

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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NAME <i>J. Gill</i>	TEL. NO. (or code) & EXT.
CODE (or other designation)	DATE <i>6/18/71</i>

MEMORANDUM

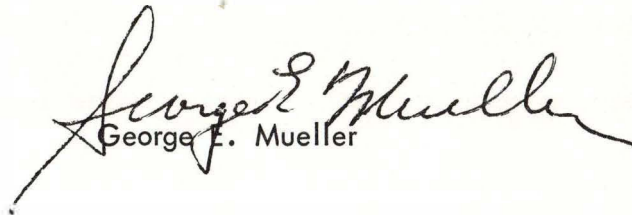
June 1, 1965

To : A/Administrator

From : M/Associate Administrator for Manned Space Flight

Subject: Gemini Flight Number Four (GT-4) Additional Flight Activities

Subsequent to the preparation of the GT-4 Mission Operation Report several new procedures and items of equipment have progressed to a stage of flight readiness. Consequently, three significant additional flight activities are now possible and have been included in the mission. These activities are: extra vehicular activities (EVA); extra vehicular propulsion; and demonstration of rendezvous with the booster second stage. Additional details of these flight plan activities are provided in the attached supplement to the basic report.


George F. Mueller

Enclosure:

MOR No. 913-65-04

Change 1

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ADDITIONAL GT-4 FLIGHT PLAN ACTIVITIES

Three additional special engineering and operational objectives are now planned for the first four orbits of the GT-4 Mission:

1. Demonstration of extravehicular activities (EVA) using a 25 foot umbilical. Potential future application includes crew transfer, in-flight repair, and inspection of orbiting objects.
2. Demonstration of extravehicular maneuvering using a simple, one-man propulsion unit. This device could be used with or without a spacecraft tether on future missions.
3. Demonstration of rendezvous with the booster second stage. This activity will provide valuable early information and maneuvering procedures necessary to rendezvous with a target vehicle. Flashing lights identical to those designed for the Gemini/Agna Vehicle have been installed on the booster second stage for this test.

The Flight Plan sequence involves post-launch separation from the launch vehicle, then maneuvering to stop the spacecraft separation velocity. The first two orbits will be flown with the spacecraft at distances less than one quarter of a mile from the launch vehicle. Nighttime separation will be sufficient to prevent the flashing lights from disturbing the pilot's visual dark adaptation. The first orbit will be occupied with operational checks of the spacecraft guidance, maneuvering, and environmental control systems. The pilots will utilize the second orbit to prepare for the extravehicular activity. This procedure involves unstowing and assembling a 25-foot umbilical, the emergency oxygen pack, a maneuvering unit, and the cameras. Over Hawaii, at daybreak, near the end of the second orbit, the cabin will be depressurized and Jim McDivitt will maneuver to within close proximity of the booster. At this point, the right hatch will be opened and Ed White will climb out and hold on the right forward portion of the spacecraft until McDivitt gives him a release command. Upon command, White will push off slowly and reorient himself with the hand-held maneuvering unit to face the booster. A 35-mm still camera (Zeiss-Contarex) mounted on the maneuvering unit will be used to photograph the booster and spacecraft with various earth/sky backgrounds. After testing his ability to maneuver in a zero gravity environment, White will maneuver back toward the spacecraft and ingress. The total time separated from the spacecraft will be approximately 10 minutes. He will be inside with the cabin repressurized by the time the spacecraft passes over Ascension Island on the start of the third orbit.

Shortly after passing Ascension, McDivitt will maneuver ahead of the booster with 5 feet per second separation velocity. Because this maneuver places the spacecraft in a higher altitude and longer period orbit than the booster, it will rise above and fall behind the booster. One orbit later, the spacecraft

will trail 16 miles behind the booster. At this point, a spacecraft retardation maneuver of 13 feet per second will initiate the visual rendezvous sequence. The spacecraft will approach the booster from behind and below. Because of unknown variation in the atmospheric density and drag of the slowly tumbling booster, the exact approach trajectory cannot be predicted. The flight crew will measure elevation angles of the booster and will initiate rendezvous maneuvers when the booster is approximately 45 degrees elevation angle above the spacecraft. By observing the movement of the booster with respect to the star background and with respect to the spacecraft inertial platform display, the crew can determine the proper lateral maneuver to null the lateral component of velocity thereby resulting in a spacecraft velocity vector which is directly toward the booster. After removing the lateral velocity difference, the pilot will apply a series of breaking maneuvers with the forward firing thrusters to reduce the closing velocity. The flight crew will measure with onboard instruments the total maneuvering velocity required for the rendezvous procedure. The spacecraft should be back in close proximity of the launch vehicle over the Northeast coast of South America at the beginning of the fifth orbit.

After the rendezvous operation is complete, the spacecraft will again separate from the booster - this time using a maneuver which will place the Gemini spacecraft on an orbit with a predicted lifetime of four days.

The EVA suit is the new G4C suit which replaces the G3C suit used so successfully by the GT-3 flight crew. The G4C suit has the following new features:

- a. Helmet - incorporation of triple lens shield (visors) for visual, thermal, impact, and micrometeorite protection.
- b. Torso -
 - 1. Change to Nomex (HT-1) "Linknet" in restraint layer for increased structural strength.
 - 2. Incorporation of strain relief zipper in sealing closure.
 - 3. Incorporation of redesigned ventilation inlet and outlet fittings with automatic locking and redundant sealing features.
 - 4. Replace Nomex (HT-1) coverlayer with integrated thermal and micrometeorite cover layer.
- c. Gloves - Incorporate new design with increased mobility, abrasion resistance and thermal protection.
- d. Bio-connector - Self-alignment, pin protective design.

Figure 1 depicts the principal physical differences between the old G3C suit and the new EVA G4C suit. Figure 2 shows that with one visor down on the new G4C helmet, there is practically no attenuation of light entering, whereas Figure 3 shows that with two of the visors down there is a noticeable difference in the amount of light that enters the astronaut's eyes. With the third visor down, there would be a similar decrease in the amount of light allowed to enter the helmet.

The multivarious layers of materials used in the EVA G4C suits are delineated in Figure 4. It should be noted that the old G3C suit consisted only of the pressure and restraint layers of Figure 4 with the HT-1 nylon outer protective layer.

The EVA spacesuit has received the following qualification tests:

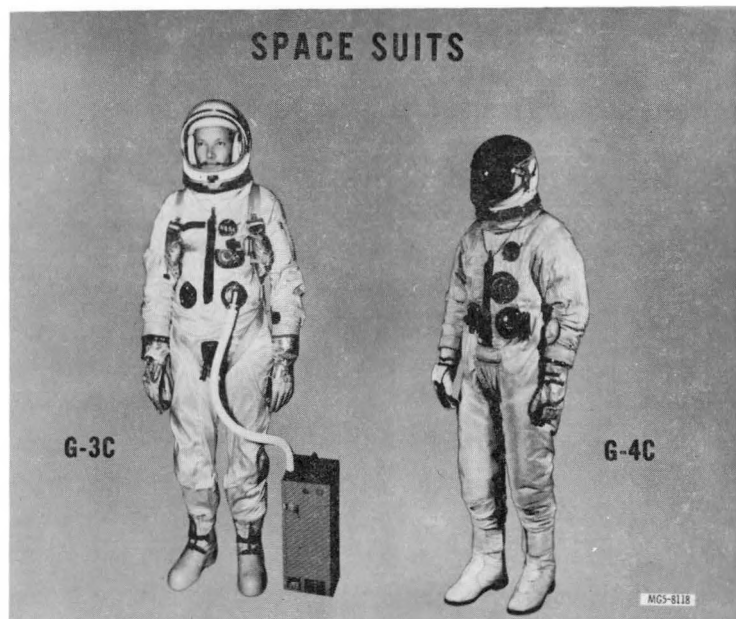


FIG. 1

G-4C
OVERVISOR
SPACE
HELMET



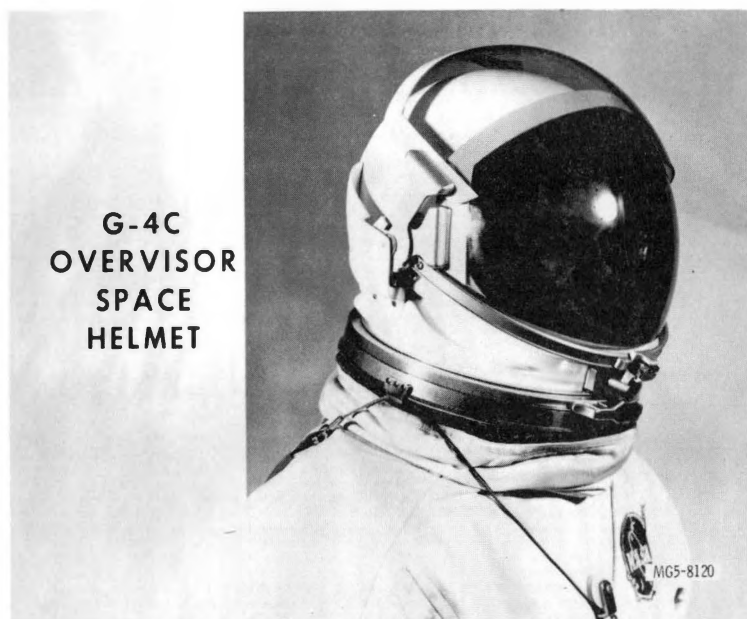


FIG. 3

G-4C EXTRAVEHICULAR SUIT

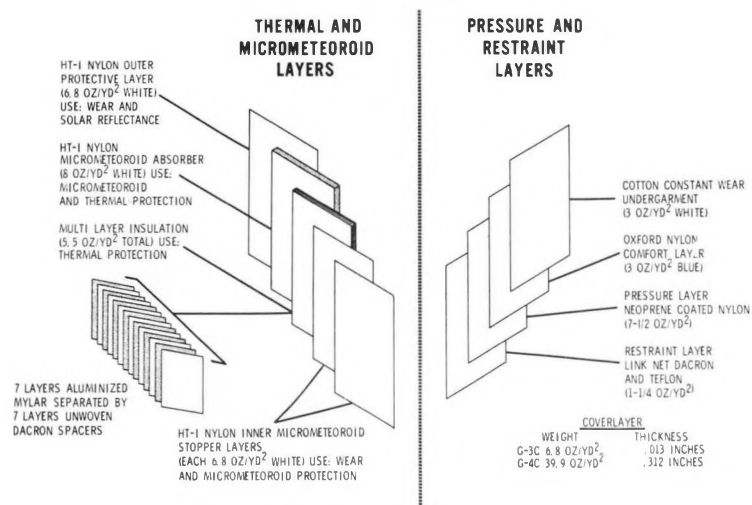


FIG. 4

- a. Leakage
- b. Proof pressure
- c. O₂ compatibility
- d. Ejection envelope
- e. Cold temperature
- f. Rapid decompression
- g. Life cycling
- h. Visor testing

Should the 25-foot long tether fail in some manner, the pilot will be carrying a chestpack that has been compatibility qualified with the G4C suit and consists principally of an emergency oxygen bottle with automatic valving.

It should be emphasized that both the primary and backup flight crews have undergone 40 minutes cabin depressurization with the hatches open at a simulated altitude of 150,000 feet in the chambers at McDonnell, St. Louis during which time they practiced opening and closing the hatches, taking pictures, and other actions that will take place during EVA.

The extravehicular maneuvering will be accomplished using a zero g Integral Propulsion (ZIP) Unit as shown in Figure 5. This device is handheld and accomplishes propulsion by jetting oxygen out through a single forward firing nozzle and two aft firing nozzles as selected and aimed by the operator. It includes a camera mounted for convenient extravehicular photography.

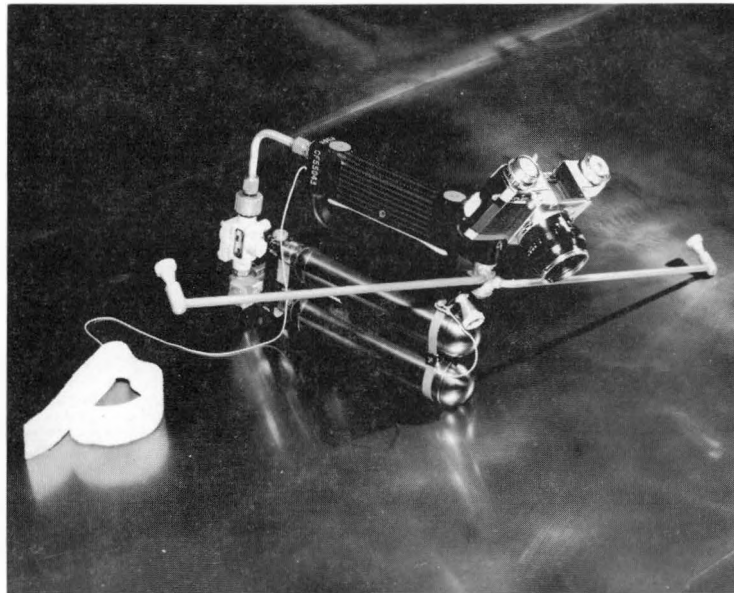


FIG. 5

Mission Operation Report
No. M-913-65-04

MEMORANDUM

May 24, 1965

To : A/Administrator

From : M/Associate Administrator for Manned Space Flight

Subject: Gemini Flight Number Four (GT-4)

GT-4, the fourth in a series of twelve planned Gemini flights is scheduled to be launched from Complex 19 at the John F. Kennedy Space Center on or after 3 June 1965. This will be the second manned Gemini mission and the longest ever attempted by a two-man crew. The purpose of the mission is to further demonstrate manned space flight for a period of four days.

The nominal launch time is 10 a.m. EDT (1400 GMT). The space vehicle is to be launched on an azimuth of 72 degrees and the spacecraft will be inserted into an initial orbit of 87-161 N.M. at an orbital inclination of 32.5 degrees. The 62 revolution mission will have a duration of approximately 97 hours and 50 minutes. The primary and backup flight crews are of the "new generation," being members of the second group of astronauts. James A. McDivitt will be the command pilot and Edward H. White, II will be the pilot. Because the duration of the flight is one of the most significant aspects of their mission, the post-flight activities will involve expanded medical evaluation as compared with previous missions, including at least 24 hours aboard the recovery aircraft carrier, the USS WASP.

After conducting various orbital maneuvers and the thirteen experiments during the four-day mission, the spacecraft will reenter and touchdown approximately 400 miles southwest of Bermuda for a water landing and carrier retrieval.

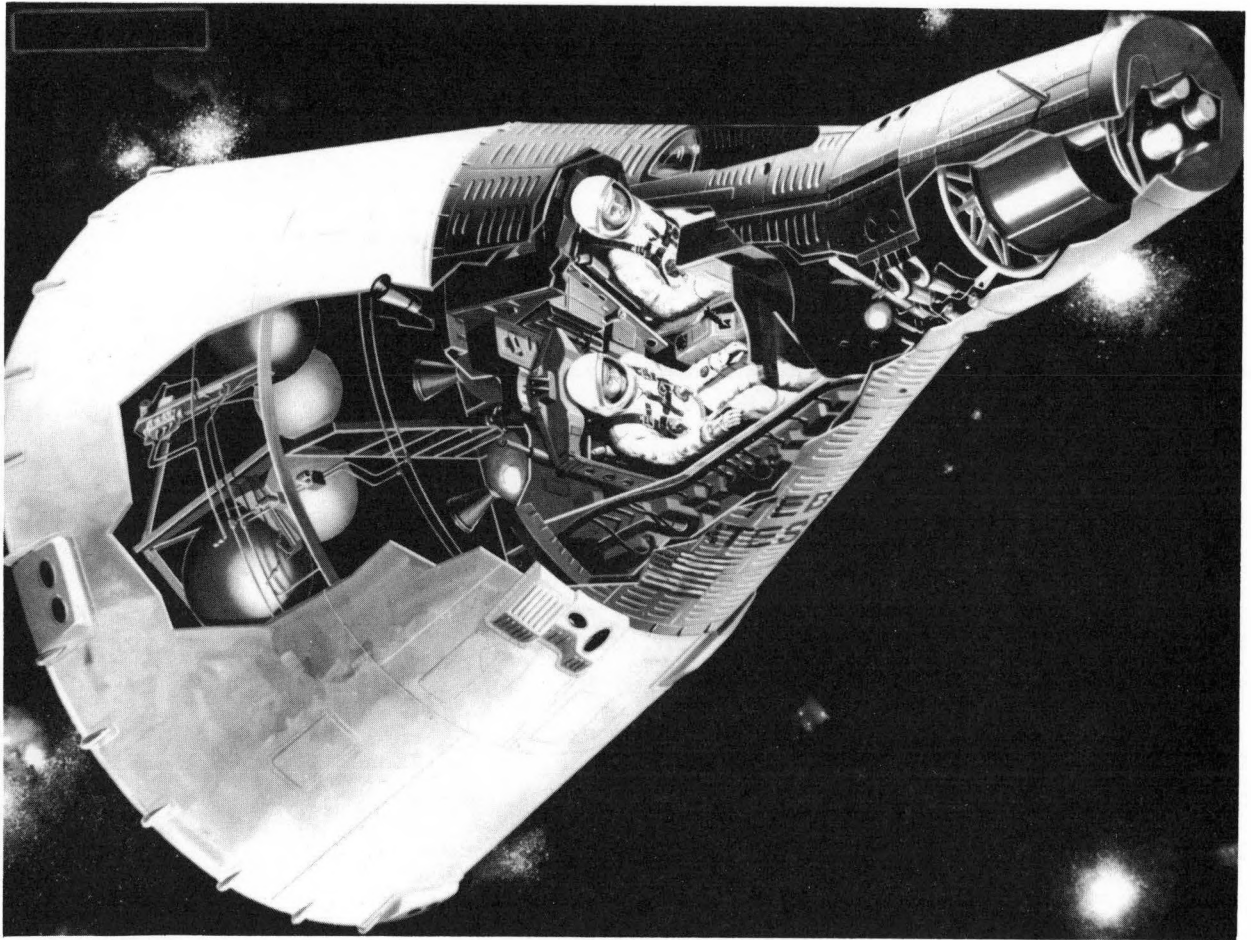

for George E. Mueller

Enclosure

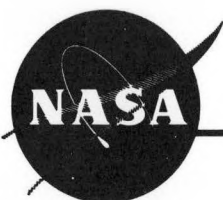
MOR No. M-913-65-04

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MISSION OPERATION REPORT



GEMINI FLIGHT NUMBER FOUR (GT-4)



OFFICE OF MANNED SPACE FLIGHT

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FOREWORD

MISSION OPERATION REPORTS are published expressly for the use of NASA General Management as required by the Administrator in NASA Instruction 6-2-10 dated August 15, 1963. The purpose of these reports is to provide NASA General Management with timely, complete and definitive information on flight mission plans and results from launchings with Scout class or larger vehicles.

Initial reports are to be prepared and issued for each flight project just prior to launch. Following launch, updating reports for each mission will be issued to keep General Management currently informed as provided in NASA Instruction 6-2-10.

Distribution of these reports has been specifically directed by General Management and they are not available for additional or general distribution. The Office of Public Affairs publishes a comprehensive series of pre-launch and post-launch reports on NASA flight missions which are available for general distribution.

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GENERAL

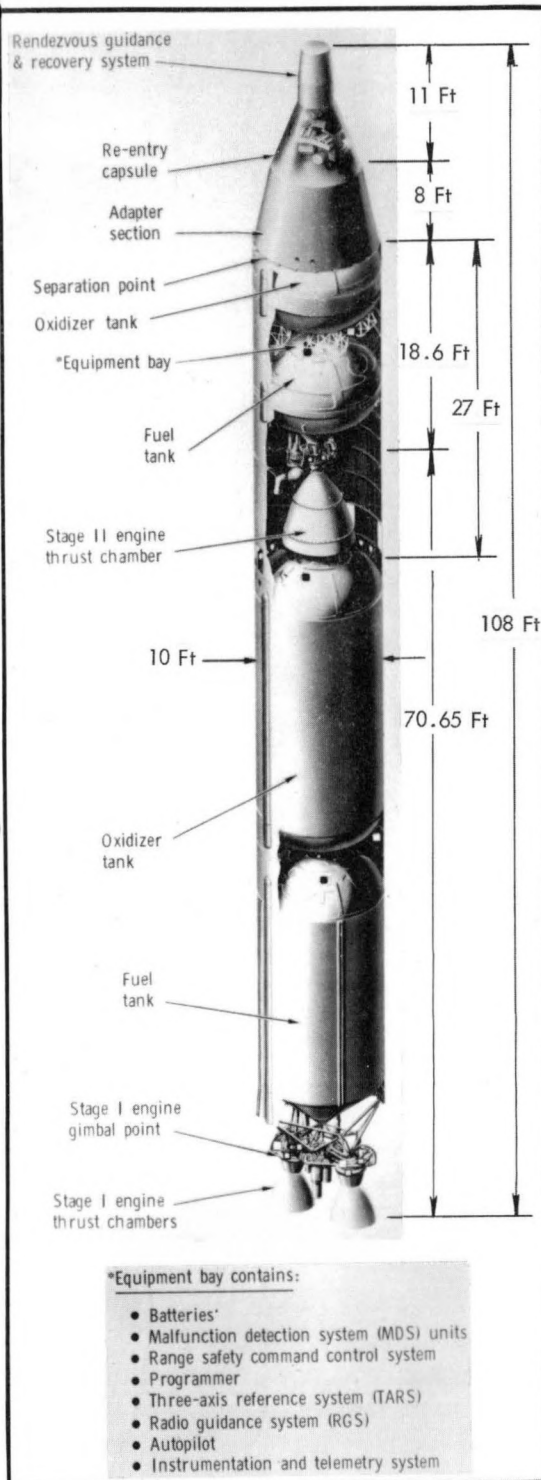


FIG. 1

Gemini Flight Number Four (GT-4) is the second manned orbital flight in the Gemini Program and the fourth flight in a series of twelve planned to develop long-duration and rendezvous capability, docking techniques, extra-vehicular activities, and controlled reentry. The first three Gemini flights demonstrated: orbital insertion capability; spacecraft structural integrity; and spacecraft systems performance and crew accommodation qualities, respectively. This GT-4 mission is intended to further demonstrate manned space flight for a period of four days, the longest ever flown by two astronauts. The space vehicle is depicted in Figure 1.

MISSION OBJECTIVES

PRIMARY

- Demonstrate and evaluate the performance of the Gemini spacecraft systems for a period exceeding four days.
- Evaluate the effects of prolonged exposure to the space environment on the two-man flight crew in preparation for missions of longer duration.

SECONDARY

- Demonstrate OAMS capability to perform retro fire backup.
- Demonstrate the capability of the spacecraft and flight crew to make significant in-plane and out-of-plane maneuvers.
- Conduct further evaluation of spacecraft systems as outlined below:

1. Structure and thermal protection
2. Environmental Control Systems (ECS)
3. Crew stations
4. Guidance and Control System
5. Orbital Attitude and Maneuver System (OAMS)

- Execute the following experiments:

- D-1, Basic Object Photography
- D-6, Surface Photography
- D-8, Radiation in Spacecraft
- D-9, Simple Navigation
- M-3, In-Flight Exercises
- M-4, In-Flight Phonocardiogram
- M-6, Bone Demineralization
- MSC-1, Electrostatic Charge

- MSC-2, Proton Electron Spectrometer
- MSC-3, Tri-Axis Magnetometer
- MSC-10, Two-Color Earth's Limb Photos
- S-5, Synoptic Terrain Photography
- S-6, Synoptic Weather Photography

UNUSUAL TASKS OF THIS MISSION

One of the interesting tasks of this mission is the duration of the flight. It will be the longest ever to be conducted by a two-man crew. Another highly interesting item is that control of the mission for the first time will be from the Mission Control Center (MCC) Houston. Some elements of the Mission Control Center at Cape Kennedy and the GSFC computing facility will be standing by as a backup during the launch phase. The computing facilities at GSFC will also be used as a backup to MCC-Houston during the orbital phase. Flight controllers will man the MCC in three shifts to give complete round-the-clock coverage of the four-day mission. Crew control of reentry will be accomplished by tracking the roll needle rather than nulling the down-range and cross-range needles as on GT-3. The experiments will, of course, contribute much information for the scientific and medical communities. The G4C suit which replaces the G3C suit used on GT-3 has the following new features: a triple overvisor, a redundant pressure closure seal (zipper), and thermal and meteoroid protection integrated in the outer cover layer. Abort procedures to be utilized by the astronauts in the unlikely event it becomes necessary for them to terminate a mission before orbital insertion are different from those used in the Mercury program. In that program, the fireball that would have been created had a conflagration occurred on the pad, would have been large enough to engulf an ejecting astronaut, so it was necessary to add an escape rocket to lift the entire spacecraft free of the area. The GLV, on the other hand, uses self-igniting fuels which, upon mixing, create a fireball small enough so that the astronauts can eject from the spacecraft in much the same manner as is done in today's high performance jet aircraft. This is called the Mode I abort procedure. The three abort modes are more fully defined by the altitude and elapsed time-after-launch parameters depicted on Figure 2.

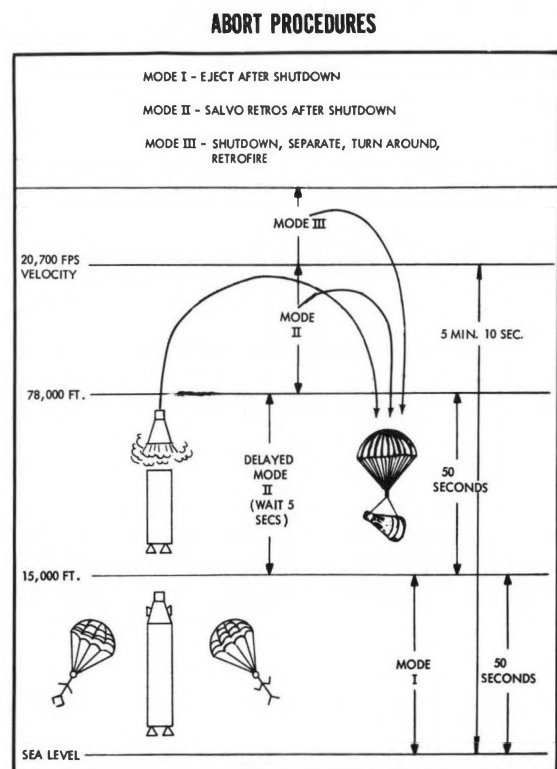


FIG. 2

LAUNCH VEHICLE DESCRIPTION

The Gemini Launch Vehicle (GLV) has been modified by man-rating an Air Force Titan II missile. The GLV has two stages, the first 71 feet long and the second 18 feet long; both stages have a diameter of 10 feet. The gross loaded weight of the two stages is 337,521 pounds and they both burn storable hypergolic (self-igniting upon mixture) propellants. First stage thrust is approximately 430,000 pounds at sea level. Second stage thrust is approximately 100,000 pounds. The various systems of the GLV have been detailed in previous Gemini MOR's and what follows is additional information concerning modifications made to GLV-4. The fuel dampener and oxidizer standpipe used to suppress longitudinal oscillations have been redesigned. Butt welding vice lapped joints have been utilized on the fuel tank conduits to eliminate minute cracks. Malfunction Detection System circuitry has been redesigned to provide separate indications of the subassembly thrust level and additional insulation has been applied to provide increased fire protection. Sixteen T/M readout points have been removed from the GLV because they are no longer required and one range safety circuit has been added to the destruct system interlocking AGE and the GLV motor driven switch control. This circuit will prevent switch cycling in the event that both set and reset signals are inadvertently applied during checkout.

TABLE I
PROJECT COST
(In Millions)

	<u>FY 62</u>	<u>FY 63</u>	<u>FY 64</u>	<u>FY 65</u>	<u>FY 66</u>	<u>FY 67</u>	<u>Total</u>
Spacecraft	30.3	205.1	280.5	165.3	122.7	19.1	823.0
Launch Vehicle	24.4	79.1	122.7	115.4	88.6	8.5	438.7
Operational Support	<u>.1</u>	<u>4.9</u>	<u>15.7</u>	<u>27.7</u>	<u>30.8</u>	<u>13.0</u>	<u>92.2</u>
Total RD & O	54.8	289.1	418.9	308.4	242.1	40.6	1353.9

This level of funding will provide for twelve Gemini Launch Vehicles, twelve spacecraft, seven Agena Target Vehicles, six Atlas booster missiles and the operational costs of flight testing and the associated Ground Support Equipment.

SPACECRAFT

The spacecraft is 18.75 feet long and its two sections, a reentry module and an adapter section will weigh 7799 lbs. fully loaded with the astronauts onboard. The configuration will be the same as was flown on GT-3 except for the following: minor changes have been made to switch positions and nomenclature, three additional (total of six) adapter

batteries will be required, radial thrusting TCA's and burst diaphragms in the "B" package that were removed for GT-3 are both installed on GT-4, and will act through the Spacecraft Centers of Gravity. An HF antenna has been added to the adapter section for orbital use and the HF transceiver there has been removed. The C-band phase shifter now has its own inverter, the recovery flashing light can now be turned off during daylight hours, the HF antenna on the cabin section has been redesigned, and the adapter S-band transponder in the adapter section has been replaced with a C-band transponder which will have a different pulse spacing from the one in the spacecraft. In the GT-4 mission S/C, urine will be dumped directly overboard from the urine bellows through a shut-off and selector valve, a solenoid valve and a heated line. Redundancy is provided by the capability to dump urine through the launch cooling heat exchanger (water boiler). The main chute disconnect cartridge has been changed from a 22-second time delay to a zero second delay and new long-life attitude thrusters have been installed.

EXPERIMENTS

The 13 experiments are depicted and described on the following pages:

1. D-1, Basic Object Photography

In conducting this experiment, the astronauts will employ elaborate photo-optical equipment to investigate the technical problems associated with observing, evaluating, and photographing objects in space. These objects include the 2nd stage of the launch vehicle and natural celestial bodies such as the moon. Data from this experiment will be used to evaluate the astronauts' ability to view and track objects, and to maintain object-camera orientation by maneuvering the spacecraft. Equipment which will be used is illustrated in Figure 3.

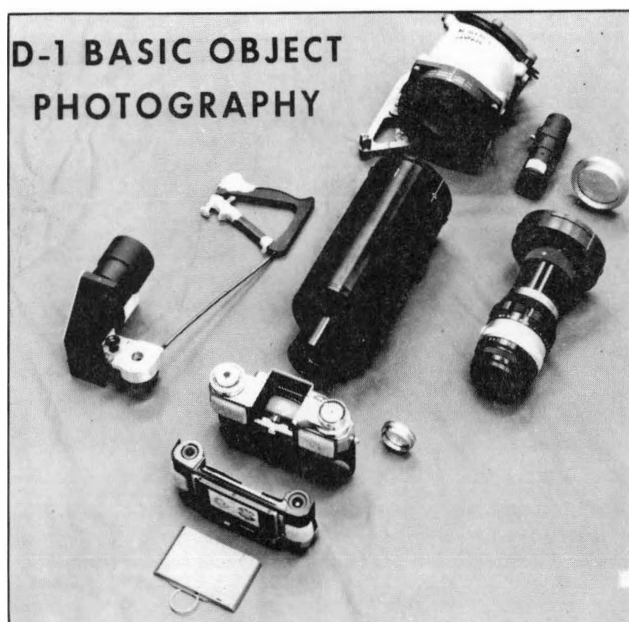


FIG. 3

2. D-6, Surface Photography

This experiment will investigate the technical problems associated with an astronaut's ability to acquire, track, and photograph terrestrial objects from a spacecraft with more elaborate photo-optical equipment than that used previously. The astronaut will photograph selected series of objects during day-side and night-side intervals of the flight using specified lens-film combinations. The resulting data will be used to evaluate the astronaut's ability to maintain object-camera orientation by maneuvering the spacecraft. Figure 4 shows the camera mount installed on the spacecraft window.

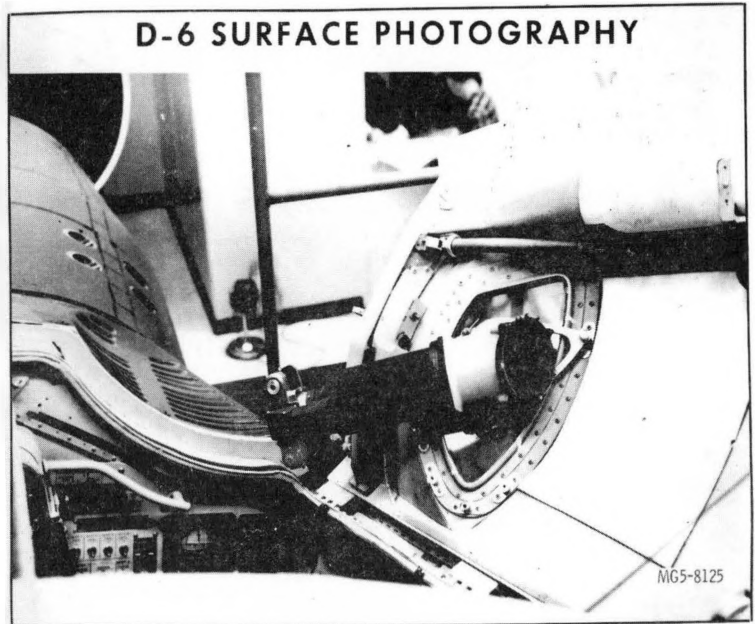


FIG. 4

3. D-8, Radiation in Spacecraft

Data from this experiment will be used to supplement external radiation measurements in studying the dose levels within the spacecraft resulting from passes through regions of varying radiation intensity. Two tissue-equivalent, current-mode ionization chambers will be used to measure the variation of absorbed dose-rate inside the spacecraft. Five small packets containing radiation detection and measurement devices will be placed at various locations in the cabin to ascertain their suitability as convenient dosimeters of space radiation and measure total accumulated dose. Figure 5 shows some of the equipment to be used for this experiment.

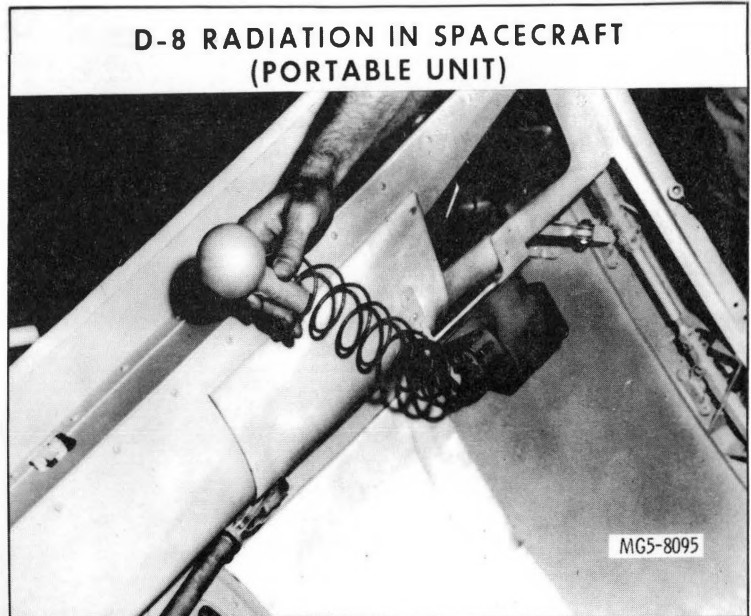


FIG. 5

4. D-9, Simple Navigation

This experiment is designed to develop and test navigation procedures which employ a simple stadimetric device and a sextant to make sightings and measurements in space using the horizon and stars as references. Data from sightings will be used in computations to determine orbital parameters. These results will be compared with actual parameters to determine the accuracy of the procedures. The hand held sextant to be used is shown in Figure 6.

