Guide to Lunar Orbiter Photographs, NASA SP-242


From the preface: “This document provides information on the location and coverage of each photograph returned by the Lunar Orbiter series of spacecraft. Small-scale maps show the overall coverage of each mission and the areas of common coverage among sites of different missions. Large-scale maps show coverage of the individual photographs at each target area. The characteristics of the cameras and of the various orbital sequences utilized are given for background information pertinent to an understanding of Lunar Orbiter photography”.

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GUIDE TO LUNAR ORBITER PHOTOGRAPHS

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Preface

This document provides information on the location and coverage of each photograph returned by the Lunar Orbiter series of spacecraft. Small-scale maps show the overall coverage of each mission and the areas of common coverage among sites of different missions. Large-scale maps show coverage of the individual photographs at each target area. The characteristics of the cameras and of the various orbital sequences utilized are given for background information pertinent to an understanding of Lunar Orbiter photography.
Introduction

The Lunar Orbiter program initiated in early 1964 consisted of the investigation of the Moon by five identical unmanned spacecraft. Its primary objective was to obtain detailed photographs of the Moon. This document presents information on the location and coverage of all Lunar Orbiter photographs and is one in a series of four NASA Special Publications documenting Lunar Orbiter photography. The others are references 1 to 3. Reference 1 contains 675 photographic plates and provides coverage of the complete Moon with more detail than any other publication. Reference 2 is a collection of approximately 180 selected photographs and portions thereof at enlarged scale, and includes captions for each photograph. Reference 3 shows each named feature on the near side on annotated high-resolution frames from mission IV. It also includes (1) an alphabetical index of features, (2) cross-indexes between listings in the catalog of the University of Arizona and the catalog of the International Astronomical Union which was published in 1935, and (3) listings of named lunar features on the near side covered during missions I, II, III, and V, and their photograph numbers.

The objectives of the Lunar Orbiter program were—

1. Photography.—To obtain detailed lunar topographic and geologic information of various lunar-terrain types to assess their suitability for use as landing sites by Apollo and Surveyor spacecraft and to increase man's scientific understanding of the Moon.

2. Selenodesy.—To provide precision trajectory information which would improve the definition of the lunar gravitational field.

3. Moon environment.—To provide measurements of micrometeoroid and radiation flux in the lunar environment for spacecraft performance analysis.

These objectives were accomplished by the flights of five spacecraft during the 13-month period from August 1966 to September 1967. In addition to references 1 to 3 on Lunar Orbiter photography, the interested reader is directed to references 4 to 7 for results of the program.

The five Lunar Orbiter spacecraft returned over 1654 high-quality photographs taken from lunar orbit. Each spacecraft was similarly equipped with two cameras which operated simultaneously and had the same line of sight but different fields of view and resolutions. The cameras utilized a common supply of 70-mm film and the dual images they recorded are referred to as medium-resolution frames and high-resolution frames.

Of the 1654 Lunar Orbiter photographs, 840 are of areas photographed on the basis of Apollo program requirements and were obtained primarily during missions I, II, and III. They were taken from low flight altitudes and provided detailed coverage of 22 areas located along the equatorial region of the near side of the Moon. The remaining 814 photographs were taken primarily during missions IV and V and include 708 of the near side of the Moon, 105 of the far side of the Moon, and 6 of the Earth. These photographs were taken from flight altitudes ranging from approximately 44 km over the near side to approximately 6000 km over the far side, and provide broad coverage of essentially the entire Moon and detailed coverage at 88 areas on the near side.

This document contains tables and maps which catalog the various types of Lunar Orbiter photography conducted and aid the user in procuring photographs of selected areas. The maps were prepared by the U.S. Air Force Aeronautical Chart and Information Center, in support of preliminary photo analyses performed immediately following each Lunar Orbiter mission.

The National Space Science Data Center (NSSDC) at Goddard Space Flight Center, Greenbelt, Md., is responsible for dissemination of Lunar Orbiter photographs and other scientific data. Scientists requiring high-quality Lunar Orbiter photographs for study can obtain them from that Center. Persons interested in Lunar Orbiter photographs for other reasons should direct their requests to NASA, Public Information Division, Code FP, Washington, D.C. 20546.

Lunar Orbiter Photographic System

A sketch of the photographic system of the spacecraft is shown in figure 1. The system was housed in a pressurized, thermally controlled container, and included the cameras, film and film handling, film processor, and readout equipment and environmental controls. The system was designed to expose, develop, and read out images for transmission to Earth by the communications system.

The two cameras simultaneously placed two discrete frame exposures on a common supply of 70-mm aerial film. Each camera operated at a fixed aperture of f/5.6 with controllable shutter speeds of 0.01, 0.02, or 0.04 second. One of the lenses had a 610-mm focal length; the other, an 80-mm focal length.

![Figure 1](https://via.placeholder.com/150.png?text=Figure+1+-+Photographic+subsystem)
Shutter, platen, and image-motion compensation were provided for each camera; the film, film advance, and shutter operation were common to both. The film was developed onboard by using a method which passed the film into contact with a web that contained a single-solution processing chemical. After the film was dried, it was stored ready to be read out and transmitted to Earth.

Figure 2 shows a schematic of the readout system which used a line-scan tube as the light source for scanning the negative image on the spacecraft film. The line-scan tube electronically scanned the beam of light a distance of 2.667 mm in the lengthwise direction of the film. The sweep of this line across the film was accomplished by a mechanical drive of the scanner lens which focused the line. One traverse of the scanner lens across the film required approximately 22 seconds; during this time the line scan was repeated over 17,000 times. The sections of film that were read out with this type of scan were referred to as framelets and were 2.54 mm wide and over 55 mm long. At this rate, 10 minutes were required to read out one medium-resolution frame, and 34 minutes for one high-resolution frame. The transmitted light was sensed by a photomultiplier tube and the resulting electrical signal was mixed with synchronization and blanking pulses and fed to the communication system modulator for transmission to Earth. The video signal received on Earth was fed into the ground reconstruction electronics (GRE) where it was converted into an intensity-modulated line on the face of a cathode-ray tube. This line was used to expose 35-mm film in a continuous-motion camera to reconstruct the framelets. The scale of the reconstructed framelets (GRE scale) was 7.18 times spacecraft scale; the framelets were approximately 18 mm wide and 40 cm long. The framelets were then reassembled. Medium-resolution frames were reassembled in their entirety; high-resolution frames were reassembled into three component sections.

The video signal was also recorded on magnetic tapes which were subsequently used to make additional 35-mm framelets. These framelets had generally improved tonal qualities over the framelets reconstructed during the missions and were used to make master negatives for use by the NSSDC in providing copies to the public.

The film supply of the spacecraft consisted of 79 meters of unperforated 70-mm Kodak aerial film, type SO-243. This film...
is a fine-grained, low-speed film with an aerial index of 3.0, which makes it relatively insensitive to space environment radiation. The film was provided with image-motion compensation (IMC) by a velocity/height (V/H) sensor which utilized the 610-mm lens. The V/H sensor also controlled the spacing of shutter operations during multiple-exposure sequences.

The full fields of view (shown in fig. 3) for the 80-mm camera and the 610-mm camera were 44.2° by 37.5° and 29.4° by 5.16°, respectively. The placement of the images of the two cameras on the spacecraft film is shown in figure 3. Images recorded by the 80-mm camera are referred to as medium-resolution frames (M frames); those recorded by the 610-mm camera are referred to as high-resolution frames (H frames). A folding mirror was employed in the optical path of the 610-mm camera and therefore the H-frame images are reversely left to right with respect to the M frames. Exposure times were recorded on the film by a binary-coded arrangement of lamps. These timing lights were located on the 80-mm camera platen and recorded exposure times to tenths of a second.

