1. Photographic Summary of the Apollo 12 Mission

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The scientific, geologic, and photographic objectives of the Apollo 12 mission were designed to achieve the maximum return of lunar data. The staytime on the lunar surface was increased to accommodate two extravehicular activity (EVA) periods. The photography accomplished during the Apollo 12 mission was designed to document and augment the experimental, observational, and geologic data obtained from the extended lunar surface activities and from the scientific instruments placed on the lunar surface. A further photographic objective was to obtain, from lunar orbit, photographs of future landing sites. Orbital photographs will aid in the planning of pinpoint landings in lunar terrain more rugged and of even greater scientific interest than the mare-type terrain at the Apollo 11 and 12 landing sites.

This chapter is a brief description of the Apollo 12 mission and is illustrated with a small sample of the hundreds of photographs taken by the astronauts during the mission. These photographs will require years to analyze completely and, thus, will be a continuing contribution to the improvement of man's knowledge of the Moon. The lunar multispectral photography experiment may aid in the determination of subtle color or tone changes on the lunar surface. The photographs taken during the EVA periods will aid in identifying the original locations and positions of many of the returned lunar samples. Photographs of Surveyor 3, when examined in conjunction with the parts of the spacecraft that were returned to Earth, will provide engineering data on the effects of Earth-made materials of long-duration exposure to the lunar environment.

During the early part of the lunar orbital phase of the mission, the crew took many photographs of the lunar surface. A series of photographs of particular interest was that series of the Fra Mauro area taken during revolution 10. These photographs of the Apollo 13 landing site showed the site at a 7° Sun elevation angle and will be used to train the Apollo 13 crew for their pinpoint landing, which will occur at approximately that Sun angle.

The lunar multispectral photography experiment was performed by Astronaut Gordon, the command module (CM) pilot, while the lunar module (LM) was on the lunar surface. Astronaut Gordon took a series of stereoscopic strip photographs with the four-camera array during two orbital revolutions and photographed selected target areas on a third revolution.

On revolution 39, the command and service module (CSM) accomplished an orbital plane change to prepare for extensive photography of future landing sites. The plane change opened up a considerable amount of new area on the lunar surface to both photographic and visual observation and placed the orbital trace of the CSM over the three potential landing sites to be photographed—the crater Lalande, an area north of the crater Descartes, and the Apollo 13 landing site in the Fra Mauro region.

On revolution 40, a terminator-to-terminator strip of photographs was taken with the bracket-mounted Hasselblad camera using the 80-mm lens. An intervalometer was used to trigger one frame every 20 sec with sufficient overlap to provide stereoscopic photography. By using this strip of stereoscopic photographs, the approach terrain into the landing sites can be better defined, which will be important in designing the profiles for the three sites.

On revolution 41, high-resolution photographs of two potential landing site areas were taken using the 500-mm lens on the Hasselblad camera.
Unfortunately, a film magazine malfunctioned, and these photographs were partially lost. The photographs of the two areas were successfully retaken on revolution 43, with another film magazine; however, this resulted in the inability to complete a second terminator-to-terminator stereoscopic strip of photographs that had been planned for revolution 44. The crater Lalande was successfully photographed on revolution 45. In addition to these photographs, the crew took several photographs of various areas using the 250-mm lens on the Hasselblad camera. The Davy Rille was one such area photographed. The Apollo 12 photographs, combined with earlier Lunar Orbiter photographs, have kindled scientific interest in the Davy Rille area, and it is planned to rephotograph this area on the Apollo 13 mission to determine if it may be selected as a future landing site.

After separation, the LM began a series of maneuvers that resulted in the successful lunar landing. Unlike the Apollo 11 LM, the Apollo 12 LM flew the entire descent phase of the mission in the heads-up position; therefore, photographic documentation of the Apollo 12 LM descent phase started with the pitchover maneuver. At this point, the 16-mm data acquisition camera vividly recorded the scene as described by Astronaut Conrad during the actual landing. The “Snowman” formation, for which the crew targeted, is clearly visible during most of the descent film. Astronaut Conrad’s landing maneuvers are also evident, as is the actual moment of touchdown, which occurs within an extensive dust cloud. This film has been correlated with the telemetered data to document the final landing maneuvers performed by the LM crew.

