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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO 14 MISSION
5-DAY REPORT

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
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PREFACE

This report is based on an evaluation of preliminary data. Apollo 14 range zero (the integral second before lift-off) was 21:03:02 G.m.t., January 31, 1971. Unless otherwise noted, all elapsed times are referenced to range zero and are referred to as elapsed time from lift-off. All references to mileage distances in this report are nautical miles.

SUMMARY

The highly successful Apollo 14 mission, manned by Alan B. Shepard, Jr., Commander; Stuart A. Roosa, Command Module Pilot; and Edgar D. Mitchell, Lunar Module Pilot; was launched from Kennedy Space Center, Florida, at 4:03:02 p.m. e.s.t. (21:03:02 G.m.t.) on January 31, 1971. The launch was delayed about 40 minutes because of restrictive weather conditions in the launch area. The activities during earth orbit check-out and translunar injection were similar to those of previous lunar landing missions. During transposition and docking following translunar injection, six attempts were required to achieve a docking. Television was used during translunar coast to observe the probe and drogue inspection, and all operations indicated a normal functioning system. Except for a special check of ascent battery 5 in the lunar module, the remainder of the translunar coast period proceeded in accordance with the flight plan. Two midcourse corrections were performed at about 30-1/2 hours and at about 77 hours. These corrections achieved the non-free-return trajectory, the desired closest approach distance to the lunar surface, and placed the spacecraft operations back on the nominal flight plan time before lunar orbit insertion.

The spacecraft was inserted into lunar orbit at 82 hours with the descent orbit insertion maneuver performed two revolutions later. The descent orbit insertion maneuver placed the combined spacecraft in a 58.8 by 9.6 mile orbit. The lunar module was entered at approximately 101-1/4 hours for activation and checkout in preparation for the descent to the lunar surface.

The lunar module undocked from the command and service module at 103-3/4 hours. Prior to powered descent, an abort signal was set in the computer as the result of a malfunction but a routine was manually loaded in the computer that inhibited the recognition of an abort discrete. The powered descent maneuver was initiated at 108 hours. A ranging scale problem, which would have prevented acquisition by the landing radar, was corrected by reinitializing the landing radar system. Landing in the Fra Mauro highlands occurred at 108:15:11. The landing coordinates were 3 degrees 39 minutes 56 seconds south latitude and 17 degrees 28 minutes 42 seconds west longitude.

Preparations were begun for the first extravehicular activity two hours after landing. A lunar module communications problem delayed cabin depressurization about 40 minutes. The Commander began his egress and descent to the lunar surface at about 113 1/2 hours and as he egressed, the modularized equipment stowage assembly was deployed for transmission of color television pictures. The Lunar Module Pilot egressed at about 113-3/4 hours. The S-band antenna was erected and activated,

the American flag was displayed, the Apollo lunar surface experiments package was deployed and various documented rock samples were taken during the 4 3/4-hour extravehicular period. The mobile equipment transporter was used during this period for carrying equipment and rock samples.

Preparations for the second extravehicular activity were begun following a 6 1/2-hour rest period. The goal of the second extravehicular period was to traverse to the top of Cone Crater. Time constraints prevented reaching the top, but the objectives associated with reaching the crater and gaining the desired samples were achieved. On the return traverse from the Cone Crater area, the antenna on the Apollo lunar surface experiment package central station was realigned and various documented rock and soil samples were collected. The second extravehicular period lasted almost 4 1/2 hours for a total extravehicular time of about 9 1/2 hours. During the extravehicular periods, at least 103 pounds of lunar rocks and soil were collected.

The ascent stage lifted off at about 141 3/4 hours and the vehicle was placed in 52.1- by 9.2-mile orbit. Rendezvous and docking operations were normal. However, during the final braking phase, the abort guidance system failed. The ascent stage was jettisoned and guided to impact approximately 36 miles west of the descent stage.

Transearth injection occurred during the 34th lunar orbit revolution at about 148 1/2 hours. During transearth coast, one midcourse correction was made with the reaction control system, and a special oxygen flow rate test was performed. Good quality television coverage was provided while the four inflight demonstrations were being performed.

The entry sequence was normal and the command module landed in the Pacific Ocean at 216:01:57. The landing coordinates, as determined from the onboard computer, were 27 degrees 2 minutes 24 seconds south latitude and 172 degrees 41 minutes 24 seconds west longitude.

PRELAUNCH ATMOSPHERIC ELECTRICITY EXPERIMENTS

Cumulus congestus clouds with showers developed about one-half hour before the scheduled launch time along a line extending from Orlando toward the northern part of Merritt Island. These clouds developed in the warm moist air mass to the south of a cold front that extended through northern Florida at launch time. Scattered shower activity was noted to the south of the front throughout the morning, and showers reached the launch area just before the scheduled launch time. The cloud tops in the launch complex area were at 15 000 feet 20 minutes prior to the scheduled launch, and were at 18 000 feet 10 minutes later. This necessitated a 40-minute hold. The cloud base at launch was at 4000 feet with tops to 10 000 feet.

