horizon while turning a few degrees between snapping each successive photo. The photos have considerable overlap. After return to Earth, the overlap is eliminated and the photos pieced together to yield a composite view of the Moon's surface as seen from a particular spot. One example from Apollo 14 is shown in figure 46. Others may be seen in the July issue of National Geographic Magazine. In addition, the overlapped regions are used for stereoscopic viewing of the surface. Truly three-dimensional views are obtained in this way.

Marble-sized rocks from the Moon have proven to be especially valuable in lunar science. They are large enough to allow an extensive set of measurements to be made, yet small enough that many of them can be collected. Accordingly, we have designed and built a tool for Apollo 15 to collect many such samples. It is termed a rake, although the resemblance to the familiar garden tool is now slight. It is illustrated in figure 47.

The Apollo Lunar Surface Drill (ALSD), used to drill the two holes for the Heat Flow Experiment and illustrated in figure 22, is used also to drill a third hole from which the samples are saved. The drill bit is hollow and allows rock to pass into the hollow drill stem. These samples, referred to as core, are about 0.8 inch in diameter. Individual pieces of rock are likely to be button-shaped and 1/4 inch thick. A few pieces may be larger. Most of the material will probably consist of lunar soil. These samples should not be confused with the samples obtained with the drive tubes

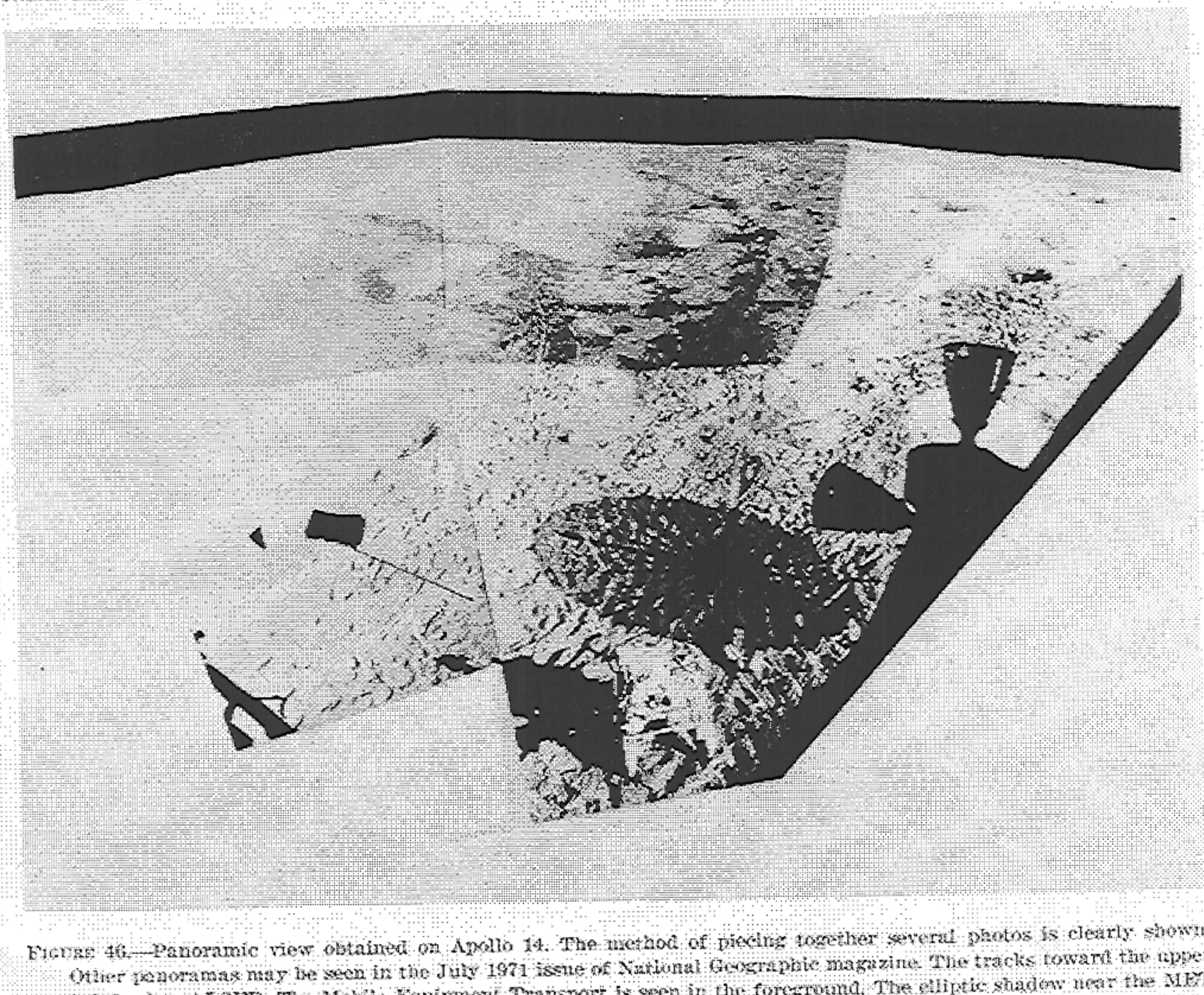

