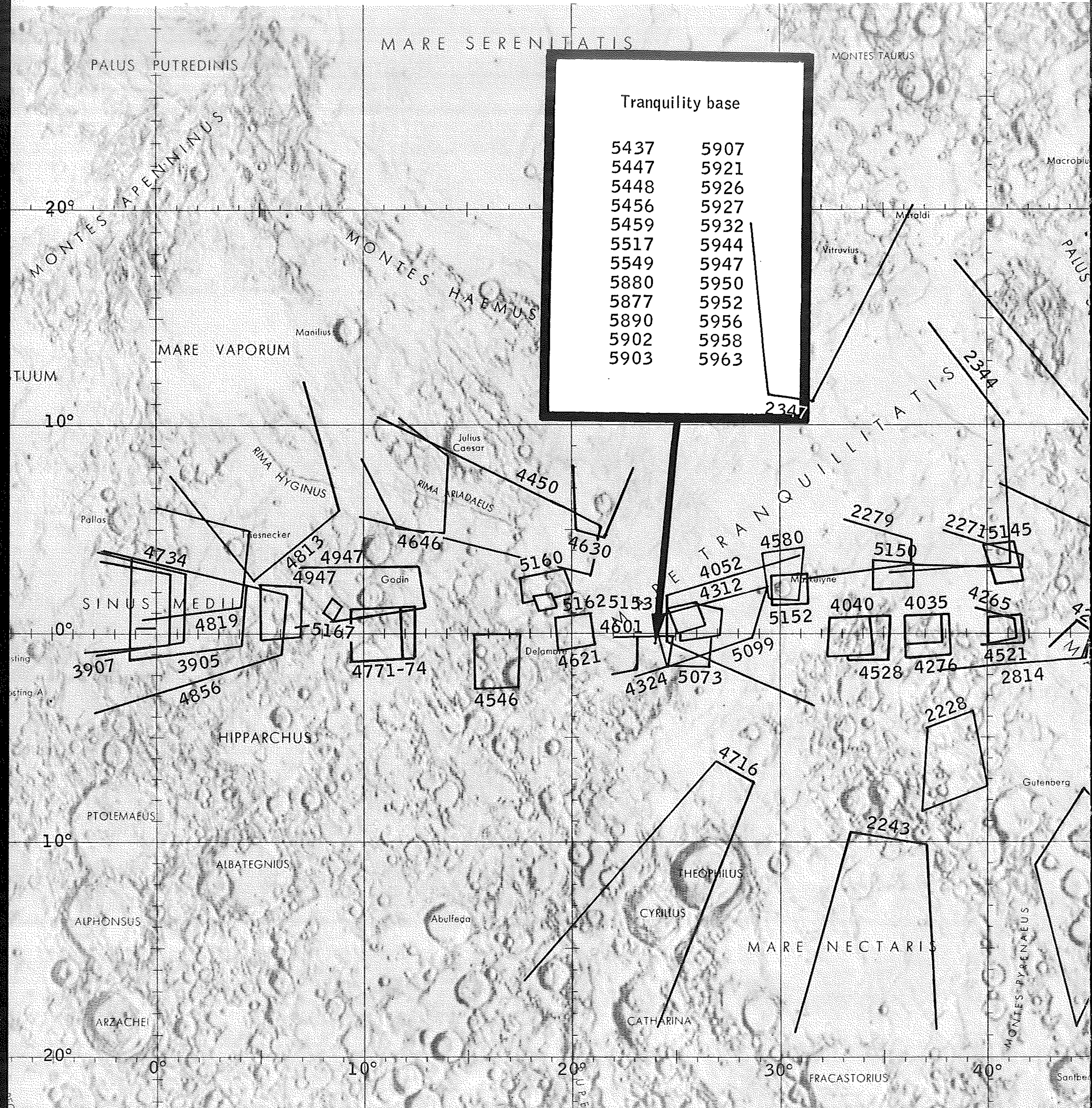
NASA SP-246

LUNAR PHOTOGRAPHS FROM APOLLOS 8, 10, and 11

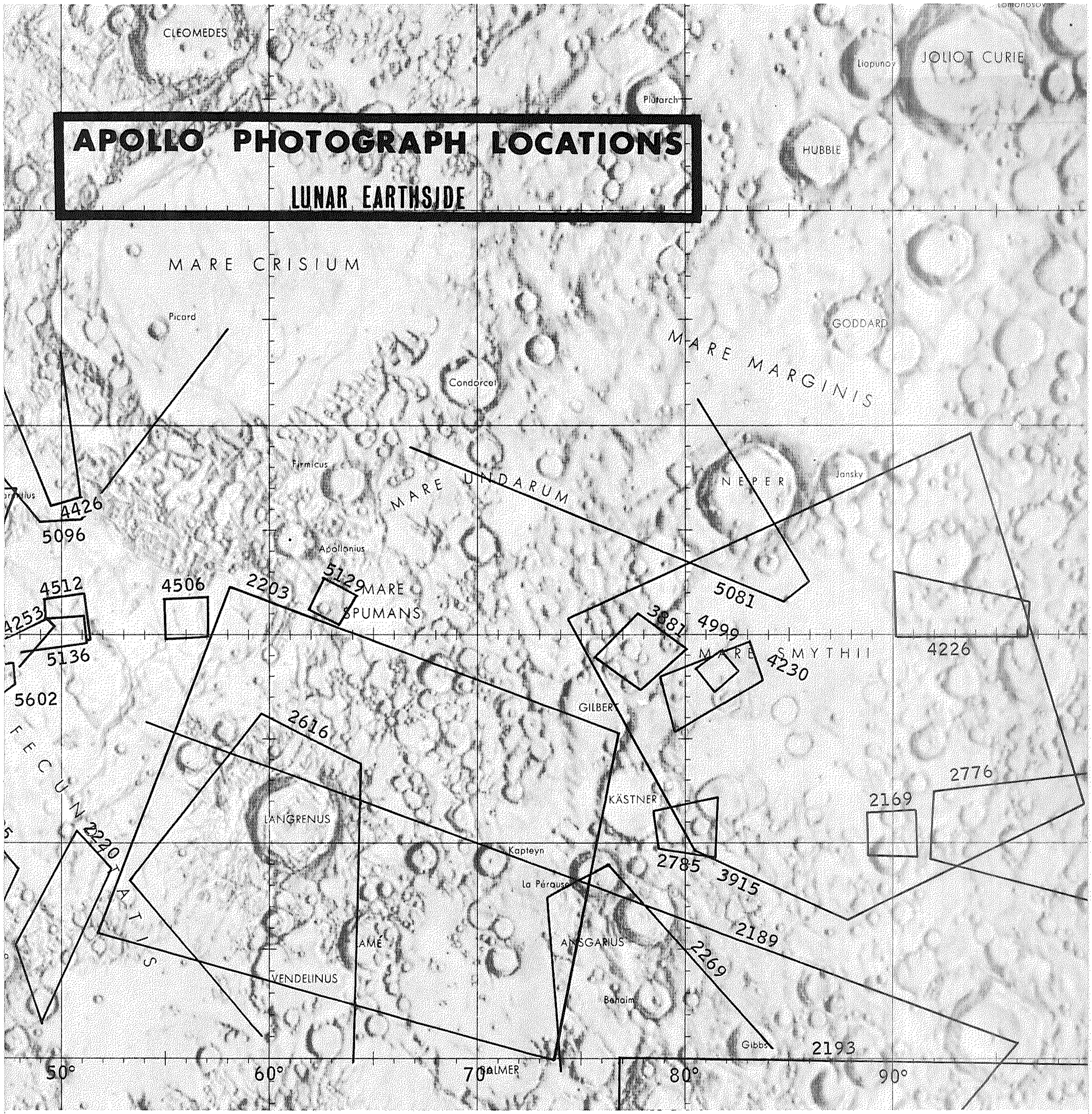
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION



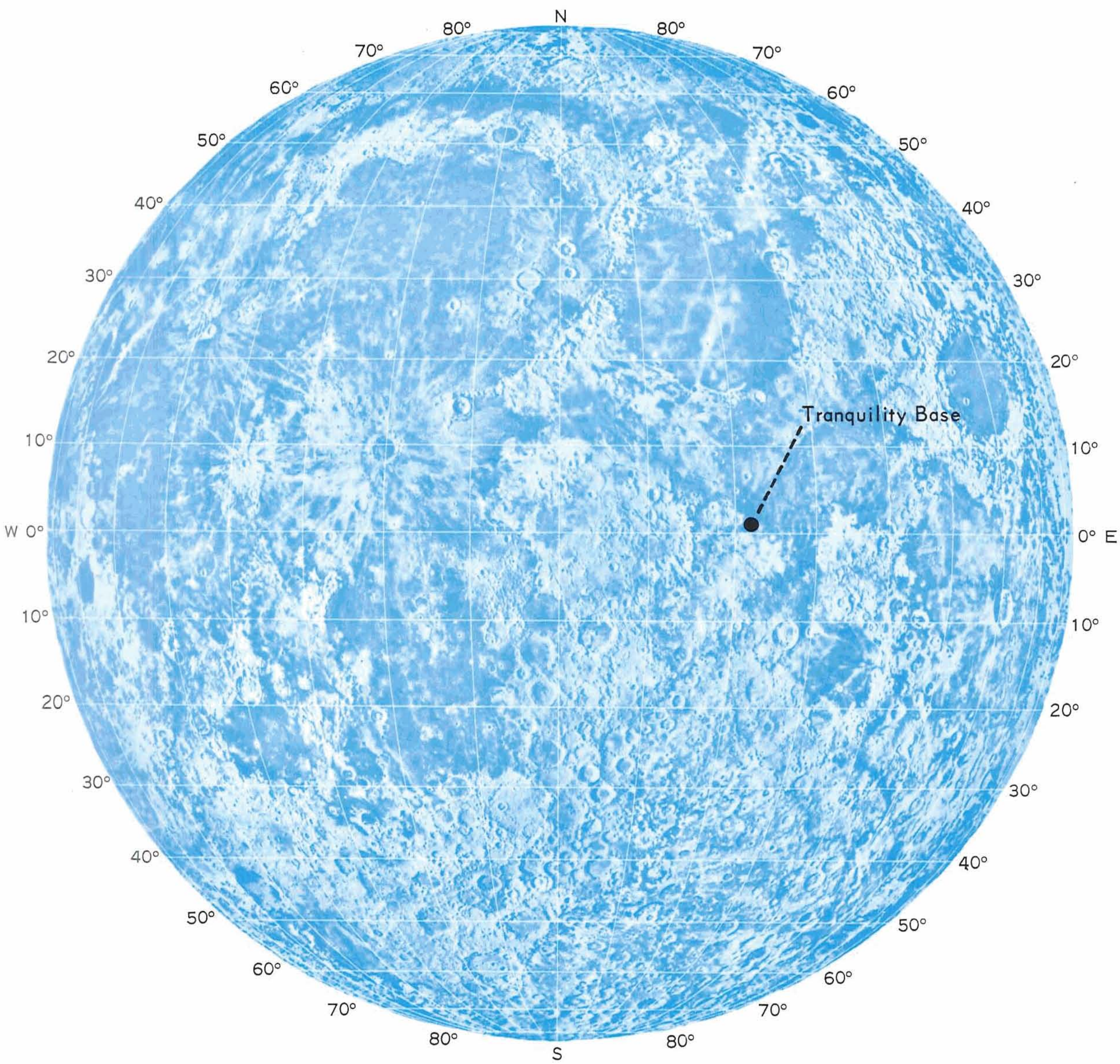
MARE SERENITATIS
PALUS PUTREDINIS
MONTES TAURUS
Tranquility base
5437 5907
5447 5921
5448 5926
5456 5927
5459 5932
5517 5944
5549 5947
5880 5950
5877 5952
5890 5956
5902 5958
5903 5963
MONTES APENNINUS
Macrobius
MONTES HAEMUS
Maraldi
Vitruvius
Manilius
MARE VAPORUM
20°
10°
0°
RIMA HYGINUS
Julius Caesar
RIMA ARIADAEUS
Pallas
Triesnecker
SINUS MEDII
Godin
Delambre
Maskelyne
MARE TRANQUILLITATIS
2347
2344
4450
2279
2271
5145
4580
5150
4052
4312
4734
4813
4947
4947
4646
5160
4630
5162
5153
4601
4621
4819
5167
3907
3905
4856
4771-74
4546
4324
5073
5099
5152
4040
4035
4265
4528
4276
4521
2814
2228
4716
2243
HIPPARCHUS
PTOLEMAEUS
ALBATEGNIUS
ALPHONSUS
ARZACHEL
Abulfeda
THEOPHILUS
CYRILLUS
CATHARINA
MARE NECTARIS
Gutenberg
MONTES PYRENAEUS
FRACASTORIUS
10°
20°
30°
40°

APOLLO PHOTOGRAPH LOCATIONS

LUNAR EARTHSIDE



LUNAR PHOTOGRAPHS FROM APOLLOS 8, 10, and 11


N
S
W 0°
0° E
Tranquility Base
80°
70°
60°
50°
40°
30°
20°
10°

NASA SP-246

LUNAR PHOTOGRAPHS FROM APOLLOS 8, 10, and 11

Compiled by
Robert G. Musgrove
NASA Manned Spacecraft Center

Scientific and Technical Information Office 1971
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Washington, D.C.

Acknowledgments

This photographic atlas was compiled by personnel of the Mapping Sciences Laboratory, Science and Applications Directorate, of the NASA Manned Spacecraft Center. Robert G. Musgrove of the Mapping Sciences Laboratory was responsible for directing and coordinating the efforts that comprised this publication.

Personnel of the Lockheed Electronics Corporation Mapping Sciences Department under contract to NASA also made substantial contributions to this document.

For sale by the Superintendent of Documents,
U.S. Government Printing Office, Washington, D.C. 20402
Price $4.00
Library of Congress Catalog Card Number 75-608546

Contents

Introduction

THE PURPOSE OF THIS PHOTOGRAPHIC atlas is to make available to scientists and to the interested public a comprehensive sample of photographs from the first three Apollo lunar missions. This atlas contains photographs of almost every type of feature and terrain that exists on the lunar surface.

Selected photographs, though not as many as are in this atlas, are available to the public through

The Manned Spacecraft Center
Public Affairs Office
Houston, Tex. 77058

Scientific users such as universities, institutions, or schools may contact

National Space Science Data Center
Goddard Space Flight Center
Code 601
Greenbelt, Md. 20771

The Data Center has been established by NASA to fulfill the needs of scientists in acquiring at either nominal or at no cost both photographic and digital data from extraterrestrial manned and unmanned missions. Foreign users interested in acquiring such data may write

World Data Center A for Rockets and Satellites
Goddard Space Flight Center
Code 601
Greenbelt, Md. 20771
U.S.A.

Apollo Lunar Photography

Much of the photography from Apollos 8 and 10 was oriented operationally; prime photographic targets were the landing sites and landmarks used for guidance to landing sites. Landmarks of particular significance are noted in captions accompanying the photographs.

The front side, or Earth-facing hemisphere, of the Moon has been studied and mapped by astronomers for several centuries, and most of the prominent features in this Earth-side region have been named, usually after famous scientists or astronomers. Prominent named features shown in the photographs are identified by name in the captions.

All of the names by which lunar features are identified must be approved by the International Astronomical Union (IAU). This scientific body governs the nomenclature of lunar features; any new or changed designations must be submitted to the IAU before the new designations can become officially recognized.

However, the Apollo program injected an entirely new, though unofficial, vocabulary into the listings of lunar features. Names such as U.S. 1, Diamondback Rille, and Boot Hill gained prominence in publications and in the news media. The reason for the development and use of this Apollo nomenclature is quite simple. The lunar-surface photographs from the mapping missions of Lunar Orbiter produced a level of detail that had never before been discernible—even by the best telescopes on Earth. From Lunar Orbiter photographs, features as small as 5 m were detectable; before the Lunar Orbiter missions, only the most powerful telescopes operating under the best atmospheric conditions could resolve objects with dimensions of 2 km. Among the thousands of lunar features and formations that had been unseen or unidentifiable from Earth, there were distinct or unique features that were especially useful for landmark tracking to the landing sites. The IAU could not assign names to these features because of the operational time constraints imposed by the Apollo flight schedule. Therefore, the Apollo crewmembers and the mission planners selected names arbitrarily for those features that were used as identification points and landmarks for navigation. These designations are not intended to be submitted to the IAU for consideration.

A few of the features of the lunar far side have been named on the basis of photographs returned from the 1959 U.S.S.R. Lunik 3 mission, the first mission to photograph the back side of the Moon. Later, the U.S. Lunar Orbiter program took extensive photographs of the lunar far side. From these Lunar Orbiter photographs, detailed lunar maps have been made. Most of the major features of the lunar far side have been temporarily assigned numerical designations by the IAU, and the IAU is currently reviewing names that have been suggested for these features. At present, however, the majority of lunar far-side features are unnamed.

Most of the designations of named lunar features are of classical extraction, and on reference charts and maps, these named features are referred to in the classical context. Thus, the Sea of Tranquility is referred to as Mare Tranquillitatis, and the Hyginus Rille is designated Rima Hyginus. In this atlas, the classical denotation will be adhered to, although the translated or current nomenclature is provided when ambiguities might occur.

Strict geologic or other interpretive terms describing the features or terrain shown in the photographs have been avoided because it is thought that the photography in this volume is so significant that the atlas should reach and appeal to as wide an audience as possible. Therefore, captions generally have been restricted to the identification of known features and unique or peculiar formations or conditions.

Because the terminator, the line of demarcation between darkness and sunlight, was at most a few degrees west of the zero meridian during the Apollo 8, 10, and 11 missions, the photography from these missions is primarily of the eastern hemisphere of the Moon. As a result, much of this atlas is comprised of lunar far-side photography. Therefore, many of the photographs in this atlas are valuable for updating existing maps and charts of the lunar far side. In ap-

APOLLO 10 AS10-34-5014

The Earth as it appears from a distance of 36 000 n. mi. is shown here. North America is the dominant landmass, with the southwestern regions of the United States and the northern areas of Mexico clearly visible. At the lower right, the outline of the uppermost portion of South America can be distinguished.

pendix A, indexes of the photography have been prepared and are presented according to mission. For each frame in the atlas, the index includes a description of the area of coverage; coordinates of the principal point; focal length of camera lens; notations on the Sun elevation and the general type of view, whether vertical or oblique; and the page on which the photograph appears in this book. The maps used in this index were printed by the USAF Aeronautical Chart and Information Center, St. Louis Mo.

Because the orbital photography taken by all three missions was similar, integrating the photography from the missions into a coherent order seemed more appropriate than attempting to separate the photographs by mission. However, the mission from which a photographic frame was selected is easily determined by the frame number. The prefixes (AS8, AS10, or AS11) to the frame numbers identify a photograph as having been taken during Apollo 8, 10, or 11. For example, AS8–2606 was taken during Apollo 8, AS10–4433 during Apollo 10, and AS11–5903 during Apollo 11.

For the most part, the photography in this atlas has been oriented so that north is at the top of each page. Sometimes this orientation presents a view that is difficult for the eye to perceive. This situation occurs especially in high-oblique photographs. In such situations, the orientation most comfortable to the eye has been selected.

The onboard cameras for all three missions were modified Hasselblad 500 EL cameras, with 80-mm and 250-mm Zeiss panacolor lenses. For certain photographs of the lunar surface, a 60-mm lens with a reseau was used. Use of this lens and reseau is apparent in the views that show crosslike fiducial marks. Although several emulsions (including Kodacolor) have been used experimentally on these missions, the photographs in this atlas were exposed on SO–368 and SO–168 (Ektachrome-type emulsions) for color and SO–168 (Plus X) and 3400 (Panatomic-X emulsions) for black and white.

For analytical purposes, black-and-white emulsions have been determined to provide a higher degree of resolution and image clarity than the color emulsions provide; therefore, much of the orbital photography is in black and white. However, most of the photographs taken on the lunar surface by astronauts Neil A. Armstrong and Edwin E. Aldrin, Jr., were in color.

APOLLO 8 AS8–14–2485

Top: Here the Moon appears in an orientation that is not seen by terrestrial observers. The eastern portion contains features of the lunar far side that until recently were unknown and, for the most part, remain unnamed. In the western portion, Mare Crisium (Sea of Crises) and just below it Mare Fecunditatis (Sea of Fertility) predominate. Near the center, the smaller Mare Marginus (Border Sea) and Mare Smythii (Smyth's Sea, named for the English admiral and astronomer, 1788–1865) are in sharp contrast to the surrounding terrain.

Right: This view of the Moon contains a level of detail similar to that obtainable from small terrestrial telescopes and provides an appearance not unlike that seen by the naked eye. The manner in which the blackness of space is emphasized when contrasted with an illuminated celestial object is of interest.

APOLLO 10 AS10–27–3955

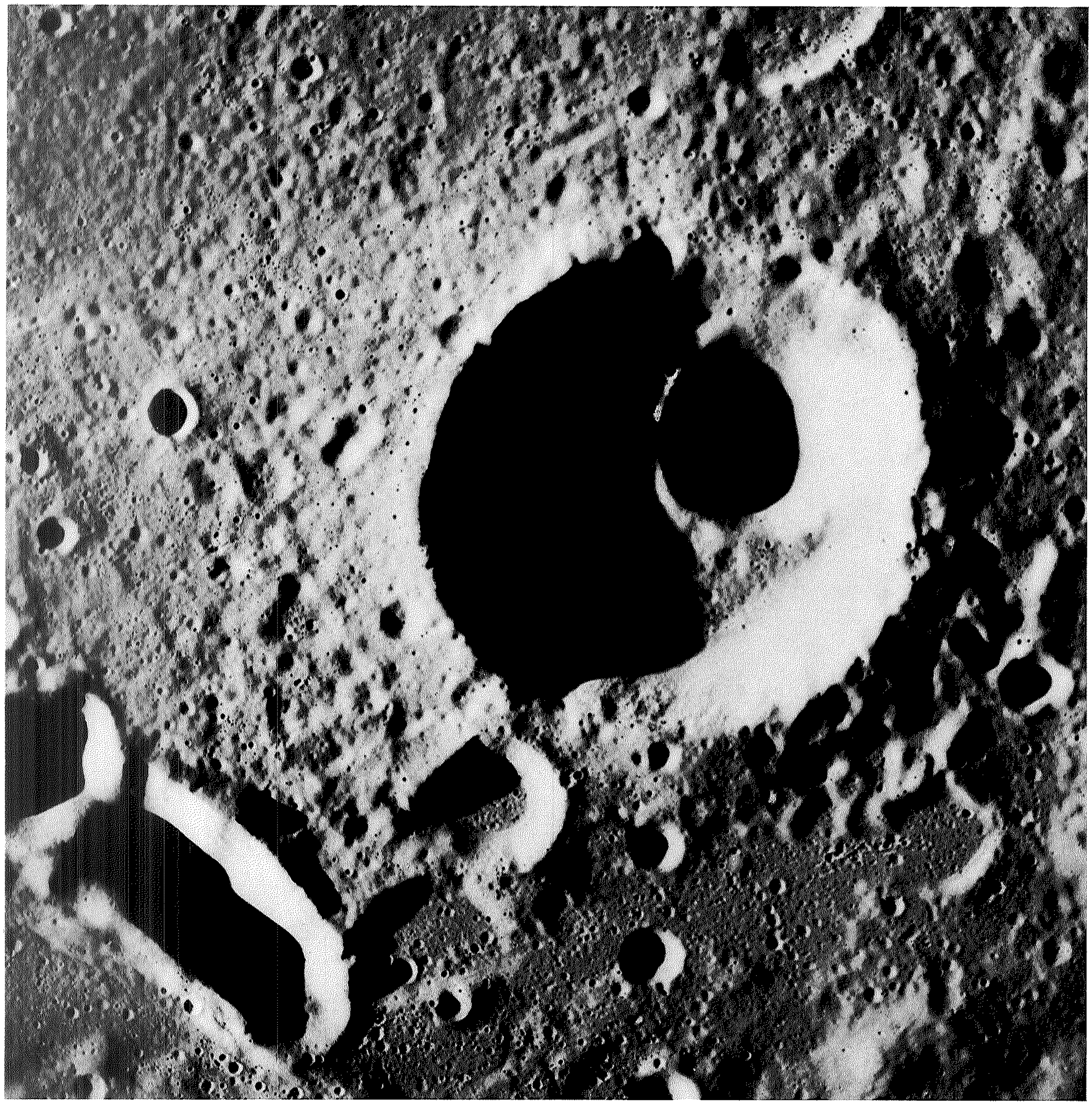
APOLLO 10 AS10-27-3929

This high-oblique view of the lunar far side includes Mare Smythii in the lower left and Mare Moscoviense (Sea of Moscow) near the horizon at the center top. Note how the rugged terrain of the lunar landscape near Mare Moscoviense stands out in relief against the black background.

APOLLO 10

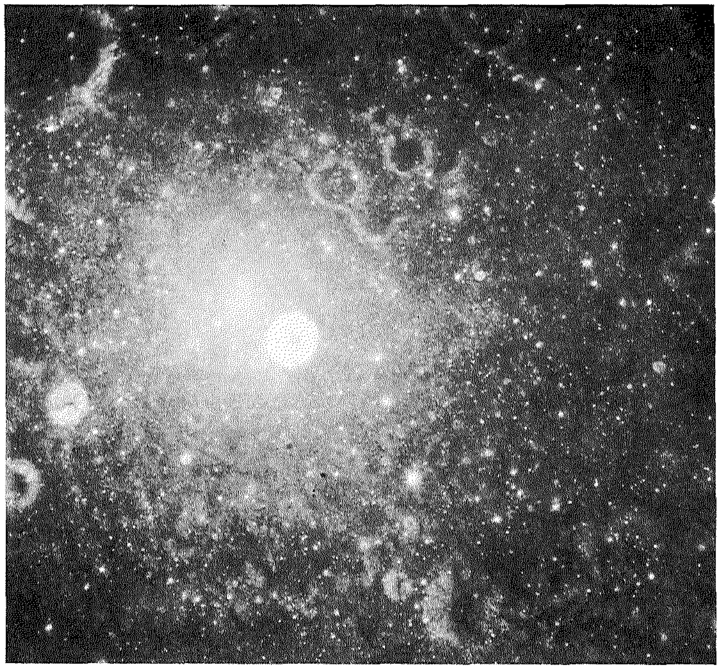
AS10–27–3915

This near-vertical view of Mare Smythii was photographed at a high Sun elevation. The illumination conditions tend to flatten out the appearance of the landscape and make smaller craters appear as bright points of reflection.

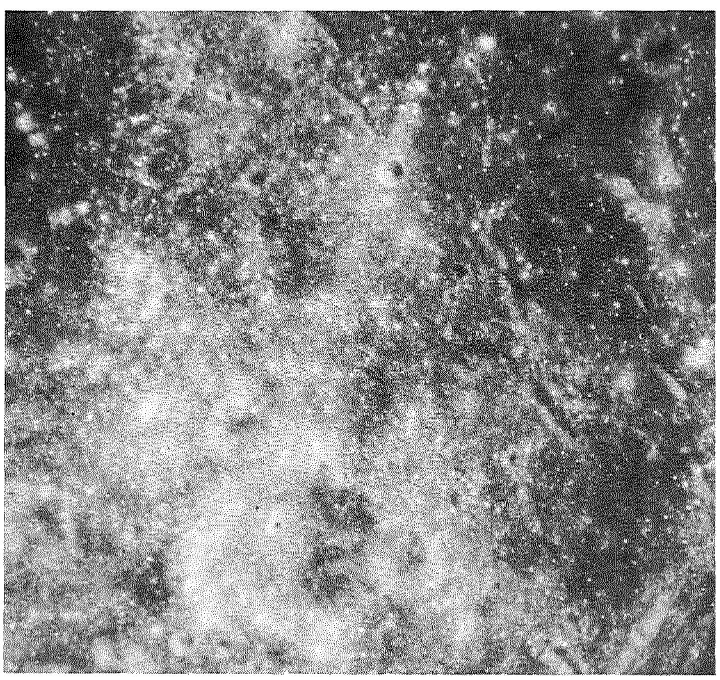


APOLLO 8 AS8-12-2052

None of the features in this region has been named; however, the keyhole-shaped crater was used for training the Apollo 8 crewmen in landmark tracking. The large crater is approximately 20 statute miles in diameter. Note the range in sizes of craters visible at the low (7°) Sun elevation.



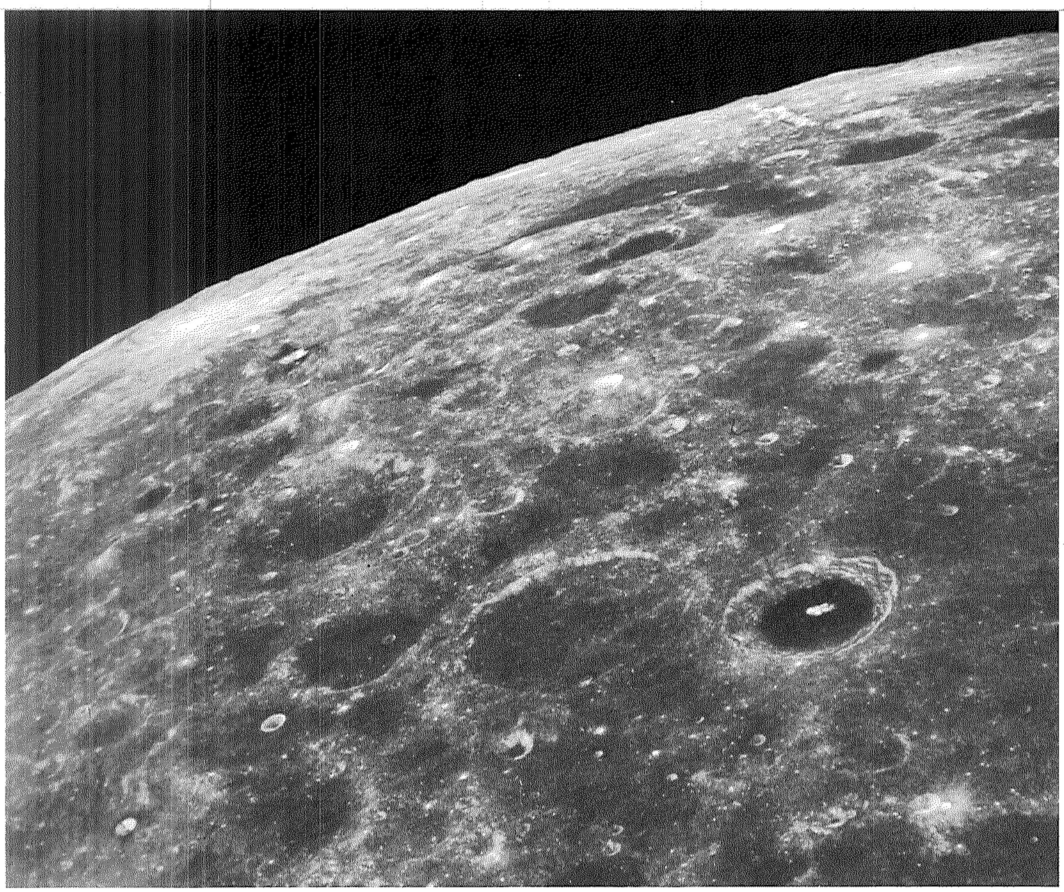
APOLLO 8 AS8-12-2148



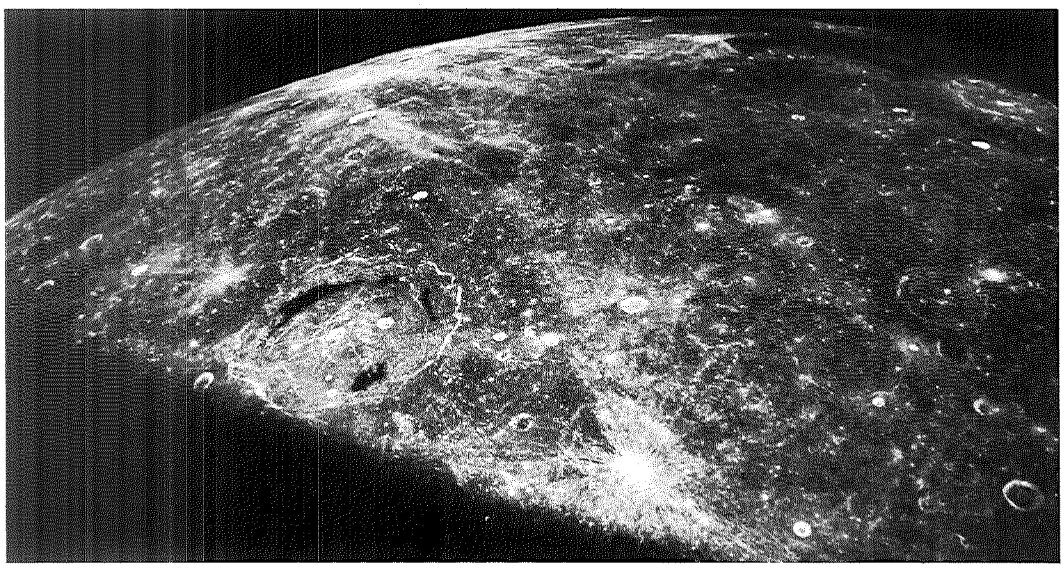
APOLLO 8 AS8-12-2169

Top left: This vertical photograph of the northern floor of a far-side basin was exposed near the subsolar point (point of maximum Sun elevation). The unnamed bright crater at the center is the focal point of the scene; thousands of tiny craters stand out as pinpoints of bright light.

Left: The southeastern edge of Mare Smythii is exposed at a high Sun elevation, emphasizing the large number of small craters existing in this region. The lineations running diagonally across the upper portion of the area also are of interest.



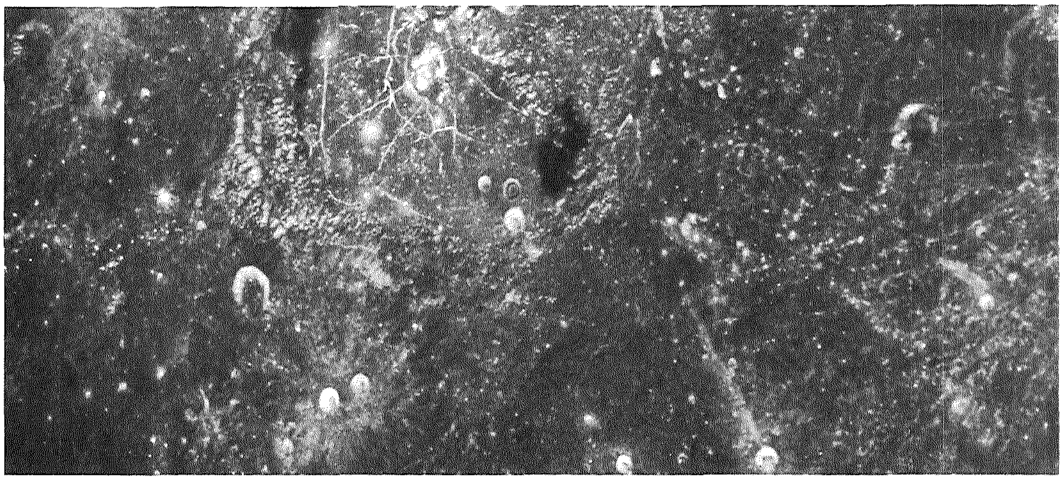
APOLLO 8 AS8-12-2192



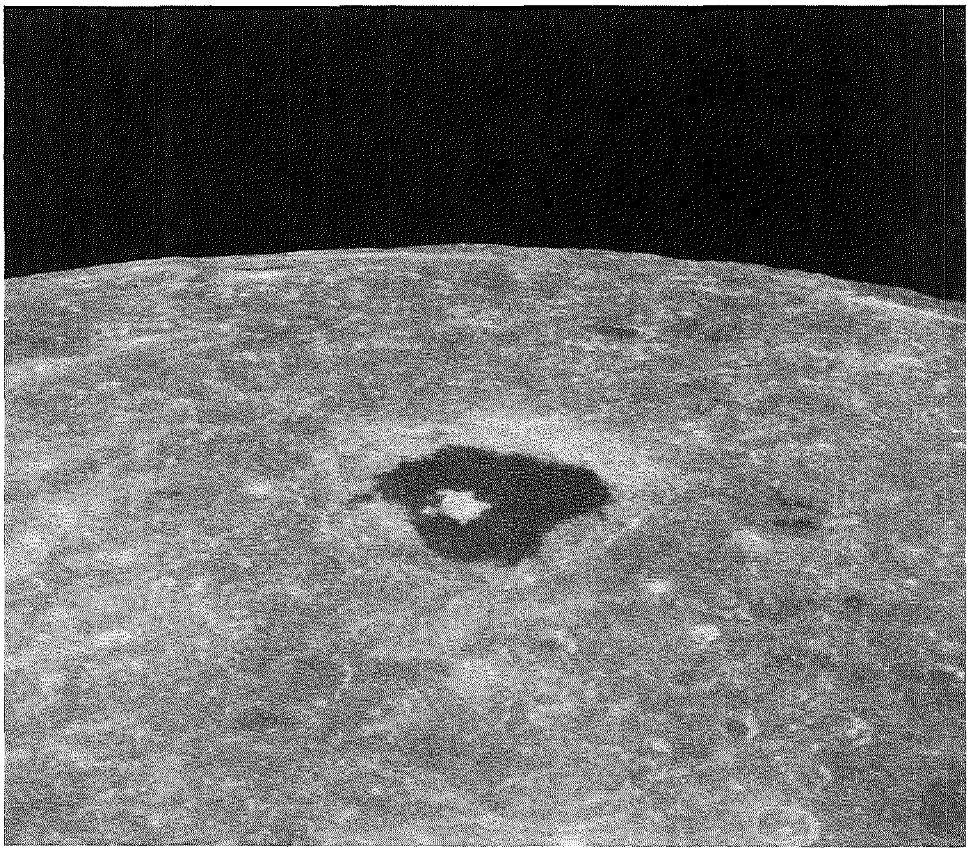
APOLLO 8 AS8-12-2189

Top: This is a southerly looking high-oblique photograph of the lunar far side. The dark-floored crater is approximately 40 miles in diameter and lies on the southeastern edge of Mare Australe (Southern Sea). Numerous other large craters can be seen in this region, including a very bright ray crater near the horizon at left.

Above: This is a high-oblique photograph of the lunar surface with the large crater Humboldt (German statesman, 1767–1835) at the lower left center and the crater Langrenus (Belgian selenographer, 1600–1675) at the far upper right. Numerous light areas and small bright-rayed craters are visible.



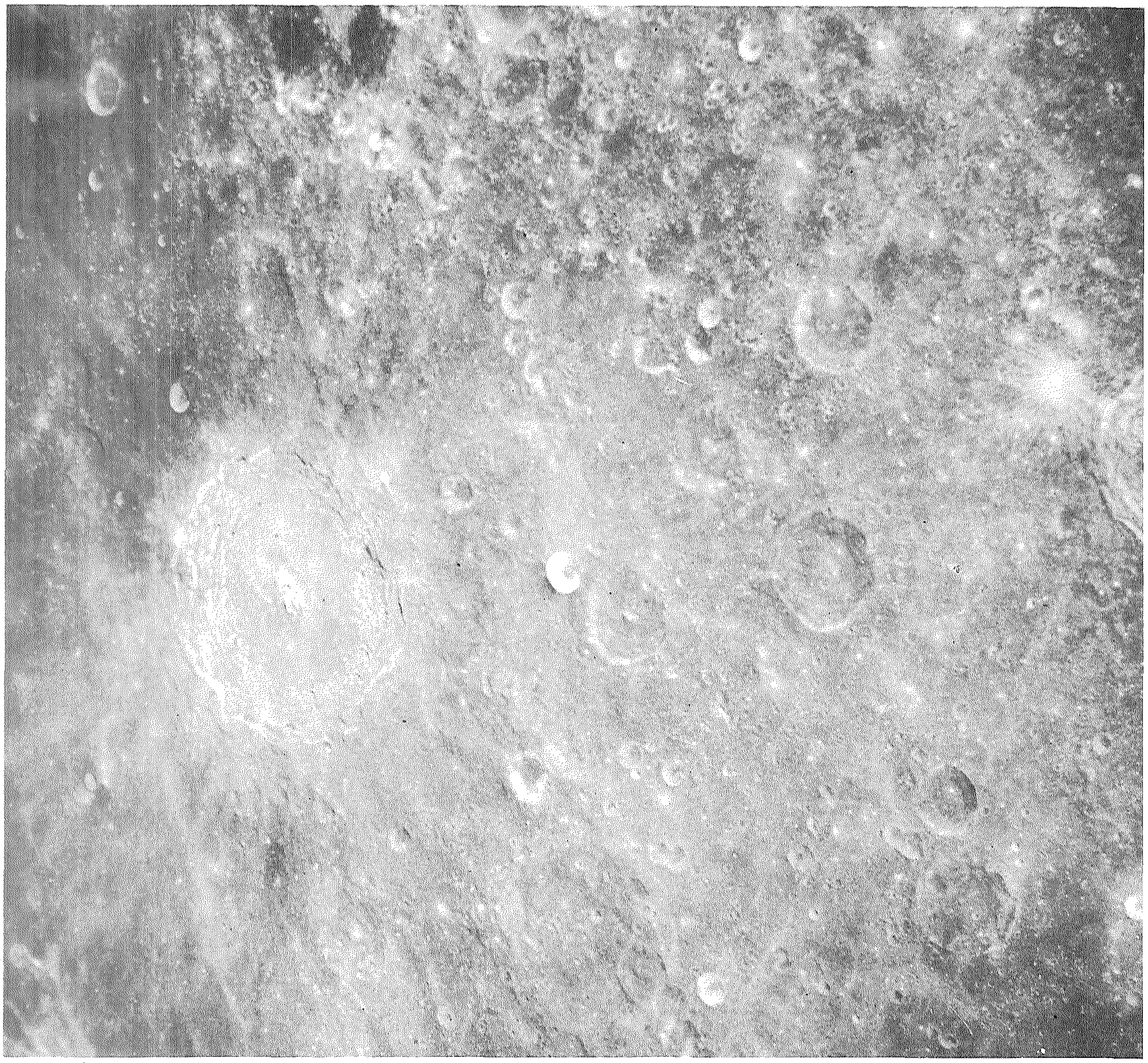
APOLLO 8 AS8-12-2193



APOLLO 8 AS8-12-2196

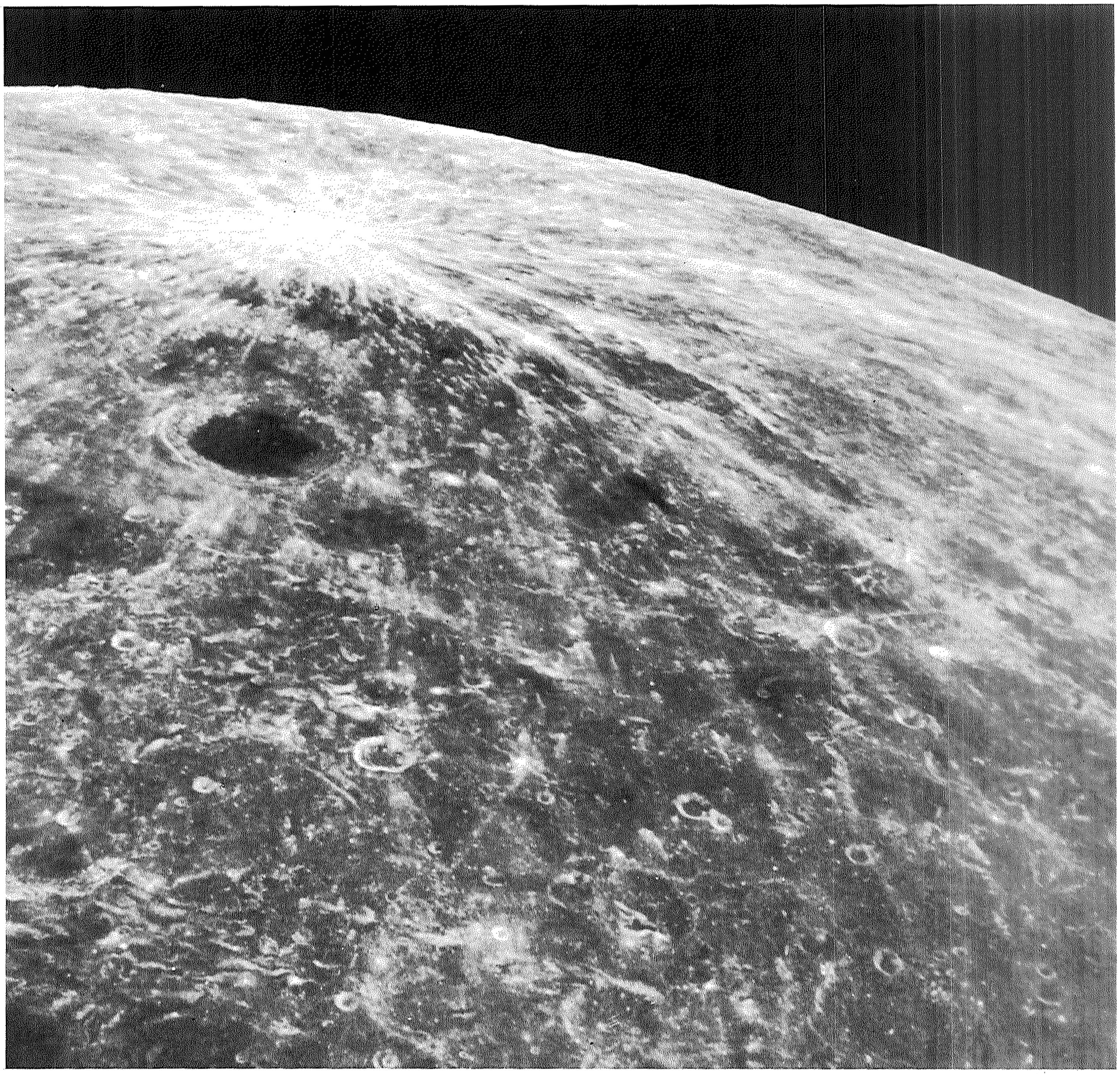
Top: A closer view of the Humboldt crater shows in detail the interesting linear patterns emanating from the center of the crater. The bright central peaks are characteristic of many lunar craters.

Above: This is an oblique view of the far-side crater Tsiolkovsky (Russian aerodynamics and rocketry scientist, 1857–1935). The crater Tsiolkovsky, approximately 94 miles in diameter, was first discovered by the Soviet Moon probe Lunik 3 in 1959. This feature particularly is distinguished by the bright central peak rising from the very dark crater floor.



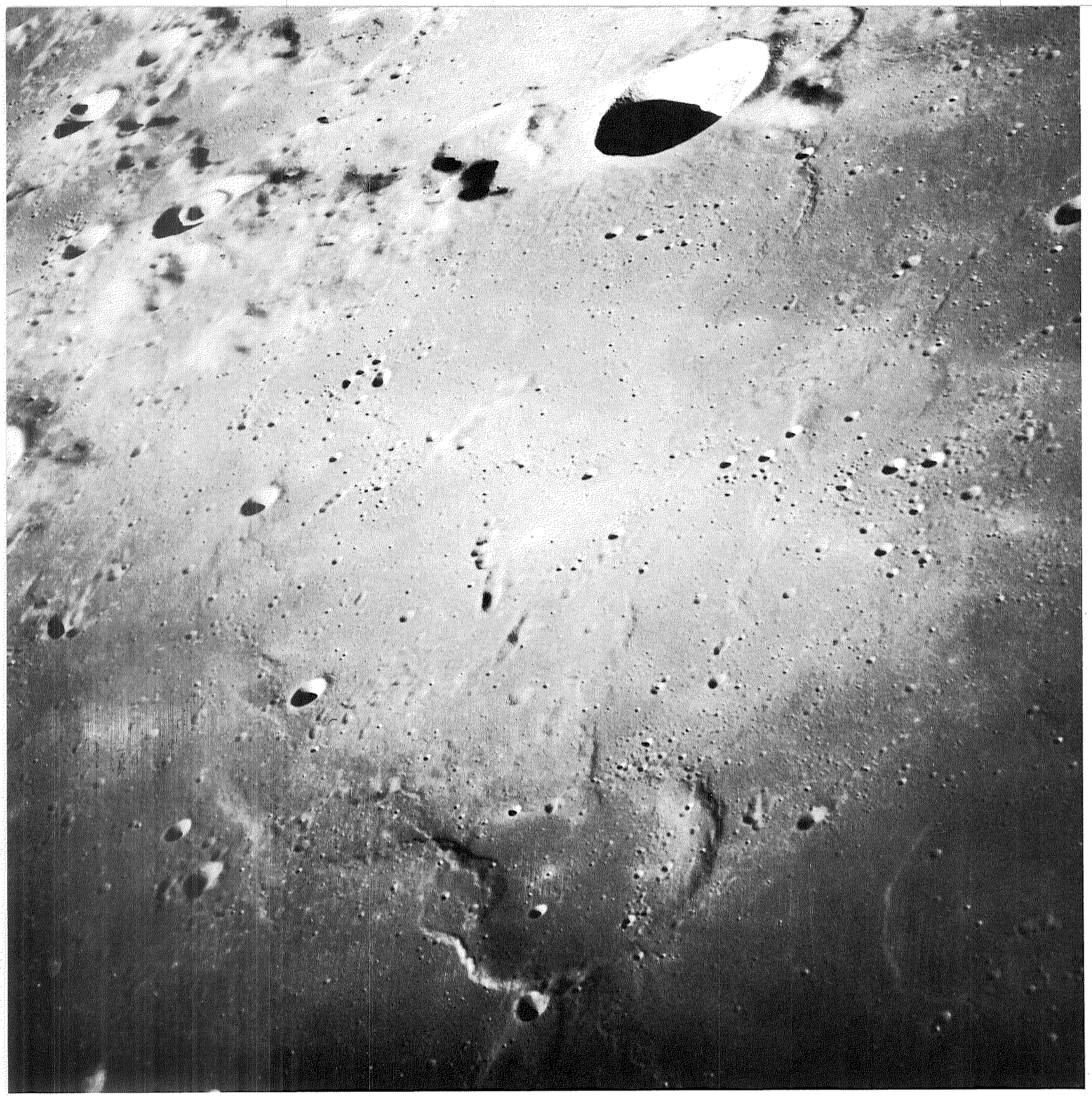
APOLLO 8 AS8-12-2203

The crater Langrenus is located on the eastern edge of Mare Fecunditatis. Langrenus, which is approximately 85 miles in diameter, shows the classic features commonly associated with large craters, such as a relatively smooth floor, terraced walls, and a central peak.



APOLLO 8 AS8-12-2209

The crater Joliot-Curie (French physicist, 1900–1958), partially shown within this high-oblique photograph at left center, is approximately 110 miles in diameter. The dark-bottomed crater Lomonosov (a Russian founder of present-day natural science, 1711–65) is approximately 50 miles in diameter. Long narrow rays have been reported in the polar region of the Earth-facing hemisphere of the Moon. The very bright-rayed crater near the horizon is now thought to be the source of these rays.



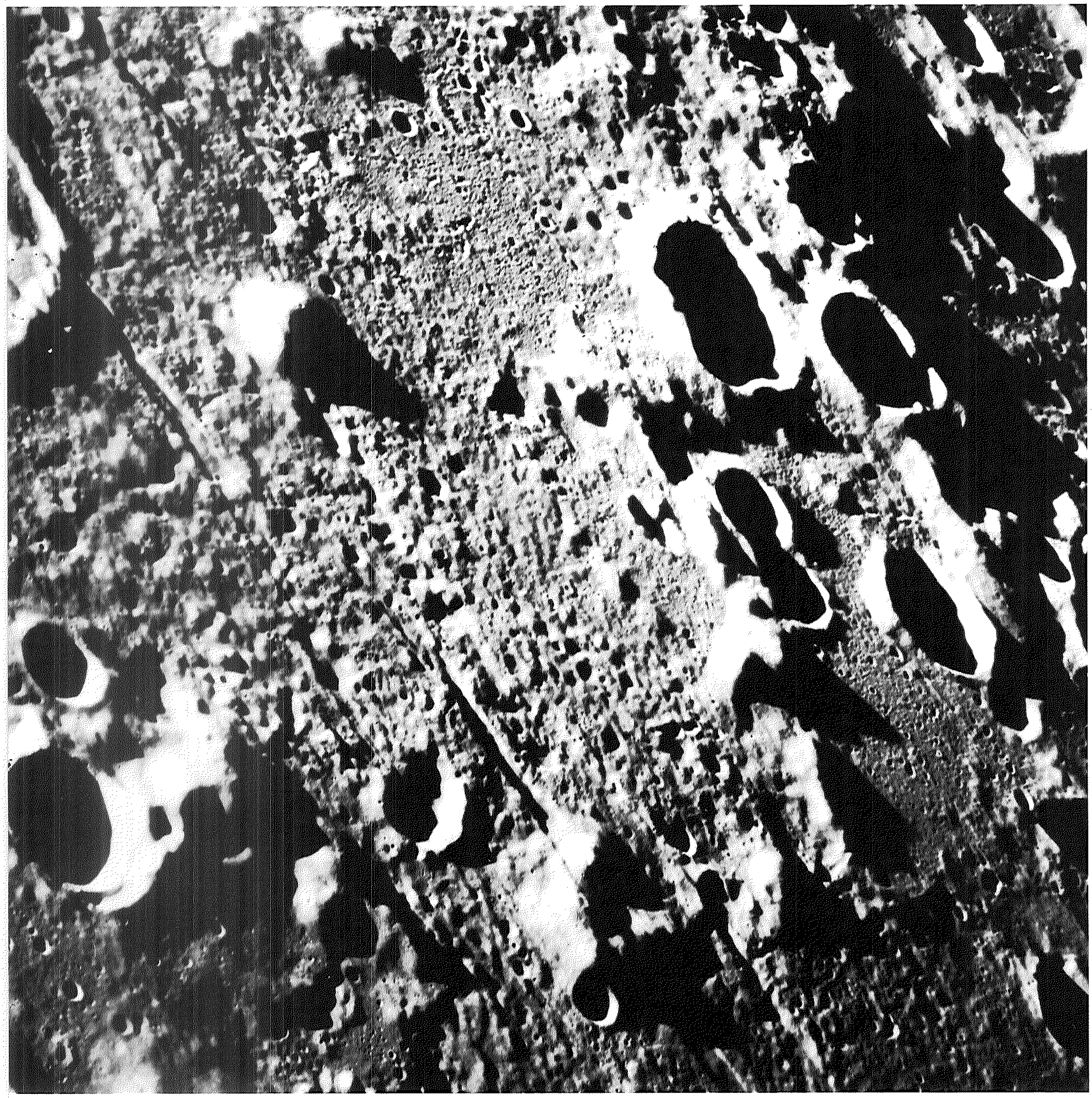
APOLLO 8 AS8-13-2220

This is an oblique photograph (looking southwest) of Mare Fecunditatis. The large crater at the top is Bellot (French explorer, 1823–56), approximately 13 miles in diameter. The interesting double, or concentric, crater at the upper left is Bellot B.