Three types of atmospheric electricity experiments were conducted in the launch complex area prior to launch and during powered flight. These included electric field measurements, radiometer measurements of the Saturn vehicle exhaust plume, and very-low-frequency and low-frequency radio noise measurements.

Preliminary data from the electric field measurements indicates that the field was enhanced to 4000 volts/meter. The estimated electric field which was associated with the Apollo 12 lightning incident was calculated to be 7500 volts/meter.

LUNAR SCIENTIFIC EXPERIMENTS

LUNAR SURFACE EXPERIMENTS

Apollo Lunar Surface Experiments Package

During the first extravehicular period, the crew deployed and activated the Apollo lunar surface experiments package. The package consists of a radioisotope thermoelectric generator power source, five scientific experiments and a central station. The scientific experiments are:

(a) active seismic experiment,
(b) passive seismic experiment,
(c) suprathermal ion detector experiment,
(d) cold cathode gage, and
(e) charged particle lunar environment experiment.

Central station.- The initial signal strength of transmitter A was nominal but subsequently dropped to a marginal level which caused intermittent losses of downlink. Antenna realignment and subsequent adjustment at ground stations eliminated the dropout problem. Station temperatures are slightly higher than nominal, but well within the predicted temperature response band. The 12-hour event timer which backs up the command functions has failed. The lunar dust detector is showing normal outputs on all sensors. No changes in the outputs of the solar cells on the top of the dust detector were observed during or after lunar module ascent.

Active seismic experiment.- The active seismic experiment was deployed in a north-south direction. The thumper fired at 13 of the 21 cable positions. Three positions were skipped to gain overall lunar surface time for the first extravehicular period. The thumper failed to fire at five cable positions and two attempts were required at two positions for success. The three geophones were verified to be operational by a calibration pulse sent before the last thumper firing. The mortar package has been deployed and aimed to fire four grenades on command. Seismic signals were recorded from the 13 thumper firings. Preliminary results indicate loose, unconsolidated material to a depth of 20 to 40 feet. Beneath this material, the measured seismic velocities suggest the presence of a somewhat more compacted material.

Passive seismic experiment.- All elements of the passive seismic experiment have operated properly since initial activation with the exception of the long-period vertical component seismometer which appears to be operating at a natural period longer than anticipated.

Signals generated by crew activities were detected at all points along their traverse. The seismic signal from the impact of the lunar module ascent stage was recorded by both the Apollo 12 and 14 seismic stations for about 1 1/2 hours. The impact occurred at a range of about 36 miles from station 14 and 62 miles from station 12. This event represents a major milestone in the geophysical exploration of the moon in that it is the first event recorded simultaneously by two widely separated geophysical observatories.

The S-IVB impact signals showed the same characteristics observed from the previous impacts. They were prolonged, with a gradual increase and decrease in signal intensity. The S-IVB impact signal lasted for about 3 hours.

Suprathermal ion detector experiment.- The suprathermal ion detector experiment was deployed south of the Apollo lunar surface experiments package central station. At turn-on, the data stream of all the Apollo lunar surface experiments package experiments became erratic. However, recycling the system produced a good data stream. At the time of turn-on, a mode change occurred and the dust cover was released. These events may have been caused by arcing. The experiment has been configured to allow outgassing of the electronics package to reduce the susceptibility to any arcing. The suprathermal ion detector experiment now appears to be operating normally.

Cold cathode ion gage experiment.- The deployment of the cold cathode ion gage experiment 4 feet southeast of the suprathermal ion detector experiment was accomplished after the crewman encountered difficulty with the stiffness of the connecting cable which tended to tip the cold cathode ion gage and the suprathermal ion detector experiments. The experiment was turned on shortly before lunar module depressurization for the second extravehicular activity period and again prior to the depressurization for portable life support system discarding to record the effects of these activities. The experiment is now in the standby mode to allow outgassing until lunar sunset. The cold cathode ion gage experiment now appears to be in good operational status.

Charged particle lunar environment experiment.- The charged particle lunar environment experiment was deployed due east of the lunar module and levelled to within 2.5 degrees of the horizontal. The system was checked and found to be satisfactory with one tolerable exception of background noise on one of the twelve channels. The high voltages are at nominal values, temperatures are well within limits, and all commands have been executed.

Laser Ranging Retro-reflector

This device is much like that deployed during Apollo 11 and the reflected signal is equivalent to that of the Apollo 11 device.

Solar Wind Composition Experiment

The solar wind experiment was exposed to the lunar environment for 21 hours. No difficulty was experienced in stowing the experiment for return to earth.

Lunar Portable Magnetometer Experiment

The lunar portable magnetometer experiment operated normally. Data were obtained from two site measurements, but a third site measurement was deleted because of time constraints.

Lunar Soil Mechanics

Dust was noted during descent at an altitude of 100 feet but no interference with visibility was encountered during the final approach. The lunar module footpads sank much deeper than on previous Apollo landings.