The angular resolution of the 610-mm cameras was 4.4 seconds of arc; for the 80-mm cameras, 34 seconds of arc. The resolution of the images recorded by both cameras was 76 lines/mm (spacecraft scale) which translates to an image resolution of approximately 11 lines/mm for the reconstructed 35-mm framelets (GRE scale). The ground resolution of vertical photographs taken from an altitude of 46 km is approximately 1 meter for high-resolution frames and 8 meters for medium-resolution frames.

Prior to launch, the spacecraft film was preexposed along one edge as shown in figure 3. The preexposures included calibration data which were used to monitor infight system operation and to evaluate final data quality. The preexposed data array included a 0.3 background density to provide a reference level for setting readout gain, diagonal focus lines to indicate optimum readout scanning-spot focus, resolution charts to evaluate readout quality independent of camera image quality, a gray scale for densitometric calibration, and an identification number. In addition, the film used on missions II, III, IV, and V was preexposed with a geometrical pattern extending across the entire format for geometric calibration purposes.

**Photographic Mission Parameters**

Table 1 (p. 7) gives the flight log of the five Lunar Orbiter photographic missions and table 2 summarizes the photographic accomplishments. The orbits for each mission were ellipses with orbital parameters selected according to the various tasks of each mission. Mission-site location and the type and extent of required coverage were major considerations in determining the most suitable orbital parameters. Apollo landing sites were to be located within the equatorial region on the near side of the Moon and therefore the first three missions utilized close-in orbits inclined slightly to the lunar equator to provide optimum coverage of these areas. Perilune altitudes for these missions were as low as 44 km, limited primarily by uncertainties in execution errors in maneuvers, uncertainties in the lunar gravitational field and elevations, and the operating range of the V/H sensor. Missions IV and V were devoted to increasing scientific understanding of the Moon and utilized highly elliptical, near-polar orbits for access to areas at high latitudes with proper illumination. Each spacecraft orbited the Moon in the same sense as the rotation of the Moon.

During each mission, photography of the near side was conducted near perilune with morning illumination and photography of the far side near apolune with evening illumination. Photographs were sequenced by using one of two exposure intervals rates. Spacecraft photographic maneuvers were based on the requirements that the camera axes must point directly at the target position at the midpoint of a sequence and that image-motion compensation is provided (when required) by proper orientation of the spacecraft with respect to the flight path. These maneuvers usually consisted of a three-axis rotation from the normal Sun-Canopus celestial reference several minutes prior to the picture taking. Each photograph in a sequence would be taken with the camera axes in the same reference after which the spacecraft would be returned to the celestial reference. Since photographs could be taken much faster than they could be processed, a looper having a capacity of 20 dual frames acted as a buffer between the cameras and the readout section. Site photography proceeded from east to west as the Moon rotated under the stationary, inertially fixed orbit of the spacecraft.

**Photographic Coverage**

**AREAS OF PARTICULAR INTEREST TO APOLLO PROGRAM**

Photography during Lunar Orbiter missions I, II, and III was conducted primarily to locate and confirm suitable manned landing sites for the Apollo program. The requirements for these sites were as follows:

- **Zone of interest.**—The sites had to be located within the zone specified by the Apollo program; ±45° longitude and ±5° latitude.
- **Site locations.**—Multiple sites which permitted at least three launch opportunities within any Apollo launch window had to be located. Launch opportunities were anticipated to occur on alternate days; thus, suitably lighted sites separated in longitude by 28°±3° were required. In addition, the capability to launch during each month of the year required sites to be located along both the northern and southern portions of the zone mentioned.
- **Site characteristics.**—Apollo landing sites had to cover an elliptical area with major and minor axes approximately 8 km and 5 km, respectively, and had to be relatively free of protrusions, depressions, or areas that would constitute a hazard to the Apollo landing vehicles. The landing-approach terrain was to be reasonably unmodulated to accommodate the guidance system of the vehicle.

Areas were originally selected from Earth-based observations that appeared to offer candidate Apollo landing sites. Areas photographed as candidate landing sites were designated primary (P) sites. Prescheduling of P sites left certain periods when photographs had to be taken in order to satisfy film-handling constraints. Sites photographed in compliance with this constraint were designated secondary (S) sites; it should be noted, however, that this designation had relevance only with respect to the mission objectives and the mission plan and not to the value of the photography.

Mission I photography was conducted from three different orbits characterized by the parameters listed in table 1. Nine primary sites concentrated in the southern part of the Apollo zone were photographed. The 610-mm camera failed to operate satisfactorily at close range and consequently most of the high-resolution frames were smeared. The medium-resolution frames were of good quality and provided coverage of extensive areas with an increase in resolution of two orders of magnitude over astronomical photographs. Secondary-site photography provided coverage of numerous areas along the equatorial region on both the near and far sides. The 610-mm
camera generally operated satisfactorily during photography of the far side; consequently, both the medium-resolution and high-resolution photographs of these areas were of excellent quality. Ground resolution of the high-resolution frames was approximately 30 meters. Two oblique exposures (nos. 102 and 117) were taken during mission I. Both are very similar in nature, cover approximately the same area, and show views of the crescent Earth and part of the far side of the Moon just beyond the eastern limb (as seen from Earth). In each case both the medium-resolution frame and the high-resolution frame are of good quality.

Mission II photography was conducted from a single orbit having the parameters listed in Table I. Photographic targets were concentrated in the northern part of the Apollo zone of interest and included 13 primary sites and 17 secondary sites. Most of the primary sites were photographed by taking multiple-exposure sequences during consecutive passes. The secondary sites provided equatorial coverage of areas near the equator on both the near and far sides. With the exception of a few photographs which were incompletely read out, no problems were encountered with the operation of the photographic system.

During missions I and II, all the primary sites were photographed by using standard techniques; that is, coverage was obtained by taking sequences of 4, 8, or 16 vertical photographs during one or more passes of the spacecraft over the site. This procedure provided stereoscopic medium-resolution coverage and high-resolution coverage useful primarily for interpretation and photometric analysis. An experiment conducted during mission II determined that even better stereoscopic coverage could be obtained with the 610-mm camera by photographing the same area during two consecutive passes with the camera axes tilted during one of the passes; this type of photography is referred to as convergent photography. The success of this experiment contributed to the decision that mission III would be a site-certification mission. It provided additional coverage of the most promising candidate Apollo landing sites photographed during missions I and II. Other factors which compelled this decision were the need for makeup high-resolution coverage of areas inadequately covered during mission I and the desire to obtain oblique views of the landing sites to simulate the views which would exist during a manned descent to the surface. The 12 primary sites photographed during mission III included 5 areas previously photographed during mission I, 5 areas previously photographed during mission II, and 2 proposed Surveyor landing sites which had been selected on the basis of Earth-based photography. To photograph all these areas under favorable lighting conditions, the inclination of the orbit to the lunar equator was increased from the 12° value used for missions I and II to a value of 21°. Whereas missions I and II employed standard photographic techniques, diverse techniques were used during mission III to take the required vertical, oblique, and converging coverage. Unfortunately, the spacecraft developed trouble with its film advance motor late in the mission and was unable to read out a substantial number of photographs. This mission provided the Apollo program with sufficient information, however, to allow the remaining two missions to concentrate on more expanded scientific objectives.