APOLLO 8

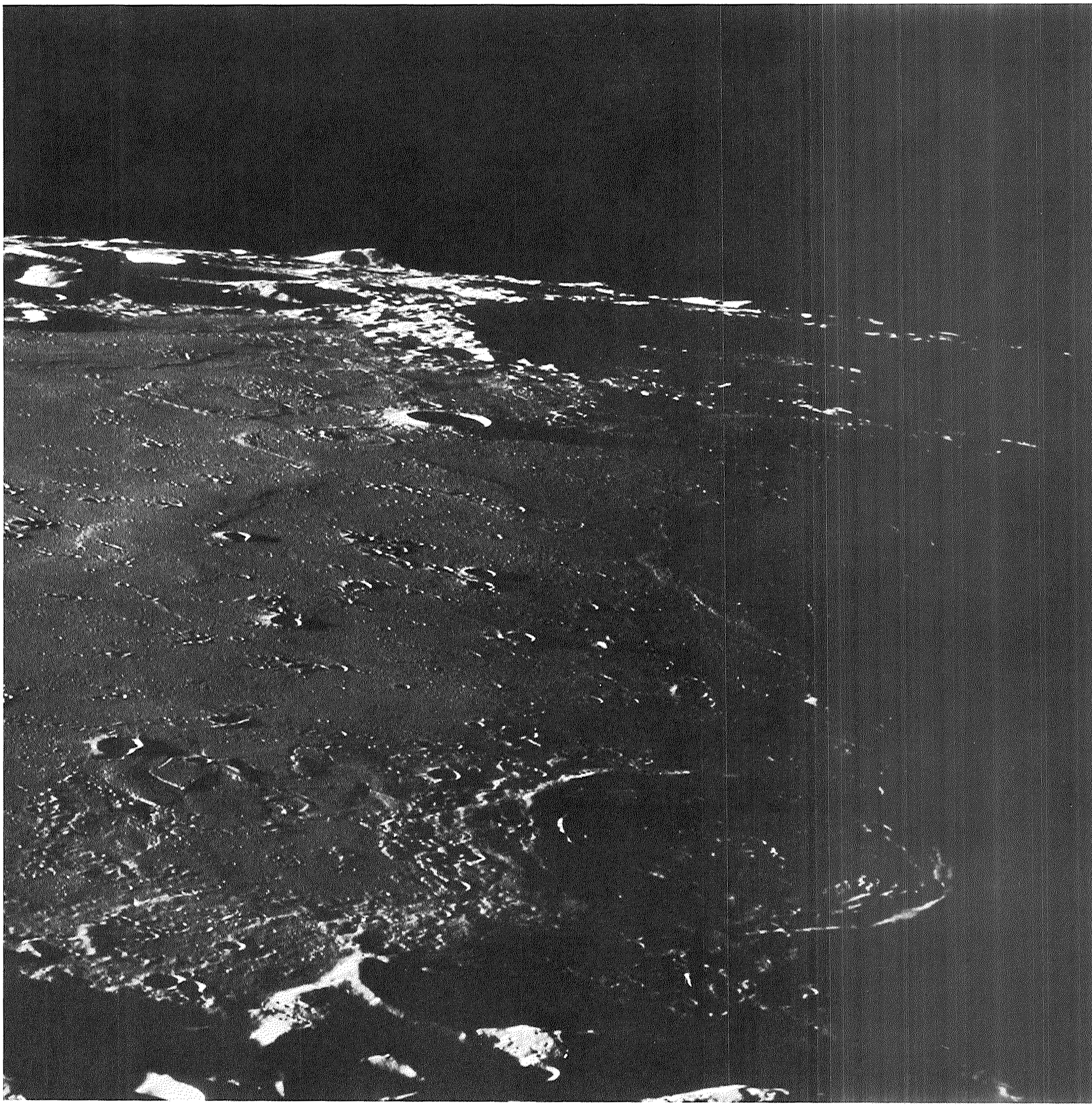
AS8-13-2225

In this oblique view, a portion of the Pyrenees Mountains can be seen in the center background at the top edge of the photograph. The large crater Goclenius (German scholar, 1572–1621) in the foreground lies on the southern edge of Mare Fecunditatis and measures approximately 45 miles in diameter. The numerous rilles scarring the floor of Goclenius can be seen; one rille extends across the entire crater floor, over the central peak, and across the rim into the smooth mare.



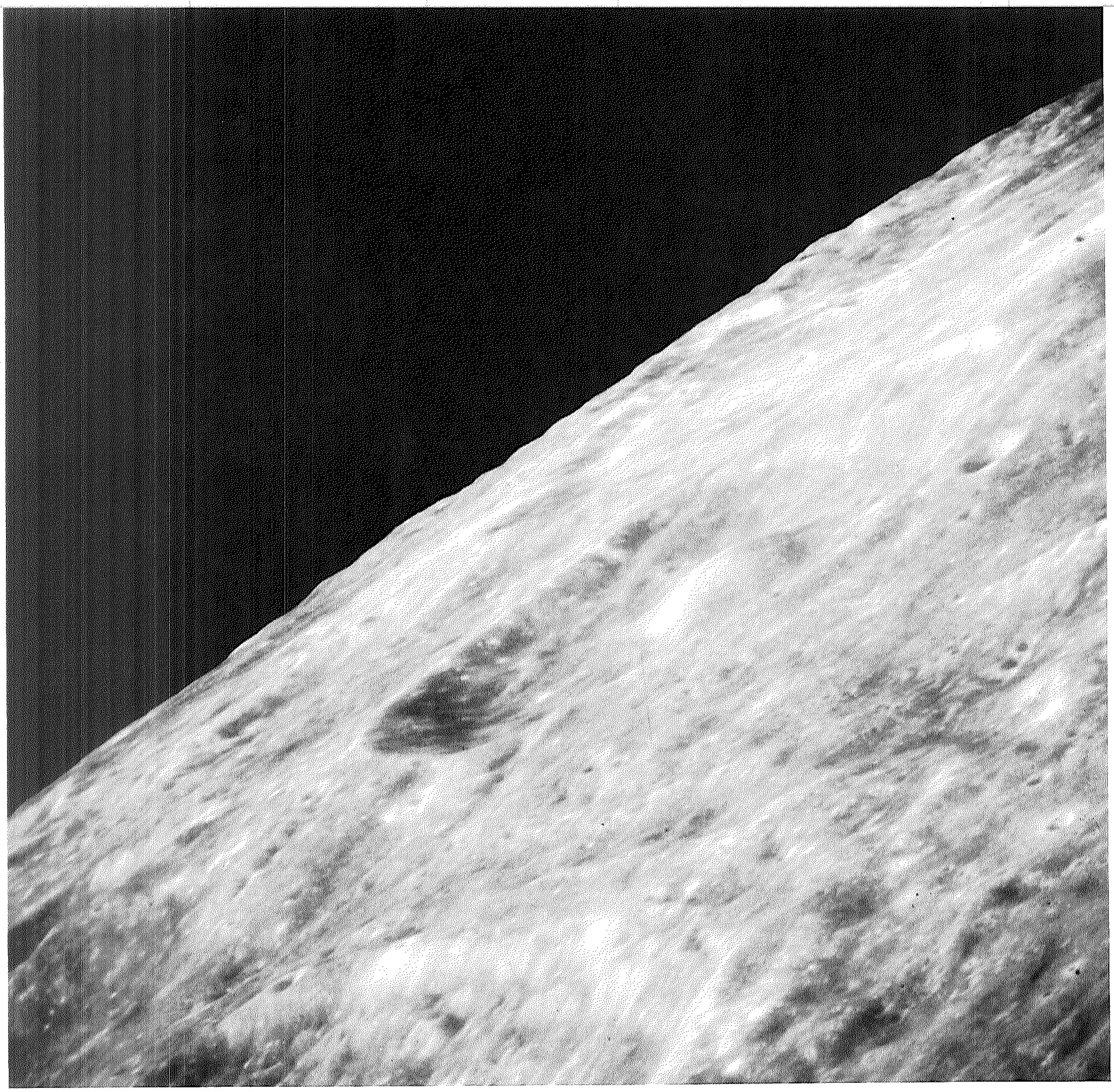
APOLLO 8 AS8–13–2228

This view was taken looking southwest across the highlands just north of the Pyrenees Mountains. The low Sun elevation emphasizes the relief. The large crater in the foreground is Lubbock D (English mathematician, 1803–85). In the middleground, the Gutenberg Rilles (German printer, 1398–1468) can be seen crossing both hills and craters. The craters in the background belong to the Capella (Carthaginian lawyer, *ca.* A.D. 450) system of craters.



APOLLO 8 AS8–13–2243

The large, heavily shadowed crater on the horizon is Fracastorius (Italian astronomer, 1483–1553). The shallow crater in the near foreground is Daguerre (French pioneer in photography known for his daguerreotypes, 1789–1851). The bright peak on the horizon at left center is approximately 270 miles from Daguerre.

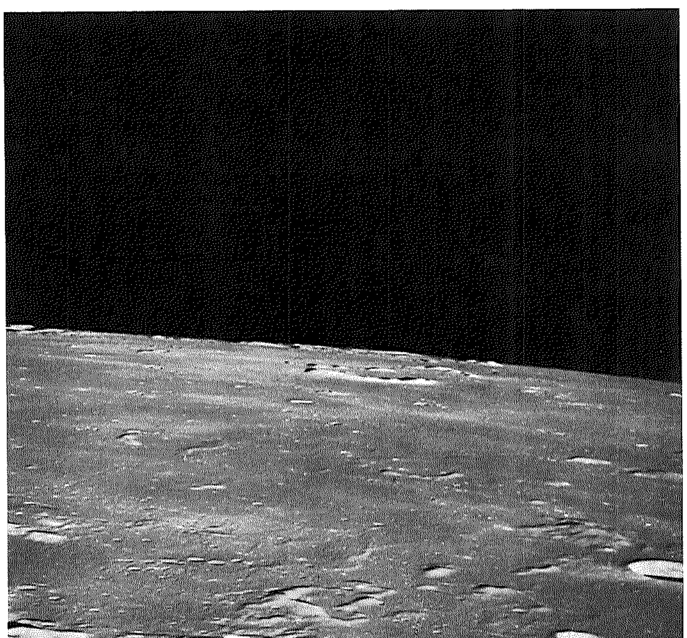


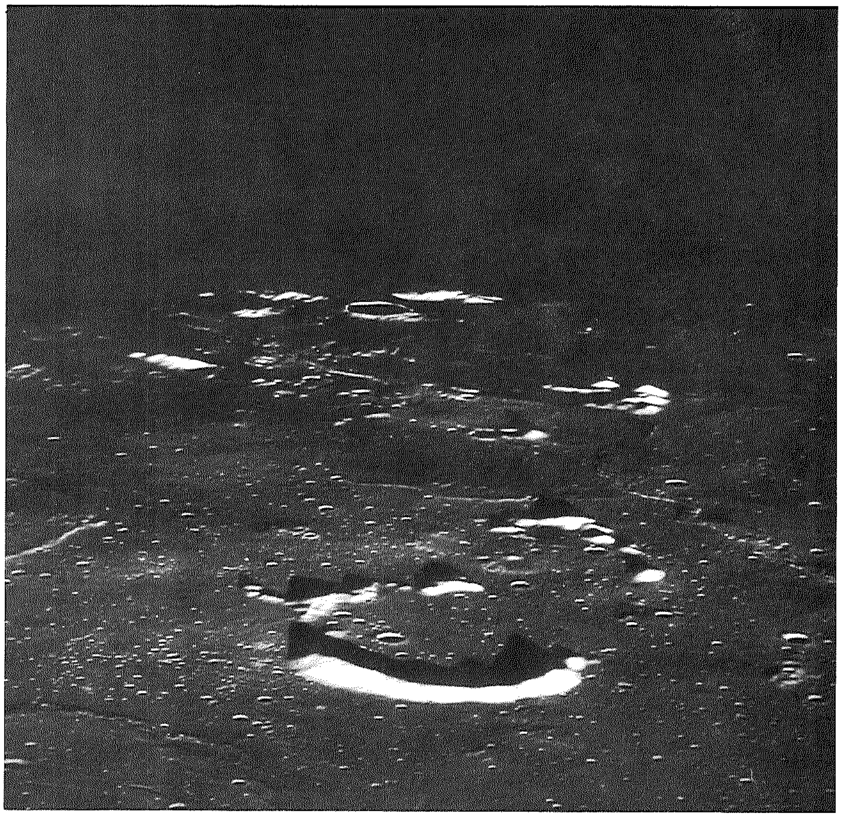
APOLLO 8 AS8–13–2269

Top: The large crater in the center is Behaim (German navigator, 1436–1506). Of special interest is the very even appearance of this crater, especially in the center where the central peak resembles a smooth dome.

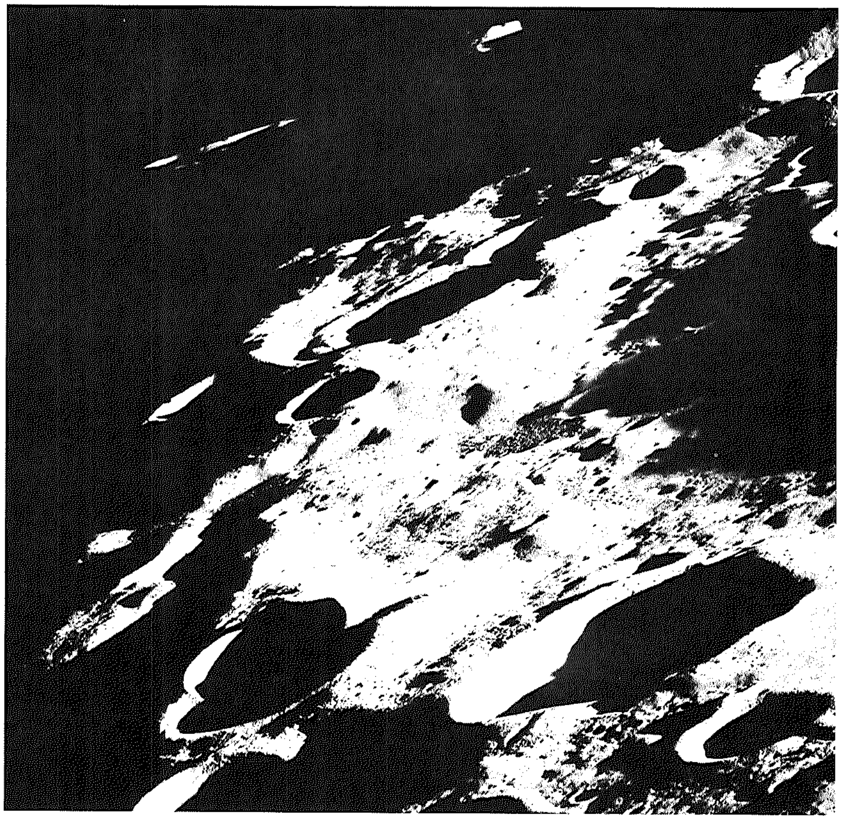
Right: This photograph is a westward-looking view into Mare Tranquillitatis (Sea of Tranquility). The two small craters in the lower right corner are Secchi A (Italian astronomer, 1818–78) and Secchi B. The large sharp-rimmed crater just beyond Secchi A and Secchi B is Taruntius F (Roman philosopher, *ca.* 88 B.C.). The large crater remnant at the center background is Maskelyne F (English astronomer, 1732–1811).

APOLLO 8 AS8–13–2271





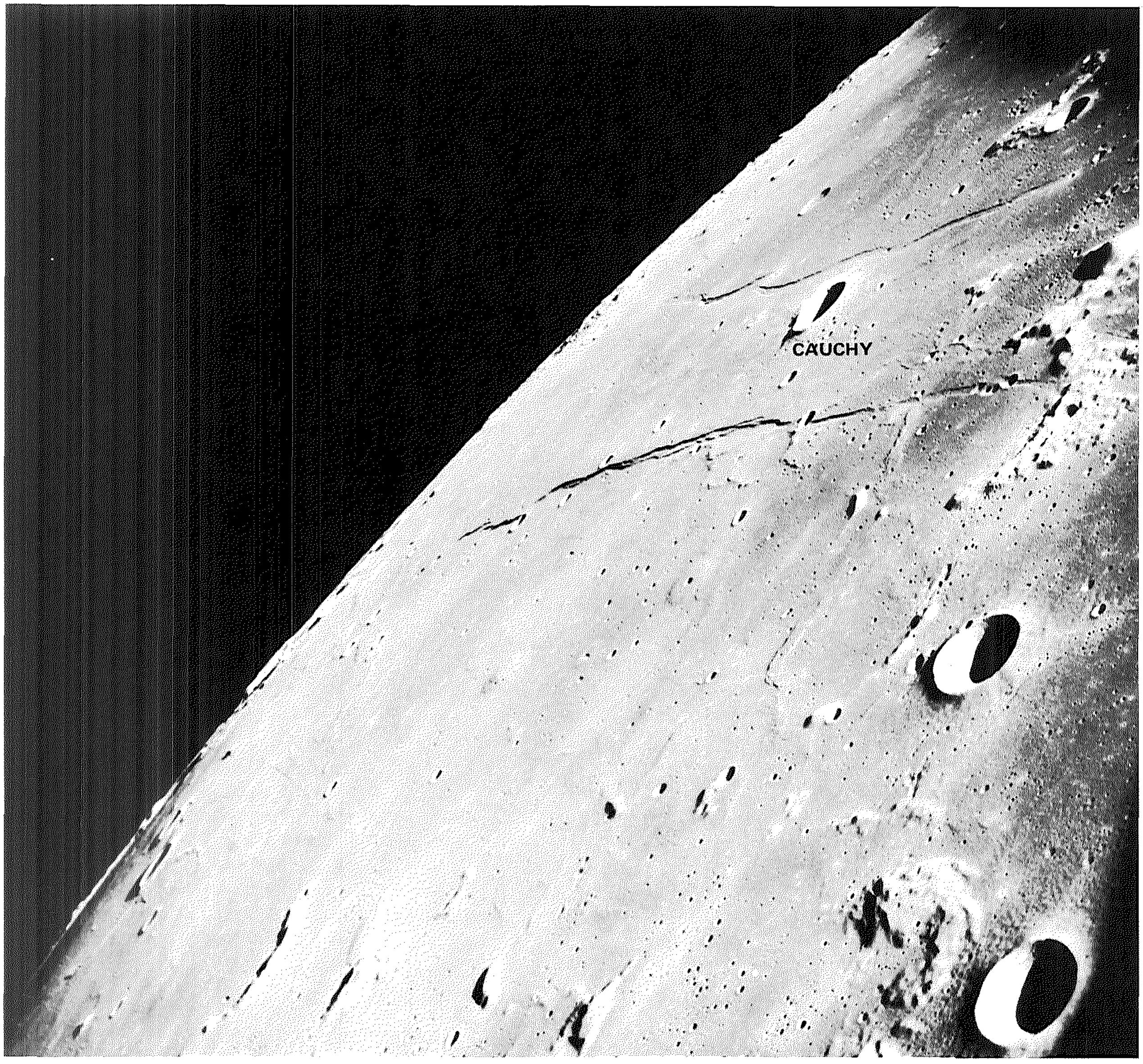
APOLLO 8 AS8-13-2279



APOLLO 8 AS8-13-2314

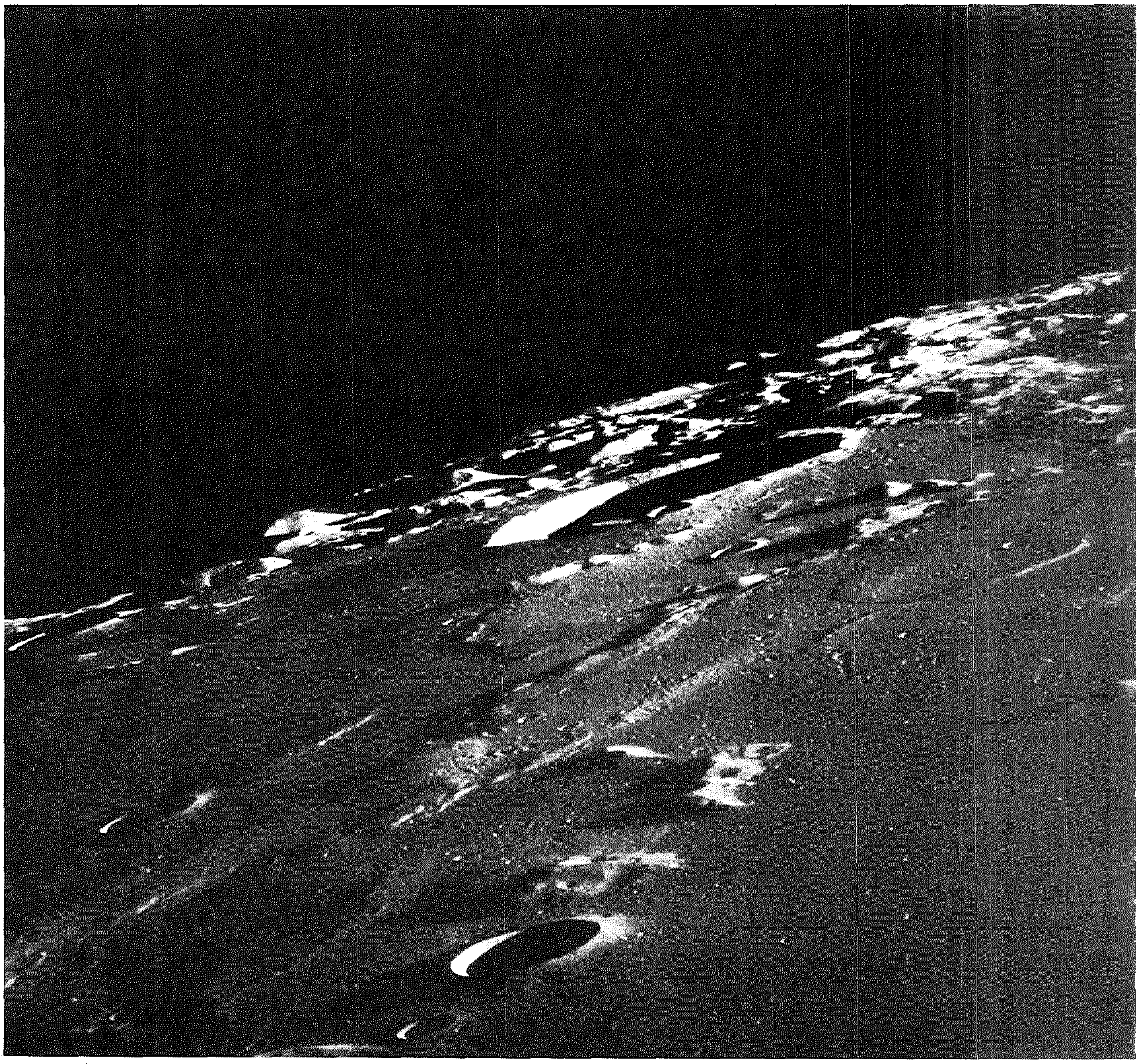
Top left: The prominent feature in the lower center is the crater Maskelyne F, an old ring crater which is 13 miles in diameter. In the center background near the terminator is the well-defined crater Maskelyne H. The distance between these two features is approximately 56 miles. The sharp protuberance near the center was selected as a control point because of its unique structure.

Left: This south-looking oblique view of the far-side terminator was exposed at a Sun elevation of 1°. The extreme contrasts of black and white lend a curious, almost artistic, quality to the scene. In the far background, a ridge apparently protrudes high enough to reflect sunlight, causing the bright, narrow, diagonal streak.



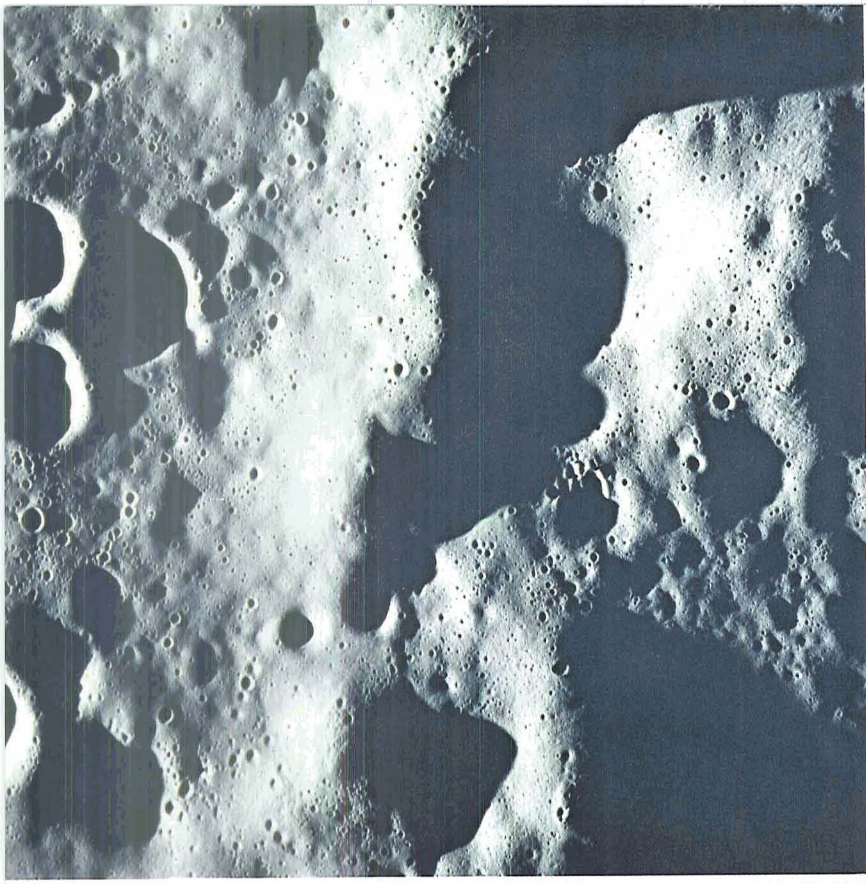
APOLLO 8 AS8-13-2344

This oblique view of the northeastern portion of Mare Tranquillitatis depicts a rather wide variety of lunar topographic features. To the right center is the crater Cauchy (French mathematician, 1789–1856). The accompanying escarpment has been designated Rima Cauchy (Cauchy's Rille). Numerous small craters, peaks, and domes also prevail in this region.

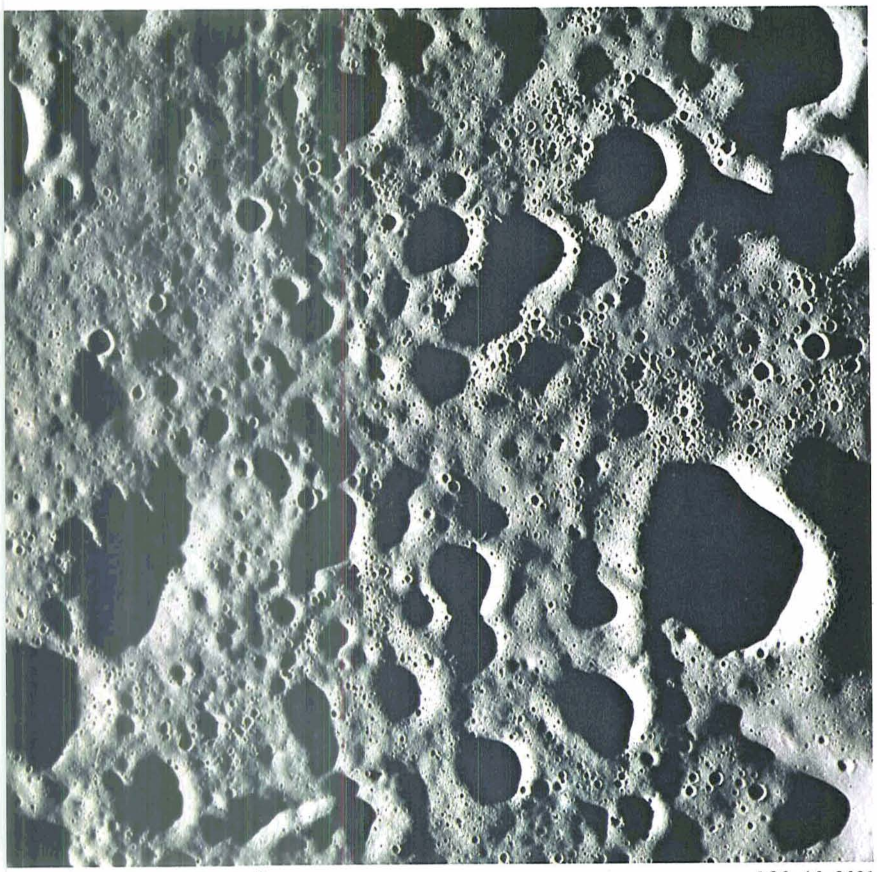


APOLLO 8 AS8-13-2347

This oblique view is looking northwest across the northern portion of Mare Tranquillitatis toward the near-side terminator. The Sun elevation was 1°. The large crater at the center of the picture is Vitruvius (Roman architect, 100 B.C.). Note the presence of a "ghost" crater just to the right of Vitruvius.



APOLLO 8 AS8–14–2399



APOLLO 8 AS8–14–2401

Top left: This photograph is one in a sequence of vertical views of the central region of a far-side basin. The deep shadows near the terminator emphasize the relief of the area.

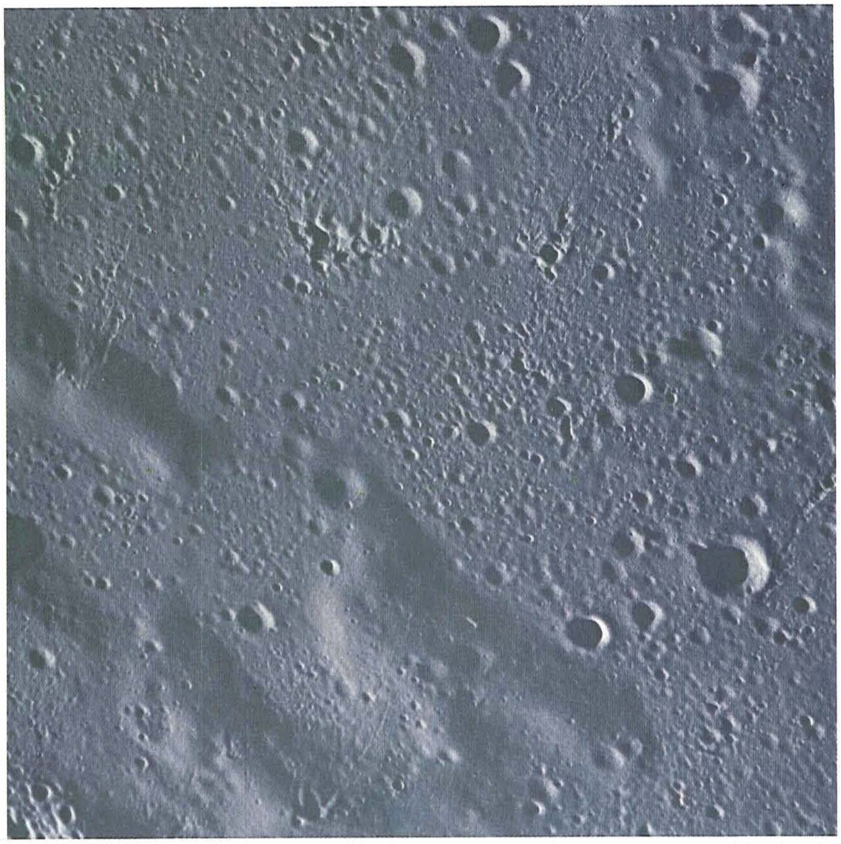
Left: Another in the sequence of vertical views, this heavily cratered area appears forbidding because of the accentuation of detail at the low Sun elevation.

APOLLO 8 AS8–14–2409

The shadow cast by the large protuberance in this far-side view indicates that this is a feature of considerable size. This area, as well as most of the other areas in this region, is heavily cratered.

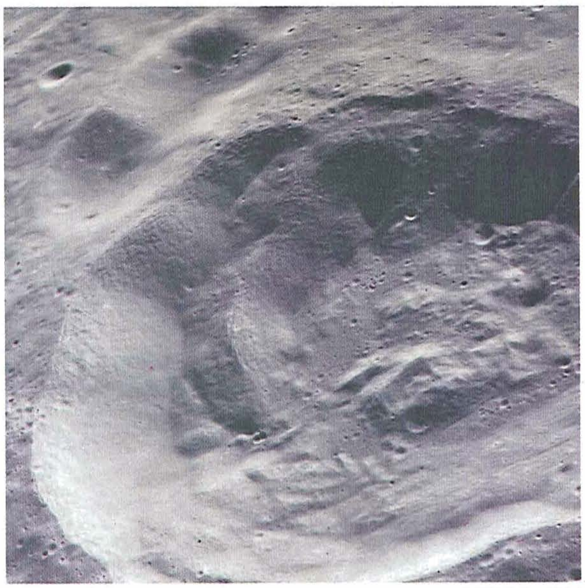
Right: The large ridges running diagonally across the area are the predominant features. Numerous small gouges can be detected running at general right angles to the ridges. The heavy cratering seems typical of this far-side region.

Below: The lunar surface in this area shows a definite fibrouslike texture not generally seen in the other views of this far-side region. Also, this area does not seem to have been subjected to the heavy cratering evident in other portions of this region.



APOLLO 8 AS8–14–2410

APOLLO 8 AS8–14–2412



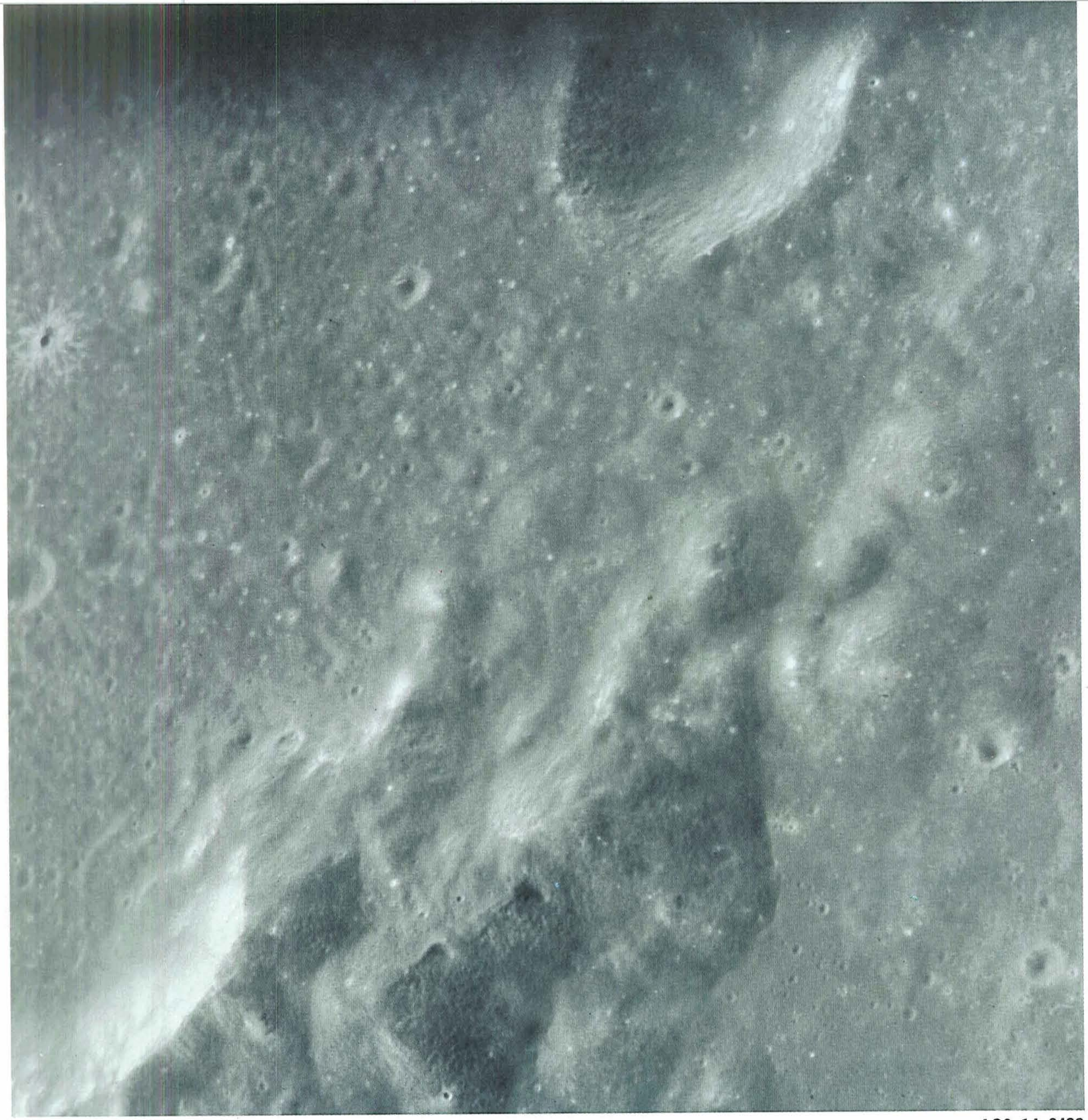
APOLLO 8 AS8–14–2420

Above: The smooth appearance of this lunar far-side crater suggests that it may possibly be an older crater. Nevertheless, it exhibits a central peak and considerable terracing of its walls.

APOLLO 8

AS8–14–2423

The large crater near the center of the photograph is approximately 10 miles in diameter. The apparent softness of the scene is belied by the presence of large numbers of small sharp-walled craters that are visible upon close inspection.

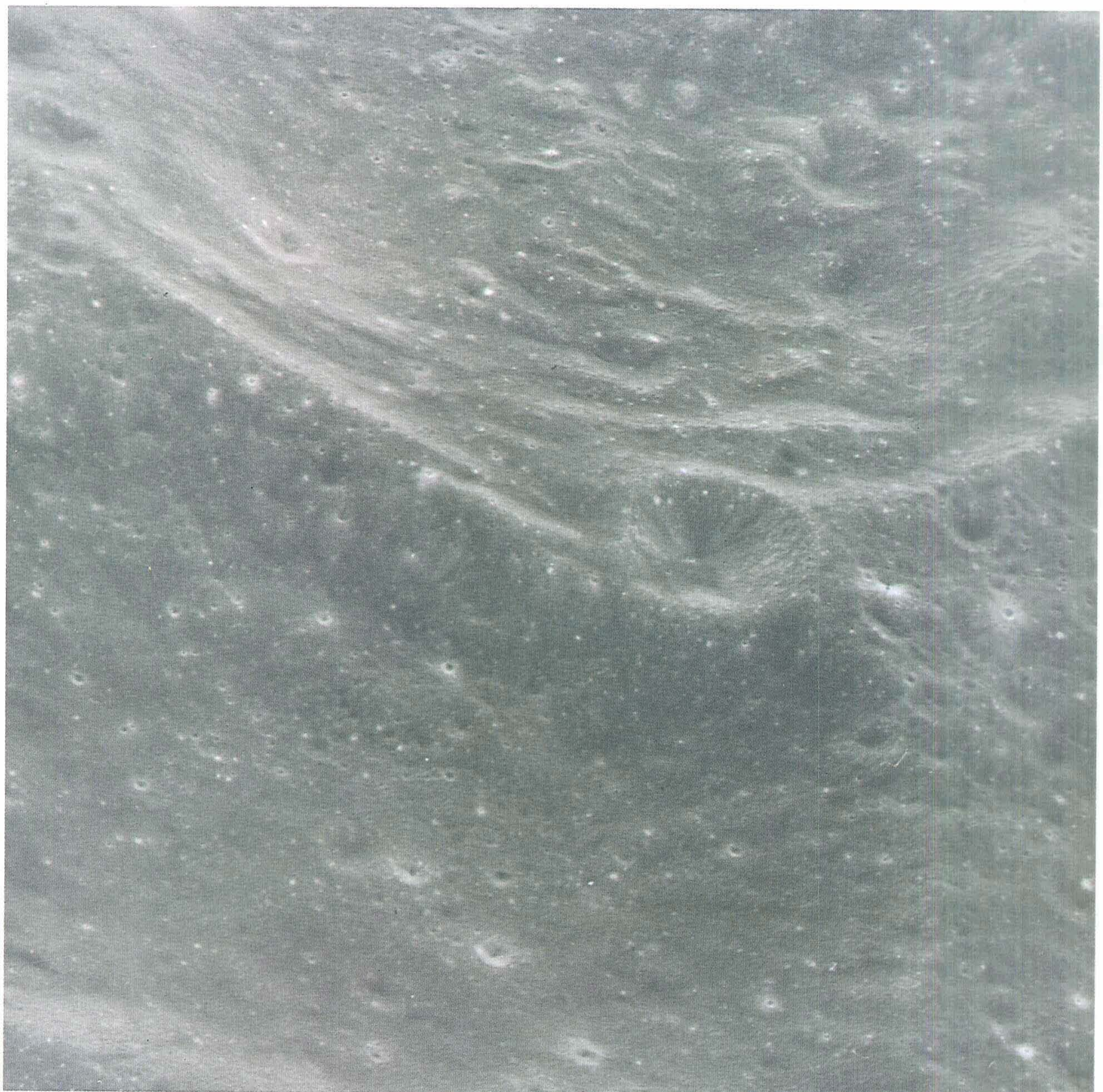


APOLLO 8 AS8–14–2433

Above: The central highland area and a 5-mile-diameter crater are evident in this low-oblique view of the central region of a large far-side crater. A recently formed bright crater and its associated ray system are located in the upper left region.

Right: Many of the smaller craters in this lunar far-side low-oblique photograph respond to the higher Sun elevation by assuming a bright appearance. Several such craters are located near the large crater at the center of the picture.

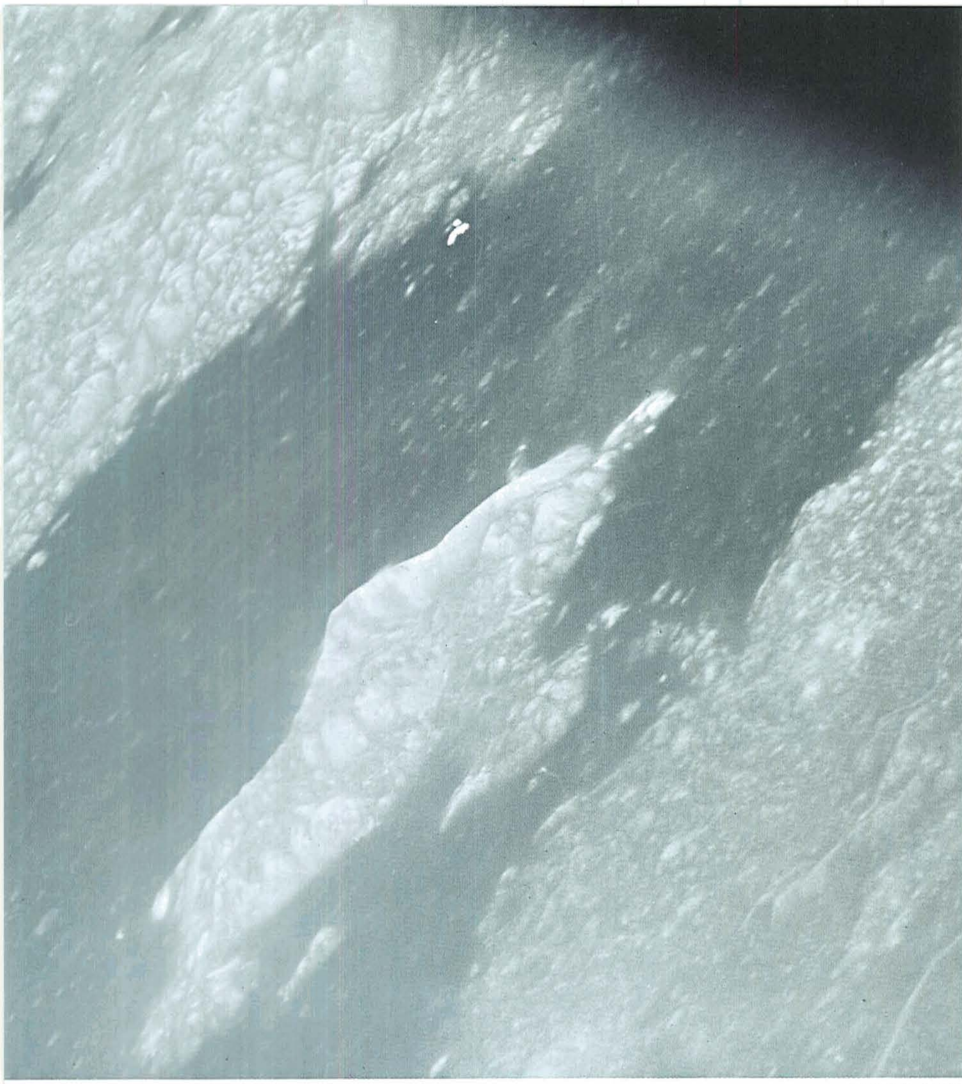
APOLLO 8 AS8–14–2439



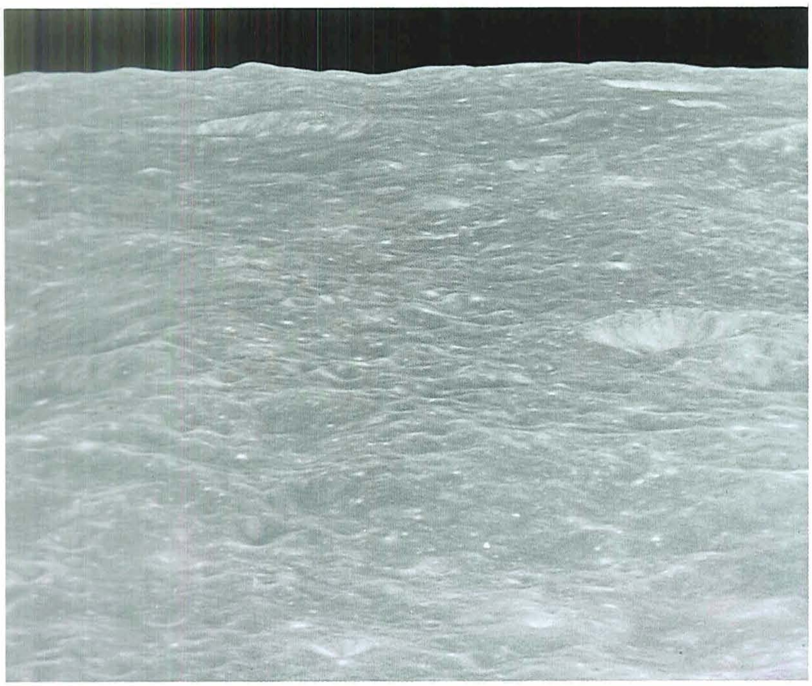
APOLLO 8

AS8-14-2442

Two craters apparently share an adjacent wall in this far-side view. The rim of the larger crater is more than 50 miles across and has been subjected to a steplike terracing. At this relatively high Sun elevation, numerous small bright craters can be seen in the area.



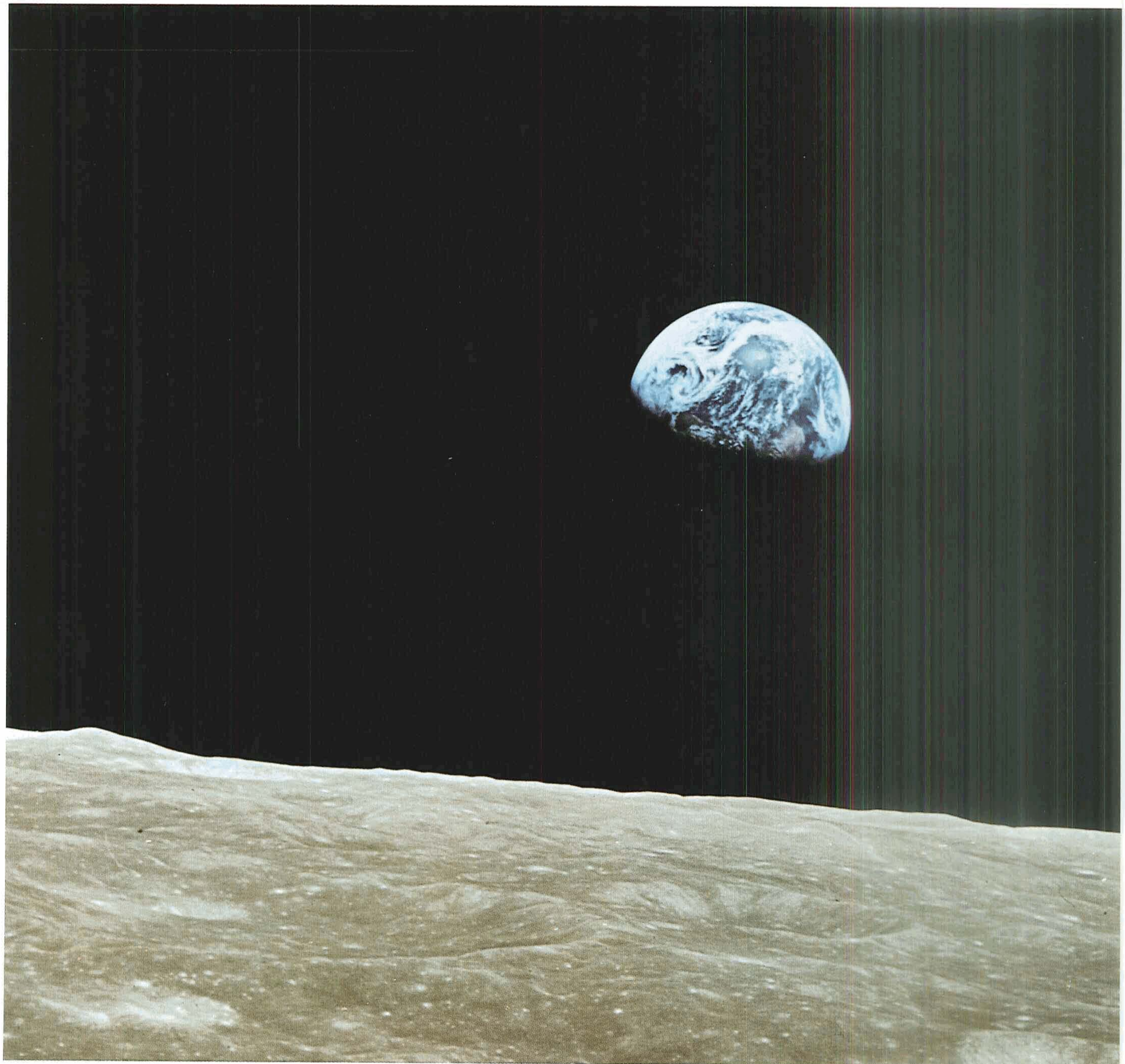
APOLLO 8 AS8–14–2451



Top left: This oblique view of the crater Tsiolkovsky depicts the prominent central peak of this unusual crater. The contrast between the peak and the surrounding crater floor is especially striking.

Left: In this lunar far-side oblique photograph, exposed with a telephoto lens, the foreshortening effects provide an interesting portrayal of lunar far-side relief.