FIGURE 46.—Panoramic view obtained on Apollo 14. The method of piecing together several photos is clearly shown. Other panoramas may be seen in the July 1971 issue of National Geographic magazine. The tracks toward the upper left lead to ALSEP. The Mobile Equipment Transport is seen in the foreground. The elliptic shadow near the MET was cast by the S-band radio antenna used for communication with Earth. The TV camera is seen on the right-hand side of the pan. The inverted cone seen just below the TV camera is part of a small rocket engine used to turn the spacecraft in flight.

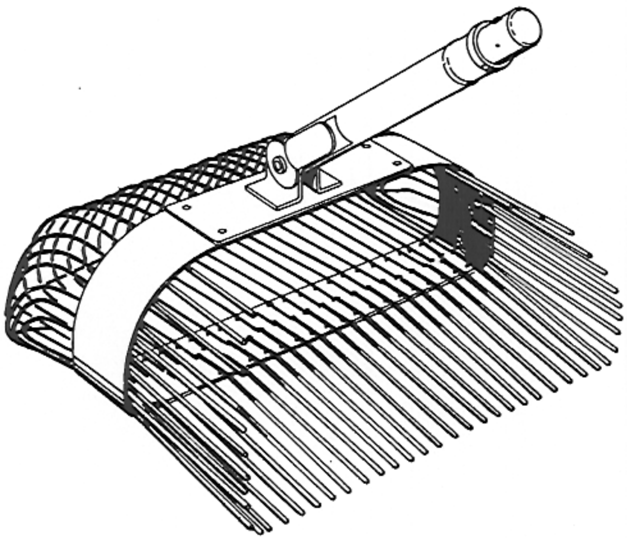

FIGURE 47.—Rake. This tool will be used on Apollo 15 to collect marble-size rocks.

which are also termed core. This equipment can drill and collect solid rock, if any is encountered, whereas the drive tubes can collect only material that is small enough to enter the tube.

Soil Mechanics Experiment

The mechanical properties of the lunar soil are important for both engineering and scientific reasons. Future design of spacecraft, surface vehicles, and shelters for use on the Moon will be based, in part at least, on the data collected in the soil mechanics experiment of this mission. To obtain data, many observations will be made during the performance of the other experiments. Such items as the quantity of dust ejected by the exhaust from the descending LM, the amount of dust thrown up by the wheels on the Rover and the depth to which the astronauts sink while walking, are all important factors in estimating the properties of the lunar soil. In addition to these qualitative observations, the astronauts will carry equipment with them with which to measure quantitatively the bearing strength of the soil, a recording penetrometer. It is illustrated in figure 48.

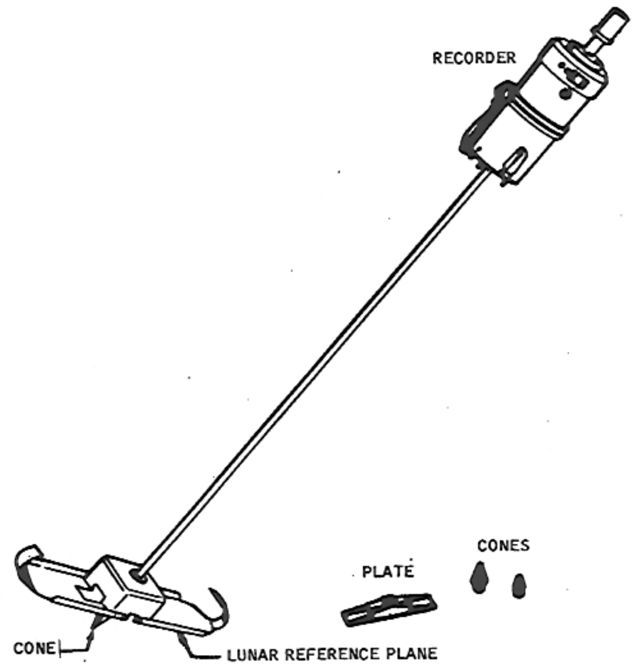

FIGURE 48.—Self-recording penetrometer.