Following touchdown, photographs of the immediate vicinity of the LM were taken through the LM windows. Panoramic mosaics of these photographs are presented in chapter 10 of this document and show the lunar surface before and after both EVA periods. Initial activities on the first EVA period were recorded by the Hasselblad cameras and by a color television camera. However, shortly after both astronauts had egressed the LM, the television camera was inadvertently pointed directly at the Sun, and television coverage of the mission was lost. Thus, the photographs taken by the crew are the only visual record of their lunar surface activities.

The 16-mm data acquisition camera was used by Astronaut Bean to record Astronaut Conrad’s descent down the ladder and his early activities on the lunar surface. Photographs of Astronaut Conrad picking up the contingency sample provided a record of the sample location and illustrated Astronaut Conrad’s movements in the 1/6g environment on the lunar surface.

Both crewmen took hundreds of photographs while on the surface, including many panoramas. They photographed the unloading of the Apollo lunar surface experiments package (ALSEP) and its deployment on the lunar surface. Some unusual features, which the crew called mounds, were seen and photographed on the surface. These features can be located on the Lunar Orbiter photography of the areas and, thus, can be used as a key to interpreting the Lunar Orbiter photography. After completion of ALSEP deployment, and at the request of geologists on Earth, the crew made a traverse to a large subdued crater approximately 300 m in diameter.

During the second EVA period, the first photographic activity after departure from the LM was to take black-and-white photographs, with polarizing filters on the Hasselblad cameras. After taking these photographs, the filters were discarded, and the astronauts began the documented geological traverse. During the course of the traverse, the crew photographed the rock samples collected, the core samples taken, and the craters visited.

The final leg of the traverse on the second EVA period took the crew to the crater in which Surveyor 3 landed in April 1967. The crew recorded photographically their activities in the vicinity of Surveyor 3; photographed the Surveyor 3 spacecraft; and with their cameras, duplicated many of the scenes first recorded by the Surveyor television camera.

Near the completion of the second EVA period, Astronaut Bean took several stereoscopic pairs of photographs with the Apollo lunar surface closeup camera. These photographs show, in exceptional detail, the fine grain structure of the lunar surface material.

On their return from the Moon, the crew followed the practice of previous Apollo crews.
and took a series of photographs of the Moon after transearth injection. Several of these photographs were planned to provide slightly different lunar aerial coverage as an aid in solving sele-
nodetic problems of the Moon.

As the spacecraft neared the Earth, the crew reported and photographed the impressive sight of the Sun being eclipsed by the Earth. This unusual sighting was reported to be one of the most spectacular views observed during the entire mission. The eclipse was photographed using color film in the 16-mm data acquisition camera and black-and-white film in the Hasselblad camera.

Reentry of the Apollo 12 spacecraft over the Pacific Ocean occurred later in the day than had previous Apollo flights, and the crew recorded an excellent sequence of reentry data on 16-mm film. The film data cover the period from the first evidence of heat-shield burning to the deployment of the three main parachutes.

Overall, the crew of Apollo 12 took many excellent photographs of scientific interest, provided extremely valuable photographic information concerning possible future landing sites, and photographed many items of engineering and scientific interest. Cameras, film types, and usage are listed in tables 1-1 and 1-II.