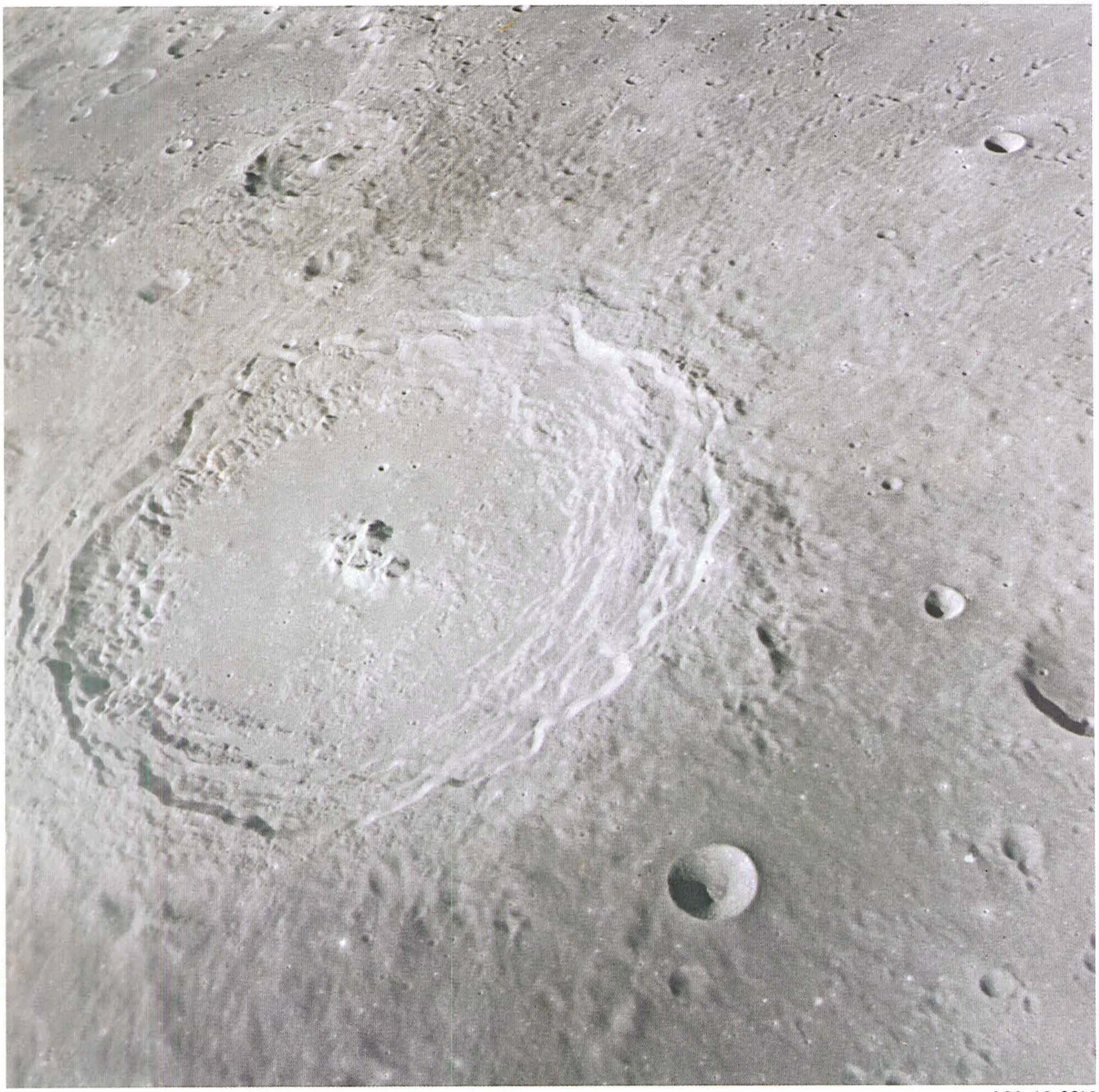
APOLLO 8 AS8–14–2453



APOLLO 8

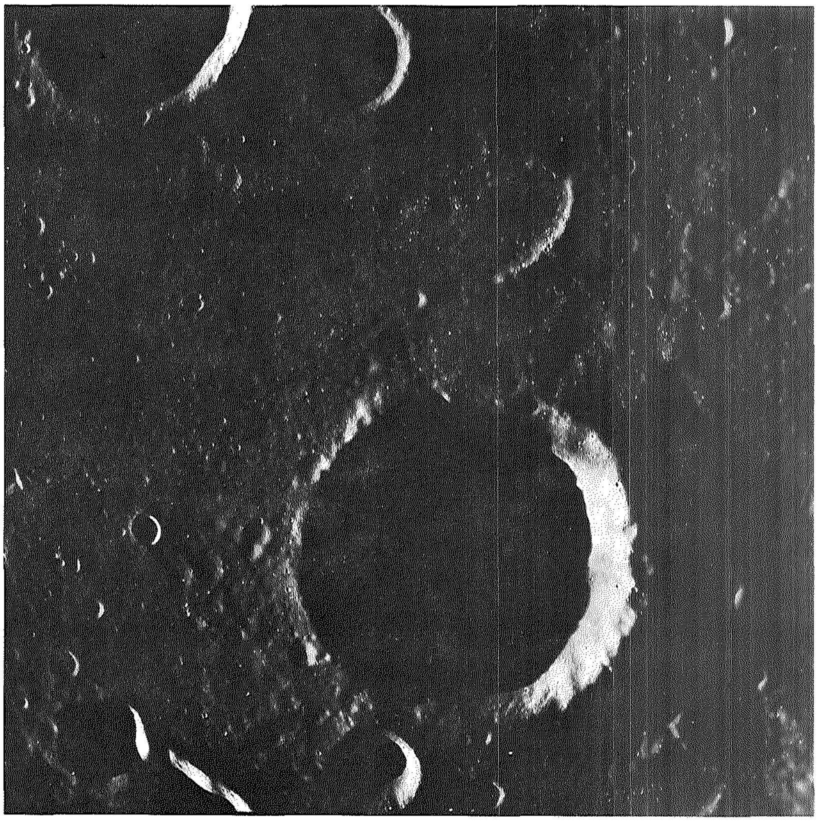
AS8-14-2383

This is a photograph of earthrise as seen from lunar orbit. The visible land area is the western portion of Africa, with heavy cloud patterns concealing much of the Atlantic Ocean.



APOLLO 8 AS8–16–2616

An oblique view of the crater Langrenus shows in detail the steep terracing of the inner walls and the smooth crater floor broken by the central peak. The large shallow crater to the upper left is Vendelinus (Belgian astronomer, 1580–1667). The fact that Vendelinus is smooth and worn as compared with Langrenus would suggest that Vendelinus is a much older crater.

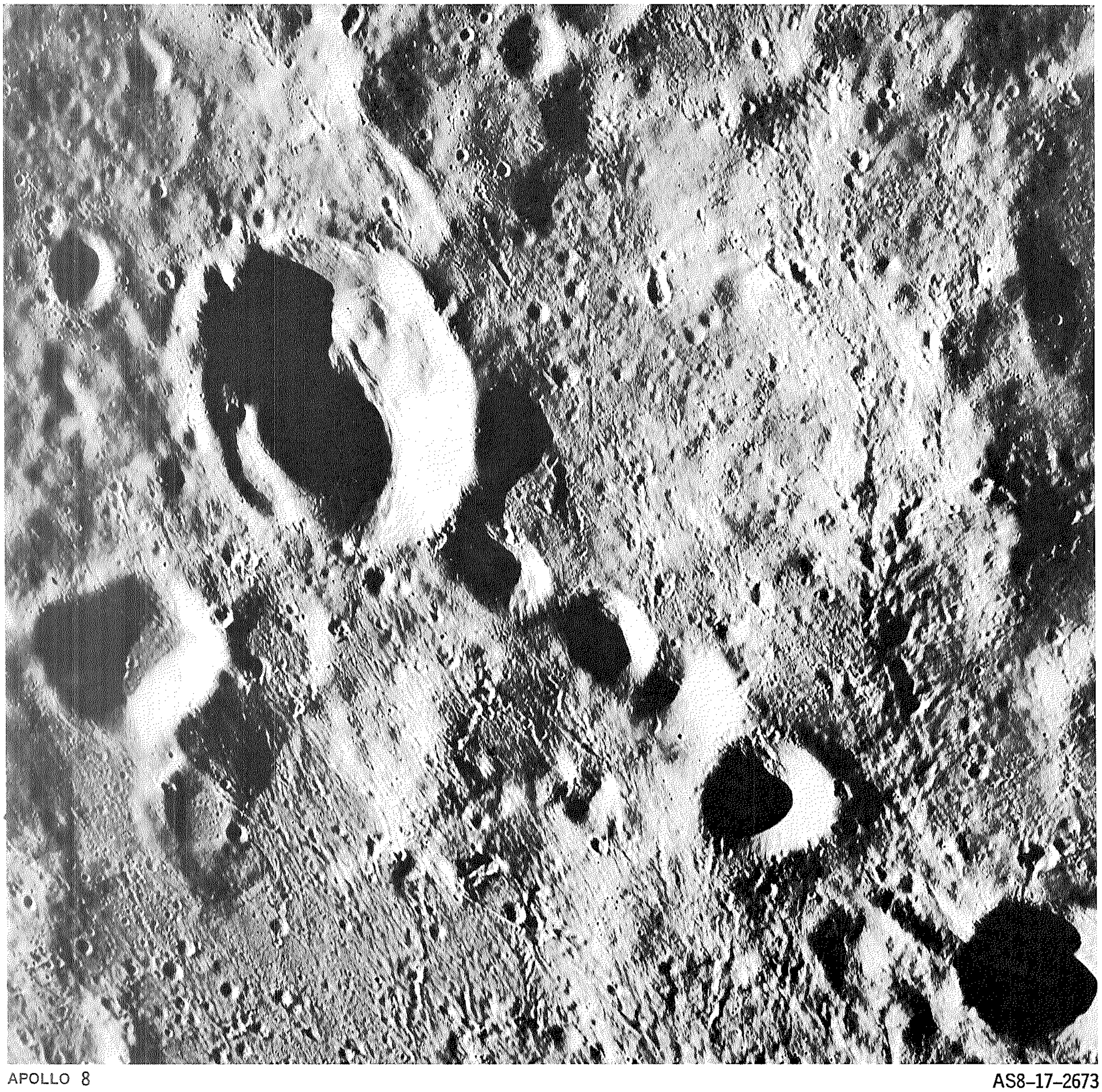


APOLLO 8 AS8-17-2664

APOLLO 8 AS8-17-2670

Top right: These unnamed far-side craters are located near the terminator. The large crater near the center of the photograph is approximately 18 miles in diameter. Because of the low Sun elevation, much of the detail in this region is obscured by shadow.

Right: This is the floor of a far-side crater that was described by the Apollo 8 lunar module pilot as being an area of possible flows. The heavy shadows on the basin floor are from the crater rim. A number of small, rolling, hummock-like structures can be seen to the lower right of this crater.



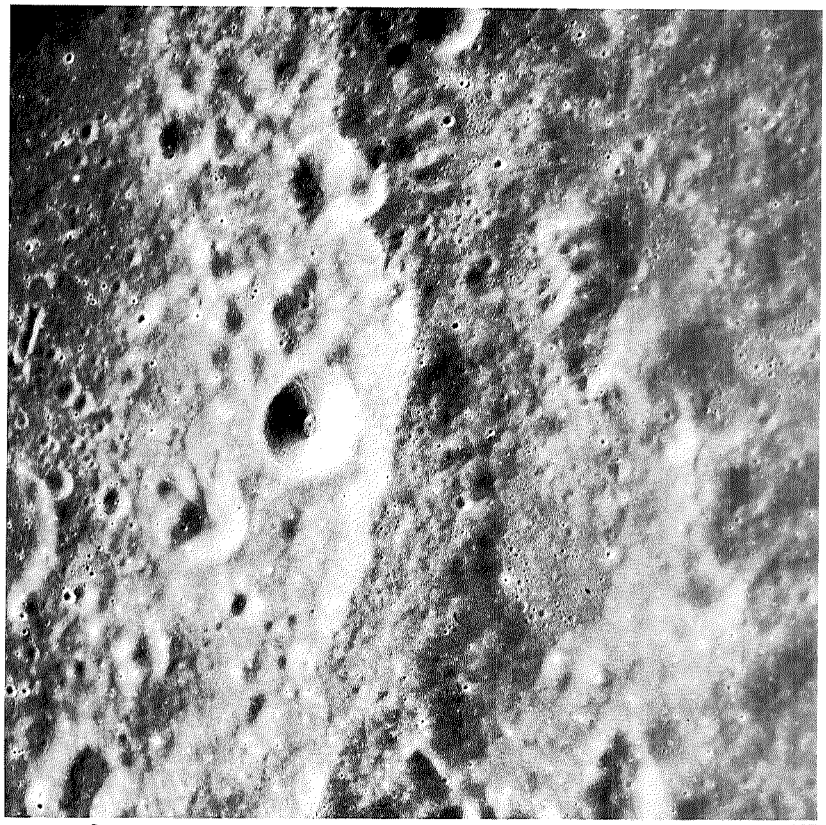
APOLLO 8 AS8-17-2673

This well-defined crater chain is located on the lunar far side. Much of the surface surrounding this crater chain seems heavily scarred and pockmarked, and linear gouges run diagonally across the area.

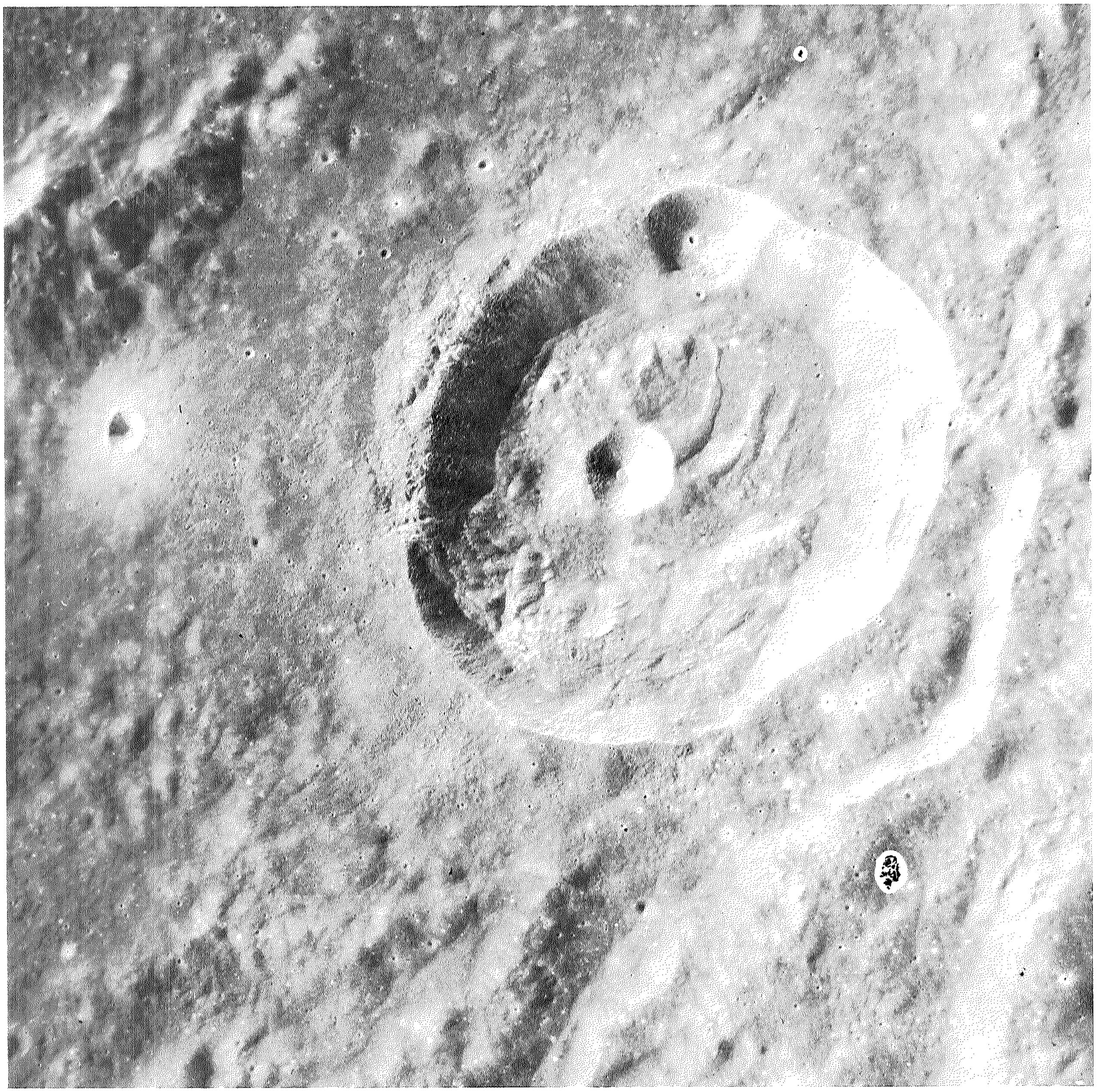
Top right: An interesting feature located near the center of this lunar far-side view is the large keyhole-shaped crater. This is a particularly rugged region with considerable relief and heavy cratering.

Right: The sharp line of demarcation just to the left of center in this view is the rim of a large, unnamed, far-side crater. The sloping crater wall appears to be very bright because the wall reflects more sunlight than the surrounding terrain.

APOLLO 8 AS8-17-2676



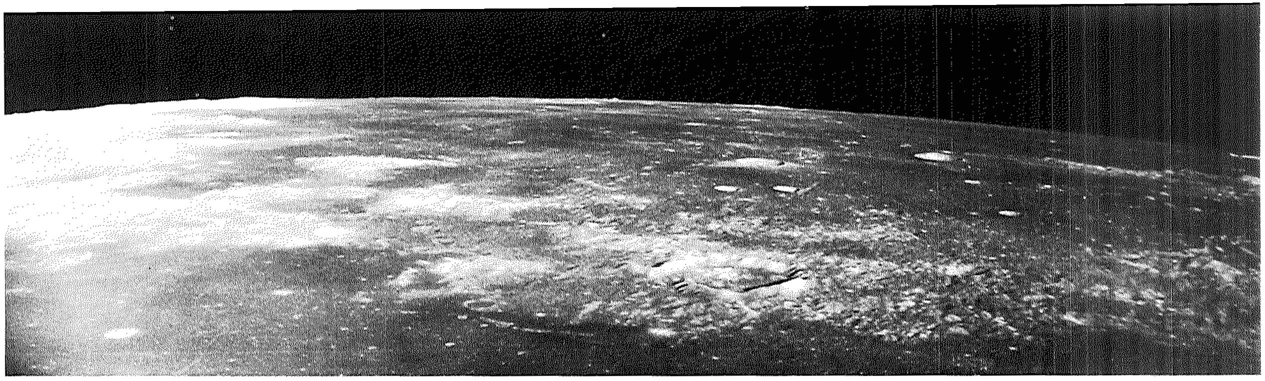
APOLLO 8 AS8-17-2697



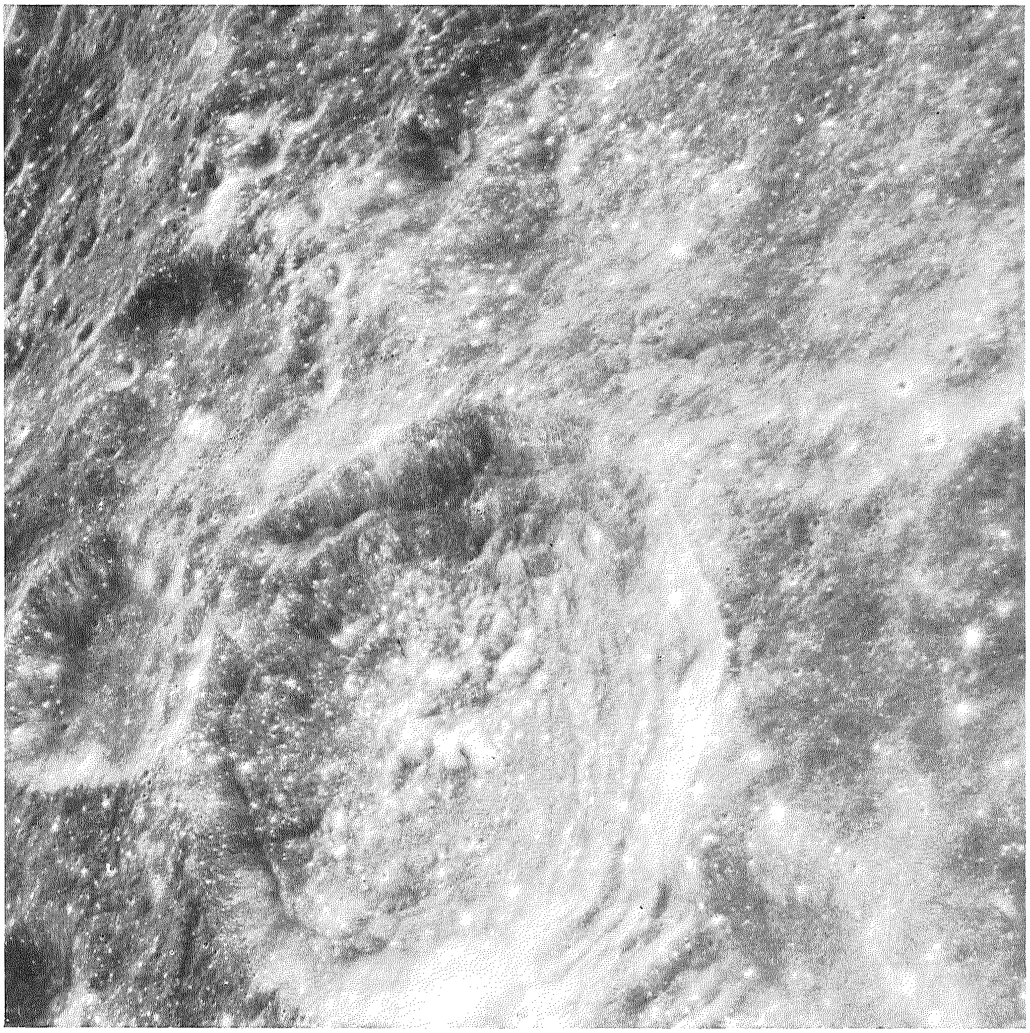
APOLLO 8

AS8-17-2704

The crater near the center of this view stands out sharply against the surrounding terrain. This is a crater within a much larger far-side crater. The central peak of the larger crater is seen near the small bright crater at the left, while a portion of the terraced walls that form the larger crater's boundary can be seen at the lower right.



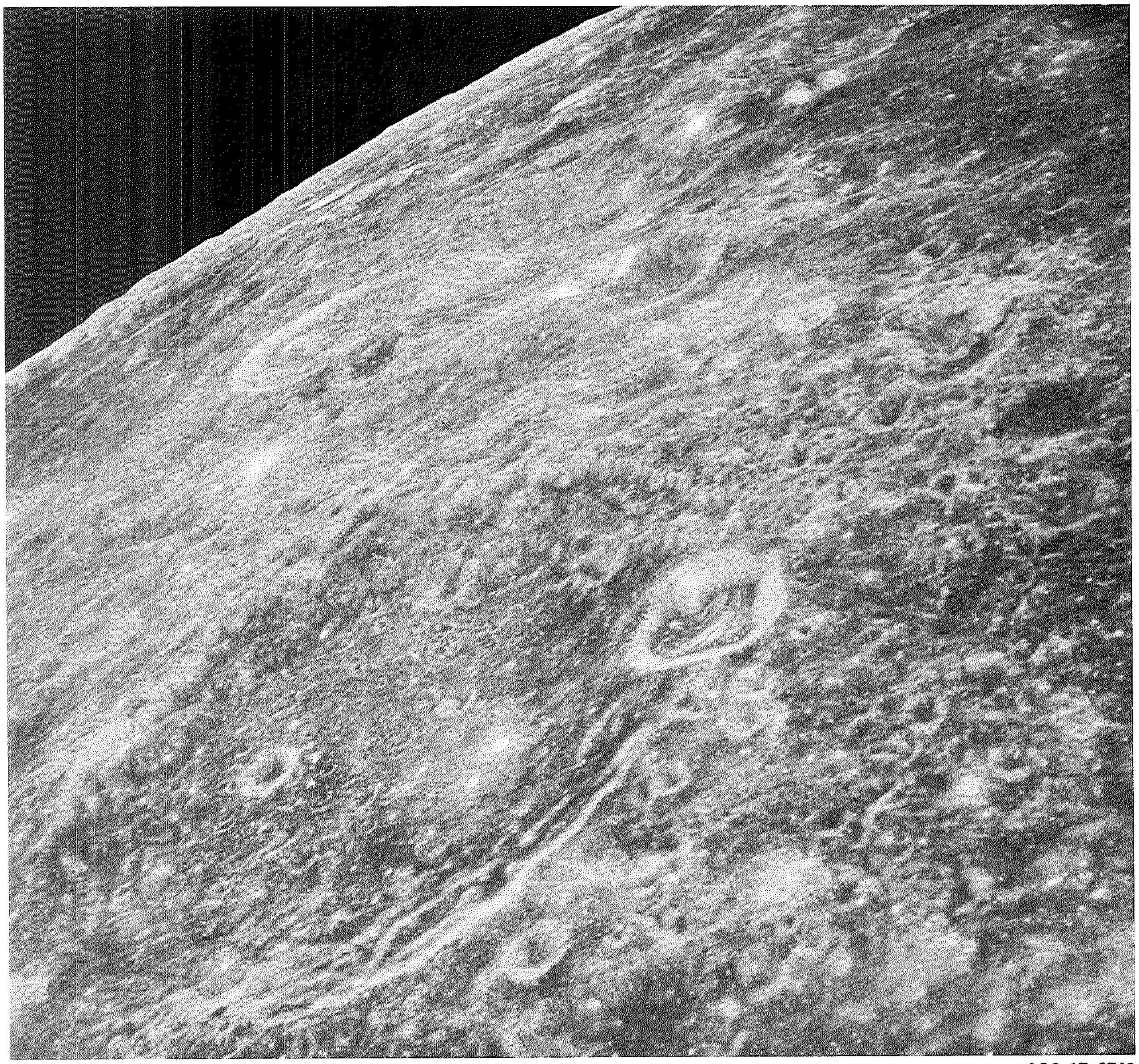
APOLLO 8 AS8-17-2814



APOLLO 8 AS8-17-2736

Top: This is a high-oblique westward view looking toward what would become Tranquility Base in Mare Tranquillitatis. The sea at the bottom of the picture is Mare Fecunditatis, and the sea extending to the horizon is Mare Tranquillitatis. The highland separating the two seas is the Secchi Peninsula.

Above: The large, unnamed, far-side crater at the lower center is approximately 30 miles in diameter. Terracing and a central peak, features common to other large craters of this type, are shown in the photograph. The mottled appearance of the surrounding area is produced by numerous small, bright, halo craters that stand out against the darker upland surface.



APOLLO 8 AS8–17–2748

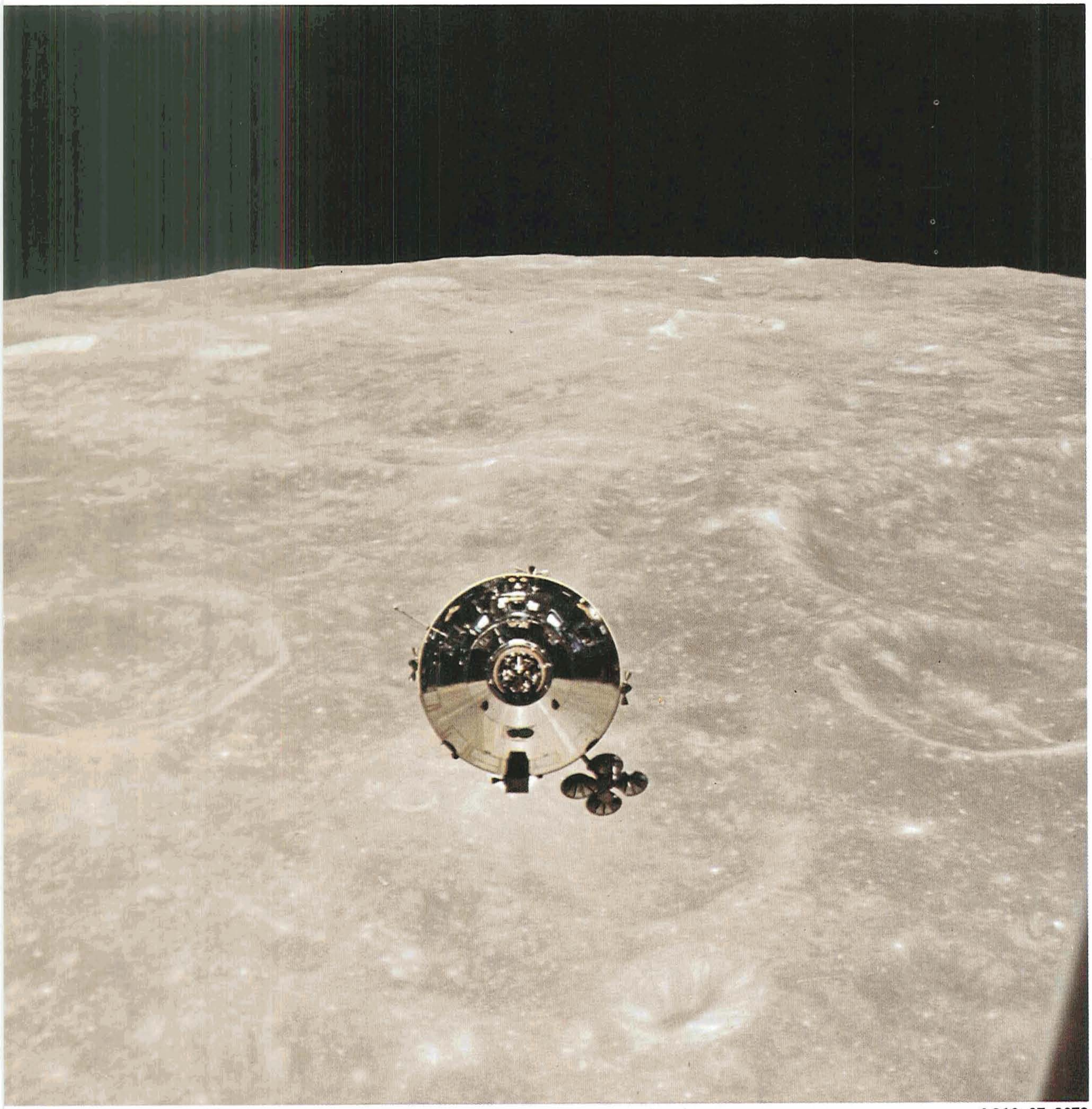
The large crater in the left-central foreground of this lunar far-side oblique photograph is approximately 60 miles in diameter. The relatively high Sun angle causes a large number of craters near the horizon to stand out as bright streaks or spots. The sharp relief of this region can be seen outlined against the black horizon.

APOLLO 8 AS8–17–2776

Above: A number of large craters are evident in this far-side view. The crater near the lower center is approximately 15 miles in diameter. A portion of a much larger, dark-appearing crater can be seen at the lower left.

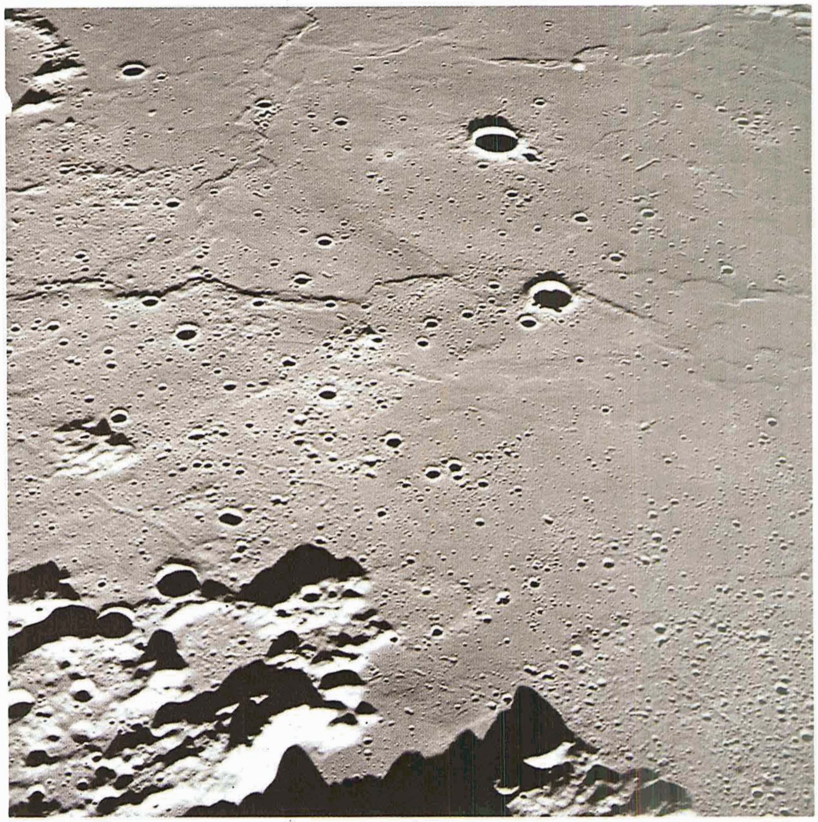
Right: This view is directly south of Mare Smythii. The crater at the top center is approximately 20 miles in diameter. The high Sun angle lends a luminescent quality to the outer walls of the larger craters. The lip on the side of the crater at the lower left is also of interest.

APOLLO 8 AS8–17–2785

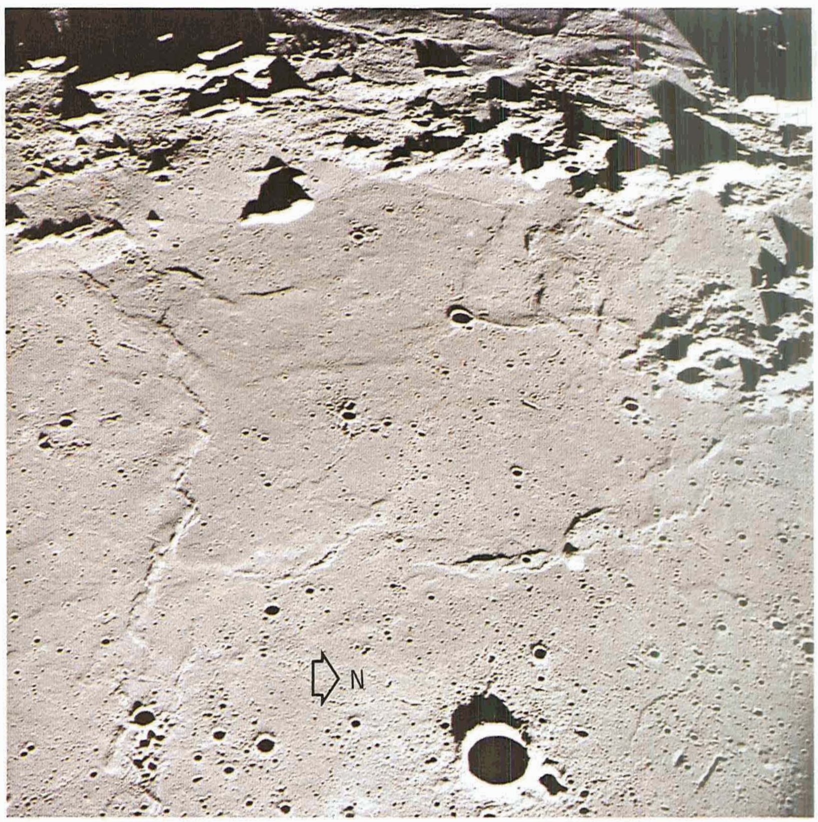


APOLLO 10 AS10-27-3873

This photograph was taken from the Apollo 10 lunar module, which was being inspected by the command module pilot. The lunar background in this view is a portion of the limb region east of Mare Smythii.



APOLLO 10 AS10-27-3905



APOLLO 10 AS10-27-3907

Top right: In this photograph of Sinus Medii (Central Bay), the two prominent craters are Bruce (American patron of the arts, 1816–1900) and Blagg (English selenographer, 1858–1944). Bruce (the crater at the top) is approximately 4 miles in diameter, and Blagg (just below Bruce) has a diameter of approximately 3 miles. The topography on the surface of Sinus Medii is accentuated by the low Sun elevation.

Right: Bruce is the prominent crater near the bottom. The low Sun elevation (ranging from nearly 6° in the east to less than 1° in the west) emphasizes the undulations occurring in an apparently smooth mare area.

APOLLO 10 AS10-28-4012

APOLLO 10 AS10-28-4013

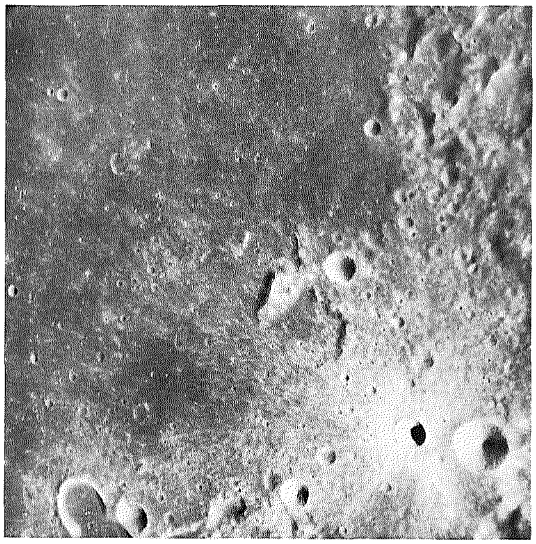
Top left: This unnamed far-side crater, approximately 26 miles in diameter, shows terracing on its inner walls. It also has an unusual break (at the right rear) in the outer rim. The peculiar shade variations and black spots are, at present, unexplained.

Left: The diameter of this far-side crater is approximately 15 miles. While the crater appears like many others of this size and age, the surrounding terrain appears quite wrinkled. Under the high Sun elevation, numerous small craters appear as pinpoints of light.

APOLLO 10 AS10-28-4035

Left: This view of the south-central portion of Mare Tranquillitatis illustrates the differences in the character of the mare and the highland regions. (Compared with the highland areas, the mare appears quite smooth.) The small, clearly defined crater at left center is Maskelyne T, which is approximately 4 miles in diameter.

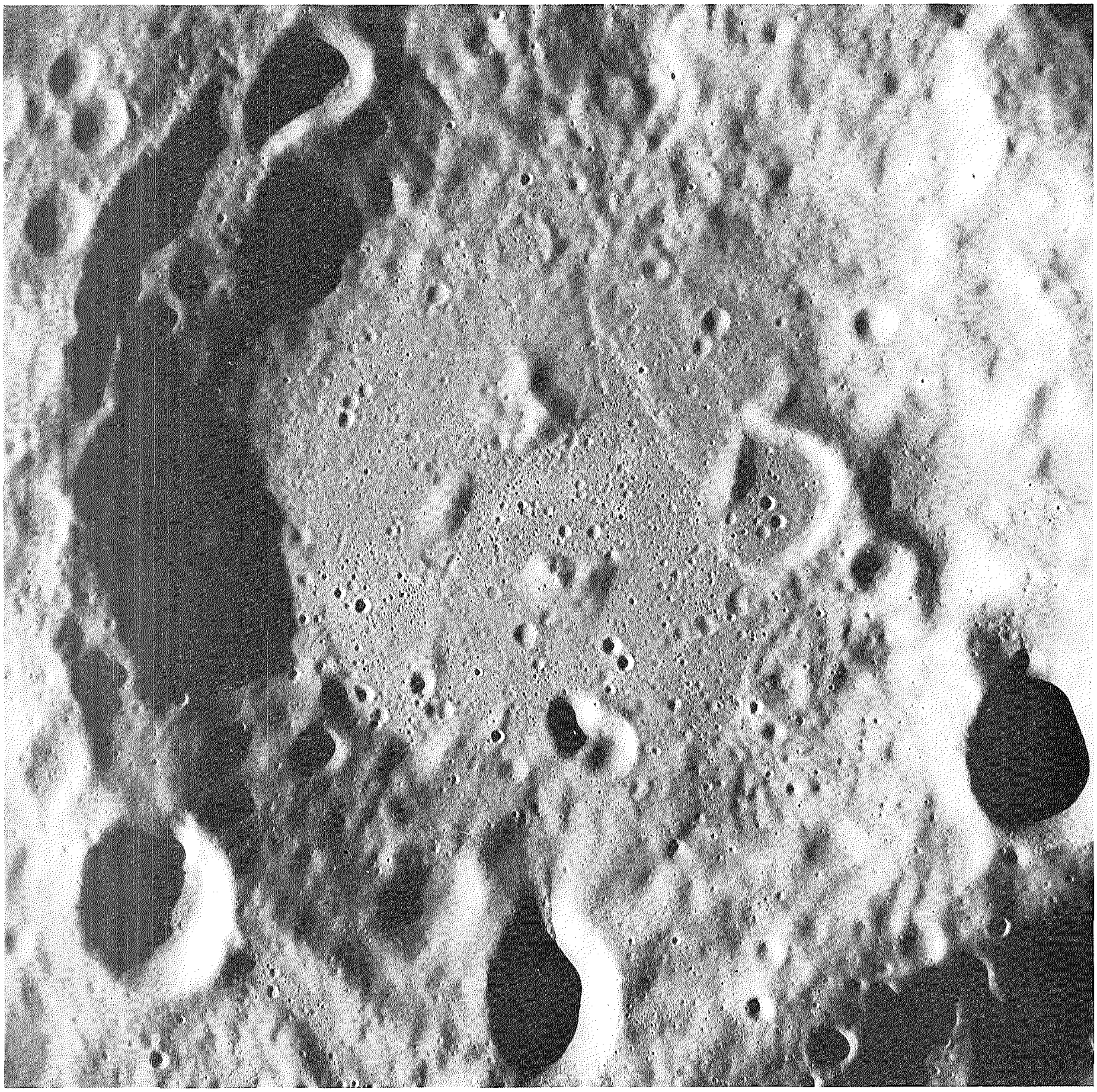
Below: This is a high-oblique view, looking east across Mare Tranquillitatis. The landing site for Apollo 11 is near the bottom center of the picture. The crater in the lower right is Moltke (Prussian general, 1800–1891). The large crater at the upper left is Maskelyne.



APOLLO 10 AS10-28-4040

Above: This near-vertical view was taken over the southern edge of Mare Tranquillitatis. The small bright-rayed crater at the bottom right corner is Censorinus (Roman grammarian and mathematician, *ca.* A.D. 238). The larger crater on the right side of Censorinus is Censorinus A. The diameter of Censorinus is approximately 5 statute miles. Even at a medium Sun elevation, the ray structure associated with Censorinus is quite apparent.

APOLLO 10 AS10-28-4052

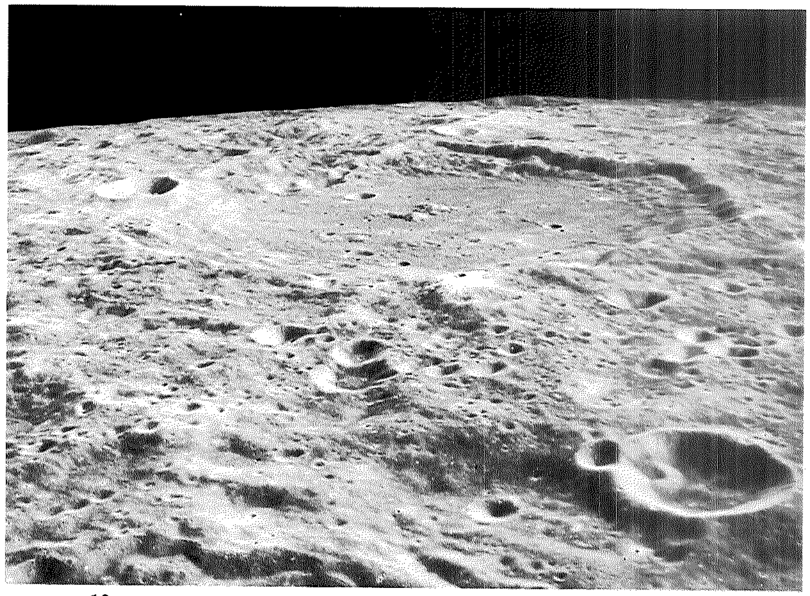


APOLLO 10 AS10-28-4067

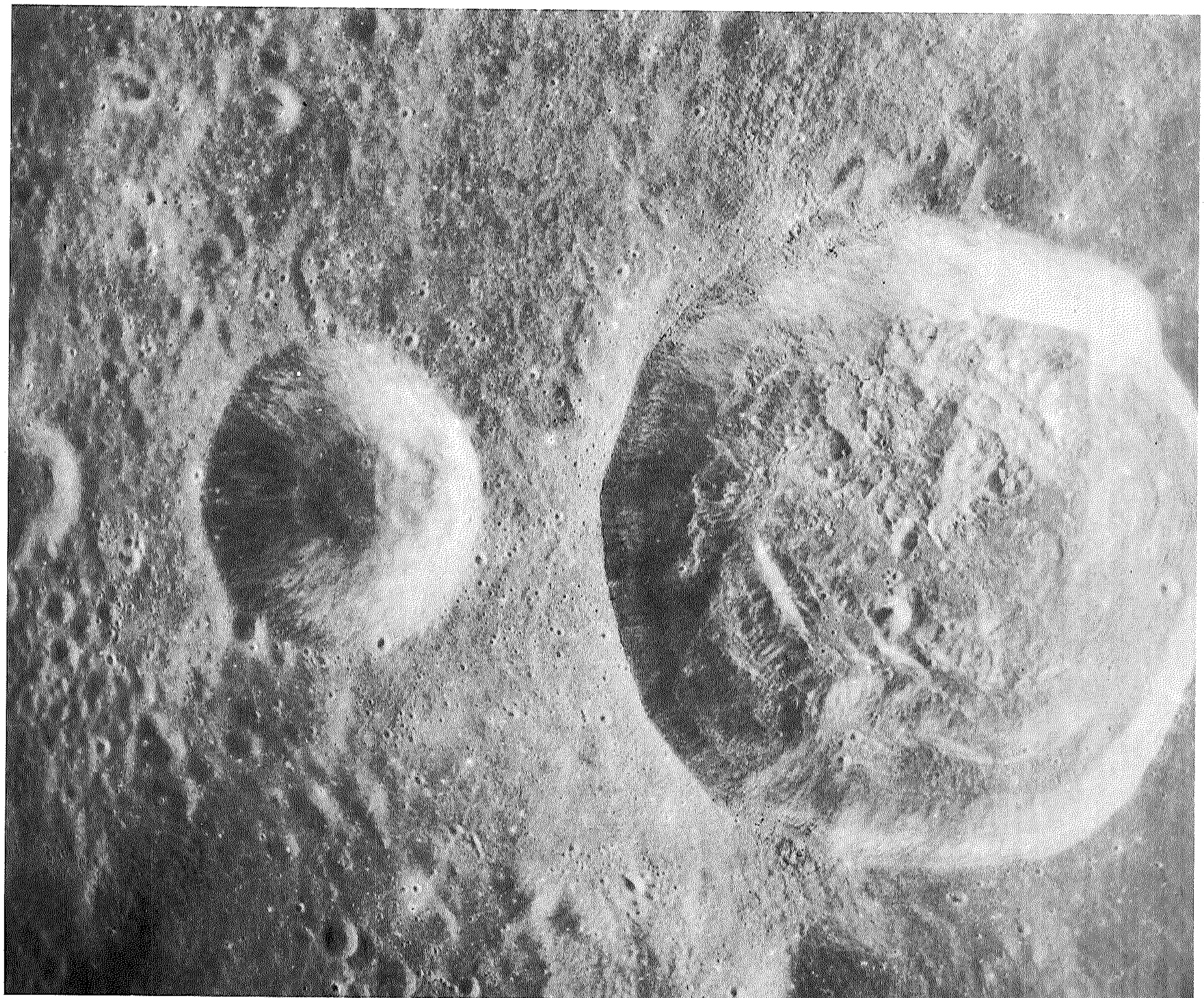
This large far-side crater is approximately 40 miles in diameter. The three smaller craters symmetrically situated on the lower third of the rim are of interest. The texture of the crater walls is readily seen because of the low Sun angle.

Right: The large unnamed crater at the center of this far-side oblique photograph is approximately 100 miles in diameter. The rough terrain in this region results from heavy cratering. A bright-rayed crater can be seen on the south-central rim of the large crater.

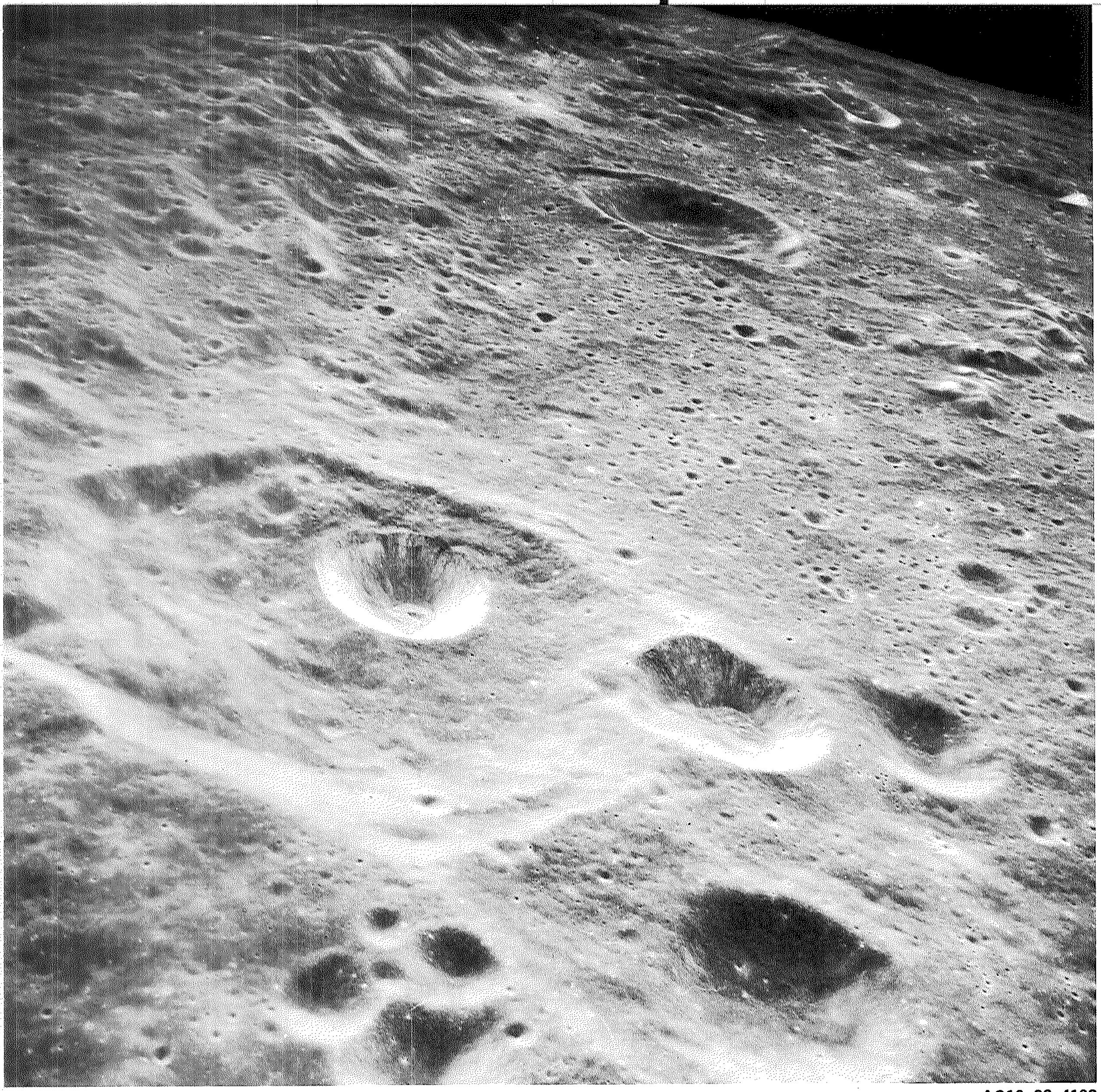
Below: The unusual alinement of these three far-side craters made them especially useful as landmark identification points. The large crater at the right, which is approximately 25 miles in diameter, has a rough floor and considerable terracing, but the crater has no well-defined central peak.



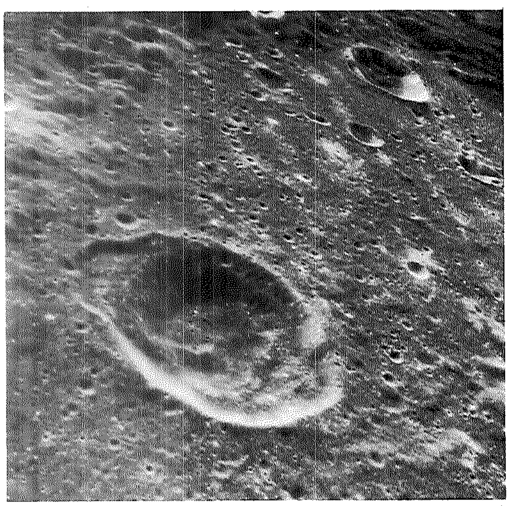
APOLLO 10 AS10-29-4180



APOLLO 10 AS10-28-4106



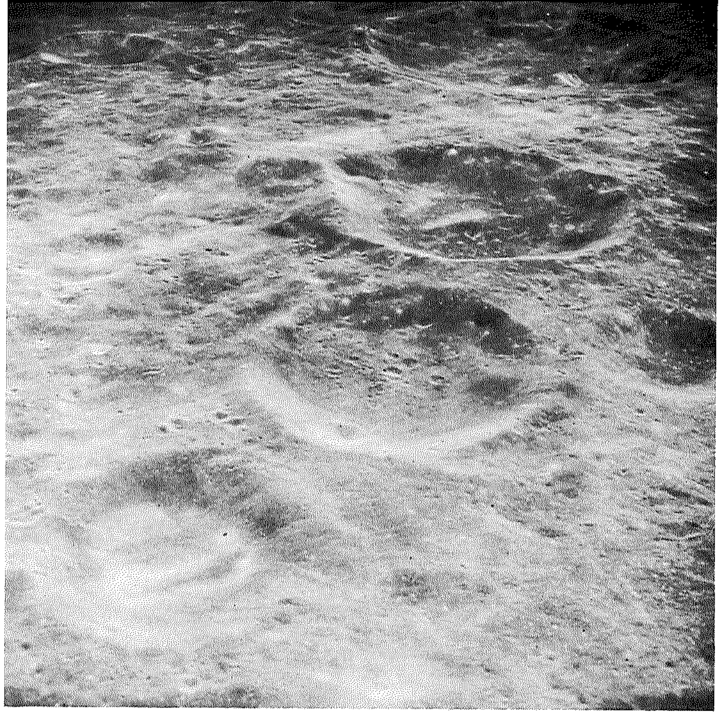
APOLLO 10 AS10–29–4183



APOLLO 10 AS10–29–4189

Above: The rectilinear appearance presented by the large crater in this far-side oblique view is unusual. From the smooth appearance, this crater appears to be much older than the bright, sharply defined crater near its center. A series of hummocky protuberances, located to the right of the large crater at rear center, can also be seen.

