equipment calibration and missile tracking exercises were conducted at all stations, and system runs successfully accomplished.

The DISCOVERER network tracked the THOR demonstration missile launched from Vandenberg Air Force Base with excellent results.

The THOR Weapon System demonstration missile fired from Vandenberg Air Force Base on 16 December was successfully tracked by the DISCOVERER communications system with the exception of the Alaskan stations, which were out of range. The data acquired by the DISCOVERER network was better than that from any other tracking network. This was the first test of the network for tracking a missile in flight, and the results were very gratifying.

[redacted]

[redacted]

C. GENERAL

1. SATELLITE AIRFRAME

The first two flight test vehicles are at Vandenberg and ready for launch on the established schedule.	The first two flight test vehicles have been successfully subjected to hot firings at the Santa Cruz Test Base with all flight equipment installed and operating. Both vehicles were accepted by the Air Force and are at Vandenberg Air Force Base. Final adjustments for flight have been accomplished.
The third flight will now use the higher performance UDMH configuration engine.	Flight objectives now require the use of higher-performance UDMH fueled vehicles on the third flight rather than the fifth, as originally scheduled. The satellite airframe design has been modified for compatibility with this engine.
The vehicles are marked as "ARPA DISCOVERER".	Vehicle markings have been changed so as to identify the vehicles only as "ARPA DISCOVERER".
Design refinements are under study.	Various investigations are underway to further refine the present design and reduce the weight of the DISCOVERER vehicles. Aluminum wiring is being studied as a substitute for the copper wire now used. The weight of the wiring harness could be reduced 30 percent if the substitution proves practical.
Major tests of hardware completed satisfactorily.	Major hardware testing has been satisfactorily completed, including DISCOVERER/THOR separation tests, tank corrosion tests, destruct tests, and qualification tests of many major components.

[redacted]

[redacted]

[redacted]

2. SATELLITE PROPULSION SYSTEM

Engine production is on schedule.

Engine deliveries are on schedule. As of 26 December, ten engines were delivered, two of JP-4 and eight of UDMH configuration.

Variable performance of UDMH engines is under investigation.

Performance variations among UDMH fueled engines have caused postponement of the engine reliability program until the cause has been determined. Fuel and oxidizer temperature deviation could be the cause of the variations. A study is underway to determine how propellant temperatures affect engine performance.

The UDMH engine qualification program is underway.

The manufacturer is conducting a UDMH engine qualification program, using a test installation simulating installation in the flight test vehicle. Engine firings began in late November and eight hot firings have been conducted to date, of which the last two were 120 seconds duration each.

3. AUXILIARY POWER SUBSYSTEM

Static power inverter design problems have been solved.

Difficulties with static (electronic) power inverters have been essentially eliminated. Satisfactory 400 and 2000 cycle static inverters have been developed for the second and subsequent flights. Inverter deliveries are somewhat behind schedule due to design changes, but immediate requirements are being met. Efforts will continue toward further refinement of the static inverter design. A conventional rotary inverter of proven performance but greater weight will be used on the first flight.

[redacted]

[redacted]

[redacted]

4. SATELLITE GUIDANCE AND CONTROL SYSTEM

Guidance and control systems for the first four flights are available.

Guidance and control equipment is on hand for the first four flights. Design refinements are being made in the equipment for use on subsequent flights for increased performance and reliability.

5. BIOMEDICAL RECOVERY PROGRAM

The third flight vehicle is being readied on schedule.

Modification and checkout of the third flight vehicle is substantially completed. This vehicle will be shipped to Santa Cruz test site during January for a hot firing of the modified, UDMH burning engine. The March launch date is expected to be met.

The first and second biomedical capsules have been received by Lockheed Aircraft Company.

The first biomedical recovery capsule has been received (Figure 1) and is being used for training and checkout purposes (Figure 2). The second capsule, for use in the first biomedical flight, has also been received. This second capsule will be installed in the third DISCOVERER vehicle at Santa Cruz Test Base.

The first four biomedical vans have been received at Vandenberg Air Force Base, and the remaining three are virtually completed. Biomedical flight countdown procedures have been completed.

Six biomedical air recovery tests have been completed with good results..

Six attempts have been made to air recover dummy biomedical capsules dropped from B-47 aircraft.

[redacted]

[redacted]

[redacted]

The six capsules were equipped with the silvered parachute, the radar target chaff, and the radio homing beacon. The first test consisted of two drops from 40,000 feet altitude. RC-121 radar tracking aircraft successfully located and tracked both capsules throughout their entire descent, vectoring the C-119 recovery aircraft to the precise intercept area.

The first biomedical capsule was recovered by the C-119 on the sixth attempt at an altitude of 7,500 feet. The second capsule was recovered on the first pass at 13,000 feet. Of the other four drops made, three of the capsules were recovered successfully. The fourth capsule was lost due to failure of the capsule-borne radio homing beacon.