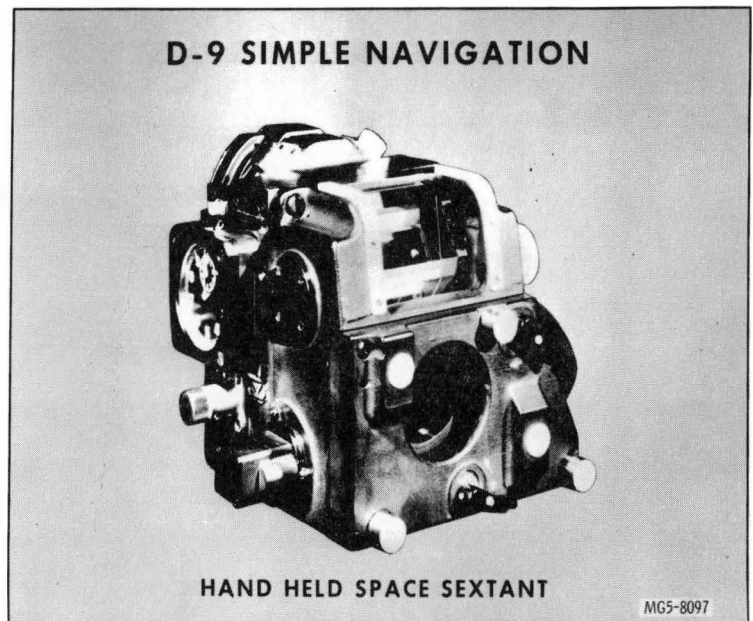


FIG. 6

5. M-3, In-Flight Exerciser

The purpose of this experiment is to assess the astronauts' capacity to perform physical work under spacecraft conditions. Monitored exercise will be performed by the astronauts prior to the flight to establish control data. Isotonic exercises employing a bungee cord and involving the arms and legs will be taken prior to and after exercising. Pulse rate will be monitored continuously. The inflight data obtained will be compared with the control data to determine the capacity for work in space. Figure 7 shows the manner in which this exercise will be performed.

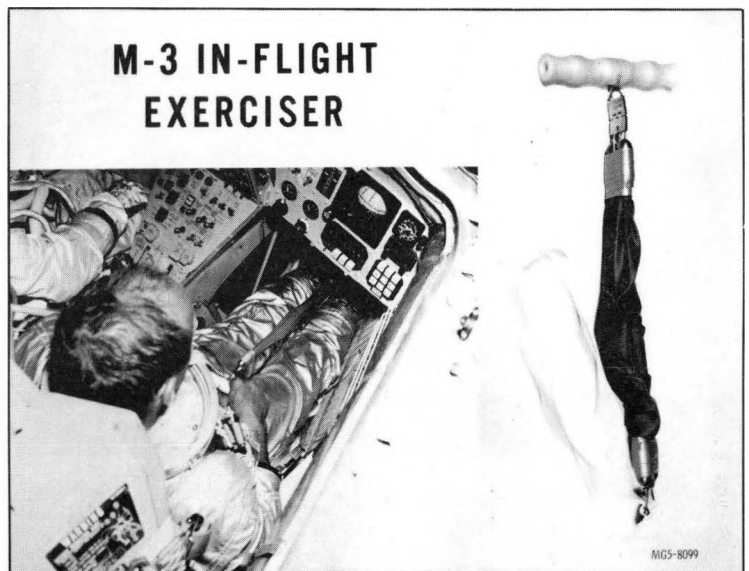


FIG. 7

6. M-4, In-Flight Phonocardiogram

The purpose of this experiment is to measure the fatigue-stage of an astronaut's heart muscle during a long-duration flight. A microphone will be applied to an astronaut's chest wall at the cardiac apex. Heart sounds detected during the flight will be recorded on an on-board biomedical recorder. The sound trace will be compared to the waveform obtained from a simultaneous inflight electrocardiogram to determine the time interval between electrical activation of the heart muscle and the onset of ventricular systole. Figure 8 illustrates the method of installation of the phonocardiogram transducer.

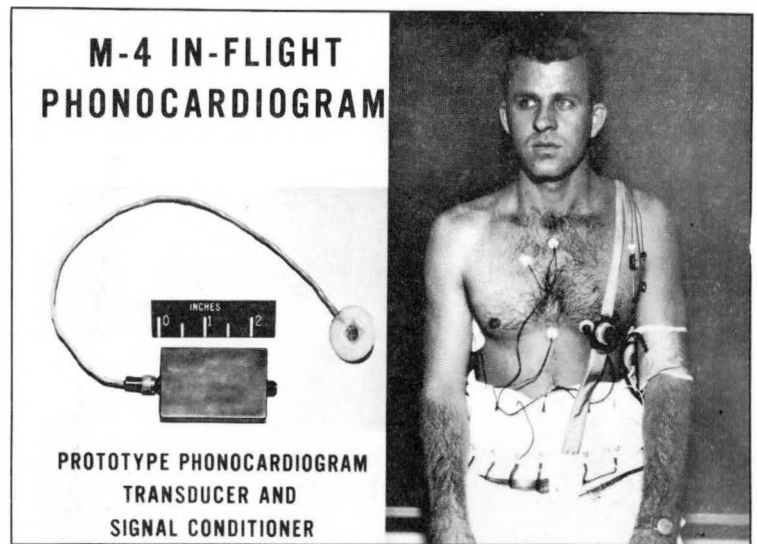


FIG. 8

7. M-6, Bone Demineralization

The purpose of this experiment is to establish the occurrence and degree of bone demineralization resulting from prolonged weightlessness during spaceflight. Special X-rays will be taken of an astronaut's heel bone and the terminal bone of the fifth digit of the right hand. Three pre-flight and three postflight exposures will be taken of these two bones and compared to determine if any bone demineralization has occurred due to the space flight. Figure 9 illustrates the laboratory procedure which will be used for this experiment.

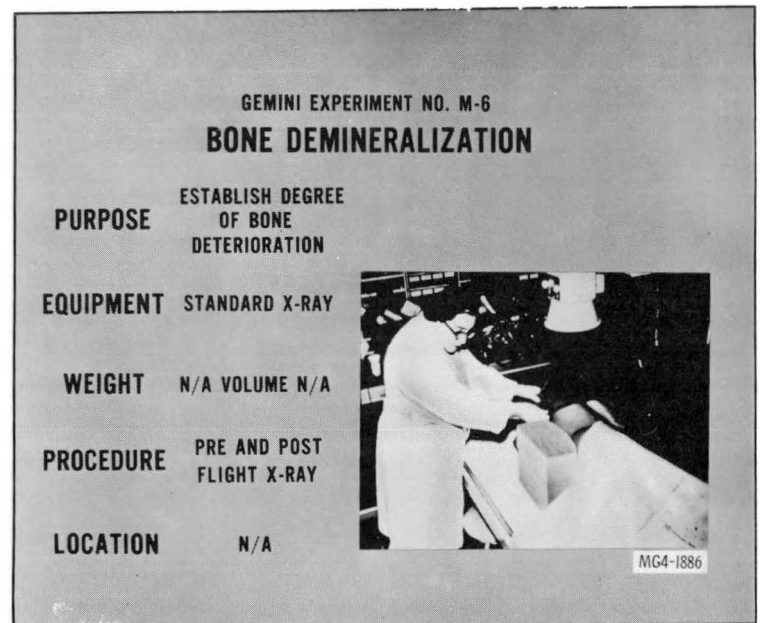


FIG. 9

8. MSC-1, Electrostatic Charge

Before rendezvous missions are attempted, an investigation must be made of the possibility of inadvertent ignition of pyrotechnics and other detrimental effects due to discharge of electrostatic charge potentials during rendezvous. In this experiment, an electrostatic-potential meter, which protrudes through the wall of the spacecraft adapter assembly, will be used to detect and measure any accumulated electrostatic charge that may be created on the surface of the spacecraft by ionization from engine exhaust. This data will be analyzed to determine if the charge is adequate to create a rendezvous hazard. Figure 10 shows the detector installation.

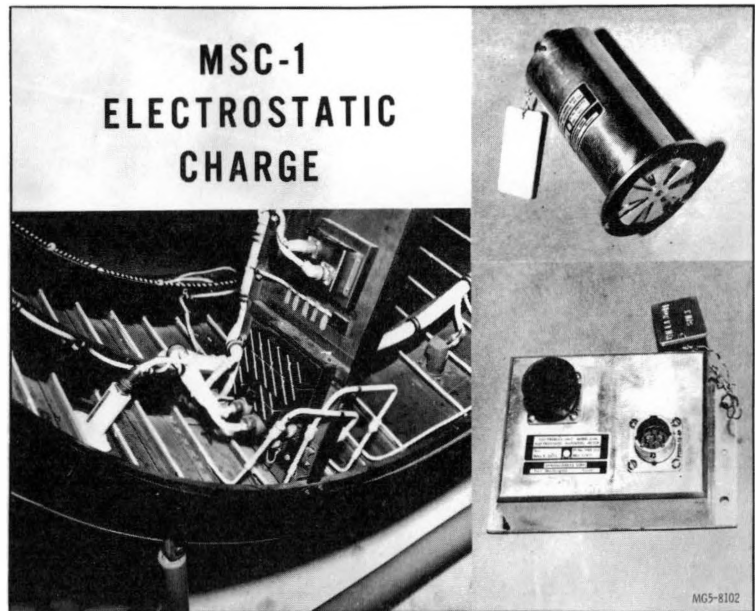


FIG. 10

9. MSC-2, Proton Electron Spectrometer

This experiment is designed to measure the quantity and energy of protons and electrons present immediately exterior to the orbiting spacecraft. This will be accomplished by means of a scintillating-crystal, charged-particle analyzer mounted on the adapter assembly of the spacecraft. Data from this experiment will be used to correlate radiation measurements made inside the spacecraft and to predict radiation levels on future space missions. The proton electron spectrometer installation is shown in Figure 11.

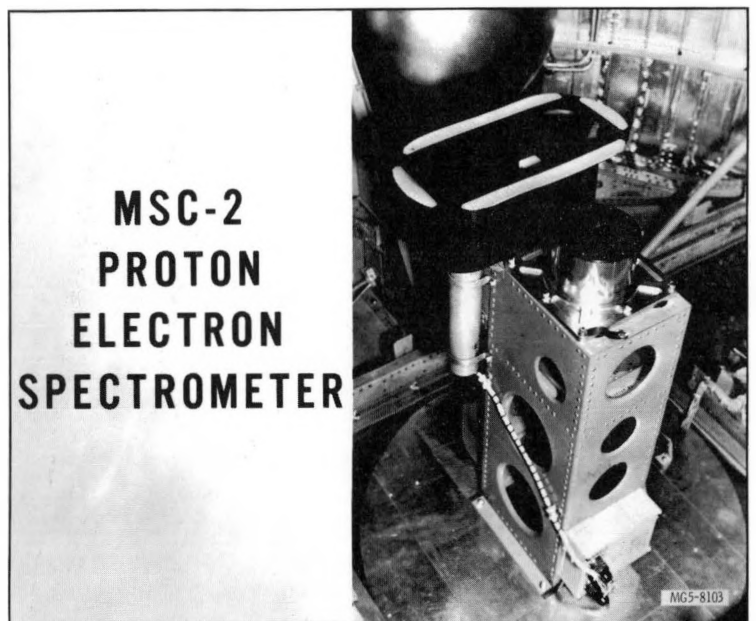


FIG. 11

10. MSC-3, Tri-Axis Magnetometer

In this experiment, the direction and magnitude of the earth's magnetic field with respect to the spacecraft will be measured. A tri-axis fluxgate magnetometer, mounted in the adapter assembly of the spacecraft will be used. The equipment installation is shown in Figure 12.

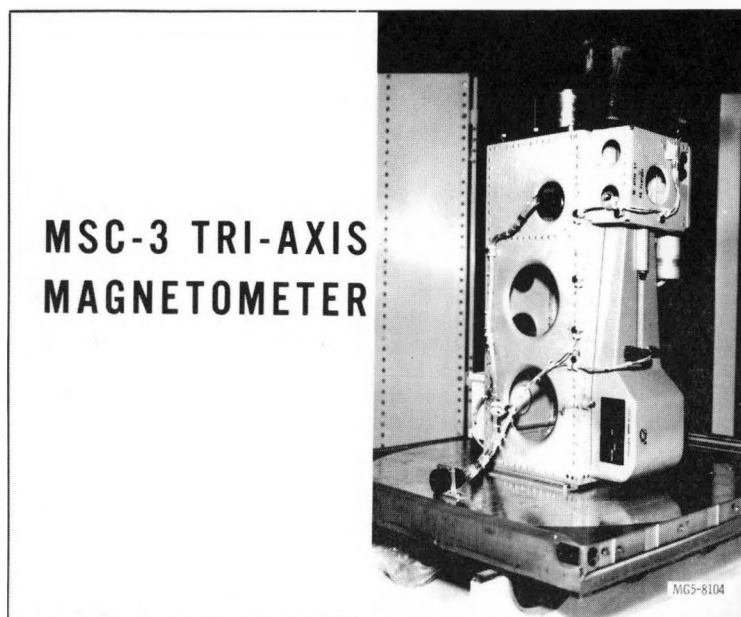


FIG. 12

11. MSC-10, Two-Color Earth's Limb Photos

The astronaut will obtain photographs of the earth's limb using a hand-held camera, black and white film, and a special filter mosaic which will allow each picture to be taken partly through a red filter and partly through a blue filter. After the flight, the negative will be subjected to careful measurements, and the resulting data will be used in statistical analyses to evaluate the limb radiance. These studies will be used to determine if the sun-lit earth's limit can be reliably observed in the short-visible or near-ultraviolet spectral region. The camera to be used for this experiment is shown in Figure 13.



FIG. 13

12. S-5, Synoptic Terrain Photography

The objective of this experiment is to obtain high quality photographs of selected parts of the earth's surface. The spacecraft will be manually oriented from an orbit mode attitude to a moderately high camera depression angle attitude. After a series of photographs has been taken, the spacecraft will be reoriented to the orbit mode attitude. Four spacecraft orientation maneuvers will be required during which approximately 40 pictures will be taken over areas of the United States. Figure 14 shows one of the photos taken by Gordon Cooper which is similar to the terrain photographs planned.

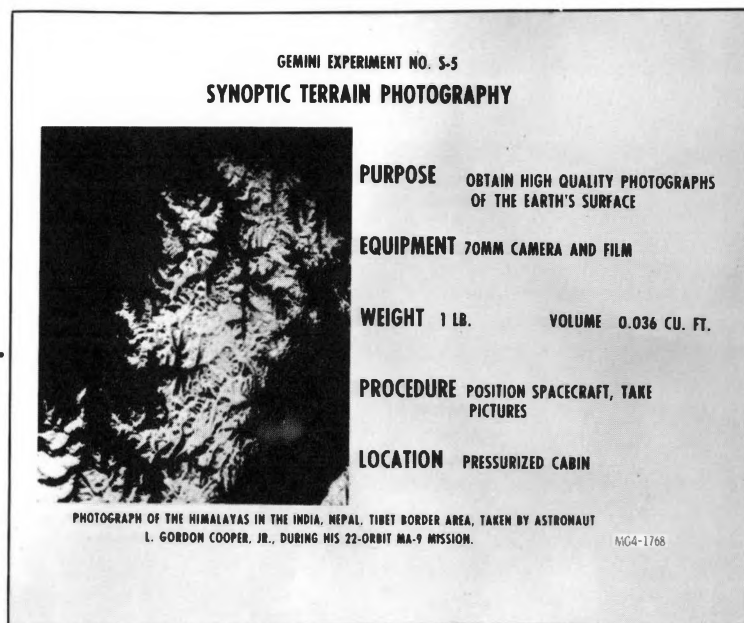


FIG. 14

13. S-6, Synoptic Weather Photography

The objective of this experiment is to learn more about the earth's weather systems by obtaining high quality photographs of selected cloud formations. As in experiment S-5, the spacecraft will be oriented from an orbit mode attitude to a moderately high camera depression angle attitude. After a series of photographs has been taken, the spacecraft will be reoriented to the orbit mode attitude. Approximately 10 orientation maneuvers will be required during which approximately 40 pictures will be taken. The photograph shown in Figure 15 taken by Gordon Cooper is similar to those planned on this flight.

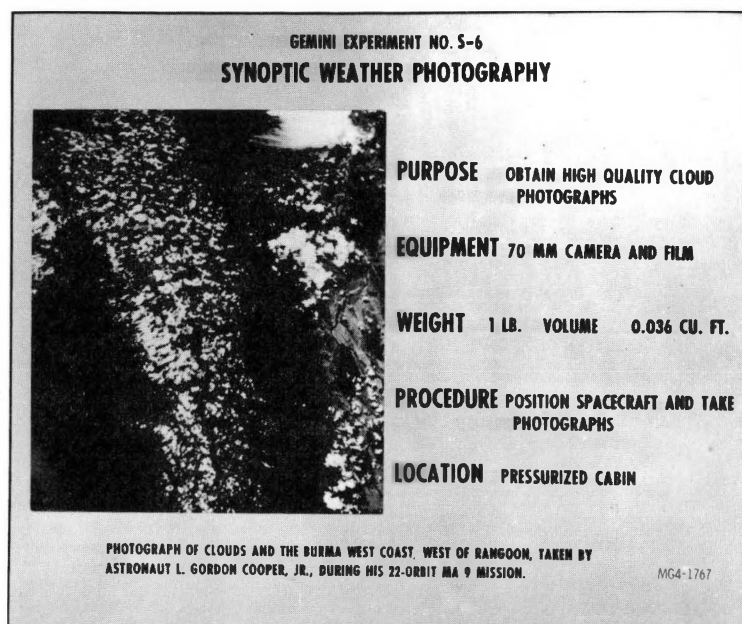


FIG. 15

ASTRONAUTS

The Command Pilot for the GT-4 mission will be James A. McDivitt and the Pilot will be Edward H. White, II. The backup flight crew will consist of Frank Borman as Command Pilot and James A. Lovell, Jr., as Pilot. Their pictures and biographies follow:



FIG. 16

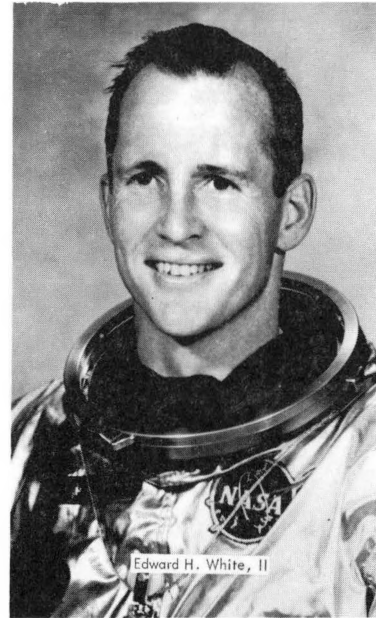


FIG. 17

JAMES A. MCDIVITT

Born in Chicago, Illinois on June 10, 1929. He graduated first in his class from the University of Michigan with a B.S. in aeronautical engineering. McDivitt is married to the former Patricia A. Hass of Cleveland, Ohio and has three children. McDivitt joined the Air Force in 1951 and is an Air Force Major. He was awarded three Distinguished Flying Crosses, five Air Medals and the Choo Moo Medal from South Korea. He is a graduate of the United States Air Force Experimental Test Pilot School and the United States Air Force Aerospace Research pilot course. He served at Edwards Air Force Base, California, as an experimental test pilot. McDivitt has logged more than 3,000 hours flying time, including 2,500 hours in jet aircraft.

McDivitt was selected as an astronaut by NASA in September 1962. In addition to participating in the overall astronaut training program he has had additional specialized duties. These duties include monitoring the design and development of the guidance and navigation systems for the Gemini and Apollo spacecraft, as well as monitoring the overall Apollo Command and Service Modules.

EDWARD H. WHITE II

Born in San Antonio, Texas, on November 14, 1930. White received his B.S. from the United States Military Academy and his M.S. in aeronautical engineering from

the University of Michigan. He is married to the former Patricia E. Finegan of Washington, D.C. and has two children. White, an Air Force Major, received flight training in Florida and Texas, following his graduation from West Point. He attended the Air Force Test Pilot School at Edwards Air Force Base, California, in 1959. White was later assigned to Wright-Patterson Air Force Base, Ohio, as an experimental test pilot with the Aeronautical Systems Division. In this assignment he made flight tests for research and weapons systems development, wrote technical engineering reports, and made recommendations for improvement in aircraft design and construction. He has logged more than 3,600 hours flying time, including more than 2,200 hours in jet aircraft. White was named as a member of the astronaut team selected by NASA in September 1962.

FRANK BORMAN

Born in Gary, Indiana on March 14, 1928. He received his B.S. from the United States Military Academy and his M.S. in aeronautical engineering from the California Institute of Technology. He is married to the former Susan Bugbee of Tucson, Arizona and has two sons.

Upon graduation from West Point, Borman, now an Air Force Major, chose an Air Force career and received his pilot training at Williams Air Force Base, California. From 1951 to 1956 he served with fighter squadrons in the United States and in the Philippines and was an instructor of thermodynamics and fluid mechanics at the U.S. Military Academy, West Point. He was graduated from the USAF Aerospace Research Pilots School in 1960 and later served there as an instructor. In this capacity he prepared and delivered academic lectures and simulator briefings, and flight test briefings on the theory and practice of spacecraft testing. Borman has logged more than 4,400 hours flying time, including more than 3,600 hours in jet aircraft. Borman was one of the nine astronauts named by NASA in September 1962.

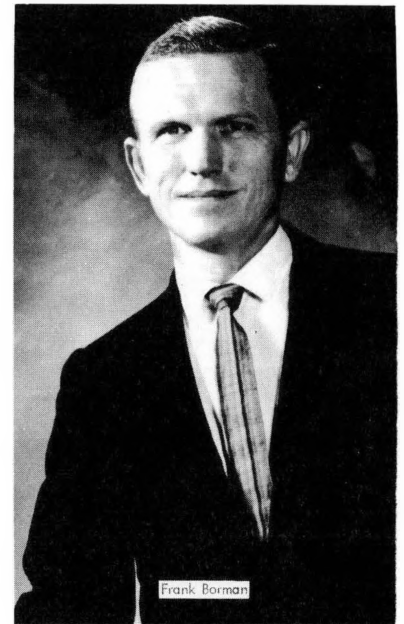


FIG. 18

JAMES A. LOVELL, JR.

Born in Cleveland, Ohio, on March 25, 1928. He received his B.S. from the United States Naval Academy. Lovell is married to the former Marilyn Gerlach of Milwaukee, Wisconsin and has three children.

Lovell, a Navy Lieutenant Commander, received flight training following his graduation from Annapolis. He served in a number of Naval

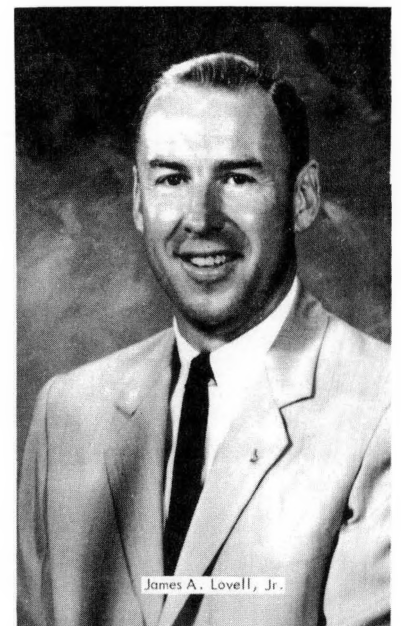


FIG. 19

aviator assignments including a three year tour as a test pilot at the Naval Air Test Center at Patuxent River, Maryland. His duties there included service as program manager for the F4H Weapon System Evaluation. Lovell was graduated from the Aviation Safety School of the University of Southern California. He served as flight instructor and safety officer with Fighter Squadron 101 at the Naval Air Station at Oceana, Virginia. Lovell has logged 3,000 hours flying time, including more than 2,000 hours in jet aircraft.

Lovell was selected as an astronaut by NASA in September 1962. In addition to participating in the overall astronaut training program, he has been assigned special duties. These duties included monitoring design and development of recovery and crew life support systems. These include space suits, environmental control system and developing techniques for lunar and earth landings and recovery.

The launch trajectory for the GT-4 mission will be similar to that flown by GT-3. Insertion will be at the same altitude, 87 miles, but the first apogee of GT-4 will be 161 miles. The Gemini launch sequence is shown in Figure 20.

FLIGHT PLAN

In addition to the various orbital maneuvers to be performed during the mission, as called out in Table II, other activities will be taking place as is shown below in Table III, a summarization of the Flight Plan. The consumable items loaded onboard the spacecraft are shown in Table IV.

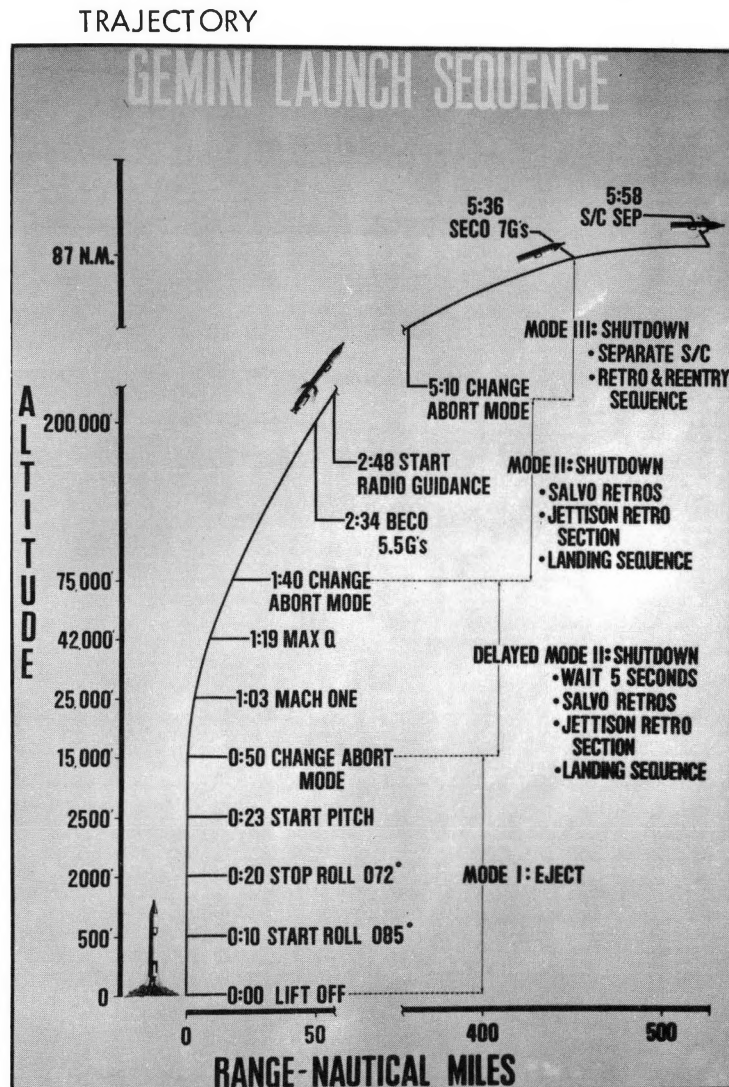


FIG. 20

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Page 14

MANEUVER	ΔV	HP/HA AFTER MANEUVERS	POINT OF APPLICATION	DIRECTION OF THRUST	TRANSLA- TIONAL THRUSTER	PURPOSE
Separation	10FPS	87/161 N.M.	SECO+2-	FWD	AFT	S/C-Booster Separation
1	7FPS	91/161 N.M.	2d Apogee	FWD	FWD	Adjust lifetime (for insertion dispersions. Evaluate thruster operation.
2A	12FPS		Apogee of 30th Rev.	FWD	Left	Adjust lifetime. Evaluate thruster operation.
+TSC #1	5FPS		Approx. 15 min after 2A	Left	Right	Evaluate thruster operation. Determine visual characteristics of thruster plume.
TSC #2	5FPS		5 min. after TSC #1	Down	Up	Evaluate thruster operation. Determine visual characteristics of thruster plume.
TSC #3	5FPS		5 min after TSC #2	Up	Down	Evaluate thruster operation. Determine visual characteristics of thruster plume.
2B	27FPS	94/134 N.M.	Perigee following 2A	AFT	AFT	Adjust lifetime. Evaluate 3-axis application.
3A	4FPS		Apogee of 45th Rev.	FWD	FWD	Adjust lifetime. Evaluate thruster operation.
3B	6FPS	93/124 N.M.	Perigee following	AFT	FWD	Adjust lifetime. Evaluate thruster operation.
4	110FPS	45/99 (45/97)*	62d Rev. (or 66th Rev.)*	AFT	AFT	Achieve OAMS retrofire. Evaluate thruster operation.

*FOR PACIFIC LANDING

+TRANSLATIONAL SYSTEM CHECK

M-913-65-04

TABLE III
IN-FLIGHT ACTIVITIES

Time HRS:MIN	Revolution No.	EVENT	Function		Day	Night
			CP	P		
0:12	1	Insertion Checklist	X	X	X	
1:45	2	D-9 Experiment	X	X	X	
		Translation Maneuver	X		X	
4:35	3-4	D-6 Experiment	X		X	
7:45	5-6	MSC-1,2,3, and 10 Experiments		X		X
		M-3 Experiment		X		X
11:15	7-8	MSC-2 and 3 Experiments		X		X
		D-8 Experiment		X		X
13:05	9	D-9 Experiment	X			
17:05	11	D-1 Experiment		X		X
19:52	13-14	M-3 Experiment		X		
24:00	16	S-5 Experiment		X		
25:58	17-18	HF Communication Tests	X		X	X
29:25	19	D-9 Experiment		X		X
31:20	20	S-6 Experiment		X	X	
31:40	21	MSC-2 & # Experiments		X	X	
		D-8 Experiment		X	X	
33:20	22	D-8 Experiment		X	X	
		S-6 Experiment		X		X
43:00	28	S-6 Experiment		X		
		S-5 Experiment		X	X	
44:25	29	S-6 Experiment		X	X	
		M-3 Experiment				X
46:48	30	MSC-1 Experiment		X	X	
		Translation Maneuvers		X		X
47:33	31	Translation Maneuvers	X		X	
		Thruster Failure Check	X			X
		Power Down S/C	X	X		X
		S-5 Experiment			X	
		S-6 Experiment			X	
52:30	33-34	M-3 Experiment		X	X	
54:35	35	D-9 Experiment		X	X	X
		MSC-2 & 3 Experiments		X	X	
56:35	36-37	S-6 Experiment		X	X	
	41	D-9 Experiment	X			X
70:26	46	Translation Maneuvers	X			X
		M-3 Experiment		X		
		Apollo Yaw Orientation	X	X	X	X
		Power Down S/C	X	X		X
76:30	49	M-3 Experiment		X	X	
77:20	50	D-9 Experiment		X	X	X
90:45	58	Power Down S/C	X	X	X	
95:45	61	M-3 Experiment		X	X	
96-35	62	Pre Retro Checklist, TR-5 Minutes	X	X	X	
		Checklist, TR-1 Minute Checklist				
97:32		Retrofire, Retro Jettison, Post-Retro Checklist	X	X	X	
97:46	63	Reentry, Drogue Chute Deploy, Pilot Chute Deploy, Main Chute Deploy, Two-Point Suspension, Touchdown, Post-Landing Checklist	X	X	X	

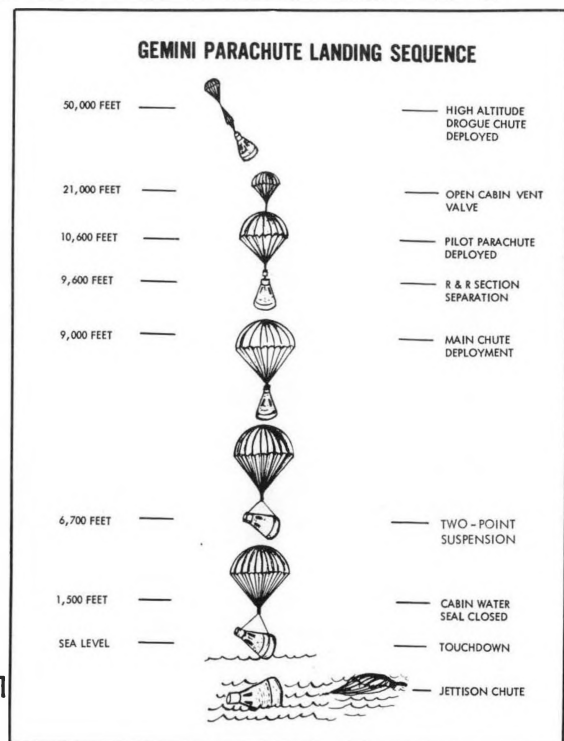
TABLE IV
GT-4 CONSUMABLE LOADINGS

ITEM	QUANTITY	REMARKS
Batteries	703 lbs. based on a 2400 A-h	Each battery has a 400 A-h capacity
OAMS Propellants		
Oxidizer	246 lbs	
Fuel	164 lbs	
Oxygen		
Primary	52 lbs	
Secondary	13 lbs	Egress bottle are also carried if ejection is required.
Lithium Hydroxide	97 lbs	
Food	1b lbs	
Drinking Water		
Spacecraft	14 lbs	
Adapter	61 lbs	
RCS Propellants		
Oxidizer	40.4 lbs	
Fuel	31.6 lbs	

LANDING SEQUENCE

At the end of the mission, the parachute landing sequence shown in Figure 21 will be employed. One item that should be mentioned in this regard is that should the 84-foot main parachute fail to open, the crew can abandon the spacecraft by ejecting and using their personal parachutes to effect a safe water landing. The latter sequence would also be employed should the spacecraft come in overland instead of the intended water landing.

FIG. 21



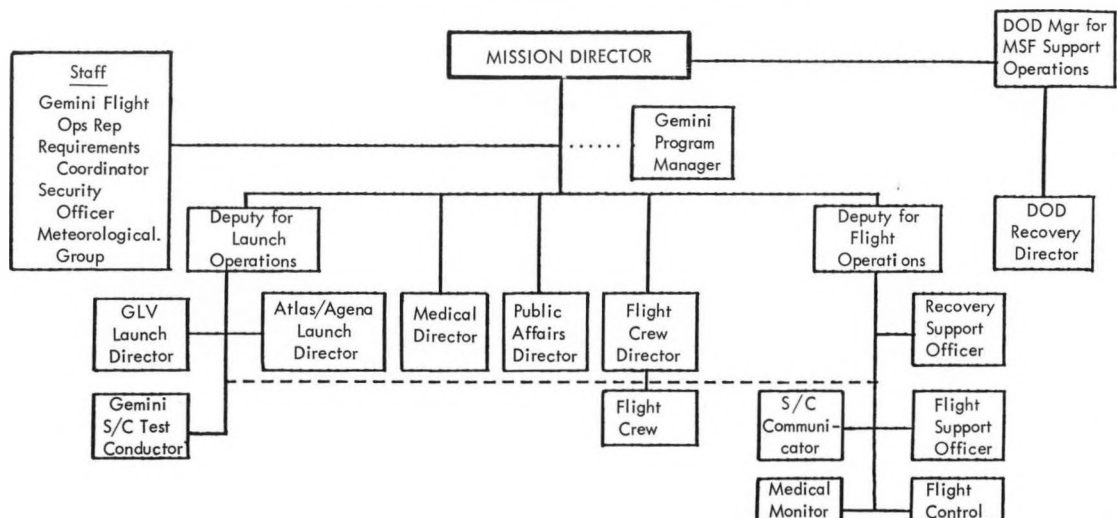
MISSION MANAGEMENT RESPONSIBILITY

The Gemini Program is managed by the Gemini Program Director who exercises his direction through the Project Manager at the Manned Spacecraft Center. The direction of a specific mission is accomplished by a Mission Director acting under the cognizance of the Associate Administrator for Manned Space Flight from the time a space vehicle is committed to flight test until the end of the Mission Period.