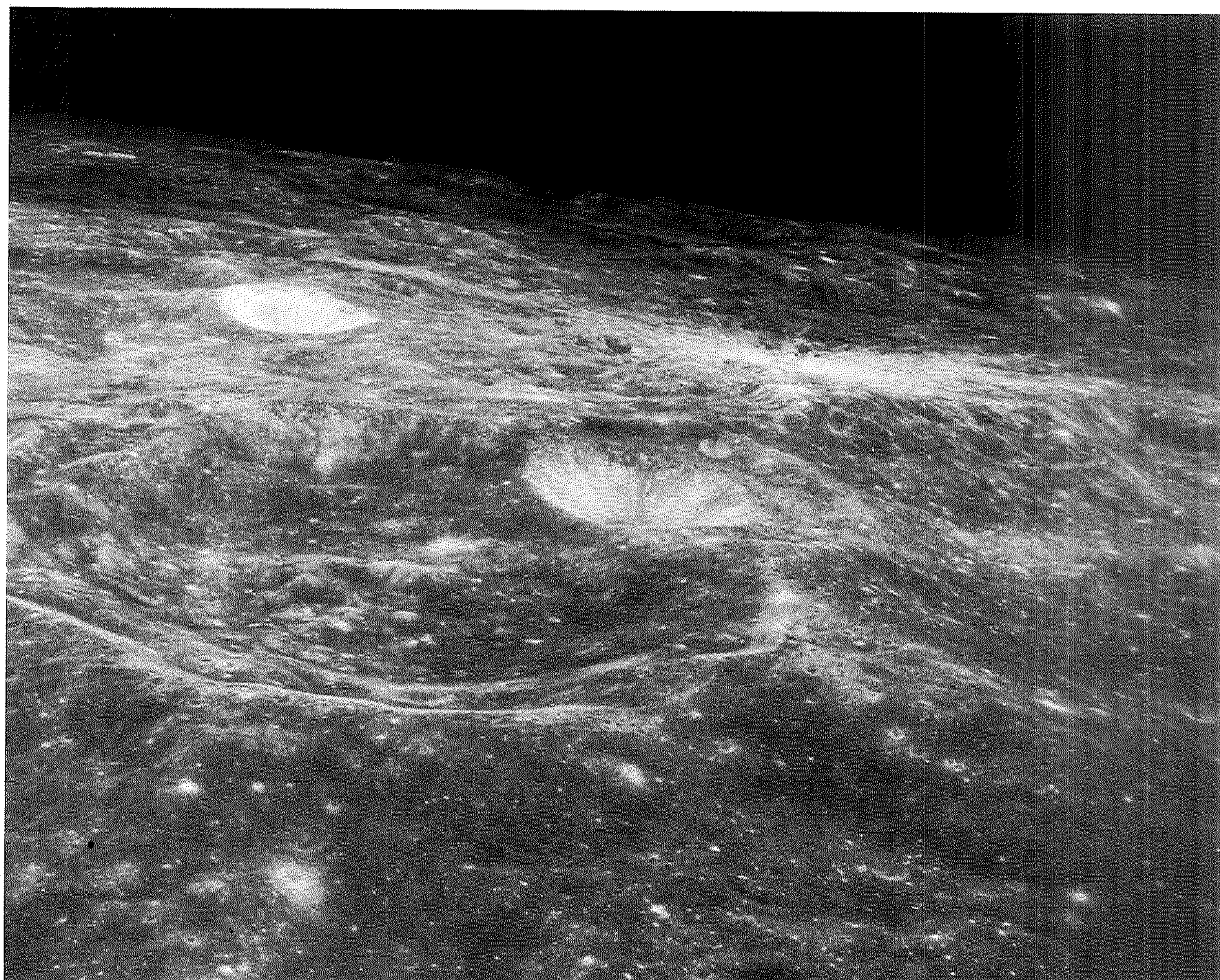
Left: This crater (visible at a distance in the preceding photograph) is approximately 20 miles in diameter. Close inspection of the crater shows a distorted lip on the left side. Terracing is also quite evident in this feature. The crater is located on the edge of a far-side unnamed basin, and the rugged terrain (generally associated with highland regions) can be seen at the left and top of this view.



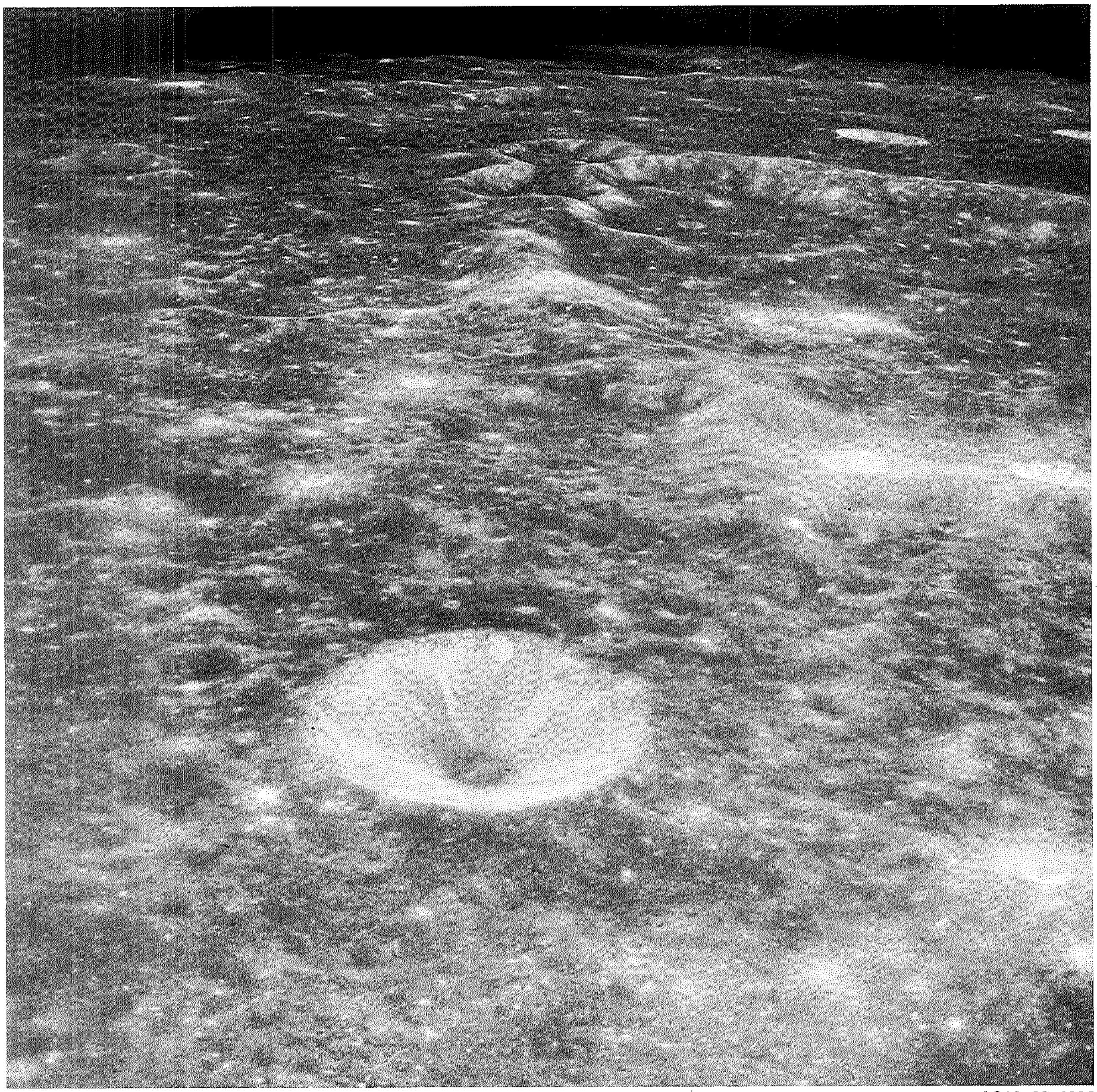
APOLLO 10 AS10-29-4205

Left: The unnamed far-side craters in this rather unusual grouping are from approximately 20 to 35 miles in diameter. A small distinctive crater is shown at the lower right edge of the crater at the top.

Below: A large, unnamed, far-side crater with a smaller crater on its outer rim is shown in the foreground of this oblique photograph. A small bright crater (left center) and a recently formed crater with a distinctive ray pattern (right center) can be seen.



APOLLO 10 AS10-29-4224

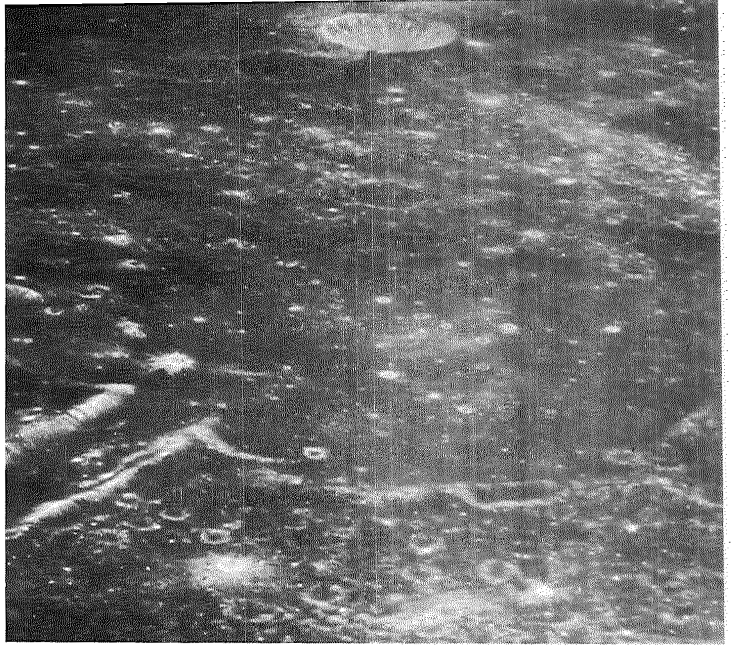


APOLLO 10 AS10-29-4226

This far-side oblique view shows the eastern edge of Mare Smythii (the dark area at the central horizon). A large bright crater is predominant in the foreground, and a mountainous ridge isolates a basin from the surrounding terrain at right center. Numerous small, bright-rayed craters also can be seen in this region.

Right: This low-oblique view is of a small area located within Mare Smythii. The area shows several unusual features. The large trenchlike feature at the left extends from a multiple-ringed structure, which lies out of view, into a basinlike area at center. Numerous bright-rayed craters and craterlets can be seen in both the basin and in the highland areas. A large crater is visible at top center.

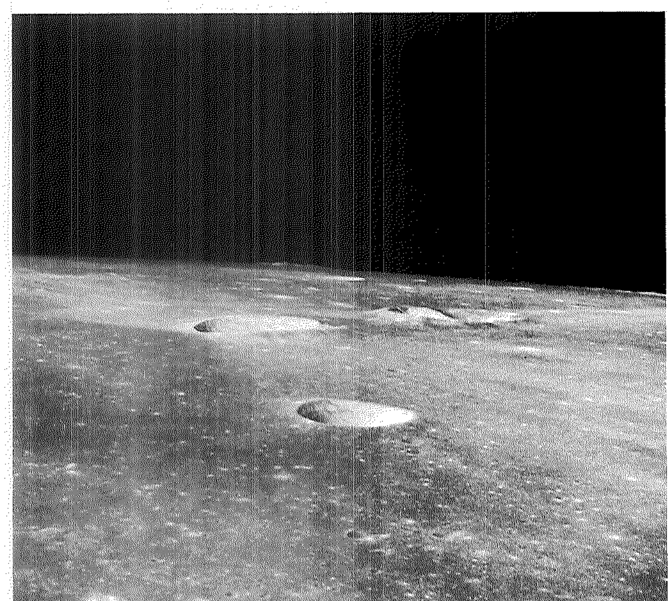
Below: In this view of Mare Smythii, the high Sun elevation provides a sharp contrast between prominent features and their surrounding background. A sinuous rille, winding across the center of the region, can be seen clearly. At right center, a large bright crater can be seen, and small ray craters are scattered throughout the area.



APOLLO 10 AS10-33-4999

APOLLO 10 AS10-29-4230

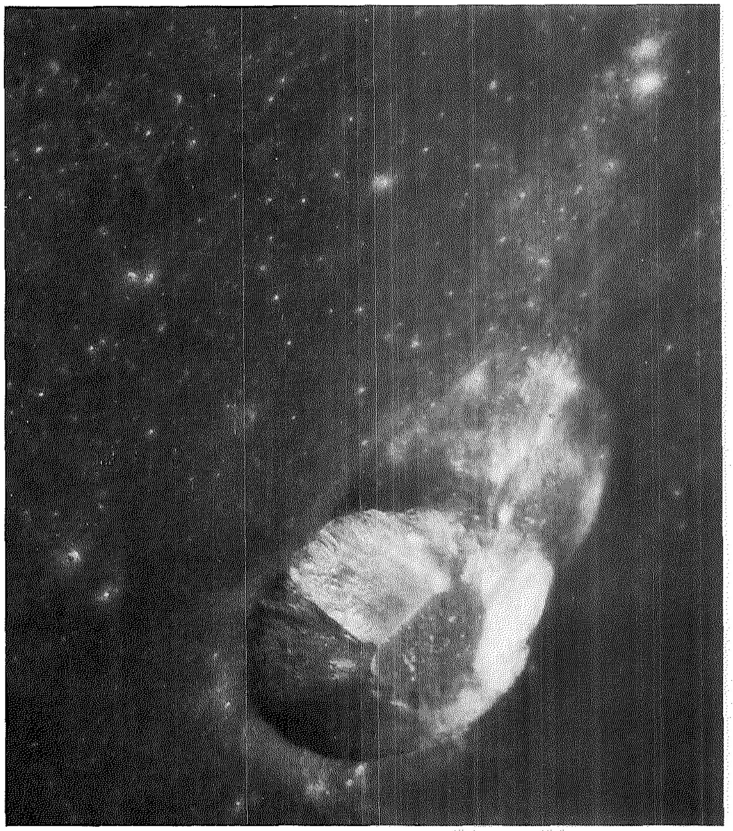
APOLLO 10 AS10–29–4253



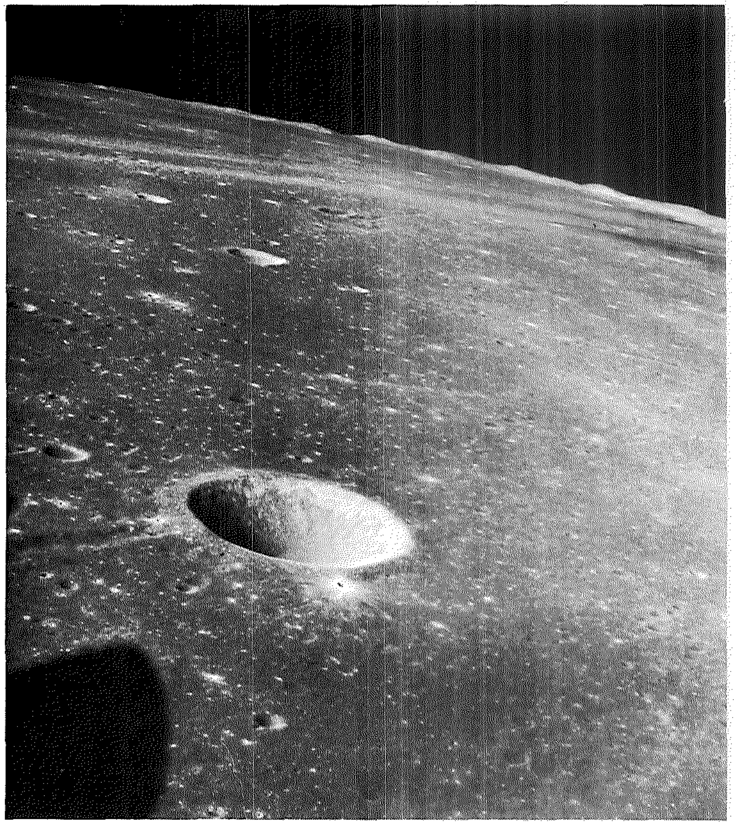
Above: This oblique photograph provides a closeup view of Messier B (French astronomer, 1730–1817), a small lunar crater shown at center. The shadowed portion of the crater shows that the steep interior walls are subject to considerable tonal variations, because of differences in reflected light. It can also be seen that the crater has outer walls that slope off gently into the surrounding mare.

Left: In this low-altitude, oblique photograph, the three predominant craters are Messier at left center, Messier A just to the right of Messier, and Messier B in the foreground. These relatively small craters range from 4 to 8 miles in diameter. Topographically higher features on the horizon are contrasted against the black sky.

APOLLO 10 AS10–29–4256



APOLLO 11 AS11-38-5602



Top right: This unique double crater is Messier A. There is an apparent break in the common wall between the older crater toward the top and the more recently formed crater in the foreground.

Right: This is a view of Secchi K, which is approximately 5 miles in diameter and is located in Mare Fecunditatis. A small bright-rayed crater can be seen at the bottom edge of Secchi K. The highland regions that mark the boundary of the mare are seen on the horizon. At the lower left is the shadow of a thrustor nozzle of the lunar module.

APOLLO 10 AS10-29-4261

APOLLO 10

AS10-29-4265

The bright crater at the top right in this oblique photograph is Secchi UA, which is located in the western portion of Mare Fecunditatis. The bright highlands can be readily distinguished from the darker mare. A broad rille to the right of center runs linearly across the area.

APOLLO 10 AS10-29-4276

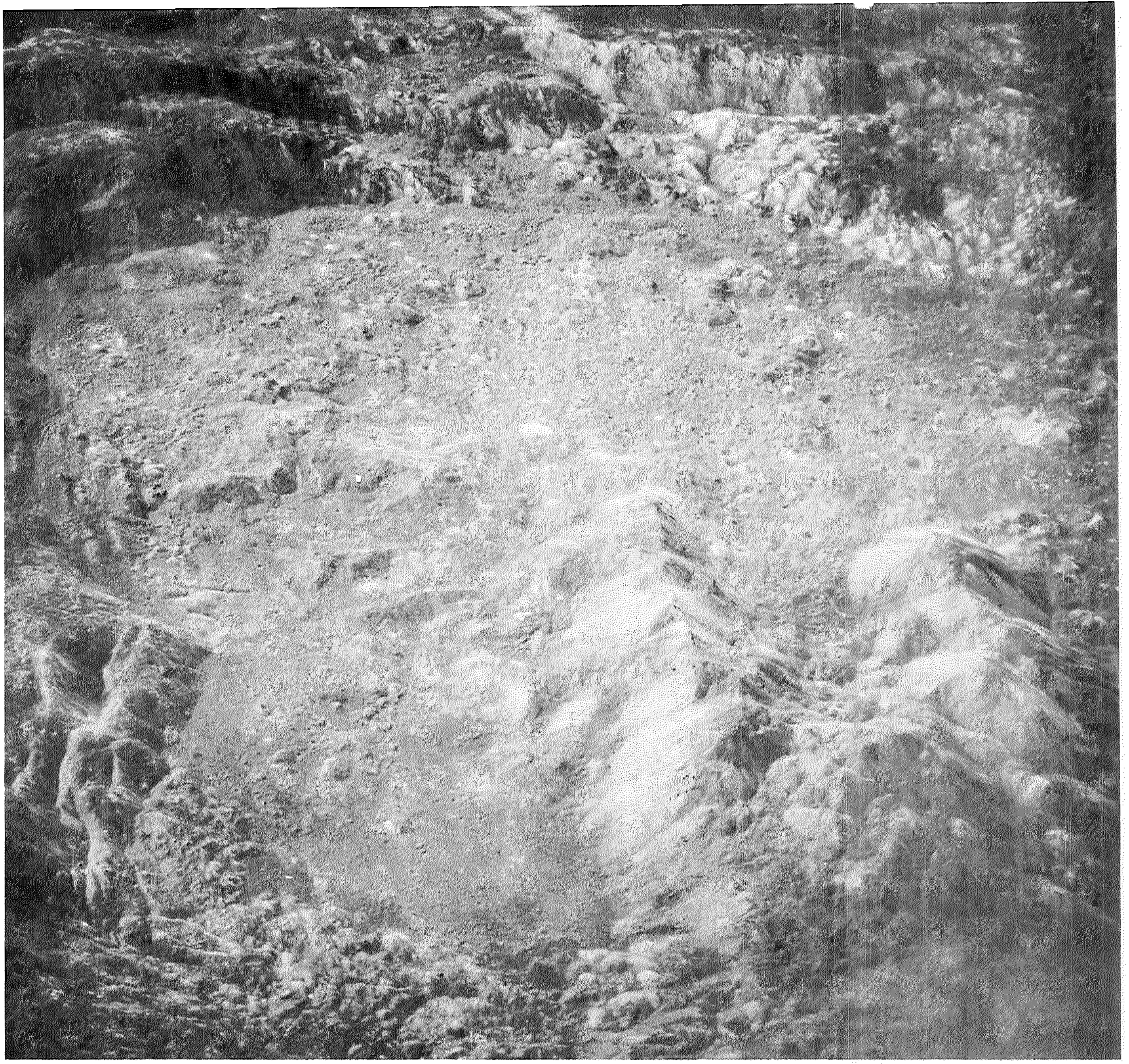
This low-oblique photograph was taken from the Apollo 10 lunar module during the descent approach to the Apollo 11 lunar landing site in Mare Tranquillitatis. The elongated hill in the center of the photograph is near Secchi B and is approximately 780 m above the surrounding mare floor. The shadowed hill at lower left provides an indication of the texture of these mare hills.

APOLLO 10 AS10-29-4312

Left: The roughness of Mare Tranquillitatis is apparent in this low-altitude oblique photograph taken from the lunar module during the descent approach to the Apollo 11 lunar landing site. A ridge runs diagonally from left to right across the center of the photograph. The large bright crater at upper left is Moltke.

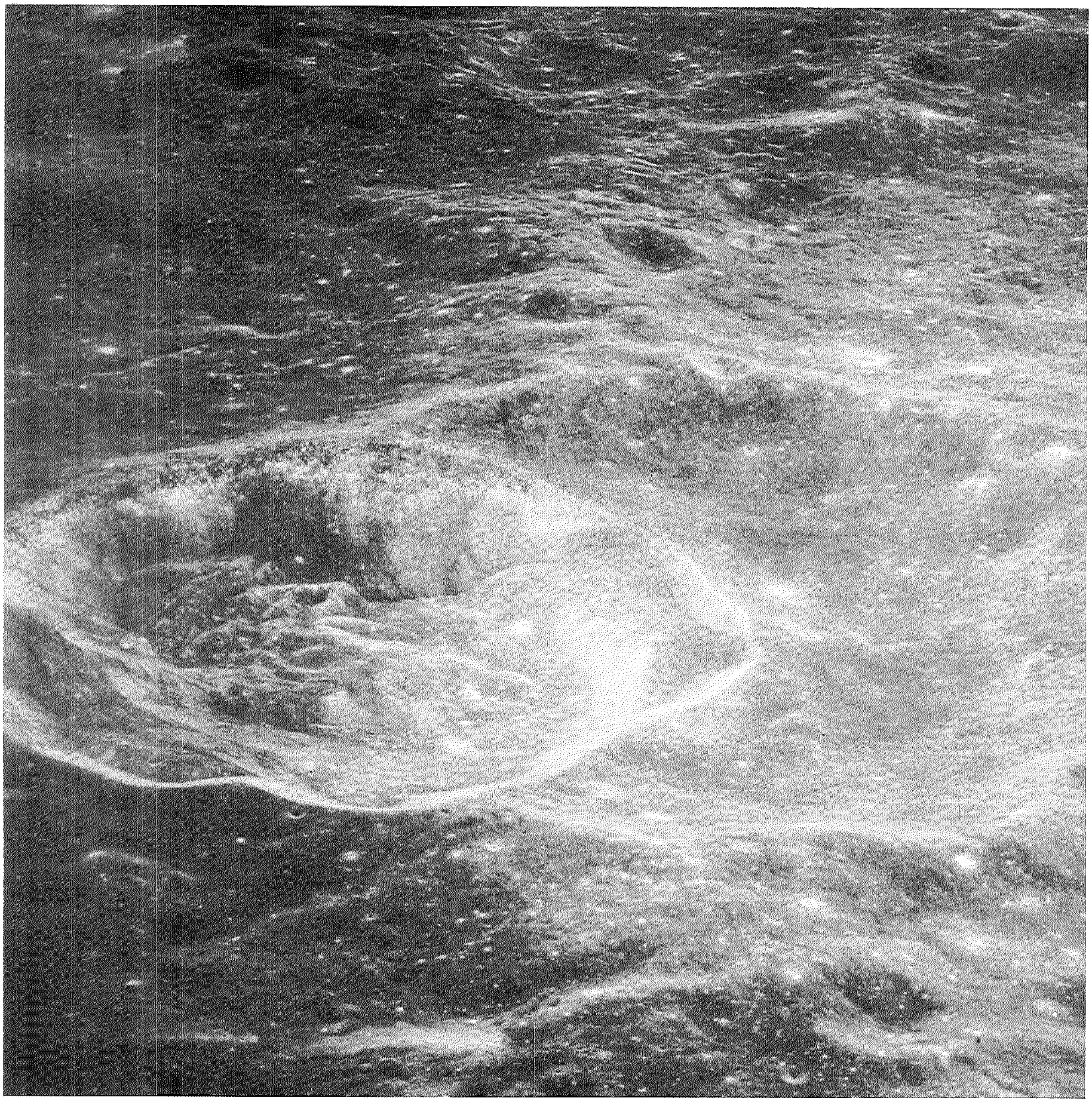
Below: The large crater in the center of this low-altitude oblique photograph is Moltke. Considerable debris can be seen on the slopes of the outer crater walls. The area surrounding Moltke is mottled and rough compared to the mare background. Directly behind Moltke and running linearly across the area is a trough, Rima Hypatia II (Egyptian mathematician, died A.D. 415); behind Rima Hypatia II, the highland regions mark the southwestern edge of Mare Tranquillitatis.

APOLLO 10 AS10-29-4324



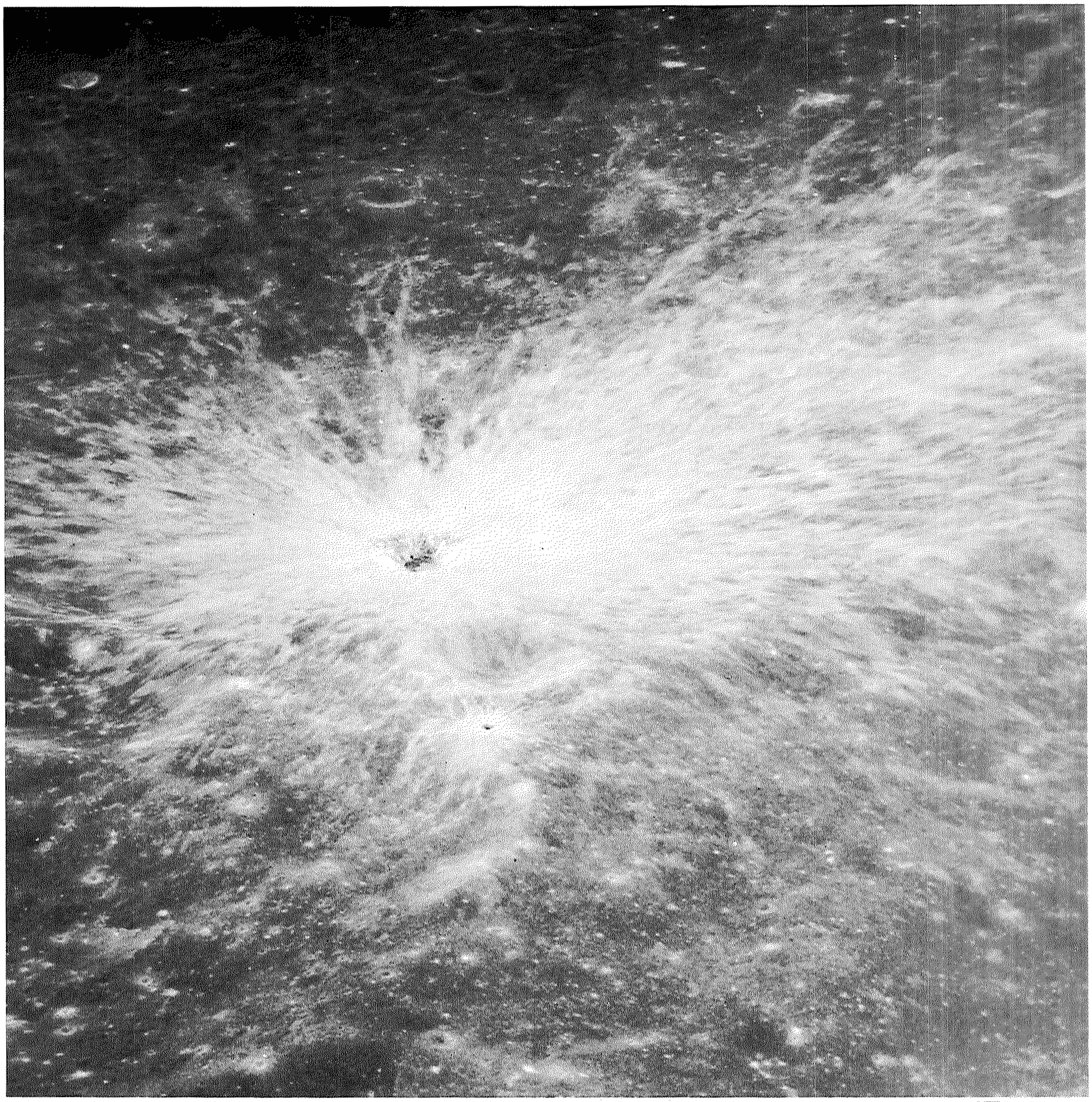
APOLLO 10 AS10–30–4356

This low-altitude oblique photograph of the central portion of a 50-mile-diameter far-side crater provides a closeup view of the interior structure of such craters. The prominent mountainous formation at right center is the central peak of the crater. The crater floor is heavily pockmarked and contains many hummocky protuberances near the top center. To the left, terracing of the inner crater walls is evident.



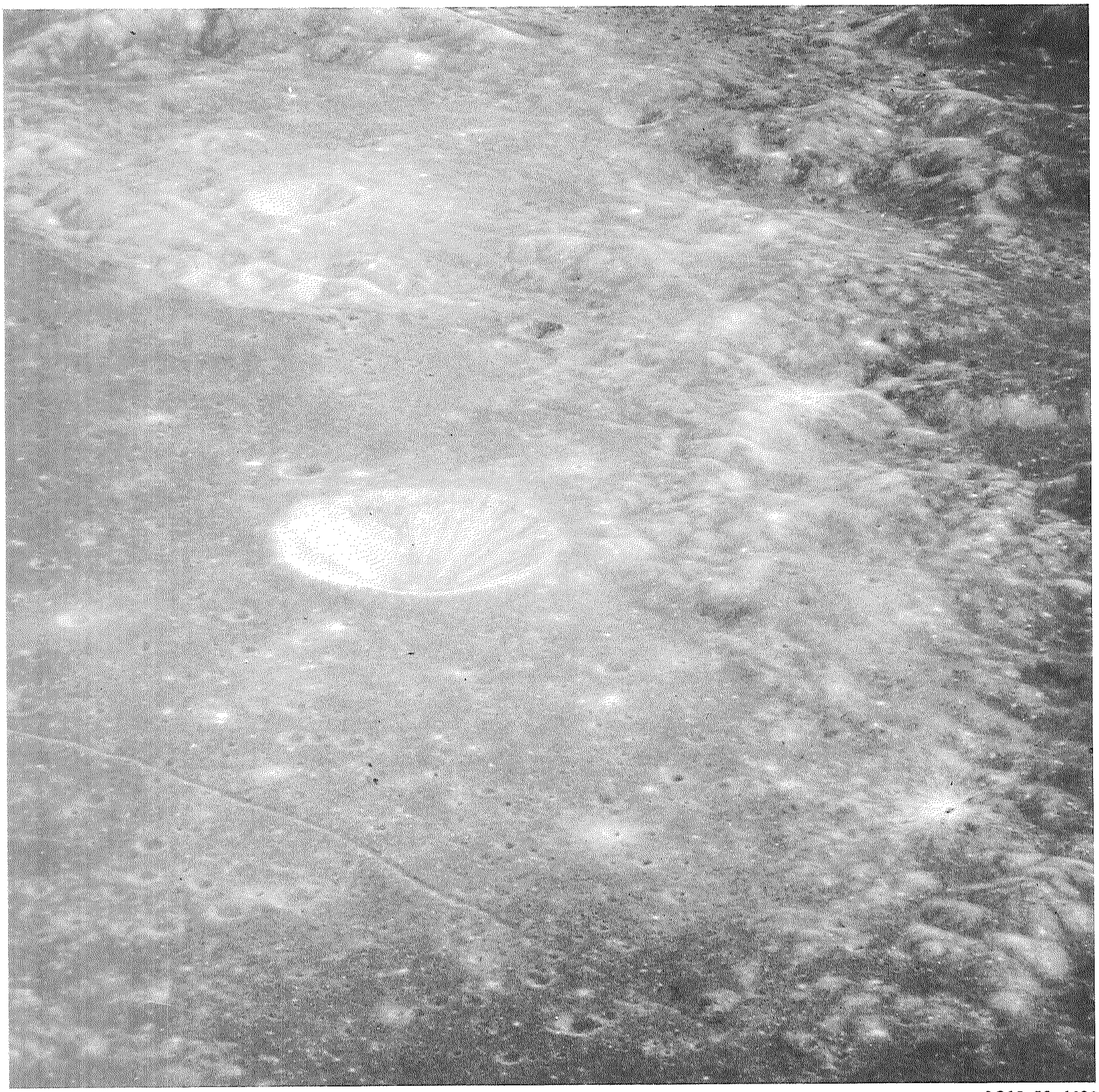
APOLLO 10 AS10-30-4371

In this view of a far-side double crater, the smaller crater gives the appearance of having been scalloped out of the lunar surface. The larger, older crater appears worn in comparison and does not display the sharp terracing of the smaller crater. The terrain in the background appears wrinkled under the relatively high Sun elevation.



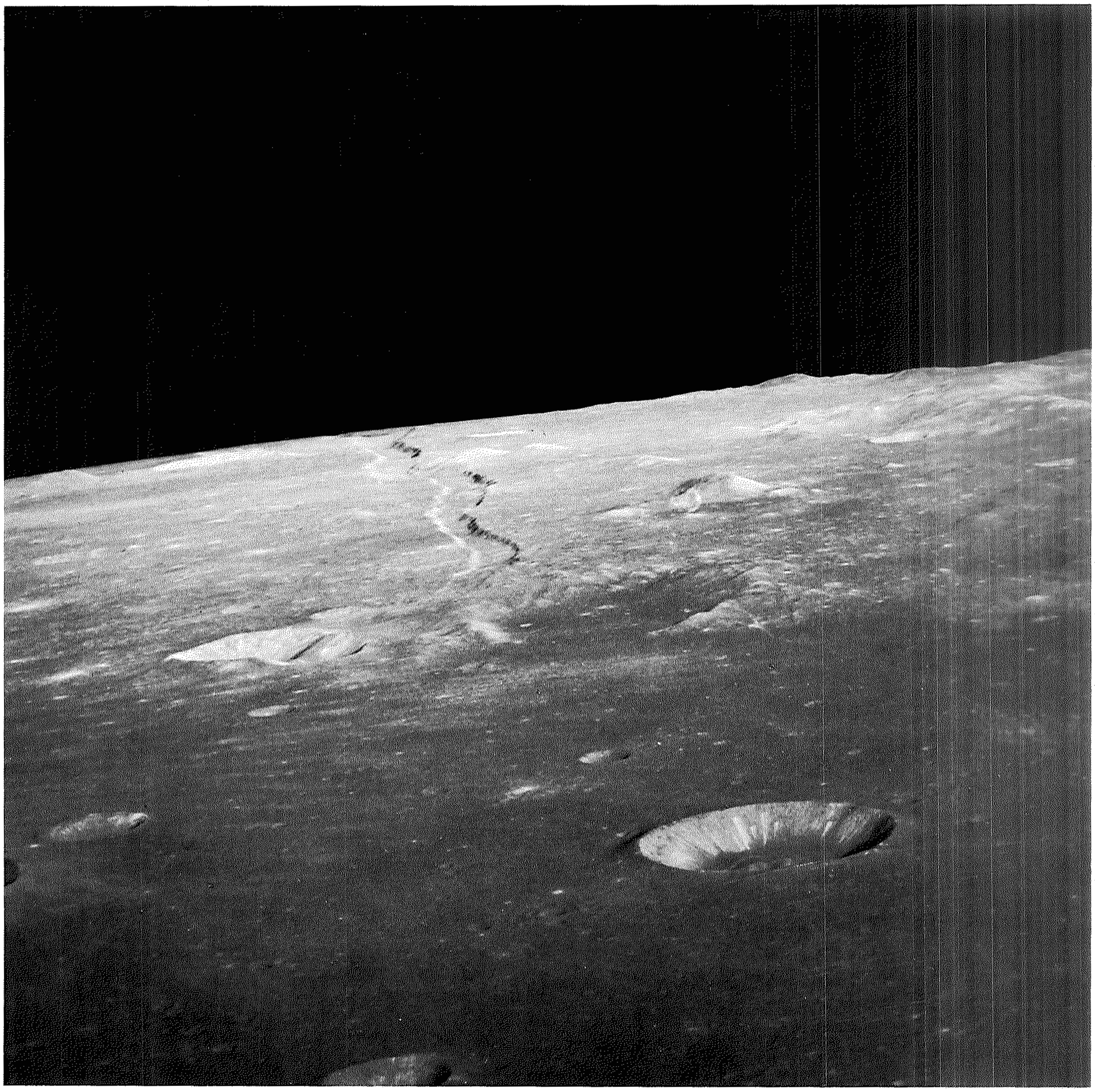
APOLLO 10 AS10-30-4372

The large, brilliant ray structure of this relatively small far-side crater implies that the crater is of fairly recent origin. It is thought that rays such as these are formed by material ejected when a meteorite impact forms a crater and that the material ejected has not yet been subjected to the effects of solar erosion and darkening.



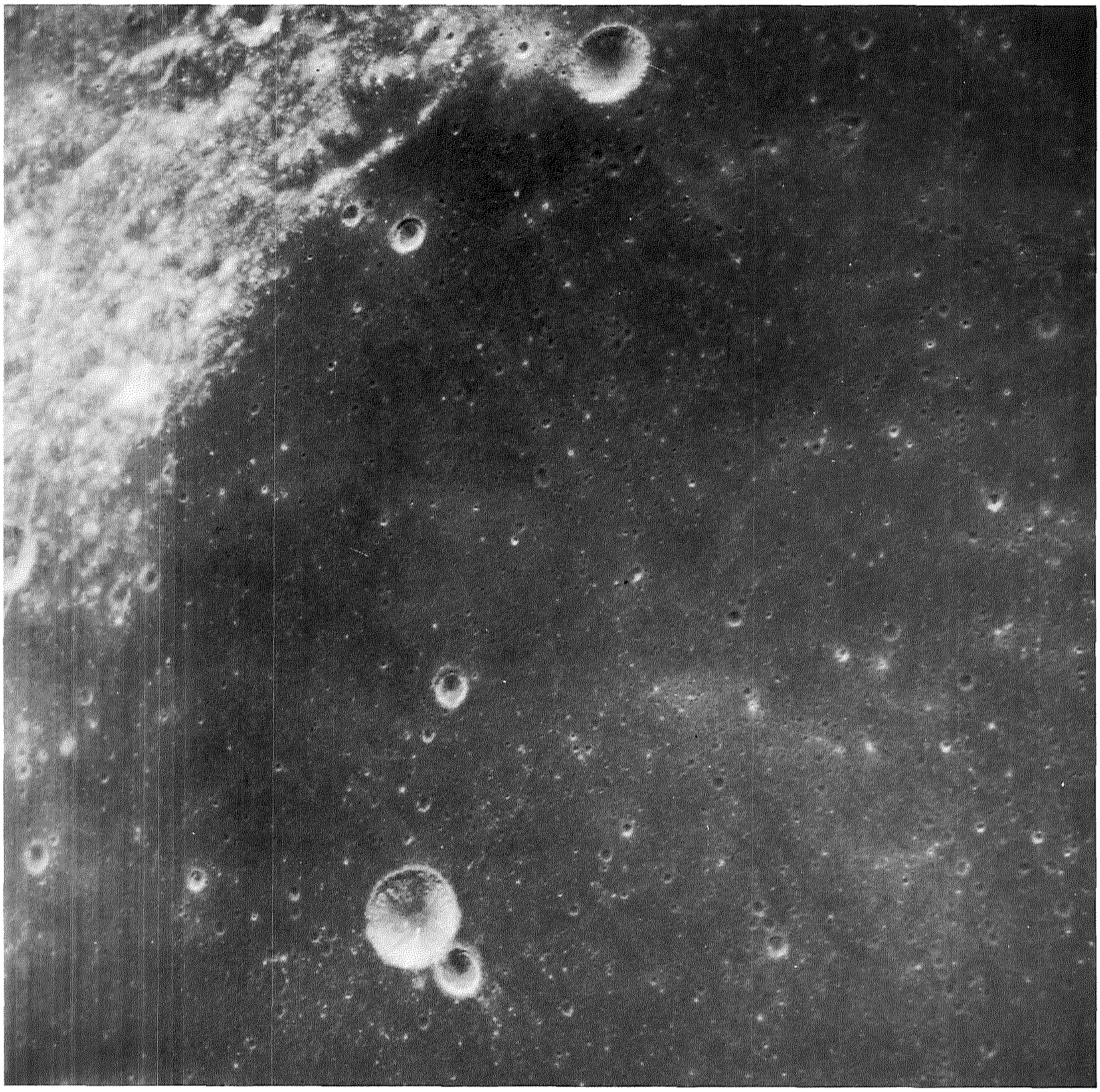
APOLLO 10 AS10-30-4426

Taruntius A, the crater in the center of the photograph, is approximately 10 miles in diameter and is located in the northern portion of Mare Fecunditatis. Near the edge of the mare, a linear rille and a small bright-rayed crater (lower right) can be seen.



APOLLO 10 AS10-30-4450

The large crater in the foreground is Manners (English naval officer, 1800–1870), and the smaller one at bottom center is Arago B (French astronomer, 1786–1853). The double crater Ariadaeus (Macedonian king, died 317 B.C.) and Ariadaeus A are at the terminus of the sinuous Rima Ariadaeus (Ariadaeus Rille) in the center background. Note how the rille in the vicinity of the double crater Ariadaeus appears to be partially filled in.

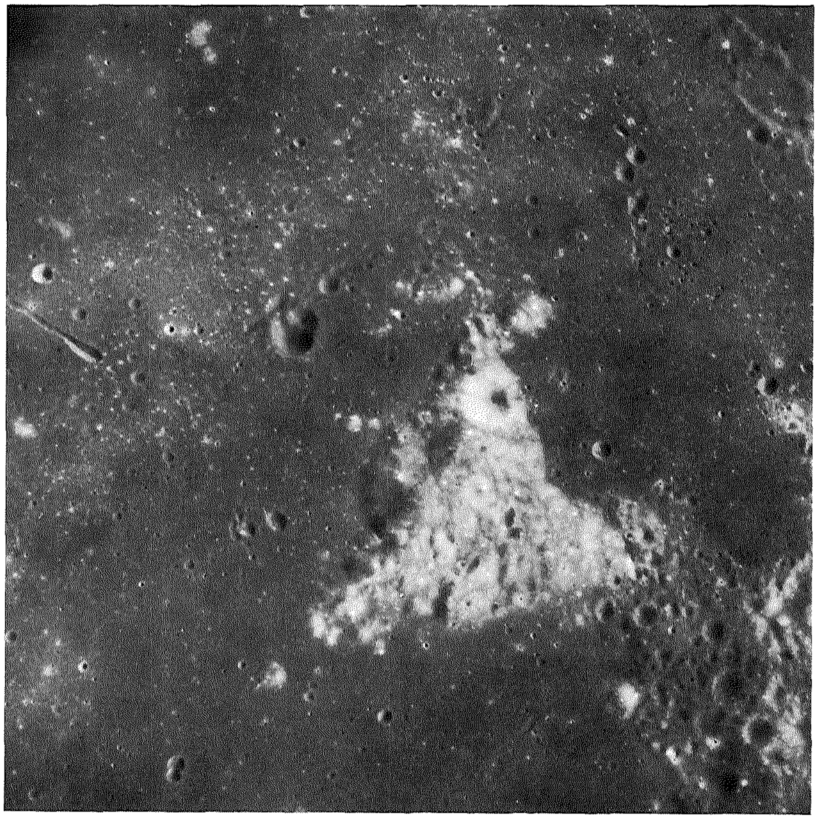


APOLLO 10 AS10–31–4506

Above: This is a near-vertical view of a northern portion of Mare Fecunditatis. The highlands at the upper left are part of the rugged terrain that separates Mare Fecunditatis from Mare Crisium.

Right: The crater at right center, Taruntius G, is approximately 5 miles in diameter and is located in the northern portion of Mare Fecunditatis. The roughness of the mare is evident by the presence of numerous wrinkle ridges and small rilles running diagonally across the area.

APOLLO 10 AS10–31–4512

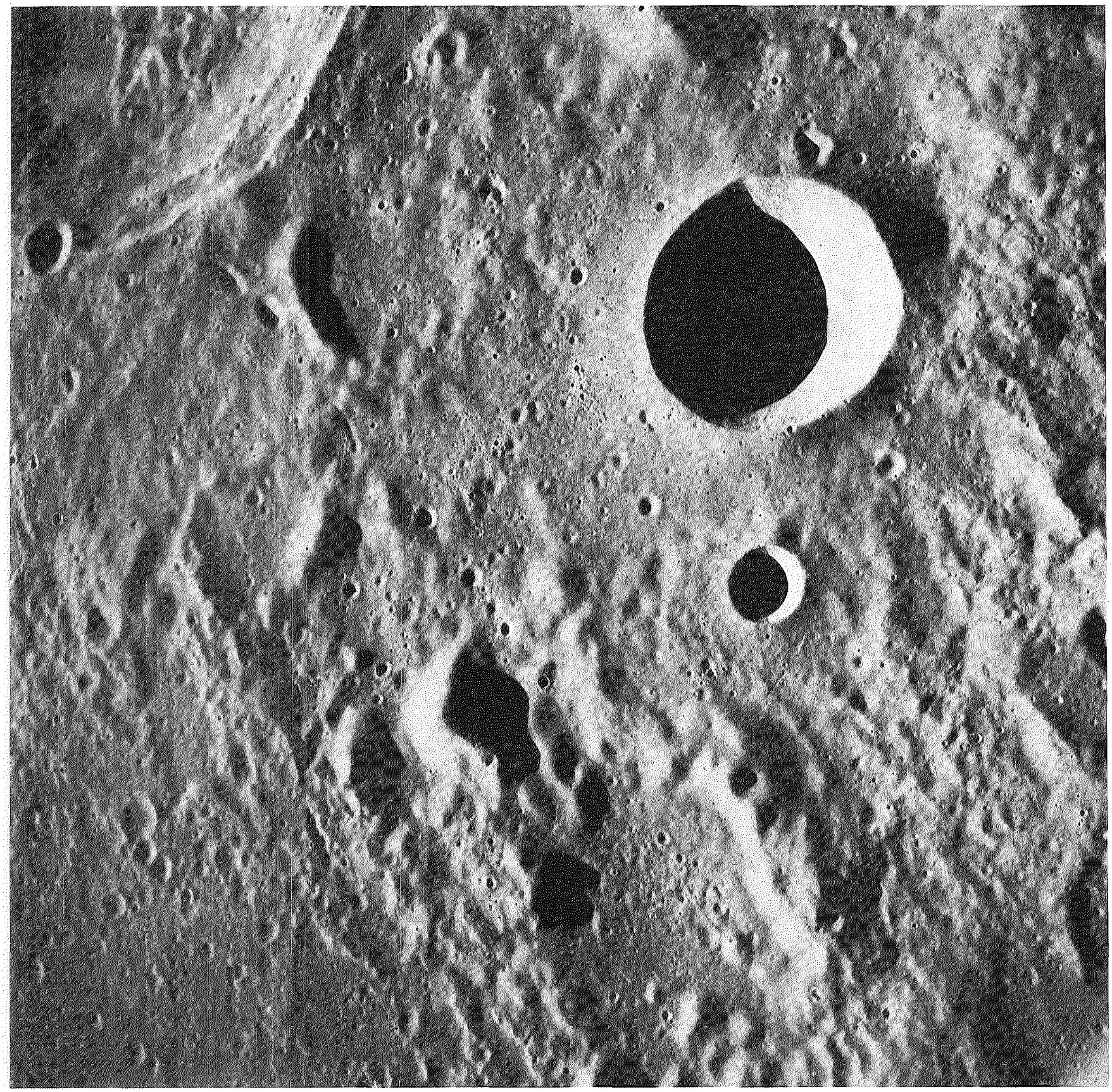


APOLLO 10 AS10-31-4521

APOLLO 10 AS10-31-4528

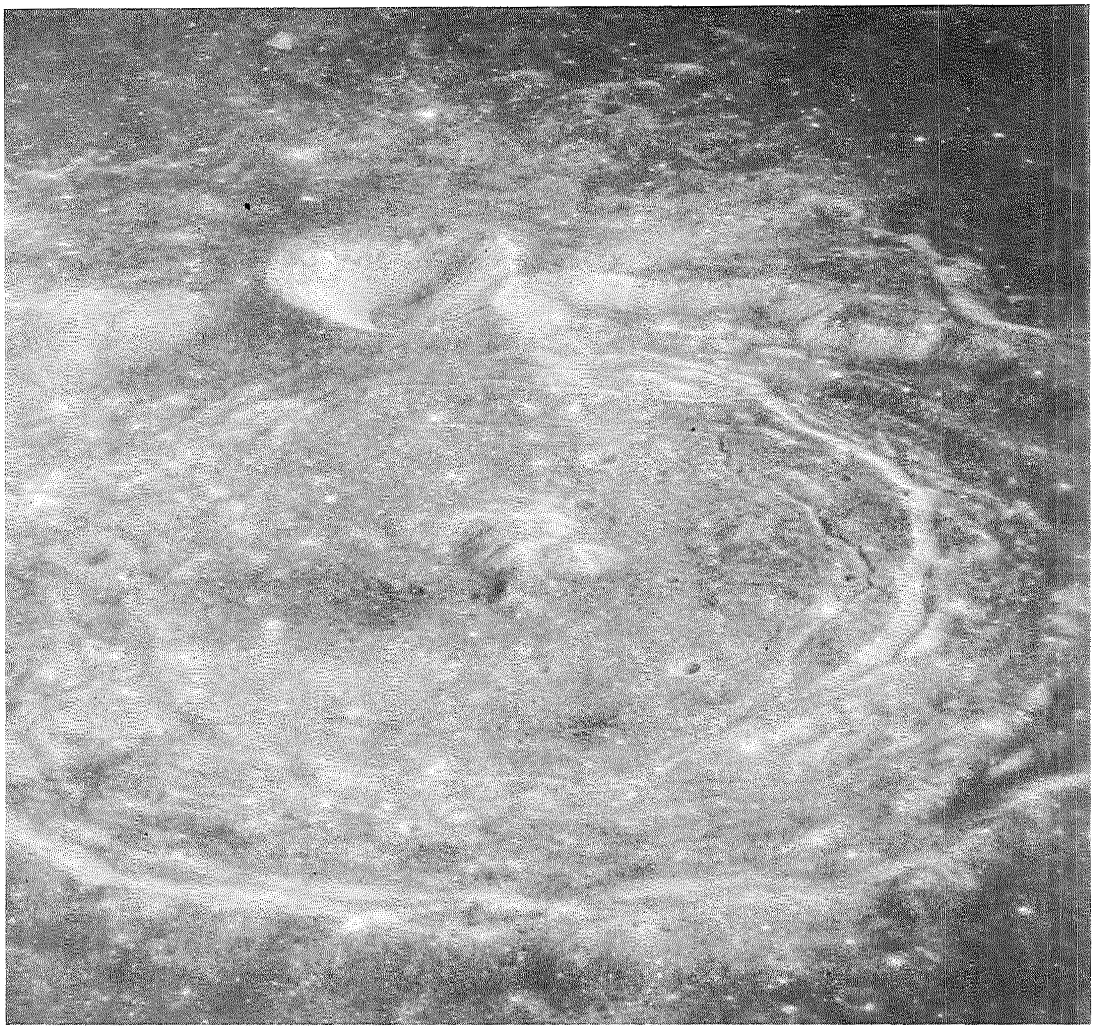
Top left: The bright crater at the tip of the highland peninsula is Secchi θ, located in the eastern portion of Mare Tranquillitatis. The highest point on this peninsula is approximately 1300 m above the mare floor. A pronounced gouge in the mare surface is evident at the left, and numerous craters are grouped together in a variety of formations.