The Hawaii Recovery Control Center is being readied.

Space has been acquired at Hickam Field, Hawaii, for the DISCOVERER Recovery Operations Control Center. The Control Center is being readied for use and will be available on schedule for the third flight. A full recovery system rehearsal will be conducted in conjunction with the March launch of DISCOVERER III.

II. SENTRY PROGRAM

A. SENTRY FLIGHTS

The SENTRY program has been reoriented, and new development plans are being prepared to establish program objectives and schedules.

Because of the ARPA-directed SENTRY program reorientation, specific program objectives and firing schedules are not yet completely developed nor approved.

[redacted]

[redacted]

Development plans are being prepared by AFBMD based on results of briefings presented to ARPA and the Air Staff on 16-17 December. When the new development plans are approved, specific progress toward new objectives will be reported.

The THOR boosted flights have been redesignated as the DISCOVERER program.

The general result of the program reorientation has been separation of the THOR boosted and ATLAS boosted flights into the DISCOVERER and SENTRY programs, respectively. Both programs will utilize the same basic satellite vehicle, although on-orbit weights will vary due to payload differences and booster capabilities.

B. FACILITIES AND SITES

1. LAUNCH

The contract for the Point Arguello launch complex was awarded on 30 December. The contract for the Guided Missile assembly building at Vandenberg Air Force Base is expected to be let by 5 February.

The contract for the launch complex at Point Arguello was awarded on 30 December. Plans and specifications for the construction of the guided missile assembly building were forwarded to the Los Angeles District Engineer on 10 November. Permission to advertise was withheld pending studies by ARPA concerning the location of the facility. However, siting on Vandenberg Air Force Base, as designed, was approved by ARPA on 19 December 1958 and funds are in the process of being released. Bid advertising will be completed in time to permit contract award on 5 February 1959.

[redacted]

[redacted]

Construction of the permanent tracking and data acquisition station at Vandenberg Air Force Base is under contract with completion scheduled for August 1959.

Construction at the Hawaii station will be completed in June 1959.

Design of the Northwest, Central, and Northeast stations is in a deferred status.

The contract for the permanent tracking and data acquisition station at Vandenberg Air Force Base was awarded on 8 December. Completion is scheduled for August 1959.

The construction required to complete the Hawaii tracking and data acquisition station is scheduled for completion in June 1959.

Design of the Northwest, Central, and Northeast tracking and data acquisition stations has been placed in a deferred status pending realignment of the technical concept of the program, as directed by ARPA.

C. GENERAL

1. SUBSYSTEMS

a. AUXILIARY POWER

Development of advanced auxiliary power supplies has been accelerated. Emphasis is being placed on solar and nuclear systems.

The comments pertaining to DISCOVERER airframe, propulsion, auxiliary power, and guidance are applicable to the SENTRY program. Reference pages 3, 4, and 5.

Development of Advanced Auxiliary Power systems (APU) has been accelerated. Emphasis is being placed on solar and nuclear systems, but high-energy storage battery systems are being developed for a back-up capability.

[redacted]

[redacted]

Solar-power unit design is about one-third complete.

The detail design of the Solar APU for the SENTRY vehicle is one-third complete. This unit will provide a minimum of 200 watts average continuous power under least favorable conditions and 600 watts under most favorable conditions. Design of the Solar APU Telemeter, which will transmit data on Solar APU operation for the lift of the unit, has begun.

High energy batteries are also being designed for backup of the Solar-Nuclear programs.

The design concept for a high energy Hydrogen-Oxygen battery auxiliary power system has been completed and detailed design criteria are being established. The design output is 250 watts, but much higher output is expected. A high-energy Borohydride-Oxygen battery is also under development. A 5-watt laboratory unit is completed and plans are completed for a 100-watt prototype unit.

B. VISUAL RECONNAISSANCE

Development of visual reconnaissance equipment is well advanced.

Current planning is for launch of photo-reconnaissance SENTRY satellites into 300 mile high circular polar orbits from Vandenberg Air Force Base. The airborne and ground components of the visual reconnaissance system are in an advanced state of development.

The developmental model of the visual subsystem payload was successfully tested.

The developmental model of the complete payload of this subsystem was operated successfully during this report period. The first photographs attained resolution exceeding 140 lines per millimeter. Thermal tests revealed no problems in maintaining the 70° F temperature desired for processing of the film within the satellite. An electronic visual reconnaissance capability is also under study.

[redacted]

[redacted]

[redacted]

C. SATELLITE FERRET RECONNAISSANCE

Ferret launches will be from Vandenberg Air Force Base.

Current planning is for launch of ferret-equipped SENTRY satellites into circular, 300-mile altitude polar orbits from Vandenberg Air Force Base using ATLAS boosters.

Flight testing of prototype ferret system components, installed in an aircraft, will begin soon.