In summary, 22 areas were photographed during the first three missions in search of Apollo landing sites. On the basis of this photography and data obtained from Surveyor I, eight candidate Apollo landing sites were selected. Although all three types of required coverage had been obtained at only three of these sites, additional coverage obtained later during mission V enabled complete certification of all sites. Table II summarizes all photography during missions I, II, III, and V taken in search of Apollo landing sites. The most promising areas were those photographed with all three types of photography indicated. Entries for "Area of interest" begin with the easternmost site and progress westward.

**Areas of General Interest**

Most of the photographs taken during missions I, II, and III were of areas which by nature of their potential use as manned landing sites were smooth and featureless. Although the secondary-site photography of these missions included a substantial number of areas interesting from the standpoint of geology and resulted in some very spectacular views, this photography was scheduled "around" the primary-site photography and was limited to areas located near the equator. The converse was true for missions IV and V, whose primary objective was to increase man's scientific understanding of the Moon.

Mission IV was assigned the task of performing a broad systematic survey of lunar-surfaced features in order to increase the scientific knowledge of their nature, origin, and processes, and to serve as a basis for selecting sites for more detailed scientific study by subsequent orbital and landing missions. Photography was planned on the basis of the coverage to be obtained by the 610-mm camera. It was desired to obtain vertical high-resolution photographs which would provide monoscopic coverage of the entire near side with a minimum of overlap. This coverage was obtained by taking 5 single-frame sequences on each of 29 consecutive passes. The orbit was highly inclined to the equator (85°) and had a pericline altitude, at the equator, of approximately 2700 km. The spacecraft was oriented with the long dimension of the frames in a north-south direction. Pole-to-pole coverage was obtained by taking, on each pass, four vertical photographs symmetrically spaced about the equator for coverage of the equatorial and temperate regions, and a fifth photograph for coverage of the polar regions. The fifth photograph was used alternately from pass to pass for coverage of the south- and north-polar regions. It was taken slightly off vertical for lighting considerations.

The near-side photography covered the equatorial regions with ground resolutions of approximately 60 meters and the polar regions with ground resolutions of approximately 100 meters. The field of the 80-mm camera encompassed nearly the entire lunar disk. The ground resolution of the medium-resolution frames is comparable to the best obtainable from astronomical photography—on the order of 1/2 kilometer.

Many photographs, taken early in the mission, were severely degraded during a period when a thermal door to the cameras failed to operate properly. In some cases the door failed to open and therefore the expected photographs were unexposed. In other cases, the photographs were degraded because of condensation on the camera windows. All the areas covered by these degraded photographs were rephotographed toward the end of the mission by six sequences taken near apolune. As in the case of all photographs taken near apolune, these photographs were taken with evening illumination.

Mission IV coverage of the far side was obtained by five sequences taken near apolune and by a number of the near-apolune sequences. The photographs taken near apolune consisted of seven medium-resolution frames (two of which were severely degraded); the high-resolution frames covered essentially unilluminated areas. Medium-resolution frames taken near perilune (with morning illumination) provided the more significant far-side coverage during mission IV. The photographs taken on the first pass covered extensive areas beyond ±90° longitude, and each medium-resolution frame taken on the polar sequences, although centered on the near side, provided coverage which extended beyond the polar caps and on to the far side.
The primary objective of mission V was to photograph 36 areas of particular scientific interest on the near side. Photography was also required to complete the Apollo requirements and to complete the far-side coverage. This combination of requirements necessitated two orbital changes. The orbital parameters are given in table 1. Photographic altitudes for the near side were on the order of 100 km to 250 km. These altitudes, which were two to five times greater than those used for the near-side photography during missions I, II, and III, were required in order to provide adequate areal coverage and acceptable ground resolution of each of the numerous sites with the limited film supply of the spacecraft. In addition, most of the remaining Apollo requirements were for converging coverage. Thus, the increase in altitude was desirable, since it enabled these photographs to be taken with less cross-track tilt than had been utilized previously.

Mission V was executed precisely as planned and accomplished each of its assigned objectives. One dual frame was also taken which shows a view of a nearly full Earth.

In summary, photography for purposes other than locating or confirming Apollo landing sites was taken during each of the five missions. It consists of low-altitude photography of the near side taken during missions I, II, III, and V; and high-altitude photography taken during each of the missions. The low-altitude photography provided detailed coverage of 88 areas from altitudes ranging from approximately 44 to 250 km; this photography is summarized in table 4. The photography at a selected number of these areas is summarized in table 5; features photographed are in alphabetical order. The high-altitude photography provided broad coverage of essentially the entire Moon from altitudes ranging from approximately 1350 to 6000 km. Whereas mission IV alone provided the broad coverage of the near side, each mission contributed to the broad coverage of the far side.

**MAPS**

Figures 4 to 11 are small-scale maps showing all the areas photographed during each mission, with the exception of the areas covered by the medium-resolution frames from mission IV. Figure 4 (p. 22) is a composite plot for missions I, II, III, and V and indicates the missions during which any given area was photographed. Figures 5 to 9 break down the coverage shown in figure 4 and present separately the coverage obtained during each mission. The photographic coverage obtained during mission IV is shown in figures 10 and 11. Figures 4 to 11 show, where the scale permits, the areas covered by individual photographs. Where scale limitations precluded showing these areas, they show only the envelope of the total coverage at each site. For each of these sites, the areas covered by the individual photographs are shown in figures 12 to 15, which are large-scale maps.

Thus, figures 4 to 15 permit one to determine all photographs covering a given area. One should first consider the coverage of missions I, II, and III, and V and, secondly, that of mission IV.

**Missions I, II, III, and V.**—Figure 4 shows the total area photographed during each of these missions. It should be noted that this figure presents only the envelope of the total coverage by a given mission in any region. Where an area of near-vertical or converging coverage is contained within an area of oblique coverage photographed during the same mission, only the boundary of the oblique coverage is indicated. Thus, the boundaries of coverage for sites PIP-8, PIP-7, PIP-8, PIP-10, PIP-11, PIP-12, PIS-15, PIS-16, V-8, V-11, V-12, V-16, and V-18 cannot be separately identified in figure 4. However, they are individually outlined in figures 5 to 9, which show the area covered at each site with the Lunar Orbiter site designations. Figures 5, 6, and 7 pertain to missions I, II, and III, respectively; figures 8 and 9 pertain to mission V. The coverage shown is the envelope of coverage of the medium-resolution frames for the near-side sites, and with the exception of mission I sites IS-3 and IS-9, the coverage of individual photographs for the far-side sites.

Table 6 gives the exposures allocated to each site for these missions; table 7 is a permuted form of table 6, and indicates the site to which each exposure was assigned. Table 8 lists the mission I, II, III, and V sites for which photographs were incompletely read out or degraded.

Figures 12, 13, 14, and 15 are photographic indexes of all near-side sites, except site IS-1, for missions I, II, III, and V, respectively. They show individual photographic outlines portrayed on the U.S. Air Force Aeronautical Chart and Information Center (ACIC) series of lunar charts (Lunar Aeronautical Charts (LAC) or Apollo Intermediate Charts (AIC)). The photographic outlines are accompanied by numbers which uniquely identify the photographs and which should be used in ordering photographs from NSSDC. The photographic outlines were determined by ACIC personnel who matched the photographic images to the shaded relief features on the charts. Thus, the inferred coordinates of the corners of the photographs and the features contained therein are only as accurate as the charts.