Bootprint penetrations ranged from 1/2 to 3/4 inch on level ground in the vicinity of the lunar module to 4 inches on the rims of small craters. As in earlier Apollo missions, lunar soil adhered extensively to the astronauts clothing and equipment. The mobile equipment transporter produced tracks 1/4 to 3/4 inch deep. The soil in the bottom of the tracks was reported as "smooth ruts in a plowed field."

The 26 1/2-inch long geophone cable anchor was used for three penetration tests. In each case, the anchor tube was pushed to a depth of 16 to 19 inches with one hand and full length with both hands.

A trench was dug in the rim of a small crater near North Triplet Crater. Excavation was terminated at a depth of 18 inches because of collapsing trench walls. Three distinct layers were observed and sampled: (1) dark brown fine-grained surface material, (2) a thin layer composed predominantly of glassy patches, and (3) very light colored granular material.

The mechanical characteristics of the soil at the Fra Mauro site appear significantly different from those at other landing sites.

Lunar Geology Experiment

The surface in the vicinity of the landing site (fig. 1) is undulating and pocked by craters up to 300 feet in size. The surface in the vicinity of Cone Crater is moderately rugged. Coarse rock fragments are sparse west of the landing site but increase in abundance east toward Cone Crater.

The geology traverse of the first extravehicular activity was shortened from that planned because of time constraints. The geology traverse during the second extravehicular activity did not reach the goal of the Cone Crater rim again because of time constraints, but the tasks accomplished along the approach to within a distance of about 300 feet should adequately satisfy the objectives.

Photography.- Photographic data will provide the precise location of the lunar module landing site. In addition, the photography will provide panoramic views of nearby geological features, the location of the traverse and, in some cases, sample locations.

Samples.- Lunar samples of several types were collected at selected stations along both extravehicular activity traverse routes. A minimum of 103 pounds of lunar material were collected during the two extravehicular periods.

Optical properties of the surface.- The rocks varied from a reddish brown gray to brownish gray and light gray. Lighter color material at 1 to 2 inches in depth on the slopes of Cone Crater is covered by brownish gray material.

LUNAR ORBITAL EXPERIMENTS

S-band Transponder

Data were obtained from the S-band transponder to accurately measure the command and service module orbit for an extended time at low altitudes. The data will be used to more precisely define the lunar mass model.

Bi-static Radar

Radar echoes reflected from the lunar surface and subsurface were measured. The data will be used to determine bulk electrical properties, surface roughness, and surface material at depths up to 30 to 60 feet.