Flight testing of prototype ferret components will begin in January using a modified DC-3 aircraft. The design of this ferret equipment (F-1) makes maximum use of commercially available components for earlier availability. The system will be tested in flights over radars in the New York City area.

Thermal environment tests of ferret equipment were satisfactory.

Ground testing of F-1 ferret equipment is proceeding satisfactorily. Thermal mockup tests reveal no serious temperature problems. The equipment was subjected to conditions simulating noon-to-midnight and twilight orbits.

Development of the ferret (F-2) equipment is on schedule.

All work on the ferret (F-2) equipment is on schedule. In comparison to the F-1 series where early availability was the prime consideration, the F-2 series is designed for reduced weight, increased performance, and greater reliability.

Report Completed on Soviet Bloc Radar

Haller, Raymond and Brown, Inc., subcontractors for high-altitude electronic reconnaissance research, completed a comprehensive report on intelligence and analysis work to date. The report covers an analysis of Soviet Bloc electronic signal environment and various aspects of the effect on a satellite-borne electronic reconnaissance system. An estimate was made of non-communication radiators for the period 1965-1970. Also included are multiple intercept

[redacted]

[redacted]

[redacted]

probabilities for new mathematical models, radar density estimates for the 1960-1962 period, and an analysis of the precision needed to identify an individual radar.

D. DATA HANDLING

Basic concepts for ground data handling systems are established.

The basic concepts for ground data handling systems for all three reconnaissance systems have been established in detail. Development and acquisition of ground data handling equipment has begun.

This subsystem is on schedule.

Development of the Data Processing System is proceeding on schedule. A detailed report reflecting the initial systems design, stage of hardware development, and immediate future plans was prepared and submitted to the Rome Air Development Center.

A system design inspection will be held in early March.

A System Design Review of the Data Processing System was held on 13-14 November at the Ramo-Wooldridge Denver facility. A system design inspection will be held at the Ramo-Wooldridge Denver facility in early March. An integrated picture of the Data Processing System will be presented to the Air Force at the time of this inspection.

Equipment specifications for photo-optical data processing equipment were completed.

Specifications for the Data Processing System photo-optical equipment were submitted for review to the Rome Air Development Center. They will then be issued to the contractor for equipment procurement. Performance specifications for the initial configurations of the ferret, photo data reduction and communications subsystems have been prepared for submission to the Rome Air Development Center.

[redacted]

[redacted]

[redacted]

III. MIDAS PROJECT

A. SUBSYSTEMS

The infrared attack alarm system is redesignated as MIDAS.

The former SENTRY infrared Attack Alarm System (Subsystem "G") has been redesignated Missile Defense Alarm System (MIDAS) and is now a separate program. Studies are in progress to reorient this program and achieve early orbital flight tests.

Successful tests of infrared emanations from rocket engines have been made at the Air Force Missile Test Center.

During this reporting period, flights of infrared instrumented B-47 aircraft were performed to gain data on the infrared emanations from ballistic missiles launched from the Air Force Missile Test Center. After initial instrumentation troubles were corrected, the tests were successful. The rocket engine of the ATLAS 10B was tracked by infrared for the entire powered flight.

Two MIDAS infrared scanners are nearing completion.

Two flight configuration MIDAS infrared scanners are nearly completed. Testing and evaluation of the units should begin in early 1959.

[redacted]

[redacted]