At many sites, especially the sites photographed for Apollo, the high-resolution frames have not been indexed. They were not indexed because there was insufficient detail on the base maps with which to make an image match, the photographs were either not read out or were degraded, or their inclusion would have cluttered the figure. The approximate coverage of these frames can be determined, for vertical or near-vertical photography, by scaling the fields of the two cameras, shown in figure 3, to the map scale of the photographic index. To determine which photographs were degraded or incompletely read out, reference should be made to table 8.

At multiple-exposure sites, the exposure numbers increase from west to east for missions I, II, and III sites (figs. 12, 13, 14), and from south to north for mission V sites (fig. 15). The maps are oriented in the standard aeronautical convention with north at the top. They incorporate the selenographic coordinate system with east (positive) and west (negative) longitudes measured from the central meridian at Sinus Medii and the longitudes increase in magnitude to 180 at the center of the far side.

**Mission IV.**—Whereas missions I, II, III, and V were assigned to photograph selected areas, mission IV was assigned to photograph broad areas and to cover the entire near side. Both medium- and high-resolution frames from mission IV cover the entire near side, and the medium-resolution frames provide the only coverage of some regions of the far side. The maps of coverage of these photographs are presented independently of those from the other missions.

With the exception of two small areas near the poles, any area which figure 4 indicates was not photographed during missions I, II, III, and V was photographed during mission IV. Figure 10 shows the area covered by each mission IV high-resolution frame. Any area for which neither figure 4 nor figure 10 indicates as having been photographed was covered only by mission IV medium-resolution frames. Figure 11 shows the area covered by a selected number of these photographs (or portions thereof). In most cases the near-side areas covered by these photographs are not shown. The outlines shown in figures 10 and 11 are accompanied by the appropriate exposure number.

Table 9 gives the selenographic distribution of mission IV exposures. Table 10 is a permuted form of table 9 and indicates
the site to which each exposure was assigned. Table 11 sum-
marizes all mission IV photographs incompletely read out or
degraded.

MAP SUMMARY.—For any given area, the photographs covering
that area are determined as follows:

Refer to figure 4 to determine whether the area was photo-
dgraphed during missions I, II, III, and V and, if so, during
which missions (s). Then, depending on the mission (s), refer
to the appropriate figure (s) among figures 5 to 9 to determine
the site (s). If the area in question is on the near side, the site
number is used to locate the photographic index for that site in
figures 12 to 15. If the area in question is on the far side, refer
to table 6 to determine the exposure number (s).

Refer to figures 10 and 11 to determine whether the area
was photographed during mission IV and, if so, by which photo-
graph (s). These figures show the area covered by indi-
vidual photographs and the exposure number for all the
high-resolution frames, but only for a selected number of
medium-resolution frames. The approximate locations of the
principal ground point and condition of the photograph, for
the medium-resolution frames not considered in figures 10 and
11, are given in tables 9 and 11, respectively.

Copies of Photographs

Each Lunar Orbiter spacecraft was supplied with sufficient
film to record as many as 426 photographs—213 pairs of
medium-resolution and high-resolution frames. The negative
images on the spacecraft film were read out in parts, termed
“framelets,” and reconstructed on Earth on 35-mm film as
positive images of the Moon at a scale (GRE scale) 7.18 ×
spacecraft scale. The framelets were then used to make reas-
sembled frames in various forms.

20- BY 24-INCH SECTIONS

The framelets reconstructed in the GRE represent the origi-
nal flight data and are designated as zero-generation positives.
The original framelets (or copies) were reassembled and con-
tact printed on to 20- by 24-inch sheet film. One medium-
resolution frame required just one 20- by 24-inch section,
whereas the high-resolution frame required three component
sections. All Lunar Orbiter photographs have been reassembled
into a 20- by 24-inch format, with the exception of the smeared
high-resolution frames of mission I.

By using second-generation, duplicate positives of the origin-
al flight data, the U.S. Army Topographic Command
(TOPOCOM) prepared third-generation 20- by 24-inch master
negatives for all photographs from missions III, IV, and V and
for the high-resolution frames from mission II. These nega-
tives were made to provide quick copies for Government agen-
cies for interpretation and mission planning and to provide the
National Space Science Data Center (NSSDC) with material
from which early copies could be made generally available to
the scientific community.

At the completion of the Lunar Orbiter program, the NASA
Langley Research Center (LRC) produced an improved set of
20- by 24-inch negatives from which high-quality copies could
be made and disseminated by the NSSDC. The video tapes
were used to generate a new set of positive framelets which
had generally improved tonal qualities over those secured dur-
ing the missions. These positive framelets were made by elec-
tronic preprocessing of the video signal prior to input to the
GRE. (However, because the video signal was intentionally dis-
torted prior to input to the GRE, the 35-mm film exhibits den-
sity variations which are not accurate representations of the
true lunar reflectance properties and should not, therefore, be
used for densitometric or photometric analysis.) The positive
framelets thus obtained were reassembled and contact printed
on to 20- by 24-inch sheet film to make first-generation master
negatives. This procedure was followed for all photographs
except those not graded A or B in tables 8 and 11. Each 20-
by 24-inch section is labeled with a photo number consisting of
mission number, a Roman numeral; exposure number, an Ara-
bic numeral; and frame type, M (medium-resolution frame)
or H (high-resolution frame). Sections of high-resolution
frames are additionally labeled with subscripts 1, 2, or 3
following the photo number to distinguish the component sections.

For example, the sections labeled V-141M and V-141H, are
mission V medium-resolution frame no. 141 and the center sec-
tion of mission V high-resolution frame no. 141, respectively.

For the photographs listed in table 12, the video tapes were
replaced additional times to produce 35-mm film with optimum
detail in the highlight areas or the lowlight areas. The photo-
graphs made from reassemblies of this film are additionally
labeled with “SP,” indicating a special play for highlight areas,
or “SP-1,” indicating a special play for lowlight areas.

Table 13 gives some characteristics of Lunar Orbiter vertical
photographs. Values given for the photographic scale apply to
the 35-mm framelets reconstructed in the GRE and also to the
20- by 24-inch sections. The ground resolutions given are in
direct proportion to the altitudes given. The reassembly code
given for the high-resolution frames is useful for orienting the
photographs. The long axis of all photographs is oriented
either in a primarily north-south or an east-west direction.

With the edge data at the top, the left, center, and right sections
(of a high-resolution frame for those frames reassembled
at the Langley Research Center (LRC)) are numbered 1, 2, and
3, respectively. The reassembly code tells which of these sec-
tions provides the northernmost (N) or easternmost (E) cov-
verage. It applies only for frames reassembled at LRC.
(TOPOCOM numbered the three-component sections of a high-
resolution frame in the reverse order: sections 1, 2, and 3 in
the LRC convention are sections 3, 2, and 1, respectively, in
the TOPOCOM convention.)