The Crew

The prime crew consists of Dave Scott, Commander, Jim Irwin, LM pilot, and Al Worden, CM pilot. Scott and Neil Armstrong during the Gemini 8 mission performed the first successful docking of two vehicles in space. Scott was the CM pilot on Apollo 9 in 1969, the third manned flight in the Apollo series and backup commander for Apollo 12. Jim Irwin served as backup crew member for the Apollo 12 flight. Al Worden served as the backup Command Module pilot for Apollo 12.

The Apollo 15 backup crew consists of Dick Gordon, Commander, Vance Brand, CM pilot, and H. H. (Jack) Schmitt, LM pilot. The prime surface crew is shown in figures 49, 50 and 51. The backup crew is shown in figures 52 and 53.

This crew, like previous ones, has undergone intensive training during the past few months and somewhat more casual training during the last few years. In addition to the many exercises needed to learn to fly proficiently their spacecraft, the astronauts have learned much about science, and in particular, about lunar science. After all, they will each spend many hours on the Moon or in orbit around the Moon performing scientific research. The surface astronauts have had tutorial sessions with many of the nation's best scientists. They are able to set up experiments, such as those of ALSEP, but more importantly, they understand the scientific purposes behind the various experiments.

Most of the time on the lunar surface during Apollo 15 will be spent observing geologic features and collecting samples. Obviously anyone can pick up rocks with which to fill boxes and bags. Only a person highly trained in the geosciences, however, can properly select those few rocks from many that are likely to yield the greatest amount of scientific return when examined in minute detail in the laboratory back on Earth. The Apollo 15 crew has spent many hours in the field studying rocks under the guidance of geologists from the U.S. Geological Survey, several universities, and NASA's Manned Spacecraft Center. The prime crew has been especially fortunate in having the constant geologic tutelage of Astronaut Jack Schmitt, a geologist himself.

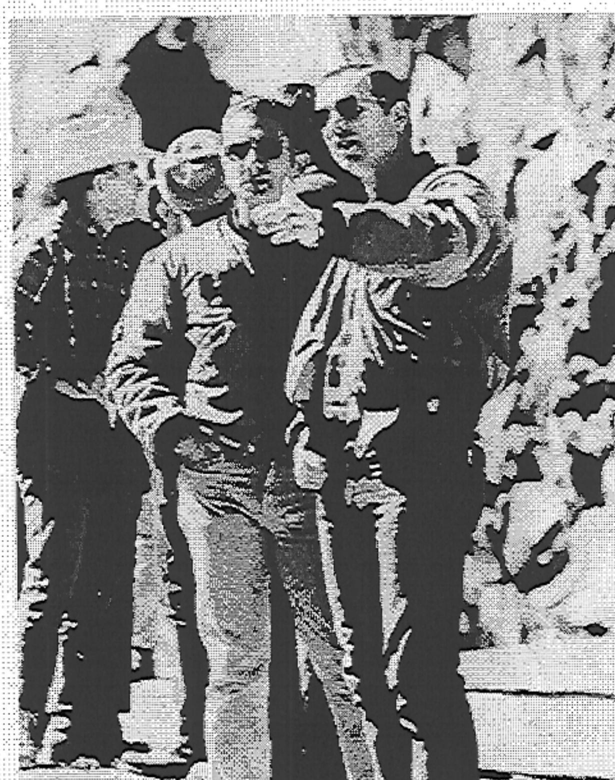

FIGURE 49.—Apollo 15 astronauts Jim Irwin and Dave Scott study geology on a field trip near Taos, New Mexico, in March 1971. In the left background, shown in profile with Texas-style hat, is Professor Lee Silver, a field geologist from the California Institute of Technology who has contributed significantly toward geological training of the crew.

FIGURE 50.—Apollo 15 astronauts Jim Irwin (left) and Dave Scott during the field trip to study geology near Taos, New Mexico. During such training exercises, the astronauts typically carry backpacks that simulate the PLSS. Note the Hasselblad cameras, the scoop, and the gnomon.

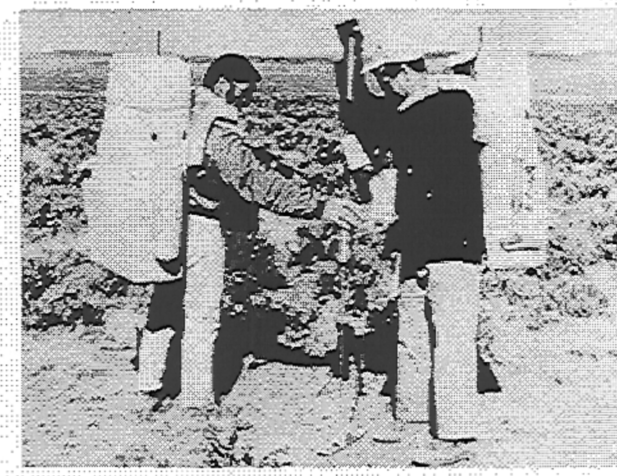

FIGURE 52.—Apollo 15 backup surface crew, Dick Gordon (left) and Jack Schmitt. They are using the self-recording penetrometer to measure soil properties near Taos, New Mexico.