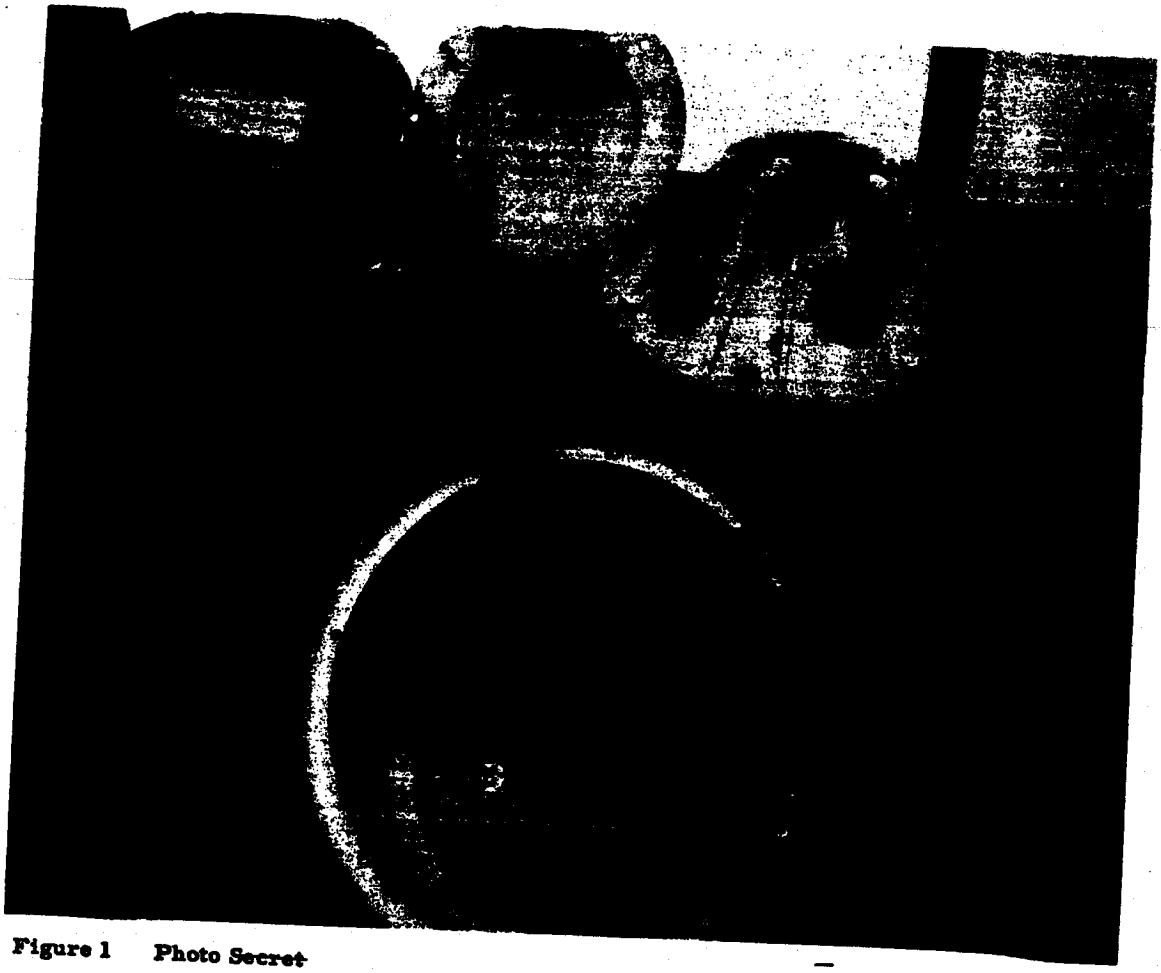


Figure 1 Photo Secret

Caption Unclassified

Disassembled component assemblies of DISCOVERER Biomedical Recovery Capsule. This Mark I Capsule weighs one hundred ninty-four pounds and will be fitted to JP-4 powered DISCOVERER satellites for flights three and four early in 1959.

(WDPCR-58-10)