**Table 1-I. Apollo 12 Photographic Equipment Used in CM**

<table>
<thead>
<tr>
<th>Camera</th>
<th>Features</th>
<th>Film</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hasselblad</td>
<td>Electric; with 80-mm lens, 250-mm lens, and 500-mm lens</td>
<td>70-mm, type SO-368 Ektachrome MS color-reversal film, with a normal ASA of 64; and 70-mm, type SO-3400 Panatomic X black-and-white film, with a normal ASA of 80</td>
<td>Used in lunar orbit to make stereoscopic strip photographs of potential landing sites</td>
</tr>
<tr>
<td>Data acquisition camera</td>
<td>With 5-mm lens, 18-mm lens, and 75-mm lens</td>
<td>16-mm, type SO-368 film; and 16-mm, type SO-164 Panatomic X black-and-white film, with a normal ASA of 80. Also, 16-mm, type SO-168 Ektachrome EF color-reversal film, with a normal ASA of 160</td>
<td>Type SO-168 film exposed and developed with an ASA of 1000</td>
</tr>
<tr>
<td>Multispectral photography experiment array</td>
<td>See section 9</td>
<td>See section 9</td>
<td></td>
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* For complete information, see section 10 of this document.

**Table 1-II. Apollo 12 Photographic Equipment Used in LM and During EVA Periods**

<table>
<thead>
<tr>
<th>Camera</th>
<th>Features</th>
<th>Film</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hasselblad (2)</td>
<td>Electric with 60-mm lens and reseau plate</td>
<td>70-mm, type SO-168 film (first EVA period) and 70-mm, type SO-267 plus XX black-and-white film, with a normal ASA of 278</td>
<td>Mounted behind right window LM; recorded LM descent (from approximately 6 km) and lunar surface activities</td>
</tr>
<tr>
<td>Data acquisition camera</td>
<td>With 10-mm lens</td>
<td>16-mm, type SO-368 film</td>
<td></td>
</tr>
<tr>
<td>Apollo lunar surface closeup camera</td>
<td>Stereoscopic; has 46-mm M-39 lens with aperture of f/22.6 and built-in light source</td>
<td>35-mm, type SO-368 film</td>
<td>Stereoscopic convergent angle of 9°</td>
</tr>
</tbody>
</table>
On November 14, 1969, at 11:22 a.m. e.s.t., the second U.S. lunar landing mission, Apollo 12, lifted off from Cape Kennedy, Fla. On board were Astronauts Charles Conrad, Jr., Richard F. Gordon, and Alan L. Bean. (NASA photograph S-69-58883)
Figure 1-2. — Shortly after translunar injection, the central portion of the United States was photographed. Lake Michigan can be seen in the upper left corner of the photograph. The river at the center of the photograph is the Red River, and the point of land visible in the lower right corner is the Yucatan Peninsula. The cloud formation suggests a frontal passage that is in the Gulf of Mexico. (NASA photograph AS12-50-7325)

Figure 1-3. — Made during the translunar coast phase of the Apollo 12 mission, this view overlooks a great expanse of the Pacific Ocean. Baja California and Mexico can be seen in the lower right corner of the photograph, and the Yucatan Peninsula and Central America are visible in the lower left center. The object near the center of the photograph and above the clouds is one of the four panels that protect the LM during launch and that are jettisoned at the time of CSM separation from the SIVB stage of the launch vehicle. (NASA photograph AS12-50-7326)
Figure 1-4.—The LM is shown in place on the SIVB stage shortly after separation of the CSM and the SIVB stage. (NASA photograph AS12-50-7329)

Figure 1-5.—Looking back to the southeast on the lunar surface, the crew took this dramatic view of the crater Humboldt. The central peaks appear "snow" white because of the high-Sun elevation angle. The arcuate fractures within Humboldt are evidence of the forces working on the surface of the Moon to change the lunar topography. (NASA photograph AS12-50-7416)
Figure 1-6. — Looking into Sinus Aestuum. A striking example of the differences in albedo of the lunar surface. (NASA photograph AS12-52-7733)

Figure 1-7. — Alphonsus, the target point of Ranger 9. The dark "haloed" areas on the floor of Alphonsus are distinctly evident. These areas are of high geologic interest. (NASA photograph AS12-51-7580)
Figure 1-8.—Looking into the terminator. The crater Kepler can be seen (at the center of the photograph) just to the east of the terminator. On the dark side of the terminator, the crew could distinguish surface detail in earthshine. (NASA photograph AS12-51-7547)