Left: This is a near-vertical view of the southern edge of Mare Tranquillitatis. The semicircular feature in the upper left corner is Maskelyne D, a significant landmark on the approach to Tranquility Base. Maskelyne D is sometimes referred to as "Bob's Bend"; similarly, the peninsular-shaped landmass has been referred to as "Barbara Mesa." These are operational nicknames given to distinctive or unusual landmarks by the Apollo 10 astronauts.



APOLLO 10 AS10-31-4546

The sharply defined crater at right center is Theon Senior (Greek astronomer, *ca.* A.D. 100), approximately 6 miles in diameter. At the upper left, a portion of the crater Delambre (French astronomer, 1749–1822) can be seen. This highland area is located west of Mare Tranquillitatis.



APOLLO 10 AS10–31–4566

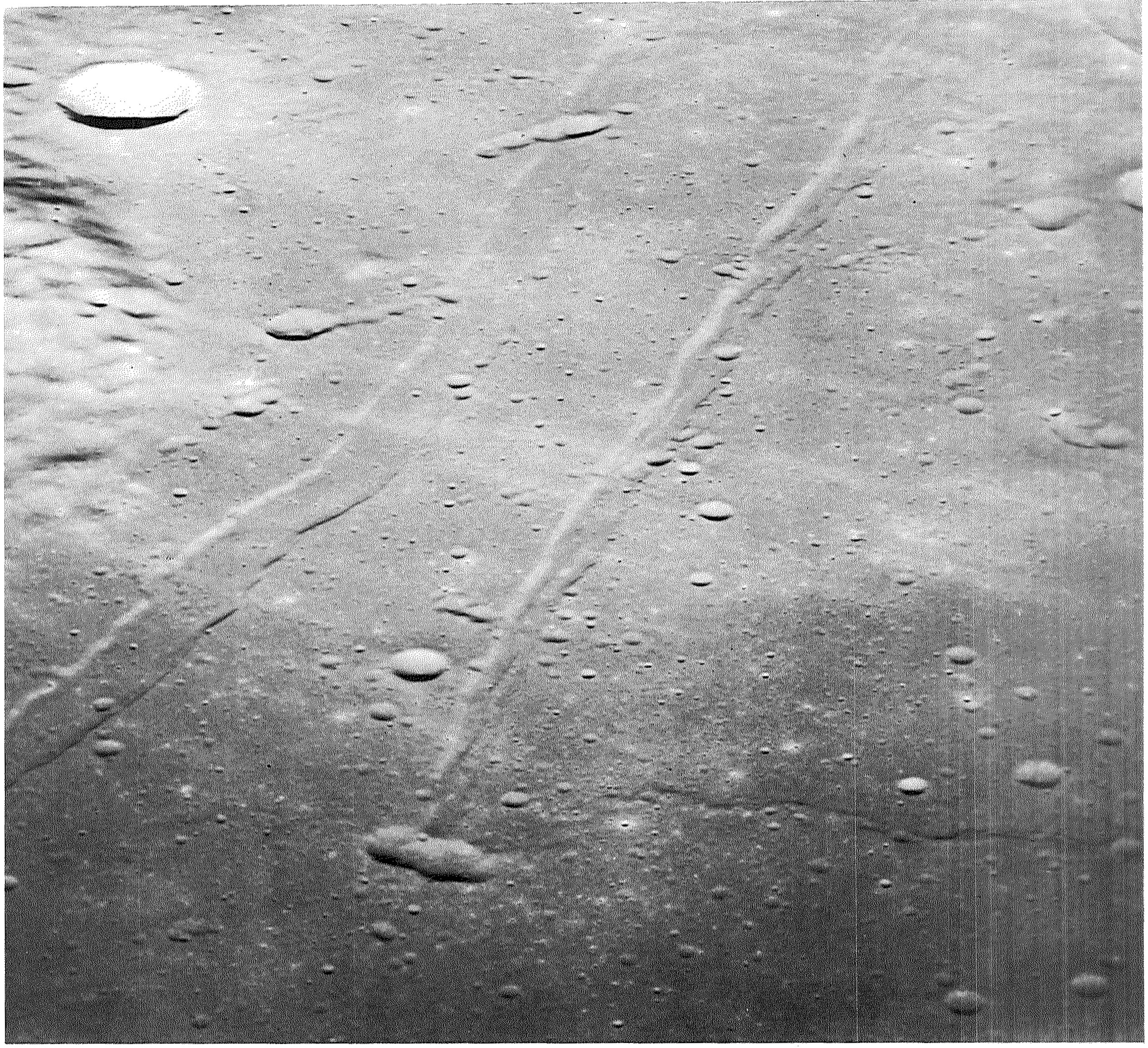
APOLLO 10 AS10–31–4580

Above: This 40-mile-diameter crater is Taruntius, located in Mare Fecunditatis. The smaller, bright crater on the rim is Taruntius C. Taruntius has a central peak, terracing, and some interesting arcuate rilles near the center.

Left: The hook-shaped feature in this view is the ring crater Maskelyne F. From the appearance, Maskelyne F is probably a very old crater that was formed before Mare Tranquillitatis was fully developed and had achieved its present level.

APOLLO 10 AS10-31-4601

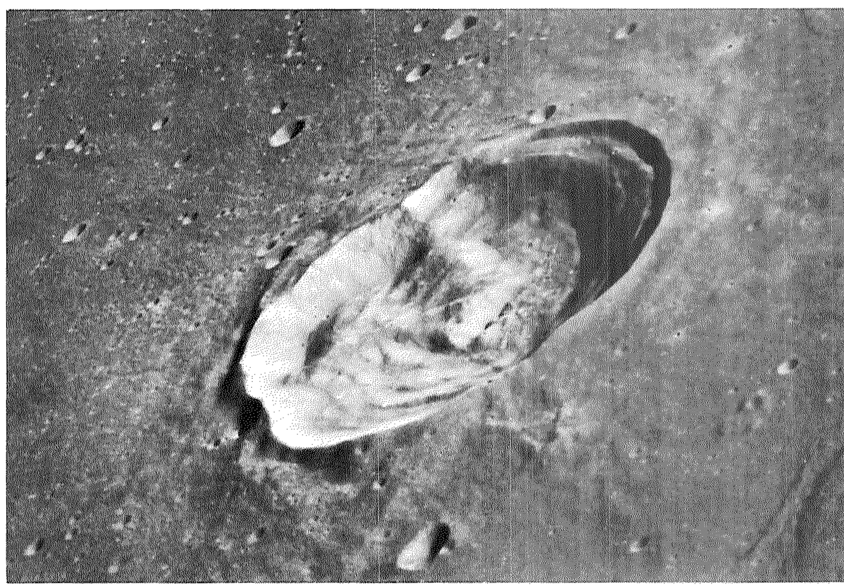
This view provides an indication of the size of Rima Hypatia I. Just beyond the crater Moltke (center) the rille forks; one branch continues through the mare and the other branch crosses the highlands that mark the southern boundary of Mare Tranquillitatis.



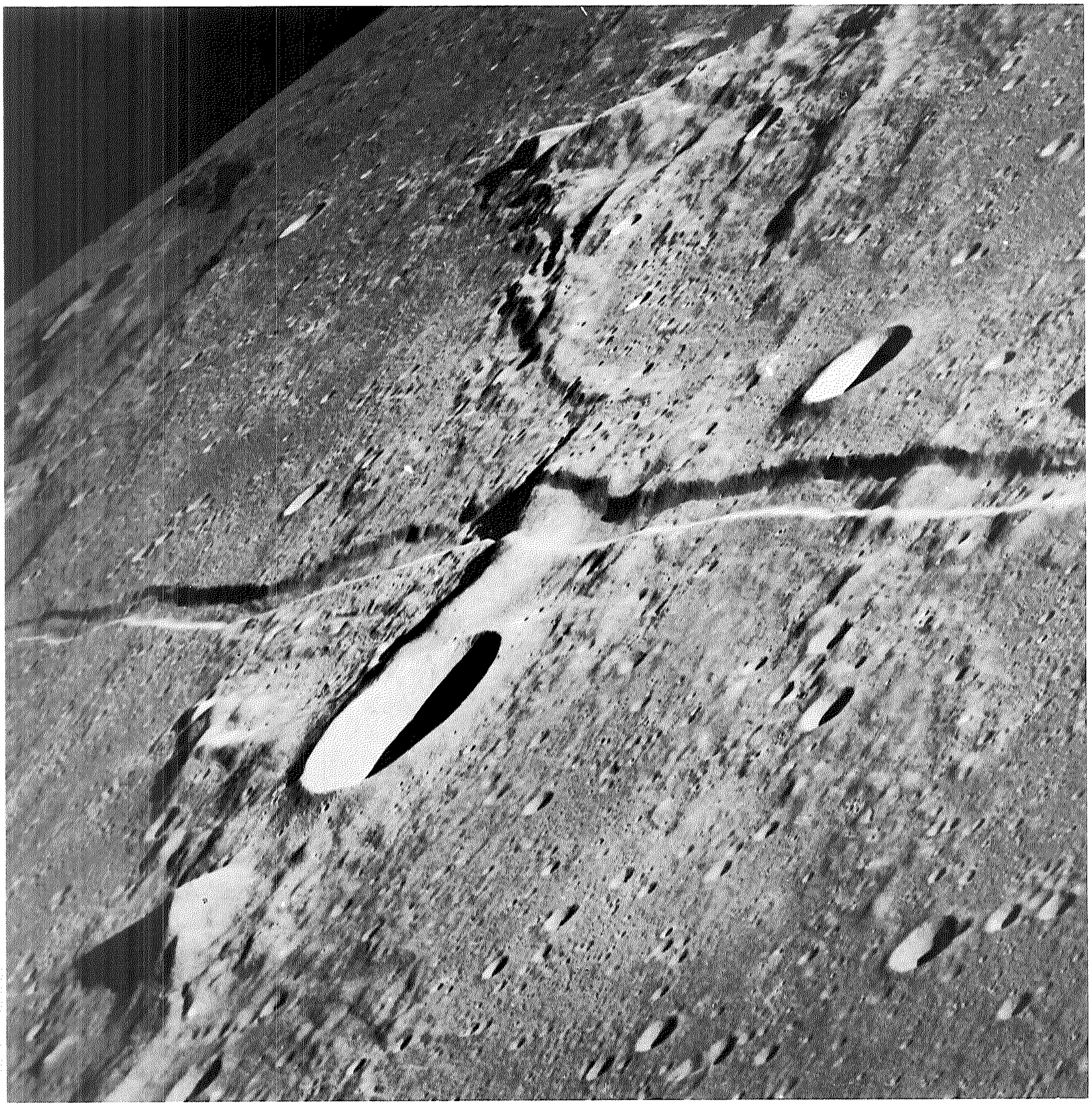
APOLLO 10 AS10–31–4621

Above: A parallel rille pattern is the outstanding feature of this oblique view of the southwestern portion of Mare Tranquillitatis. The broad rille at left is Rima Hypatia I, and the rille passing through the center of the area is Rima Hypatia II. At the top left is the crater Hypatia E.

Right: The large crater in the center of the photograph is Arago. Arago is located in the western portion of Mare Tranquillitatis and is approximately 18 miles in diameter. Terracing, characteristic of many lunar craters, is evident in Arago.

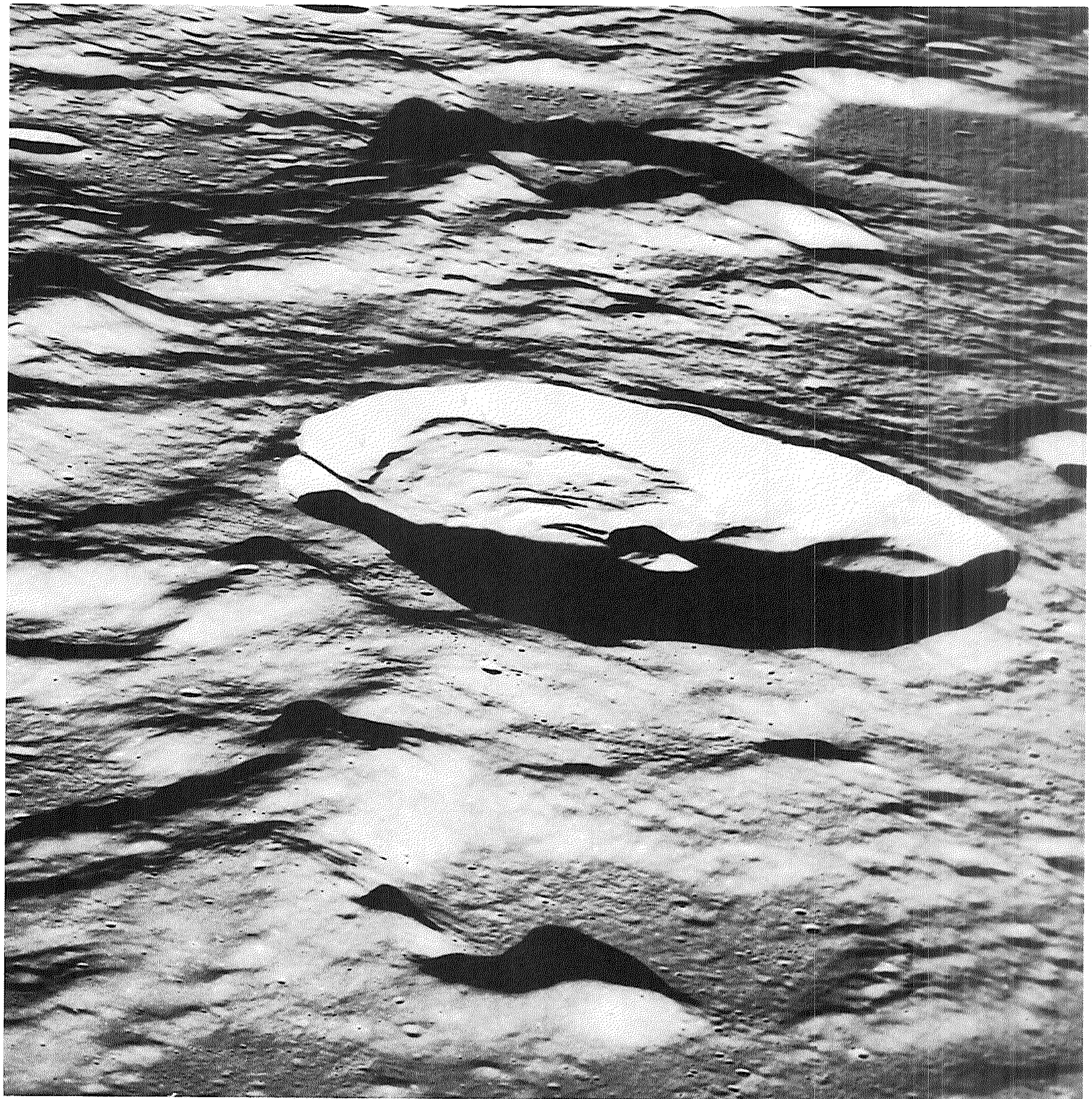


APOLLO 10 AS10–31–4630



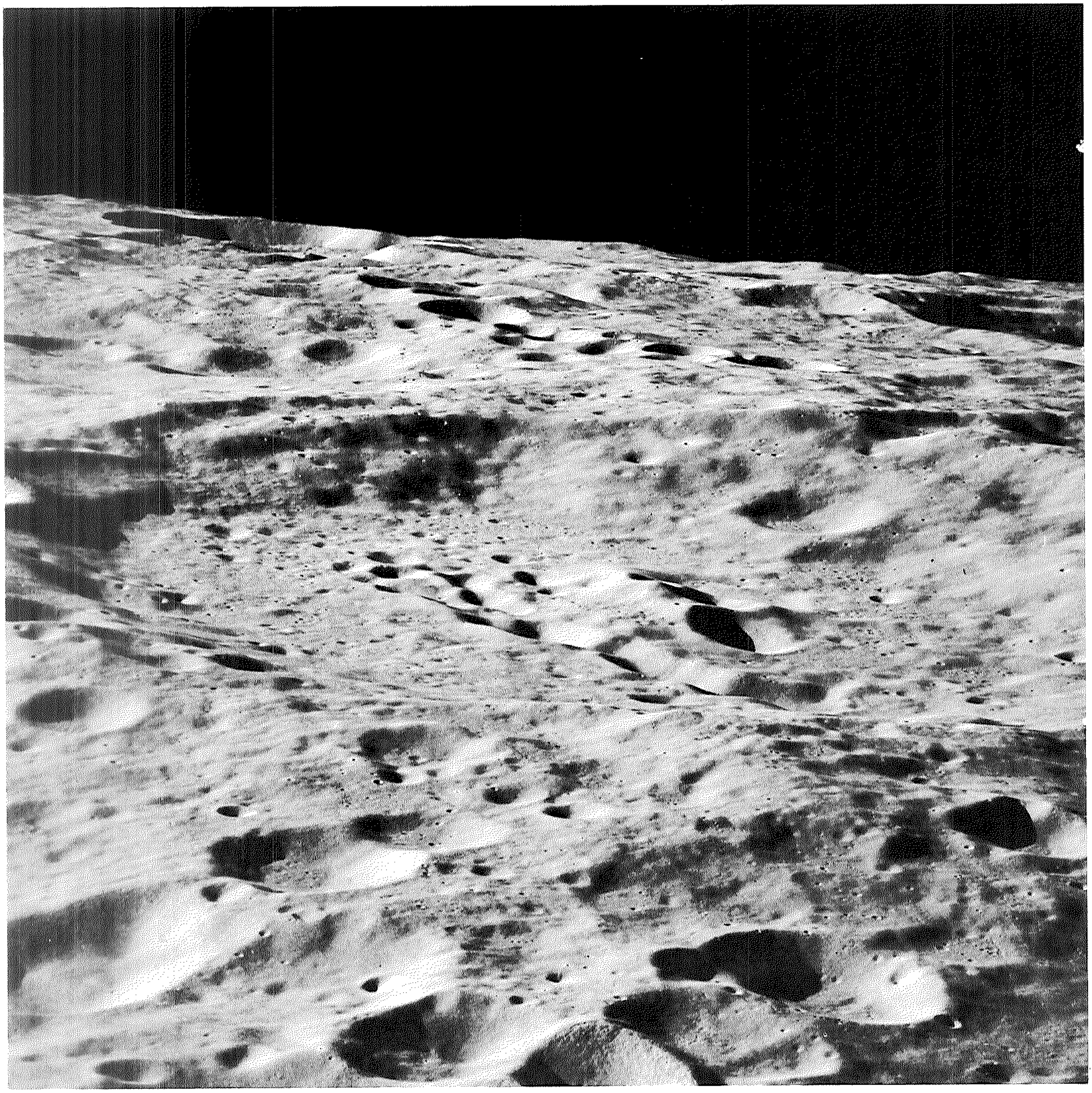
APOLLO 10 AS10-31-4646

The broad linear rille in this unusual oblique view is Rima Ariadaeus, which is approximately 3 miles wide. The large crater below the rille is Silberschlag (German astronomer, 1721–91), which is approximately 9 miles in diameter. As can be seen from the photograph, the rille crosses a variety of terrain (ranging from mare to highland surfaces).



APOLLO 10 AS10-31-4647

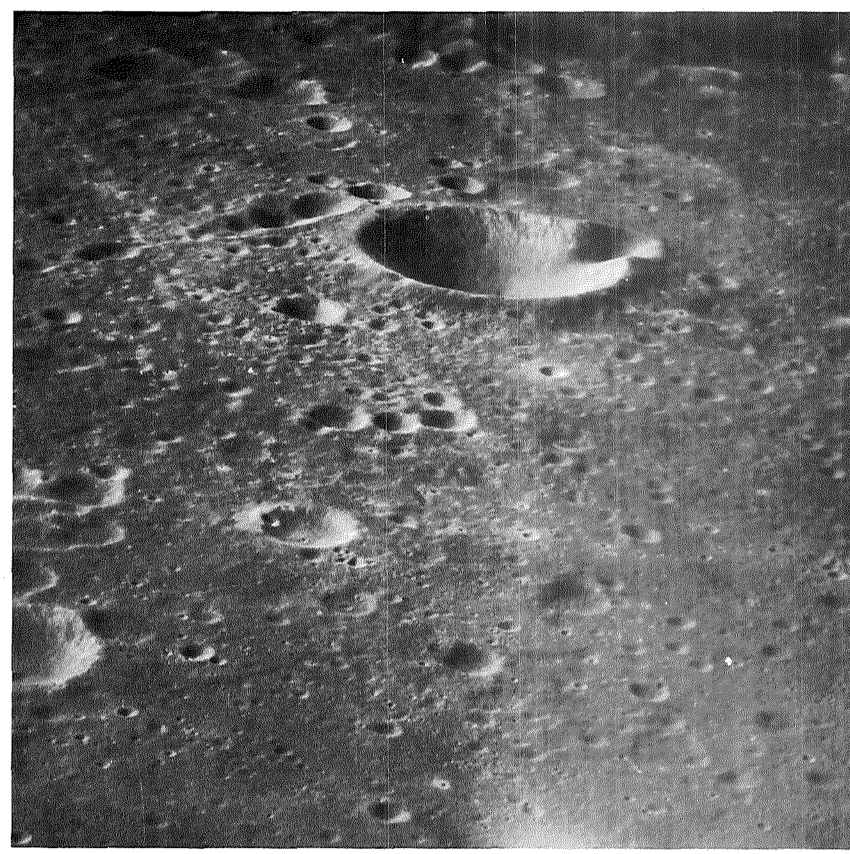
The large crater at center is Godin (French explorer and mathematician, 1704–60). This crater, which is approximately 27 miles in diameter, is located in the highland region that separates Mare Tranquillitatis from Sinus Medii.



APOLLO 10 AS10–31–4654

The large crater in this far-side oblique photograph is approximately 60 miles in diameter. Of particular interest are the crater chains occurring in the floor of this crater and in the rough area at top center. Two other large craters can be seen near the horizon at top left and top right.

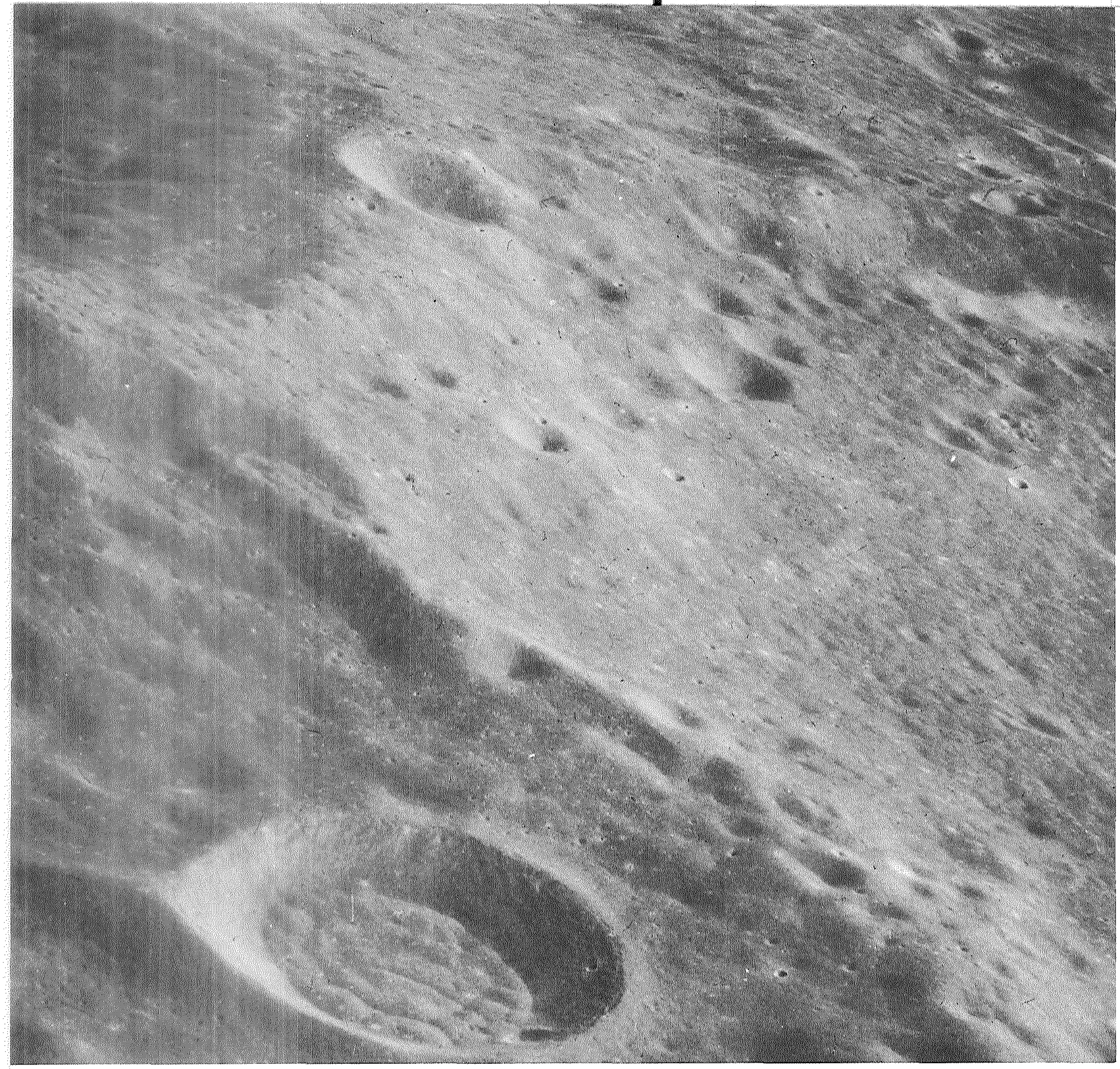
APOLLO 10 AS10-31-4665



APOLLO 10 AS10-31-4673

Top right: The large crater at the top of this view is approximately 25 miles in diameter and is located in one of the unnamed lunar far-side basins. Above and to the right of this top crater the beginning of a rough upland region can be seen. At the center, approximately midway between the two large craters, is a double crater with a small bright-rayed crater below the double crater.

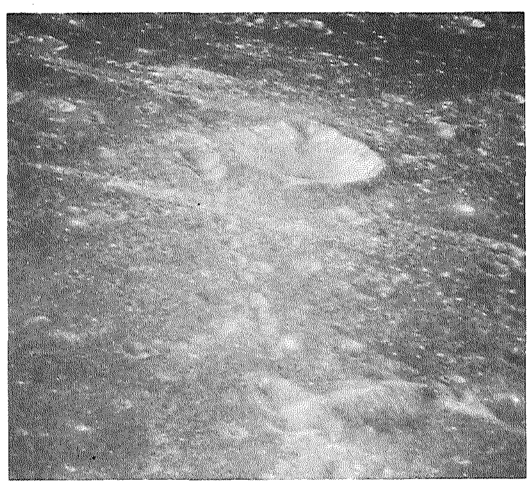
Right: The large crater in the center of this far-side oblique photograph is approximately 5 miles in diameter. A small crater is located on the rim of the large crater, while a crater chain runs tangentially to the rim opposite the side on which the small crater is located. At the top of the photograph are rugged highlands that mark the edge of the far-side basin in which these craters are located.



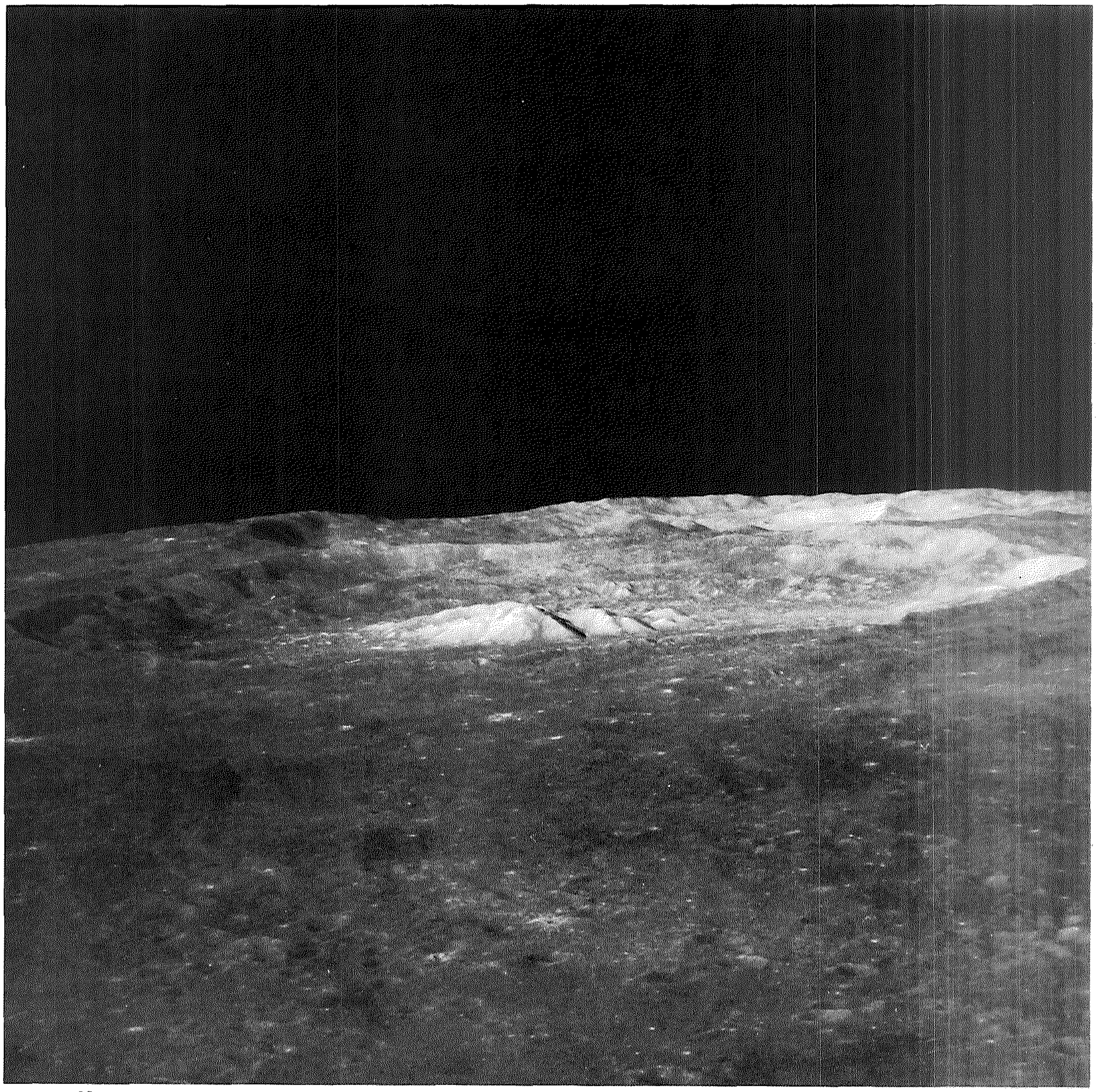
APOLLO 10 AS10-33-4975

Above: The frying-pan-shaped crater in this oblique photograph is located on the outer rim of a large, unnamed, far-side crater. This frying-pan-shaped crater has a relatively flat floor that has apparently been subjected to fracturing.

Right: A distinct crater chain can be seen running from the top to the bottom of this far-side oblique photograph. Crater chains of the size shown in this photograph are rare on the lunar surface and interpretations as to their cause (i.e., impact or volcanism) vary. At the center and to the right of the crater chain is a large, recently formed crater with a smaller crater located on its outer rim.

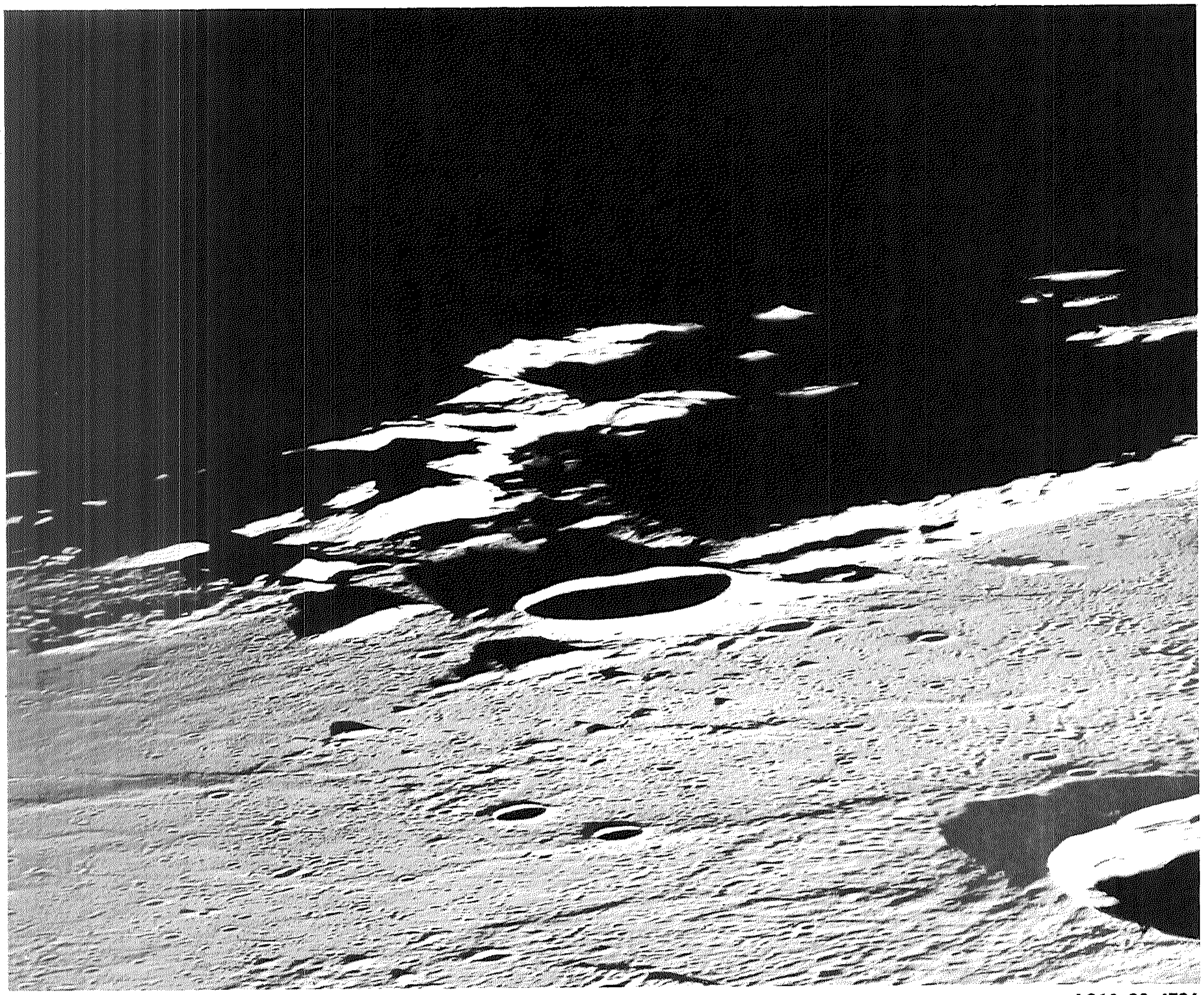


APOLLO 10 AS10-33-4914

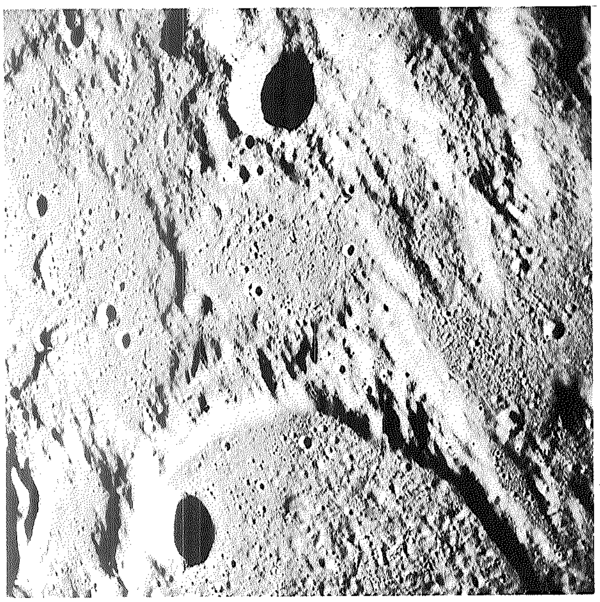


APOLLO 10 AS10–32–4716

The two craters seen in this low-altitude oblique photograph are Theophilus (Saint and Bishop of Alexandria, *ca.* A.D. 412) in the center foreground and Cyrillus (Saint, A.D. 444) on the horizon behind Theophilus. Both craters are quite large (approximately 65 miles in diameter), and both have extensive terracing of their side walls and prominent central peaks.



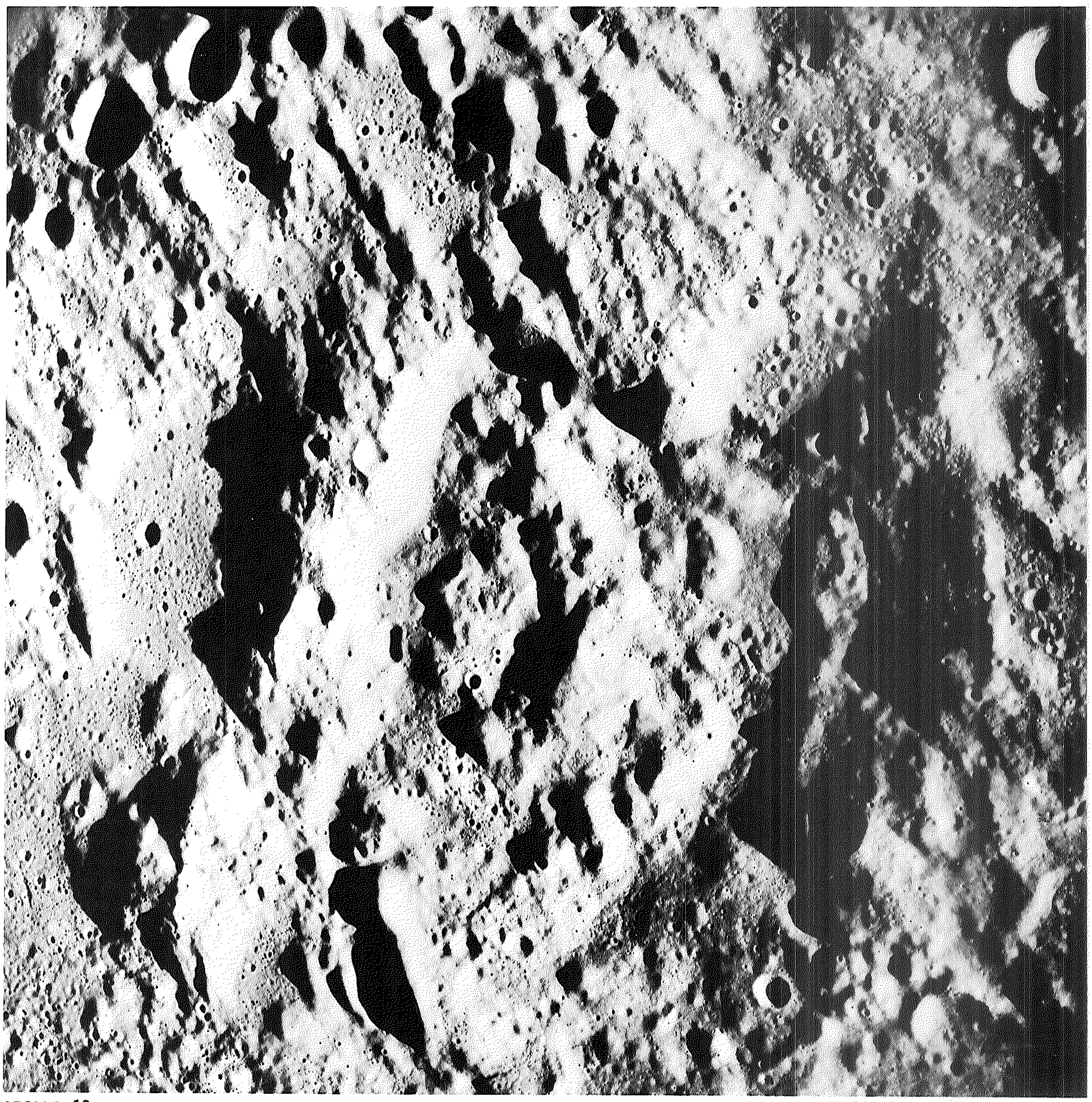
APOLLO 10 AS10-32-4734



APOLLO 10 AS10-32-4771

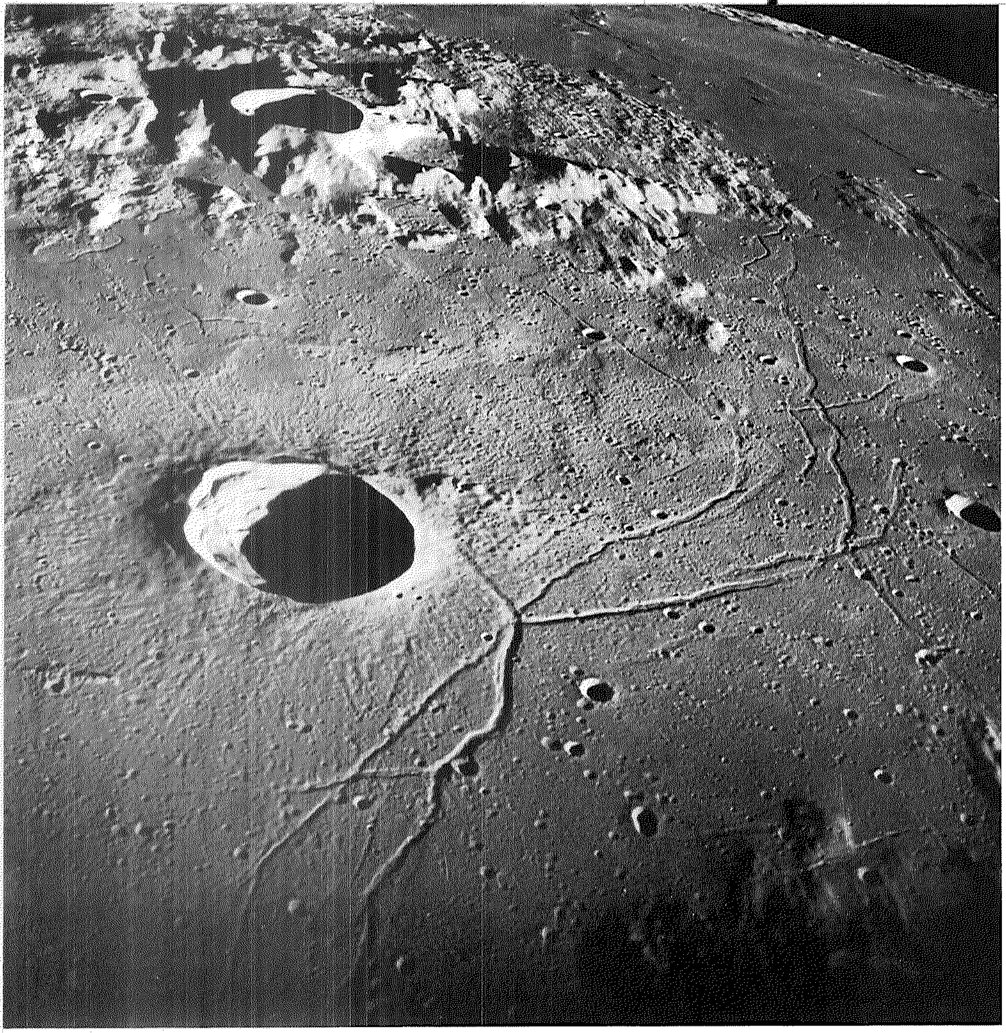
Above: The crater in the center of this oblique view is Chladni (German physicist, 1756–1827), located at the southern tip of the highlands extending into Sinus Medii. The crater that is partially visible at the lower right is Triesnecker (Austrian astronomer, 1745–1817). A highland mountain range is illuminated under the low Sun elevation and stands out against the blackness of the terminator.

Left: This near-vertical photograph of the highland region between Sinus Medii and Mare Tranquillitatis shows, at bottom, a portion of the large crater Lade (German selenographer, 1817–1904). The smaller crater, inside the western rim of crater Lade, is Lade M. Godin B is at the top center. A concentration of small craters can be seen on the upper portion of the rim of Lade.

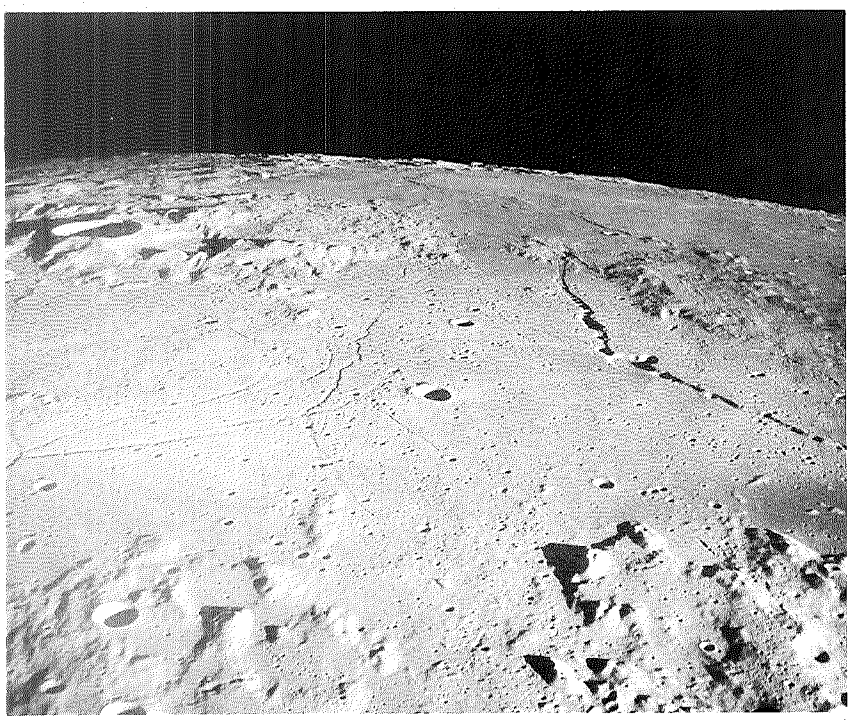


APOLLO 10 AS10-32-4774

This near-vertical view shows a highland area that lies between the crater Lade and Sinus Medii. The low Sun angle, which emphasizes the topographic features of the area, clearly reveals a surface pockmarked by thousands of small craters. This view lends credibility to the hypothesis that the lunar surface is continually bombarded by meteorites.



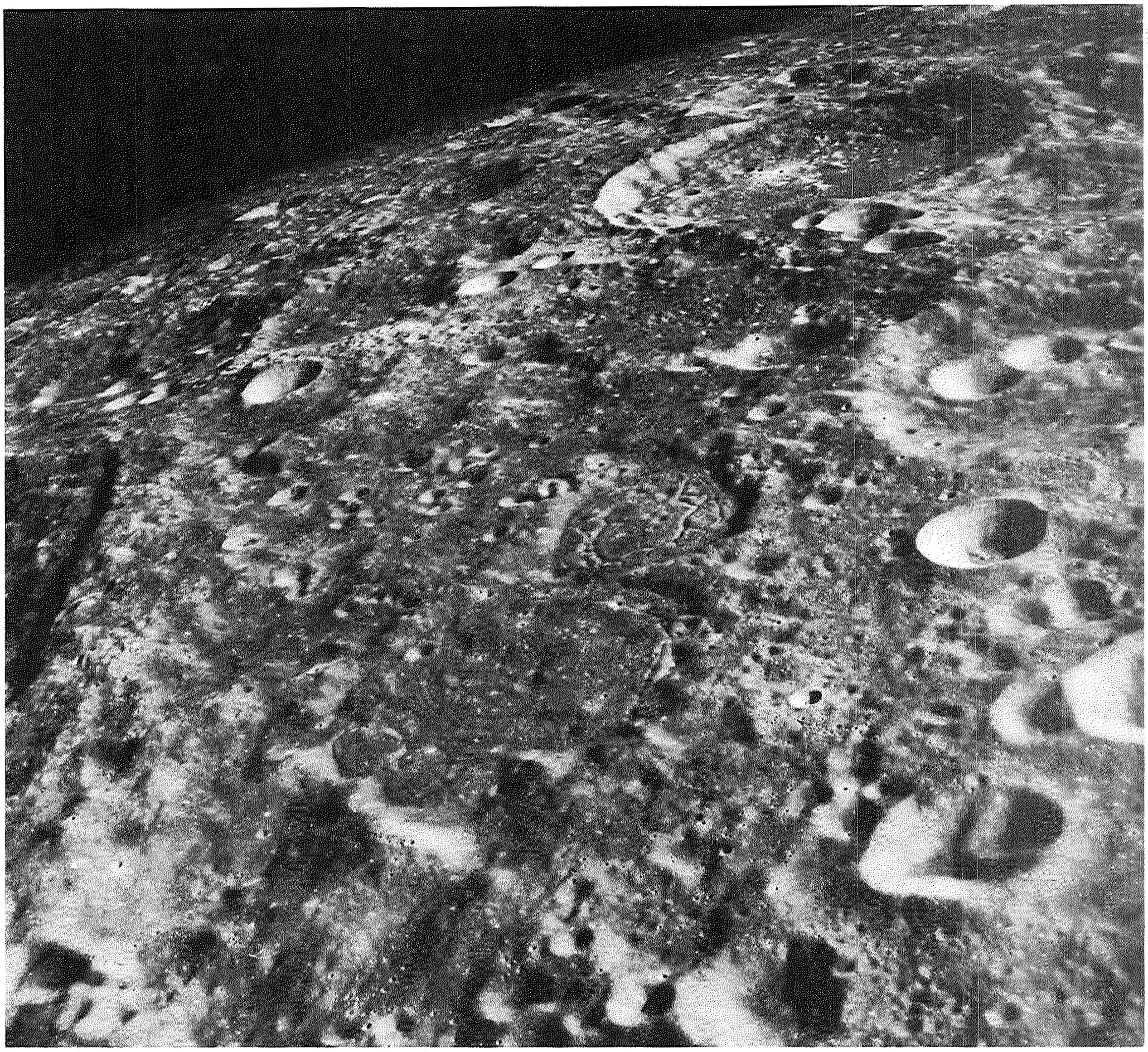
APOLLO 10 AS10-32-4819



APOLLO 10 AS10-32-4813

Top left: The crater Triesnecker (Austrian astronomer, 1745–1817), approximately 17 miles in diameter, and its associated network of crisscrossing rilles (the Triesnecker rilles) are located in the northeastern portion of Sinus Medii. This extensive series of rilles extends beyond Sinus Medii into the smooth floor of Mare Vaporum at upper right. The large crater at the edge of the highlands above Triesnecker is Ukert (German historian, 1780–1851).

Left: This oblique view is centered on Sinus Medii, with the crater Hyginus (Spanish astronomer, *ca.* A.D. 100) and the sharply defined Rima Hyginus (Hyginus Rille) to the right. The crater Hyginus, located where the rille makes a bend, lies near the northeast margin of Sinus Medii and is approximately 6 miles in diameter. From the crater, Rima Hyginus extends east-southeast toward Mare Tranquillitatis and northwest toward Mare Vaporum (Sea of Vapors). The rille is approximately 2 miles wide and more than 130 miles long. The rilles visible at center left are the Triesnecker rilles. The crater Triesnecker is just out of view at center left.