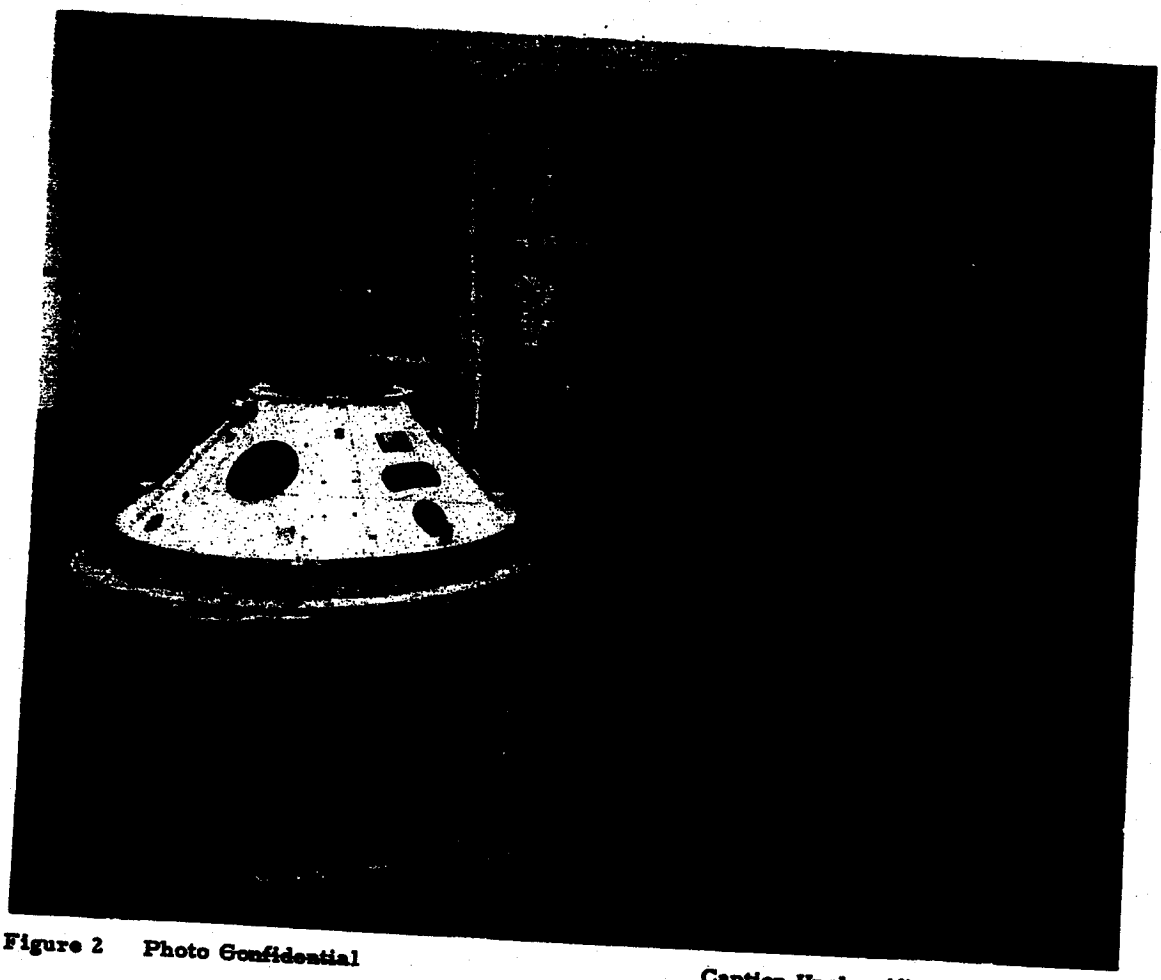
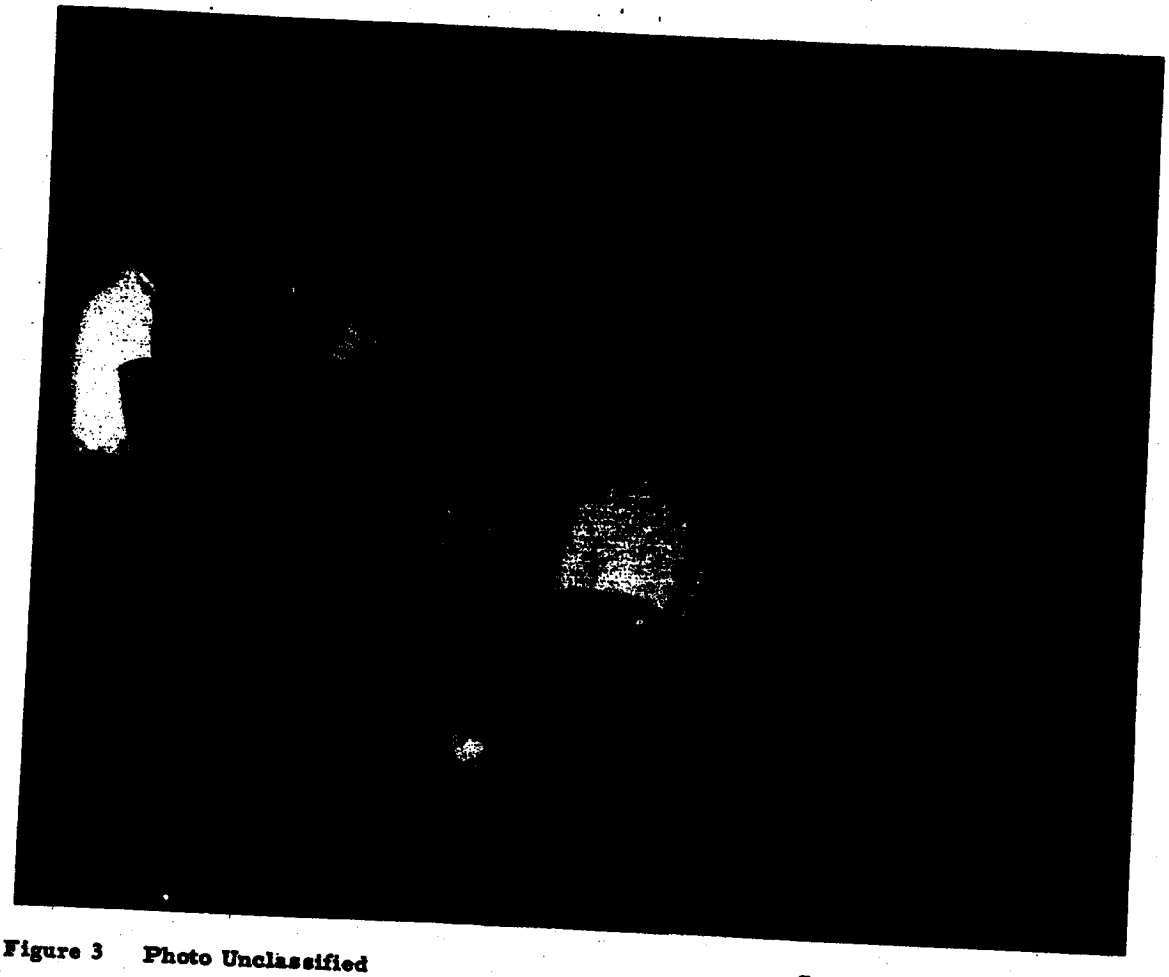