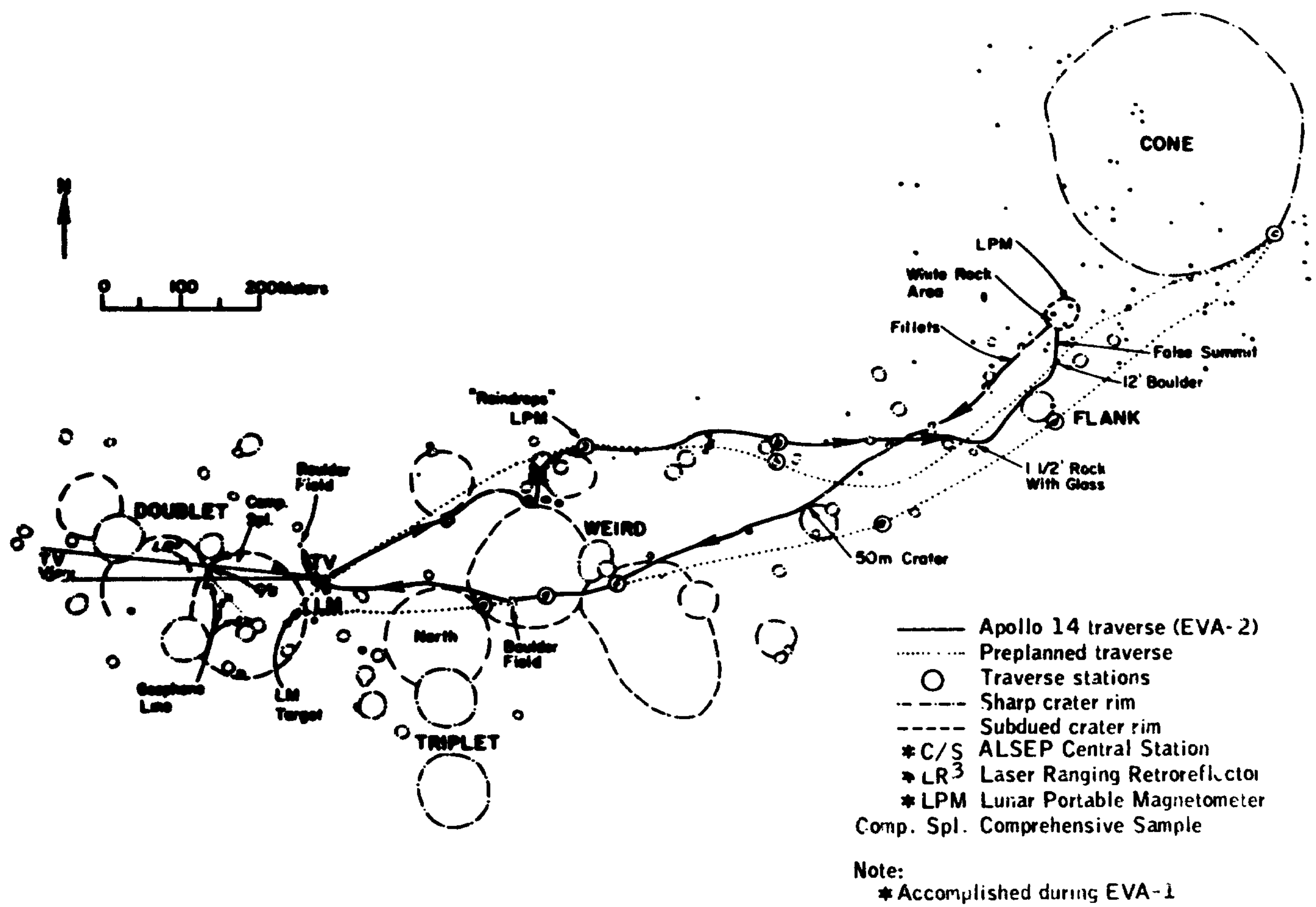

Figure 1.- Preliminary traverse map of second extravehicular activity period of Apollo 14.

Gegenschein From Lunar Orbit

Photographs were taken in total spacecraft darkness after sunset and earthset to determine if there are dust particles at the Moulton point that produce light at the Gegenschein point.

INFLIGHT DEMONSTRATIONS

LIQUID TRANSFER DEMONSTRATION

The initial evaluation of the performance of the unit was obtained during the television transmission at 172 hours. Both baffle designs were successful in permitting liquid transfer; however, in the unbaffled tanks, transfer did not occur. Motion picture film was obtained during the demonstration.

HEAT FLOW AND CONVECTION DEMONSTRATION

The demonstration contained four independent cells that detect convection directly or detect convective effects through measurement of heat flow rates in the fluids. The data were recorded on the 16-mm film and the heat flow rates were displayed by the use of color sensitive, liquid-crystal thermal strips, which were also photographed.

COMPOSITE CASTING DEMONSTRATION

The demonstration was designed to evaluate the effect of zero-gravity on the preparation of cast metals, fiber-strengthened materials, and single crystals. The seventeen specimens were processed in a small heating chamber during the transearth portion of the mission.

ELECTROPHORETIC SEPARATION DEMONSTRATION

This demonstration evaluated the feasibility of electrophoresis of liquids in space when convection and sedimentation effects are suppressed. The electrophoretic separation apparatus demonstrated the quality of the separations obtained with three sample mixtures having widely different molecular weights: (1) a mixture of red and blue organic dyes; (2) human hemoglobin; and (3) deoxyribonucleic acid (DNA — the molecules that carry the genetic code from salmon sperm.)

TRAJECTORY

The basic trajectory profile was similar to that of previous missions. However, there were a number of differences: (a) The service propulsion system was used to perform the descent orbit insertion maneuver. (b) The command and service modules were placed in the low-perilune orbit (9.6 miles). (c) A direct rendezvous was performed using the ascent propulsion system to perform the terminal phase initiation maneuver.

The service propulsion system was used to insert the spacecraft into a 169- by 58.4-mile lunar orbit. The sequence of events during the mission is shown in table I. Table II lists the maneuvers performed during this mission. After approximately two revolutions in lunar orbit, the service propulsion system was used to insert the spacecraft into a 58.8- by 9.6-mile descent orbit. The docked vehicles remained in this orbit for some 19 hours.

The command and service modules undocked and performed a circularization maneuver to raise the pericynthion to 56 miles, leaving the lunar module in the lower orbit. The lunar module then executed powered descent and landed at its target. The preliminary location of the touchdown point (3 degrees 39 minutes 56 seconds south latitude and 17 degrees 28 minutes 42 seconds west longitude) was determined from crew comments and descriptions of surface features as viewed from the lunar module windows. With reference to these descriptions, the location has been determined to be as shown in figure 2.

While the lunar module was still on the surface, the command and service modules performed a plane change maneuver to place the command and service modules and the lunar module in the same orbital plane at lunar module ascent.

The lunar module ascent maneuver was executed and the vehicle was inserted into a 52.1- by 9.2-mile orbit. A tweak maneuver refined the orbit for rendezvous.

The lunar module ascent stage was impacted on the lunar surface 36 miles west of the Apollo 14 landing site and 62 miles east of the Apollo 12 landing site.

The transearth injection maneuver was executed on the 34 revolution. Only one midcourse correction was performed during transearth coast.

Earth entry trajectory was normal and the landing point was less then 1 mile from the planned landing point as determined from the onboard computer. The landing occurred at 216:01:57.