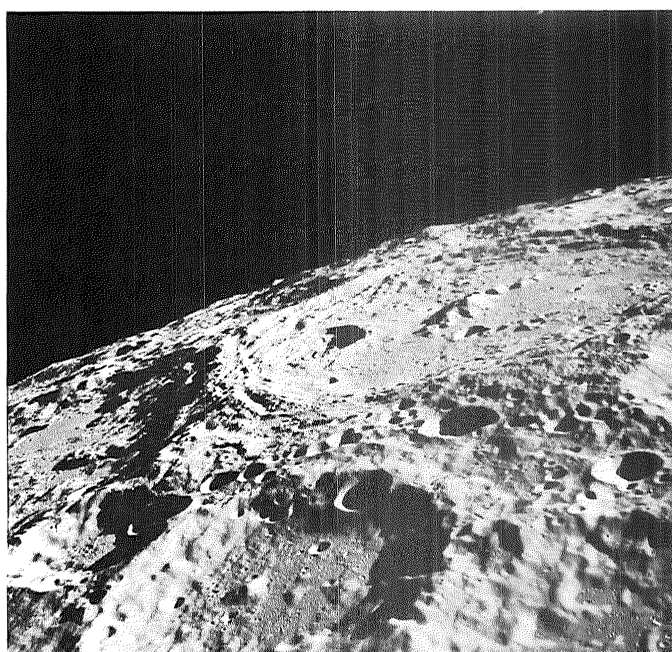


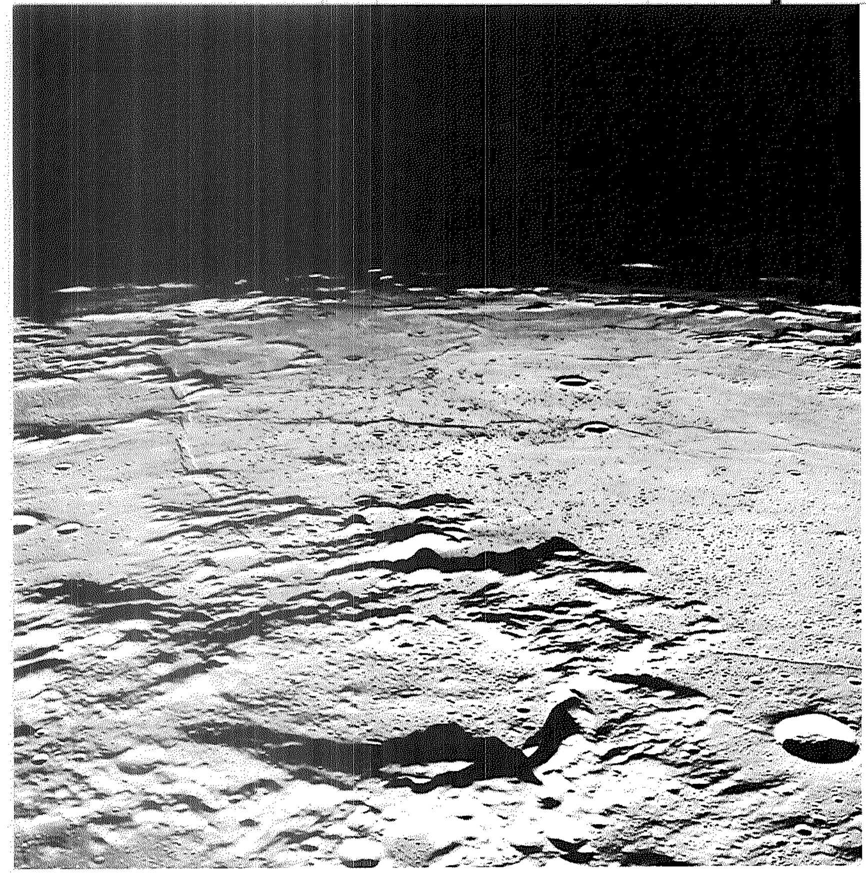
APOLLO 10 AS10–32–4828

Above: The diameter of the large crater (at upper right) in this far-side view is approximately 65 miles. This crater is typical of the more recently formed, large, far-side craters. A bright-rayed crater is located above and to the left of the central peak of the large crater. In the center are two adjacent craters with peculiar fracture patterns in their floors. These peculiar patterns imply that these craters have been subjected to volcanic activity.

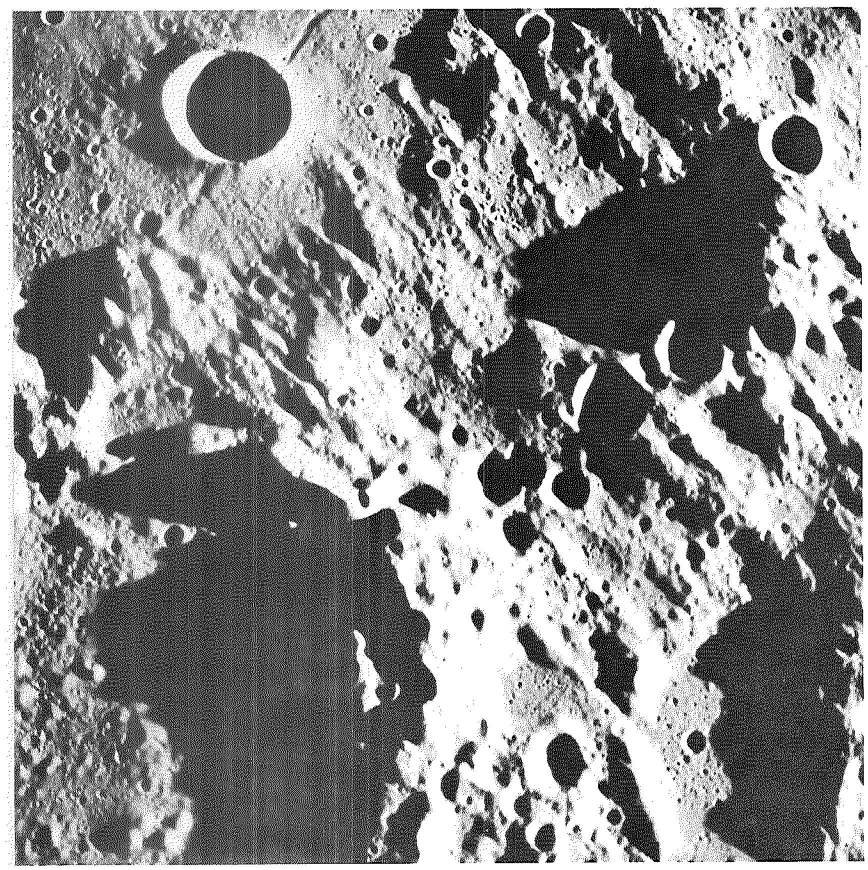
Right: The heavy shadows, caused by the low Sun elevation, give an indication of the roughness of this far-side region. The terraces of the large crater at the top of the photograph are distinctly steplike in appearance.

APOLLO 10 AS10–32–4823





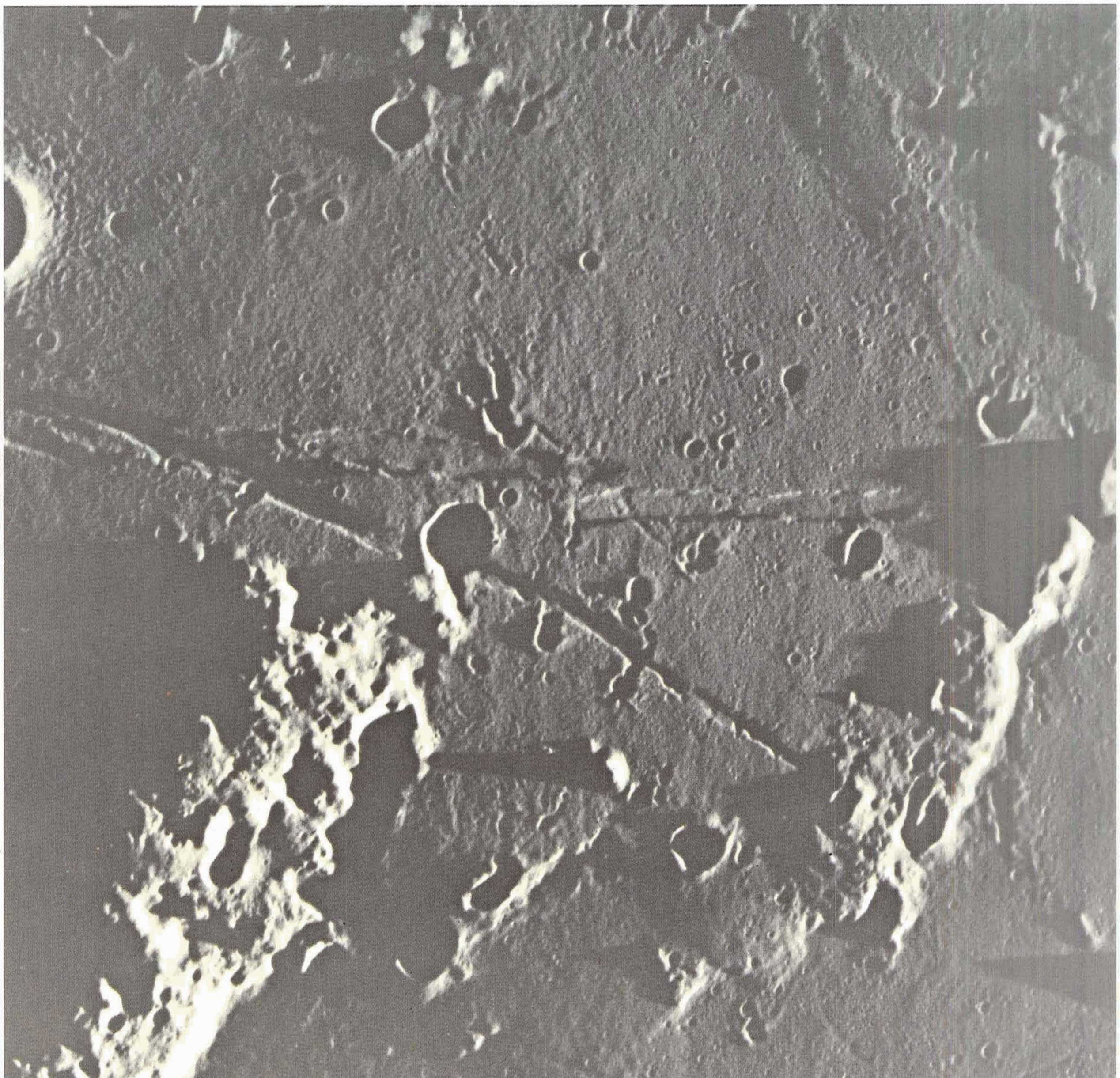
APOLLO 10 AS10-32-4856



APOLLO 10 AS10-33-4947

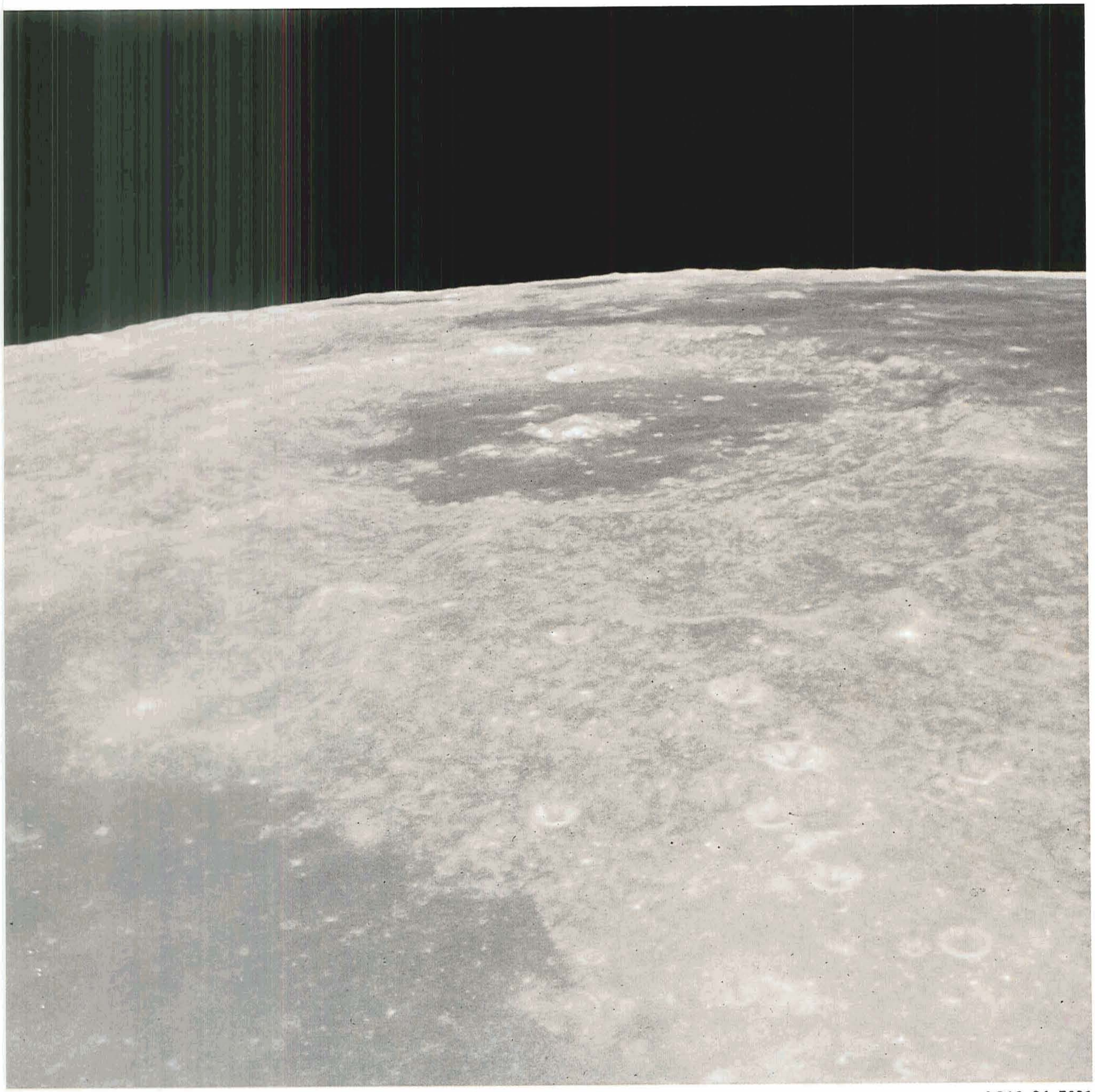
Top left: The large circular feature in the foreground of this oblique view of Sinus Medii is the crater Rhaeticus (German mathematician, 1514–76). The smaller crater, to the right of Rhaeticus, is Rhaeticus A, while the two distinct, small craters at the right center are Bruce (top) and Blagg. The rille at the left of the region is Rima Oppolzer I (Austrian astronomer and physicist, 1841–86). The low Sun angle emphasizes the numerous small craters in Sinus Medii, giving the landscape a speckled appearance.

Left: The sharply defined crater at upper left is Rhaeticus A, which is approximately 7 miles in diameter and lies on a small rille. The crater Rhaeticus at lower left is much more poorly defined and is partially obscured by shadow. The area shown in this view is located at the eastern edge of Sinus Medii.



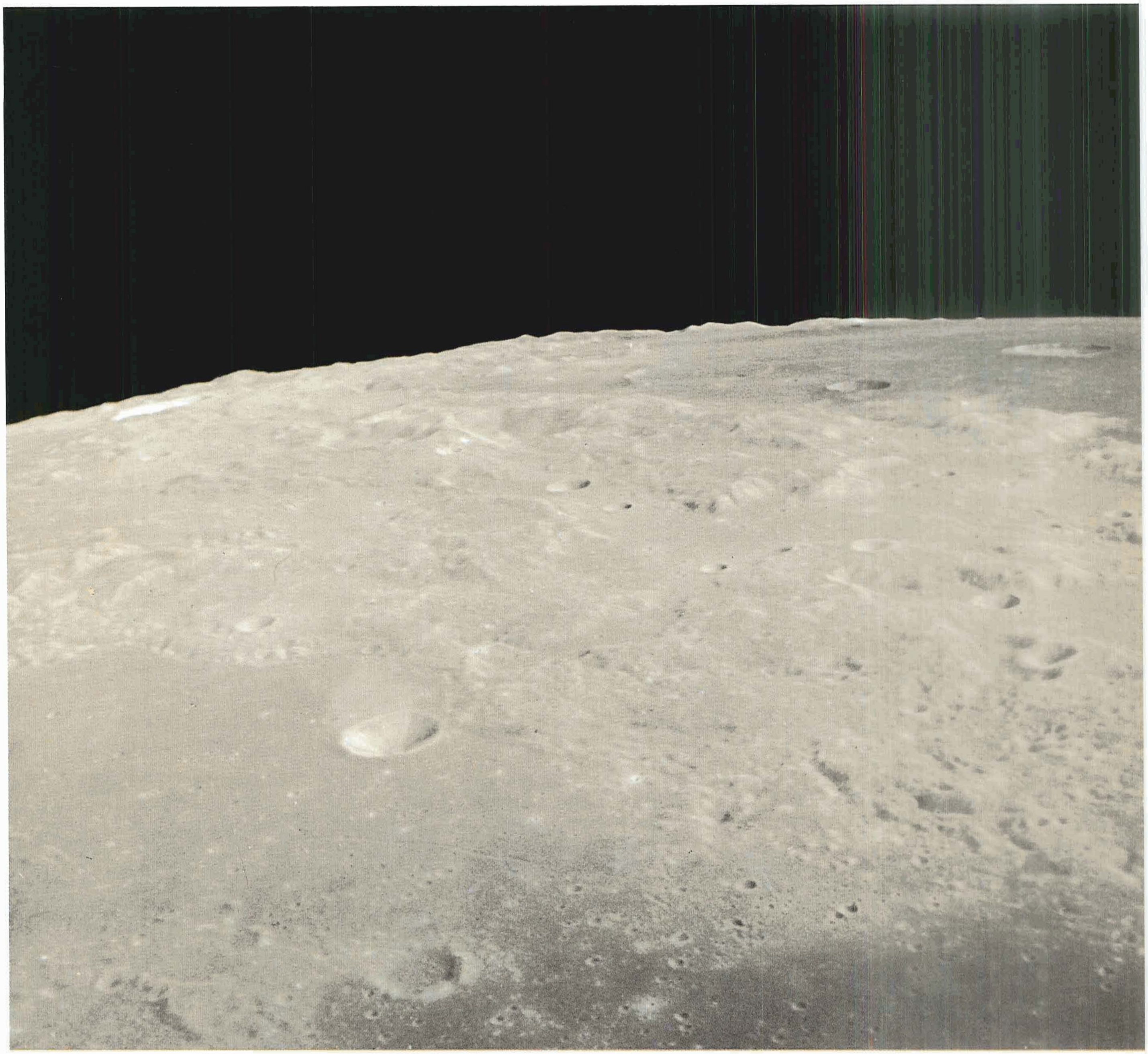
APOLLO 10 AS10-34-5073

The area shown in this view is on the southern edge of Mare Tranquillitatis. The crater at top left is Moltke. Rima Hypatia I is the rille that extends diagonally across the photograph. The landing site for Apollo 11 is approximately 15 n. mi. northwest of this area.



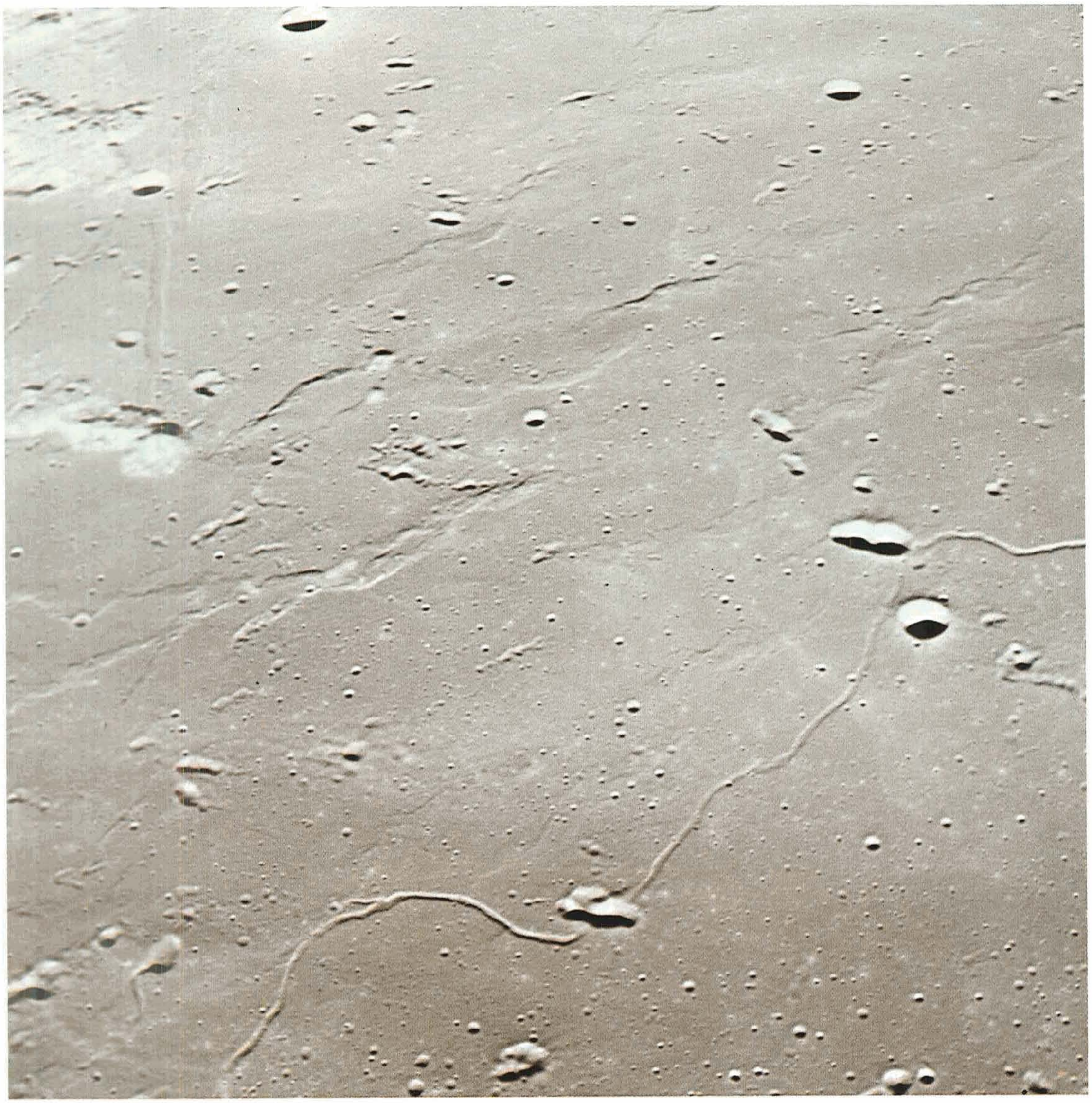
APOLLO 10 AS10-34-5031

This photograph of the eastern limb is a high-oblique view of the crater Neper (Scottish mathematician, 1550–1617) looking west-northwest. Mare Smythii is in the lower left corner. Neper is at upper center, and Mare Marginus is at upper right.



APOLLO 10 AS10–34–5096

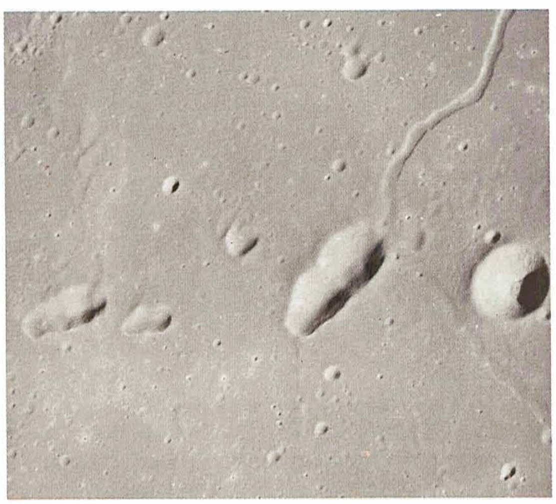
This is a high-oblique view of a portion of Mare Crisium and the adjoining highland. Mare Crisium is the dark mare in the upper right of the photograph, and the crater Picard (French astronomer, 1620–82) is the most prominent feature visible in that mare.



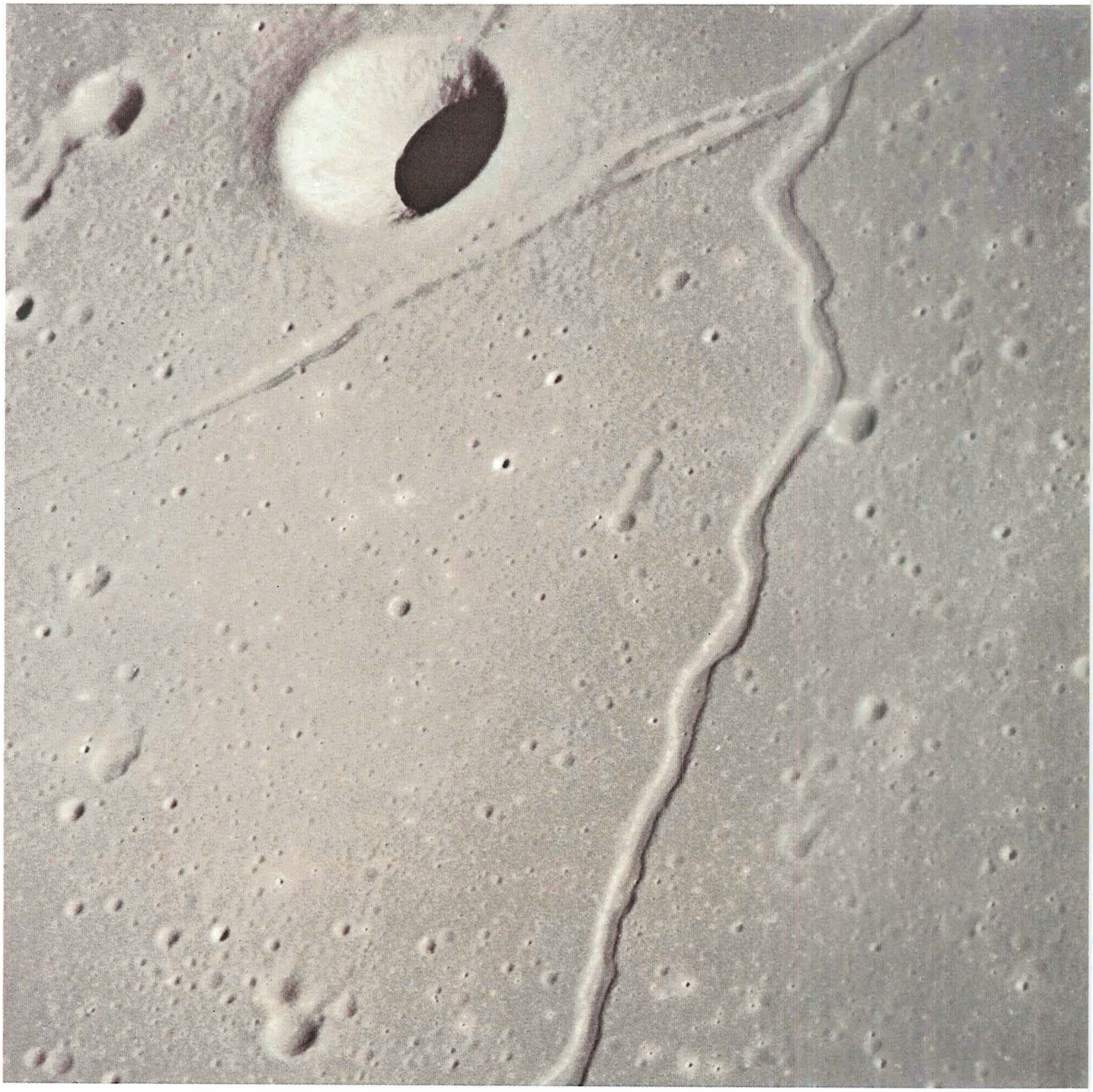
APOLLO 10 AS10-34-5099

Top: This is a view of the approach to Tranquility Base, which is just out of view in upper right center. The Apollo 10 crew gave nicknames (or code names) to most of the prominent features shown in this photograph. The features shown were given nicknames such as Thud Ridge, The Gashes, Faye Ridge, Diamondback Rille, Sidewinder Rille, and Last Ridge.

Right: This low-oblique photograph was taken on the approach to Tranquility Base, approximately 55 n. mi. east of the landing site. It shows Diamondback Rille connecting with an elongated crater. The circular crater at right center is Maskelyne X, which is approximately 2 miles in diameter.



APOLLO 10 AS10-34-5152



APOLLO 10 AS10–34–5153

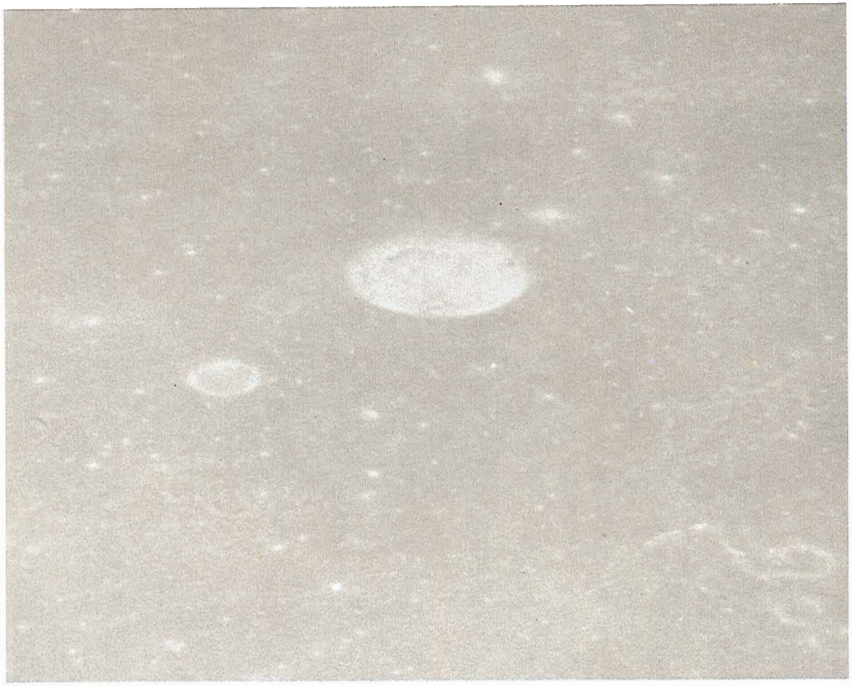
This is a view of a northern segment of Diamondback Rille, which shows the rille branching off into a fork. The crater at upper left center is Maskelyne G. A footprint-shaped crater is located to the left of Maskelyne G.

APOLLO 10 AS10-34-5129

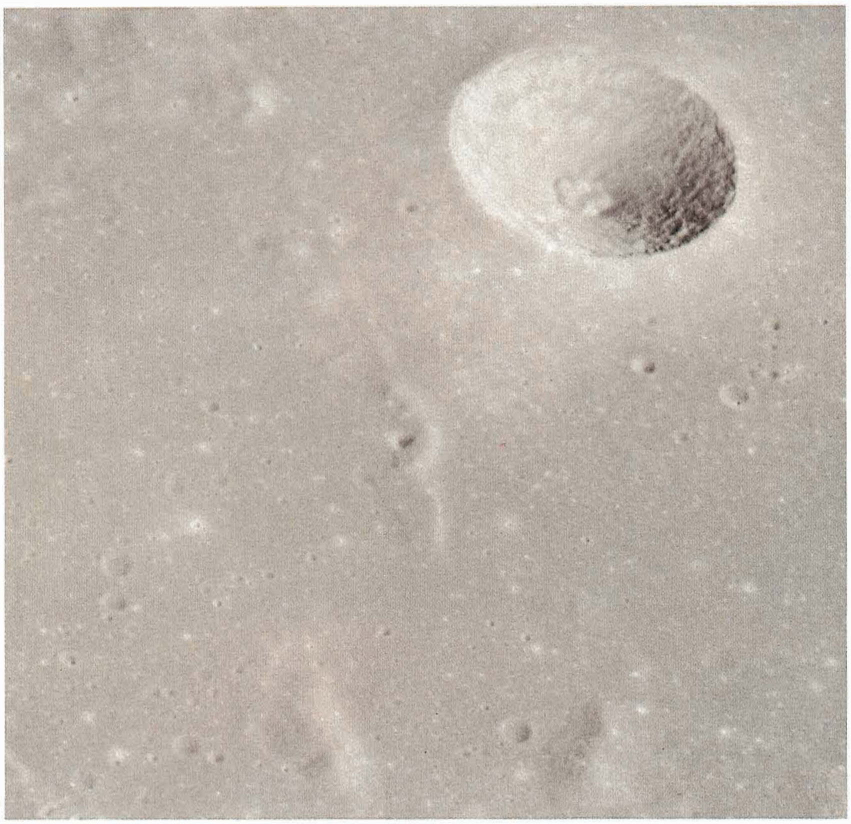
Above: This crater, located in Mare Spumans (Foaming Sea), has a very bright ray structure. It is generally believed that such brilliant ray patterns are associated with craters that have been formed relatively recently.

Left: The largest crater in this view of a part of Mare Tranquillitatis, at left center, measures approximately 1¼ miles in diameter and is 13 miles southeast of a proposed Apollo program touchdown point. The small crater on its rim is used as a navigation landmark.

APOLLO 10 AS10-34-5150



APOLLO 10 AS10-34-5136



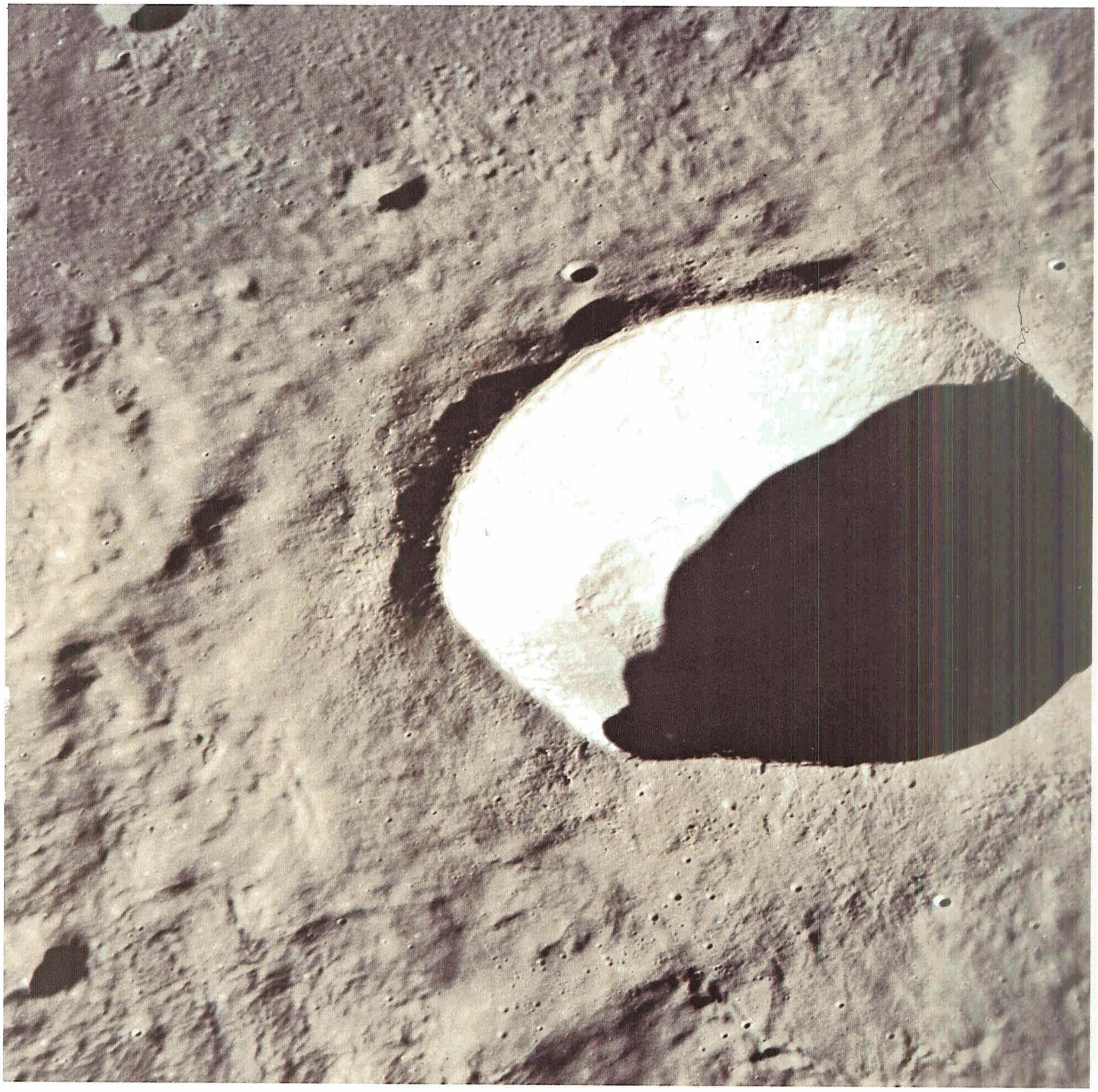
APOLLO 10 AS10-34-5145

Top: The large bright crater in the center of this view of Mare Fecunditatis is Taruntius H. This crater, approximately 8 miles in diameter, appears very bright at high Sun elevations. Tonal variations can be detected on the crater slopes.

Above: The large crater at upper right is Taruntius F, approximately 9 miles in diameter and located in the eastern portion of Mare Tranquillitatis. The texture of the crater walls is clearly visible in this view. At lower center are several hummocky features.

APOLLO 10 AS10-34-5160

This is the crater Ritter (German geographer, 1779–1859), located on the western edge of Mare Tranquillitatis and approximately 18 miles in diameter. The interior floor of Ritter shows sharp fracturelike lineaments, which are emphasized by the heavy shadows cast at low Sun elevations.



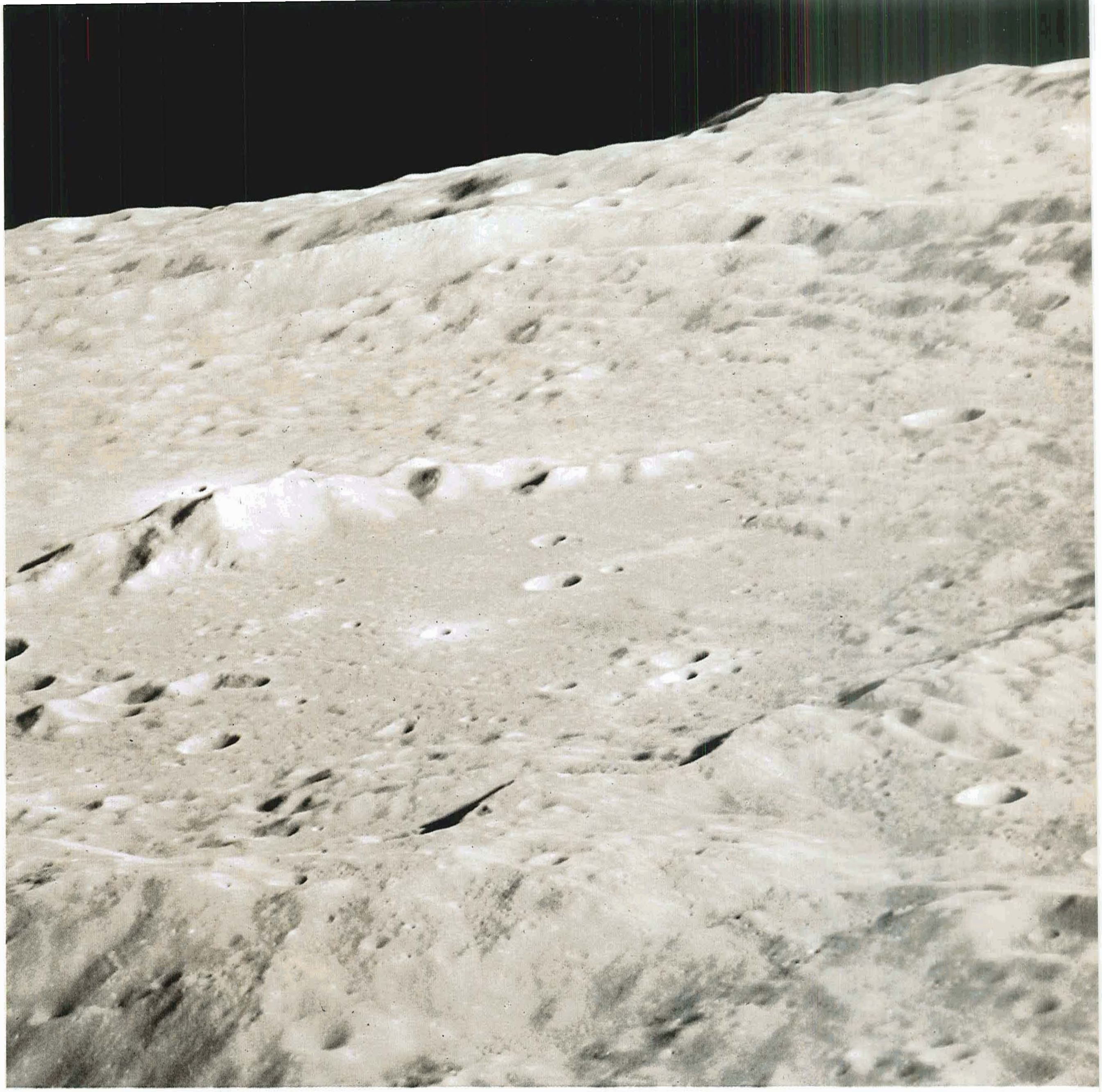
APOLLO 10

AS10-34-5162

This is the crater Schmidt (German selenographer, 1825–84), located at the western edge of Mare Tranquillitatis, south of crater Ritter and west of Sabine, and approximately 10 miles in diameter. The most notable features of Schmidt are the sharp rim, ray pattern, relatively rough floor, and surrounding hummocky terrain. Numerous boulders, easily resolvable on a photograph of this scale and quality, can be seen in the area surrounding the crater and on the crater floor. Most of these boulders range in size from 68 to 122 m.

APOLLO 10 AS10-34-5167

This view shows a portion of the highlands between Mare Tranquillitatis and Sinus Medii. The crater at right center is Godin D. The rough terrain of the highlands area is evident under the low Sun elevation.



APOLLO 10 AS10–34–5171

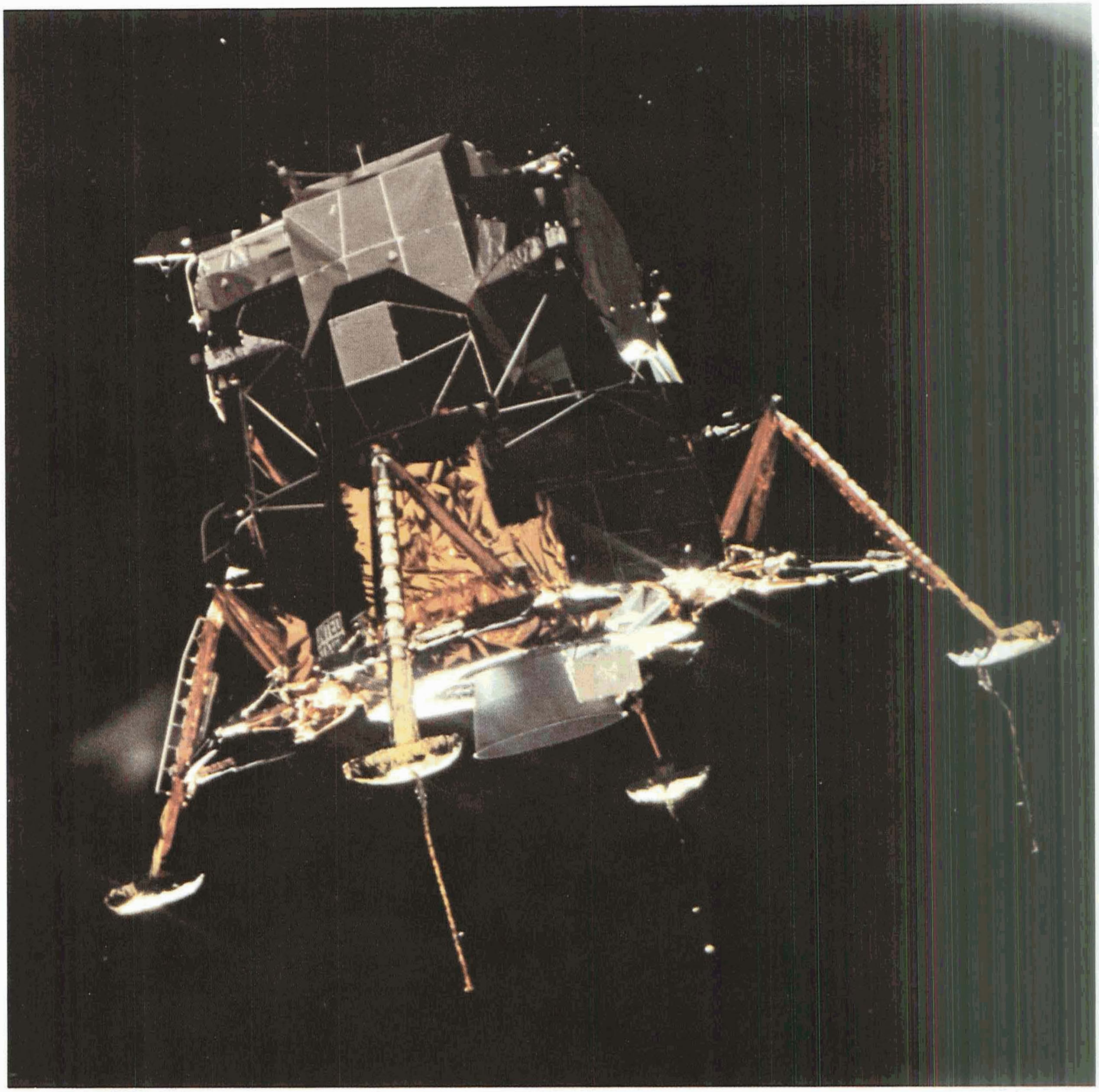
The large crater in this lunar far-side view is approximately 100 miles in diameter. Terracing and a prominent central peak are evident. The relief, contrasted against the black sky, shows the ruggedness of the surrounding terrain.

APOLLO 10 AS10–34–5172

Above: The sharply defined, steep-walled crater in the center of this far-side oblique view is approximately 12 miles in diameter. Rubble, probably ejecta material, can be seen on the outer slopes surrounding the crater. A larger, more subdued crater is located above the steep-walled crater.

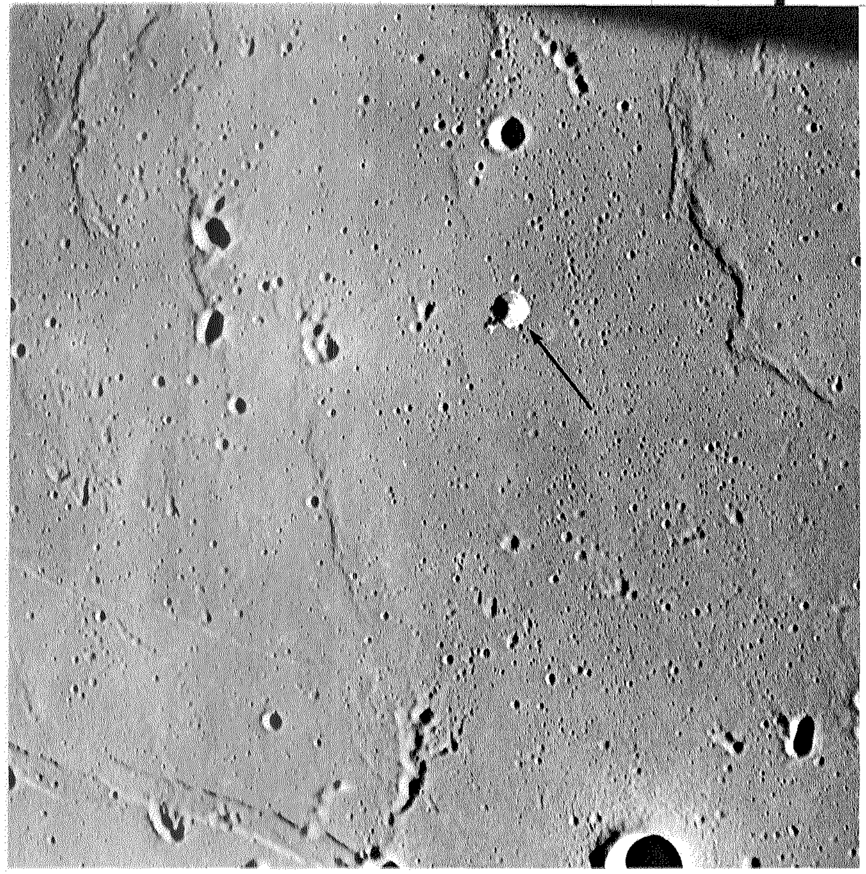
Right: This far-side oblique view is dotted with several distinct, bright craters. The photograph provides a representative view of a rugged area of the lunar surface.

APOLLO 10 AS10–34–5173

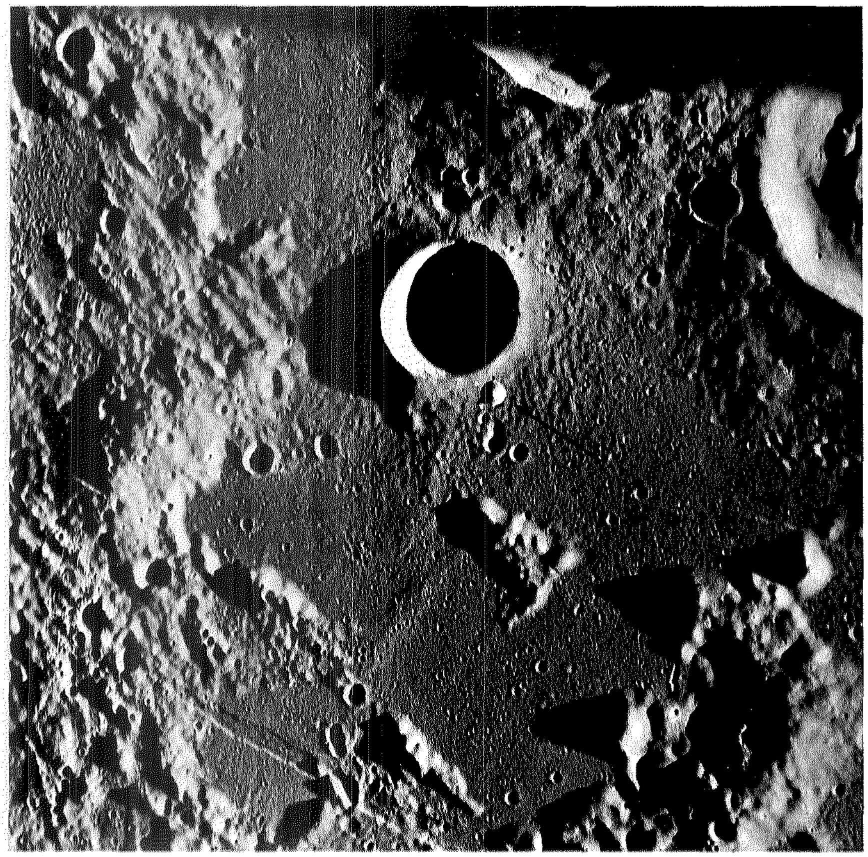


APOLLO 11 AS11-44-6581

The Apollo 11 lunar module Eagle is shown as it appeared following separation from the command module. Separation was performed in preparation for the descent to the lunar surface. The rods protruding from the footpads are touchdown sensors that shut off the descent engine automatically when contact is made with the lunar surface.



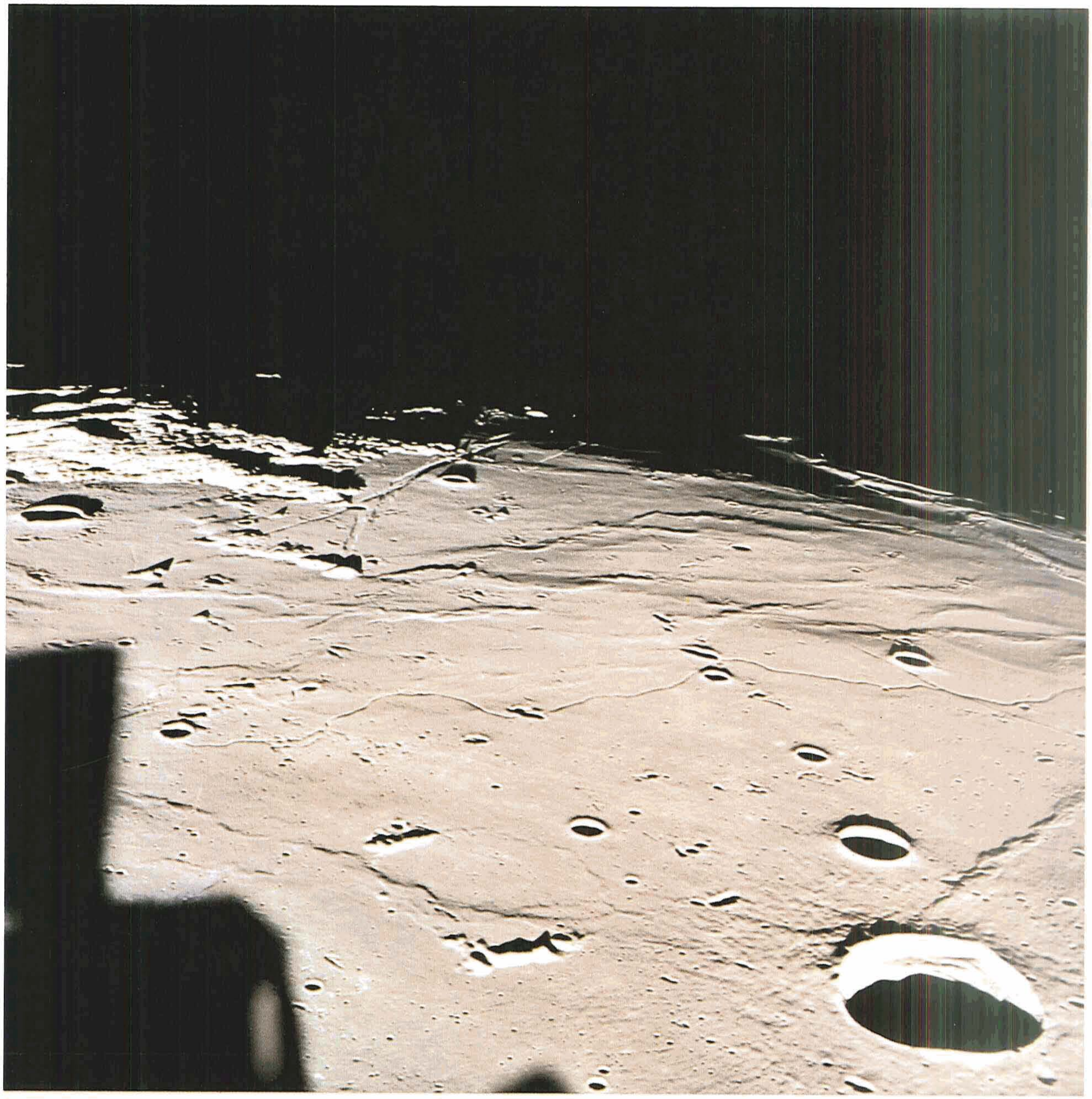
APOLLO 11 AS11-37-5447



APOLLO 11 AS11-37-5448

Top left: In this view, the command module, located just right of center, nearly blends into the background that shows the surface of Mare Tranquillitatis. Moltke is the large crater at lower right, and Rima Hypatia I crosses the area in the lower left corner of this photograph.