<u>TITLE</u>	<u>NAME</u>	<u>ORGANIZATION</u>
Program Director (Acting)	Dr. G.E. Mueller	NASA Headquarters
Deputy Program Director	Mr. W.C. Schneider	NASA Headquarters
Program Manager	Mr. C.W. Mathews	MSC
Mission Director	Mr. C.C. Kraft	MSC

PROGRAM MANAGEMENT
NASA HEADQUARTERS Office of Manned Space Flight
PROJECT MANAGEMENT Manned Spacecraft Center

<u>TRACKING & DATA ACQUISITION</u>	<u>SPACECRAFT</u>	<u>LAUNCH VEHICLE</u>
MSC GSFC ETR	MSC McDonnell Aircraft Co.	MSC SSD Aerospace Corporation Martin Company Aerojet General

OPERATIONS ORGANIZATION FOR MISSION PERIOD

TRACKING AND DATA ACQUISITION

The ground support network for GT-4 will be the Gemini Manned Space Flight Network (MSFN) illustrated in Figure 22 and tabulated in Table V. There will be, however, some minor modifications to the MSFN for the GT-4 mission. These changes for the GT-4 flight are primarily in locating the range tracking ships in positions most advantageous for the orbits to be flown.

TABLE V - NETWORK REQUIREMENTS FOR GT-4

Network Ground Station	Code	Tracking			Telemetry						Command		A/G voice		Flight Controller Manned Sites
		Radar	Mistram	Acq. aid	Gemini launch vehicle		Spacecraft								
		C Band	or others as listed	PCM	FM/FM	Links received	R/T	D/T	RSDP*	DCS	Tone	UHF	HF		
Merritt Island	MILA	X													
Cape Kennedy/ Mission Control	CNV/ MCC		GE-Mod III-G	X	Xa	3	X	X	X	X	X	X	X		X
Patrick AFB	PAFB	X													
Grand Bahamas	GBI	X			Xb	Xa	3	Xb	X		Xc	Xc	Xc	Xc	
Grand Turk	GTI	X					3	Xb	X	X	Xc	Xc	Xc	Xc	
Antigua	ANT	X					3	Xc	X	X	Xc		Xc	Xc	
Ascension Island	ASC	X											Xc	Xc	
Valkaria, Fla.	VAL		X												
Eleuthera Island	ELU		X												
Bermuda	BDA	X		X			3	Xb	X	X	Xc		Xc	Xc	
Canary Island	CYI	X		X			3	X	X	X	X		Xc	Xc	X
Kano, Nigeria	KNO			X			2	Xa					Xc	Xc	
Tananarive	TAN						2	Xa					Xc	Xc	
Carmanron	CRO	X		X			3	X	X	X	X		Xc	Xc	X
Canton Island	CTN			X			2	Xa					Xc	Xc	
Hawaii	HAW	X		X			3	X	X	X	X		Xc	Xc	X
Guaymas, Mex.	GYM			X			3	X	X	X			Xc	Xc	X
Corpus Christi	TEX			X			3	X	X	X	X		Xc	Xc	X
Rose Knot Victor	RKV			X			3	X	X	X	X		X	X	X
Coastal Sentry	CSQ			X			3	X	X	X	X		X	X	X
Range Tracker	RTK	X		X			2	Xa					Xc	Xc	
Pt Arguello, Cal	CAL	X		X									Xc	Xc	
White Sands, NM	WHS	X		X											
Eglin AFB	EGL	X		X											
MSC, Houston	MCC									X					X
Telemetry Aircraft	(d)														

NOTES:

- a - Record Only c - Remoted to and from the MCC
 b - Remoted to MCC d - Three telemetry aircraft in primary recovery area
 * Remote Site Data Process (RSDP)

The ground network support facilities include the MCC-Houston, Cape Kennedy (CNV), Air Force Eastern Test Range (AFETR) downrange stations, the MSFN, and Goddard Space Flight Center (GSFC). Real time tracking and the acquisition of data for post flight evaluation will be provided by optical and photographic systems, MISTRAM, GE Mod III radar, C-band radar, and the Impact Predictor (IP) 7094. The network as listed in Table V will monitor spacecraft and launch vehicle PCM telemetry. The flight controller-manned stations, as shown in Table V will display selected spacecraft data for real-time evaluation and transmit these data to the MCC via teletype. The MCC will use both the Digital Command System (DCS) for transmitting commands. All the remote sites that are flight controller-manned, except for GYM, will have the DCS command capability. Tone commands for use by the Range Safety Officer will be used for manual fuel cutoff (MFCO), auxiliary second stage cutoff (ASCO), and Destruct.

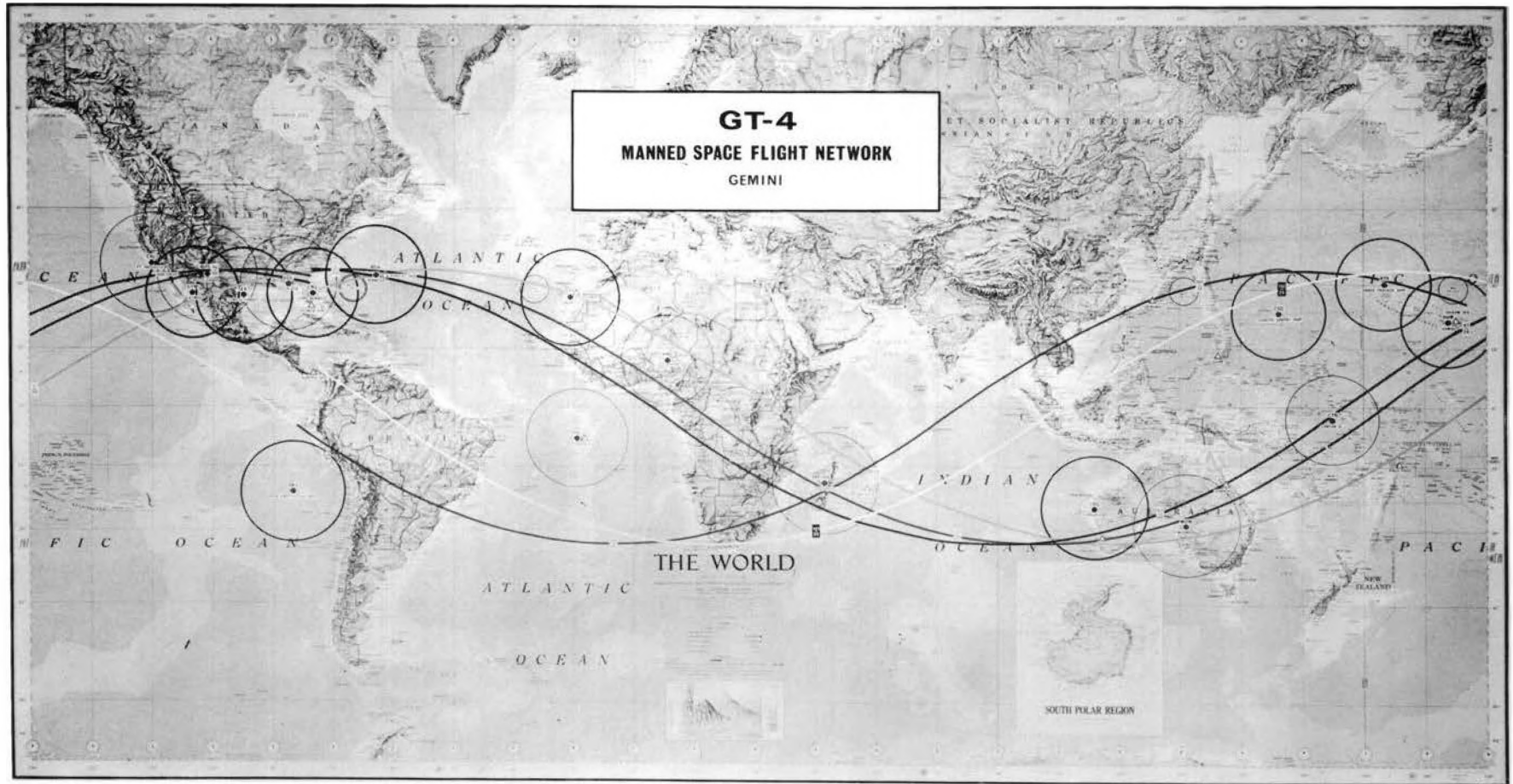


FIG. 22

BACKGROUND

Project Gemini is the stepping stone between the comparatively simple one-man orbital flights of Project Mercury and the complexities involved in the multi-man lunar flights of Project Apollo. As such, Gemini's prime reason for being is to increase knowledge of man's capabilities in space and in developing operational techniques to support the Apollo Program. Thus, Gemini's objectives become:

- a. Long-duration flights - up to fourteen days
- b. Rendezvous and maneuver in space
- c. Docking with a target vehicle
- d. Extra-vehicular activities by the astronauts
- e. Controlled reentry
- f. Operational training for all flight personnel concerned

To accomplish these objectives, a series of flights have been planned of which this GT-4 is the fourth. The first three demonstrated respectively: orbital insertion capability, spacecraft structural integrity, and crew accommodation qualities. The four-day manned flight will further demonstrate manned space flight capabilities for the support of future missions of even longer duration. The remaining eight Gemini flights, all of which will be manned by two astronauts, are tabulated in Table VI with type of mission and approximate date of flight:

TABLE VI		
<u>Mission No.</u>	<u>Mission Objectives</u>	<u>Date</u>
GT-5	Seven-day flight with experiments*	Latter 1965
GTA-6	Radar rendezvous and docking	Early 1966
GT-7	14-day Extra-vehicular activities	Early 1966
GTA-8	Optical rendezvous and docking	Early 1966
GTA-9	Simultaneous countdown and rendezvous	Mid 1966
GTA-10	Direct rendezvous	Mid 1966
GTA-11	Apollo-LEM rendezvous simulation	Late 1966
GTA-12	Apollo-LEM abort simulation	Early 1967

*Includes rendezvous evaluation pod

The planned end-of-the-mission touchdown point is in the Atlantic Ocean approximately 400 miles southwest of Bermuda as is shown in Figure 23. This is the primary landing area. The GT-4 mission employs a zone concept for recovery which establishes four recovery zones: East Atlantic, West Atlantic, West Pacific and Mid-Pacific. Each zone consists of a circular area with a radius of 240 nautical miles in which various ships and planes will be stationed. An aircraft carrier will be stationed only in the primary landing area as illustrated in the recovery forces diagram

GT-4 PRIMARY AND SECONDARY LANDING ZONES, RECOVERY SHIP SUPPORT AND CONTINGENCY RESCUE FORCES

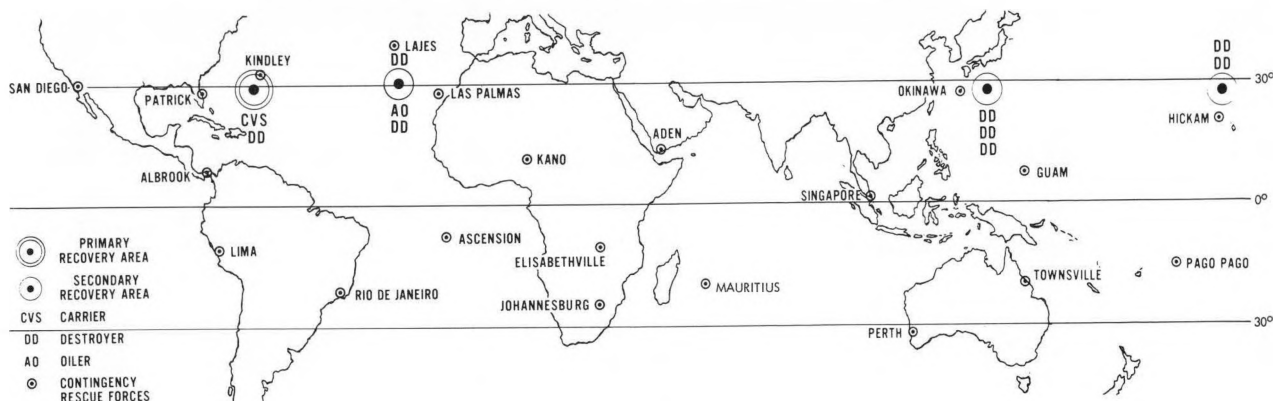


FIG. 23

of Figure 24. Other areas in the world along the ground tracks are called contingency landing areas. Because these contingency landing areas are world-wide, it has been necessary to pre-position certain aircraft with their associated crews, pararescuemen, and paramedics so that they will be able to reach the spacecraft in sufficient time to render aid to the downed astronauts. These contingency forces have been deployed to the bases shown in Figure 23.

It should be noted that there are numerous types of aircraft in the launch area and primary landing area for telemetry, weather reconnaissance, aerial photography, and recovery operations. In addition to these aircraft there are also several helicopters in the primary recovery area from the aircraft carrier that are carrying swimmers. These swimmers deploy into the water and attach an auxiliary flotation collar to the spacecraft. Launch area recovery forces are depicted in Figure 25.

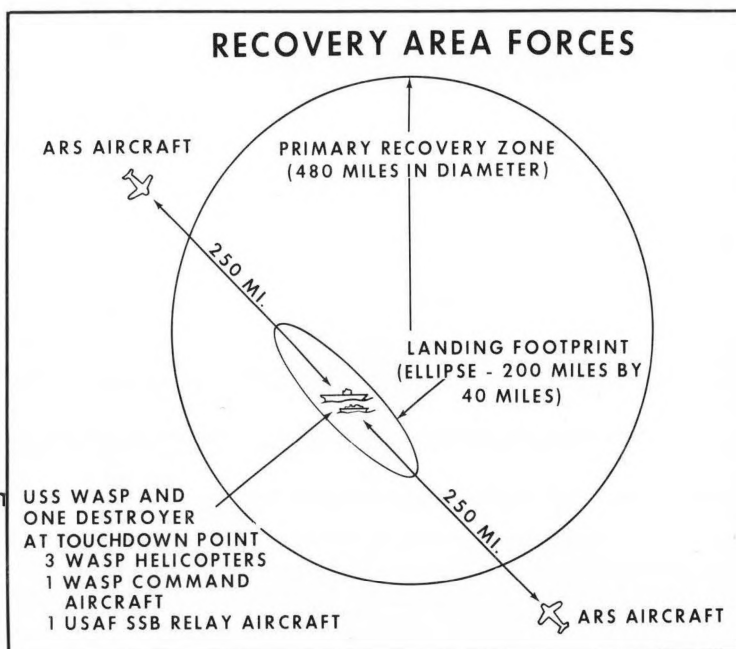


FIG. 24

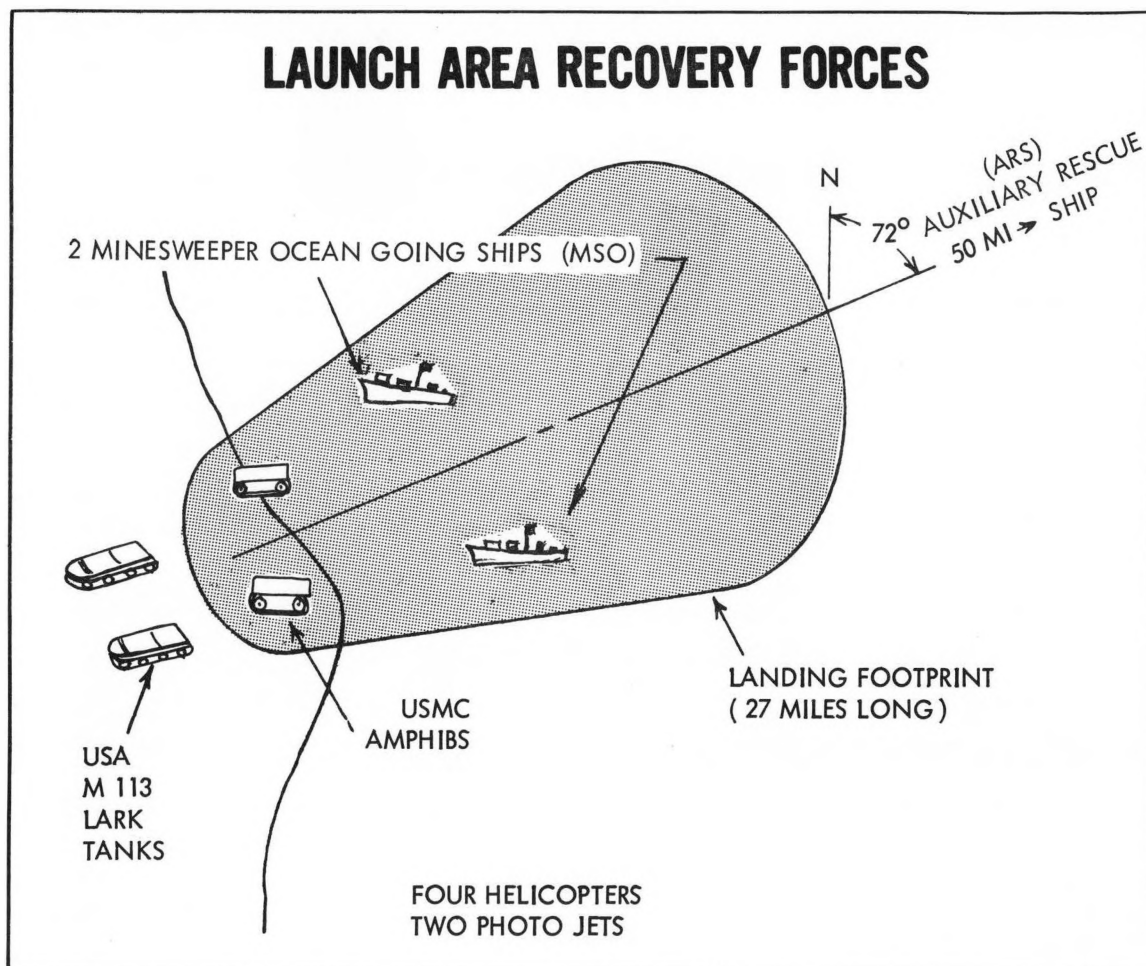


FIG. 25

NASA ROUTING SLIP

	CODE	NAME (if necessary)	ACTION
			APPROVAL
			CONCURRENCE
1.		<i>Liech</i>	FILE
2.			INFORMATION
			INVESTIGATE AND ADVISE
3.			NOTE AND FORWARD
			NOTE AND RETURN
4.			PER REQUEST
			RECOMMENDATION
5.			SEE ME
			SIGNATURE
6.			REPLY FOR SIGNATURE OF:
7.			

REMARKS:

I want to send cogs. of
this enormous transmission
if at all possible to
Dr. Franklin Roach, Boulder
Lawrence Dunkelmann, ~~GP~~ STC

How can it be done?

Helcon to O. Smistad - other cogs.
available 9/21]

FROM:	CODE:	NAME:	DATE:
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NASA ROUTING SLIP

	CODE	NAME (if necessary)	☒ ACTION ☐ APPROVAL ☐ CONCURRENCE ☐ FILE ☐ INFORMATION ☐ INVESTIGATE AND ADVISE ☐ NOTE AND FORWARD ☐ NOTE AND RETURN ☐ PER REQUEST ☐ RECOMMENDATION ☐ SEE ME ☐ SIGNATURE ☐ REPLY FOR SIGNATURE OF:
1.		<i>Gen IV</i> <i>File</i>	
2.			
3.			
4.			
5.			
6.			
7.			

REMARKS:

Record of Expts.
 Debriefing at MSC
 Ca. June 25, 1965

FROM:	CODE:	NAME: <i>JRF</i>	DATE:
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EX13 ROUTING SLIP

NAME	INITIAL
N. G. FOSTER	
R. L. COX	
W. A. EATON	
G. C. HRABAL	
R. A. MOKE	
F. B. NEWMAN	
O. SMISTAD	
B. BROCKER	
M. M. MALINAK	
FILE	

REMARKS

→ PLS SEND TO
DR JOCELYN GILL

JOCELYN- C_y OF AFTERNOON SESSION OF GT-4
EXP. DEBRIEFING. FOR INFO- NF 7-6-5

Dunkelman:

Belt 11

1

35 or something like that down from looking at the air glow edge on
Now the air glow was discovered quite a number of years ago when it was
studied from the ground the hard way and, uh, uh, by betometer (?),
and by (triangulation), by trying to determine how high it was, it was
many years before one had some idea how high the air glow really was,
and in a moment we will indicate how in a matter of seconds Glenn and
~~especially~~ Carpenter was able to determine in a matter of seconds how high
it was. And then he did away with 30 years of hard work. Again, there
was a discovery made there, but the point was that in a few seconds from
the right vantage point you can do a job. Now with the air glow then
looking edge on it sort of, uh, ... we'll ... a band we never mean by
band a real perfectly designed band like in the slide or something like
that, it sometimes a little fuzzy but this is the air glow band and this
is the earth, and this is roughly about 90 kilometers as determined by
Carpenter and by rocket passing through the air glow. Uh, this is the air
glow edge on that we have heard about this morning uh, it was used in
connection with the (Sextant) experiments and so on. Now I just wanted
to give you some idea of where we stand in brightness. Now, uh, before
Glenn was to have gone off uh, the thought was to have him ^{attempt} intimate some
visual observations during whatever time he might have. And NASA head-
quarters and we at Goddard uh, thought about it a little bit and, uh
Murry (Drewman) and Johnson (GILL) and myself thought perhaps a little
work on the air glow might be a good beginning. And uh, uh, John Glenn
was given a narrow, interference filter very similar to this type that was
used over the (Sextant). Uh, he, he, us, did not have very much time

Dunkelman & Rubin attended
Rochaer Jell to Marched,
M. Carolina

Debriefing
McPitt & White
Gemin II
Ca. June 25, 1967

J. Jell
Code SGM

to use it, but he, uh, did, uh, have a chance to observe the air glow with the naked eye and he saw it edge on and he called it, uh name for it at the moment and and really the first time you see a thing like that you don't know whether it haze or luminous sort; it does look hazy. Unfortunately, the press and other people kept that term in existence a long time, so long that a number of astronomers in Europe papers on this. Much of this haze layer was really a hazy layer and consist, consisting of dust particles and so on. Really, what Glenn saw was air glow edge on a luminous layer. There may be a little dust there, *Harry Martin* ~~Murray~~ may have something to say about that, but the predominate feature is it is a self luminous layer. Now, Carpenter has more time to observe it. He took the interference filters back up with him, and uh, he was able to time a star passing through the air glow as the star was setting and he noted it and turned it very carefully through the air glow the upper the lower and when it disappeared. From that careful timing information one was able to pin down the exact time of the air glow. Roughly 90 kilometers. And this is what took many many years to do from the ground by triangulation (?) which is very very difficult cause you never know how to take care of that transmission was later done by rocket passing through the air glow returning when the . . . was But (Carpenter) was able to do this in a matter of seconds. Well that started observation. Uh, we had hoped that later on perhaps the light which is very difficult to see near the sun, on earth you can see it only when the sun is, oh, some

20 or so degrees below the horizon. We sometime see astronauts might be able to see that. Uh, Cooper was able to see the . . . light, and uh, White and McDivitt saw the . . . light, very well. Uh, the let's see there's another point here; well, we'll go back to that in a moment. The reason I think have the other designs to show what can be done. If we have time to show what can be done by extending visual observations we will do so. Uh, some of these new results, uh, that McDivitt and White were able to record are very interesting. Uh, first of all, they saw a structure in the air glow and this is the first time this is reported. In one instance, a uh, is seen some structure in the air glow that they're looking edge on turns (white) This has never been observed before. It is very hard to observe this with a rocket; you don't know when to fire the rocket to do that. They, they observed that. They observed another interesting thing. They observed meteor going into the earth's atmosphere down below them. It is the first time a meteor is reported from uh, uh, space by an astronaut. And it was a very peculiar experience for them I am sure because they saw the things below them going down into the earth's atmosphere. They saw when they were over Australia, they saw uh, over Australia they saw (southern) lights uh, this again is the first time I think this is reported by astronauts. They saw these these silver lights below them as a, a curtain I think that they can guess a lot better than I could. Uh, uh, and this is sort of below them. They both saw the uh, southern light? Uh, these, these are sort of night time phenomena. There are some interesting twilight phenomena that is difficult observe from rockets or satellites and they have been watching sunrise and sunsets. Uh, they found sunrises more

spectacular than sunsets. I will try to explain that in a moment if I can. Uh, going to go back a moment to what Cooper, uh, what Schirra uh, saw during a twilight right after sunset. He observed, uh, the planet Mars and he observed at twilight, the sun had just set, a very spectacular array of colors, he describes them very carefully in the report, in the blue book, his blue book, and summary's blue book too. Uh, he described a rather interesting blue band that's three blue bands; you can call Schirra's blues. Uh, is true and he's able to do quite well, with blues. He observed a dark blue, light blue, and a dark blue. And the word "light" is a difficult word. When one says light one doesn't know whether one means the blue was a lighter hue or it was brighter. But, it, it appears to be a light blue, and one has to use these words for what they stand. Anyway, we uh, from what these observations were is (reportedly) on to a tape and is (debriefing) and afterwards we are all very consistent. We had an order to try to construct this thing. The first time around it needed a little correction when Schirra saw it; the second time around he was somewhat, he was quite pleased with it. We didn't quite know what this thing (band) was at first; we're still not too sure. Uh, we think it might be looking timeless tube because the tomorrow is use the same technique for timing as Carpenter had started. Uh, we think possibly, one is observing the ozonosphere edge on. The ozonosphere is approximately, uh, oh, from 10 to 15 kilometers high up to 20, something like that. It seems to have a maximum around 25 or 20 kilometers. The, uh, ozone as you know, is very very absorbing in the ultraviolet,

in fact complete absorbant below 3000 for solar radiation coming . . . does not penetrate. There is another weak band of ozone in the red, yellow, and green . . . in the . . . band uh, at, uh, distance 5000 . . . 4000 . . . 6000 . . . 7000 and if by clock uh, absorption this way then a weak ozone band or something like that. And it does subtract, it does absorb a bit of the red, yellow, green and the ozone is completely transparent and the reason 4500 down to 35 then it starts taking off again and then it becomes again the well known deep absorption uh, in the ultraviolet. Well, uh, there is only an equivalent of 2 millimeters or 3 millimeters . . . 2 or 3 millimeters equivalent of ozone in the upper atmosphere that is of course, because complete (continuation) of the sunlight. However, when you look at this edge on you're looking through quite a long path and this, perhaps, this ozone does seem to this weak absorption begins becoming equal. So it does attract out a lot of red, yellow, and green light that otherwise would exist in this rarely atmosphere, this blue atmosphere that (uses) . . . scattered light. There's certainly a lot of red, yellow, and green in the blue sky anyway. And by attracting that out you end up with another kind of blue, ozone blue, which looks probably differently from, different from the . . . blue. In fact, this is what it was. We weren't sure and then yesterday, late yesterday, uh, the astronauts showed us some of the movies they were taking, they had been taking with their gun camera and uh, on the whole in some of the very spectacular sunsets, there this band appears. There's a light of blue. Again, uh, they weren't that light that the coloring in the top of these . . . naked eye, but, uh, this is very true.

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Anyway, there's a case where Schirra's visual observation has been confirmed by photography, motion picture photography. The explanation I give may or may not be right, I don't know. I haven't had a chance to look at all the other problems. There's also a dust layer in here within this general region too around 20 kilometers which could add some scattering and the situation down by the white light too well, I don't know, it may be very complicated. So here's another situation where an observation, later confirmed by, uh, another set of astronauts doing the job by (physical) means. Uh, Cooper made some very interesting observations. At night he, uh, during moonless nights, he had no trouble seeing clouds looking straight down. And this is interesting because uh, well, we know why he can see the clouds now that he says he could. It is simply that these clouds are being illuminated by the airglow. The air glow is the Light source is illuminating down on the clouds and air glow is very transparent in solar radiation and that sort of thing, so when you look down you're getting uh, sort of right behind it, you're getting an intensement of, of light here and you see clouds and of course the rest is a factor of two different So he has no trouble seeing clouds. This is interesting because the people now are working on the pole-vault air glow experiment which will be launched this year. Uh, well, we no, they haven't time to figure how they separate the air glow observations clouds But again this particular observation brings to light some problems will face people who are working on a major satellite. There's another interesting little by-product. Cooper also had no trouble seeing the earth from at night. Uh, without moon. This is

reasonable too, because uh, as you look in this direction you see the always the edge on air glow. But you also are looking through the air glow, as it is coming around; you're looking sort of taking two passes through the air glow instead of one, long big path and you are getting some light; and you are not getting very much light from the surface of the earth. So there is a kind of a (positive) contrast. There's a little bit of light here and up in here. Uh, McDivitt and White reported the same thing, although, McDivitt said that when we asked him what was moon condition, he says wasn't concerned about it because he could see the earth lem all the time. Well, fine, if the moon is out it is illuminating the earth's lem and perhaps the it was a little brighter than the air glow when there is no moon the other way around. But the point is there is a line of demarkation, at night. In fact, they prefer, the thing the line of demarkation is much more firm at night than in the daytime. The daytime, day the cloud situation is uh, very difficult but there're clouds at night, too, but uh, I think, one . . . effect of (night) one is not seeing too much detail. It seems that they, they may have something to say about this. Uh, uh, I haven't had much time to think about it but, uh, they did seem to feel that this, this, situation at night was a little bit deeper in the daytime, than in the daytime. Does the air glow vary in elevation?

Uh, yes, it does. Uh, but not very much. Not the uh, uh, the visable air glow and the, the green air glow, the green continues. Oh, I might make one statement. I, I think maybe by our not being careful enough early in the game, by separating the 5577 atomic oxygen green line of

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the air glow from the continuous ^{use} we may have caused people to think that there's something very magic about the green (line).

5577

4477 atomic oxygen green line of the air glow from the continual we may have caused people to think that there's something very magic about the green (line). If you are starting the green line certainly you want to observe the green line are built very carefully to observe (holding) the green line in and uh, would continue (near). But for applications it may not be always wise to subtract the (continuum). In other words, while you're dealing with and this is again those 4000, 7000 23 mentioned 5577 is the green line right here but there's a strong continuum right along here. A lot of light here; this is the light we've been talking about. This visual night (glow) visible night glow edge on is is the total. So there's a lot of light there and just in the Sextant experiment constructively critical perhaps the reason why the didn't work too well is after one is throwing away a lot of light. Uh, this is not as bad as the case of fog lights you know. Remember years ago the fog lights were yellow. They were light wasters. There is no reason, the only reason why they worked well is they were low down so eventually the yellow disappear. But you don't want to waste any light. However, White will point out to you or he did prefer using the green filter and McDivitt preferred not using the filter. So First to depends a lot your own method of observation. I do want to point out that one has to be very careful how one makes applications of air glow. Uh, recall any other, uh, things, they, you weren't here yesterday; know a little bit about it.

Uh, I think I should sensitivity if each of the astronauts

starting with Glenn who had trouble getting

Well, I really don't want to get into that too much for this reason. Finally, there will be a very fine experiment carefully planned through the

I mean sensitivity uh,

Oh, uh, uh, O. K. Well, Glenn didn't a change to get and therefore he wasn't able to make the same acute observations for example, as Cooper was able to make because for example, I don't think Glenn had an opportunity to really get and see very much on the daytime skies but you mean maybe, uh, that type of uh,

Well, uy, yes, uh, or even starlight.

Oh, alright, fine, alright, I see what you mean. What was the (landing) orbit magnitude?

Yes.

O. K.

Uh, going back to let me continue with that

Uh, in one case Cooper was taking a small, woke up and opened his blind and looked out and he was on the day side. The earth was directly below him, the sun was directly behind him. So the earth was not illuminating any portion of the window nor was it illuminating anything that the window saw. There is not primary, secondary area

Like that. He had a pretty good situation and he did see stars in the daytime but he did indicate that he was not able to see as well in the day side as he did at night and he saw quite well at night. And, again we know there's a day air glow but its very difficult to measure and here is a beginning of a subjective observation of, of its (men) at the

(station) and I hope some day there will be sensitive enough to
on board so that during the day side one can look and observe physically
what the day air glow is. Now this is very important because here we
have the orbiting next year and very important background prob-
lem. Two of the orbiting observatories are above the
air glow, this air glow. But the day air glow is much higher and uh,
at least, there's good evidence in the rocket measurements that it's
higher and it's sort of associated with a red air glow. And, so here's
our situation where an astronaut was able to subjectively note the difference
between day and night in the (sky) Uh, McDivitt and White were able to
see down to 7th and 8th magnitude stars where as the other astronauts
were not able to see so well. Again it may be a question of time
(darkmentation) perhaps not that much more time but uh,
they were getting down to uh, the kinds of sensitivity that uh,
should be possible under, under good conditions of dull atmosphere.
Uh, should we mention anything (about) the window (pane) and uh,
to hear more about it, the question on did uh, White smear something on
the window or take something off with his elbow or something. It appeared,
from what we heard, that he took something off there has been some
accumulation (?) then scattering the medium on the window and we took
some of it off and when it look at what he did, they have to look in, in
through the window, it looked black where he had rubbed something off,
and this seems to make sense because scattered light coming in and
scattering off window which had accumulation of little particles which
are brought or something which would get in the light the place where
he moved it and again it looked. But after all the cockpit inside is

relatively black compared to the outside. And this is true and they looked out through the window uh, there seemed to be a change. In fact, they have a photograph of this (spot) talk about that. Uh, they are very uh, they say the astronauts have taken advantages of every possible opportunity to note something unusual. And he keeps all the copies Uh, I think we can look a little bit to the future. I think we all would like to extend the range of vision and the way to do that is with image converters. This may be very practical. Uh, if one is dealing with uh, the idea of perhaps using a violet lens rather than a blue to get down to a region that is many more comments on. You may be getting into a region where the eye is not very sensitive or not sensitive at all, yet it is a very interesting region to do practical navigation well, there one can use the image converter and have the eye become sensitive through an image converter to uh, (the near violet). There are many observations that have made from rockets that are hard to repeat. Uh, for example, ultraviolet aurora. We're not sure this happened but uh, two of these in a rocket and through air and it got saturated and it turns out that it probably was a very strong ultraviolet aurora over Wallops Island. And fortunately two of the (sactometers) worked and because they were to such high sensitivity but the other two were Well, uh, there was no visable counterpart of this area; there was no way of knowing it; satellites have astronauts might be able to look around and see ultraviolet aurora. They saw this aurora in south Australia visually. Well, that's the beginning. Perhaps with image converters they might pick up some other aurora. ultraviolet uh, is a very region; we don't know whether the position of the aurora is going to be

than other kind, uh portions. Now here again an image converter will convert.... light to visible light. Uh, their observations that have been made of these nebulocities(?) which may or may not be so, these are ultraviolet nebulocities(?) in the 1200-1300 region. Again one might have an image converter or create an image in a matter of a moment, look at a line(?) and see if one can see this nebulocities(?). Maybe one... instrumental problem(?) we don't know. In this type of experiment very difficult to achieve. Uh, well, I think that's about all I wanted to say uh, I am sure you'll get a much better feeling of how these observations were made and how they appeared; the astronauts when they tell you about the, when.... The last thing on our program is the astronauts, and they've obviously been delayed so I suggest we take a coffee break while we wait for them..... We'll cut our coffee break short. Colonel McDivitt and Colonel White have shown up here. Uh, maybe we can recount(?), take a minute and recount for them what we've done. Uh, our intent here was to have each of our experimentors go through the background of the experiment, go through the experiment, and also give some of your comments you gave to them yesterday, so as to fill in as much background as you could. I think that the speaker(?) would appreciate, if you would, uh, gave some of your own comments and observations on each of these experiments, where you participated more than the (switch was in operation?), and, uh, give them the opportunity to ask a few questions based on the other things they talked about this morning... And I guess this morning we went through the medical experiments first... the medical experiments

and, uh, choice as to how you.....