TABLE I.- SEQUENCE OF EVENTS

Events	Elapsed time Hr:min:sec
Lift-off (Range zero = 21:03:02 G.M.T.)	00:00:00.6
Translunar injection	02:28:32.0
S-IVB command module separation	03:02:29.4
Translunar docking	04:57:02
Spacecraft ejection	05:47:30
S-IVB separation maneuver	05:55:30
First midcourse correction	30:36:07
Second midcourse correction	76:58:11
Lunar orbit insertion	81:56:40
S-IVB lunar impact	82:37:52
Descent orbit insertion	86:10:52
Lunar module separation	103:48:01
Lunar orbit circularization	105:11:46
Powered descent initiation	108:02:26
Lunar landing	108:15:12
Start extravehicular activity 1	113:38:57
Apollo lunar surface experiment package first data	116:48:10
Plane change	117:29:32
End extravehicular activity 1	118:27:57
Start extravehicular activity 2	131:08:14
End extravehicular activity 2	135:43:14
Ascent	141:45:35
Tweak maneuver	141:56:48
Terminal phase initiation	142:30:51
Terminal phase finalization	143:13:42
Docking	143:32:50
Lunar module jettison	145:34:57
Final separation	145:49:57
Lunar module deorbit	147:14:16
Lunar module lunar impact	147:42:22
Transearth injection	148:36:01
Third midcourse correction	165:34:56
Command module/service module separation	215:32:47
Entry interface (400 000 feet)	215:47:44
Begin blackout	215:48:02
End blackout	215:51:19
Drogue deployment	215:55:47
Landing	216:01:57

TABLE II.- MANEUVER SUMMARY

Maneuver	System	Firing time, sec	Velocity change ft/sec	Resultant orbit	
				Apocynthion, miles	Pericynthion, miles
Translunar injection	S-IVB	351.2	10 346.5		
First midcourse correction	Service propulsion	10.2	71.1		
Second midcourse correction	Service propulsion	0.6	3.5		
Lunar orbit insertion	Service propulsion	372.2	3022.4	169.0	58.4
Descent orbit insertion	Service propulsion	20.7	205.7	58.8	9.6
Lunar module separation	Service module reaction control	2.7	0.8	60.2	7.8
Lunar orbit circularization	Service propulsion	3.8	77.2	63.9	56.0
Powered descent initiation	Descent propulsion	765.0	6639.1		
Plane change	Service propulsion	18.4	370.5	62.1	57.6
Ascent	Ascent propulsion	432.0	6066.1	52.1	9.2
Tweak maneuver	Lunar module reaction control		10.0	51.3	8.8
Terminal phase initiation	Ascent propulsion	3.6	88.5	60.0	45.5
Terminal phase finalization	Lunar module reaction control			62.1	57.6
Final separation	Service module reaction control	7.0	1.2	62.3	56.8
Lunar module deorbit	Lunar module reaction control	75.4	186.1	58.9	-44.4
Transearth injection	Service propulsion	148.1	3460.6		
Third midcourse correction	Service module reaction control	2.2	0.5		