SOURCE OF COPIES

The results of all space science flight experiments are made
available through the National Space Science Data Center
(NSSDC). Copies of all Lunar Orbiter photographs and back-
ground information including photographic system calibra-
tions and photographic supporting data are available from the
NSSDC. For further information, scientists located within the
United States should address their inquiries to—

National Space Science Data Center
Code 601.4
Goddard Space Flight Center
Greenbelt, Md. 20771

Scientists from abroad, to—

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

In ordering copies, the photographs should be specified by
mission number, exposure number, and frame type (M or H).
When interested in a particular section of a high-resolution
frame, the position of that section relative to the central sec-
tion—northern, eastern, etc.—should be stated. The quantity
of Lunar Orbiter photographs available from the NSSDC, in
terms of 20- by 24-inch sections, is given in table 14.
<table>
<thead>
<tr>
<th></th>
<th>Mission I</th>
<th>Mission II</th>
<th>Mission III</th>
<th>Mission IV</th>
<th>Mission V</th>
</tr>
</thead>
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<td><strong>Injection into lunar orbit:</strong></td>
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<tr>
<td>Date</td>
<td>8/14/66</td>
<td>11/10/66</td>
<td>2/8/67</td>
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<td>22:03</td>
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<td>10/29/66</td>
<td>10/11/67</td>
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<td>1853</td>
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<td>Inclination, deg</td>
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<td>11.29</td>
<td>20.91</td>
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<td>Exposures taken</td>
<td>5 to 42</td>
<td>5 to 215</td>
<td>5 to 215</td>
<td>5 to 196</td>
<td>5 to 32</td>
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<td></td>
<td>20.91</td>
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<tr>
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<td>3:28</td>
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<td>Exposures taken</td>
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<td>24 to 30</td>
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<td>3:28</td>
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<tr>
<td>Exposures taken</td>
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*Last communication with spacecraft. Date of impact estimated at 10/31/67.*
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<th>Number of photographs obtained</th>
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<td>Number of exposures</td>
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<td>Partial frames</td>
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<td>Not useful for interpretation or not read out</td>
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<td>0</td>
</tr>
<tr>
<td>Subtotal</td>
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<td>61</td>
<td>58</td>
<td>0</td>
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<td>696</td>
<td>52</td>
<td>288</td>
<td>0</td>
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TABLE 3.—Photography in Search of Apollo Landing Sites

(a) Photographic information

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<thead>
<tr>
<th>Area of interest</th>
<th>Approximate location</th>
<th>Vertical and near-vertical photography</th>
<th>Converging photography</th>
<th>Oblique photography (west looking)</th>
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<tbody>
<tr>
<td>Viciaty of search site*</td>
<td>Longitude</td>
<td>Latitude</td>
<td>Site</td>
<td>First sequence, exposures</td>
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<tr>
<td>IP-1</td>
<td>42° E</td>
<td>1° S</td>
<td>IP-1</td>
<td>52 to 67</td>
</tr>
<tr>
<td>IP-2</td>
<td>37° E</td>
<td>3° N</td>
<td>V-8</td>
<td>25 to 32</td>
</tr>
<tr>
<td>IP-2</td>
<td>36° E</td>
<td>0°</td>
<td>IP-1</td>
<td>5 to 50</td>
</tr>
<tr>
<td>IP-2</td>
<td>34° E</td>
<td>2° N</td>
<td>IIIP-2</td>
<td>35 to 42</td>
</tr>
<tr>
<td>IP-3</td>
<td>32° E</td>
<td>1° N</td>
<td>IIIP-1</td>
<td>5 to 20</td>
</tr>
<tr>
<td>IP-5</td>
<td>25° E</td>
<td>3° S</td>
<td>IIIP-5</td>
<td>63 to 72</td>
</tr>
<tr>
<td>IP-3</td>
<td>21° E</td>
<td>4° S</td>
<td>V-8</td>
<td>50 to 60</td>
</tr>
<tr>
<td>IP-5</td>
<td>21° E</td>
<td>2° N</td>
<td>IIIP-3</td>
<td>49 to 62</td>
</tr>
<tr>
<td>IP-6</td>
<td>20° E</td>
<td>0°</td>
<td>IIIP-6</td>
<td>63 to 72</td>
</tr>
<tr>
<td>IP-4</td>
<td>14° E</td>
<td>0°</td>
<td>IIIP-3</td>
<td>49 to 62</td>
</tr>
<tr>
<td>IP-5</td>
<td>1° W</td>
<td>0°</td>
<td>IIIP-8</td>
<td>135 to 199</td>
</tr>
<tr>
<td>IP-6</td>
<td>2° W</td>
<td>4° S</td>
<td>IIIP-7</td>
<td>135 to 199</td>
</tr>
<tr>
<td>IP-7</td>
<td>2° W</td>
<td>2° N</td>
<td>IIIP-9</td>
<td>188 to 195</td>
</tr>
<tr>
<td>IP-9</td>
<td>13° W</td>
<td>1° N</td>
<td>IIIP-10</td>
<td>146 to 153</td>
</tr>
<tr>
<td>IP-11</td>
<td>28° W</td>
<td>0°</td>
<td>IIIP-8</td>
<td>124 to 131</td>
</tr>
<tr>
<td>IP-7</td>
<td>28° W</td>
<td>2° S</td>
<td>IIIP-7</td>
<td>157 to 172</td>
</tr>
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<td>27° W</td>
<td>3° N</td>
<td>IIIP-9</td>
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<td>34° W</td>
<td>2° N</td>
<td>IIIP-10</td>
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<td>36° W</td>
<td>3° S</td>
<td>IIIP-11</td>
<td>176 to 183</td>
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<td>IP-13</td>
<td>41° W</td>
<td>2° N</td>
<td>IIIP-11</td>
<td>176 to 183</td>
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<td>IP-9.2</td>
<td>43° W</td>
<td>2° S</td>
<td>IIIP-12</td>
<td>181 to 184</td>
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</table>

*Search sites: Areas of vertical coverage photographed in search of Apollo landing sites. Candidate Apollo landing sites selected on the basis of this photography were certified by the additional vertical, converging, and oblique photography listed. Search sites which did not reveal areas suitable for Apollo were not rephotographed except in an incidental manner. These areas of common coverage are not indicated in this table but may, however, be determined by reference to the index maps.

(b) Vertical photography

<table>
<thead>
<tr>
<th>Note reference</th>
<th>Exposure, internal rate</th>
<th>Stereoscopic coverage, medium-resolution frames</th>
<th>Monoscopic coverage, high resolution frames</th>
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<td>2</td>
<td>Fast</td>
<td>88</td>
<td>Continuous</td>
</tr>
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<td>3</td>
<td>Slow</td>
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<td>Continuous</td>
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<tr>
<td>4</td>
<td>Fast</td>
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</tr>
<tr>
<td>5</td>
<td>Slow</td>
<td>52</td>
<td>Continuous</td>
</tr>
<tr>
<td>6</td>
<td>Fast</td>
<td>88</td>
<td>Continuous</td>
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*Lateral overlap given for photographs taken on adjacent sequences.
### Table 4.—Photography of Areas of General Interest—Near Side