Figure 2 Photo Confidential

Caption Unclassified

Mark I Biomedical Recovery Capsule standing beside Laboratory Checkout Console. Space-environmental tests are conducted to determine heat and radiation characteristics as they are likely to affect the space-borne animals and equipment.
(WDPCR-58-10)



UNCLASSIFIED

Figure 3 **Photo Unclassified**

Caption Unclassified

A portion of the checkout console for the DISCOVERER satellite. This equipment is installed in the blockhouse adjoining launch pad 4 at Vandenberg Air Force Base. (WDPCR-58-10)

UNCLASSIFIED

Figure 4 **Photo Unclassified**

Caption Unclassified

Thor booster lowered to horizontal position for mating with the DISCOVERER satellite flight test vehicle.

(WDPCR-58-10)

Figure 5 Photo Unclassified

Caption Unclassified

Transporter-erector being raised preparatory to lowering Thor missile 160 for mating with DISCOVERER satellite flight test vehicle.

(WDPCR-58-10)

Figure 6 Photo Unclassified

Caption Unclassified

United States Air Force Thor missile 160, booster for the first DISCOVERER satellite, on launch pad during checkout prior to mating with the satellite vehicle seen at the right.

(WDPCR-58-10)

Figure 7 Photo Unclassified

Caption Confidential

Mating of first DISCOVERER flight test vehicle to Thor missile. The satellite and its integral second stage weighs approximately 7,000 pounds at launch. Orbiting weight of the satellite after fuel exhaustion is approximately 1,300 pounds. (WDPCR-58-10)