(Actually) two hours in space.

I don't think there are any questions on that.

Ha, Ha.

The X-rays (?) didn't cause any significant hardships as far as the.....
to flight. They made us get up what, 10 minutes earlier.

Yeah.

Well, you can hack (?) that. Since there was only 4.3.(?) I guess
That's most serious problems and I wanted a milkshake or something
as soon as I landed and I couldn't have it. Said I couldn't have any
calcium until, what, (20 hours afterwards?)

As far as the flight problems

That's a pretty safe floor (?) my heel didn't hurt at all.

Mine's all healed up.

Ha, Ha.

I didn't think you had enough shield at the moment (?)

Ha, Ha.

The uh, phonocardiogram (?) like some of the other senses (?)....
couple days (?) Not so that we couldn't carry on the mission.

It wasn't any more bothersome than any of the other ones.

I'd been interested in, interested in knowing, uh, the.....
results of them.

It hasn't come up.....

Yeah.

What I'm really interested in is whether or not our motion disturbed
the microphone enough so that you heard a lot of other things.....and
not necessarily our heart. But we did uh, always have the band on the.....

had the.....man on the tape.

The EKG?

On the biometry tape recorder.

They were arranged in such a manner that the - the phonocardiogram by itself was not recorded on both tape recorders. It was only recorded on one tape recorder. And since we were not necessarily interested in the man who was awake, because he was moving around and you weren't going to try to get around to that anyway. Whenever one went to sleep, his biomed tape recorder was on. Most of the flight profile on the biomed.....

Do either of you talk in your sleep?

No, I don't believe so.

Jim doesn't, do it?

There were some - throughout the sleep I felt fine. I know I moved around, moved my arms and tried to get more comfortable.

I only used about half of my first three sleep periods, which.....

Are there any other questions on that?

On the group of.....your heel to heel, meaning that all the calcium has been redeposited by the time the third X-ray was being...

No, it is all healed up right now. There is nothing wrong with it.

We don't really have the data yet, I just talked to Dr.....

We heard this morning that 8 to 10 percent, 8 to 10 percent calcium deficient.

Well, we made a.....and I am afraid we loss - not quite back

Not quite all back.

Not quite all back and we were a little curious. We wondered if maybe

we do provide extra shielding on the right side of the pilot's heel until a couple of weeks from now we will check it again out of curiosity. It is not part of the protocol or anything else.

That's all right.

But, we are just curious to find out. Now we realize that you have just been parading...

.....the more you jomp around on it the more it comes back.

I don't know if you think you have been jomping more or.....

I will tell you one thing - I haven't had my fair share of ice cream and milk.

When had you taken your last X-rays?

Postflight, about, it's a little over 10 days, it was supposed to be 10 days and it turned out to be 12, I believe.

We just had them.

Came down the 7th right, and we just did it yesterday morning, so there it is, the 23rd, about the 23rd day.

I think if it is a function of exercise, and....

It is not a direct function, I mean that is one variable, but it is just a curiosity that we had expected that it would be back up by now and it is not quite back near pre.

Well, what is it now? How many percent down is it? Can you tell?

Well, it varies now between the two of you. And these are still very preliminary now. We took those yesterday, and we - they were still practically wet when we were doing it, but we are still

probably 4 or 5 percent below what you were when we took our pre-flights, and those were very constant, especially the first two. Well, if we are still 4 or 5 percent down, then we only went down about 8 percent.

Right.

What is the sensitivity in your method?

Well, as I pointed out this morning, it depends on the situation, but we think we are definitely within 3 percent. It - we produced it on several machines - many times we get much closer than that, but we are not - we don't want to go out and say that we are - it varies. What was your experience with the exercise?

Yes, well let me comment on this first, because I think I deviated further the experiment. But after about 2 days I felt that I wasn't getting any exercise at all, and there is a limit to how much pushing on the floor that you can do, so I got clearance from Dr. Grady, to go ahead and use the exerciser throughout the remainder of the flight. Not only as a method of exercise as prescribed in our medical type 1 passes, but also as a form of exercising my arms and legs, however I saw fit. And I did do this through the remainder of the flight. I think the reason I did this, I sort of felt it was advantageous to go 4 days and be capable to get outside the spacecraft by myself than to sort of stay in the state of hibernation. I kind of liked your comment yesterday, something about rather than turning into a pumpkin. Something like that, I thought it was funny. Really, we were - I was getting much less exercise than I had anticipated. There was a spurt early in the flight when I was getting everything out, getting everything stored before the EVA and we

had a lot of, a fair amount of exercise there. Then I found I could reach everything that I needed to reach without really....myself all over the inside of the spacecraft. I managed to get all the food out which is a - in a lg is a fairly difficult task, I managed to get it out without any effort whatsoever, once I got the first one off. They were all....and they were in a box right behind me and I just - I always left one hanging out. It was big enough so it wouldn't go back into the hole and it was taped all.....and I didn't have to worry about losing it, so I just reached back and find it, and I just jerked it and pretty soon the next meal would flop out, then I would take the scissors and cut that one off, with no effort whatsoever, and I anticipated that I might have to turn around and reach back in there and could do a lot of exercises that.....

Another thing that we thought might provide exercise just didn't so you had to make it. And I wasn't that - I didn't feel like during a lot of exercises for exercise sake because we weren't getting all the sleep that was thought we should have and I just lost the desire to be doing pushups or anything like that, but I did feel that I needed more exercise than I was getting.

I think that something ought to be made clear though here, I think we are using the word exercise rather freely here, in a common lay sense, and again the experiment here as it was designed was not necessarily - a work capacity or a work heart capacity test. It is not a thing designed to provide the crew with an extensive amount of

exercise, and I think - I guess because - you probably - might have guessed he had about 60 pulls that you were really heating yourself up a little bit under those conditions.

Well, I made the comment that 30 was kind of trivial.

Right.

Then I said 60 warmed me up in the suit more than I would have liked to have been, I was kind of warm most of the time anyhow, and it just made me a little warmer. So it wasn't a real big exercise workload, the kind of exercise that you would do over in the gym.

Right. I think that some people just get a misconception of this thing - this exerciser - the fact that we call it that that we use the word exercise, that we should use the proper prospective here, what actually was taking place, which is a very short spurts of energy expenditures; yes, but not exercise like in a gym or a real good workout, of any type.

Do you feel that the ventilation in the suit was adequate?

I did, but there again, it was adequate but marginal. You couldn't do a lot of exercise, you would get a heat load. As a matter of fact, when Ed was exercising a lot, I could actually feel the heat going up into my side of the suit also. And Ed had a - Ed felt warmer than I did all during the flight.

I think you are aware that you had different temperatures on our suits.. Which will help explain the difference in the feelings as far as the environment.

How could you feel the heat when he exercised?

Well, it is a closed loop. There are two branches to the loop.

But, the hot air went out, went through a bunch of contraptions, and eventually came back into both of our suits again, same way that mine did. He didn't have a closed loop for himself only, and I had another closed loop. We had a closed loop that was closed - but we were part of the same mechanical unit, so that anytime the air temperature went up in the suit, regardless of whether Ed added the heat to it or whether I added the heat to it, it went across the heat exchanger and it was only taking out so much of the heat, so it essentially it came in a little higher temperature than it would have if he wasn't exercising. So, you can notice these small temperature changes.

Was the noise level associated with the cold air through the....

I think so, yes.

Probably no, but I think probably your noise in your intercom was - er - was so much more than that, you probably didn't even notice it as much as you had.

You get used to it. Just like flying the P33, you get somebody in here that is not used to the hot make sitting in there it probably gets pretty objectionable in a short period of time, but when you are used to that, after a period of time, you know there is a noise, but you know what it is and you can put it away. I think another interesting thing about the exercise, though, not particularly the exerciser, but the desire to do, I thought there was a decreasing desire to do some of the exercise at work. You just didn't really - I did what I had to, but I did go boomerang around the inside of the spacecraft unnecessarily. As far as the workload is concerned. I don't know whether this is a getting tired process, or to the lack of desire to have to do work, and I think Jim somewhat expressed the

same feeling.

Did your freak electric static charge worked on electron and magnometer, we didn't get any performance at all on those three.

First, from an instrumentation standpoint, we had - the switches were acceptable, even to me, I thought Ed was asleep when we had to turn those things on, I had to reach across with this thing we call the swivel stick which is about this long and has an unusually shaped end on it that we could reach under the switches and flick them on and off with it.

Ed, did you see the..... extend?

No.

It wasn't extended?

No, it wasn't extended.

Did you ever see the the back end, did you get far enough back to get to look in deep enough to see it?

No.

Did you hear it extend?

No. I extended it the first time but I really didn't see it.

Throughout the flight, what - we probably - what did it cycle there, about 5 times.

Just in case that anyone time there was something wrong with it, wouldn't extend, would you attempt to extend it going through the extend cycle about 4 or 5 times during the flight.

Just in case something was wrong with it at any one time that it might get out to it. We never retracted it, so, if it works, then nothing could have happened.

When did you turn the switch off? The.....switch.

As soon as it was extended, after about 30 seconds or so. What ever it said in the flight.

30 seconds.

Have you got any data back on it yet?

Seven on the computer.

Any other questions on those three?

What was the cost of the photography? The weather and marine photography.

Did you skip MSC-10?

Okay, 10.

I would like to say we got some good pictures and I appreciate it.

There again, it was a pretty straight forward experiment. We didn't have any difficulty with it.

I've got a couple of questions about the ES5. A couple of things that came up last night. You said - you know the systematic photography across the United States, every 5 seconds, how did you time that?

Count, or clock or how?

I started the event timer with the digital clock that we got in minutes and seconds, and then I controlled spacecraft and then I set the mark every 5 seconds.

I see, and Ed cranked the camera on and took the pictures.

Did the same subject, do you think that one man could do this by himself. This is important to the flight plan, do you think it takes both men to do it?

I think so; it would be very difficult to time it and control the spacecraft as you take the pictures.

I think you could get some degree of pictures, but I don't think that you could get the same set that you got. The set we lost in the southern part of Mexico, I believe I did one time when Jim was asleep, but it was not nearly as long a period and I think it was only probably about 12 pictures. This is shorter piece, but the country isn't very long.

Yes.

Well, were focusing it then Ed.

Yeah, I just wanted to get it all set up ahead of time, and by the time we passed there we didn't change it a great deal. But on the pass that we made across the United States, it was, I think, most precisely held straight down, and we went much longer period of time and there were controls that were made, and to sit there and fiddle with the controller and time yourself and turn the camera and take the picture, you can't do it as exact as you can.

Okay, I will put that in as a firmative request for my experiment if at all possible, have both pilots on the job.

For any of your sequence pictures.

Yeah. Those other ones, the target.....

End of belt.

O. K., I'm going to put that....address prefer request for my experiment if that is at all possible to have both pilots on the job for any of your sequence pictures.

Another one's Target of Opportunities if you don't need the controls.....

.....the ones that we've got you weren't all straightened out.....

.....you don't necessarily pass over them, you know.

The thing they want to take a picture of is over here; it's best to take a picture.

You guys certainly have your eyes open, buy some of those things-- that volcano shot, that reshot structure especially, that's really going to give us the mileage.

Could you make a comment just on the general stability of the spacecraft,pulsing and you stopped once, and you were waiting; how long did it take for rates to build up, for instance, how long could a fellow count on maybe pulling position in general? Whoever got the rates stopped I'd say it takes him a couple of days for him to get started. There's nothing to make them go except that rotating machinery which is practically nil.....

So, just a matter of the metal break with the jet.....

But you have to remember, though, as you get your rates all stopped, you're inertially fixed and the thing's rotating underneath you, so you're not stopped with the respect that what you want....

Forty degrees per minute....per second.

In the same vein, do you notice any reactive motion in the spacecraft when you're inside, when you disturb it, when you move around at all?

I could feel Ed moving around, but whether I felt it moving around

an....because he was actually moving the spacecraft or whether I felt it moving around because he was bumping it, either that, now I didn't move you really, but I'm sure that you quite felt some (stable?), so I don't know whether it was that kind of a thing I was feeling or whether it was the spacecraft effects. I don't.....

You don't tend to.....you don't tend to pick up these motions from the spacecraft.....

I remember several times when I kicked into the footwell that you mentioned; you could hear that, but I'm sure that was just something that he heard, and that I didn't really disturb the motion of the spacecraft.

What about the externally.....I mean, could you disturb.....

Sure could.

Sure could.

Then you were aware that when he did it?

I sure was.

But I also knew it too. I knew the times when, when I kicked off hard on the spacecraft, so I...and this was the times that I wanted to get all the way out to the end of the cutter, and that was the time that Jim remarked, one time when I really punched off it hard, and when he said, "Hey, you're putting rates of two degrees per second on the spacecraft."

Then I could read the.....

I knew I was, when, you know, when you're sitting out on the end of the nose, and you kick down on it, it's going to move.

.....do you have any figures on what the....used to stabilize the spacecraft.....

I used, uh, translation of bigger percentage than mine was.....

'Cause you're only translating your.....

.....need some pictures, sir.

Do what?

.....Did you just fix yourself in one position.....?

Yeah, that's kinda hard (for me) to say, a way to describe; but I used proportionally of the fuel that I used, probably, three quarters of it, translating in about a forth of it just in the pitch and yaw maneuvers that were made, and I didn't try to take out roll..... and I didn't really (put in) very much roll; one time I called--I called out roll on my tape a couple of times, but pitch.....

Could you....did you understand though that when he did these pitch and yaw maneuvers he wasn't trying to translate, he was actually just demonstrating that this could be done?

Yeah, all I did was pitch a little bit or yaw a little bit, yaw, do a little of this type of maneuvers with it, and to see if I could stop it and put in in so that I didn't put all the motions in too. So it wasn't truly, I see what Jim's driving at...that you don't want to say that to translate from point A to B is three quarters in translation, and a quarter in attitude. That's what you were getting, right?

Yeah.

Of my fuel that I carry in the gun I probably use three quarters in translation and a quarter in attitude, but you don't need very much

in attitude. One time I got pitched over backwards and I did use the gun to take that out, because I just didn't want to use the oxygen.

One more quick question:some of the (numbers? members?) say that you were moving the structure about in a one-side configuration..... It's pretty big, but it very well has to be within your work area-- you know, in your suit, you're rather restricted on where you reach, you don't reach underneath and behind you especially, but out in front; if a guy would've handed me something that's big, I could've held it.

Ten, twenty feet.....

What?

Ten feet?

Ten, right, ten.....Ten by ten sections.....

Wait, now wait a minute, we're talking about smaller things right now.

Ten by ten what?Moving where? Do what with it?

I couldn't move it an inch, because I wouldn't have anything to... how would I move it? I'd go the other way if I moved it this way.Propulsion....equal?

No, I don't think this is us, it's not what we were demonstrating with it....

I'm just saying, look at that....

Yeah. I see what you're interested in.

One thing you gotta be careful of...

You got a center of gravity that big thing you're talking about,

and I don't know what happened--unless I knew where that was I could really very well get pretty close.

I knew where mine was.

These things, these things are weightless up there but they're not baskets that fly away, once you get these things going, you gotta stop them again, if you started pushing, if you had a...some means of proportion, you've got something like the sides of this table going, and if it hit that wall down there, it'd go right through it.

This is the general question I'm leaning at: Is it, well, I'm trying to get it...with the distinction that you can use itautomatic tape stabilization.....

You'd have the same problem with automatic stabilization that you... would..... Sure.

But with automatic stabilization you might, it would set down in fine (resistance to) the motion where with this thing you wouldn't... with a gun you, probably, would you know, how to find, you've gotta find.....

You mean, you have to find your automatic stabilization as soon as you've held on to a ten by ten box, it would stabilize you and it too?

Well, if you could still hold on, and so forth, it would start firing the stabilizer.

Oh, and within limits of its control.....

Yeah, I think you would find out that it wasn't designed to do that.

See, if you had a system that would strap to you....

.....It might not be very much, though.

Just a second, Bob. You had a system that was strapped to you that had automatic stabilization and translation of a person, well, than you've got the whole of a box or something that you were holding when you were down in one corner of it. I'm sure that you wouldn't have enough stabilization control authority to handle the translation of something like that, because you're putting your engine... Well, it depends on his mass. Again you said it's mass. If it were magnesium bonds or something, then.....

.....

I think we're asking.....

Yeah, well I know what we're talking about--we're talking about building a space station. I'm as anxious to do that as the next guy, but this isn't quite what we looked into. I appreciate your question; we certainly have to fact up to it.....

On-stabilization, uh, suppose you were trying to take off (both pictures) on Gemini, compared to Mercury.....

Would it take you what?

Suppose you try to take one photo picture of the star, say three stars, uh, what do you think your sensitivity in terms of angular accuracy would be for, say, ten seconds or three seconds focus, angular-wise, but (who) took pictures of the horizon and.....changes four degrees per second.

Oh, does that to the dyed balloon?

Well, it's a very special question on generalization, you know, you're moving around, how can you, can you counteract the motion on the vehicle, for instance, the Gemini capsule to take stabilizer... Yeah, you'd have to, if you want to compare it with Mercury stabilizer,

you have to go back and get moment of impulse of the control system, then apply it to the moment of inertia of the spacecraft, and then do the same with the Gemini....

No, in this case he'd be moving a camera.

Pardon?

Move the camera to control the angle.

Do you just hold it?

You hold it, yeah. We could take them as well as you could in Mercury, according to how stable they tie it.

It's quite possible that you could stabilize the spacecraft better than you could stabilize the.....

Yeah, can you get that in the spacecraft.....Thank you.

Uh-huh.

I would (use) the spacecraft to stabilize it...to hold it out the window, kinda hold it out the window, you have to, you don't have to move the stabilizer.

The spacecraft is moving, that means that you've gotta, you have to move your hand at the, an opposite rate, or the opposite direction, the same rate that the spacecraft is moving, I don't think that you want to do that, because you've got a stabilizer thing in your hand holding it, what you would probably do is brace your hand up against the side of the spacecraft and take the picture, then you're going to get.....

.....

Yeah, you see we've got a site on the spacecraft (blastoff) that has a radical that you're going to light for night so with the minimum impulse that we have in the spacecraft, we could fix it on a star,

and get a fixed attitude stabilized in this manner. It would probably be rather.....(unstable?)

I have the feeling it would be very stable. Some of our section sitings over there, particularly when we were working on the Apollo siting, where I was keeping a certain fixed two stars on a certain location on my window, and Jim just doing it over there with pulses..... He didn't have the radical on....

He had the radical on. On, yeah.

.....You were well within a degree taking a few minutes of oxygen. You can hold it within a degree or a quarter of a degree. You can get the exact answer to this if you just analytically....

Do you have the data?

No, I can't quote it to you off-hand. It's not in the order of hundreds of degrees per second.

My overall impression was that we were more stable than I thought we would be when we wanted to stabilize.

....We've looked at our agenda here, and it's got some general questions in the end, get a good stabilization study going....

That's fine, were there any more questions on the terrain photography?

I've got a question. Can a fellow, you know, look at the movies and see if we got any terrain on there?

Yeah, as a matter of fact, I got the impression from what you showed us yesterday afternoon, that there's quite a bit of terrain.

And also some of the 35-millimeter films.

Yeah.

Did you know there were some pictures taken outside of the window

of the 35-millimeter?

Uh, yeah,

Most of them are, I think, blocked, because we have to be over the water, but, if I'm not mistaken, on the little bit I just caught a look, there might be some land bands.

Oh, yes, as a matter of fact, you got three or four, uh, they're toward the end of that box of 35-millimeter slides. It shows spectacular structures probably, they weren't taken outside, they were over Asia somewhere but they were really nice. Those definitely should be blown up, also the movies.

We did take a lot of movies of the clouds.

We did just, a couple of times, just turn the thing on. We weren't going to take movies around us of things that were still, and wanted - to get a big structure of the.....area, so I took some over the Pacific, on the - up over the northern Pacific between Hawaii and the United States, about 3, 4, or 5 minutes.

We took a lot of ocean movies....

Was there ever any question in your mind as to whether or not you were looking at clouds, did you always get.....

Daylight.

Daylight and nighttime.

Daylight, there is never any doubt.

At night time it is kind of hard to see the ground.

One question from the pictures, it did not appear to be too ground, but were you able to be conscious of haze or dust layers, say over your deserts, or even over pollution areas of cities and so forth. Were you conscious of seeing the industrial pollution or the dust?

Over North Africa a couple of times we commented on dust storms, although they weren't really dust storms?

We weren't sure that was a dust storm, right. Remember I said that is a, and then we said well maybe not.

It wasn't a dust storm as you would see it from an airplane where you see the wind blowing on or prior to the desert.

We decided it wasn't a dust storm, just a dusty haze.

Over North Africa.

Over North Africa. Over north India there was quite a pronounced haze redorded.

I would way you were, far less conscious of it. In fact, a rather interesting thing, it's - on one of our first passes over the Cape I was looking on talking to the Cape at that time, I told them I could look down and see the Cape, launch pads, and everything was quite clear. But in fact, the weather down there was not clear at all. Some of the fellows were leaving at that time to go back to Houston, and the visibility was very, very low. You could see a mile or something and it was all quite.....

We could see straight down but we couldn't see the hangover at all.

Another question, did you ever - Gordon Cooper noted that there was static on his radio the same time when he saw lightening discharge on the ground. Had you - did you get any static that you might have correlated with being near disturbed weather on the ground?

This is sort of a chance observation if you made it.

No, I don't think I did.

No, I didn't either. We was a lot of lightening..

We - we had no...

This was a sort of a chance observation.

No, I wouldn't say that I did

. . . . I guess you would call it but you couldn't . . . it didn't
at any rate.

Did you notice the with the flash if lightning

There was an awful lot of lightning . . .

Sure was, South America and . . .

Any more coverage on the water photography?

Yes . . . on atmospheric phenomena . . . Did you feel as though you would
have time to study them instrumentally? I mean from the time that they come
into view until they pass out of view? Did you go through the exercise
with the instrument - let's say a hand-held spectrometer or

Did I phrase the question?

I think so but I'm not sure of the
duration that your studies require.

That's my problem - I was trying to get some feel as to the duration
that you had something in sight.

Does this . . . reduce the phenomena . . . where you'd fly along in regard
to what the weather was and you'd say O. K., at 5 minutes after eleven
I'm gonna do a spectrometer study and then you'd set the thing up and
at 5 minutes after 11, you would start it or is it something where you
would say - When I pass over this fungus . . . that's been reported to
be 25 miles north of Tripoli - I'm going to study which of these
things are

You see the big problem is finding these things.

In looking for objects on the ground and things like that you just don't find them 500 miles in front of you.

How about something in the sense of a target of opportunity? You see it without advanced warning.

I would think you'd have on the order of a minute or 80 seconds maybe to study it if you have your (equipment) already mileage if you wanted to look at it you've got to aim the spacecraft as it, say.

Aiming the spacecraft at it is not difficult. If you've got a field to do it, you can track right on a point. If you say a thunderstorm, say, off to your left, you could maneuver the spacecraft around there and just keep pointing at it as it went by.

About how many miles would 60 seconds - 80 seconds -

Well of course 25° down 45° down -

That's about 80 seconds.

That's 80 seconds, roughly.

That's right. For the (normal) altitude

So, you can figure that out in miles, but-

I've got a whole set of data if you want it for various altitudes on just this type of (answer).

You've provided enough-

And I think you can probably see it from the 30° down below the horizon 45° down - you might be able to start seeing these things

I think you can get a real good feeling for it if you'd take a look at some of the tracking film on which we looked for an object on the ground,

found the object, and then tracked it all the way. And as soon as they get that film and put the pieces in to make it - it's a sequence camera - it's not a real movie camera - as soon as they put the pieces in and insert the extra frames so it is in such a movie camera, I think you can get a real idea of exactly how long you can see. So if you know how much requirement you have as far as using your instrumentation is concerned, you can tell exactly whether you can or what kind of measurements you can make. Then you can also theoretically figure it out, too.

The big problem is to identify the object If you're looking for a specific object, a certain thunderstorm or the northeast corner of the Red Sea or something, that means that you don't - you're not going to be able to pick it up and aim the spacecraft at it 30° below the horizon. You're going to have to wait awhile. You're probably not going to get it picked out 'til later, so that your time on the target is going to be less. Of course, you know the range is changing very rapidly. That thing is below you - say it's right below your track. When you first see out of that 45° it's going to be roughly 200 miles away and if you pass over it'll be 200 miles away. So that the range is essentially doubling. If you're interested in something that requires anything like a constant range, I don't know exactly how you'd do that. This is a problem that you-
Dr.

Let me try to rephrase that question although I think it was answered in the seeing those movies yesterday you were tracking, I think my answer to it was a yes, but let me rephrase the question about

these targets of opportunity. Let's take the airglow for a moment here. There's the night airglow, the twilight glow, and the day glow. Now there are no of day glow. That would take (perhaps a) second exposure, and you know where to look the next time around, and (you can do that forever.)

The twilight airglow might take 10 seconds to get

And the night airglow you would want maybe 4 minutes. Now how do you feel about if that were programmed in with proper spectographs? Either hand-held or on the capsule. How do you feel about it? Taking a one-second exposure of the dayglow, a 10-second exposure of the twilight glow, and a 4-minute exposure of the nightglow. You're moving all the time, but the phenomena are pretty much the same during that period.

One second's no problem for us. Four minutes, you might have to be a little blurry.

I think you could probably, if you tried enough, you could probably get a 10-second

Four minutes--

Well of course the spectograph can the time to permit a fair amount of motion, too.

You'd get something on the--

Schirra might have been able to take twilight, day, and night airglow. If the spectograph could stay in orbit, the person would have to go back in. So shortly after that, the experiment was tried in a rocket and the rocket stabilization was a problem, too. With timing after four minutes, the exposure one did get the spectograph because the thing was able to point in this direction even though it did wobble a little bit.

I wouldn't think you'd want to hand-hold a 4-minute one, I'll tell you

that-

No, no.

You'd have to be spacecraft-modern. You could get the rates down low and you could-

O. K.-

You could certainly hold it within a half a degree. But now your half-degree- You'd have half-degree tones within the spacecraft . . . (I think that would do it).

That's all right. You can build in a certain amount of smear (so you can get a very good day).

Wait a second - let me ask you another thing. What is the airglow that you're looking at now. How will you look at this? Whereabouts is it going to be?

Well, it will be at the horizon, or a degree or two above it.

I know, but you see, you're looking at - the horizon behind you is gone down - by very fast. The airglow is essentially - if you're looking at a different piece of the airglow - not the horizon at a certain spot. Now are you going to look behind you and look at continually changing airglow or look in front of you and see a continually changing airglow or are you going to try and look out at night in viewpoint and try to pick up a piece of airglow and track

That's a very good question. I would say one would be very satisfied to pay the integrated aspect it's moving.

One should also try the other experiment. Ha Ha Ha.

I didn't mean that I didn't think of your experiment, Dr. _____

I didn't mean to complain.

Part of the game.

The

. airglow over lighted areas, I think that that would be more easily done than trying to track a certain spot in the airglow because that means that if your flight path is this way, you've got to aim the spacecraft over here and then you've got to track it along like this. It would seem to me that it's easier to just put it some place and hold it there.

MM-hmm.

And especially from the pilot's standpoint when you've got a gunsight or something like it. maintain that spacecraft essentially wings level with . . . and if the pitch attitude's proper, you don't have to worry about the translation across the

This is a question on both 5 and 6. In terms of pre-warned subjects, like the these storms, and this sort of thing. A lot of pre-warned subjects. To your eye, how far below the horizon could you feel you could pick up say a weather phenomenon. Now you're not looking through the atmosphere at something in the atmosphere. Do you feel you could see say 10° below the horizon? Can you come up with some estimate there. If you're pointed head essentially try the plane towards it so it's in your window.

Wouldn't this depend upon what the phenomenon was--

.

. . . covered a 1000 miles on the side - let's make it more 500 miles on the side - I'd be able to see that at 10° below the horizon. If it were a line of thunderstorms, I think probably 20 or 30° . If you're looking for some of the things that we were looking for at 30°

below the horizon, I thought that was a good place to look for small objects. When we say small objects, they have to have large identifying features near them; maybe if we're going to start looking for something like the -

. (could be a cloud)

-the Red Sea 30° below the horizon, I think you could probably start picking it up. This is below the apparent horizon. This is below the local horizontal.

Right.

As to water and land you say it may be 20 to 30° . As for clouds, perhaps about the same, or maybe further up?

A little further up.

Further up.

To tell the difference between a storm and just a sheaf that's so far off that you can't tell if it's just a sheaf of clouds or is it honestly a storm gathering.

You see as you get farther out there, 0° below the horizon . . . when you're looking like that you don't know the difference. One degree either side covers 100's of miles, so if you get right down below you one degree either side only covers a couple miles. So, if you get too close to the horizon, you're really not confining any point out there.--

The point is, if I set up for say 30° or 20° below the horizon, would that be a good place to give a man a value on to set up?

I think 20° would be (easier, yes.)

I think 20° would be easier.

30° ?

More than that.

You just can't differentiate in what you're looking at.

Well you see we're playing a game here between giving you enough time to get on it so you're on it when you get there and at the same time not so far that it's wasting time.

Really to me you're not wasting time at all when you tell me where to start even if you start me way out. To tell you the truth, I want to start looking as soon as I--

O. K.

I'll tell you all this though, if you're just going to give one time--
No. That's no good.

Which time would you like, now? I was talking--

If you're going to give them multiple times, you know, start early and just continue out, but if you're just going to give one time, then I'd say 30° .

30° .

Or 20° maybe, but no closer to the horizon.

From the earth's horizon. That's about 45 half the horizontal, or something like that.

It's about 5 20.

No.

.

No sir, it sure isn't. More about a minute and a half. Then he goes.

You've got to get a man on it early enough to have the same kind not to throw all your weight fields picking around and wait for it for a long time.

. your real key, though is the first time you look at it it's pretty hard to find it. As soon as you've gone by it once, maybe missed it once, the next time you come through, you can give it up there at 10° if you want. You know exactly what you're looking for and you know what's coming before and you go right up to it and get a . . .

Cause you're saying about 30 to do that or 45 down from the horizon for terrain and perhaps a little further up for weather. 10° further up for weather on a first-on a chance basis target of opportunity.

I just wanted to ask you that in your - part II of this - under the great and under the terrial - what is the ground altitude that you took 4 shots with the pitch down - I don't know if both of you were up or not. You pitched down and you fired a thruster as a preliminary to the experiment on the rediacal light to see how much the thruster flame would and could interfere with the target. I was just wondering what you actually observed on the

Any brightness of the thruster and so forth and if it could have any effect on the target. I haven't found a photograph yet.

Well on something like, you'd better really get over there and look for them because they're going to turn out balck and your polaroid probably isn't going to print them.

Yeah, that's probably why we haven't seen them.

They're in the black-and-white roll, aren't they?

Yes. They were in the black-and-white roll.

. document out on the tape.

The document out on the tape and I think that's probably the part where the tape

I believe it's in the book there, Tim.

Do you recall how they came out? You could see light or . .

Oh, no. No. It's in the same ball park, but the diagonal light that we saw maybe once or twice. You looked like you saw it once, and

You did see it once.

Well, we thought we did from what we'd been briefed up to

Did you draw a picture of it yesterday?

Yeah.

I could comment. We talked quite a bit about this after the GT-3 flight and I know Gus and John both had quite a bit to say about it if you want to check the notes on it.

You mean on the-

On the bright thrusters, yeah.

Wait a second. I think they may have been talking a lot about the re-entry control system.

No. No. No.

Do you know what caused you to see it? Was it reflected off the spacecraft or was it an aura of glow somewhere around-

A glow from behind.

You're just seeing that section of the glow that comes your way.

Now - Is it primary or secondary glow. Was it particles themselves . . . to the light, or you think reflections off the particles that were round?

I don't think you could tell. It was so dim, you couldn't tell.

Did you discuss yesterday particles of space and

I don't think you could help - -

.....

You discussed yesterday particles of space junk?

Yes we did, do you have any particular question?

I would like to have the information later though.

We.. what was your question?

I was just curious about the amount of junk you had about the spacecraft.

.....

From the spacecraft?

Well, from the spacecraft and also the amount in the spacecraft?

From the spacecraft.

I am not talking about any strange particles that appeared.....

And also, when you were outside the spacecraft, whether you could keep any geometry of any junk off the spacecraft? Particular the spacecraft angle of view.

No, the spacecraft only. I didn't see any - -

You didn't see any particles - -

Satellites or particles floating around.

I saw the glove float off.

It was a definite.

But it was not small particles floating off the spacecraft?

There were all kinds.

But you have no geometrical picture of these when you were outside the spacecraft.

I think they float in all directions. When you dump the urine, you have a snow storm out there. It is really beautiful. Snow flakes

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all over. Millions of them. And it doesn't make any difference which way they are going but you can see them come off by the window and they look like they are going off spherically, from what you can see. Now maybe they are not going out the back, but I doubt that. Did you see them at any other time? Glenn mentioned that he had seen them, ice crystals, they weren't associated with such situations as this -

You see a crystal or two go by every once in a while.

You know, I think that these are associated with systems in the spacecraft.

The exhaust?

Yes, we've got a water cooler and the water separator and the suit loop pumps in the water and the evaporator, and there are things going overboard.

I think that it might be pretty obvious that they're from the spacecraft. They are going away generally.

I think a point that Jim made, and I think I've made it clear, but maybe not, that they were actually going small end forward, actually, the first time we were going front end forward quite a bit, and it looked like the streamlines were going back, and you thought, well, that is the way it ought to go, there is a little bit of flow. But several times we got around to going small end forward and the streamline and the little particles were going equally as well this way. So, I know that this is a theory that some people had that there is enough particles even in a very reduced flow area to cause a streamline but apparently not.

Gordon Cooper said he thought that he could use it as a yaw reference if he had to, perhaps.

The particles coming out the back.

But then we saw that he could absolutely could not use it as a yaw reference.

They were going straight forward.