Figure 1-9.—The difference between day and night on the Moon. The terminator is just to the west of the crater Gambart, which is at the extreme north in the photograph. This view is representative of the lunar surface as seen by the crew as they crossed the terminator twice every orbit. The Apollo 13 landing site is located in the highland region in the shadow area of the photograph. (NASA photograph AS12-50-7438)
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FIGURE 1-10. — An oblique view looking northwest at the highland area north of the crater Fra Mauro. This photograph was taken from the CM at an orbital altitude of 60 n. mi. The Sun elevation angle was 7°. The Sun will be only slightly higher when Apollo 13 lands in this area. (Arrow indicates landing site.) Although taken early in the mission, this photograph supplements the site photography taken later. (NASA photograph AS12-52-7597)

FIGURE 1-11. — The Fra Mauro area. This photograph was taken with a 500-mm lens from the CM at an approximate orbital altitude of 60 n. mi. This photograph is representative of the photography taken during the final orbital phase of the mission. The arrow indicates a hilly area slightly north of Fra Mauro Crater that has been selected as the landing site for the Apollo 13 lunar mission. This photograph was taken with a 40° Sun elevation angle. (Compare with fig. 1-10.) To take this and other orbital photographs, Astronaut Gordon constantly had to adjust the pitch of the spacecraft to accomplish image motion compensation. (NASA photograph AS12-53-7833)
Figure 1-12. — Davy Rille, potential landing site for a future lunar mission. The proposed landing site is at the point where the rille touches the highlands in the east. North is at the right of the photograph. (NASA photograph AS12-51-7485)

Figure 1-13. — The LM is above the floor of the giant crater Ptolemaeus in this westward-looking oblique. The LM appears to be close to the surface, even though it is some 60 n. mi. high. This was one of Astronaut Gordon’s last views of the LM as he began his ½ days of solo flight around the Moon. (NASA photograph AS12-51-7507)
PHOTOGRAPHIC SUMMARY OF THE APOLLO 12 MISSION

Figure 1-14. — A high-oblique view looking northeast. This photograph was taken from the LM. The large crater Copernicus is in full view, and the Carpathian Mountain Range is visible on the horizon. The stark lunar relief is accentuated by the low-Sun elevation angle. (NASA photograph AS12-47-6875)

Figure 1-15. — Earthrise as seen from the LM. This photograph was taken before the LM started its final descent to the lunar surface. (NASA photograph AS12-47-6880)
After collecting the contingency sample, Astronaut Conrad took several panoramas in the vicinity of the LM. In this panorama, the LM, Surveyor Crater, the television camera, and the S-band antenna are visible. The Surveyor 3 spacecraft can barely be distinguished in the shadow of the crater. (NASA photograph S-70-22360)

The crew erected the American flag after landing and collecting the contingency sample. The long shadow of the LM and the bleak lunar surface serve as a fitting background. (NASA photograph AS12-47-6897)
FIGURE 1-18. — Astronaut Bean unloading equipment from Intrepid. Astronaut Conrad was standing to the north of Intrepid when he took this photograph. Both the edge and the interior of Surveyor Crater are just to the east. (NASA photograph AS12-46-6749)

FIGURE 1-19. — After unloading the ALSEP, Astronaut Bean used the “barbell” carry to take the ALSEP to its deployment site. (NASA photograph AS12-46-6807)
FIGURE 1-20.—The deployed ALSEP is visible in this northwest-looking view. The lunar surface magnetometer experiment is in the foreground, and the other objects on the lunar surface (from left to right) are: a discarded subpallet and cover; the solar-wind spectrometer experiment; the suprathermal ion detector experiment, with the darker radioisotope thermoelectric generator behind it; the ALSEP central station, with an astronaut adjusting the antenna; the passive seismic experiment (PSE); and the discarded PSE girdle. The deployment of the ALSEP was one of the major tasks of the first EVA period. (NASA photograph AS12-47-6921)