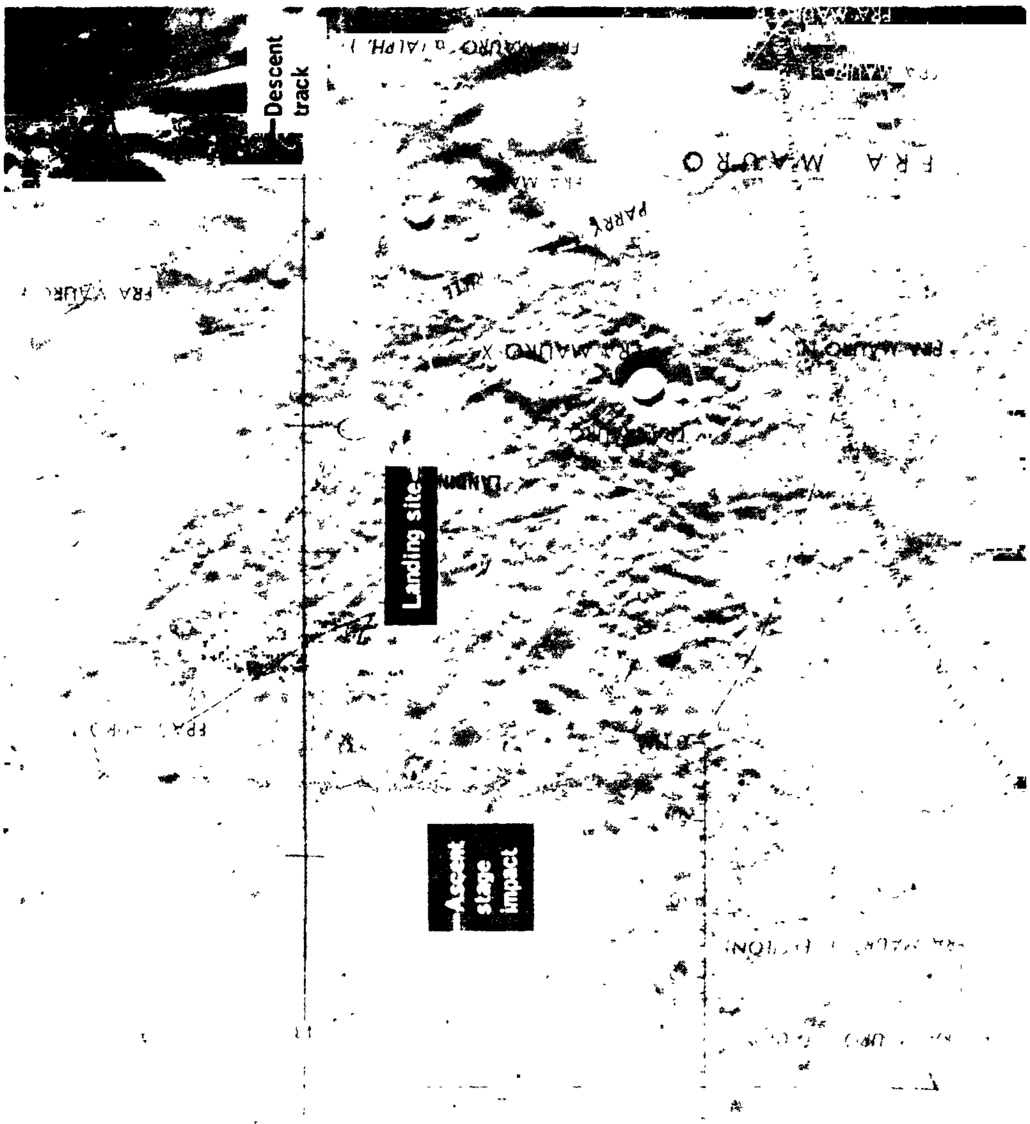

Figure 2.- Preliminary landing and impact locations.

COMMAND AND SERVICE MODULE PERFORMANCE

MECHANICAL

The command and service module docked successfully on the sixth attempt with the normal mechanical sequence. For the sixth attempt, normal automatic docking was selected for the first time in the Apollo missions. However, this sequence did not contribute to the success of the docking. The measured rates and indicated reaction control system thruster activity during all translunar docking attempts show that capture should have occurred each time. Actuation and inspection of the mechanism was performed in the command module following docking. All indications from this investigation were normal. Subsequent undocking and lunar orbit docking were normal. The probe was returned for postflight analysis.

FUEL CELLS AND CRYOGENICS

The fuel cells provided 435 kW-hours of energy at an average of 29.0 volts and 69 amperes. The fuel cells consumed 304 pounds of oxygen and 38.3 pounds of hydrogen, resulting in the production of 342 pounds of water.

Fuel cell performance was normal, however, during translunar coast, oxygen tank 2 pressure tracked tank 3 during the heater cycle. This indicates a check valve leak at low differential pressures.

COMMUNICATIONS

The communications system performance was good except for the high-gain antenna. During translunar coast and lunar orbit, the high-gain antenna auto-tracking mode operated intermittently. However, during the transearth coast period, the antenna was used several times in the automatic tracking mode with no difficulty.

GUIDANCE AND CONTROL

Performance of the guidance, navigation, and control systems was satisfactory. Because of the 40-minute delay in lift-off, the launch azimuth was changed from 72 degrees to 75.56 degrees, and the platform was realigned to compensate for the delay. The onboard computer time was satisfactorily updated inflight to coincide with the flight plan.

The second midcourse correction maneuver was a minimum impulse service propulsion system firing. Performance was nominal and velocity residuals were small.

Landmark tracking was accomplished in lunar orbit using the rate-aided optics feature. Backup targeting was performed for the rendezvous using optical marks, since no acceptable ranging data were received from the VHF until after terminal phase initiation.

REACTION CONTROL SYSTEM

Total propellant consumption was 102 pounds less than predicted, although about 60 more pounds of propellant were used during the initial docking attempts. The service module quad B oxidizer manifold pressure was lost at command and service module/S-IVB separation, but quad B helium and fuel manifold pressures verified proper system operation.

ENVIRONMENTAL CONTROL SYSTEM

The environmental control system performed normally throughout the mission. The potable water quantity transducer, although waivered prior to lift-off, provided normal readings during flight.

A high oxygen flow test was conducted during transearth coast and the desired cryogenic flow was achieved. About 2 hours into the test, the test was terminated because of unexplained low oxygen manifold and water tank pressures. Data showed that a urine dump was made causing the unexpected low pressures.

LUNAR MODULE PERFORMANCE

THERMAL

At rendezvous, some loose material was noted in the vicinity of the lunar module ascent stage base heat shield; however, all measured systems temperatures were well within limits. Analysis of the photographs of this material will be made.