Any way you were going, they were always flowing with you, and it was there were two urine dump systems on the spacecraft, one dumped out the right side and one dumped out the left side. The one on the right side you could see out the right window and they would eventually come on the left side and you could see them out both windows. Predominantly on the right side. When you dumped from the left side, it was predominate on the left side.

They always appeared to be spherical.

You could look out and they were going straight - you know you would look out and they were going straight up this way.

They were very brilliant.

As a matter of fact, the prettiest sight of the whole flight was - you'd do this right a sunset and you would have a perfectly black sky with all these - with the sun shining on all these particles.

It was real pretty.

What were your thoughts regarding participating in the coordinated ground-spacecraft experiment where something has to be done on the ground concurrently with your - doing something else, from the spacecraft.

You mean one more participant?

I think you would be able to do something like that.

You mean laying out patterns on the ground for visual.

Oh, let's say creating a hurricane or something such as that where

you would visually, you would observe something down below you.

We were essentially doing something like that on our flight - on our flight plan, and we didn't follow it exactly. We were getting information from the ground on when to do certain things. We were essentially doing that.

They told us when we were coming over Carla, a hurricane, and the hurricane name, give accounts of the extensive cloud areas.

It was unfortunate at that time though; there were no characteristic clouds that characterized a tropical storm. There was just a big structure of cloud mass, we took some pictures of it. They don't give you the circulation that you would like to see, but they can tell you - this is what we did on the ground tracking too, they told us where to look to pick up certain targets. We did, we picked up the targets.

We did the same actually with getting into the anomaly. We had requested position versus altitude. We had to change time and run ours down a little bit.

As a matter of fact, we got orbit tracked up there which we couldn't really do a great deal with our own selves because the orbit track had time check right along it and we could independently know at a time when we were coming over an object of interest on the ground. Ed, did you experience any difficulty in operation of the..... camera? How to erect the camera.

I believe we might have. I am not sure whether we had one or two difficulties with it. When we - I brought the camera back in and gave it to Jim, he said it was set on about.....

Not when you handed it to me some time later.

Some time later, but we don't know whether we got gimmied around in the spacecraft or whether it was my big fat handed glove I turned the wheel and actually turned it about - you have to turn it this way to find out what you turned it to and I am afraid - of course I held it this way and I could have done that with the hand on the clock. So, this might be one source of error which would have been due to the operation of it. Another one though, that we had prior to the time that continuous taking pictures, the inside shutter doesn't back - doesn't open - so you drop the front shutter all you want and you get a black frame and we got quite a series of black frames on the film. But this may be a mechanical problem that we had, as far as operating the camera, the mounting of the camera on the gun itself, made it difficult to operate. The same thing, if you had a camera that was 3 foot wide and one and one-half foot long it would be harder to operate.

I realize that. I noticed that in one of your shots from the spacecraft you had a white smear in the print. Now, is that one you experienced also during your training period?

The white smear, I believe is the picture Jim took of the window, and it had that smear on the window.

No, this was in the print itself. You know the one I am referring to.

Yes, the one you took right right front nose straight into Jim's window. Is this the one with the white symetrical streak all the way across the window.

That's right.

There are 2 frames.

We are not sure what they are at all.

There is a symmetrical one on each one of them.

Well, it goes back across the film, about 90 degrees.

Is it straight?

Straight, it's a pretty, the same width all the way across.

It might be my helmet tie-down strap.

No, this was a different exposure on both sides.

This is particular too, because the exposure goes all the way across the film. You.....

It is not within the frame itself. So there is a peculiarity there.

With respect to the black frame, the people have looked at it and they don't think this is a mechanical problem. It is an exposure problem most likely. We are investigating it further.

I also, was talking to some people on the cameras on it and they felt that it was an image of some type with the brightness out there, even if you are shooting at about 200 feet. It wouldn't be black.

There would be an image there you could bring it out.

Are these things really black, or is there anything on it?

Well, I don't know.

We just held it up like this and looked down, and that is about all we have done too, Jim. I don't think -

That is the only way I have and I couldn't see anything.

I haven't run a good detailed study yet.

But as bright as it is out there, just remember the, it was my visor, I think I had about 8 percent of light coming through which is about a normal type of light for me. It is really bright out there. I don't see how, even at a 1000; because with the recommended

setting I think is about 500 that you would have some type of an underexposed something you can see.....

I think so.

Our measured success of that camera hasn't been high.

I'm afraid every time we used it, it failed.

Of course, we are getting a lot of these things, but when we go to trace them down, we can't really tie them down.

Well, I can tie down about 3 times for you. When the film in the altitude chamber in exactly that mode, the shutter doesn't fall,

That is, the mirror in the back doesn't fall.

It's got a handle on that one and he discovered the reason for it.

They had this camera back at McDonnell right now.

The one we had on the flight.

The one we had on the flight and they are looking at it to see if there were any of those kind of event frames, that they found.

Is that the one - -

No, the problem that they found in the altitude chamber was a bent part. But they don't know how it got bent, they don't know what made it bend, but they are going to look at this camera to to see if there were any of those kinds of frames apparent.

I think what is also interesting to me. I remember looking in the film and it looks like the film I saw has a lot of sequence. It looks like they put two rolls together.

Yeah, I could figure out the sequence.

I could look at the roll of the original sequence and I think we could almost tell if we had a camera failure or we had an exposure failure. Because the exposure failure, you had it, from then on

your pictures would be black and maybe if you had a random failure of the mirror back there it might take a picture sometime, sometime not. The back plate - there were exposures on almost every frame. There weren't these, I guess a fairly large number of frames that were black.

Were the frames intermittently that were black on these?

No, no, that I recall. I looked - I didn't look at all of them - but I looked at a fairly good string of them and there were a couple of them, one or two points, one point where there is a small overlap in the frame, but that is about the only problem that we found on the black and white.

Well, are there exceptions in the color that are black?

In the color, yes. There are.

I think this is - -

I don't know - -

There is no indication that you got a random failure in the mirror then?

Right, you see we are applying this on GT-5. Three experiments and we are kind of concerned about that.

I think you should be really.

Did you see dust particles floating out the cabin when you had the hatch open. If you did, what floated out?

Yes, we did see dust particles, there was dust floating from the inside to the outside, I think they are just going from a high pressure area to a low pressure area.

Just obvious.

Right, my suit pedals had a leak rate of about 90 cc's.....

Anyway, my suit leaked, they all do you know so that there is getting something on the inside, also, we had a lot of things in there that were probably outcast.

Also, the insides were dirty.

I don't agree with that. There was a definite flow of particles from the inside to the outside.

How did you get the glove outside.

I think that may have - -

No, the glove wasn't put out, it went out by itself.

I can't say for sure that anyone hit it, but there is something very interesting that unless you see it, it never dawned on me before, but we had some periods of time where Ed was asleep and I didn't have much to do, so I fooled around with what things do in zero g and I almost had a perfect conservation of energy until you release an object and push it off in a certain direction, it continued to ricochet around the spacecraft until it catches onto a lever or it gets wedged in something, but it doesn't seem like when you drop a ball on the ground it goes boom, boom, boom, boom, and finally stops, it is kind of like that. It keeps going - - - If you take something and spin it, it will just stay there and spin. I took one of the food bags we had which were about this long and about that wide and very thin and I would just spin it like that and it would just stay there and spin. With no decrease in - essentially no decrease in flotation rate. Another indication I observed, I had a piece of metal that was screwed onto the instrumentation panel that had a round disc with a loop in it and then it had a chain link dewitt and then there was another chain link dewitt, and that

chainlink was screwed onto the instrument panel, so that there really was - the metal a link, then another fixed link, and there were, we had a fan in our suit loop, and you could feel that inlet valve underneath the instrument panel, and I really shouldn't be very much air going through there because you only blowing just a small portion of the air from the cabin and mixing it with all the small air or oxygen in the suit itself, so you just sort recirculate a little bit of air from the cabin and mixing it with mostly air from the suit and it just so happened that I noticed the particles within the spacecraft tended to flow down and you could get a redefinite streamline fell through my leg and this metal was mounted just above that, but up against the flat panel so that the.....

End of tape.

and the Spacecraft tended to pull down to here the redefinite streamline down through my legs and this metal was mounted just above that, but up against a flat panel so that the ballad of the panel is here and the metal is mounted up in here. And I watched that thing start into motion. Really, I'd just touch it and it would start loffing. It would loff over like this and bounce up like this. And it went on for - one time I timed it for over 20 minutes and other times for as long as 30 minutes - and the only thing that ever stopped it from this continuous motion - this loffing back and forth - was a piece of gawkroll that we had glued on underneath it and every once in a while it had an edge on it like a nickel or a dime where it essentially came off like this and every once in a while I'm sure that that edge got stuck in the gawkroll, but it never, ever stopped unless it got stuck in the gawkroll. And the same kind of thing could have happened to the glove. It might have been put in motion in the spacecraft and then just I wasn't looking at it AND it could have been ricocheting around inside the spacecraft for a long time and it finally went off.

The same thing applies to your strap.

I think what you ought as far as a flowout of spacechart is concerned, there's a tremendous example of it in the first part of the film.

on my helmet tied-on strap. It's definitely taking exactly the path of the flow - comes up, goes out, and arches over, and if you recall, the glove came out and followed exactly that path. It came up and out, arched over, and went right out the right side of the spacecraft over the top of the

It continued right on out.

You can see there was a fair amount of sun in and out of the cockpit.

Quite a bit.

You could see all the dust particles. You can count the streamline on the way out. Maybe we'll have a touch on these last two experiments and then come back if there - just to make we touch on all the the radiation experiment inside the cabin. Is there any comment or question that that this was the little ball.

Right. Ed White, why don't you comment on that?

Yeah, this is a fairly straightforward experiment in which I'm sure the people responsible that are familiar with it. It was a measuring device in which we measured the spacecraft radiations for 1-minute periods of time at 6 different spots of the spacecraft and this we did at prescribed times during the flight. A very straightforward experiment.

That's all the background (up to) this morning. Are there any questions about it? The last one was the Hangdella Sexon experiment

We covered this in great, great detail yesterday, and I don't

Did anybody brief on that experiment? I think it would be better if y'all asked questions on it because if we went through it, it would take about three hours. Does anybody have any questions about it?

No, I think we got a very good thorough field for it yesterday when we went through it in detail.

That leaves the visual observations.

Yes.

And I know you went through that yesterday and I listened carefully.

That's right. We won't have to -

And I personally asked Glen, Cochran, Schirra, and Cooper if they say a meteor and they all said negative.

And then you both said you saw a meteor.

No, a falling star. Ha Ha.

I think there's a difference between what we say and what we were expected to see as far as meteors are concerned.

Are you talking about micro-,eteorites striking the--

No, I'm talking about meteors in the atmosphere.

O. K.

Below. O. K. Below we saw them.

Little ones.

Ah, little ones.

Yes. Now, one of the obvious situations is that you said you said a 7th magnitude star. So probably your visual sensitivity was better than another observation. The window was better or something. Is that it?

Did you make a count of the number of the--

Wait a minute. What are files you use success?

Well, if you have poor visual sensitivity, then the number of meteors observable drops off very quickly with the sensitivity of the eyes.

You see, 10th magnitude, you could see a lot more meteors in the atmosphere than you can if you 2nd magnitude. And the question arises

How many do I exceed

. 2nd order of meteors.

Yeah.

They were 2nd order meteors and --

They were quite bright.

O. K. You saw only bright ones. About how many did you see?

About how often did you see any? Could you have made a count of them and said, "Let's look at meteors for awhile"?

Yes, we could have.

Could you have sat down there and counted them all off as you say them and give them relative attention?

You see, I hesitate to give you a number because I think that if we did, you'd tend to come to the wrong conclusion because we weren't looking out of the windows at night all the time.

No.

Quite often we had things to do inside and we turned the lights up and never even looked out

Oh, you weren't dark enough, is that it?

No, we already were looking out. We were attempting to look out and we couldn't see out because we had the lights way up and, first, we were working at the window, and secondly, if we were we couldn't have seen. So if we give you a number, make sure that you don't say that, O. K., we say 15 meteors in four days and therefore they're going to see and that's not right.

No. O. K. But because. -

If you want a number, I saw probably between 10 and 20, but again I wasn't looking out all the time.

No, so you really weren't looking for a meteor, right?

No, we sure weren't.

And you have to remember, also they occur in a rather uninteresting place.

They don't occur up in the heavens, they occur down below you. This is the area that you spend a great deal of time looking at in the night. You're looking up at the stars.

We came to the conclusion that you looked at the ground in the daytime, you looked at the horizon starting at night, and if you were looking somewhere else, you really didn't see much. You find out that sky, in the daytime you don't see anything--

I was just curious whether it would be worthwhile to spend a little bit of time looking sort of at the ground close to the horizon and trying to count meteors in terms of finding out what --

I'm sure we could.

Getting a count on.

It occurred quite low down You looked down at 30° and there'd be meteors; at 45° there'd be meteors. Obviously well below you. Did they look any different from shooting stars from a balloon?

The thing that I noticed about them is that they were short and I think this is probably because you're looking at them from above and the angle -- the length of them -- of short, and you're seeing them as they come down through the atmosphere from above and so you see a line that's only that long from above. Up there it's only that long, and then when you look at them from down below you see them come all the way down and they appear to me--

They're probably microscopic. The random slope direction.

Sometimes they're real little tiny short ones and--

And I think the short ones would more be an indication that they were very dim ones, because the dimmer the meteor, the shorter the trail.

Well that seems reasonable.

Unless you're looking down at them

But what you're looking at right here then if it was dark.

To tell you the truth, I think what's more important is the angle that you're looking at them at.

Well anyway, we did see a lot of them. And they're not difficult to see.

And I don't think we were looking at anything that approaches a 7th magnitude meteor.

You see we could see--

Well, I was just curious whether this was the reason why the--

. Much brighter than that. I didn't see any real dim ones. As a matter of fact, since we weren't looking for them, you know, we wouldn't have seen them. You look up there and you say "I wonder what magnitude star I can see" and you look around and you say "O. K., I know that's a 3rd magnitude and that's a fifth and then I see that one over there is dimmer than the fifth and that one's even dimmer so that eventually you come to the conclusion that maybe you can see 7th magnitude I saw those because I was looking for them and I could come to that conclusion, but I never looked out at them to see how dim a meteorite -- I was only seeing the ones that I was attracted to while I was looking for something else.

So that might be a nice thing to (ask) on the next (flight).

Well, if you looked out for them, you probably could see a lot dimmer ones.

Dr.----- general question or something?

.
.

Do you remember on your consumption of oxygen

You shouldn't ask. That's a hard one for me to answer. I know what the flow into the suit was and-

Look, somebody might have given you the

I don't believe that you could get that figure because you see it was an open roof system and-

What's not used goes right on. In fact, not only that, it comes in at a fixed rate and it goes right over the sides.

You can't get that when you're fueling.

Did you come across any unusual problem outside the vehicle that you didn't expect?

No.

Here's one you may not want to comment on. Do you have any comments to make in regard to the capability of putting man aboard and hide inside the vehicle, the satellite without actually ?

Doing what?

Putting a man aboard

You mean go over and take a look Sure. That's one of the reasons we're doing this.

You think it's perfect.

Pull up along side of it and go over and take a look at it.

(You don't foresee any unusual problems, do you?)

No.

. the tumbling (mold)?

Excuse me?

Even if it's in the tumbling mold?

You're going to use some good judgment about what you do as far as going

. It's the same kind of problem we have associated with the booster. We spend quite a bit of time ahead of time trying to determine exactly how much of the tumbling booster we could plan to go up and take a look at and we finally came to the conclusion that it was up to the pilot's good judgment to approach the booster using his own judgment on it. There just wasn't a way to put a handle on it - well it's tumbling so many degrees and out of plane and you can go or you can't go. I think if you see it, you'll know whether you can or you can't.

Is the problems connected with the difficulties in closing the hatch unidentified?

They're working on those, I think. I'm not sure that they completely completed the case.

I was asked to find out whether we have some lubricants in the very close cauldrons was contributed?

I think that kind of information should come from the systems people who have done a lot of work on it.

.
Yes, I think

Are there any other general questions?

Yes, I have one. In your effort to photograph specific objects on the ground, what kind of siting devices - did you use optical siting? Did you try at any time to use the reflex viewing arrangement of the 35 mm? uh siting device?

For siting?

yes.

We looked out through it but it was mounted in such a manner that you

couldn't do any more than look out.

You couldn't aim at a particular point and correct for-

No, because it amounted to looking over this way and then controlling the spacecraft back that way.

In addition to that, you had up and down, which is worse.

A reduced

That's the reason I asked the question. I wondered if you had used that particular thing and whether it was useful.

You could see what you were looking at, yes, but, controlling a spacecraft, no. I think you could have made a little near - actually got around to that part of it you did the first time. But if you wanted to take a picture of a specific object, and one person was controlling the spacecraft and the other person was going to take the picture, he could take the pictures when he saw them in the viewer. control the spacecraft too it would be a -

One other point is how accurately do you think you can point a photo-system with the optical site?

Certainly with $\pm$ a half a degree.

Plus or minus half a degree.

Probably less than that. Maybe on the order of a quarter.

Do you have a picture of the site again?

No, we don't.

There's a difference between the open bars on the site.

Do you havt to go, Bill?

No, I don't.

I can give you a better answer if you come and ask me in a day or two

when I get a little - let me look at the site again.

There's visual observations.

Excuse me. Let me answer one more.

Have you seen the tracking film?

No.

Look at that - you could probably putting a grid on a screen.

I could show you what I was using as the target. You could -

. feel the view that you got - that you're looking at.

Knowing the field you know, I'm sure you could calculate exactly what you can do.

Exactly what you can do.

That's the second thing I want to ask Dr. White about - comments of fields of view. You went outside the spacecraft and then you had a wider field of view.

Yeah.

How would you describe the difference in field of view in terms of your visual sensibility in looking at the lemo. Any problems about that?

Oh, golly.

It's like looking out the bathroom window versus looking out the front window, out a picture window, which is like going to a movie theatre where you have a little film there and then going to one of these wide-screen ones. You have to turn your head to see it all.

Did you find the space plate quite adequate?

Well, I said you have to turn your head to see it.

Could like you see then the whole horizon? Did you find any differences

along the horizon?

You can see the curvature in the horizon when you're just looking out the window of the spacecraft. And then when you're looking out there you see— O. K. then, you could compare one part of the horizon to another to look for variations.

Yes.

In daylight.

Yes.

You could see a great deal of the horizon out the window

Did it look all the same — uniform — or did you find any variations?

No, I didn't. It looked just the same — like three more pieces of dough . . .

What about stars in the daytime?

I didn't see any outside. And I didn't specifically try to chaff myself to do that.

. scattered light

It was very bright out there and I even looked in the shaded areas which weren't shaded deed shade but behind the door, places like that. Were Cooper and Schirru in the daytime? Saw a dayglow.

.....deep shade, behind the door, places like that.

Were Cooper and Schirra in the daytime?

Sort of date-low.

Could you see that also?

What did they describe as the basis?

They.....the sky had a brightness to it.....above them.

And when Cooper woke up, he was mostly in the daytime. He (noticed)
out on the window he knew it was daytime right away.

.....Ha Ha Ha.

I could tell by up and down.....

I tell ya, I wouldn't be uh I would hesitate that there was actually
phenomena like day glow because it might be uh....You could liik out
the window and whether you're at night or in the daytime. But it
may (not) have anything to do with what's out there. It might not
have anything to do with the spacecraft.

You've got two windows, anyhow. You can tell whether you're.....

There's more to it than that. You know you've got a big long nose

sticking out on that spacecraft; and if the sun is shining on that nose, you know darn well it's based on it. Also the light on the nose is reflected back into the windows gives you a light. And there's a lot of things outside that window that give light to your eyes. We found that there was a flim on (the cone?) that gave light to your eyes. There are so many things around there that would give you a clue. You could indeed be placed out into a.....if you tllk that same spacecraft and I knew there wasn't anything outside, no dayglow, just nothing but an absolutely black sky up there, shining light on the spacecraft, I would get the impression that I was in the daytime. I hesitate to lead you down the wrong path.....

Did you see stars in the daytime from inside the spacecraft?

At sunset and sunrise that you couldn't when you shaded both one's sides. Here again it's the same kind of problem. We had something on the windows; we had the bright nose of the spacecraft, the sun was shining on the spacecraft anyplace it eventually came into the windows.....in the form of money. And I, once or twice when we were in free drift, I could see something bright up in the sky. I couldn't tell you whether it was a planet or whether it was a star or anything. But you've got a lot of light coming into the spacecraft on the day side from the sun....doesn't have anything to do with what's out there. It has to do with the fact that you've got a lot of nose sticking out, you've got a lot of window, there was something on the window, and even if there wasn't anything on the window, the light comes in the window from the sun and is reflected around inside the spacecraft. You've got sources of light just all

over the place.

It follows, then, if you switch that, I mean the next time is terical and the next time was great.....that if you could get out in the spacecraft at night,.....

You'd see a lot more. You say it's "great" because you saw 7th magnitude stars, but Ed and I both proved that we could see more stars flying in an airplane at 40,000 feet here on earth than we could up there.

But then if you want to look at the diagolectric example, which is geometrically extended object--you're looking through this little narrow angle restriction whereas if you'd gone outside you could see this elongated phenomenon with ease--the same with looking at meteors.... You're making some conclusions right now that we're not--haven't made--nor making.

Well I'm trying to get your impression as to whether--

And I'm not sure before when you were talking about the dayglow of what conclusion you drew from what I said. Are you trying to imply that there's a difference between a night sky and a day sky which are obviously.....or between the sky and the ground in the daytime?

I'm trying to find out how well your seeing conditions were compared to the Mercury crew's.

Uh-huh.

And the implication that I get is that the implication is the same condition in the daytime with terrical, probably because of the way the spacecraft is shaped and multiple scattered light.

I think you're drawing improper conclusions.

O. K.

I don't see why you say that the seeing conditions in the daytime were extremely poor.

In terms of visual acuity, for looking, for example, at stars,-- Well, how about for turning down and looking at objects on the ground.

Now that's visual acuity, also.

Yes.

And I thought it was outstanding.

Looking at bright objects, you see. Where you don't have a high contrast required.

You mean on the ground they're bright, yes.

Then there is a high contrast required on the ground. If you're looking out at a star, you know, you've got a bright star against a black sky. That's pretty high contrast. The same thing looking down at the ground. You're looking at a white road going across a dark field. You can see those things.

Yes, but the only problem here is that you're looking through a haze or a scattered layer of light.....scattering into the spacecraft or on the window. For instance, the case if there's no scattered (frost) on the spacecraft. When that disappears at night you can see directly through the window and your visual sensitivity goes up to a maximum of (photographication).

Which obviously must have happened because of the way things were.

Let me tell you what I think. I think there are so many things involved in spacecraft geometry, the windows, the layer on the

windows, the light coming through, that I couldn't tell you whether there's anything that if I looked up above I could see an image, or not. But I think that possibly, if we could find a long black tube and a window with no film on it and some way of closing off all the light inside the spacecraft, I feel that maybe I could look up and I could have seen the black sky (and the stars).

Yeah, we didn't have that, so I wouldn't draw that conclusion from what I saw up there. All I can say is that you couldn't see up and see the stars in the daylight because of all these other reasons. Now if you eliminate other reasons, I think probably you could. I wouldn't say for sure that that's right. The point that interests you when you're talking about acuity, is to look down on the ground and you can see very small objects in the daylight. So that with one is (resolution) and the other one is sensitivity to different light levels. And I'm talking about light levels from Gemini, in terms of having a noisy background.

I want you to be careful of the conclusion that you made. You've got three things that you're obviously trying to make conclusions out of, and I want to be sure that you didn't make some of your own conclusions out of them. Out of this Mercury, they have Mercury, and you're going to compare Mercury and Gemini observations and you took the inside-the-spacecraft observations and said at night it was great and in the daytime it was lousy. Well, in the daytime I didn't feel it was lousy. I don't know what standard you're comparing it against. You're comparing it against Mercury. I think you'd be very careful in drawing that conclusion.

And then there's another area that you want to make conclusions on

and that's vision outside the spacecraft, and I (can) make a comparison between those two and I have already; but you can see clearer from outside the spacecraft. And I was quite surprised at this because I had three visors on: one of them was a left-hand visor which isn't high on optical properties and one of them which is a sun visor which is probably pretty good optically with a gold coating on it and then a flexiglass which is very high in optical qualities. And I felt as far as vision was concerned, I could see better outside the spacecraft and I'd love to be able to make some further visual testing out and I think we probably will do this--take the visors up, this type of work, later on. So you're comparing three different things and I think we can definitely tell you some conclusions between inside and outside as far as Gemini is concerned. I'd be very careful against saying that the vision out of Mercury was worse or better with respect to what we could see out of Gemini in the day. At night we were able to see and compare high magnitudes down to what we felt was 7th order magnitude stars.

(The only thing that)bothers me just a little bit is you saying because Gordo said he could -- he woke up in the daylight -- pointed at the sky, he could tell whether it was day or night, and therefore it was an airglow. Now I could wake up and tell whether it was day or night, too, but it wasn't because there was any airglow. It was because I had sun in the spacecraft. And I think.....

Gordo also saw.....in the daylight. So that's the second indication.

Yeah, this is a unique situation. He happened to be in a situation where the earth was beneath and the sun was behind him and there was no lightning scattered into his window or anything or at least apparently there wasn't anything. He didn't feel there was any and that he had a good opportunity. There's only one datum

(?) Two were there when they have poor days.

Shade on the windows.

You know the stars are there; there's no question that they're up there and if we make the conditions right we can see them.

Couple times I did see stars or planets or something in the daylight. I couldn't tell you what they were, what magnitude they were at all. All I could tell you is that as we drifted around some random positions I could see some sorts of light coming through the window.

I think the point that we tried to make also is we have been working on Apollo and we know that stars and measurement of stars in the daytime and the lighting conditions are very important. And on a routine operation in this matter, the stars weren't there. This is the observation that I felt I made and I think we've both been working in (guidance). I think this is what Jim was driving at also. I was looking for them in the daytime because I wanted to see them out there in the daytime; I didn't want to see them in a cloud (Apollo?). But they weren't there to the extent that I would like to have seen.

As a matter of fact, that was one of the real surprises we had. They just aren't out there. At least they weren't out there in the configuration we

You see a passing star of a 1st or 2nd magnitude out there, that's not going to do you a bit of good as far as anything but saying "O, look, I

see one" because you don't have any idea what it is certainly can't get into measurement.

Results of this..... Maybe we can give Dr. (Ritch) a chance.

Did he have any questions?

I was curious as to what the difference is between sunset and sunrise.

.....

Well, particularly with respect to the shape of the sun and how much does it spread out in latitude. Is it different for night and day?

We sort of concluded that the sunrise was prettier than the— no the sunset was prettier than the sunrise. The sunrise seems to be to my way of thinking was more white and blue. But the sunset was many colors. A lot of red. It is red and blue. They were much prettier. I don't know why because we've got some movies with us.

Actually we do have some movies that we tried to vary on some of them the aperture and I think we've got, at least at certain times during the filming, we've got a fairly true representation of what's up there. The colors in the pictures really do look right and, in fact, I was pretty happy with them. There are certain parts in there that give you pretty close to the impression that we got, and I think these will also show you that the sunset is a little more spectacular than the sunrise. Now there is one thing that certainly is different in the sunrise. When the sun comes, it really comes up with such a much higher rate and it just booms right up and bang it's light and a big ball of fire from the sun comes up. Now when it goes down, though, it's the reverse, and it kind of dies out slowly and you can maybe sit there and enjoy and absorb the colors a little more. Maybe that's the reason... that the sunset is a little prettier.

Is the sunset more brilliant than the sunrise?

Yes.

Contrast-wise?

Right.

How about the elongation?

Wait a second. When you say it's really

That was brightness.

Sunrise is more brilliant.

Sunrise is more brilliant. Up it comes.

See it's dark and then the next thing it's light. It's really light.

Sunset seems to take longer and the gradation-

And more color.

More colorful.

What about the elongation and latitude? Is there a difference in sunset and

Does the sun squash down elliptical?

No. It doesn't move. It goes so ... You know ... It takes about 4 seconds to reverse the whole thing there and it's so bright, you don't notice it squashing Did you?

No, I didn't. No, I've seen a lot of peculiar sunsets and moonsets; the sun and moon have ears on them and things like that-

It's all due to the thick amount of atmosphere that you're going in.

It all goes pretty quickly and I didn't notice that the sun came up in any different shape was set, but it may have.

You know, one thing on the films when you see them, the bottom part looks like the reflection or something, either in the lens or - I don't think

it's in the processing - must be in the lens under the film. The - down at the bottom part kind of duplicates and lets magnitude look on top and that's really not fair. It doesn't reflect down and what you see is only on top.

Did you see any difference between moonsets and moonrises?

No, I didn't.

Did you see any (classing) of the moon?

The elongation that you see?

No. I didn't. I didn't notice any.

I thought the interesting thing, too, about the moon is that clarity - that you see it's quite clear when you look at it here, but also it just looked like a little silver globule going down. It just goes right down. You have no scanning or anything associated with it.

And no, either.

That's right, it goes right down. And also, your viewing of the stars beyond my comment on this earlier doing this. It doesn't obscure your viewing - the moon being up there doesn't particularly bother you as far as the (stars?)

Then you could always tell where the horizon was because of the stars which you know appeared.

And then the airglow.

Could you also tell from the stars? sort of a supplemental picture of the horizon from the stars?

...the air glow.

Can y'all tell if it's dark? Some little (Supplemental? Subliminal?) picture of the horizon?

Well if you watched a certain star, you could tell when it went below the horizon. You just can't look out there and say, "O. K., that's the horizon." It depends on the stars. Now, you can look out there and say, "O. K., now, that's the horizon; not because of the stars."

Because of the lack of the stars and also the air glow.

And also thunderstorms on the horizon (of the Lark?)

proves that you can get it (pictures?). But you never can say that--and I never would ever say that I could take a pencil and draw a very fine line and say that's the horizon at night. As a matter of fact, in the daytime, either.

Did you get the point that Edward made about the moon, though, that when you look at it from even far and high, you can see all these stars. You see the moon; but you don't see just the light of the moon. You see a lot of glow around it. ...And from on earth. But up in orbit I didn't see any glow around it. I saw the light--I saw the moon. Right next to it was dark.

There's nothing around it. It's sharp.

Even when you see a sharp rim here on earth--You see, if the moon were here and was that big around I'd tend to see glow around here.

Even when the moon is in (venus?) You do at times.

That depends on the humidity on a clear night.

Normally when the moon's out on a clear night, you have a lot of haze and stuff around it. (that's not there?..air?) which you'd expect when you're out of the atmosphere. You know, we received a picture in the mail which if you just, having been on a space flight, I think

it means a little more to me....now that I think about it.

Expecially as you look at it now and the artist has taken these things and he's put them in very clearly on a stark black background--and you know and you say, "Gee, isn't that artificial looking?" But that's not artificial looking. That's the way it really does look. The moon's up there on a stark black background (and the other artists should [paint] like that.) I'd like to ask Colonel White what color was his (watch) (blush)

Just silvery white.....I suppose.

....."Dr. (Acre)"--

I take it you would not have any trouble finding the sun if you were to try orienting at some angle with respect to this.....

You wouldn't have to do too much searching if you wanted to line up with the sun in order to.....

No, No. You can generally tell where it is by the brightness. The same holds true with an (open landing).

You can find it on the way in. It's easier if you've got an attitude reference with inertial references working and you just go up there and swoop across the sky and you can find it. But if you've got to get up...

You've got to go find it without any references (out in the space-craft), I guess if you get on the horizon and get all set and then start a pitch rate or something you can go find it. But when you're drifting freely, and you don't know which way is down, you simply end up looking up at the sky and you don't know how to get to the local horizontal--it might be right there and your plane here and you're

not sure until you start looking for it like this and you can search around for a long time.

You can search a long time...

And never get back down to the horizon, but if you establish (a per rate) well you can get there. The big thing is how much fuel you've got to expend.

You get right on the horizon and pick up.....Milky Way well it can help you...well you can get there. The big thing is how much fuel you've got to expend. You get right on the horizon and pick up.... Milky Way, well it can help you.

Dr. (Ayer), I think we're getting close to time to go home here In regard to your (meter) program (in your notes that you made in the auditorium) could you make any recommendations as to the new make-up of that meter program?

I think Ed and I have a common recommendation that we don't fly many more flights in GMT and elapse time at the same time. We've got a one real problem to kinda sort all this stuff out, and I think we ought to fly these things in allotted times...I think that's the one single recommendation we'd make that stands head and shoulders above all other ones. Trying to correlate the time is very tough.

Beyond that, would you say that you could make recommendations as to make-up of the...books?

I thought the books were outstanding and I think that make-up modifies this suit to certain white as the way we ought to go at them.

I think they're outstanding, too, and, of course, Ed and I designed

them, so we're prejudiced. Ha Ha Ha. No, as a matter of fact, we have a flight planner over in the spacecraft center. You roll three times during flight--You roll (when you come down to) liftup from the launch bases which you have never looked at and about 20 hours later we rolled around for 20 hours--I never even got it to 20 (here)

Just part of re-entry we rolled it around some more and then gave up 70 hours.

(We milked some stuff on it). Storm books are real good. Excuse me, let me see these books. We have a book like this. To do any real time flight planning, you have to have access to the--everything--all at once, and you don't want to have to get every something on a roller when you've got to roll through it like this. If you want to know what's going to happen in 95 hours, you just open the book up and turn over to 95 hours. Then if you want to compare that with say 40 hours--you want to have a comparison there, you can't do this on a roller film. Unless you've got some quick access, a way of getting that out like you had your own sort of a meteor microfilm.

Did you take notes on your book, sir?

Yes, we did. I think one thing that we did decide on is that the time-scales that we have in our flight plan here are--neither one of them are exactly right. The early part of the mission was highly expanded; the latter part was washed down a little. I think we have six hours per page in the latter stage and we have an hour per page

in the early stage. I think probably three hours per page or something like that would give us more room to write the notes.

Has that book been reproduced?

Yes, it has. There are copies for everyone.

Let me ask you one here. Do you think you could hold half a degree in pitch on the night horizon with the radical?

Sure. Just do it on the top of the air glow layer and you'd have no trouble at all.

You wouldn't need a filter, or anything.

No. You don't want to make the air go away or any dimmer. And the sight is (difficult) as it is and it's adequate to use at night.

But then you could take pictures, otherwise.

Take pictures at gunsight.

What were you going to do when you held this?

The sharp point is down, and fortunately, it was a camera now designed by Spacecraft. It's a flush-mounted camera for GT5 and diagonally, push down the right window, so the camera is looking up like this. So the spacecraft is on over at an angle like this. It's not a 4-satellite camera is what I'm saying. So while the point is probably good, I'd hate to see the thing get out that O. K. we can pull out the dike. I like the way it's certainly designed. Actually, there's more to it than that. The experimenter will go with a 30° cut through the radial light, so this has nothing to do with the experiment anymore. Only one time it did.

And you also have other than just a flipper on the radical you could

hold.....7 points.