FIGURE 1-21.—Looking back at the LM from the ALSEP deployment site. The ALSEP central station is approximately 600 ft from the LM. The magnetometer and the passive seismometer are clearly visible. Only a small part of the rim of Surveyor Crater, which is located behind the LM, can be seen at this distance. (NASA photograph AS12-47-6928)
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FIGURE 1-21. — Looking back at the LM from the ALSEP deployment site. The ALSEP central station is approximately 600 ft from the LM. The magnetometer and the passive seismometer are clearly visible. Only a small part of the rim of Surveyor Crater, which is located behind the LM, can be seen at this distance. (NASA photograph AS12-47-6928)
After deploying the S-band antenna and the solar-wind experiment and after erecting the flag, the crew moved around the LM and photographed their spacecraft on the edge of the Surveyor Crater. Surveyor 3 is below the rim of the crater and cannot be seen in this view. (NASA photograph AS12-47-6899)

This mound on the lunar surface was photographed looking towards the southwest. This type of feature and its formation have generated considerable interest among lunar geologists. (NASA photograph AS12-46-6795)
Figure 1-24. – Two panoramas of the large subdued crater visited during the first EVA period. The crater is more than 300 m across and was visited near the end of the EVA period. (NASA photograph S-70-22361)

Figure 1-25. – The tools of the lunar geologist. The gnomon, the core tube, and the tool carrier were carried on the documented geology traverse during the second EVA period. (NASA photograph AS12-49-7320)
Figure 1-26. — A panorama looking southwest across Head Crater. Astronaut Conrad rolled a rock down the side of this crater. Head Crater was visited during the early part of the second EVA period. (NASA photograph S-70-24309)

Figure 1-27. — A panorama of Bench Crater. This crater was selected by the geologists as a key crater to visit during the second EVA period. (NASA photograph S-70-24311)

Figure 1-28. — A panorama of Sharp Crater. This crater was at the outermost point of the crew's traverse during the second EVA period. (NASA photograph S-70-22363)
Figure 1-29.—The LM is visible at the extreme right center of the photograph, with Head Crater visible in the foreground. The view, taken during the second EVA period, is toward the east-northeast. The astronaut is moving away from Head Crater. (NASA photograph AS12-49-7213)

Figure 1-30.—The core-sample tool embedded in the lunar surface near Halo Crater. In this southeast-looking view, the loosely compacted lunar soil is clearly visible, and Halo Crater can be seen in the background. (NASA photograph AS12-49-7288)
FIGURE 1-31. — The LM on the lunar surface near the rim of Surveyor Crater. A portion of Surveyor Crater is visible in the foreground. The flag is visible just to the left of the LM, and the ALSEP can be seen at left center of the photograph. (NASA photograph AS12-49-7317)

FIGURE 1-32. — Footprints left by the astronauts walking on the interior slope of Surveyor Crater. The footprints are sharp, and a slight break in the lunar soil can be seen. (NASA photograph AS12-48-7098)
FIGURE 1-33. — A closeup of the lower part of Surveyor 3. Those parts that were not returned to Earth were photographed extensively by the Apollo 12 crew. (NASA photograph AS12-48-7138)

FIGURE 1-34. — Astronaut Bean and two U.S. spacecraft on the surface of the Moon. This photograph and figure 1-29 clearly show how close Astronaut Conrad landed the LM to its predesignated landing point. After completing their work around Surveyor 3, the crew moved back toward the LM. (NASA photograph AS12-48-7133)
Figure 1-35.—The Moon, photographed after transearth injection. The geographic areas visible include Smyth’s Sea, the Sea of Crises, the Sea of Fertility, and the Sea of Tranquility. The areas of coverage on this photograph are from approximately 110° east longitude to 25° east longitude. (NASA photograph AS12-55-8221)

Figure 1-36.—A photograph of the solar eclipse, taken from the CM during transearth coast shortly before reentry. (NASA photograph AS12-53-7917)