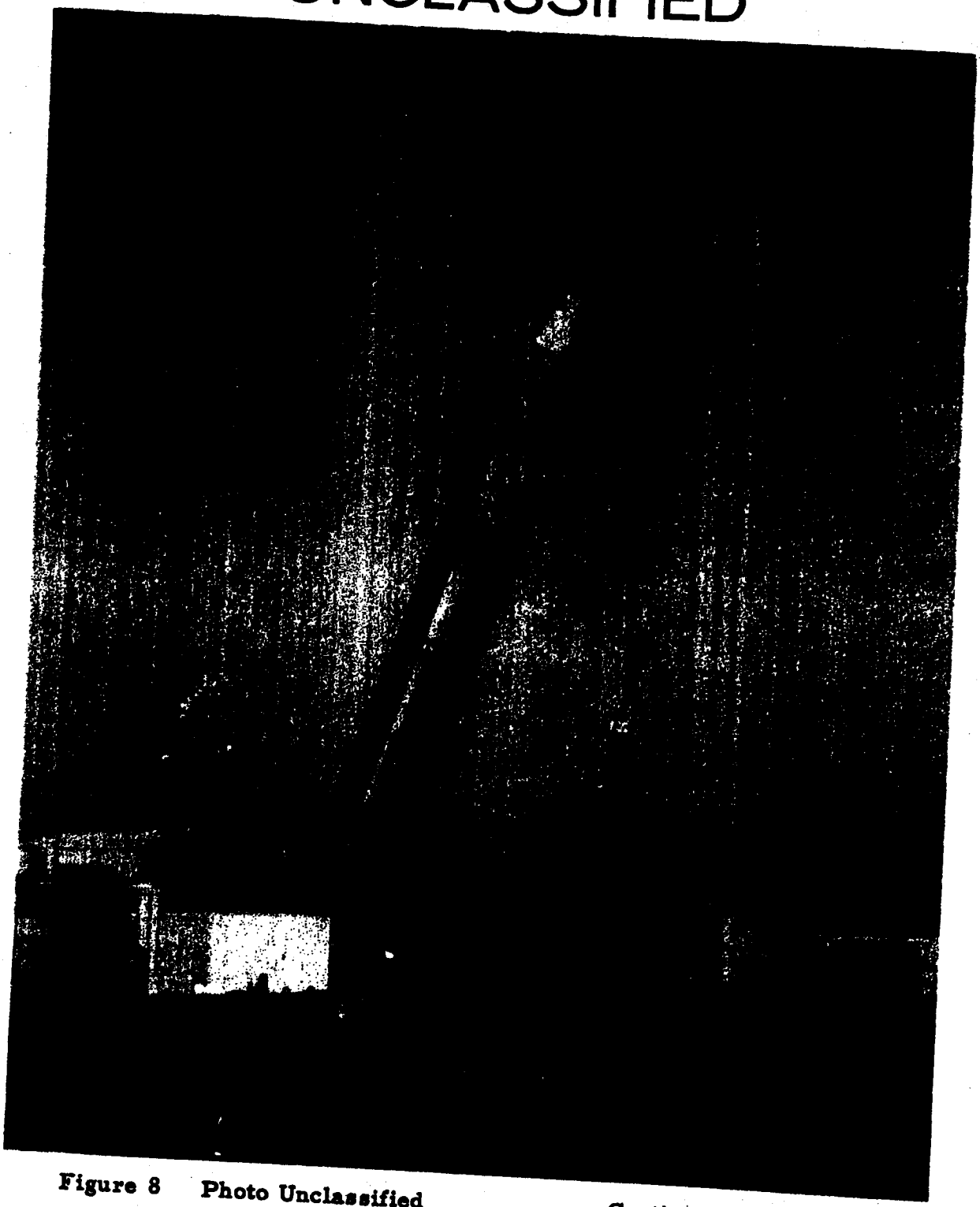


Figure 8 Photo Unclassified Caption Unclassified

First DISCOVERER flight test vehicle being raised to launch position on pad 4 Vandenberg Air Force Base. After fueling, the 78 foot booster-satellite vehicle will weigh more than 100,000 pounds.

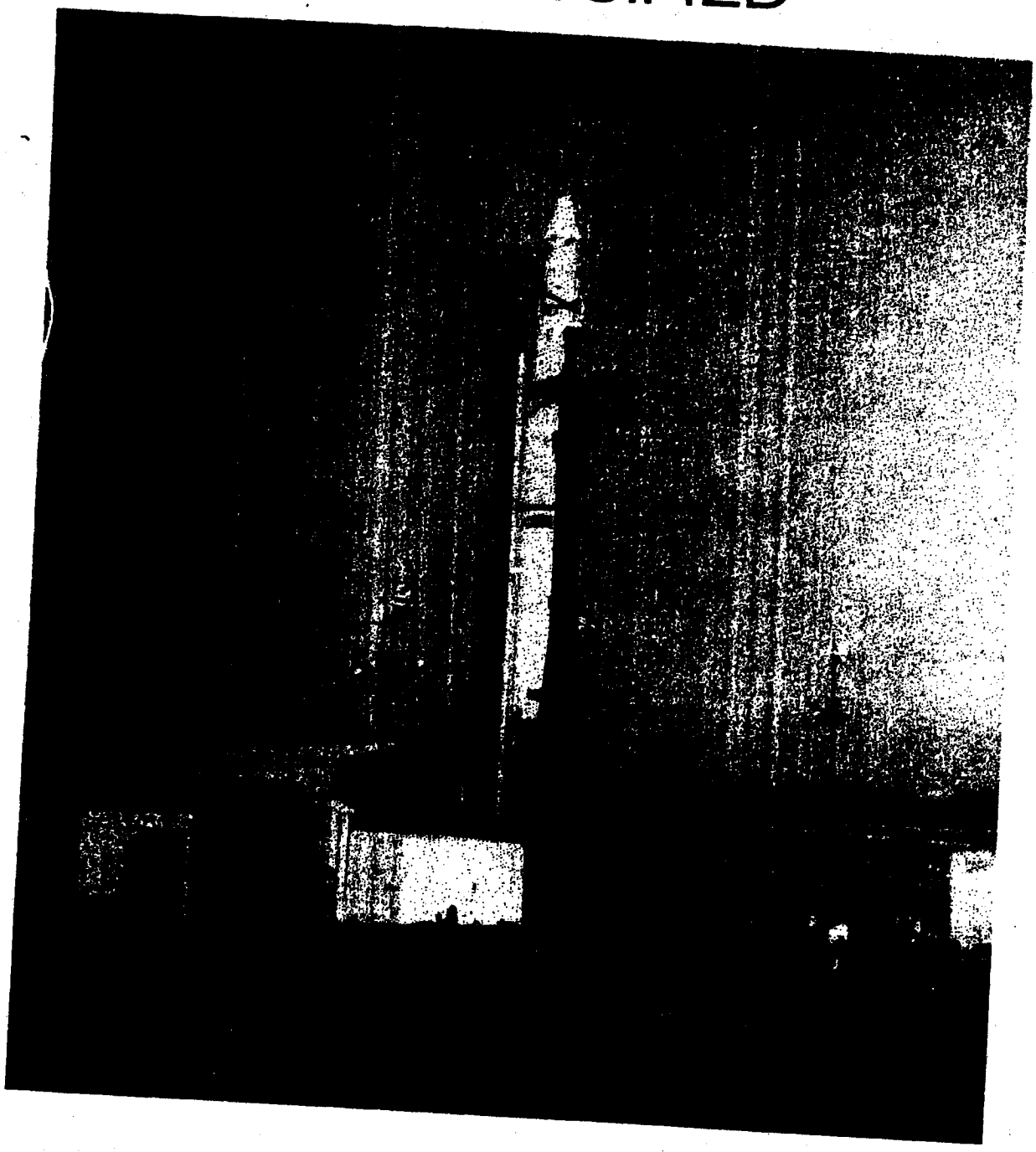


Figure 9 Photo Unclassified Caption Unclassified

First DISCOVERER satellite mated to first stage Thor missile 160, Vandenberg Air Force Base. The 78 foot booster-satellite will be launched vertically and inclined into an south-southwest trajectory leading to its orbit about the earth. (WDPCR-58-10)