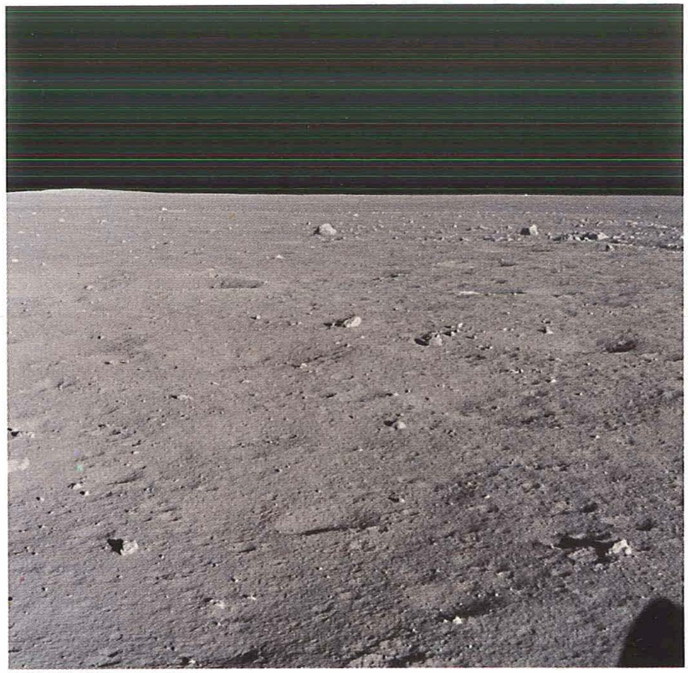
Left: In this photograph, the command module is at the southeast rim of the crater Schmidt (top center). Portions of craters Sabine (top right) and Ritter (above and to the left of Sabine) are also visible. Almost the entire spectrum of lunar features can be seen in this view: smooth mare, rugged highlands, large and small craters, and well-defined rilles.



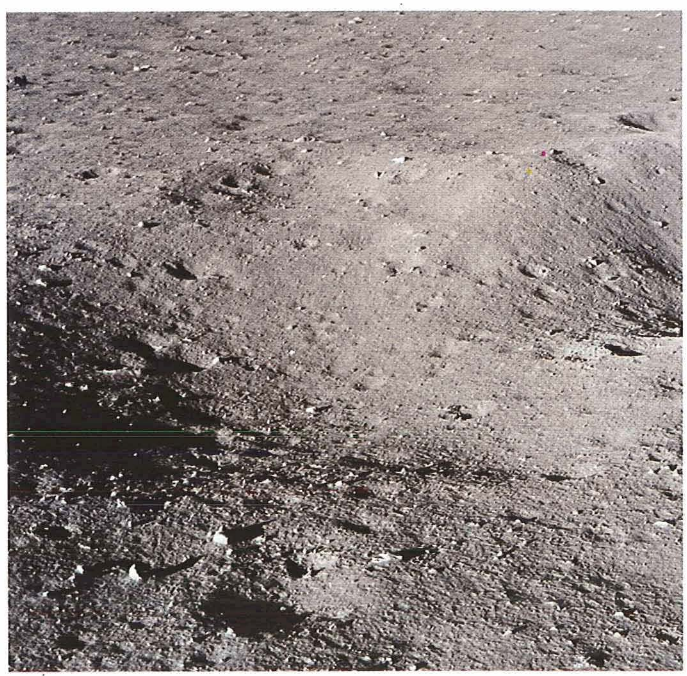
APOLLO 11

AS11-37-5437

This westward-looking low-oblique view is centered approximately on Tranquility Base, which is located at the terminator. The major crater in the lower right foreground is Maskelyne, with Maskelyne B just above. Torricelli C (Italian physicist, 1608–47) is the crater above the shadow of the lunar module thrustor nozzle on the left side of the photograph; and Moltke lies near the center of the photograph, near the terminator and just to the right of Rima Hypatia.



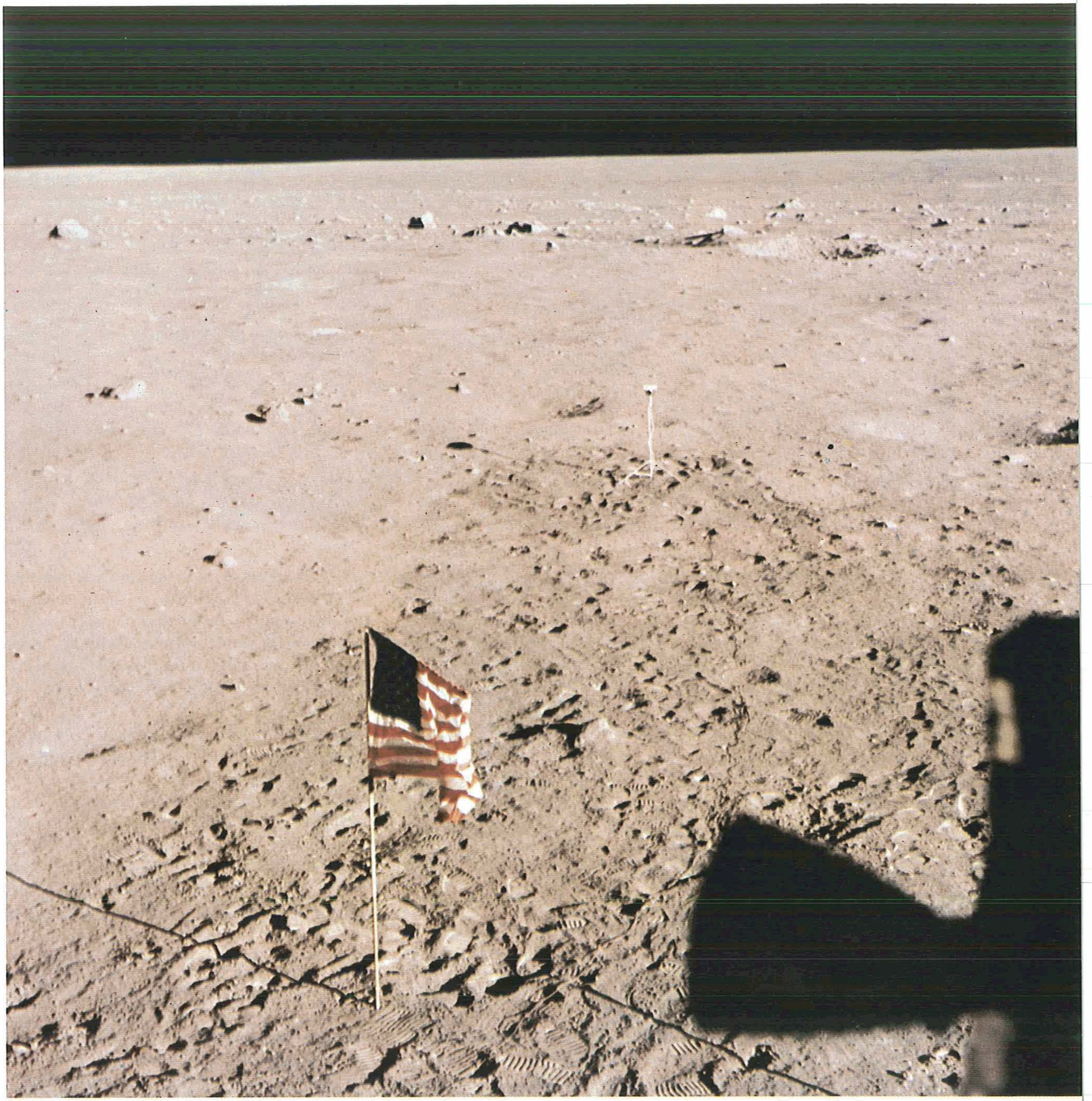
APOLLO 11 AS11-37-5456



APOLLO 11 AS11-37-5459

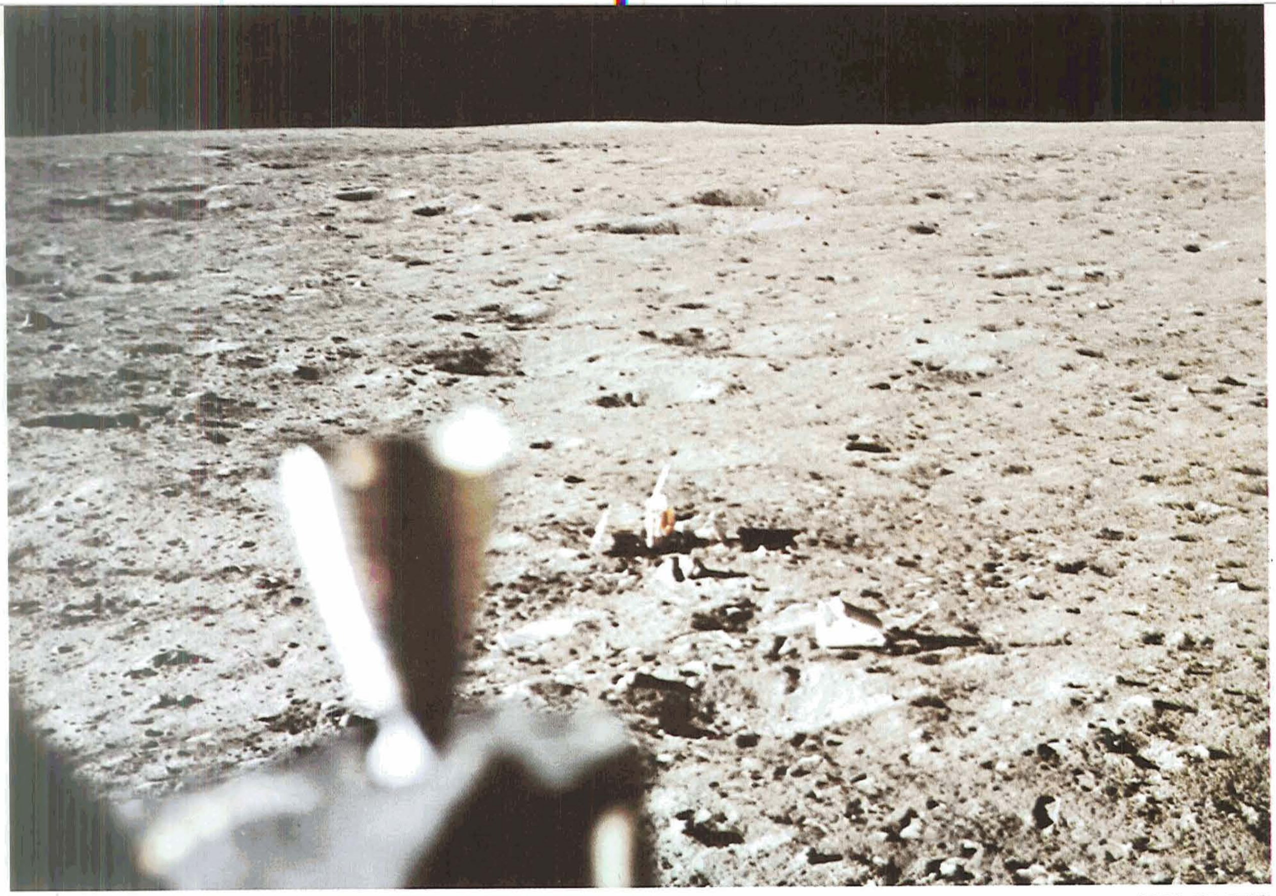
Top right: This view was taken before the Apollo 11 astronauts began their extravehicular activity. The area nearby is pockmarked with many small craters, and numerous boulders are strewn about the surface. Note the coarse, granular texture of the lunar surface.

Right: Looking southwest from Tranquility Base, the lunar surface appears relatively smooth, even under a low Sun elevation. The large crater has smooth undulations and the gentle rim lines that are associated with older craters. However, some of the minute craters seen are steep-walled and covered with small pebbles, features which perhaps denote a more recent origin.



APOLLO 11 AS11-37-5517

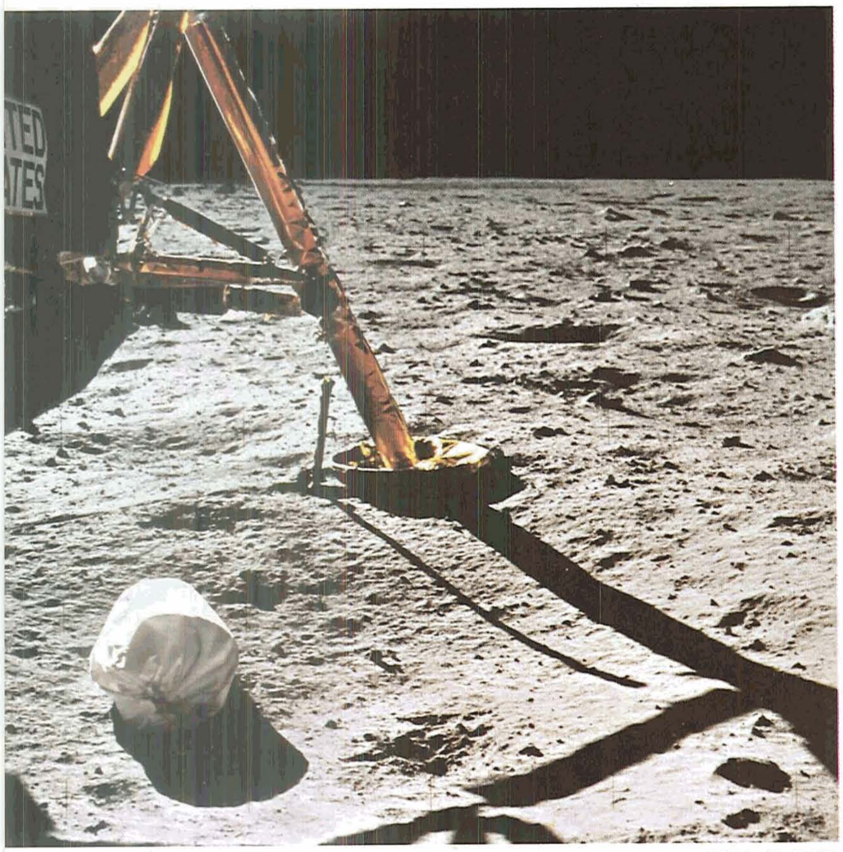
In the foreground is the U.S. flag. The brace on which the flag was mounted was bent slightly, giving the flag the appearance of being unfurled in a breeze. In the center background is the television camera mounted on its stand; the connecting cable can be seen at center foreground. The surface around the flag and the television camera has been disturbed by the footprints of the first men on the Moon, and the imprints of the cleated soles of the astronaut's boots are clearly evident.



APOLLO 11 AS11-37-5549

Above: This southern exposure from the lunar module shows the passive seismic experiment package (left) and the laser-ranging retroreflector experiment (right) deployed on the lunar surface. Many flat-rimmed craters pockmark the lunar surface as far into the distance as the eye and the camera lens can discern.

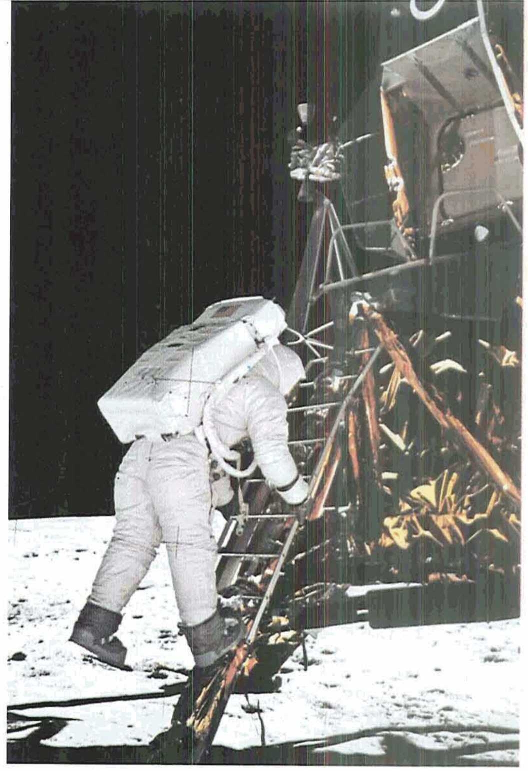
Left: In this view, the camera is looking toward the southeast, and a portion of the lunar module stands out clearly against the lunar terrain in the background. Three of the four legs of the lunar module had slender metallic breakaway probes that penetrated the lunar surface at touchdown. One of these probes can be seen embedded immediately behind the lunar module leg. The bag in the foreground was used for equipment transfer between the spacecraft and the lunar surface.



APOLLO 11 AS11-40-5850

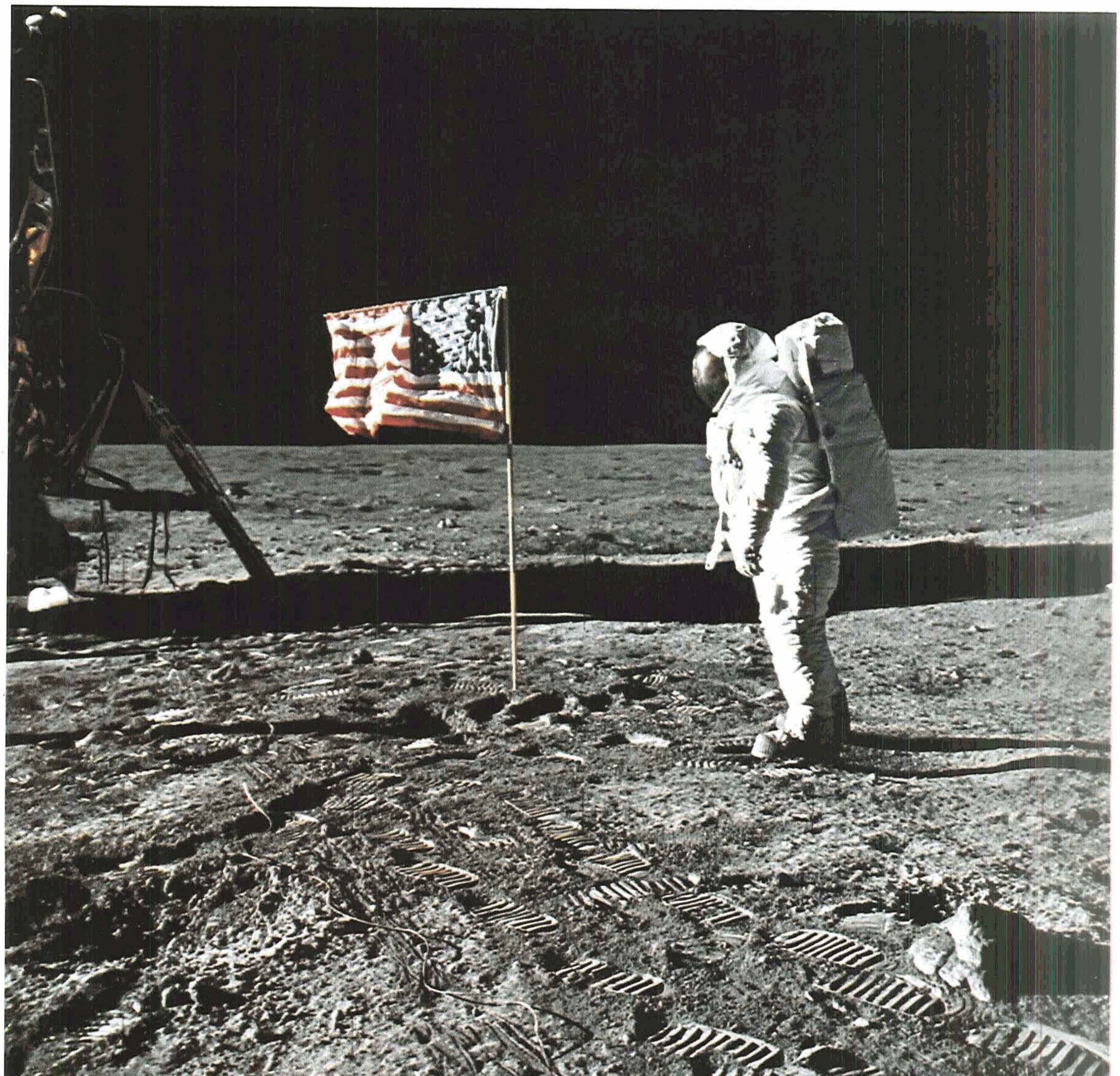
Right: Astronaut Edwin E. (Buzz) Aldrin, Jr., descends the ladder of the lunar module to the lunar surface for the first time.

Below: Astronaut Aldrin stands near the American flag. Footprints and the television camera cable are visible in the foreground.

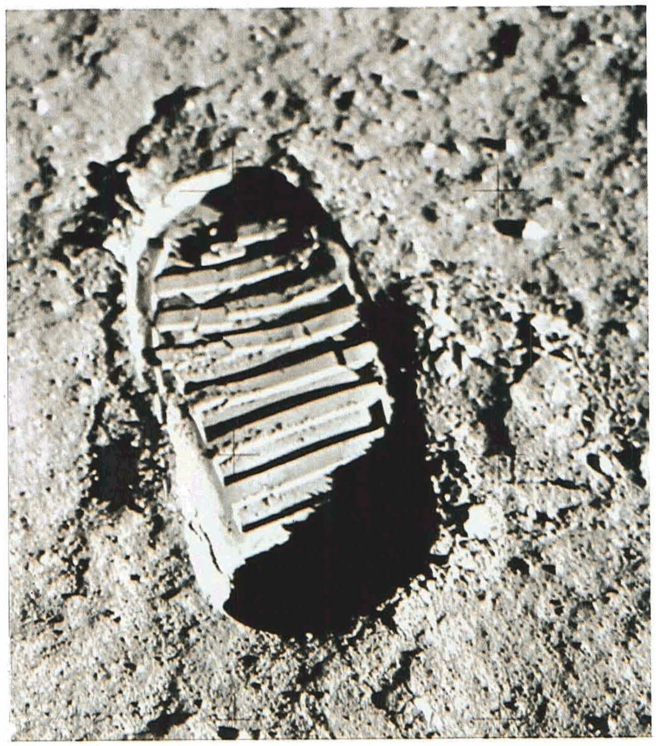


APOLLO 11 AS11–40–5868

APOLLO 11 AS11–40–5875



APOLLO 11 AS11–40–5880

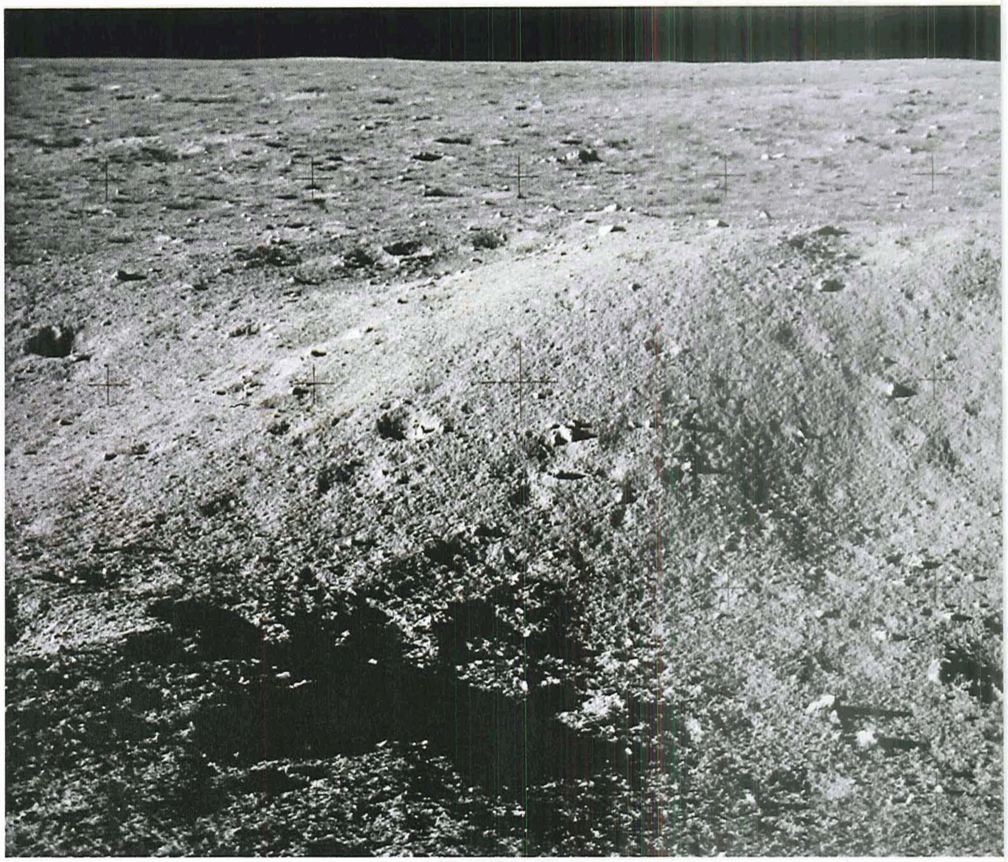


APOLLO 11 AS11–40–5877

Top: This almost-perfect outline of the traction cleats on the astronauts' boots implies that the lunar soil has a very fine texture. A more coarse material would not have permitted the appearance of such a fine detail.

Above: This overhead view shows a detailed section of the lunar surface and the amount of compaction caused by the weight of a man.

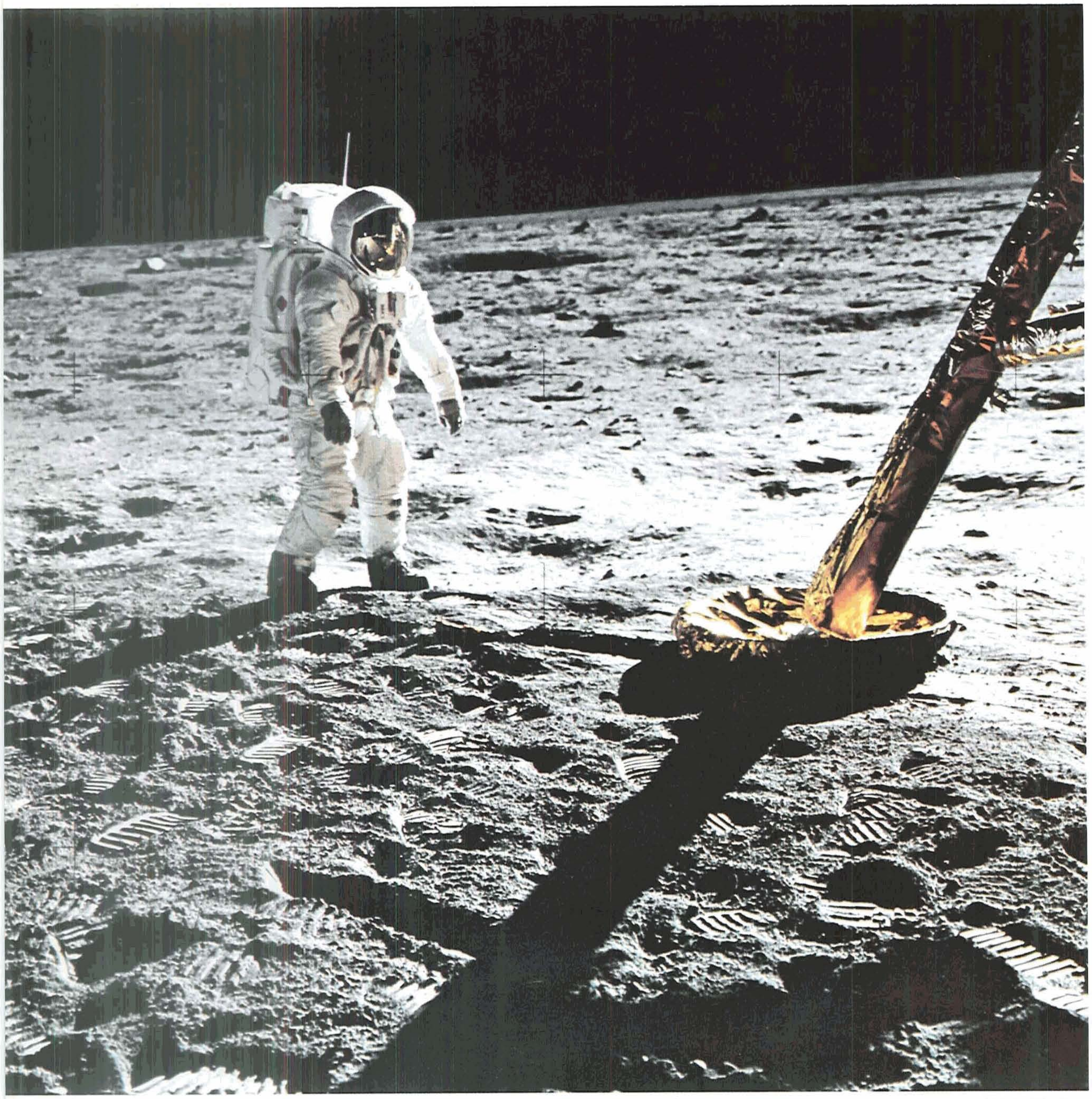
APOLLO 11 AS11–40–5885



APOLLO 11 AS11–40–5890

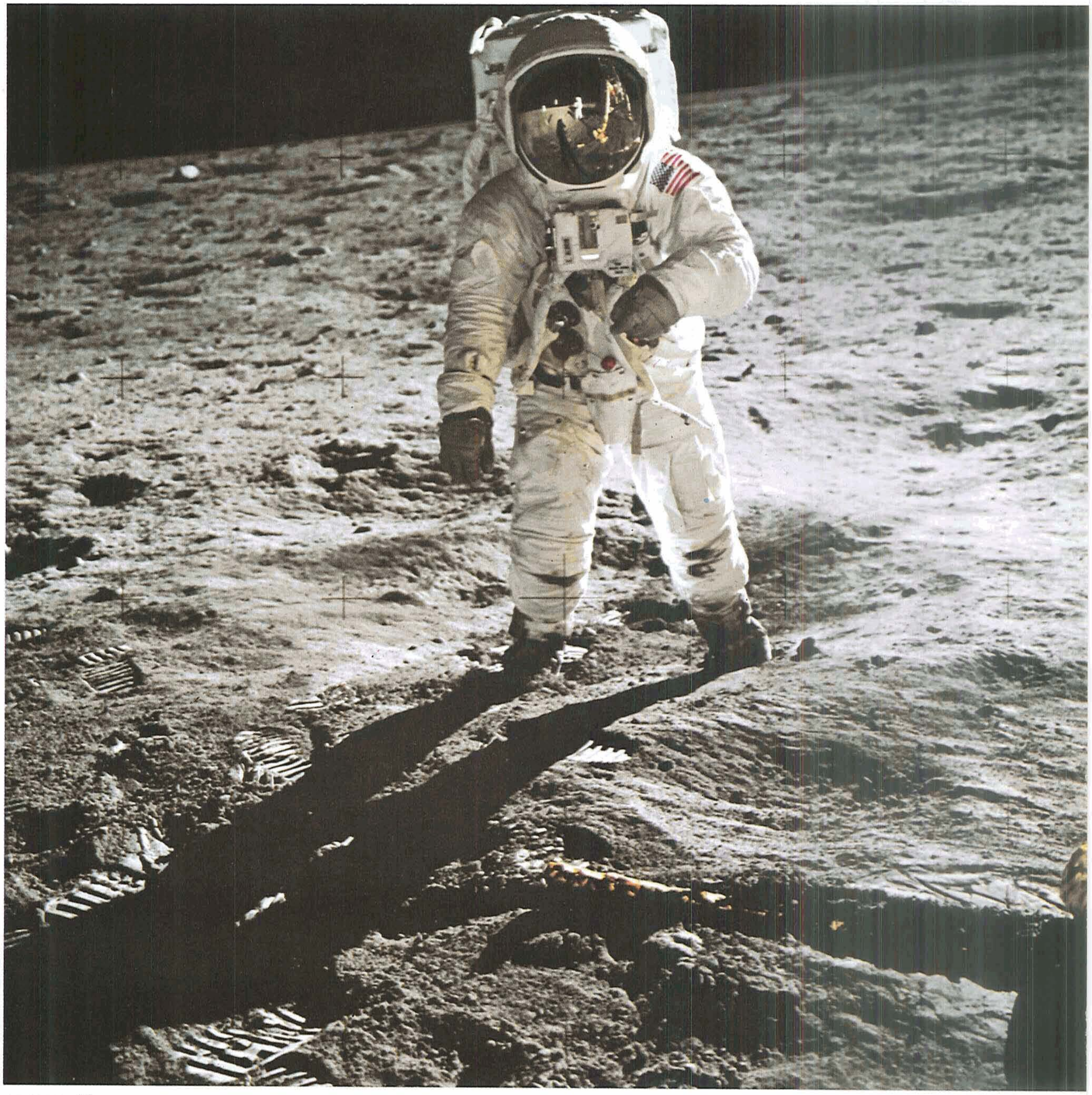
Top: To the right of the center, the television camera keeps a lonely vigil on man's first activities on the lunar surface. The paths made by the astronauts have uncovered a portion of the lunar surface that is darker than the undisturbed surrounding region.

Above: This view looks south across a portion of the rim of a 120-ft-diameter crater. The interior slopes of this crater are strewn with rocks and boulders. The intense blackness of shadows on the lunar surface can be seen from the shadows cast by the crater rim in the foreground of this photograph.



APOLLO 11 AS11-40-5902

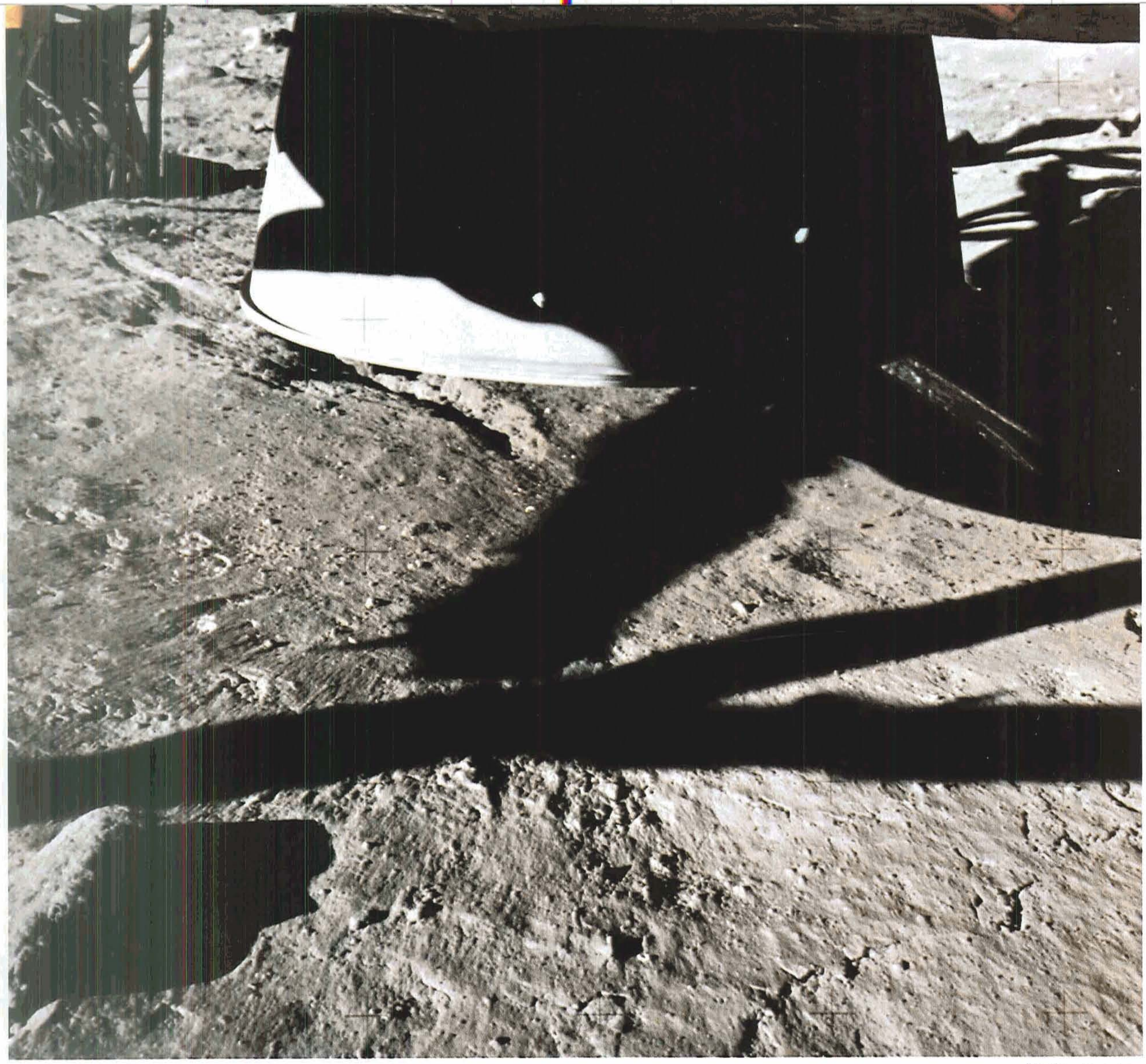
Astronaut Aldrin stands looking at the lunar module at Tranquility Base. The lack of a pronounced footpad imprint demonstrates the overall firmness of the surface. The scuffed footprints show the extremely fine granular texture of the lunar soil.



APOLLO 11

AS11–40–5903

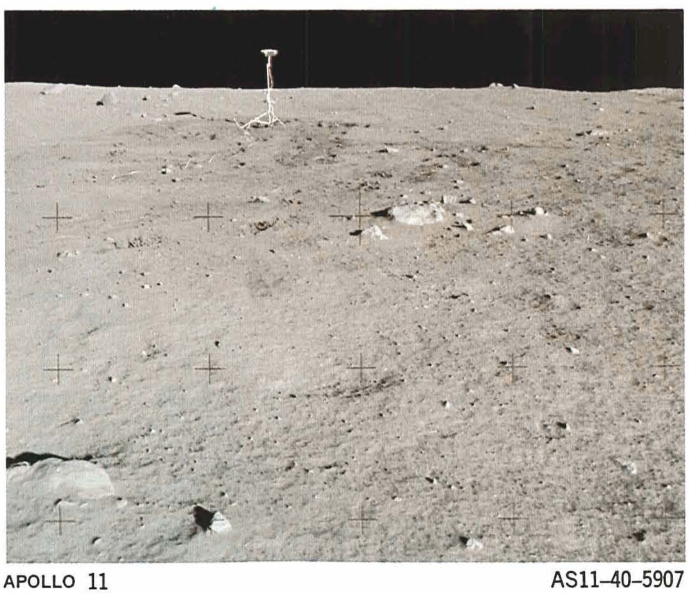
The image of astronaut Neil Armstrong photographing astronaut Aldrin is clearly seen in the reflections on the helmet visor of astronaut Aldrin. Astronaut Armstrong, the lunar module, and the shadow cast by Aldrin are mirrored in the reflection.



APOLLO 11 AS11-40-5921

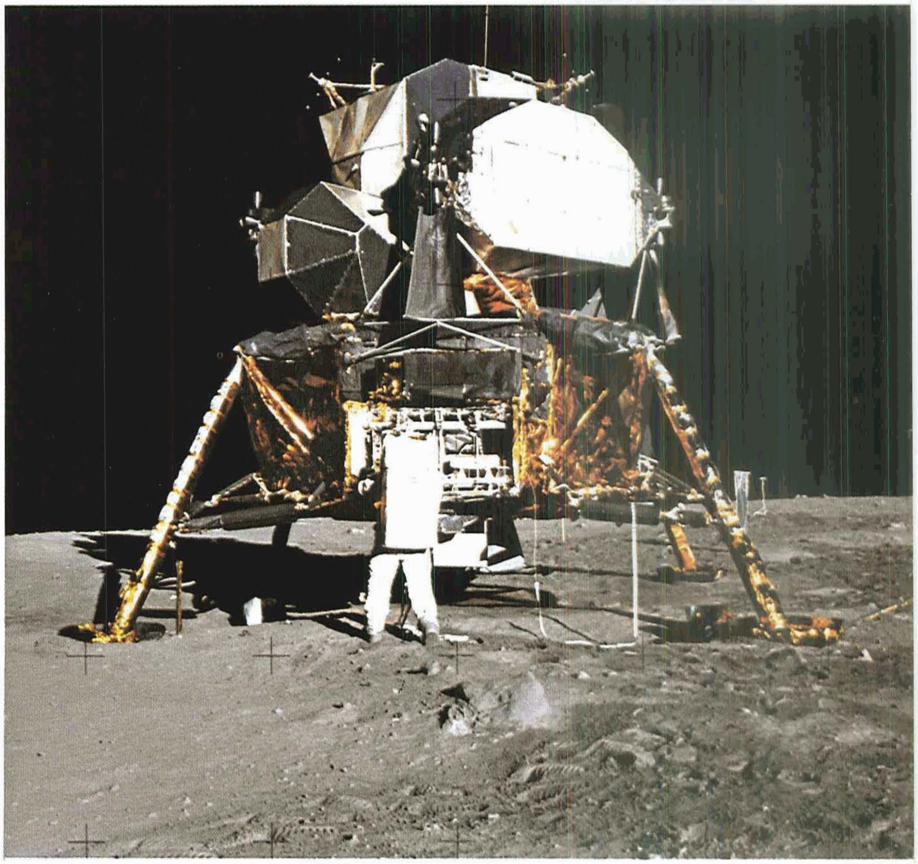
Above: In this view, the lunar surface beneath the descent engine nozzle (top center) is shown. The area has been swept clean of loose, unconsolidated material by the engine exhaust. Small radial striations emanate outward from the exhaust center, indicating the path taken by the expelled surface material.

Right: A small cluster of rocks, some smooth and others sharply angular, can be seen near the center of the landscape. The television camera mounted on its stand and the power cable leading from the camera to the lunar module are seen in the background. A crater is at top right on the horizon.



APOLLO 11 AS11-40-5907

APOLLO 11 AS11-40-5926



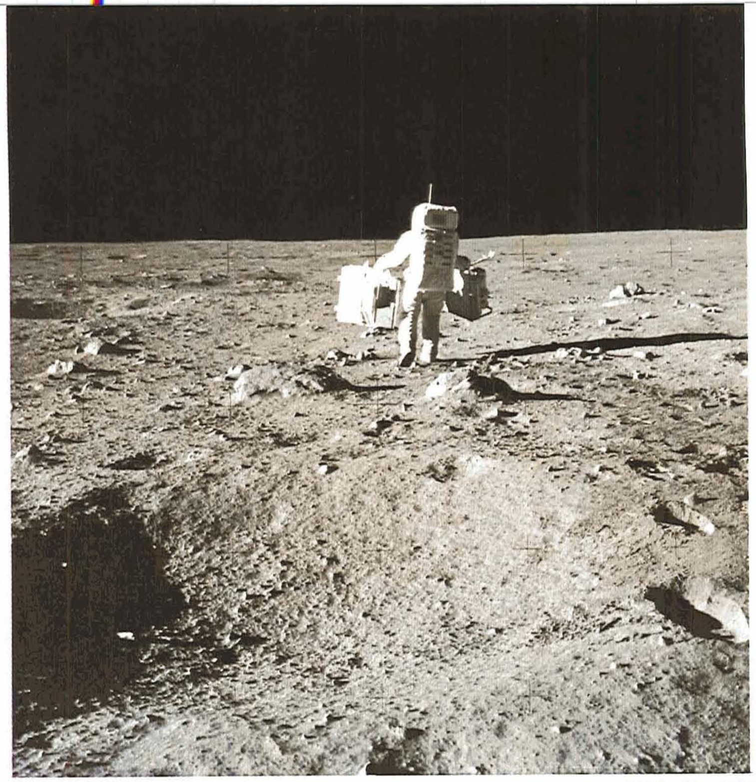
APOLLO 11 AS11-40-5927

Top right: Loose surface material disturbed by the lunar module footpad can be seen piled along the left side of the footpad. Penetration of the footpad into the lunar surface appears to have been minimal. The gold foil wrapping seen on this and other portions of the lunar module is a thermal barrier designed to protect the spacecraft from excessive heat.

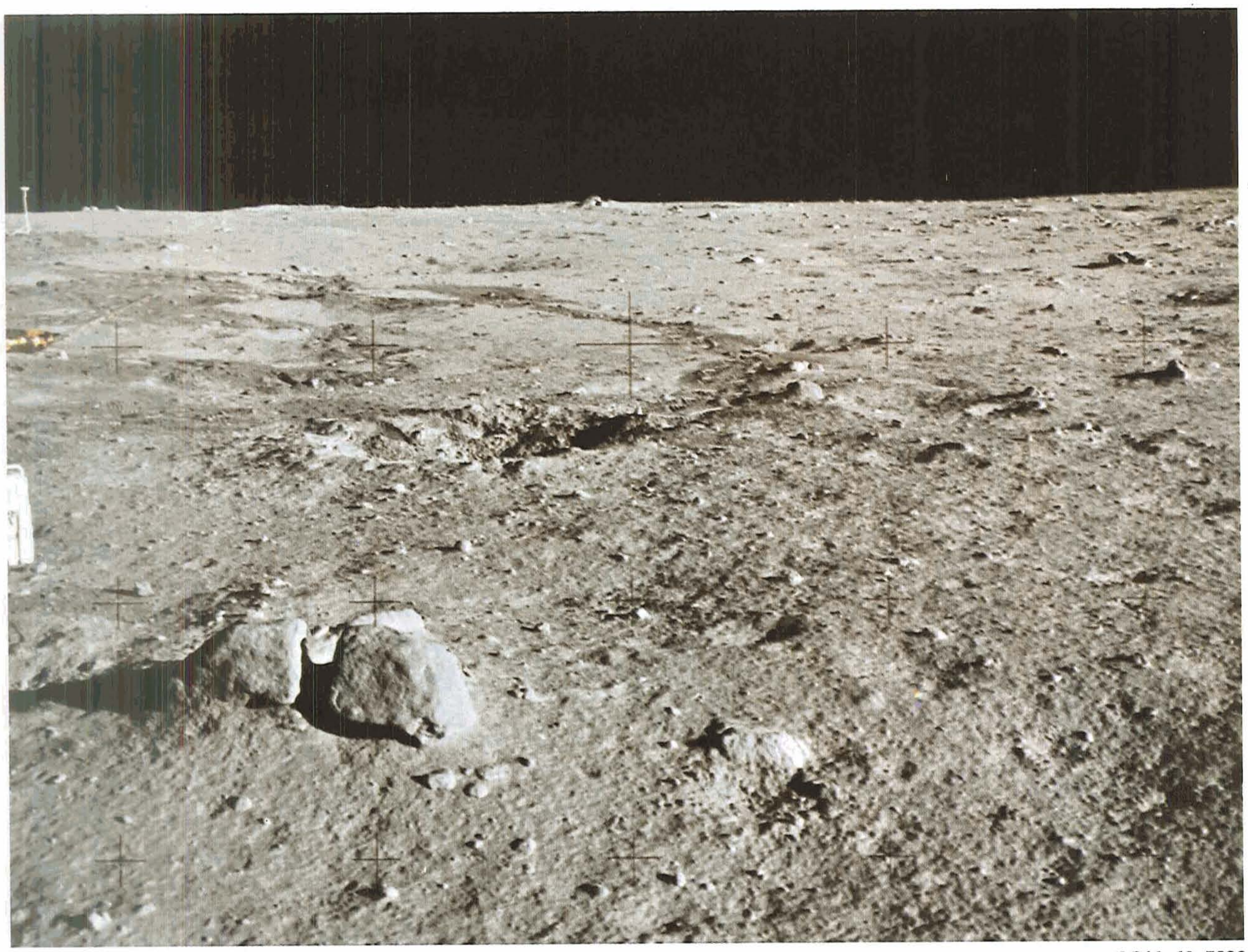
Right: This photograph shows the seismometer and the laser-ranging retroreflector being removed from the storage compartment in the descent stage. These are part of the Early Apollo Scientific Experiments Package (EASEP), which is deployed on the lunar surface to send data about the lunar environment back to the Earth.

Right: Astronaut Aldrin is shown in this view in the process of deploying the seismometer and the laser-ranging retroreflector experiment. This area is strewn with boulders and is the site of several large craters. At the right are the footprints Aldrin made as he carried the experiment equipment. The footprints are deeper than those seen in other photographs, probably because of the added weight of the equipment.

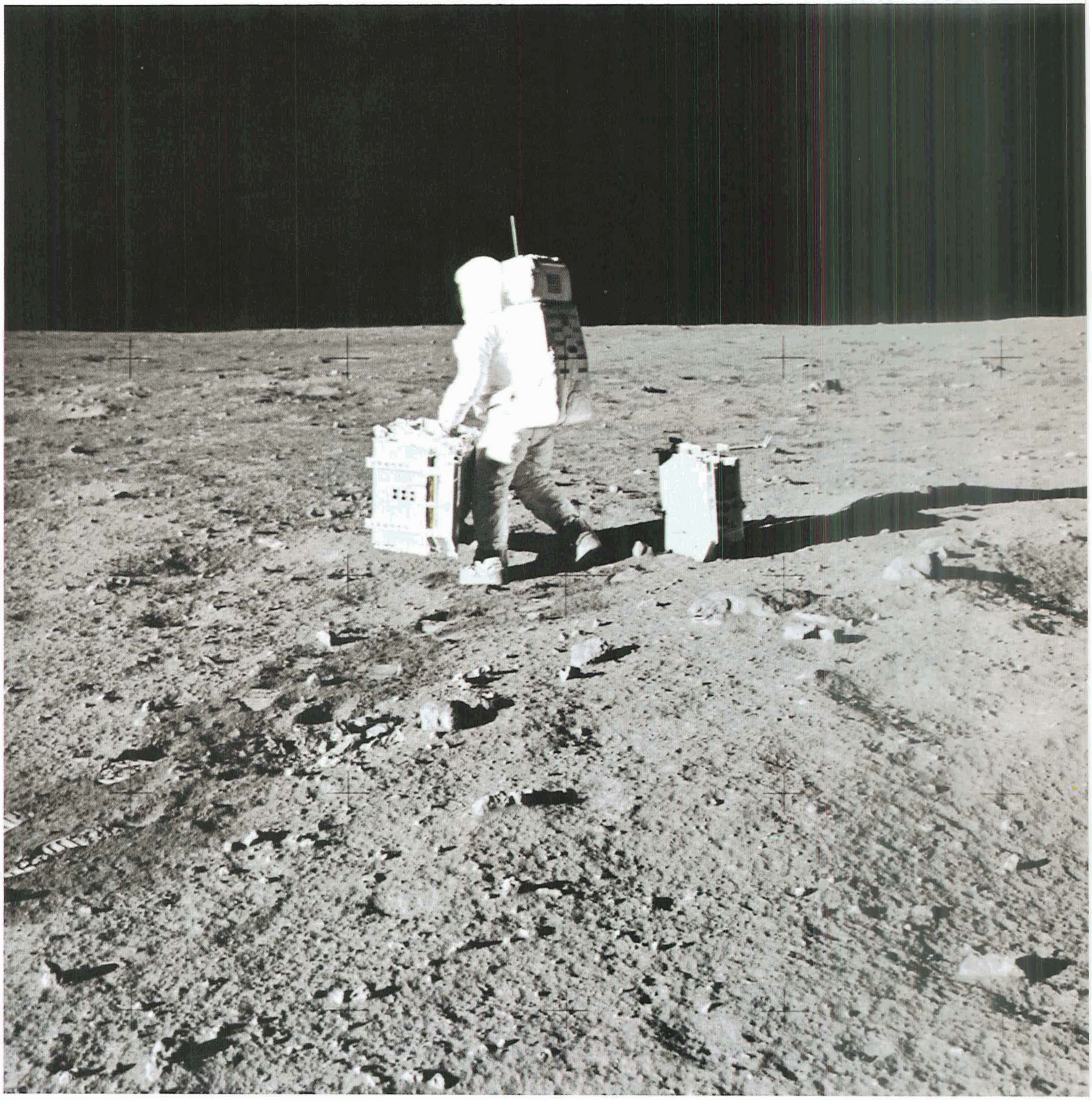
Below: The rather uniform cleavage between the two large rocks in the foreground indicates that they may have previously been a single large rock. In the background is a small crater with footprints around it, and at the extreme left center is the stereo camera that was used to photograph lunar sample locations.