I'd like to get your feeling on calcium balance coming up on the seven.....what do you think how it will affect your post-flight. I don't know how it's going to affect your postflight, but I know it's going to be a real problem. You've just got a lot of things to do. There are a lot of things that can't be done until two weeks before the flight. If you get involved in the bit data--gathering exercises before the flight, I think that it could indeed jeopardize the whole flight. This is my personal opinion. I sort of thought that some of the medical examinations that we had should be moved back earlier. We had a big medical examination at FLTA and that's one of those few days we got a lot of other things that should be taking place and I can't see that my physical condition changed in the last week. Except maybe I got sleepier. But I just feel that when you put all these things into the last couple weeks, you really--the guys that are flying the flight--have got to get ready and there's almost an infinite amount of work to do. You just can't do it all, and if you take time for data-gathering exercises, I sort of feel that it jeopardizes the success of the whole flight. You think you could--another question--Do you think if you had a camera in the right window with a swizzle stick arrangement for pitch, do you think could telescope sites could lock onto have control better pitch than you could with a rigid mounted camera in the right window. You're talking about a control of the mounting for the camera. A control of the pitch; a control of the mount and the pitch.

Is this a ball-jocket-socket type of junkhead or something.

It's not a ball and socket, but a pitch.....for holding a pitch attitude.

Oh, for the air glow.

For the air glow, yes.

This would be for one minute photographing.

For minutes

Some of them may be up to 22 minutes.

Wow. I'd hate to be a

You mechanize it with a low-speed electronic drive and a rheostat-type drive on it.

No. Manually. A manual swivel. Let's do sound effects for the good old

Yeah,....Elroy T. V.'s charging, you're not going to have more than 20 minutes exposure of night air.

Ha Ha Ha We're safe there, aren't we. Ha Ha Ha

A swivel stick here in the right coming out; you have authority taken on a different one.

Larry, did you talk to them about the Northern lights below the southern lights.

I tried to.

Oh, excellent, excellent.

I just covered a few little things and I surely would like to hear your comments about the um I would love to. Venus.

Yeah, we were really impressed with the planet Venus up there and we took some pictures of it and it did come out with about $\frac{1}{5}$ the

magnitude and brilliance that it really appears up there. It's a beautiful sight. After the dark up there, it's very brilliant and much more large as far as I was concerned and bright in magnitude than anything I've seen looking from the ground.

(Mercury) proved very, very pretty.

I bet you caught a photograph, too.

Yeah, just.....you know and you've just--

Yeah, the colors on those things.

The colors that we took on the ground weren't too graphic.

Did you ever see--

Black.

Was there anything else?

Black actually looked beautiful and this is the way the sky looks.....

The sky's black, but it's a beautiful black background. But that doesn't come out on the picture.

Was the radical any good in the day?

(Hasistas) would be brighter than it is.

About twice as bright.

Twice as bright.

You could see it on the ground.

If you can't see it on the cause, that's the big thing here.

You could see it on the land.

You could see it on the land and the water. It was fine. But when you cross the crosscloud, I think we ought to have two rings of brightness.

You know right now it's very bright and just the next beat tannicals look very dim and then you've got a gradation of dims.

I think the dim gradation is excellent.

I think we need a little variation of brightness.

Did you find any difference in the two windows? Did you see any ventigral difference in those two windows?

We couldn't change places. Ha Ha Ha

See I looked in mine, he looked in his, and there wasn't any way in the world that we could--

You couldn't get near enough to start a ration?

No. No. You really can't.

Independent of your ration. You're pretty safe to check your radical brightness against the bright cloud right on the earth.

You know on a bright day like this.

Shoot, they said it was checked against the snowbank.

You can't bank there. You're in trouble.

Unless there's a.....

A couple of times I was looking for it.

Those were dirty St. Louis snowbanks. (snowguns?) Ha Ha Ha

O. K., I think.....the more you want to say. If you'll wrap it up. I think between this morning and Jim and Ed's comments this afternoon we can extract everything we present.....

I'd like to say something. The way it looks right now, you have 11 experiments and everyone of them is a total success. There is no indication that there's anything, any anomaly and there's no indication that there will be any anomaly. Just a quick look.....

Certainly nothing operational, I mean it's not operational.....

There's nothing at all. Now you've got a couple of equipment problems, but you expected that I'm told. It was perfect as far as

experiments go. There was nothing that could have been done to improve it. This is the way the guider shows it; this is the way the mock-up.....

Even the experiment you didn't have a very successful flight.. Ha Ha Ha.

Well, we've got how many more....8 more to go, huh. Ha Ha.

What,.....

No, flights.

End of tape.

GT-4Meteors:

Both McDivitt and White mentioned seeing a number of meteors below them: "We saw quite a few fall and burn up below our altitude. They were about one-half to one-third as high as we were when they were consumed. We never saw one above us." (short and swift?)

As the accompanying plots of numbers of meteors against the months of the year shows the amount of meteor activity in early June is at a rather low

p206

*Fig. 1(Roach's plot of Olivier data from Smithsonian Contrib. to Astrophys. No level, beginning to rise very shortly after that towards a peak in August. on the average from to altitude Regardless of their brightness/meteors appear ~~at~~ 40 and 60 miles/in the earth's atmosphere. Bright meteors are seen to reach about 40 miles, whereas ~~brighter~~ large fireballs may still be seen as low as 20 miles or so.

The average height throughout the path is greater for fainter meteors and for those of high velocities. Actually the bright objects are larger and hence travel further before they are consumed, often traveling for several hundred miles before they are consumed.

Planets

The pilots remarked that "the planets are so clear and bright," and later that "all the sunsets had the planet in it." They have in fact recorded Venus in the horizon bands on one of their sunset pictures. At that date Venus ~~was~~ was still close to the sun being (angular distance?) Sup.conj. Apr. 11) about 15deg. east of the sun (eve. star). On the color print S-65-34771 the image of Venus can be distinctly seen amid the horizon bands.

Draft
Symposium report

2.

Zodiacal Light

~~The astronauts~~ Mc Divitt and White were taking 16 mm. movies ~~experimenting~~ before one "capsule dawn" when they noticed the zodiacal light and described it ~~as~~ thus, "it was a shaft of light and a long time before the sun came up." On the ground observers can note the cone of light in the eastern sky or western sky after the sun has set and gone down about 18 deg. (about an hour after sunset or an hour before sunrise.) Pilots at 40,000 feet can follow it for a longer span since they are away from disturbing city lights.

Condition of the Window:

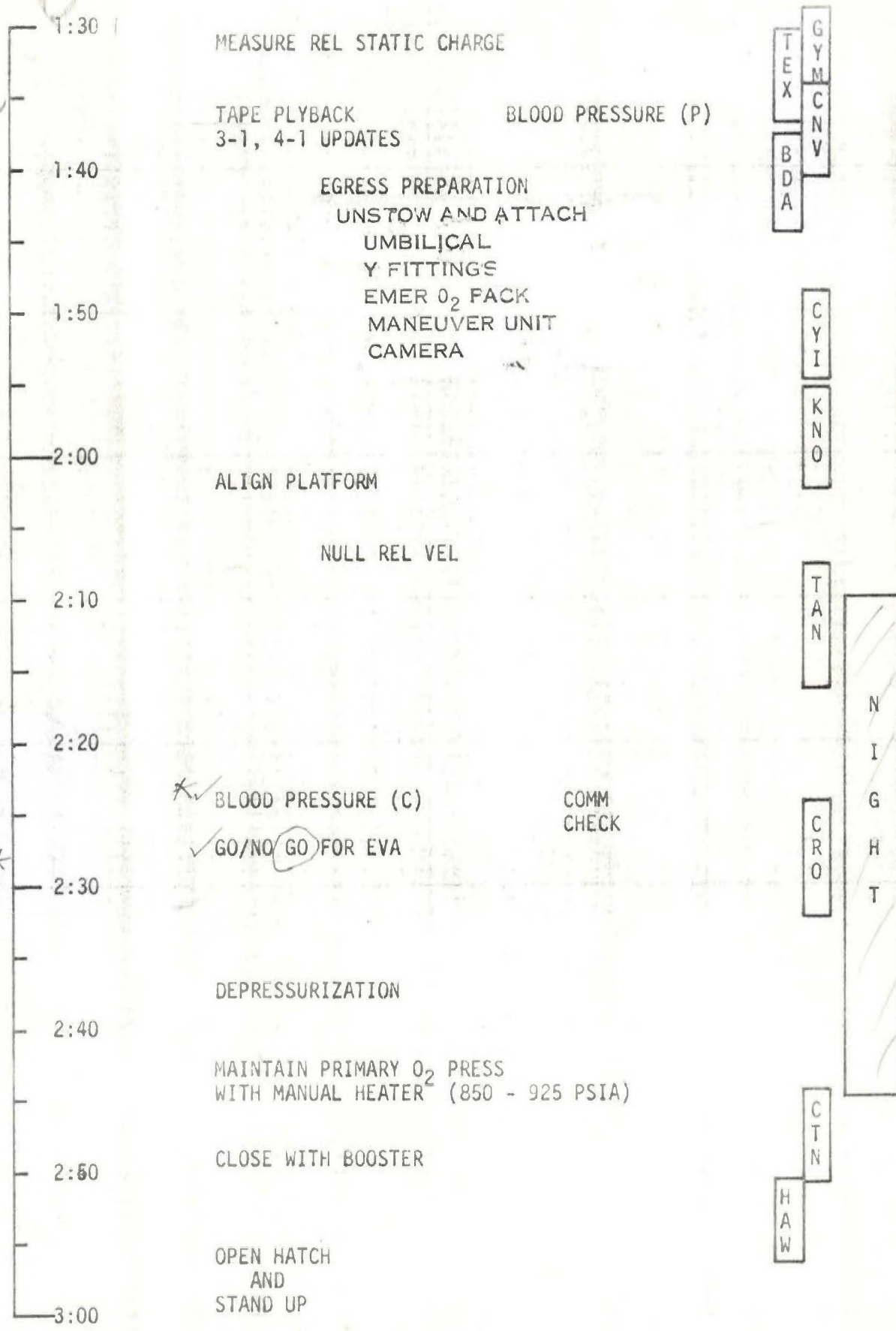
The Gemini optical window is quite superior to the Mercury window. Nonetheless the pilots note that "both their windows were foggy;" and at one point during EVA White rubbed his sleeve accidentally on Jim's window smudging it —probably partially removing the silicon film.

Kathy:

File GT-4

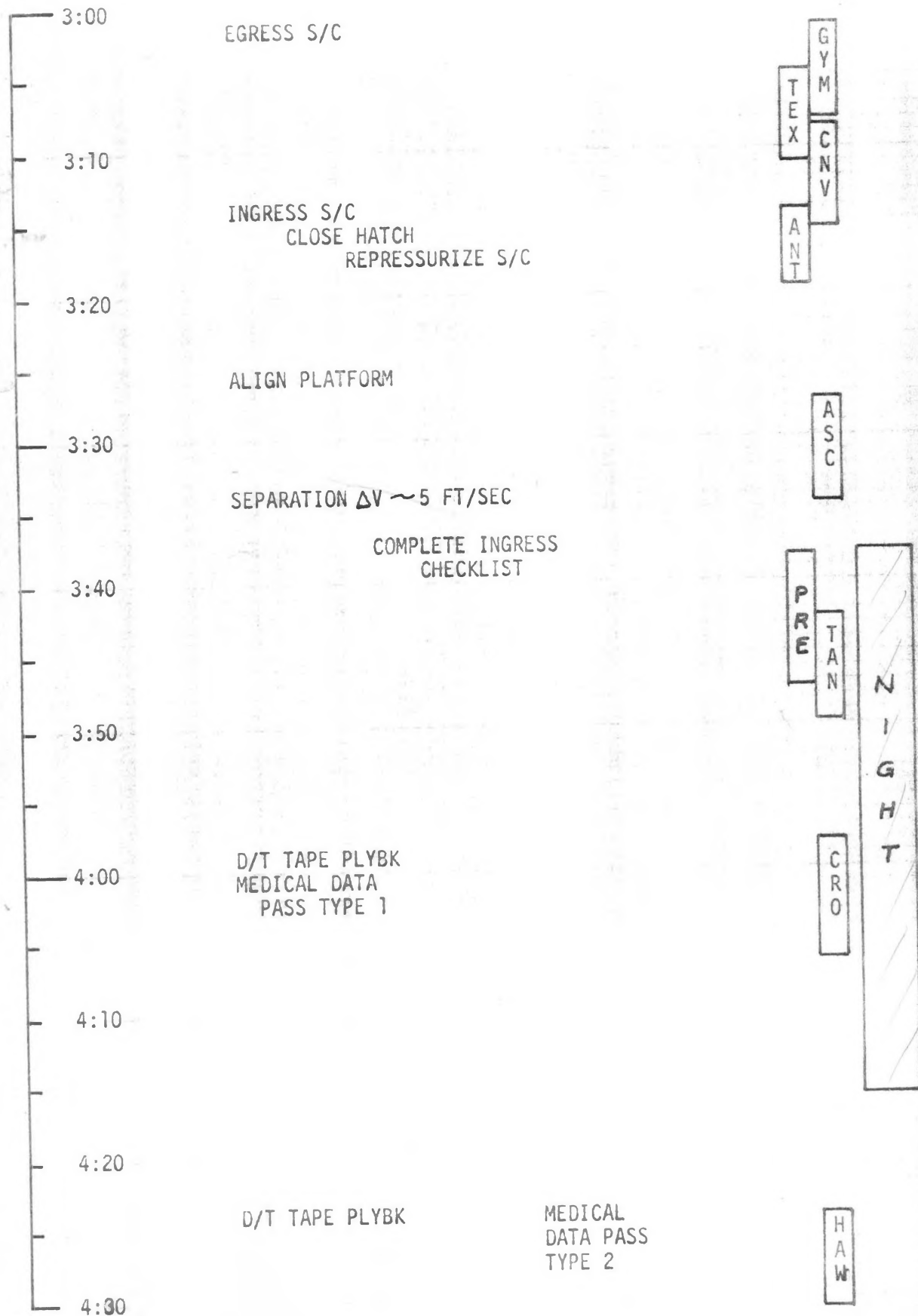
mission

JRZ



c.e.t.
3:59
3:5 145 / 70 *
color

Cat.



6:00

INITIATE TERMINAL REND PHASE

MEASURE ΔV REQ'D

H
A
W

6:10

G
Y
M
T
E
X
C
N
V
A
N
T

6:20

CLOSE WITH BOOSTER

PHOTOGRAPHS DURING APPROACH

6:30

INCREASE SEPARATION WITH
BOOSTER PRIOR TO DARKNESS

6:40

A
S
C

6:50

P
R
E
T
A
N

N
I
G
H
T

7:00

7:10

7:20

GO/NO GO FOR AREA 18-1

7:30

C
S
Q

4:30
4:40
4:50
5:00
5:10
5:20
5:30
5:40
5:50
6:00

MANEUVER UPDATE

ALIGN PLATFORM

CLOSING $\Delta V \sim 13$ FT/SEC

ALIGN PLATFORM

D/T TAPE PLYBACK

MONITOR BOOSTER ELEV

GYM
TEX
CNV
ANT

ASC

TAN

CRO

CSQ

HAW

NIGHT

*darken
(either
X-etching
or shading)*

7:30
7:40
7:50
8:00
8:10
8:20
8:30
8:40
8:50
9:00

D/T TAPE PLYBK

MANEUVER UPDATE

ALIGN PLATFORM

SEPARATION $\Delta V \sim 5$ FT/SEC

SEXTANT BOOSTER/STAR
OBSERVATION

FLASHING EIGHT EVAL.

H
W

T
X

G
Y
M

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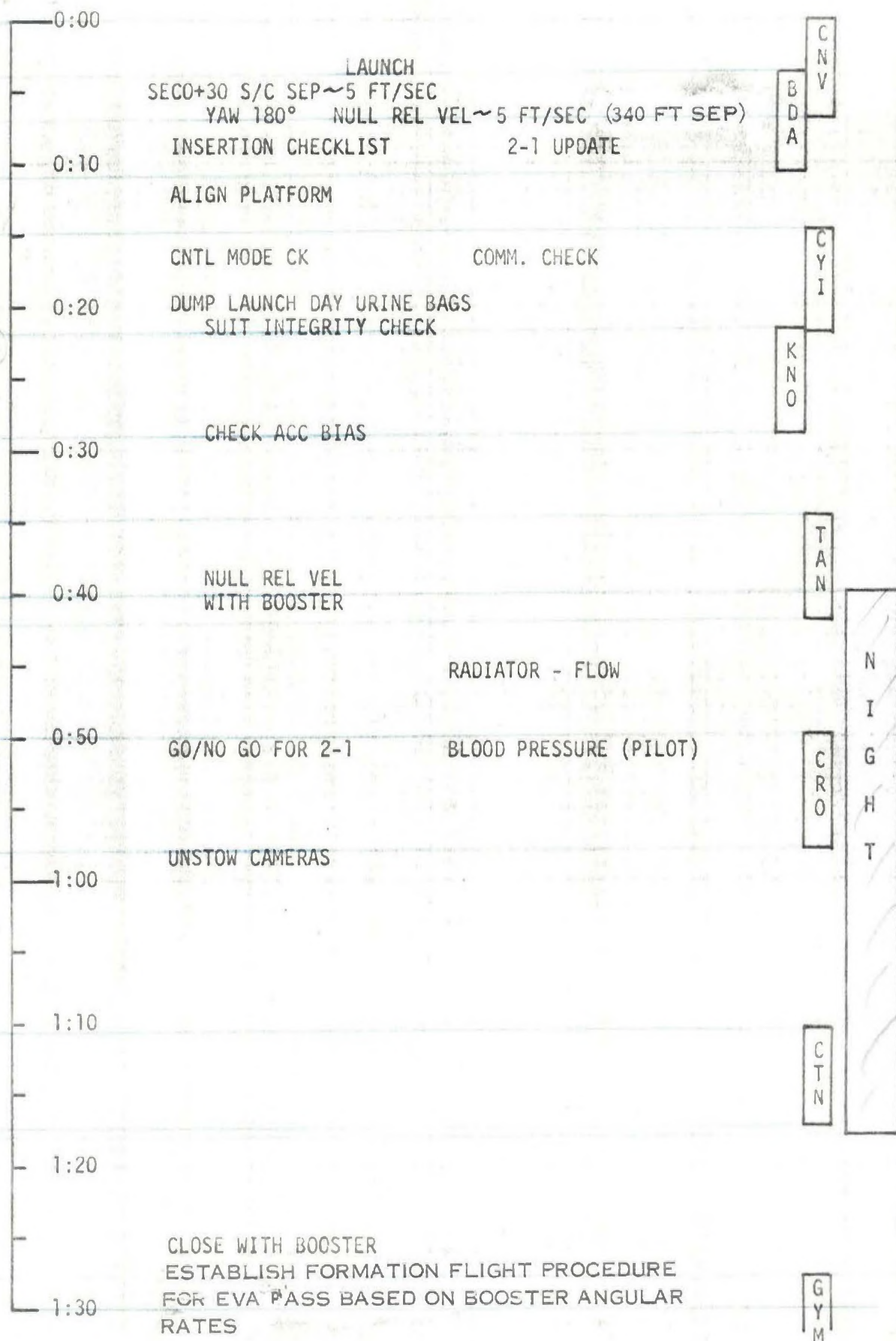
P
R
E

H
A
W

NOMINAL GT-4 TRANSLATIONAL MANEUVERS

<u>Point of Application</u>	<u>ΔV</u>	<u>HP/HA After Maneuvers</u>	<u>Direction of Thrust</u>	<u>Translational Thruster</u>	<u>Purpose</u>
SECO +30	5		Posigrade	Aft	S/C-Booster Separation
	5	86/153	Retrograde	Aft	Station-Keep on Booster
Beginning of 3rd Rev (3:33)	5	88/154	Posigrade	Fwd	S/C - Separation
99 min. later (5:12) 4th Rev	12.5	82/153	Retrograde	Aft	Rendezvous Maneuver (Start intercept
76 min. later (6:28) 5th Rev	21	86/150	Posigrade	Various	Terminal Phase/Braking
106 min. later (8:14) 6th Rev	12	93/150	Posigrade	Aft	Orbital Lifetime Adjust - 45 days
15th or 16th Rev	25-30			Various	**Adjust lifetime - 4 days
30th Rev					Adjust lifetime - 3 days
45th Rev					Adjust lifetime - 2 days
62nd Rev (or 66th Rev*)	+110			Aft	Achieve OAMS Retrofire

** Lifetime Adjustments will be minimum required
 * For Pacific landing
 + If available



48
(P AUG 30 '63 C/P)
Cm

AIR PAR AVION **MAIL**

Dr. J. B. Blizard - Metallurgy	
From	
DENVER RESEARCH INSTITUTE	
UNIVERSITY OF DENVER	
P. O. Box 8786, Denver, Colorado 80210	
To:	Dr. Jocelyn Gill
	NASA Headquarters
	1512 H Street, N.W.
	Washington 25, D.C.

Clippings

GT-4 File

clippings - Wash. Post

GT-4

Astronauts Track Missile in Space In 'Typical Day' Aboard Gemini 5

By Howard Simons
Washington Post Staff Writer

HOUSTON, Aug. 24—Astronauts L. Gordon Cooper Jr. and Charles Conrad Jr. spotted, tracked and photographed a Minuteman intercontinental ballistic missile launched from California today as their Gemini 5 spacecraft orbited the earth.

"I see it, I see it!" Conrad shouted as the missile streaked through space on its way to a watery target in the Pacific.

For two minutes the astronauts watched the Minuteman.

Conrad took six pictures of it. At the same time, an infrared or heat-sensing device recorded the kind and amount of heat being emitted by the solid-fueled ICBM—a thousand of which constitute the bulk of America's strategic nuclear punch.

Conrad and Cooper continue to circle the earth in their fourth day. They have already been granted permission to continue their journey for another day and Gemini officials see no current problems that might foreshorten an eight-day mission. If all goes well, the astronauts will pass the four-day mark at roughly 10 a.m. (EDT) Wednesday.

"Dull" and "Typical"

Today was variously described as "dull," "typical," and "busy."

Flight Surgeon Charles Berry characterized the day as "dull," which he explained is "a good day" medically. The astronauts were "alert"

and appeared to have mastered the temperature-regulating mechanism, which was giving them the chills and causing them to shiver, particularly during sleep.

Astronaut James McDivitt called it a "typical" day, during which the astronauts were catching up with their experiments. Some of these were successful; others were not.

Cooper had repaired his faulty reticle, or gunsight, which helped the astronauts better to pinpoint targets in space and on the ground. Hence, they took a heat-sensing measurement of the star Deneb, which they were unable to do the day before. The astronauts also have photographed the mysterious zodiacal light, which is thought to be a backscattering of light from dust orbiting the earth.

Trouble in Spotting

Attempts to see giant 2000x 2000-foot eye charts on the ground near Laredo, Tex., have been less successful. Although they could see smoke from smoke pots set out to help them pinpoint the Laredo charts, they first missed the charts altogether and then saw two that they misidentified.

More visible to the orbiting sightseers were contrails from three airplanes near Jacksonville, Fla., "and all the streets in it (Jacksonville), and the Cape (Kennedy) and all the way down to Miami."

But the experiment that caused the most excitement was the successful tracking by the astronauts of the Minute-

man missile from Vandenberg Air Force Base in California.

The 65-foot Minuteman was launched at 12:37 a.m. (EDT), as part of a missile combat crew training mission. Shortly after the ICBM was off the pad Conrad spotted it.

The Minuteman was flying a path 155 statute miles north of Gemini 5's path. The point of closest approach to the spacecraft was 201 miles. At the time Conrad and Cooper tracked the missile, they were 125 miles above the earth's surface.

Questions Raised

The fact that the heat-sensing measurements and the photographs of Minuteman and other targets are being conducted for the Defense Department has raised some questions here.

The problem, essentially, seems to be this:

National policy has cast the activities of the National Aeronautics and Space Administration in a peaceful light. Great care has been taken to divorce the military aspects of space from civilian program, notably space flight effort.

The kind of information being gathered by Cooper and Conrad does have potential application for the military.

The challenge, therefore, is whether the Nation should preclude all military scientific and engineering experiments from NASA's activities.

Chronology of astronauts' fourth day in orbit.

Page A10.

Water Excess Forces Cut in Gemini's Power

By a Washington Post Staff Writer

HOUSTON, Aug. 25 — A new problem aboard the Gemini 5 spacecraft and a new American man-in-space record dominated today's orbital activities of astronauts L. Gordon Cooper Jr. and Charles Conrad Jr.

Too much nondrinking water is being produced by Gemini's fuel cell and threatens to flood the power-producing cell. To stem the flow of excess water, Gemini officials decided to reduce the amount of power used by the astronauts for experiments.

Flight Director Christopher Columbus Kraft does not regard the problem as serious. The astronauts still will be able to orbit for eight days. They still will be able to perform their planned experiments. What will be limited in the remaining days of the flight are extra experiments that might have been added to the space flight plan.

New Space Record

The new record established by Cooper and Conrad roughly at noon (EDT) today, in Gemini 5's 62d orbit, bested that for duration of an American space-flight.

The old record was set early in June by astronauts James A. McDivitt and Edward White who stayed aloft for 97 hours and 37 minutes.

From the Control center here, McDivitt radioed the orbiting astronauts:

"Let me be the first to congratulate you on setting a new American record for manned spacecraft."

An even more impressive record will fall to the two Americans at about 9 a.m. Thursday.

At that time Cooper and

Conrad will have been in space longer than any other human. When the astronauts pass Cosmonaut Valery F. Bykovsky's 1963 endurance record of 119 hours, it will also mark the first time that America has wrested a major manned space flight record from Russia.

There were these other highlights today:

- Cooper and Conrad saw and recorded a second Minuteman intercontinental ballistic missile fired from California. They also saw and recorded a rocket sled test at Holloman Air Force Base in New Mexico. And, after several previous and unsuccessful attempts, they got a good look at the aircraft carrier Lake Champlain.

"I can see her turning bigger than heck," was the way Conrad put it.

- The astronauts took some pictures of Cuba. "Just scenic shots," said Cooper. They also photographed cloud patterns, thunderstorms and, on request of U.S. Weather Bureau scientists, they tried to photograph the eye of tropical storm Doreen roughly 200 miles south of Hawaii.

In spite of mild discomfort brought on by itching, continued cold and sleepless nights, Cooper and Conrad were said to be in "extremely good condition" by Kraft and chief flight surgeon Charles Berry.

Relief for some of Conrad's itching came when he asked for and received permission to cut the tight pneumatic cuffs around his thighs. The experimental cuffs were designed to counter the effects of weightlessness on the cardiovascular system. But the power supply for the cuffs, which automatically tighten and relax con-

tinuously, ran out of gas. Just how much this reduces the value of the experiment is not yet known.

Discussing another medical matter, Dr. Berry said there was absolutely no concern over the fact that apparently only one astronaut has had a bowel movement over the last four days of flight. Indeed, according to Dr. Berry, the astronauts could maintain their present regimen for eight days without ill effect.

Fuel Cell Problem

As for the fuel cell water problem, what is involved is this:

Fuel cells convert oxygen and hydrogen gases into electricity, heat and water. The more power the fuel cell is asked to produce, the more of these byproducts it produces.

Similarly, lesser demands for electricity mean lesser amounts of water and heat, too. This is why the Gemini officials have taken a "conservative" approach and ordered the astronauts to use less power.

Because the fuel cell water is poor in color and taste and high in acid, it is being used to press upon a plastic bladder containing the astronaut's normal drinking water supply. But the fuel cell is producing more water than desired and officials fear if the situation continues, a back-pressure could result and flood out the fuel cell.

Anticipating a similar problem on longer flights, Gemini officials already are developing filters that will make the fuel cell water clean and tasty for drinking.

Finally, Gemini officials announced today that barring unforeseen difficulties, the

astronauts are expected to land in the Atlantic Ocean off Bermuda at 10:27 a.m. Sunday.

Round-by-Round Story Of Gemini 5 Flight

HOUSTON, Aug. 25 (UPI) — Here is a chronological account of the activities of the Gemini 5 Astronauts:

56th, 57th Orbits

No voice contact was established with the spacecraft during its 56th orbit, which began at 1:30 a.m., and during the 57th the ship's track took it out of range of most of the tracking stations.

58th Orbits

With both astronauts awake, Gemini Control at Houston relayed a long list of experiments for them to perform. Cooper reported that the tight schedule was still hampering performance of experiments.

59th Orbit—6:19 a.m.

"We would like to request that we keep everything to a minimum in the evenings," Cooper told fellow astronaut Elliot M. See Jr. "We, for some reason, are having trouble sleeping." He said noise from the experiments posed a problem.

60th Orbit—7:54 a.m.

Gemini Control relayed congratulations to Cooper from his wife Trudy on passing the total space flight record of 119 hours 6 minutes, counting his earlier orbital flight.

Bad weather over Laredo, Tex., forced cancellation of a test on this pass of whether the astronauts could spot huge eye charts on the ground.

Cooper reported that he had seven hours of sleep. He said his beard was itching, but that

the skin sensors in his suit were more irritating than the beard. "Pete's (pressure) cuffs are itching him a lot," he noted.

61st Orbit—9:29 a.m.

Cooper and Conrad watched the firing of a rocket sled at Holloman Air Force Base, N.M. "There it goes, we see it!" cried Conrad. "We could see it very well, we were right on the money with the tracking," Cooper reported. The astronauts used infrared detection devices to measure radiation from the rocket's engine.

62d Orbit—11:03 a.m.

At the beginning of the orbit, Cooper and Conrad spotted the aircraft carrier Lake Champlain steaming in circles in the Atlantic near Bermuda. At the end of the orbit, they watched a second Minuteman missile launch from Vandenberg Air Force Base, Calif. They were unable to track the rocket on their infrared radiation detection equipment.

Conrad reported he slept six hours last night "in bits."

63d Orbit—12:38 p.m.

Cooper made the flight surgeon's heart flip by remarking nonchalantly, "We feel much better since we got our suits off." The surgeon quickly realized Cooper was joking. Conrad was allowed to remove some inflatable pressure cuffs around his thighs. He said they "itch pretty bad" and were not working anyway.

64th Orbit—2:13 p.m.

Cooper reported he and Conrad had completed all of the day's assigned experiments except one. The spacecraft was powered down and

Conrad was told to get some sleep.

65th Orbit—3:50 p.m.

Cooper photographed Trop-

ical Storm Doreen in the Pacific as an experiment for the Weather Bureau.

The 66th orbit, which began at 5:26 p.m., the 67th, which started at 7:02, and the 68th, beginning at 8:36, apparently were relatively quiet.



Bavarian
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Celebrating Year
727 11th St.

How It Went on Gemini's 4th Day

On their Gemini 5 space-flight yesterday, Astronauts L. Gordon Cooper Jr. and Charles Conrad Jr. sighted a Minuteman launching and repaired an important sighting system aboard their craft. Following is a chronological account, as compiled from news dispatches, with times in Eastern Daylight Time.

40th Orbit—12:05 a.m.

The pair drifted quietly into the 40th orbit with Conrad asleep. Dr. Duana Catterson at Gemini Control in Houston reported the astronauts had consumed 13 pounds of water each, "pretty nearly an optimum curve for water intake."

41st Orbit—1:38 a.m.

Conrad continued sleeping soundly and only one contact was made with ground tracking stations during the orbit.

42nd Orbit—3:14 a.m.

The quietest orbit of the flight thus far, in terms of space-to-ground communication. For a 70-minute period the spacecraft was out of voice contact range. Conrad was still asleep and Cooper had a meal. Cooper said he had reassembled a defective reticle "and it works fine." The reticle is a sighting device necessary for the success of a number of Gemini 5 experiments.

43d Orbit—4:50 a.m.

The spacecraft made contact with the Carnarvan, Australia, tracking station and flight observer Chuck Lewis gave the astronauts landing and experiment data.

44th Orbit—6:27 a.m.

With both astronauts wide awake and the spacecraft passing over the United States, Gemini Control at Houston relayed instrument readings and experiment directions to the crew.

This exchange between communicator David Scott, an astronaut, and Conrad took place:

Scott—"Okay. You look real good here on the ground. Do you have any questions on the experiments?"

Conrad—"No. I'd say we got a full day. I hope we can get them all done. How's the weather back there in Houston?"

Scott—"Oh, It's real nice. Just hot and sunny as usual. No rain in particular. Just once in a while a little thunderstorm."

Conrad—"Rog."

Scott—"Say, we've noticed that the temperature up there is a little cooler than we expected. How's your comfort?"

Conrad—"Cold. We are taking the inlet hoses off our suits every once in a while to warm up. It has been quite cold."

Chief Flight Director Christopher Kraft Jr. said good morning to the astronauts and told them, "You are doing a good job up there."

Conrad—"I'll tell you one thing, Mr. Kraft. Gordo's beard is white."

Kraft—"A Rip Van Winkle, eh?"

Conrad: — "Nope, Santy Claus."

Cooper—"Boy, putting those two coolant loops in the circuit really cooled it down. We both have been sitting here shivering for the last few hours."

Kraft—"Turn the valve to warm and it will shut off the flow completely. We will monitor on the ground and let you know if it gets too cool."

45th Orbit—8:03 a.m.

Cooper had a meal consisting of orange drink, spaghetti and meat, butterscotch pudding, toasted bread cubes and cheese sandwiches. He said he saw three airplanes approaching Jacksonville, Fla. He and Conrad saw smoke signals sent up near Laredo, Tex., to help them find a huge pattern of white gypsum laid out on the ground, but they could not see the pattern. Fellow astronaut James McDivitt told the men they could go at least 62 orbits.

46th Orbit—9:35 a.m.

An attempt to photograph

landmarks near Dallas was abandoned because of a cloud cover over the target area, but the astronauts insisted on trying the experiment later. "We're going to pick a good site somewhere over the U.S. and get it because we're all rigged for it," Conrad said.

Gemini control reported a few minutes later the men were able to get a picture of a ship west of Bermuda.

47th Orbit—11:12 a.m.

As Gemini 5 approached California, a Minuteman missile was fired from Vandenberg Air Force Base, Calif.

At an altitude of 125 miles, Cooper and Conrad got a fine view.

Conrad: "I see it, I see it... Hey Gordo! Right through that hole in the clouds. There he goes, bigger than heck."

Cooper: "Yeah, we saw him going 'way out above us."

The Minuteman, climbing in a high suborbital arc, came within 200 miles of Gemini 5, Space Agency officials said.

Conrad reported he sighted the Minuteman 10 seconds after launch when it had pierced the overcast. The Minuteman peaked at an altitude of 575 miles and headed down the Air Force western test range over the Pacific Ocean to hit a mythical target.

The astronauts said they took about six photographs of the flying rocket and made infrared measurements of its exhaust plume.

Conrad also spotted Holloman Air Force Base, N.M., and Bergstrom Air Force Base, Tex., as he whirled over them.

As they ended the orbit, the astronauts had their radar trained on Cape Kennedy and reported they were able to keep in touch with the Cape longer than expected.

48th Orbit—12:47 p.m.

Cooper and Conrad reported they were getting "some strange readouts" from their on-board computer. Officials said the signals were not a cause of "major concern," but would be watched closely. Cooper and Conrad finally spotted the checkerboard eye chart laid out near Laredo, Tex.

49th Orbit—2:22 p.m.

Space officials on the ground noted Cooper sounded "just a wee bit tired." He was given a long updating on the flight plan and was told to watch for the Kilauea volcano in Hawaii on the next orbit. The astronauts hoped to measure the intensity of infrared radiation from the volcano.

GEMINI—From Page A1

Gemini Makes Precision Maneuvers



Mrs. Charles Conrad Jr., accompanied by her father, Winn DuBose, sits in the viewing booth behind Gemini Control Center

and gets a first-hand view of the progress of her husband's flight aboard the Gemini 5 spacecraft.