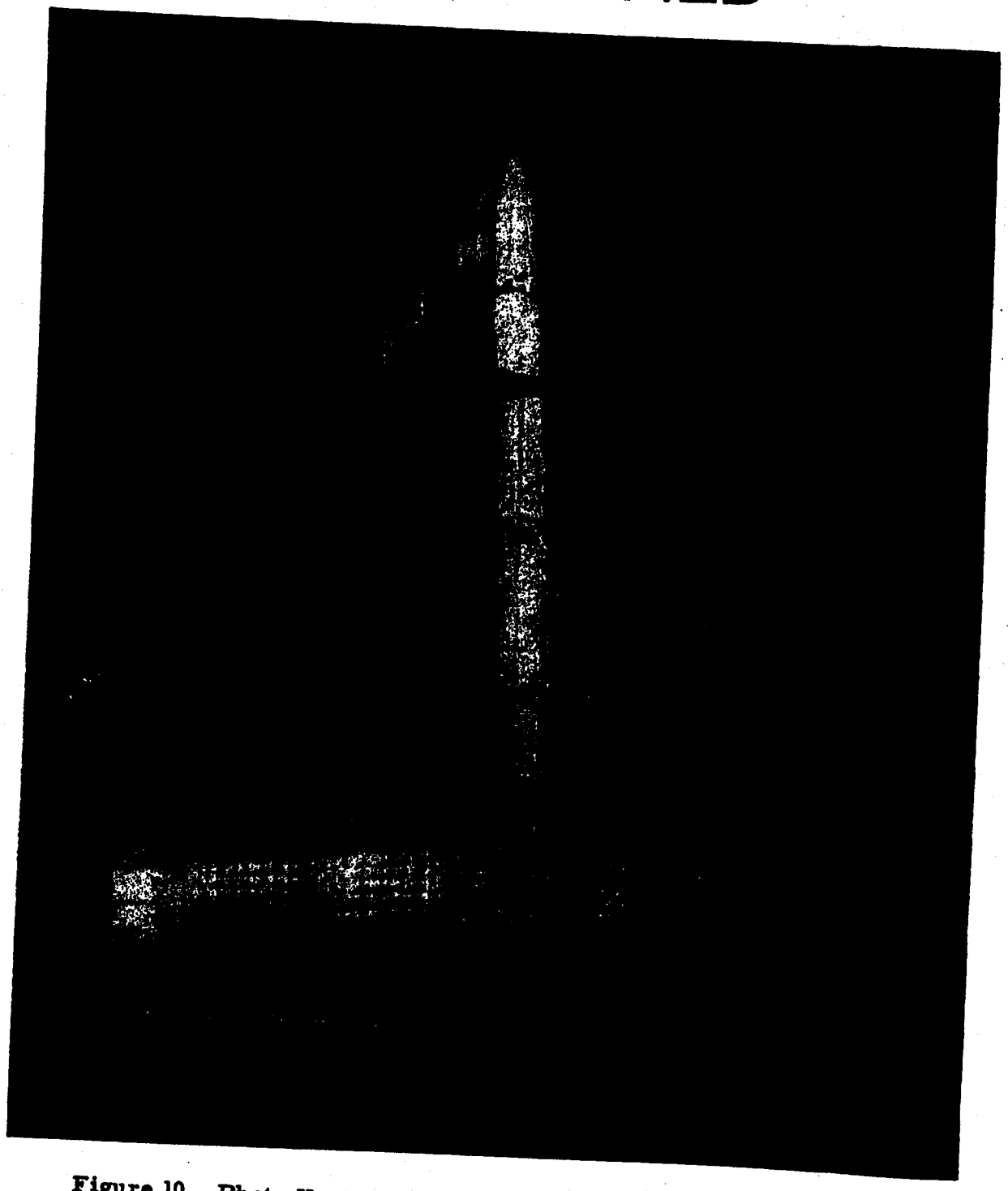


Figure 10 Photo Unclassified Caption Unclassified

First Discover satellite and its Thor booster on launch pad 4, Vandenberg Air Force Base. Technicians are held aloft by huge "cherry picker" cranes while working on umbilical connections in preparation for fueling.
(WDPCR-58-10)

[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)	11
Ballistic Missiles Center (Hq AMC)	3
Assistant CINCSAC (SAC MIKE)	2

[redacted]