COMMUNICATIONS AND TELEVISION

Steerable antenna acquisition and tracking problems were encountered on revolutions 11, 12, and prior to powered descent initiation. Because of crew activities, and the unsuccessful acquisition attempts, the omnidirectional antennas were selected and satisfactorily used for communications during powered descent. The steerable antenna performed satisfactorily after the ground station uplink mode was changed.

During the latter part of the first extravehicular activity, the television resolution degraded. When the camera was activated at the start of the second extravehicular activity, the resolution was normal and remained so throughout the extravehicular period.

RADAR

The landing radar range scale factor changed improperly to low scale just prior to powered descent. This condition prevented acquisition of ranging signals at slant ranges greater than 3500 feet, and velocity signals at altitudes greater than about 4600 feet. The landing radar circuit breaker was recycled and the radar properly reinitialized in the high range scale after which acquisition in range and velocity was satisfactory. Initial slant range acquisition occurred at about 38 000 feet which reduced to about 26 000 feet in 8 seconds, a rate which was not expected. Subsequent performance of the landing radar, however, was nominal.

ELECTRICAL POWER

The performance of all batteries was good with one concern. Ascent battery 5 open-circuit voltage had decreased 0.3 volt as compared to the values prior to lift-off. The descent batteries delivered 1191 ampere-hours out of a nominal total capacity of 1600 ampere-hours and the ascent batteries had delivered 220 ampere-hours at lunar module jettison out of a nominal total of 592 ampere-hours. The dc bus voltage was maintained above 29.0 volts and the maximum observed current was 73 amperes during powered descent.

DESCENT PROPULSION SYSTEM

The powered descent firing was nominal with a firing time of 765 seconds. The minimum propellant quantity remaining at landing was 2.7 percent which is equivalent to 60 seconds of hover time.

GUIDANCE AND CONTROL

Prior to powered descent, the abort discrete was sensed by the computer four times. This discrete is normally sensed when the abort switch is depressed and causes the computer to switch to the abort program. In order to avoid an unwanted abort, a procedure was developed (and manually loaded into the computer) which inhibited recognition of the abort discrete. The bit was also set once after the ascent phase.

The post-landing attitude of the lunar module was about 1.8 degrees pitch down, 6.9 degrees roll to the right, and 1.4 degrees yaw left.

During the final braking phase before rendezvous, the abort guidance system switched from the operate to the standby mode. Cycling applicable circuit breakers and mode switches did not eliminate the problem.

ENVIRONMENTAL CONTROL SYSTEM

The primary water sublimator rejected heat loads well within the predicted range. The system and its components functioned satisfactorily except for the indicated high and erratic speed of the water separators. The flight cabin leakage was approximately 0.03 lb/hr.

EXTRAVEHICULAR MOBILITY UNIT

A communication problem caused a 40-minute delay in preparation for the first extravehicular activity. Recycling through the checklist corrected the problem.

The crew egressed the lunar module for the first extravehicular activity and both crewmen remained on minimum cooling throughout this period.

Pressure decay rates of the Commander's and the Lunar Module Pilot's extravehicular mobility unit, which consists of the oxygen purge system, portable life support system, and suit, were within specification prior to both extravehicular activities. Just prior to egress for the second extravehicular activity, the wrist cable in the right extravehicular glove of the Lunar Module Pilot was reported as broken, and the lateral movement of his right wrist could not be controlled. This problem apparently did not significantly hamper operations during the second extravehicular activity period. The Lunar Module Pilot extravehicular gloves have been returned for postflight analysis.

MODULAR EQUIPMENT TRANSPORTER

The modular equipment transporter was used on both extravehicular activities and operated adequately. The force required to pull the modular equipment transporter appeared to be as expected.

FLIGHT CREW

The duration of the first extravehicular activity was 4 hours and 49 minutes and includes a 30-minute extension to the nominal plan. All the planned extravehicular activity crew tasks were successfully completed in the first extravehicular activity period, with the exception of the traverse to the Doublet Craters and the attendant documented sampling. The crew had fallen 50 minutes behind the timeline at the completion of Apollo lunar surface experiment package activities. Therefore, only 10 minutes were available to obtain the comprehensive sample and the football-size rock.

The duration of the second extravehicular activity was 4 hours and 35 minutes which included a 15-minute extension. The crew were able to accomplish all the main objectives of the second extravehicular activity; however, several activities had to be eliminated because the traverse up Cone Crater took longer than expected. A return to the Apollo lunar surface experiment package was required at the end of the traverse to realign the antenna. The activities that were not accomplished included a communications evaluation and photography at Cone Crater. In addition, two geology sites (sampling and photography) were deleted and the requirement to obtain a contaminated sample was eliminated.

The lunar topographic camera exhibited noisy operation during the Descartes photographic pass on lunar revolution 4. One hundred and ninety-five frames of photography were obtained while the lunar topographic camera was operating normally. The remainder of the photography was accomplished with the camera in a degraded operating mode.

Because of the delayed lift-off, the elapsed time was updated at about 55 hours after lift-off by plus 40 minutes 02.9 seconds. This update made the ground elapsed time clocks in the spacecraft and the Mission Control Center again agree with the flight plan time.