APOLLO 11 AS11-40-5944

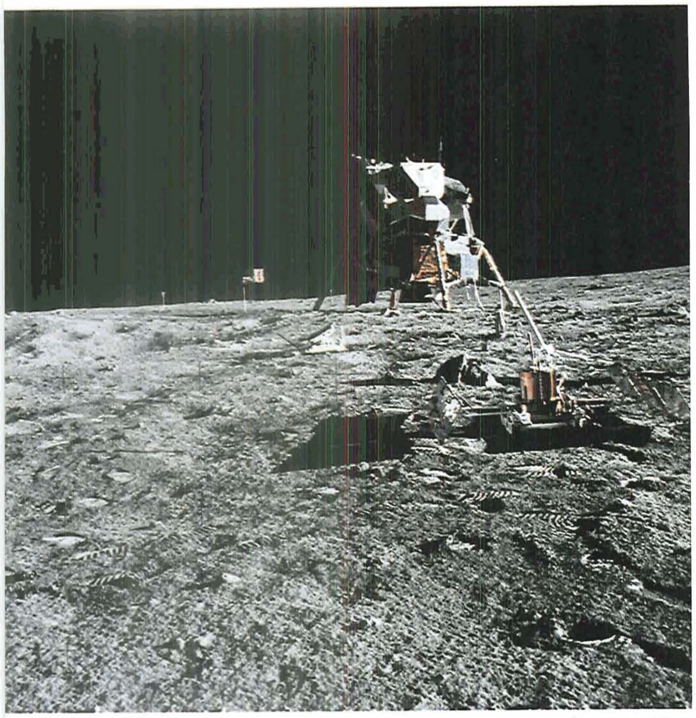


APOLLO 11 AS11-40-5932



APOLLO 11 AS11–40–5945

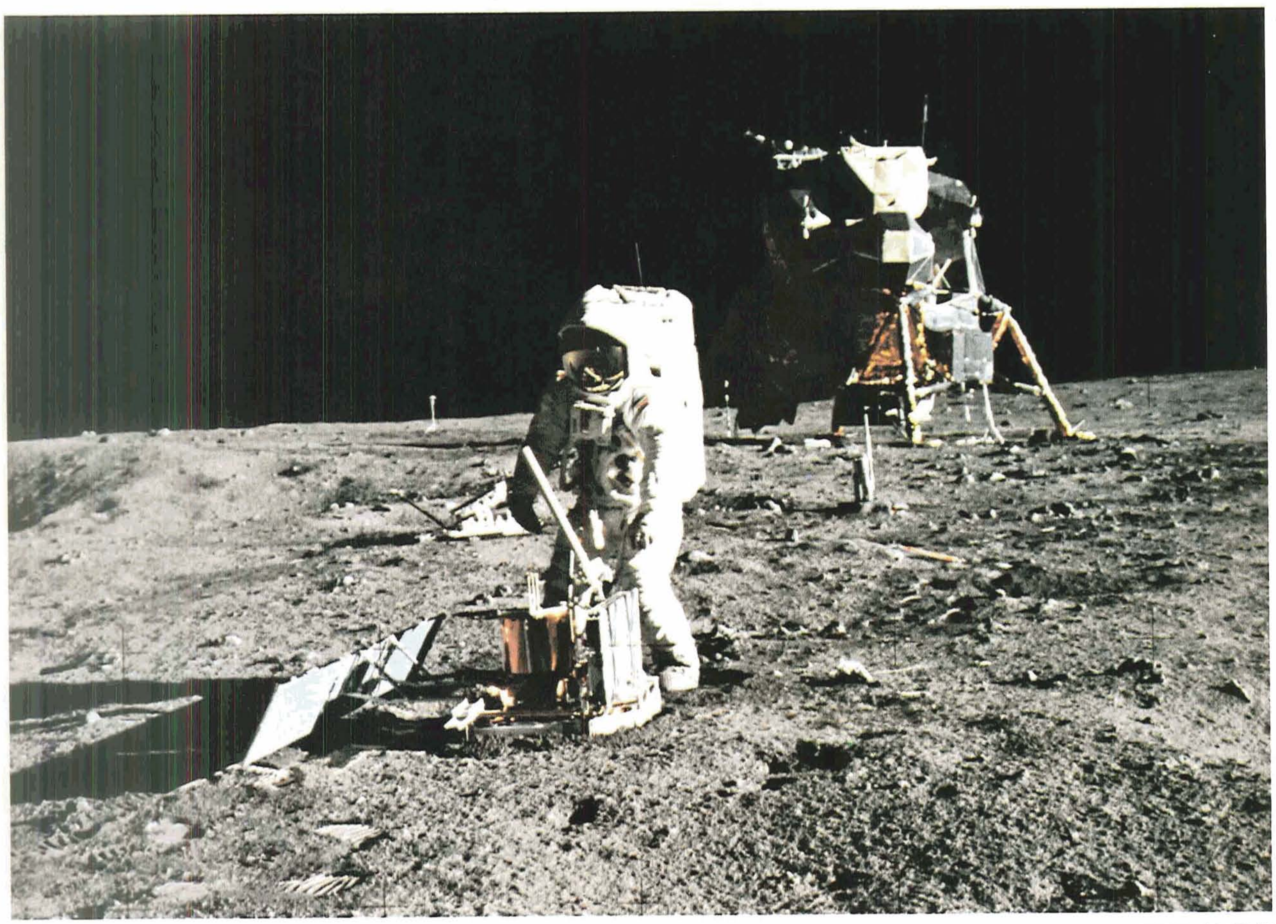
Astronaut Aldrin is shown in this view deploying the seismometer and the laser-ranging retroreflector.



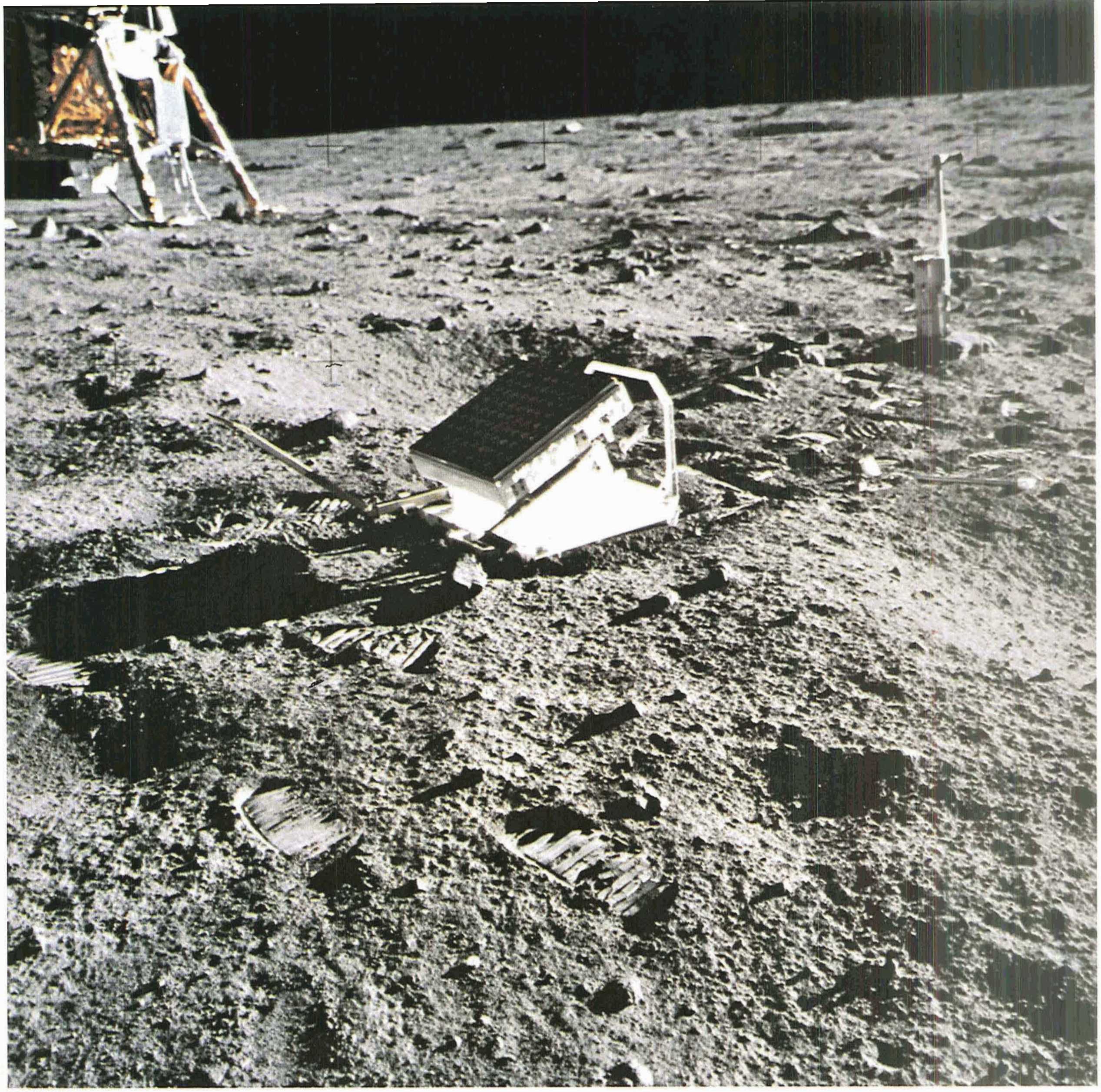
APOLLO 11 AS11-40-5950

Left: This view shows Tranquility Base and the arrangement of the scientific experiments. From left to right are the television camera, the American flag, the laser-ranging retroreflector, and the stereoscopic camera. The lunar seismic experiment equipment is visible in the foreground.

Below: Astronaut Aldrin is deploying the solar panels of the passive seismic experiment package. The laser-ranging retroreflector has already been deployed in the background. To the right of the laser-ranging retroreflector and in front of the lunar module is the stereo camera. On the horizon, just left of center, the television camera is visible.

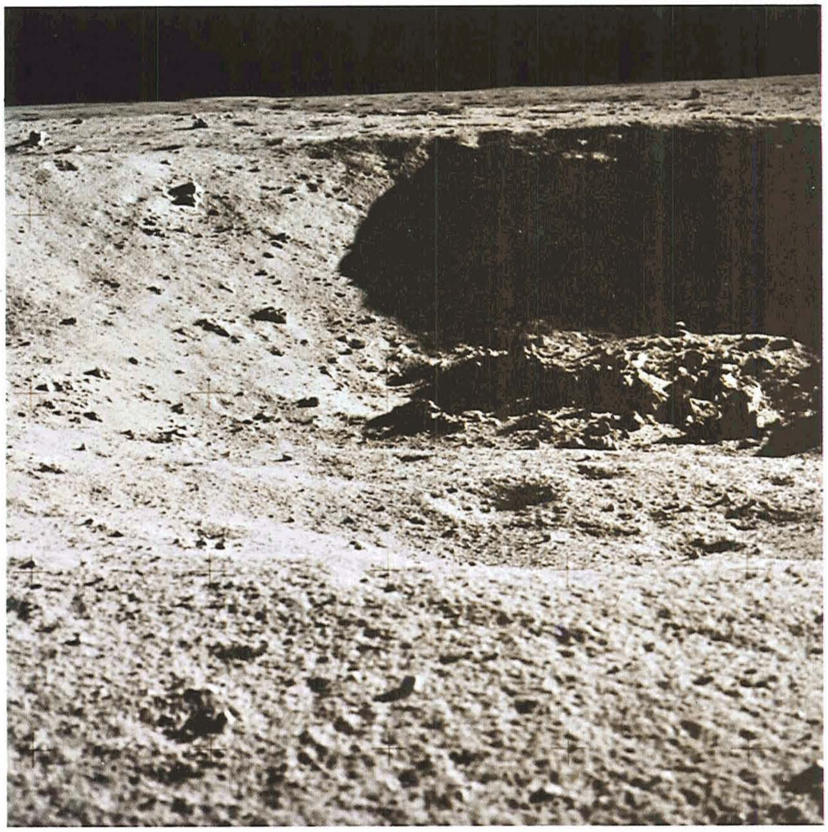


APOLLO 11 AS11-40-5947

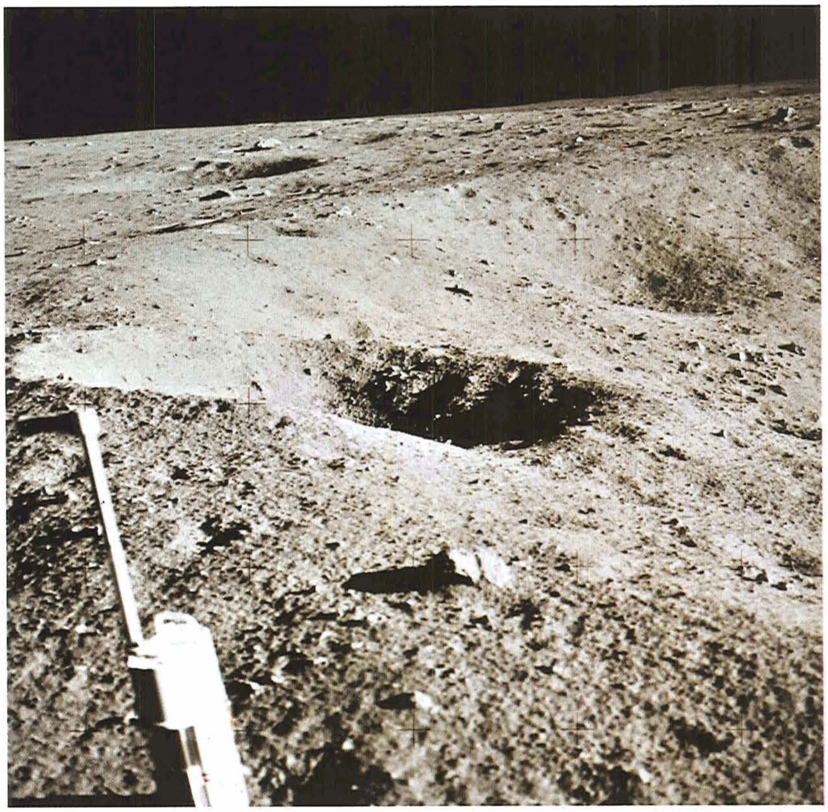


APOLLO 11 AS11–40–5952

This is a closeup view of the laser-ranging retroreflector experiment. The purpose of this experiment is to reflect back to Earth the laser beams directed at the reflector from Earth. From data obtained from this experiment, more precise Earth-to-Moon distances can be determined.



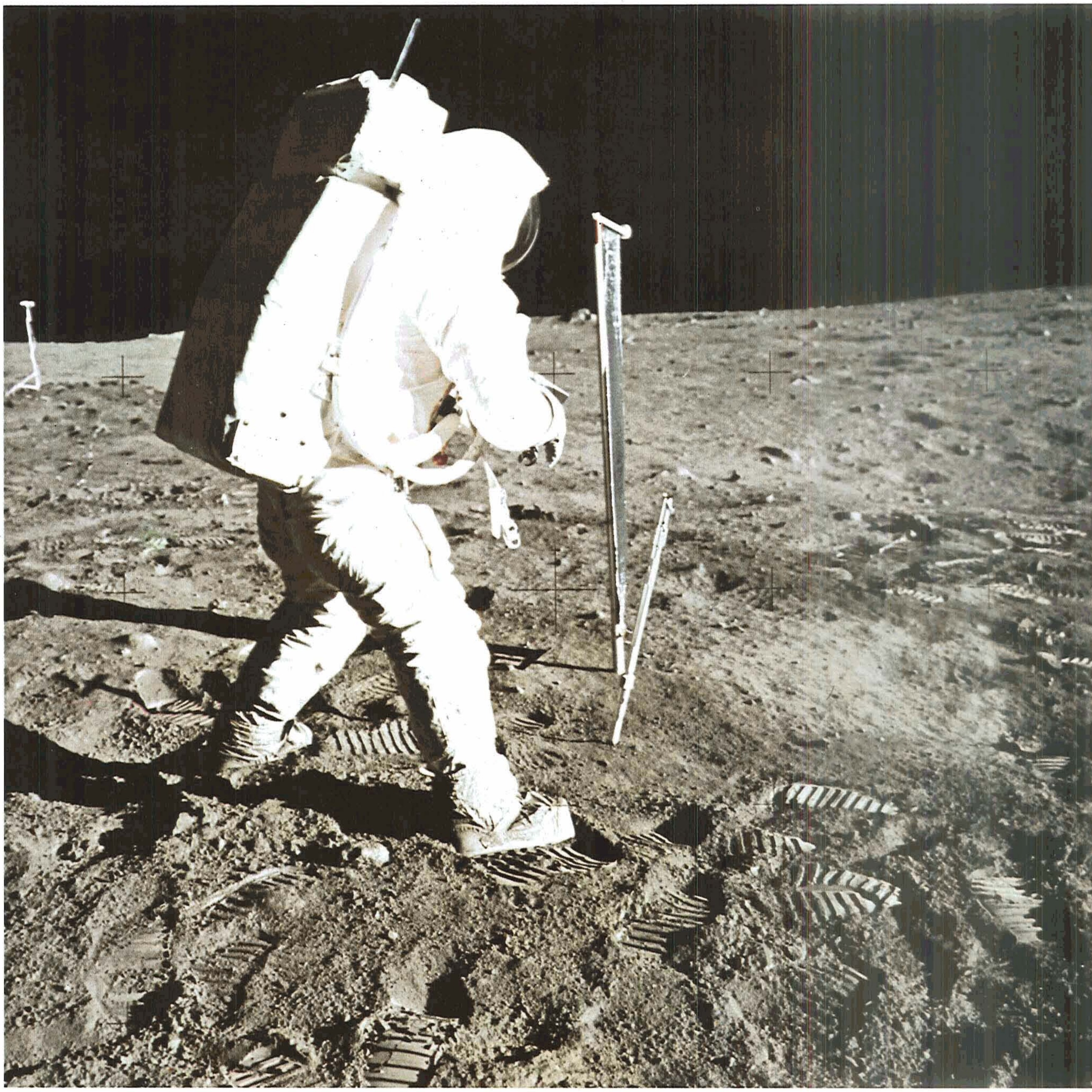
APOLLO 11 AS11-40-5956



APOLLO 11 AS11-40-5958

Top right: In this view of the central portion of a 120-ft-diameter crater, a concentration of rubble and large debris can be seen. This is probably material that was not ejected during the crater-formation process.

Right: This view of the western portion of the 120-ft-diameter crater shows a fairly large crater at left center on the edge of the rim. Two other craters of considerable size are also visible; one crater is just inside the rim at top center, and the other crater is at top left outside the rim. In the foreground is the stereo camera.

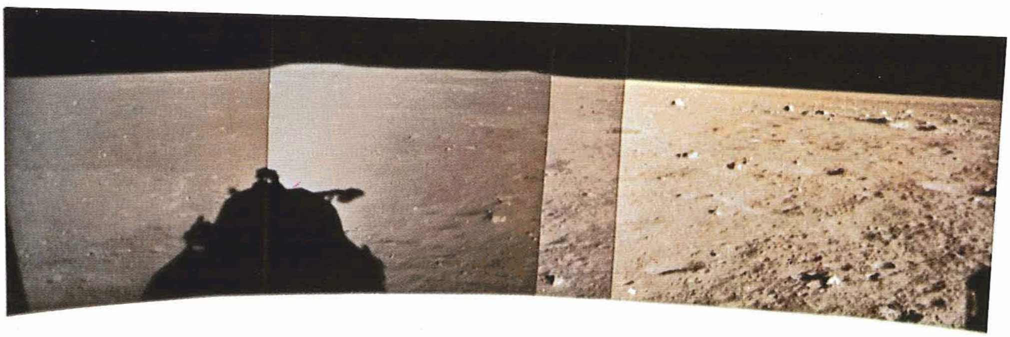


APOLLO 11 AS11-40-5963

Here, a core sample tube is being pounded into the lunar surface by astronaut Aldrin. Next to the core sample tube is the mast that is holding the solar-wind foil panel. The television camera is at the upper left.

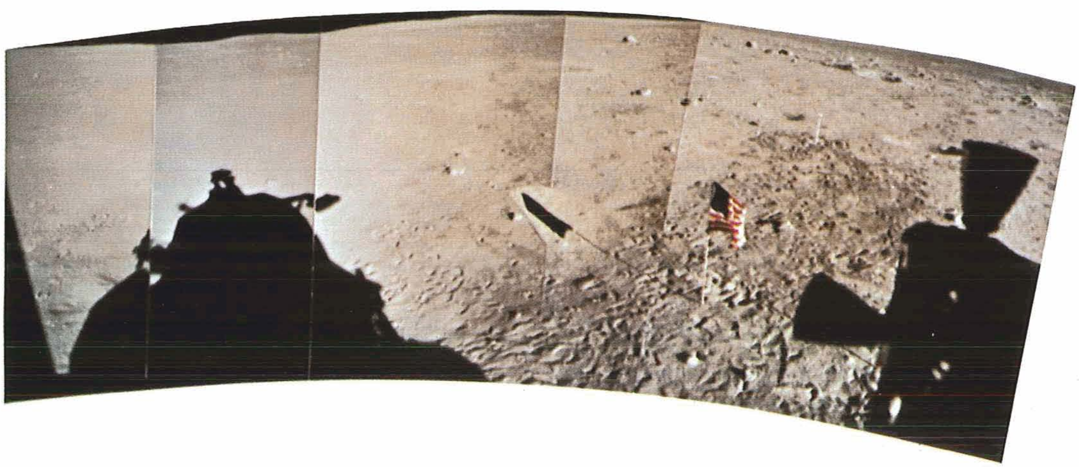
APOLLO 11 AS11–40–5899

This is the plaque that was left on the Moon proclaiming that the Apollo 11 astronauts "came in peace for all mankind."



APOLLO 11 Panorama A

This panorama was taken from the lunar module before extravehicular activity was begun.

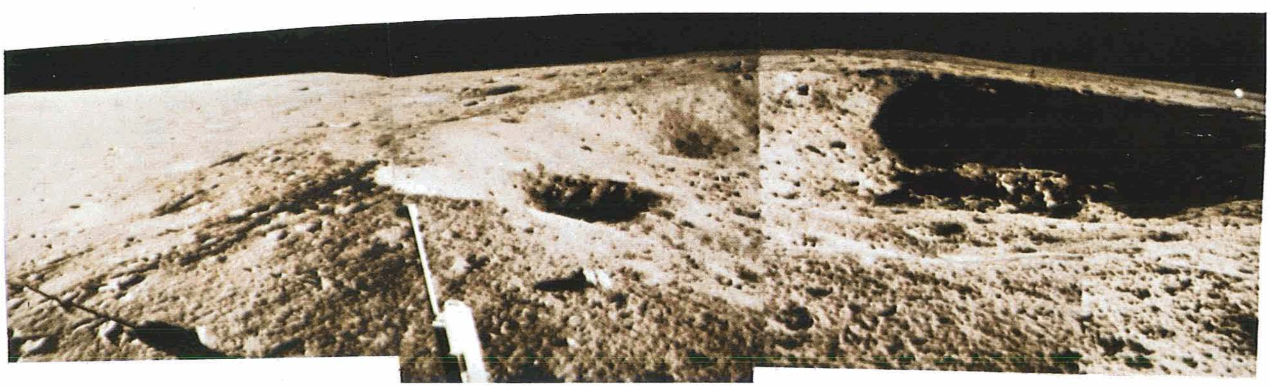


APOLLO 11 Panorama A

This panorama was taken from the lunar module after the historic "Moon walk."

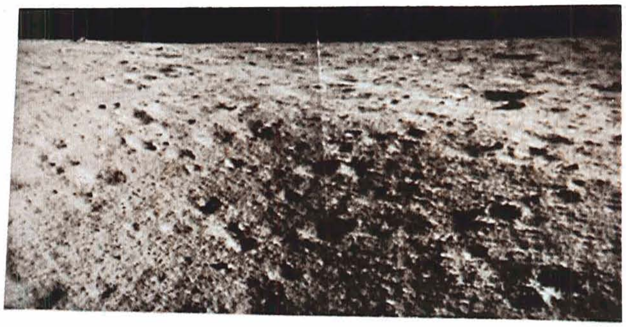
APOLLO 11 Panorama B

This panorama was taken looking east from the lunar surface.



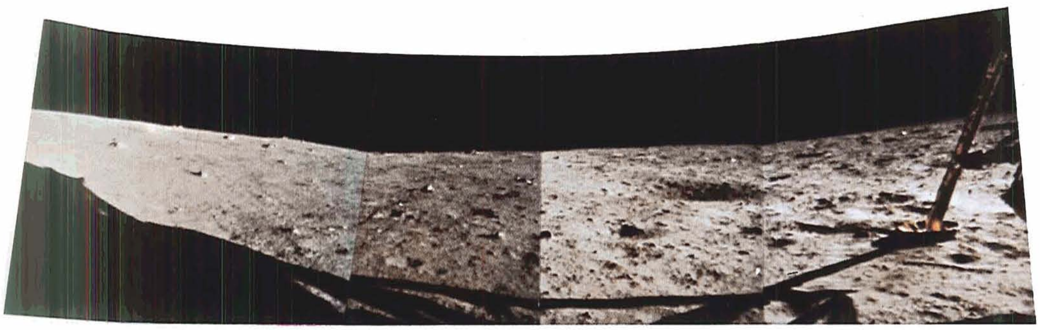
APOLLO 11 Panorama B

This panorama, taken from the lunar surface, shows the large crater that was approximately 20 ft east of the lunar module.



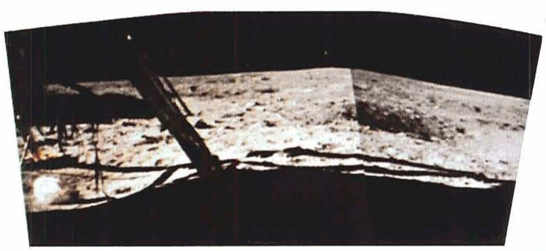
APOLLO 11 Panorama C

This panorama was taken looking northwest from the lunar surface.



APOLLO 11 Panorama C

This panorama was taken looking north from the lunar surface.

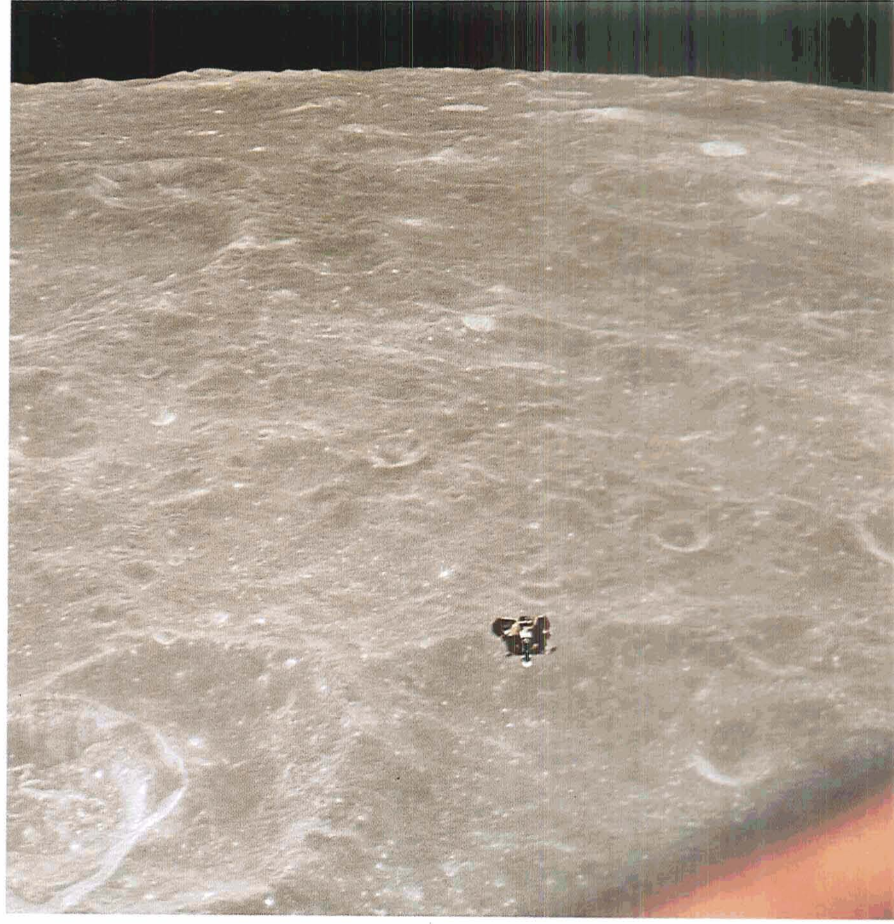


APOLLO 11 Panorama C

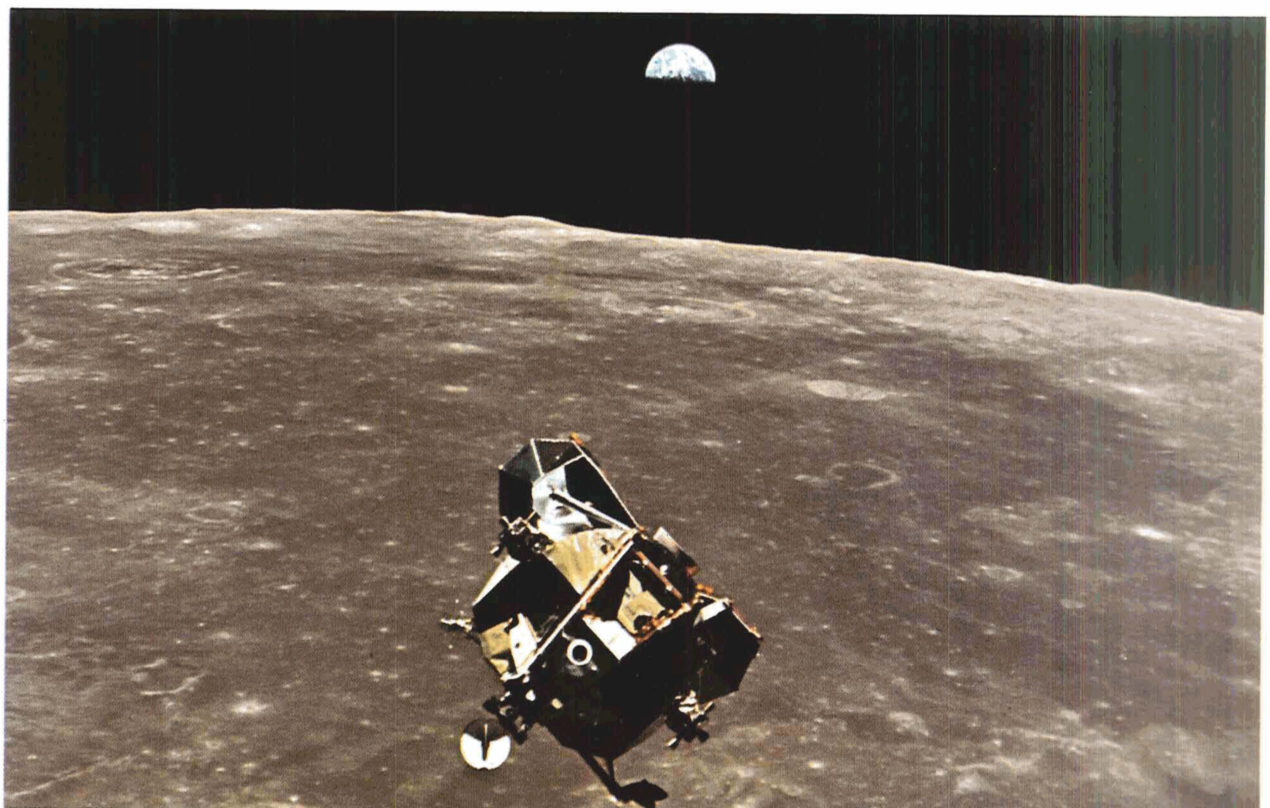
This panorama was taken looking south from the lunar surface.

Right: The ascent stage of the lunar module Eagle is shown preparing to rendezvous with the command module Columbia.

Below: Eagle prepares to dock with Columbia after man's first successful landing on the Moon.



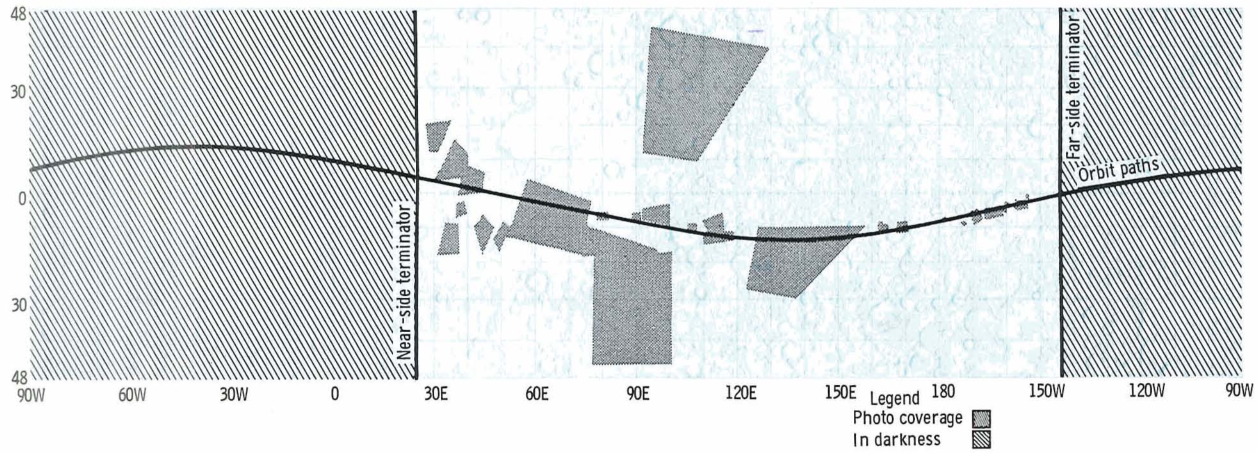
APOLLO 11 AS11–44–6623



APOLLO 11 AS11–44–6643

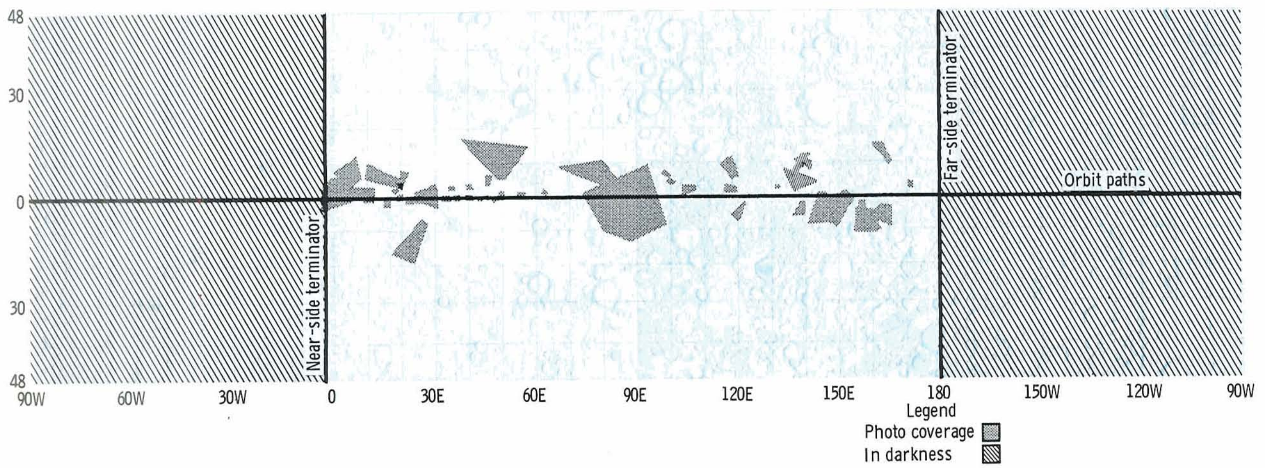
APPENDIX A
PHOTOGRAPHIC INDEXES

APOLLO 8



Frame no.	*Description*	*Principal point*		*Focal length, mm*	*Sun angle*			*View*		*Page no.*
		Longitude	*Latitude*		*High*	*Medium*	*Low*	*Vertical*	*Oblique*	
AS8–12–2052	Keyhole-shaped crater	157 W	5 S	80			X	X		6
2148	Far-side basin	106 E	10 S	80	X			X		7
2169	Mare Smythii	90 E	8 S	80	X			X		7
2189	Humboldt and Langrenus	72 E	26 S	80		X			X	8
2192	Mare Australe	100 E	40 S	250		X			X	8
2193	Humboldt	90 E	27 S	250	X				X	9
2196	Tsiolkovsky	130 E	21 S	250	X				X	9
2203	Langrenus	68 E	9 S	250		X		X		10
2209	Joliot-Curie	100 E	24 N	250	X		X		X	11
AS8–13–2220	Mare Fecunditatis and Bellot	49 E	12 S	80			X		X	12
2225	Goclenius	45 E	11 S	80			X		X	13
2228	Lubbock D and Gutenberg Rilles	38 E	6 S	80			X		X	14
2243	Fracastorius and Daguerre	35 E	15 S	80			X		X	15
2269	Behaim	79 E	18 S	80		X			X	16
2271	Taruntius F	40 E	4 N	80			X		X	16
2279	Maskelyne F	35 E	4 N	80			X		X	17
2314	Far-side terminator	150 W	12 S	80			X		X	17
2344	Rima Cauchy	On horizon		80			X		X	18
2347	Vitruvius	In space		80			X		X	19
AS8–14–2383	Earthrise			250	X				X	27
2399	Far-side basin	155 W	3 S	250			X	X		20
2401	Far-side basin	156 W	3 S	250			X	X		20
2409	Far-side basin	162 W	4 S	250			X	X		21
2410	Far-side basin	163 W	6 S	250			X	X		22
2412	Far-side basin	165 W	7 S	250			X		X	22
AS8–14–2420	Far-side crater	175 W	10 S	250		X		X		22
2423	Far-side crater	180 W	8 S	250		X		X		23
2433	Far side, central highland	161 E	10 S	250		X			X	24
2439	Far-side craters	150 E	12 S	250	X				X	24
2442	Far side, adjacent-walled craters	137 E	12 S	250	X				X	25
2451	Tsiolkovsky	128 E	21 S	250	X				X	26
2453	Far side	113 E	12 S	250	X				X	26
2485	Lunar disk			250						3
AS8–16–2616	Langrenus	61 E	9 S	250		X			X	28

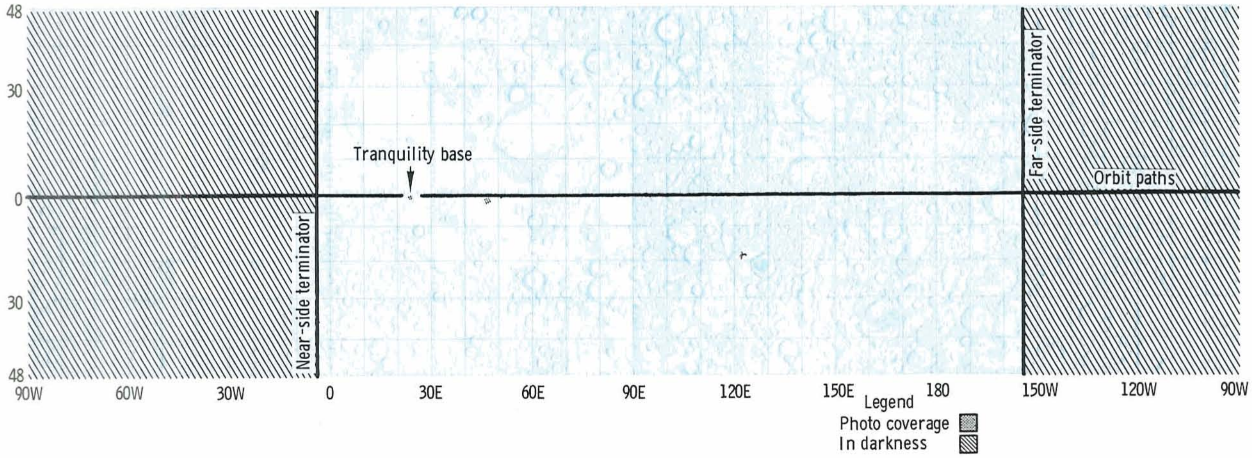
Frame no.	Description	Principal point		Focal length, mm	Sun angle			View		Page no.
		Longitude	Latitude		High	Medium	Low	Vertical	Oblique	
AS8–17–2664	Far-side craters	157 W	4 S	80			X	X		29
2670	Far-side crater	162 W	7 S	80			X		X	29
2673	Far-side crater chain	166 W	6 S	80			X		X	30
2676	Keyhole-shaped crater	170 W	0	80			X	X		31
2697	Far-side crater	170 E	11 S	80		X			X	31
2704	Far-side crater	164 E	10 S	80		X		X		32
2736	Far-side crater	127 E	12 S	80	X				X	33
2748	Far-side crater	110 E	10 S	80	X				X	34
2776	Far-side craters	93 E	9 S	80	X				X	35
2785	South of Mare Smythii	81 E	9 S	80	X				X	35
2814	Mare Tranquillitatis and Mare Fecunditatis			80			X		X	33



Frame no.	Description	Principal point: Longitude	Principal point: Latitude	Focal length, mm	Sun angle: High	Sun angle: Medium	Sun angle: Low	View: Vertical	View: Oblique	Page no.
AS10–27–3873	Command module	85 E	0	250	X				X	36
3905	Sinus Medii	4 E	1 N	250			X		X	37
3907	Sinus Medii	1 E	1 N	250			X		X	37
3915	Mare Smythii	88 E	3 S	250	X			TEI		5
3929	Mare Smythii and Mare Moscoviense			250				TEI		4
3955	Moon			250				TEI		3
AS10–28–4012	Far-side crater	123 E	5 S	250	X				X	38
4013	Far-side crater	124 E	3 S	250	X				X	38
4035	Maskelyne T	37 E	0	80		X		X		39
4040	Censorinus	32 E	0	80		X		X		39
4052	Tranquility Base	26 E	1 N	80		X			X	39
4067	Far-side crater	172 E	0	80	X			X		40
4106	Far-side craters	133 W	1 N	80	X			X		41
AS10–29–4180	Far-side craters	149 E	7 S	80		X			X	41
4183	Far-side crater	142 E	2 N	80	X				X	42
4189	Far-side crater	139 E	2 N	80	X				X	42
4205	Far-side craters	119 E	0	80	X				X	43
4224	Far-side crater	100 E	3 N	80	X				X	43
4226	Eastern limb	97 E	1 N	80	X				X	44
4230	Mare Smythii	81 E	1 S	80	X				X	45
4253	Messier B	48 E	1 S	80		X			X	46
4256	Messier craters	47 E	3 S	80		X			X	46
4261	Secchi K	45 E	0	80		X			X	47
4265	Secchi UA	42 E	0	80		X			X	48
4276	Mare Tranquillitatis	38 E	0	80		X			X	49
4312	Mare Tranquillitatis	25 E	0	80		X			X	50
AS10–29–4324	Moltke	24 E	0	80		X			X	50
AS10–30–4356	Far-side crater	119 E	4 N	250		X			X	51
4371	Far-side craters	107 E	0	250		X			X	52
4372	Far-side ray crater	100 E	4 N	250		X			X	53
4426	Taruntius A	50 E	7 N	250	X				X	54
4450	Rima Ariadaeus	17 E	5 N	250		X			X	55

Frame no.	Description	Principal point		Focal length, mm	Sun angle			View		Page no.
		Longitude	Latitude		High	Medium	Low	Vertical	Oblique	
AS10-31-4506	Mare Fecunditatis	56 E	2 N	80	X			X		56
4512	Taruntius G	50 E	1 N	80	X			X		56
4521	Secchi θ	40 E	1 N	80		X		X		57
4528	Maskelyne D	33 E	2 N	80	X				X	57
4546	Theon Senior	16 E	0	80			X	X		58
4566	Taruntius	46 E	6 N	250	X				X	59
4580	Maskelyne F	35 E	4 N	250	X				X	59
4601	Moltke	24 E	1 S	250	X				X	60
4621	Rima Hypatia I and II	22 E	0	250	X				X	61
4630	Arago	22 E	6 N	250	X				X	61
4646	Rima Ariadaeus	13 E	7 N	250		X			X	62
4647	Godin	11 E	2 N	250		X			X	63
4654	Far-side crater	164 E	10 N	250		X			X	64
4665	Far-side basin	143 E	7 N	250	X				X	65
4673	Far-side basin	140 E	7 N	250	X				X	65
AS10-32-4716	Theophilus	25 E	12 S	250		X			X	67
4734	Chladni	1 E	4 N	250		X			X	68
4771	Lade	10 E	0	80	X			X		68
4774	Highlands	8 E	0	80			X	X		69
4813	Hyginus	5 E	8 N	80			X		X	70
4819	Triesnecker	4 E	5 N	80			X		X	70
AS10-32-4823	Far-side craters	162 E	10 S	80			X		X	71
4828	Far-side crater	146 E	4 S	80	X				X	71
4856	Rhaeticus	2 E	0	80			X		X	72
AS10-33-4914	Far-side crater chain	139 E	7 N	250	X				X	66
4947	Rhaeticus A	6 E	1 N	80			X	X		72
4975	Far-side crater	139 E	6 S	250	X				X	66
4999	Mare Smythii	82 E	1 S	250	X				X	45
AS10-34-5014	Earth	In space		80				TLI		2
5073	Rima Hypatia I	24 E	1 S	80			X	X		73
5081	Neper	85 E	4 N	80	X				X	74
5096	Picard	50 E	11 N	80		X			X	75
5099	Mare Tranquillitatis	27 E	1 N	80	X				X	76
5129	Mare Spumans	64 E	1 N	250	X				X	78
5136	Taruntius H	50 E	0	250	X				X	79
5145	Taruntius F	40 E	3 N	250	X				X	79
5150	Mare Tranquillitatis	35 E	2 N	250		X		X		78
5152	Maskelyne X	27 E	1 N	250		X			X	76
5153	Maskelyne G	27 E	1 N	250		X			X	77
5160	Ritter	19 E	2 N	250			X		X	80
5162	Schmidt	20 E	1 N	250			X		X	81
5167	Godin D	8 E	2 N	250			X	X		82
5171	Far-side crater	161 E	5 S	80		X			X	83
5172	Far-side crater	158 E	6 S	80		X			X	84
5173	Far-side craters	157 E	9 S	80		X			X	84

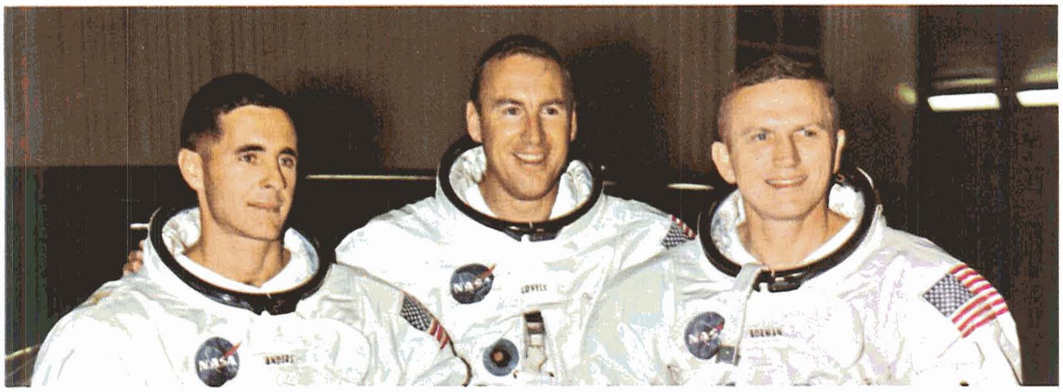
APOLLO 11



Frame no.	*Description*	*Principal point*		*Focal length, mm*	*Sun angle*			*View*		*Page no.*
		Longitude	*Latitude*		*High*	*Medium*	*Low*	*Vertical*	*Oblique*	
AS11-37-5437	Tranquility Base	24 E	0	80			X		X	87
5447	Moltke and command module	23 E	0	80			X	X		86
5448	Command module above Schmidt	18 E	0	80			X	X		86
5456	Tranquility Base before extra-vehicular activity			80			X			88
5459	Southwest from Tranquility Base			80			X			88
5517	U.S. flag and television camera			80						89
5549	Seismic and laser experiments			80						90
AS11-38-5602	Messier A	47 E	2 S	80			X		X	47
AS11-40-5850	LM footpad			60						90
5868	Aldrin on ladder			60						91
5875	Aldrin near U.S. flag			60						91
5877	Astronaut's bootprint			60						92
5880	Astronaut's boot			60						92
5885	Television camera and footprints			60						93
5890	Across 120-ft-diameter crater			60						93
5899	Plaque			60						104
5902	Astronaut facing LM			60						94
5903	Reflections on astronaut visor			60						95
5907	Television camera and horizon			60						96
5921	Descent engine nozzle			60						96
AS11-40-5926	LM footpad			60						97
5927	Removal of seismic and laser experiments									97
5932	Lunar landscape			60						98
5944	Aldrin with lunar experiments			60						98
5945	Aldrin deploying experiments			60						99
5947	Aldrin placing seismic experiment			60						100
5950	Tranquility Base			60						100
5952	Laser reflector			60						101

Frame no.	Description	Principal point		Focal length, mm	Sun angle			View		Page no.
		Longitude	Latitude		High	Medium	Low	Vertical	Oblique	
5956	Central portion of 120-ft-diameter crater			60						102
5958	Western portion of 120-ft-diameter crater			60						102
5963	Aldrin driving core sampler			60						103
AS11-44-6581	LM preparing descent			80						85
6623	LM preparing to rendezvous			80						107
6643	LM preparing for docking			80						107
Panorama A	Panoramas from the LM									104
Panorama B	Panoramas from the surface									105
Panorama C	Panoramas from the surface									106

APPENDIX B
CREW AND LAUNCH PHOTOGRAPHS



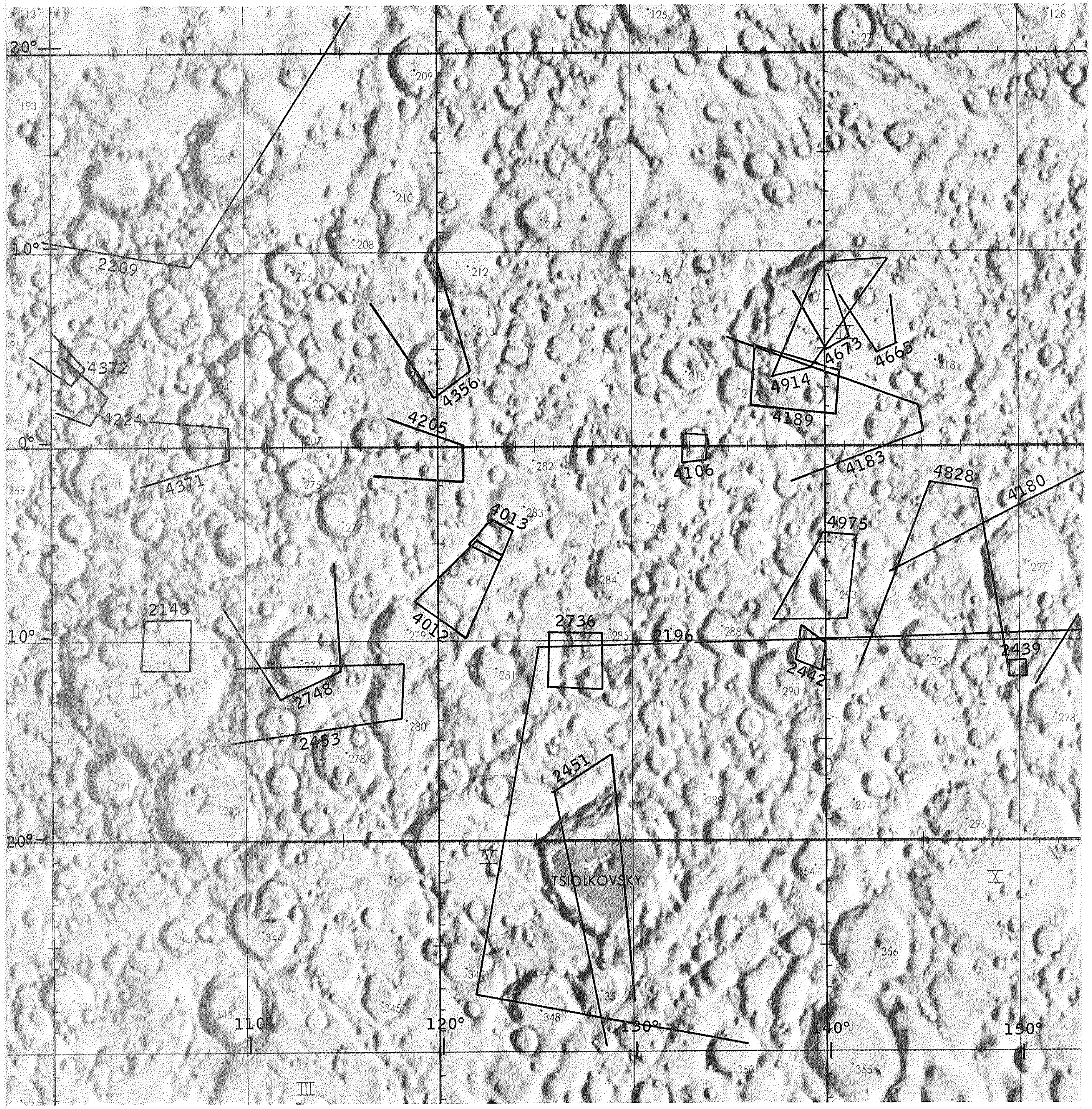
Apollo 8 crew *(from left to right):* William A. Anders, James A. Lovell, and Frank Borman.

Apollo 10 crew *(from left to right):* Eugene A. Cernan, John W. Young, and Thomas P. Stafford.

Apollo 11 crew *(from left to right):* Neil A. Armstrong, Michael Collins, and Edwin E. Aldrin, Jr.

To the Moon. S–69–19268

☆ U. S. GOVERNMENT PRINTING OFFICE : 1971 O - 418-258



20°
10°
0°
10°
20°
110°
120°
130°
140°
150°
2209
4372
4224
4371
4356
4205
4106
4914
4673
4665
4189
4183
4828
4180
4013
4012
4975
2148
2748
2453
2736
2196
2442
2439
2451
TSIOLKOVSKY

APOLLO PHOTOGRAPH LOCATIONS
LUNAR FARSIDE
4654
4828
4067
2399
2664
2401
2409
2673
2412
2676
2052
2410
2670
2423
2420
5172
4823
5171
2433
2697
2704
2314
160°
170°
180°
170°
160°
150°