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<tr>
<th>Site</th>
<th>Approximate center of coverage</th>
<th>Type of photography</th>
<th>Remarks</th>
<th>Site</th>
<th>Approximate center of coverage</th>
<th>Type of photography</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>IS-1</td>
<td>9° E 1° S</td>
<td>NV, 16f, 4f</td>
<td>Mare Smythii</td>
<td>V-29</td>
<td>3° W 12° N</td>
<td>NV, 4f</td>
<td>Rima Bode H</td>
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<tr>
<td>IS-2</td>
<td>72° E 2° N</td>
<td>NV</td>
<td>Petavius</td>
<td>IS-12</td>
<td>6° W 3° N</td>
<td>NV</td>
<td>Near Schröter, north of Mösting</td>
</tr>
<tr>
<td>V-1-1</td>
<td>61° E 26° S</td>
<td>NV, 4f</td>
<td>Petavius B</td>
<td>IS-16</td>
<td>6° W 0° N</td>
<td>NV, 4f</td>
<td>Mösting C</td>
</tr>
<tr>
<td>IS-4</td>
<td>60° E 1° N</td>
<td>NV</td>
<td>Stevinus A</td>
<td>IS-14</td>
<td>8° W 6° N</td>
<td>Oblique</td>
<td>Candidate Surveyor site</td>
</tr>
<tr>
<td>V-2.1</td>
<td>58° E 20° S</td>
<td>NV</td>
<td>Tarantius</td>
<td>IS-30</td>
<td>11° W 12° S</td>
<td>NV, 4f</td>
<td>Tycho</td>
</tr>
<tr>
<td>V-4</td>
<td>53° E 32° S</td>
<td>NV</td>
<td>Messler and Messier A</td>
<td>IS-34</td>
<td>11° W 13° N</td>
<td>NV, 4f</td>
<td>Gambrat C, thermal anomaly</td>
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<td>50° E 2° N</td>
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<td>IS-39</td>
<td>15° W 2° N</td>
<td>NV</td>
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<td>V-34</td>
<td>16° W 8° S</td>
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<td>Fra Mauro</td>
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<td>Oblique</td>
<td></td>
<td>V-33</td>
<td>16° W 14° N</td>
<td>NV, 4f</td>
<td>Copernicus secondaries</td>
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<td>IS-32</td>
<td>17° W 4° S</td>
<td>Oblique</td>
<td>Fra Mauro</td>
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<tr>
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<td>40° E 3° N</td>
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<td>IS-15</td>
<td>17° W 0° N</td>
<td>NV</td>
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<td>Oblique</td>
<td></td>
<td>IS-16</td>
<td>18° W 7° N</td>
<td>NV, 4f</td>
<td>Copernicus, northerly oblique</td>
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<tr>
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<td>34° E 1° S</td>
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<td>20° W 1° N</td>
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<td>32° E 5° N</td>
<td>NV</td>
<td>I-96 relates domes near</td>
<td>IS-13</td>
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<td>IS-22</td>
<td>22° W 1° N</td>
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<td>Imbran flows</td>
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<td>IS-23</td>
<td>22° W 1° N</td>
<td>Oblique</td>
<td>Near Reimbold, grooves and chain</td>
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* Type of photography: NV, vertical or near vertical
  Oblique
  XXf or XXX (applied to multiple exposure sequences). The number of exposures taken per sequence followed by the exposure interval rate: I, fast rate to give 83 percent forward overlap between consecutive medium-resolution frames and continuous high-resolution coverage; and s, slow rate to give 52 percent forward overlap between consecutive medium-resolution frames and discontinuous high-resolution coverage.

* Remarks

* Sites at which photographs were incompletely read out or secured in degraded form. See table 8.

* Photographs of these sites were taken on separate orbits having different orbital parameters. Although high-resolution coverage was read out independently of each other, they provided continuous coverage of specific areas.
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**TABLE 5.—Sites of Selected Areas of Special Interest**
### TABLE 6.—Exposures Allocated to Each Site for Missions I, II, III, and V

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* Sites at which photographs were incompletely read out or obscured in astrograph form. See table 8.

* Photographs on the far side were all taken during the graded mission. Sites near the cratered region were designated as follows: mission I, 28, 38, 39, 36, 97, 39, 40, 115, 116, 126; mission II, 33, 126. Photographs were all taken during the graded mission. Sites near the cratered region were designated as follows: mission I, 28, 38, 39, 36, 97, 39, 40, 115, 116, 126; mission II, 33, 126.

* Earth photographs. Lunar Orbiter took 2 exposures of Earth. Mission I exposures 169 and 172 yielded photographs showing a crescent Earth and an oblique view of the far side of the Moon beyond its eastern limb (as seen from Earth). Mission II, exposure 27 (designated as site VA-8), yielded photographs showing a nearly full Earth.

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TABLE 7.—Assignment of Exposures for Missions I, II, III, and V

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* Film-handling considerations required that this frame be advanced through the camera without being exposed.

An exposure taken for diagnostic test purposes. The medium-resolution frame was exposed; the high-resolution frame was smeared during exposure.
### TABLE 8.—Missions I, II, III, and V Sites for Which Photographs Were Incompletely Read Out or Degraded

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*The photo rank is given for all photographs at each site, but only for those sites where one or more photographs was incompletely read or degraded. All photographs noted are ranked A100 except for mission I high-resolution frames which are ranked C100.

*Explanation of photo rank: An image quality grade of A, B, C, D, or E, based on subjective evaluation, is assigned to each photograph and represents the state of the original film as secured from the spacecraft. This letter is followed by a number expressing the percent of the frame that was read out. Letter grades are: A, a photographs free of image degradation; B, a photograph slightly degraded during exposure in the spacecraft, but which is usable for interpretation; C, a photograph which is severely degraded during exposure in the spacecraft but is usable for interpretation; D, an image which is completely useless for interpretation; and E, a photograph which is completely useless for interpretation.

*This photograph was incompletely developed in the spacecraft and is not useful for interpretation.
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¹ Exposures in latitude bands B, A, R, G, D, and N were taken near perilune with morning illumination. Photographs in bands F, G, and H were taken near apolune with evening illumination.

² Exposures for which photographs were incompletely read out or secured in degraded form. See Table 11.
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<td>IV-29H</td>
<td>204</td>
<td>IV-33G</td>
<td>205</td>
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* Film-handling considerations required that this frame be advanced through the cameras without being exposed.

Sites designated by: IV denotes mission IV; arabic numeral, pass number; and letters indicate the latitude band of photography. See Table 9.
TABLE 11.—Mission IV Sites for Which Photographs Were Incompletely Read Out or Degraded

<table>
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<tr>
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<th>Exposure number</th>
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<th>Exposure number</th>
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<td>IV-34C</td>
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</table>

a The photo rank is given for all photographs at each site, but only for those sites where one or more photographs were incompletely read out and/or secured in degraded form. All photographs not listed are ranked A100.

b Explanation of photo rank: An image quality grade of A, B, or C, based on subjective evaluation, is assigned to each photograph and represents the state of the original film as secured from the spacecraft. This letter is followed by a number expressing the percent of the frames that was read out. Letter grades are: A, a photograph free of image degradation; B, a photograph slightly degraded during exposure in the spacecraft, but which is usable for interpretation; and C, a photograph which was severely degraded during exposure in the spacecraft and which is unusable for interpretation. Consideration is given only to those degradations associated with the operation of the photographic system. Many photographs contain blisters associated with the spacecraft's development process and others are overexposed to varying degrees. Generally, neither of these blisters seriously affect the usefulness of the photograph for interpretation and are not considered here. NRO indicates the photograph was not read out at all and No exp indicates the spacecraft film was unexposed.

c Mission IV exposures taken at apogee for coverage of the far side are 29, 51, 52, 95, 99, 103, 104, and 147. For each exposure, the high-resolution coverage is located on the illuminatied side of the terminator except for small portions of photographs IV-42H, IV-143H, IV-144H, and IV-145H.
**TABLE 12.—Photographs Processed for Emphasis of Detail in Highlights and Shadows**