NASA Photo from UPI

looks very good for eight days, and there is nothing that says it shouldn't."

In a mishap on the ground, trouble developed in a computer memory system at Gemini 5 mission control late today, but was cleared up within 11 minutes.

The failure in the memory system did not adversely affect the flight. It developed in the historical data drums, which provide instant displays of flight trends.

After the problem was solved, personnel, who had calculated lost data manually, programmed the trends into the drums. The drums store flight information for 12 hours, then are erased.

The failure occurred at 6:23 p.m. (EST) during the 37th orbit.

As for the astronauts, their day was filled with experiments, sightseeing from space, and some complaint.

Cooper's Complaint

The complaint came from Cooper. In a brief flare-up of irritability, the normally lachrymose astronaut said the flight planners were not giving the astronauts enough time to get their chores done. "We can't get the equipment put together and torn apart by the time they are putting these things (the experiments) together," said Cooper.

Report on Sightings

As for the sights, the astronauts reported seeing their home territory of Houston, and nearby Clear and Taylor Lakes. They also saw Florida, the Bahamas and Cuba.

But there was a lot they did not see, too, largely because of the faulty reticle. Missed, for example, was a planned view of an aircraft carrier and destroyer; a star called Denub, and a Minuteman missile sent aloft from Cape Kennedy, which, though not planned to be viewed by the orbiting astronauts, was the object of their attention as they passed roughly 1000 miles away.

In spite of their difficulties in viewing the world around them, Cooper and Conrad are doggedly performing as many of the 17 medical, engineering and scientific experiments as possible.

Indeed, today an Air Force spokesman reported that the astronauts had recorded more than an hour of radiation data; information on the amount and kind of heat emitted both by objects of nature and man-made objects—in space and on the ground.

Pod Heat Measured

One man-made object in particular, the small radar evaluation pod, was measured by the astronauts for its heat signature.

The Air Force spokesman noted from a preliminary analysis that it gave off roughly as much heat as had been anticipated.

This is the first time that a space object has been studied in this manner by Americans from space. Such infrared or heat-sensing devices could

prove useful to the military for satellite inspection in space.

The radar evaluation pod, which was to have played a significant role in a Gemini 5 rendezvous attempt on Saturday, is expected to plunge into the earth's atmosphere and a fiery disintegration during the evening of Aug. 26. Today, Gemini officials indicated that if they knew on Saturday what they know now it might have been possible to have carried out their original rendezvous plans with the small pod.

Since Saturday, ground tests have shown that would have been possible with the amount of oxygen available on Saturday. What the officials did not know at that time was when the falling pressure in the oxygen would stabilize, if at all.

Nonetheless, Gemini officials obviously are delighted with their makeshift simulated rendezvous carried out today.

It involved making believe that an Agena rocket was at a given point in space—actually the point a real Agena is expected to be at during the forthcoming Gemini 6 mission. Then, using radar data from ground stations, commands were sent to Gemini 5, instructing Cooper and Conrad to maneuver on four different occasions during three revolutions around the earth.

How Craft Was Maneuvered

What Gemini officials assumed was that the Agena was in an elliptical orbit whose high point and low point were about 210 and 141 miles respectively. To effect a near rendezvous with the imaginary Agena the astronauts had to maneuver their craft into an orbit with high and low points of 193 and 124 miles above the earth.

After four maneuvers, including an orbital plane change of roughly 150th of a degree, Gemini 5 virtually achieved the high and low points desired.

An orbital plane change works this way:

The plane of every orbit cuts through the earth's center. Most of these orbits are with reference to the Equator. The angle the plane makes to the Equator is its inclination. Through the use of propulsion, spacecraft can alter that inclination and, hence, change their orbital plane.

Police Reinforced After Ramleh Attack

Reuters

TEL AVIV, Aug. 23—Reinforced the township of Ramleh, where a crowd of Jewish youths attacked the Arab quarter yesterday.

The youths attacked the Arabs after the funeral of a Jewish youth killed on Friday in a collision between his motorcycle and a taxi driven by an Arab. Some 12 Arabs were injured in the attack. Police said today they had arrested 22 of the youths.

Staking of Claims On Moon Ruled Out

Associated Press

The Government has some advice for would-be moon homesteaders: Forget it.

"The moon belongs to the world, not the first arrival," said a spokesman for the National Aeronautics and Space Administration.

"We assume that any exploration there will be handled on an international cooperative basis much like that in Antarctica."

Over the years, however, many Americans have contemplated a life beyond earth. Some even filed claims with a county recorder, listing the moon or part of it as their own.

Venus Heat Held Caused By Snowfall

BLACKSBURG, Va., Aug. 23 (AP)—Venus, the red hot planet between the earth and the sun, is almost as hot on its "black side"—the side away from the sun—as its lighted face, and it is kept hot by snowfalls, a Johns Hopkins University theoretical physicist speculated today.

Dr. John Strong, a pioneer in balloon telescope astronomy, dropped this curious item into the scientific pot on the first day of Virginia Tech's fifth annual space conference. The conference is devoted to "the exploration of Mars and Venus."

Strong described for 250 scientists the instrumentation and techniques of the November, 1964, balloon ascent producing the identification of ice crystals in the atmosphere of Venus. Water vapor had been discovered on a 1959 balloon flight.

He speculated that a 120-mile-an-hour wind on the face of Venus drags the ice crystals around to the back side, there, presumably, to become the "warming snowfall."

Dr. Strong told the engineers, teachers and researchers from universities, space exploration companies and government that man's current knowledge of Venus owes as much to "Gulliverian speculation" as to documented research.

Later this year, he said, another balloon carrying equipment from his laboratory is expected to bring back more information on the characteristics of Venus.

He told the conference the automated, unmanned balloon is much preferable to the manned vehicle; also that a balloon gondola is never an easy base from which to fix on and track a planet like Venus.

Dr. Dick Brouwer, director of Yale University observatory, spoke on the orbits of Mars and Venus.

He was asked by reporters about speculation about life on Mars.

"Cross it off," he answered with a laugh.

Disposal of Body Waste Is Easy for Astronauts

HOUSTON, Tex., (AP)—Disposal of body waste is no problem on the space trip of astronauts L. Gordon Cooper Jr. and Charles Conrad Jr.

A plastic bag with a new-style adhesive lip is used for collection of feces. The adhesive provides a secure attachment to the body.

A germicide inside the bag prevents the formation of bacteria and gas.

After use, soiled items, toilet tissues and a wet towel are placed in the bag, which then is sealed, rolled and stowed in empty food container spaces.

The bags will be brought back to earth for analysis. Urine is disposed of with an adaptation of the relief tube system currently used in military fighter planes.

Tooth-brushing is just that. The brush hangs on the spacecraft interior by means of the material used as fasteners on golf gloves and women's purses.

There is no toothpaste on board, so the astronauts squirt their mouths full of water, brush and swallow.

Washing after each of the day's four meals is done with wash pads and towels that resemble deodorant pads and face cloths.

The pads are treated with a nontoxic disinfectant that has no odor but does clean and is lint-free.

Cooper and Conrad will resemble grizzled old prospectors because scientists have not found a way to get rid of whiskers.

Fainting Possible At Orbits' End

ABOARD USS LAKE CHAMPLAIN AT SEA, Aug. 23 (UPI)—The physician for the Gemini 5 astronauts aboard the recovery carrier Lake Champlain said today there is a "possibility" they may faint when they leave their capsule at the end of eight days.

Dr. Howard Minners said they might experience the faintness a person feels who has been bedridden for some time and first gets to his feet. "The treatment is simple," said Minners. "Lie down." He called the faintness "orthostatic hypertension."

West Va.

Chronological Account of Orbits As Space Flight Enters 3d Day

Following is the chronology of the Gemini 5 space flight of Astronauts L. Gordon Cooper Jr. and Charles Conrad Jr., compiled from news dispatches.

Shortly after midnight Sunday Gemini 5 had completed 24 orbits and 38 hours of its 121-orbit, 190-hour scheduled voyage.

25th Orbit—12:15 a.m.

Gemini Control at Houston concluded that Conrad's husky voice resulted from lack of sleep and not from any serious throat condition. Dr. Duane Catterson said it had "not affected his ability to perform." Cooper continued to catch up on sleep.

26th Orbit—1:48 a.m.

Conrad tried several simple experiments as the capsule passed over central Asia. Cooper woke up and Conrad began a long sleep. Ground Control said the flight "looked real good."

27th Orbit—3:31 a.m.

The orbit began along the west coast of South America near the equator. While his companion remained in a deep sleep, Cooper made contact with the Canary Island tracking station and conducted a successful purge of the fuel cell oxygen and hydrogen systems. He also made periodic checks on electron and ion flux interaction with the spacecraft.

28th Orbit—5:05 a.m.

Cooper ate a substantial meal of concentrates of chicken and gravy, bacon and eggs and chocolate pudding. Conrad continued to sleep.

29th Orbit—6:39 a.m.

Conrad woke up and had the following conversation with the Canary Island tracking station:

Surgeon: "You're pumping full scale. We have a good blood pressure . . . Give me a mark when you begin exercising."

Conrad: "Stand by—mark."

Surgeon: "We have a good blood pressure."

Conrad: "Roger, the command pilot (Cooper) is taking his two-hour period nap now. The pilot (Conrad) slept about 4 hours 45 minutes of his six-hour period, very soundly."

Surgeon: "How's your water intake?"

Conrad: "Twelve and a half pounds of water for the command pilot, 11 pounds 3 ounces

for the pilot (roughly six quarts each). I'm just getting ready to eat Meal Charlie."

30th Orbit—8:14 a.m.

The astronauts reported that each had slept a total of about 10 hours since the flight began at 10 a.m. Saturday. The oxygen pressure, at more than 100 pounds, was up 10 pounds from the previous day and 40 pounds from the low point Saturday when it appeared that the mission might have to splash down prematurely after the sixth orbit. Control gave the capsule instructions for performing a simulated rendezvous with a make-believe Agena rocket on the 32d through 34th orbits.

31st Orbit—9:47 a.m.

The mission passed the two-day mark. The astronauts again complained of the workload ordered by Ground Control in this conversation with astronaut James A. McDivitt, mission communicator at Houston:

Cooper: "You might have a little talk with the flight planning people. They're filling us just a little bit too full. We can't get the equipment put together and torn apart in the time they're putting these things together."

McDivitt: "Okay, Gordo, I'll take a check on that . . . I think one of the flight planning problems, Gordon, is that the weather is not too good today, so they are trying to stick them (experiments) in where they have good weather . . ."

Cooper: "Yeah, well some of these . . . were just bang, bang, bang right together. We just can't do them that close together. That's rather poor planning."

McDivitt: "Okay."

Conrad: "We got to watch these lens changes. We got every piece of gear in the spacecraft floating around in here. We can't keep up with it."

McDivitt: "Roger, roger."

Then later:

McDivitt: "Hey, Pete. Gemini 5 Houston here. Why don't you make a few comments for the better sex."

Conrad: "Hello there. We just passed over Tampico, Mexico."

McDivitt: "Pete, Pete. Jane's up here. Why don't you say something?" (Jane is Conrad's wife.)

Conrad: "Hello there. How's all the boys (his four sons) doing?"

McDivitt: "She says fine."

Still later in the orbit, the

banter turned into an impromptu variety act with this exchange between the capsule and Houston:

McDivitt: "You sure do talk a lot."

Conrad: "Say again."

McDivitt: "I said you sure do talk a lot."

Conrad: "What do you want me to do, sing you a song?"

McDivitt: "Think you can?"

Cooper: "He sings off key."

Conrad: (in a singsong) "Over the ocean, over the blue, here's Gemini 5 singing to you. (Pause) Well, I'm going back to talking."

McDivitt: "Get you a job with the Houston Astros."

At 11:18 a.m. control told the spacemen they could go at least until the 47th orbit or until about noon Tuesday.

32d Orbit—11:21 a.m.

The astronauts powered up their equipment and executed the first of four blasts from their maneuvering rockets to change their orbit and bring them into theoretical rendezvous with the phantom Agena, whose track was being programmed by a ground computer. By comparing the latter with the actual track of Gemini 5, Control would later estimate the closeness of the simulated linkup.

33d Orbit—12:56 p.m.

Cooper and Conrad performed two more rendezvous maneuvers. The command pilot spotted a huge checkerboard design laid out on the ground near Laredo, Tex., as a test of the astronauts' ability to see from more than 100 miles in space.

34th Orbit—2:31 p.m.

The astronauts completed the make-believe rendezvous attempt and learned they had come within two minutes of being in the right spot at the right time. Then they turned off much of their electrical equipment, successfully performed a routine test of their fuel cell system, and settled down for some sleep and meals.

35th Orbit—4:07 p.m.

While Conrad slept, Cooper snapped pictures of selected landmarks in an experiment designed to help future astronauts navigate successfully home from the moon. A medical check indicated both spacemen were in excellent condition. Cooper was told weather conditions around the world were good.

36th Orbit—5:43 p.m.

Conrad reported that the temperature gauge in the capsule cabin had failed, but he said a hand-held gauge was working. Ground Control said the temperature reading made from telemetry data was 74 degrees. During the orbit, the astronauts photographed a tropical storm.

37th Orbit—7:19 p.m.

The Ground Control center reported that the radar set aboard the spacecraft was becoming too cold. To warm it up, officials ordered the astronauts to turn the radar on. The temperature rose from 16 degrees to 26 degrees, which is normal. All other systems aboard the capsule were also operating normally.

Advertisement

Key

same O/L, meaning on fix
on rho

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2 & 3 pg maps - Dunkerton's
expos. verifies this.

5-10 factor cut down

MA - 9 window got worse

during mission. worse!

Satell. night ←

* Condensate on window during
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GT-8 Rusting & Ell. See

Air fuel / worse than ♀

2 d. at Unit
fine and fresh

tape on switch

Conrad -

R + 10 days

Sept. 8

Date a

pix from Houston

Bert M.

⑦ Space Photography

Baumann, R.C. Pg. from
Viking II Rocket at
alts up to 158 miles

NRW 4489 JLC

Feb. 1955

⑩ Baumann, Pg. from
Viking 12 Rocket
up to 143.5 miles

NRW 5273

Apr. 1959

⑪ Lathrop, P.A. & Rush
Report of missile & space
Dept., G.E. Co, Phila. 1959

⑫ Evans, Baumann
ractic Met. Photo
Probe, NASA TN
D-706, Feb 1962

⑬ Conover, J. H. &
Soller, Cloud
Patterns as seen 250-580
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Contrib to Intell. Met.
GRD Ranch notes no
36, AF CRC-TN-60-
427, Bedford, June
1960, pp 31-45

Geminis 2 in space

PRIOR to
GT-4'S Walk-In-Space

5/19/65

Ques. to which Chas. Mathews would like answers

Save J.R.S.

Pearse

1. Pictures will be taken before opening the hatch: (Before de-pressurization)

What will happen to the film when the hatch is opened? nothing!

H63-3437

GT-5 Tom/Brake

Insult. by Branch in

MSC

2. During pressurization:

How long can you use the film? 30 mins? or what?

3. Pressurization in cabin:

After exposure to outside (outer space) and a very low temp. (10 deg.F.), how long will it take for the film to recover?

4. Will cold temp. cause problems with rolling the film? Will it break?

5. If one waited a period of time inside capsule, how long would this be?

for film to recover

ESTAR
base
Ektachrome
50-217
Everb.
in 2.5 mil
ESTAR
polyester

Norm Foster

pictures:-

glass vac. interface different from

GT-5

Conrad
also briefed

briefing went O.K. McQuitt + White got a reporter

ERP:

May 10th //

55 & 56

MSC/10 info (4 mil Estar)

Document

Bu. of Standards calibrated
lenses

W. Darling & focal length
of lenses / Stewart / Bean dist

Sounding Rockets & Satellites focusing
Leman!

an early or. Review
J. Bryan Bird & A. Thomas

1463-486

WIV

Tablet of 204
1964

Space & Geographical
applic date & focal length
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NRL 4489

Using 4 x 12 pg documents

adjustment of focus

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cd check focus -

GSFC - cd to done under
vac. cond.

5/18/65

45 min

Conference

Stoddard
373-4686

4.7 min
Hess

Rusty - suggestion

How about assignment of an astronaut to
NASA HQ propa office for 3-6 mos.

Medical

Scientific (SM)

Astronauts want to be in on planning

Hess (SM)

16 min
movie

Stoddard = [Huck briefing notes]

Roy Stokes

Robt.
Baumann

134-
5116

Underwater poster

several yrs ago
Ft Churchill
70 mm cameras

heretically - sealed &
in water tight &
fix taken thru quartz
windows

White Sands
Compensate focus

N. Foster

Photography

134 - 5781 ←

problem

focus!

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Science not
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→ Col. Glenn (June briefing)

[11] Rubin

Eclipse is on schedule.

picture - GSFC

stabilized set up (rocket)

Aerotec 4.8

30 Nov 1964

bright air glow

← sl. dark-adapted

Rte 180, 385, Cities
Texas & New Mexico

finnish

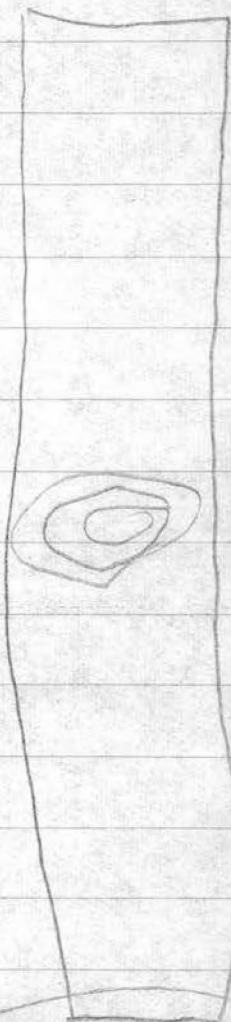
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other astronauts

morale

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on



2 color - south link

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For Norman Foster

5/19/65

Vacuum pg

calls -

Beattie,

Stuhlinger

Duntley

Shorenstein

T. Gold

E. Levin

Cunningham

Bill Armstrong - who's develop
camera for A surf?

Apollo (Ed Levin)

Office in Houston

→ Donbach's group developing in Houston

→ Sasser (tech monitor
in study stage)

handheld camera for Lunar surface

George Goetz Am. Optical Co.

Edgerton, Brewsterhouse & Frier (film) exports

Edgerton etc in Boston EGG

underwater

[across from MIT]

Sasser has study contract for

Pf

Instrumentation Pg. (editorial staff)
good source of info.

Photogrammetry

Clutch Mather - (white sands
about)

① Before de-pressing -
what will happen to film

② during pressing,
How long can you use film

③ 5/11 pressure in cabin
How long for it to recover
so can put
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ESTAR

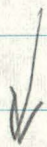
TN D-706

Feb 1962

p. 14, 15, 16

NASA Pet 4.43

read to



Norm Foster

Eastman Kodak

MSRS. Soren & Butts

Tell him about
Apollo contract!

Opik: (Haven 60 mi.
regard of brightness

faintest disappear at
52 mi.

brightest 40 mi.

ones. It turned path
scattered for fainter nebulae
& for those with high vel.
large football after
20 mi.

bright
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before Orion.
fast-moving brown out
quicks,
velocities?

$$1 \text{ mi.} = 1.60935 \times 10^5 \text{ cm} = 1.60935 \text{ Km}$$

$$1 \text{ mi.} =$$

GT-4

Meteors

Height & velocity,
Nos. - F. Ranch

Regardless of their brightness, meteors are
~~passage~~ between 40 and 60 miles in
the earth's atmosphere. Bright meteors
are seen about 40 miles, large fireballs
often as low as 20 miles or so.

The average height throughout the path
is greater for fainter meteors & for those with
high velocities. Actually the bright objects
are larger and go further before they are
burned up, often traveling rather slowly
for several hundred miles. The

P. 206 shooting stars

White

"I am quite a fan, fall & burn up below
our altitude. They were about $\frac{1}{2}$ to $\frac{1}{3}$
as high as the pilots when consumed (O/S)." 4

Med

- oh yes -

never saw one above us.

BT-4

Week D.C. 10/9/65

Views

photo of ♀ in horizon bands, No. = S 65 34771
Seen at every sunset

Sunsets all had 4

air glow structure

new item in air glow observations.

ht. meas. with sextant

geom. height

horizon bands

||||| ?

"flaring"
sketch in
logbook

p. 1 notes
Boulder

Gill to do: - 8.193 "planets are so clear bright"

♀ in ~~dark~~ twilight bands
asteroids

does Larry
have slide?

Feb. lt. mainly 0.239

Reach

Dip of horizon

Polar aurora

logbook sketches

2+ to 3 - intensity, below color

lighting from outside tape (lines) "fresh"

Bunkelman

Air glow - geom. ht.

horizon bands

(4)

p. 205 E. d. Cont.

taking movies during this
"it was a shaft of light & a long time before sun came
up."

p. 206 Shooting stars

white

saw quite a few, fell & burned
below our altitude

$\frac{1}{2}$ - $\frac{1}{3}$ as high as we were when being
burned.

McD - ok yes

[never saw one above us]

McD - never

p. 207, 208

Horizon

& horizon very clearly

McD

altitude clusters not blending

p. 209

p. 216 Both windows were pretty foggy

207 MSC-10

Earth Lick photographs

event line indicator
frame

(could not
shutter)

Imp.

0.0

Ask M.D. / White or Mercur

1. Pictures of Auroras? what camera?
p. 202 1st time had many settings:
 $\frac{1}{250}$ at f/11

What unit? tape?
lasted for 3 or 4 mins. or so (p. 203)

2. Airglow measures (O.)

optical characteristics of all cameras.

When did they take the movies?

Times of Sun Camera fix

Times of airglow measures

Contrast phenomena

Take 3 FILMS to M.D. to get needed original prints

on board tape:

around sightings times (on board tape)

weather on earth - "Black" background

Ratio of albedos

Boulder

Sept 1, 2, 1968

1.

Gill

$$S \text{ K} = 3.5 \frac{\text{cm}}{\text{mm}} = 3.8 \frac{\text{cm}}{\text{mm}}$$

$$h \text{ S} = 20.5 \frac{\text{cm}}{\text{mm}} = 20.8 \frac{\text{cm}}{\text{mm}}$$

$$f = 21.8 \frac{\text{mm}}{\text{cm}} = 21.7 \frac{\text{mm}}{\text{cm}}$$

$$-1.2 \frac{20.8}{19.6} \frac{\text{mm}}{\text{mm}}$$

$$S = (1.5 \text{ mm}) \text{ OK}$$

$$f = \text{horizontal} = 21.8 \text{ cm} \checkmark$$

$$h = \text{earth to white layer} = 20.2 \text{ mm} \text{ OK}$$

① NASA Tech. Report { Roach, Dunkerton, Gill }

② Condensed version for the book summary

S-5 on Rev 32 over U.S.

Start at 17:40 GMT?

Good
revised.

Drawing ask to sketch for flights
in Angkor (F. Roach)

Size of features determined by window

(10 - 10') maybe / specific 30 - 300 Km

usually too large to see from ground

11:45 GMT
add 8:45 (Houston) 20^h & 30 mins.

Gill

Planets: 11 sunsets all had the planet in it. 4
Venus - seen at every sunset & p.g. in horizon
trans in Leo

Vol I, p. 205

Photo of Venus in horizon bands tape dumps
? S-65-34848 ??

See original, S-65-34771

air glow
structure (only raw thing)
 meas. with sextant

sharp line of demarcation - sighting line.
 5577 in air glow layers (
 about 20% of layer.

Brownish patches
 Schinia, Cooper

Roach

Dip of horizon
 Polar annular

~~Report~~

Dunkelman

Air glow - Jan. Lt.

Horizon bands

Depression of sun

Gill

20 m Venues in twilight bands (15° from sun)

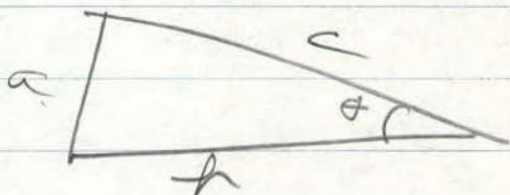
Measures

Ques to ask white/mc D.

$$\sin \theta = \tan \theta \\ = \theta \text{ in rad.}$$

Log book material
Sketches of universal

$$\sin^2 \theta + \cos^2 \theta = 1$$



$$\boxed{\sin \theta = \frac{a}{c} = \tan =} \\ \cos \theta = b/c$$

on board tape

time of universal sightings

films (16 mm)

orbit # may get film tape +

cd estimate the times of $\sin \frac{1}{2} \theta =$

horizon band photos

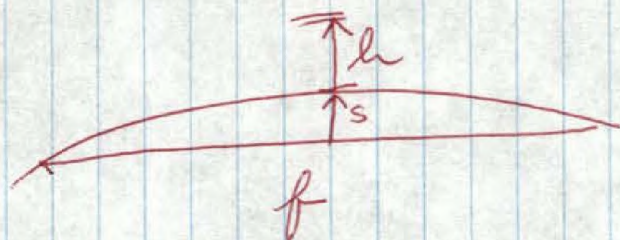
GT-4 Refs.

The Sky and Eye - F. Roach
S & T Vol 17 Feb 1958

Color threshold, etc.

2+3- interval. Amoral

P. 207



Concave vs. convex
spectacles

Radical Light

White probably saw it
one by surprise

Planets

Brightness of Venus

Venus

Mars

meters (visual meters)

90-100 km

classical return background

Aug 11-14

Frank Hankin

Annual Review - paper plot - chance of results
Best reference for Legend

Sunsets v. Sunrises

Take written

Meteors -

Give some info on meteor heights
to compare with height of spacecraft

Sunsets

NASA ROUTING SLIP

	CODE	NAME (if necessary)	ACTION
			APPROVAL
			CONCURRENCE
1.	M6SD	A. J. Lippard	FILE
2.	M6S	E. W. Hall	INFORMATION
3.	M6	W. C. Schneider	INVESTIGATE AND ADVISE
			NOTE AND FORWARD
4.		Gill	NOTE AND RETURN
			PER REQUEST
5.		Cato AC	RECOMMENDATION
			SEE ME
6.			SIGNATURE
7.		Rathy - Ben X	REPLY FOR SIGNATURE OF:

REMARKS:

file pls

FROM:	CODE: M6SD	NAME: Dobeneck	DATE: 7-22-65
-------	------------	----------------	---------------

GT-4

UNITED STATES GOVERNMENT

Memorandum

TO : SM/Manned Space Science

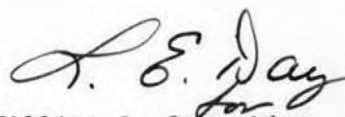
DATE 22 JUL 1965
M-C MGS 1352.2

FROM : MG/Deputy Director, Gemini Program

SUBJECT: Technical Analysis of Gemini (GT-4) Photography

The attached TWX on the subject matter from Willis Foster to Robert Piland on July 16, 1965, has been coordinated by Mr. Liccardi of my office and Dr. Gill of your office. I believe that this TWX satisfies the request of your letter to me of July 16, 1965 on the same subject.

I do not anticipate any problems in your office receiving the S-5 70MM film, however, should you encounter any difficulties my office will prepare additional authorization that may be deemed necessary to expedite this matter.


William C. Schneider

cc: Dr. J. Gill



Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

MR. ROBERT O. PILAND
EXPERIMENTS PROGRAM OFFICE
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

INFO TO: DR. PAUL LORMAN, GODDARD SPACE FLIGHT CENTER,
GREENBELT, MARYLAND
MR. LEO CHILDS, CODE ET22, MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

IT IS REQUESTED THAT YOU AUTHORIZE THE APPROPRIATE AUTHORITIES AT
MSC TO RELEASE THE ORIGINAL FILM OF SPOOL 3 OF MAGAZINE 8 (WHICH
COVERS THE SOUTHWESTERN U.S.) TO MR. LEO CHILDS, MSC, FOR 2 TO 3
DAYS. MR. CHILDS WILL CARRY IT TO DATA CORPORATION, DAYTON, OHIO
FOR MEASUREMENT ON THEIR ~~MICROSCOPIC~~ ^{MICROSCOPIC} THE PURPOSE OF THESE
MEASUREMENTS IS TO DETERMINE THE TRUE RESOLUTION OF THE 8-5 TO 10
PHOTOGRAPHY ON GT-4. WE REFER TO A TELEPHONE CONVERSATION BETWEEN
EMERY HARRIS OF YOUR OFFICE AND ANTHONY LICCARDI, CDSF, LAST NIGHT.

WHILE MAKING THE RESOLUTION ANALYSIS WE ARE ASKING DATA
CORPORATION TO MAKE FIVE (5) SETS OF CONTACT PRINTS AND ONE (1)
DUPLICATE NEGATIVE OF SELECTED FRAMES USING VERY FINE-GRAINED
MATERIALS WHICH GIVE ALMOST 100% TRANSFER. THESE PRINTS AND FILM
WILL BE USED FOR FURTHER ANALYSIS BY AGENCIES IN THE WASHINGTON
AREA.

PAGE TWO

DR. PAUL LONGMAN PRINCIPAL INVESTIGATOR ON THE S-5 EXPERIMENT HAS
CONCURRED IN THESE ARRANGEMENTS. IT IS UNDERSTOOD THAT
MR. LEO CHILDS WILL SAFEGUARD THE FILM IN TRANSIT AND AT DATA
CORPORATION. AT DATA CORPORATION THE CONTACTS ARE
MR. WILLIAM OCHOA, CHAIRMAN OF THE BOARD AND MR. ROBERT BOONE.

WE WILL GREATLY APPRECIATE YOUR EXPEDITING OUR OBTAINING THIS
IMPORTANT SCIENTIFIC DATA WHICH CAN BE ACQUIRED FROM THE S-5
TO THE FILM.

VILLIS B. POSTER
DIRECTOR
MANNED SPACE SCIENCE PROGRAMS

cc: MI/Schneider
MIS/Liccardi
EN/Colvocoresses

Jocelyn B. Gill
Chief, Inflight Sciences

20593

7/16/65 2:00 p.m.

UNCLASSIFIED



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON, D.C. 20546

IN REPLY REFER TO: SM(JRG:com)

Dr. F. Saiedy
U.S. Weather Bureau
National Weather Satellite Center
Suitland, Maryland

Dear Dr. Saiedy:

We are pleased to inform you that the Office of Space Science and Applications has recommended to the Office of Manned Space Flight that the following experiment be flown on the early Gemini series of manned space flights:

Title: Spectrophotography of Clouds ✓

Principal Investigator: Dr. F. Saiedy

Sponsoring Institution: U.S. Weather Bureau
National Weather Satellite Center

Present plans call for ten manned Gemini missions, spaced three months apart, beginning in the last quarter of Calendar Year 1964. Overall responsibility for manned space science investigations is assigned to Mr. Willis B. Foster, Director, Manned Space Science Division, NASA Headquarters. The Manned Spacecraft Center, Houston, has been assigned implementation responsibility for the Gemini scientific payload under the direction of Dr. Jocelyn Gill, Chief, In-Flight Sciences, a member of Mr. Foster's staff. Will you please inform Dr. Gill by letter of any co-investigator(s) officially associated with your experiment. Technical coordination for your experiment will be handled by Mr. Roy Stokes, Manned Spacecraft Center, Houston, Texas, telephone number, HU 3-7633.

In accordance with the National Aeronautics and Space Administration's policy for the release of data, experimenters are granted a period of time for exclusive use of the data. For Gemini, you are granted a period of six months from the receipt of the data. If this time period is not satisfactory, please get in touch with Dr. Gill to discuss a period which would be mutually agreeable to the NASA and yourself.

Experimenters are encouraged to publish experimental results promptly in order to inform the scientific community as early as possible. A brief analysis of experimental results with illustrations where appropriate is required to be furnished to the experiment coordinator within two weeks following the mission for the postlaunch memorandum prepared by Manned Spacecraft Center. Experimenters are also encouraged to coordinate and exchange data among themselves in order to enhance to the fullest extent, the scientific benefits of each mission. It is important to the conduct of your experiment that all Gemini schedule deadlines be met and that you keep your MSC experiment coordinator informed on progress of your experiment at all times.

We hope that the planning of your experiment and the construction and integration of your flight hardware will be brought to satisfactory completion in order that your experiment, along with those of the other experimenters on the attached list, may serve to make the Gemini scientific payload a successful addition to the United States Space Program.

Sincerely yours,

Homer E. Newell
Associate Administrator
for Space Science & Applications

Enclosure:
List of
Approved Experimenters

UNITED STATES GOVERNMENT

Memorandum

TO : SM/Manned Space Science

DATE: 22 JUL 1965
M-C MGS 1352.2

FROM : MG/Deputy Director, Gemini Program

SUBJECT: Technical Analysis of Gemini (GT-4) Photography

The attached TWX on the subject matter from Willis Foster to Robert Piland on July 16, 1965, has been coordinated by Mr. Liccardi of my office and Dr. Gill of your office. I believe that this TWX satisfies the request of your letter to me of July 16, 1965 on the same subject.

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Day for
William C. Schneider

William C. Schneider

cc: Dr. J. Gill



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NAME OF AGENCY NASA HEADQUARTERS		PRECEDENCE	1245 UNCLASSIFIED CLASSIFICATION
ACCOUNTING CLASSIFICATION <i>SM</i>		ACTION: INFO.: PRIORITY	
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STANDARD FORM 14 REV. MARCH 15, 1957
GSA REGULATION 2-IX-301.00
14-304

TELEGRAPHIC MESSAGE

OFFICIAL BUSINESS
U. S. GOVERNMENT

MESSAGE TO BE TRANSMITTED (Use double spacing and all capital letters)

THIS COL. FOR AGENCY USE

MR. ROBERT O. PILAND
EXPERIMENTS PROGRAM OFFICE
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

INFO TO: DR. PAUL LOWMAN, GODDARD SPACE FLIGHT CENTER,
GREENBELT, MARYLAND

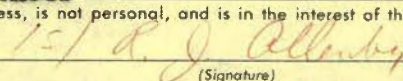
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AREA.

DO NOT TYPE MESSAGE BEYOND THIS LINE

962

NAME OF AGENCY ACCOUNTING CLASSIFICATION THIS BLOCK FOR USE OF COMMUNICATIONS UNIT	PRECEDENCE ACTION: INFO.: TYPE OF MESSAGE ☐ SINGLE ☐ BOOK ☐ MULTI-ADDRESS	SECURITY CLASSIFICATION STANDARD FORM 14 REV. MARCH 15, 1957 GSA REGULATION 2-IX-301.00 14-304 TELEGRAPHIC MESSAGE OFFICIAL BUSINESS U. S. GOVERNMENT
MESSAGE TO BE TRANSMITTED (Use double spacing and all capital letters)		THIS COL. FOR AGENCY USE
START MESSAGE ADDRESS HERE PAGE TWO DR. PAUL LOWMAN PRINCIPAL INVESTIGATOR ON THE S-5 EXPERIMENT HAS CONCURRED IN THESE ARRANGEMENTS. IT IS UNDERSTOOD THAT MR. LEO CHILDS WILL SAFEGUARD THE FILM IN TRANSIT AND AT DATA CORPORATION. AT DATA CORPORATION THE CONTACTS ARE MR. WILLIAM GOROG, CHAIRMAN OF THE BOARD AND MR. ROBERT BOONE. WE WILL GREATLY APPRECIATE YOUR EXPEDITING OUR OBTAINING THIS IMPORTANT SCIENTIFIC DATA WHICH CAN BE ACQUIRED FROM THE S-5 70 mm FILM. WILLIS B. FOSTER DIRECTOR MANNED SPACE SCIENCE PROGRAMS cc: MG/Schneider MGS/Liccardi SM/Colvocoresses DO NOT TYPE MESSAGE BEYOND THIS LINE		
NAME AND TITLE OF ORIGINATOR (Type) <i>Jocelyn R. Gill</i> Jocelyn R. Gill Chief, Inflight Sciences		ORIGINATOR'S TEL. NO. 20593
I certify that this message is official business, is not personal, and is in the interest of the Government.  (Signature)		DATE AND TIME PREPARED 7/16/65 2:00 p.m. SECURITY CLASSIFICATION UNCLASSIFIED

SM (JRG:kby)

JUL 14 1965

Dr. Karl G. Henize
Dearborn Observatory
Northwestern University
Evanston, Illinois 60201

Dear Karl:

Thank you so much for your letter of 24 June telling me that you were not present at the GT-4 debriefing. I am sorry you could not make it, but I am aware that the rescheduling was most inconvenient. It was a most interesting two-day session with one day for the individual experimenters and another day for the general scientific public.