BIOMEDICAL EVALUATION

The health of the Apollo 14 crew was excellent throughout the mission and all physiological parameters obtained from the crew remained within the expected range. No medications were reported taken. During the translunar coast, the crew reported seeing numerous light flashes in their eyes during both low-illumination and dark-adapted periods. Crew sleep was adequate during translunar and transearth coast. The Command Module Pilot's sleep was also adequate during lunar orbit. However, the Commander and the Lunar Module Pilot slept only 2 and 5 hours, respectively, between the two extravehicular activity periods. Metabolic rates during extravehicular activities for both crewmen were less than expected.

Shortly after initial ingress, the Commander's electrocardiogram signal went full-scale, but returned to normal 1 1/2 hours after liftoff. During the lunar surface activity, the Commander's signal had wide oscillations of the baseline. However, heart rate information for metabolic assessment was obtainable.

After about 2 days of flight, the Lunar Module Pilot's electrocardiogram data showed intermittent full-scale deflections. The data were satisfactory after the harness was replaced.

The Lunar Module Pilot's personal radiation dosimeter failed to count after 26 hours. In order to have dosimeters on both extravehicular crewmen, the Command Module Pilot exchanged his unit with the Lunar Module Pilot's. The total inflight radiation dose to the crew was well within the expected limit.

MISSION SUPPORT PERFORMANCE

FLIGHT CONTROL

The multiplexer which processes the analog flight control data in the launch vehicle instrument unit was lost shortly after lift-off. Transmission was recovered on the S-IVB VHF downlink, but there was an early loss of data because of limited VHF range.

All launch vehicle digital computer data was lost; however, the launch vehicle executed a nominal non-propulsive vent indicating that the computer was still functioning properly. Because of this problem, there was no launch vehicle guidance and navigation data, including attitude and attitude rates during transposition, docking and ejection. Other data were available to verify a safe tank condition.

Because of the multiple docking attempts discussed earlier in this report, the service module reaction control system propellant levels dropped below the flight plan values. A set of cislunar navigation checks was deleted during translunar coast and the second midcourse correction was performed with the service propulsion system to improve the reaction control system status. Contingency procedures were developed to obtain undocking should the captive latches not have released normally, and for redocking should the docking problem have been encountered again. Procedures for extravehicular transfer were also developed in case docking could not be achieved. A stowage plan was developed for returning the probe for engineering evaluation.

During the lunar module inspection period, as previously reported, lunar module ascent battery 5 was reading an open-circuit voltage of 36.7 volts (0.3V low). An analysis of this condition called for a return to the lunar module prior to lunar orbit insertion to verify the load-sharing capability of this battery. The test showed that battery 5 did share its part of the load and was acceptable for landing.

During the lunar module activation sequence, the abort bit was set in the lunar module guidance computer. A procedure was uplinked to the crew to reset the abort bit in the computer. A procedure was given to the crew for powered descent to inhibit the abort guidance program during descent.

Problems were also experienced with the steerable antenna during the lunar module activation phase. The powered descent was performed on the lunar module omnidirectional antenna utilizing the 210-foot receiving antenna. Communication and high-bit-rate data were satisfactory throughout descent with some dropouts during the switchover to the aft omnidirectional antenna.

The crew used optics-only ranging procedures for the terminal phase initiation onboard calculations because of the loss of acceptable VHF ranging signals.

Because of the problems encountered with the high-gain antenna, tests were made during periods of lunar orbit and transearth coast to verify various modes of operation.

NETWORK

The support provided by the Mission Control Center and the Manned Space Flight Network ground instrumentation systems was satisfactory. There were no problems which affected the mission support requirements.

RECOVERY

The Apollo 14 crew and spacecraft were successfully recovered in the Pacific Ocean at about 27 degrees 0 minutes south latitude and 172 degrees 39 minutes 30 seconds west longitude by the primary recovery ship, USS New Orleans. The following table lists the significant recovery events on February 9, 1971.

Events	Time, G.m.t.
Electronic contact by aircraft	2055
Radar contact by USS New Orleans	2056
Visual contact by aircraft	2100
Visual contact by USS New Orleans	2100
Voice contact by aircraft	2101
Command module landing	2105
Flotation collar installed	2119
Command module hatch open	2134
Crew in egress raft	2141
Crew aboard helicopter	2148
Crew aboard USS New Orleans	2153
Crew in Mobile Quarantine Facility	2203
Command module decontamination complete	2237
Command module aboard USS New Orleans	2255

Landing occurred less than 1 mile from the target point, and approximately 3 miles from the primary recovery ship. Landing was normal, and the command module remained in the stable I position.

There were light seas and winds in the recovery area. Low scattered and high broken clouds did not hamper helicopter operations, and the helicopter crews were able to retrieve the two drogue parachute covers.

The crew entered the mobile quarantine facility to begin the return trip to Houston and were found to be in good physical condition.

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