<table>
<thead>
<tr>
<th>Area of interest</th>
<th>Photographs for which SP highlights are available</th>
<th>Photographs for which SP-1 lowlights are available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structures on bright peak and wall of Petavius</td>
<td>V-33M, V-34M, V-36M</td>
<td>V-63M, V-63H</td>
</tr>
<tr>
<td>Details of areas in and around Censorinus</td>
<td>V-63M, V-63H</td>
<td></td>
</tr>
<tr>
<td>Area of Littrow Rilles</td>
<td>V-66M, V-66H</td>
<td></td>
</tr>
<tr>
<td>Bright crater in Sulphidus Gallus Region</td>
<td>V-96H</td>
<td></td>
</tr>
<tr>
<td>Bright walls of Hyginus Rille craters</td>
<td>V-96H, V-97H</td>
<td></td>
</tr>
<tr>
<td>Slopes in vicinity of Alpine Valley</td>
<td>V-102H</td>
<td>V-102H</td>
</tr>
<tr>
<td>Slopes in vicinity of Hadley Rille</td>
<td>V-104M, V-105M, V-106M, V-107M</td>
<td>V-104M, V-105M, V-106M, V-107M</td>
</tr>
<tr>
<td>Bright walls of crater Alphonsius</td>
<td>V-116H, V-117H, V-118H, V-119H</td>
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</tr>
<tr>
<td>Walls of crater near Rima Bode II</td>
<td>V-122H</td>
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</tr>
<tr>
<td>Bright walls of crater Tycho</td>
<td>V-126H</td>
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</tr>
<tr>
<td>Walls of crater Fra Mauro and other slopes</td>
<td>V-138H</td>
<td>V-138H</td>
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<tr>
<td>Bright walls of crater Copernicus</td>
<td>V-152M</td>
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</tr>
<tr>
<td>Scarp of the Imbrian flows</td>
<td>V-160H, V-161H</td>
<td>V-160H, V-161H</td>
</tr>
<tr>
<td>Steep slopes in vicinity of Tobias Mayer</td>
<td>V-164M, V-165M, V-166M, V-167M</td>
<td>V-164M, V-165M, V-166M, V-167M</td>
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<tr>
<td>Bright slopes of Jura domes and the terra ridges</td>
<td>V-182M, V-184H, V-185H</td>
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<tr>
<td>Walls of crater Aristarchus</td>
<td>V-198H, V-199H, V-200H</td>
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<tr>
<td>Sinuous rille and bright walls of Schröter's Valley</td>
<td>V-204H</td>
<td>V-204H</td>
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### Table 13. Some Characteristics of Lunar Orbiter Photographs

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<th>Medium-resolution frames</th>
<th>High-resolution frames</th>
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<tr>
<td></td>
<td>Typical spacecraft altitude, km</td>
<td>Photo characteristics</td>
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<td>Mission I:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposures 5 to 27, 29, 31 to 34, 41, and 42</td>
<td>240</td>
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<td>Other exposures</td>
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<td>1:96 000</td>
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<td>Mission II</td>
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<td>Mission III</td>
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<td>Mission IV:</td>
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<tr>
<td>Perilune photos:</td>
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<tr>
<td>Equatorial regions</td>
<td>2710</td>
<td>1:47 000</td>
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<td>Temperate regions</td>
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<td>Polar regions</td>
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<td>Apolune photographs</td>
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<tr>
<td>Extreme value</td>
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* All Lunar Orbiter photographs are distinguished by faint parallel lines running width-wise. These lines are spaced at approximate 20-mm (0.75-inch) intervals on the 24-inch sections and provide a convenient rule for measuring the ground distances given.

* All photographs on this row were taken obliquely. The values given for photographic characteristics apply only to the nadir point which in most cases were located in an unilluminated area; however, the values given provide a gross characterization of these photographs and are given for a comparison with the other listings and for completeness. Photographs without superscripts are vertical photographs.

* See text, page 6, for explanation of reassembly code.
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<th>Mission III</th>
<th>Mission IV</th>
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<td>907</td>
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<td>141</td>
<td>210</td>
<td>747</td>
</tr>
<tr>
<td>20-inch by 24-inch sections (subtotal)</td>
<td>42</td>
<td>615</td>
<td>482</td>
<td>417</td>
<td>639</td>
<td>2186</td>
</tr>
</tbody>
</table>

|            | Medium-resolution frames |            |             |            |           |       |
| C100       | 0 | 0 | 0 | 22 | 0 | 22 |
| C (<100)   | 0 | 0 | 0 | 10 | 0 | 10 |
| Not exposed | 0 | 0 | 0 | 6 | 0 | 6 |
| Not read out | 0 | 3 | 54 | 9 | 1 | 67 |
| Total frames | 0 | 3 | 54 | 47 | 1 | 105 |
| 20-inch by 24-inch sections (subtotal) | 0 | 0 | 0 | 32 | 0 | 32 |

|            | High-resolution frames |            |             |            |           |       |
| C100       | 192 | 0 | 0 | 12 | 0 | 204 |
| C (<100)   | 0 | 0 | 0 | 4 | 0 | 4 |
| Not exposed | 0 | 0 | 0 | 11 | 2 | 13 |
| Not read out | 0 | 2 | 38 | 4 | 0 | 44 |
| Total frames | 192 | 2 | 38 | 31 | 2 | 265 |
| 20-inch by 24-inch sections (subtotal) | 0 | 0 | 41 | 0 | 41 |
| 20-inch by 24-inch sections (subtotal) | 248 | 823 | 639 | 615 | 841 | 3166 |

*Copies of all photographs are available from the NSSDC as 20- by 24-inch sections with the exception of the smeared high-resolution frames of mission I. Copies of these photographs are, however, available as 9½-inch roll film or paper.*
References


(a) Equatorial region, near side.

**FIGURE 4.** Mission index for missions I, II, III, and V.
(b) Equatorial region, far side.

Figure 4.—Mission Index for missions I, II, III, and V.—Continued.
Remainder area covered by mission IV.

(c) North polar region.

FIGURE 4.—Mission Index for missions I, II, III, and V.—Continued.
Medium Resolution Coverage

High Resolution Coverage

Mission II
Mission III
Mission IV
Terminator Limit

Remaining area covered by mission IV.

(d) South polar region.

Figure 4.—Mission Index for missions I, II, III, and IV.—Concluded.
Mercator projection

LEGEND

- Medium Resolution Coverage
- High Resolution Coverage
- Terminator limit

Terminator positions are indicated at those sites for which the terminator falls within the site footprint. The exposures taken at each site are given in table 6.

(a) Equatorial region, near side.

Figure 5.—Site index for mission I.
(b) Equatorial region, far side.

FIGURE 5.—Site Index for mission 1.—Concluded.
Terminator positions are indicated at those sites for which the terminator falls within the site footprint. The exposures taken at each site are given in table 8.

(a) Equatorial region, near side.

Figure 6.—Site index for mission II.
Figure 6.—Site index for mission II.—Concluded.
The high-resolution coverage at sites P-3, P-4, S-1, S-5, and S-7 are indicated by a small square since scale differences do not permit actual areas of coverage to be shown. Terminator positions are indicated at those sites for which the terminator falls within the site footprint. The exposures taken at each site are given in Table 6.
TERMINATOR POSITIONS ARE INDICATED AT THOSE SITES FOR WHICH THE TERMINATOR FALLS WITHIN THE SITE FOOTPRINT. THE EXPOSURES TAKEN AT EACH SITE ARE GIVEN IN TABLE 6.

(b) Equatorial region, far side.

**Figure 7.** Site Index for mission III.—Concluded.
(a) Equatorial region, near side.

**Figure 8.—Site Index for mission V.**

At each site the envelope of coverage of the medium-resolution frames is shown. Terminator positions for those sites containing the terminator are indicated by delineating ticks. The exposures taken at each site are given in table 6.
At each site the envelope of coverage of the medium-resolution frames is shown. Terminator positions for those sites containing the terminator are indicated by delineating ticks. The exposures taken at each site are given in table 6.

(b) Equatorial region, far side.

FIGURE 8—Site index for mission V.—Continued.
At each site the envelope of coverage of the medium-resolution frames is shown. Terminator positions for those sites containing the terminator are indicated by delineating ticks. The exposures taken at each site are given in table 6.

(c) North polar region.