I am attempting to plan the next Inflight Experimenters meeting to occur in juxtaposition with the Scientific Debriefing Sessions in Houston. At present, we are hoping for a whole week of meetings in Houston, August 30 - September 3. So put this on your calendar with the thought that last-minute shifts are still the order of the day in this business.

I want to congratulate you on the fine reports you have been submitting for your S-13 experiment and especially the document entitled "Definitive Plan." The full documentation of your experiment is very important and I am glad to see you are keeping up with that. I want to urge you to look into the final stages of documentation for equipment delivery at the Cape. Just this week we had a trying experience of a co-experimenter arriving with his piece of equipment and McDonnell refusing to accept it. Some 4 or 5 pieces of documentation with "stamps," etc. were missing and the experimenter had apparently never even heard of these pieces of paper. In the orderly assembly of the spacecraft and its equipment much documentation has, of course, to be assembled, time-consuming as it is.

I suggest that you have Mr. Wackerling check very carefully into the documentation required for McDonnell to accept a piece of experimental

equipment for an actual flight. in the event that you should make use of a Boggess camera. I also plan to have this as an agenda item at the next Experimenters meeting.

Best of luck with your membership on the Astronomy Subcommittee. You will certainly find it educational.

Have a good summer.

Sincerely yours,

Jocelyn R. Gill

Jocelyn R. Gill
Chief, Inflight Sciences
Manned Space Science Programs

cc: Dr. Al Boggess, III/GSFC
Willis B. Foster, SM
Subject File
Reading File

DEARBORN OBSERVATORY
NORTHWESTERN UNIVERSITY
EVANSTON, ILLINOIS 60201

24 June 1965

Dr. Jocelyn Gill
Chief, Inflight Sciences Branch
Code SM
Manned Space Science Programs
NASA Headquarters
Washington, D. C. 20546

Dear Jocelyn:

In connection with the astronaut debriefing conference, I'm sorry if my lack of attendance has caused you any embarrassment. I simply couldn't make it on such short notice. I was at the University of Wisconsin when the news reached me on Wednesday morning. Having just driven for three hours to get there I was reluctant to turn around and leave immediately as would have been required for me to catch a late afternoon plane to Houston.

I hope that it might be possible for me to attend the next debriefing in which the astronauts may be discussing either open hatch activities, spacecraft stabilization, or operation of the General Purpose Camera.

As you are probably already aware, I have just received an invitation from Dr. Newell to become a member of the Astronomy Advisory Subcommittee. I am delighted both for the honor of having been so chosen and also by the implication that astronomical observations from manned space vehicles have at last been recognized as worthwhile scientific activities. I thank you for your very considerable efforts in backing my original proposals and in making it possible for this whole situation to develop so favorably.

Sincerely,

Karl

Karl G. Henize

KGH:mjw

● GT-4 file

SM (JRG:cvd)

JUL 14 1965

TO: Manned Spacecraft Center
Chief, Photographic Division, Code BT2

FROM: NASA Headquarters
Chief, Inflight Sciences

SUBJECT: Request for duplicate movie films and color prints of
all 70 mm, hand-held pictures

One copy of each of color movie films which include sunsets, sunrises, horizon bands, limb of earth and terrain views is requested to be forwarded to Dr. J.R. Gill, Code SM, NASA Headquarters. Please send these air mail since this material is needed soon for preparation of an astronomical report on GT-4. One of the most important films for this purpose is Magazine 9.

Two sets of color prints of all color still pictures which were taken with Hasselblad 70 mm camera (on GT-4) are also requested. It will be adequate to send these by regular mail. These prints pertain mainly to the S-5 and S-6 Gemini Experiments.

Jocelyn R. Gill

Jocelyn R. Gill

GT-4 file

SM (JRG:kby)

JUL 1 1965

TO : Manned Spacecraft Center
Mr. Robert O. Piland, Deputy Manager
Apollo Spacecraft Program Office

FROM : Chief, Inflight Sciences Branch
Manned Space Science Programs

SUBJECT: Request for copies of transcript of voice tape from GT-4

As per our telephone conversation some days ago, the following persons will greatly appreciate receipt of copies of subject transcript, viz.

1. Dr. Franklin Roach
National Bureau of Standards
Bureau of Central Radio Propagation
Boulder, Colorado
2. Mr. Laurence Dunkelman
Institute for Defense Analyses
400 Army-Navy Drive
Arlington, Virginia
3. Mrs. Winifred Cameron
Code 641
Goddard Space Flight Center
Greenbelt, Maryland
4. Dr. J. R. Gill
Code SM
NASA Headquarters
Washington, D.C. 20546

Jocelyn R. Gill
Jocelyn R. Gill

cc: MGS/Mr. Liccardi
SM Reading Files SM File: Sci. debriefing GT-4 file

CONCURRENCES: SM:JRGill:kby 20593 7/1/65

OFFICIAL FILE COPY

OFFICE CODE ►						
SIGNATURE ►						
DATE ►						

SM (JRG:kby)

JUN 17 1965

Dr. Elizabeth Roemer
U.S. Naval Observatory
Flagstaff Station
Flagstaff, Arizona

Dear Pat:

Thank you so very much for responding to my request for comet photographs and ephemerides so that I could apprise the GT-4 astronauts on this subject.

I do not know how you managed to assemble this material and send it to me so promptly. The timing was perfect -- it arrived just in time so I could forward the comet photographs along with some other information I was mailing to them.

Hope the western weather cleared sufficiently so that your trip was not difficult from that standpoint.

Thanks again for your contribution to the GT-4 mission.

Best regards,

Sincerely yours,

Jocelyn R. Gill

Jocelyn R. Gill
Chief, Inflight Sciences Branch
Manned Space Science Programs

cc: SM Files

JR Gill
SM:JRGill:kby 20593 6/7/65

SM (JRG:kby)

JUN 17 1965

Dr. Elizabeth Roemer
U.S. Naval Observatory
Flagstaff Station
Flagstaff, Arizona

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Sincerely yours,

Jocelyn R. Gill

Jocelyn R. Gill
Chief, Inflight Sciences Branch
Manned Space Science Programs

cc: SM Files

SM:JRGill:kby 20593 6/7/65

SM (JRG:kby)

JUN 17 1965

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U.S. Naval Observatory
Flagstaff Station
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Jocelyn R. Gill

Jocelyn R. Gill
Chief, Inflight Sciences Branch
Manned Space Science Programs

cc: SM Files

SM:JRGill:kby 20593 6/7/65

SM (JRG:kby)

JUN 17 1965

Dr. Elizabeth Roemer
U.S. Naval Observatory
Flagstaff Station
Flagstaff, Arizona

Dear Pat:

Thank you so very much for responding to my request for comet photographs and ephemerides so that I could apprise the OT-4 astronauts on this subject.

I do not know how you managed to assemble this material and send it to me so promptly. The timing was perfect -- it arrived just in time so I could forward the comet photographs along with some other information I was mailing to them.

Hope the western weather cleared sufficiently so that your trip was not difficult from that standpoint.

Thanks again for your contribution to the OT-4 mission.

Best regards,

Sincerely yours,

Jocelyn R. Gill
Jocelyn R. Gill
Chief, Inflight Sciences Branch
Manned Space Science Program

cc: SM Files

SM:JRG111:kby 20593 6/7/65



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D. C. 20546

IN REPLY REFER TO: SM-(JRG:kby)

Dear

We are enclosing lists of Gemini photographs for Missions IV through VIII which you requested. These include the numbers that Creative Arts* can utilize in filling orders. The Gemini IV material can be ordered by the magazine, spool, and frame numbers (Example: Gemini IV, Magazine 16, Spool 5, Frame 31). The Gemini V, VI, VII, and VIII material can be ordered by the "HC" number (Example: 65-HC-701).

Note that the column "GET" signifies ground elapsed time and can be converted to GMT, which is Greenwich Mean Time.

We hope this information will answer your needs. Thank you for your interest in the Gemini photographs.

Sincerely yours,

Jocelyn R. Gill
Manned Flight Experiments Office

Enclosures:

Lists of Gemini IV, V, VI,
VII, VIII photographs

* Creative Arts
Attn: Mr. Tinsley
814 H Street, N.W.
Washington, D.C.

From

NORTHERN ARIZONA SOCIETY
OF SCIENCE AND ART, INC.

FLAGSTAFF, ARIZONA
P. O. Box 1389



National Aeronautics & Space Admin.

Code: ~~111~~ Dr. Jocelyn R. Gill

Washington, D. C. 20546

Order No.
.....

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- ☐ Insured
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☐ Book Post
☐ Printed Matter

EXPRESS

- ☐ Prepaid
☐ Collect
☐ Pieces
Value.....

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for postal inspection if necessary.

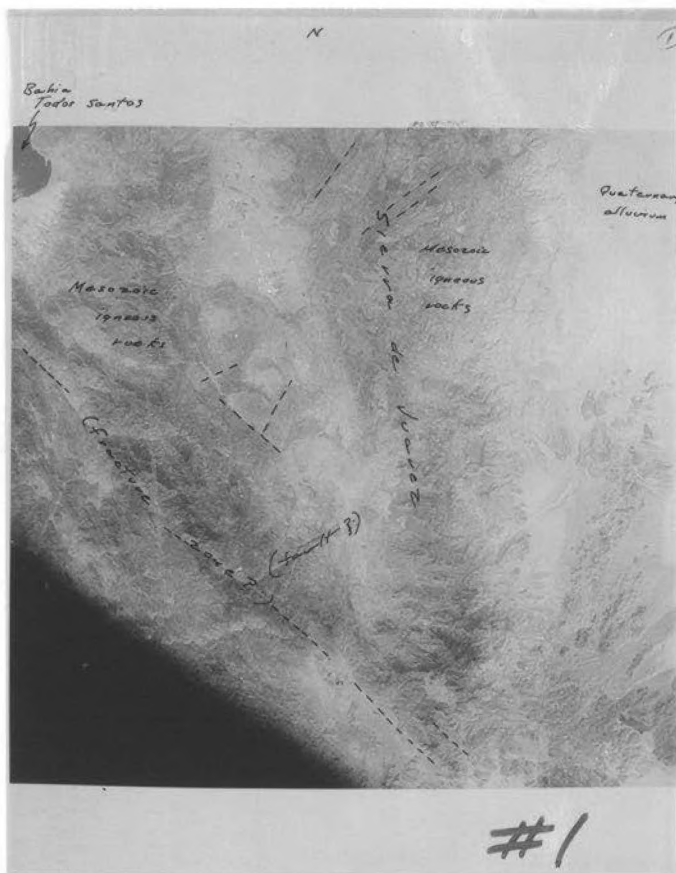
RETURN POSTAGE GUARANTEED

For the Science Sem. 10 (EARTH SCIENCES)
Su Sharpshooter (P. J. J. J. J.)



No. 55 6 x 9

BELMONT CLASP



F614E2A

POLAROID

J. R. Gill
Cado SM
NASA HQ
Wash. D.C.

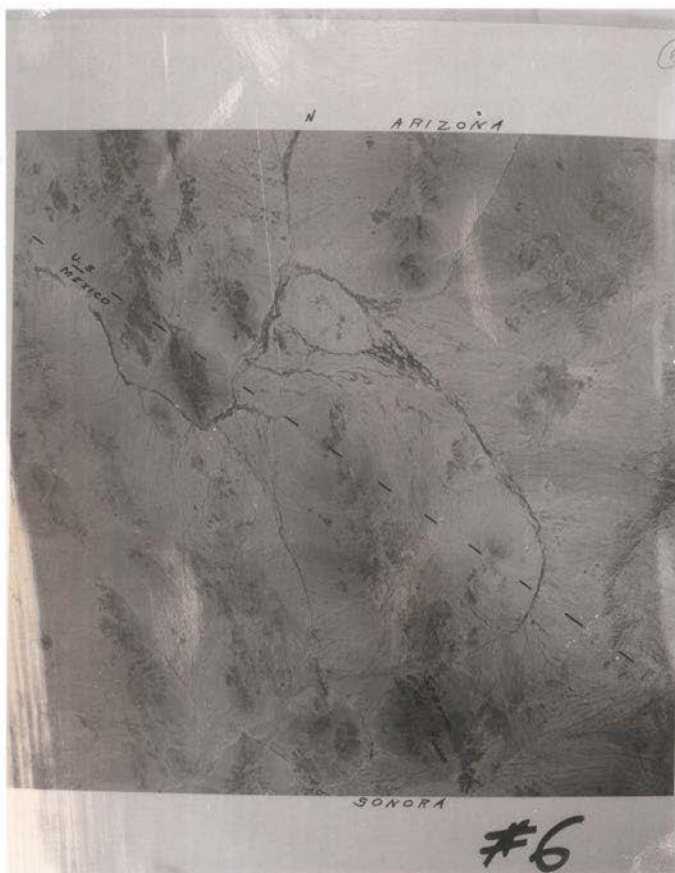
②



F514E2A

FOLAROID

J. R. Fill
Code 5M
NASA HQ
Wash. D.C.



PAGE 19

FOLIOID

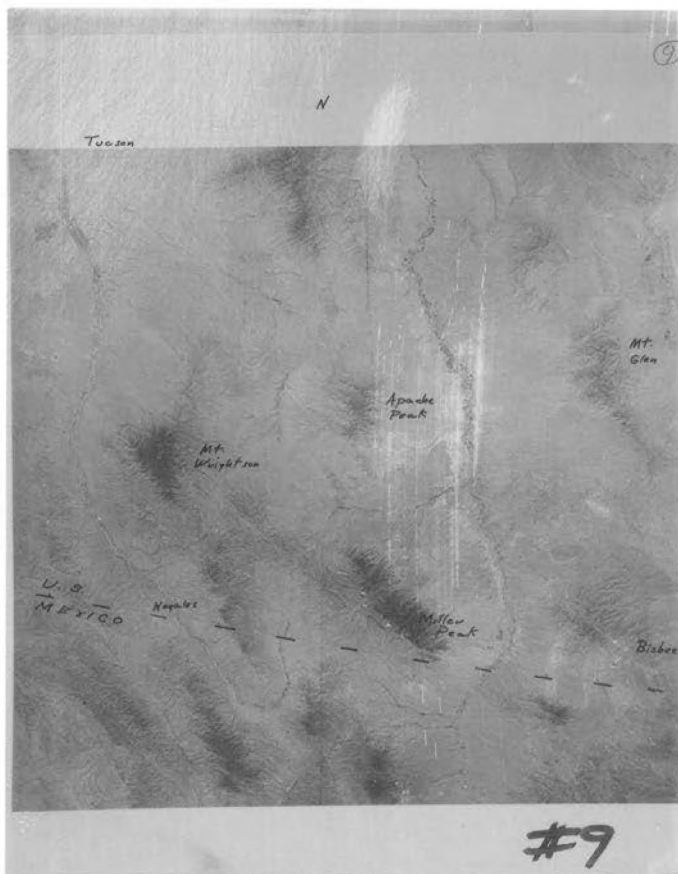
J. R. Jell
Code SM
NASA HQ
Wash. D.C.



F512228

POLAROID

J. R. Felt
Code SM
NASA HQ
Wash. D.C.



F510228

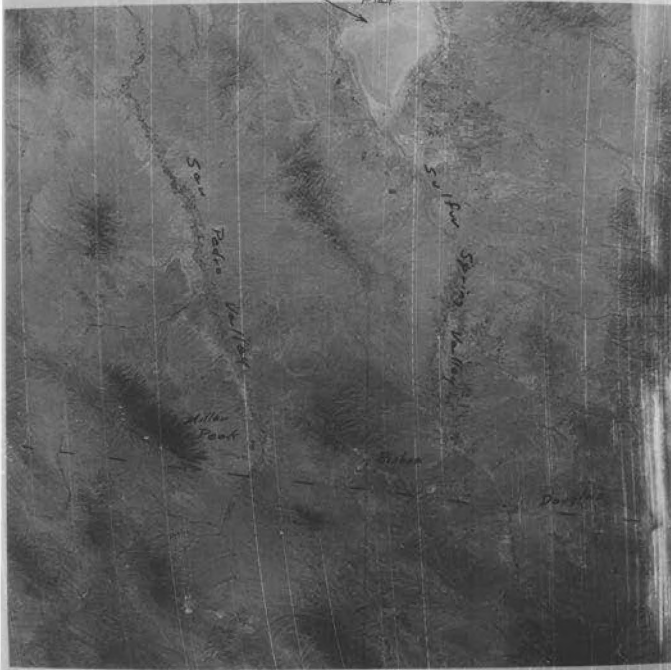
101A0010

J. R. Sill
Code SM
NASH HP
Wash. D.C.

(10)

N

So. Pacific Willcox (playa)
H.R. Flat

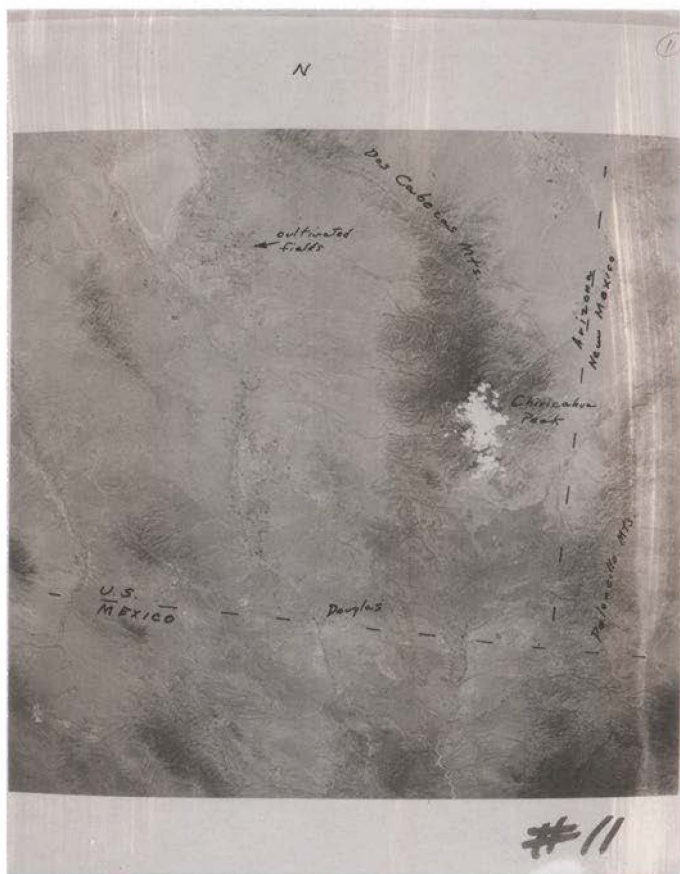


#10

POLAROID

POLAROID

J. R. Lill
Code SM
NASA HQ
Wash. D. C.



PS14223

POLAROID

J. R. Fille
Code SM
NASA HQ
Wash. D.C.

PS10229

PC140010

J. R. Full
Code SM
NASA HQ
Wash. D. C.

N

Florida
Mts.

Sierra

Cariboulla

Sierra
Caribou

Caribou
Sierra

Laguna
de
Guamán (playa)

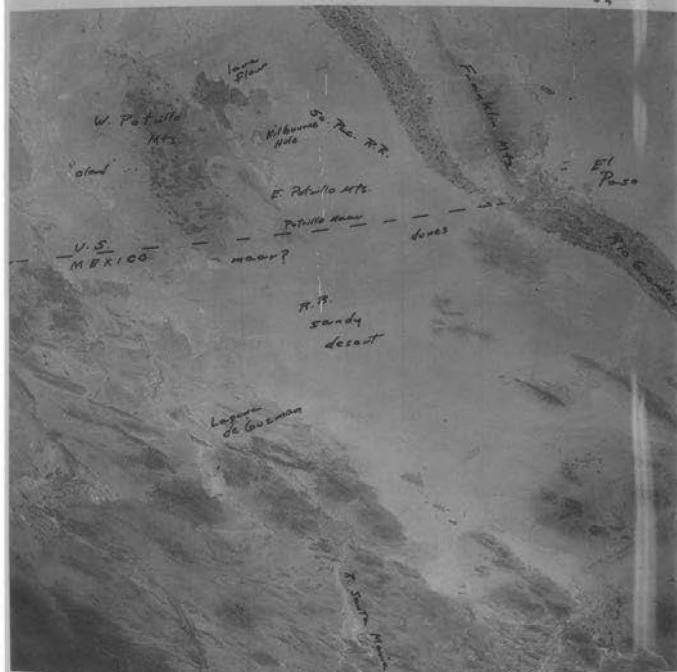
#3

PL 42504

PL 42504

J. R. Gill
Code SM
NASA HQ
Wash. D. C.

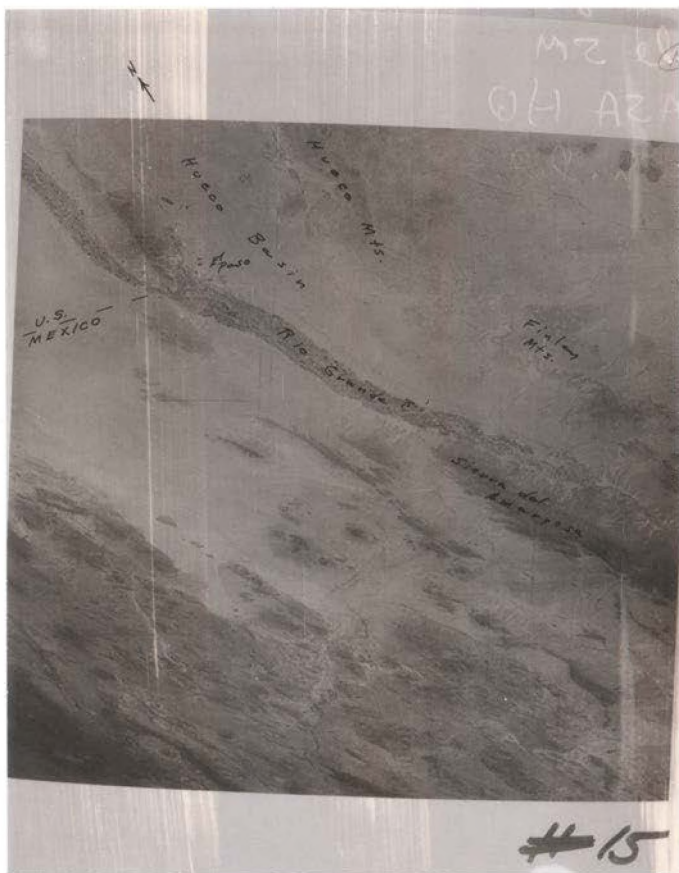
U.S. 541 R.R.



#14

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POLAROID



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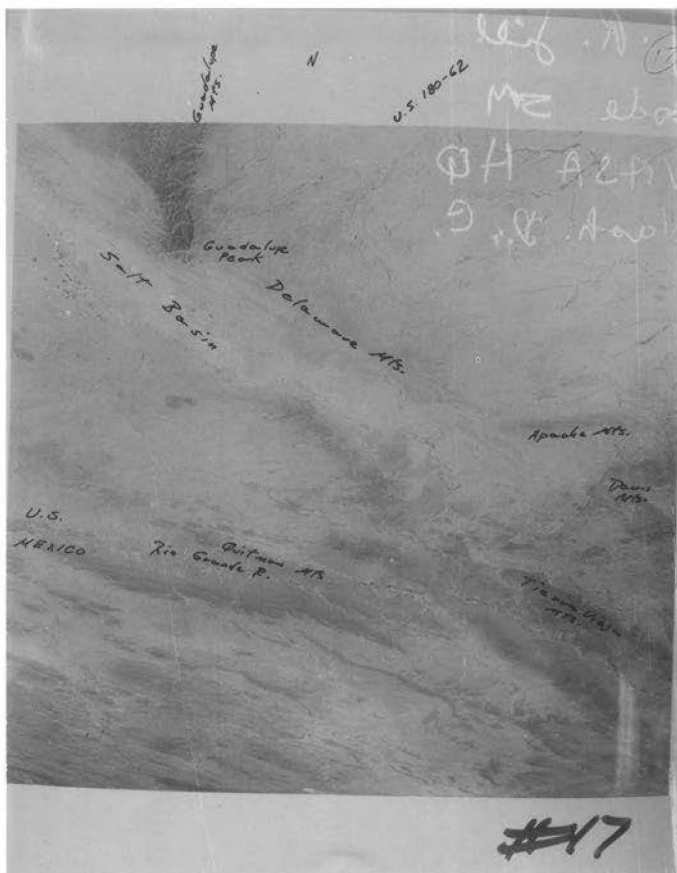
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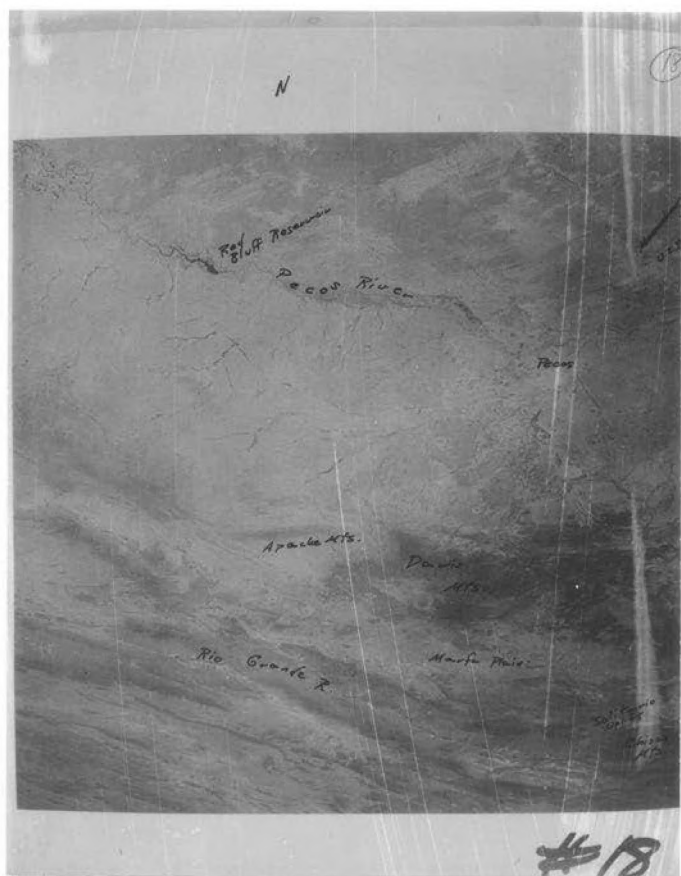
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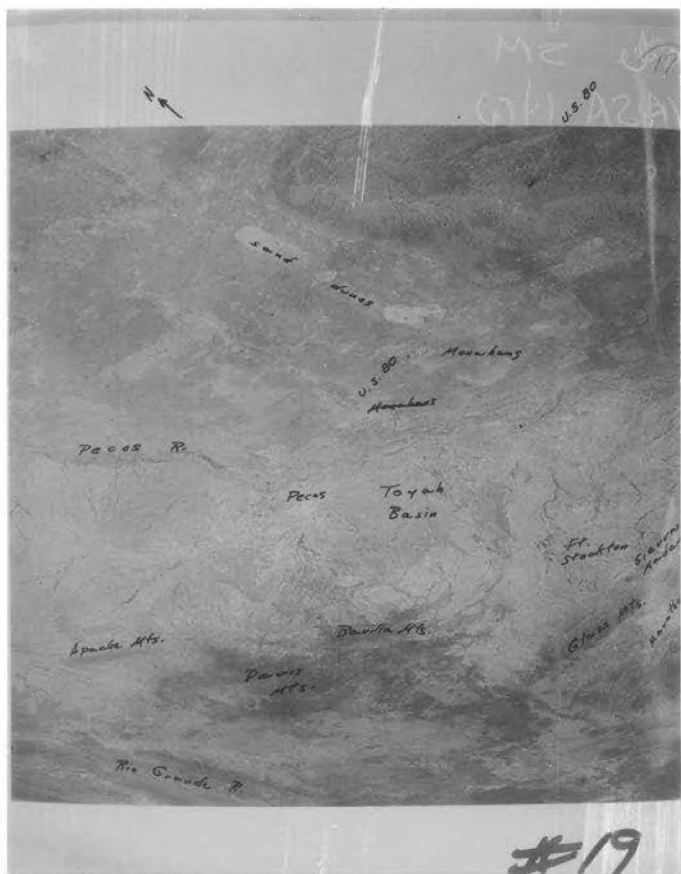
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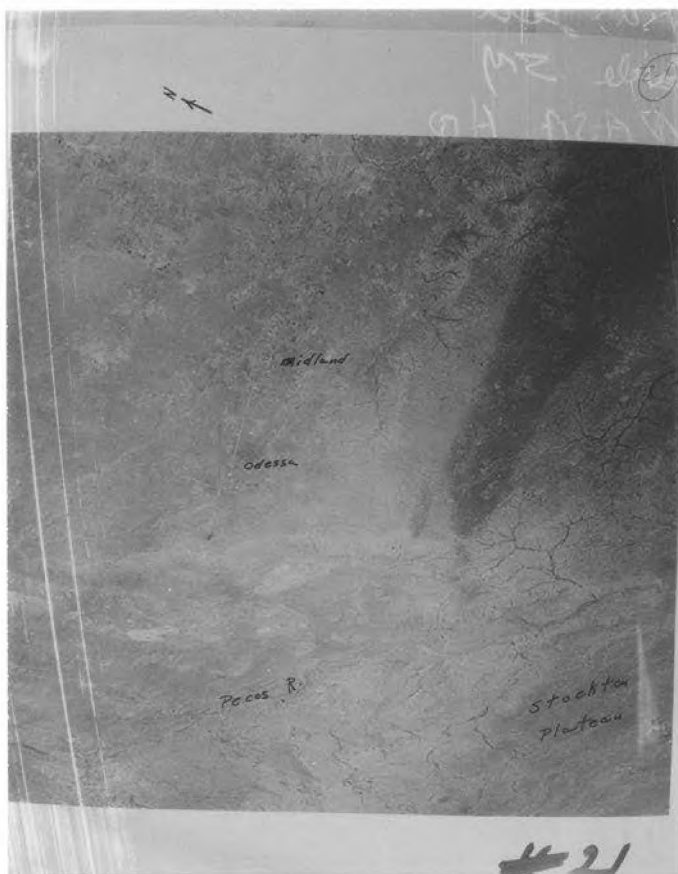
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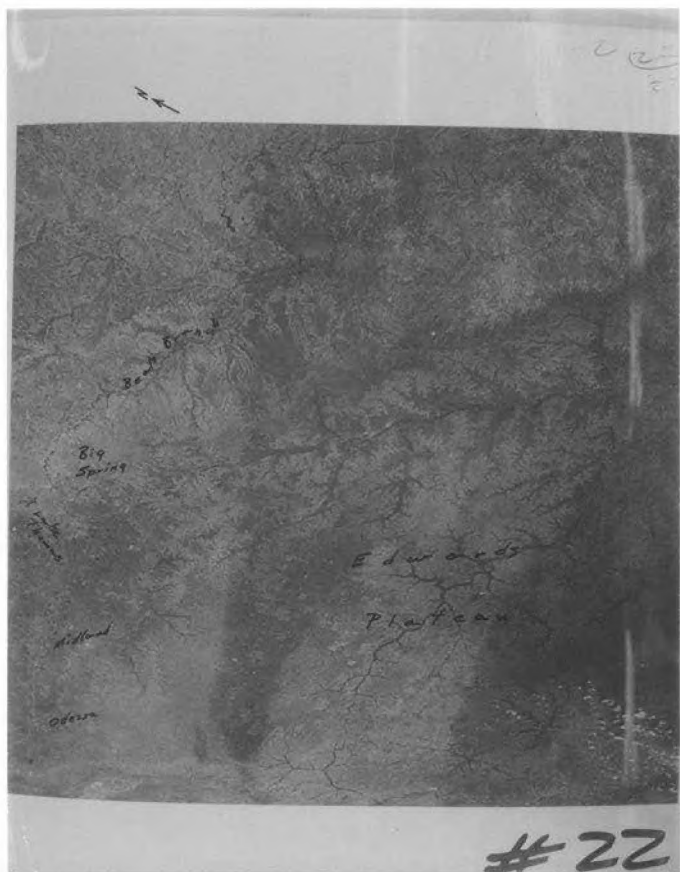
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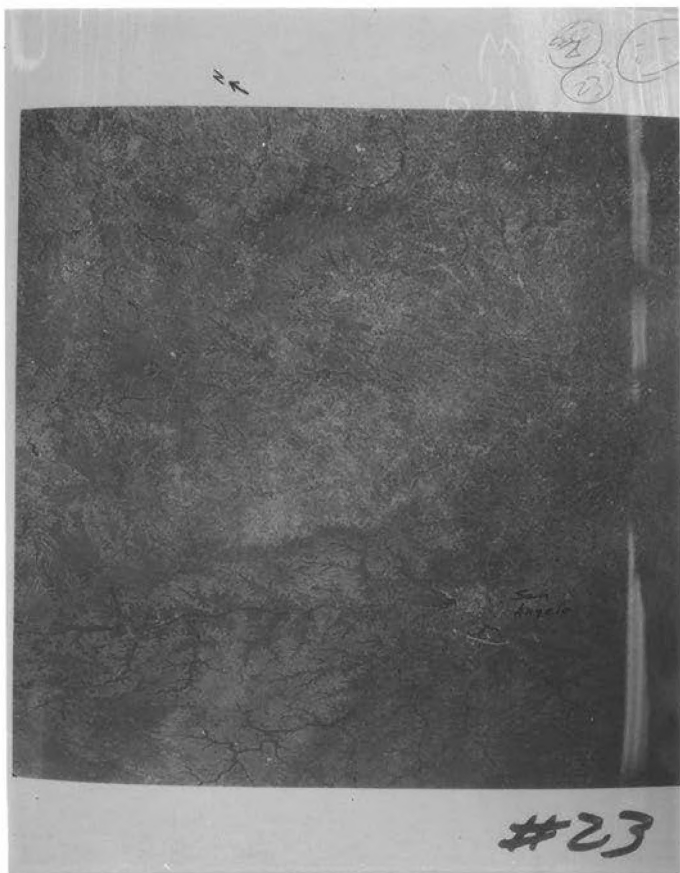
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