FIGURE 8.—Site Index for mission V.—Continued.
At each site the envelope of coverage of the medium-resolution frames is shown. Terminator positions for those sites containing the terminator are indicated by delineating ticks. The exposures taken at each site are given in Table 6.

(d) South polar region.

Figure 8.—Site Index for mission V.—Concluded.
At each site the envelope of coverage of the high-resolution frames is shown. Terminator positions for these sites containing the terminator are indicated by delineating ticks. The exposures taken at each site are given in Table 6.

(a) Equatorial region, far side.

FIGURE 9.—Photographic indexes for mission V high-resolution frames of the far side.
At each site the envelope of coverage of the high-resolution frames is shown. Terminator positions for those sites containing the terminator are indicated by delineating ticks. The exposures taken at each site are given in table 6.

(b) North polar region.

FIGURE 9.—Photographic Indexes for mission V high-resolution frames of the far side.—Continued.
At each site the envelope of coverage of the high-resolution frames is shown. Terminator positions for those sites containing the terminator are indicated by delineating ticks. The exposures taken at each site are given in table 6.

(c) South polar region.

Figure 9.—Photographic Indexes for mission V high-resolution frames of the far side.—Concluded.
Terminator positions, for those frames containing the terminator, are indicated by delineating ticks. Numbers given are exposure numbers. An asterisk indicates the high-resolution frame is significantly degraded.

Figure 10.—Photographic Indexes for mission IV high-resolution frames.
Terminator positions, for those frames containing the terminator, are indicated by delineating ticks. Numbers given are exposure numbers. An asterisk indicates the high-resolution frame is significantly degraded.

(b) Equatorial region, far side.

Figure 10.—Photographic Indexes for mission IV high-resolution frames.—Continued.
Terminator positions, for those frames containing the terminator, are indicated by delineating ticks. Numbers given are exposure numbers. An asterisk indicates the high-resolution frame is significantly degraded.

(c) North polar region.

Figure 10.—Photographic Indexes for mission IV high-resolution frames.—Continued.
Terminator positions, for those frames containing the terminator, are indicated by delineating ticks. Numbers given are exposure numbers. An asterisk indicates the high-resolution frame is significantly degraded.

(d) South polar region.

Figure 10.—Photographic Indexes for mission IV high-resolution frames.—Concluded.
(a) Equatorial region, near side.

Figure 11.—Photographic indexes for selected mission IV medium-resolution frames of the far side.
(b) Equatorial region, far side.

**Figure 11.** Photographic Indexes for selected mission IV medium-resolution frames of the far side.—Continued.
NORTH POLAR REGION

Terminator positions, for those frames containing the terminator, are indicated by delineating ticks. Numbers given are exposure numbers. An asterisk indicates the medium-resolution frame is significantly degraded.

(c) North polar region.

FIGURE 11.—Photographic Indexes for selected mission IV medium-resolution frames of the far side.—Continued.
Terminator positions, for those frames containing the terminator, are indicated by delineating ticks. Numbers given are exposure numbers. An asterisk indicates the medium-resolution frame is significantly degraded.

(d) South polar region.

Figure 11.—Photographic indexes for selected mission IV medium-resolution frames of the far side.—Concluded.
FIGURE 12.—Photographic Indexes to mission I near-side sites.
(c) Site IP-3.

(d) Site IP-4.

Figure 12—Photographic Indexes to mission 1 near-side sites.—Continued.
Figure 12.—Photographic indexes to mission 1 near-side sites.—Continued.
FIGURE 12.—Photographic index to mission 1 near-side sites.—Continued.

(g) Site IP-7.

(h) Site IP-8.1.
FIGURE 12.—Photographic indexes to mission 1 near-side sites.—Continued.
Figure 12.—Photographic Indexes to mission I near-side sites.—Continued.
FIGURE 12.—Photographic Indexes to mission 1 near-side sites.—Continued.
Site 18-16.

Site 18-17.

Figure 12.—Photographic Indexes to mission 1 near-side sites.—Continued.
Figure 12.—Photographic Indexes to mission I near-side sites.—Continued.
FIGURE 13.—Photographic Indexes to mission II near-side sites.
(c) Site III-3.

(d) Site III-4.

Figure 13.—Photographic Indexes to mission II near-side sites.—Continued.
(e) Site IPP-5.

(f) Site IPP-6.

Figure 13.—Photographic Indexes to mission II near-side sites.—Continued.
Figure 13.—Photographic Indexes to mission II near-side sites.—Continued.
(k) Site III-11.

(1) Site III-12.

Figure 13.—Photographic indexes to mission II near-side sites.—Continued.
Figure 13.—Photographic indices to mission II near-side sites.—Continued.
Site I18-7.

Figure 18.—Photographic Indexes to mission II near-side sites.—Continued.
FIGURE 13.—Photographic Indices to mission II near-side sites.—Continued.
(y) Site II-15.

Figure 13.—Photographic indexes to mission II near-side sites.—Continued.
(a) Site II-18-17.

Figure 13.—Photographic Indexes to mission II near-side sites.—Concluded.
FIGURE 14.—Photographic Indexes to mission III near-side sites.
Figure 14.—Photographic Indexes to mission III near-side sites.—Continued.
FIGURE 14.—Photographic indexes to mission III near-side sites.—Continued.
Figure 14.—Photographic Indexes to mission III near-side sites.—Continued.
FIGURE 14.—Photographic Indexes to mission III near-side sites.—Continued.
(r) Site III-8.

Figure 14.—Photographic Indexes to mission III near-side sites.—Continued.
(a) Site III-19.

(b) Site III-15.

Figure 14.—Photographic Indexes to mission III near-side sites.—Continued.
(u) Site III-84H.

Figure 14.—Photographic indices to mission III near-side sites.—Continued.
(v) Site III-83.

Figure 14.—Photographic Indexes to mission III near-side sites.—Continued.
Photographic Indexes to mission III near-side sites.—Continued.
FIGURE 14.—Photographic Indexes to mission III near-side sites.—Continued.
FIGURE 14.—Photographic indexes to mission III near-side sites.—Continued.
FIGURE 14.—Photographic Indexes to Mission III near-side sites.—Continued.
Site III-25.

Figure 14.—Photographic Indexes to mission III near-side sites.—Continued.
FIGURE 14.—Photographic Indexes to mission III near-side sites.—Continued.
FIGURE 14.—Photographic Indexes to mission III near-side sites.—Continued.
(II) Site III-39.

Figure 14.—Photographic Indices to mission III near-side sites.—Continued.
Figure 14.—Photographic Indexes to mission III near-side sites.—Concluded.
(a) Site V-1.

(b) Site V-37.

Figure 15.—Photographic Indexes to mission V near-side sites.
(4) Site V-4.

(5) Site V-5.

Figure 15.—Photographic Indexes to mission V near-side sites—Continued.
Figure 15—Photographic Indexes to mission V near-side sites—Continued.
(i) Site V-19.

Figure 15.—Photographic Indexes to mission V near-side sites.—Continued.
(a) Site V-22.

(b) Site V-23I.

Figure 15.—Photographic indexes to mission V near-side sites.—Continued.
FIGURE 15.—Photographic Indexes to mission V near-side sites.—Continued.
(a) Site V-29.

Figure 15.—Photographic indices to mission V near-side sites.—Continued.
FIGURE 15.—Photographic Indexes to mission V near-side sites.—Continued.

(ij) Site V-40.

(kk) Site V-41.
(rr) Site V-50.

Figure 15.—Photographic Indexes to mission V near-side sites.—Concluded.