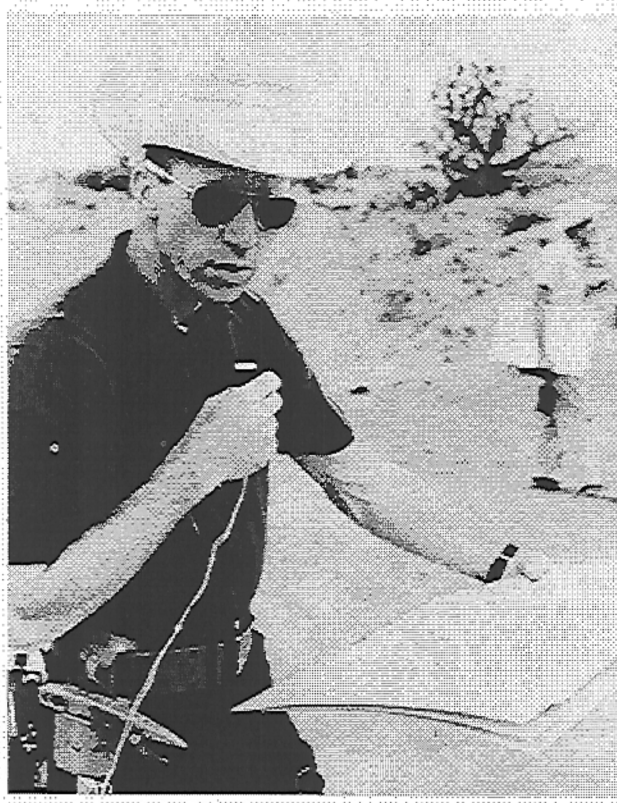

FIGURE 51.—CM Pilot Al Worden. A major part of the crew's training in science is the study of geology. Worden is recording his observations of the rocks at this training site.

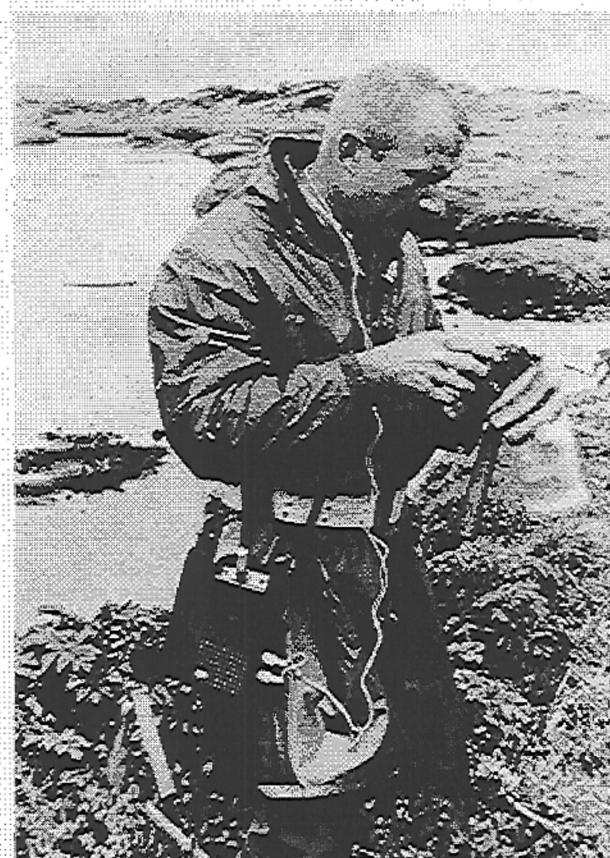

FIGURE 53.—Astronaut Vance Brand collects rocks on a training trip to Iceland. During the training exercises, the astronauts record their observations on the rocks and geological features.

Acronyms

ALSEP	Apollo lunar surface experiments package
ALSRC	Apollo lunar sample return container
CCIG	cold cathode ion gauge
CM	command module
CSM	command and service module
DPS	descent propulsion system
e.s.t.	eastern standard time
EVA	extravehicular activity
HFE	heat flow experiment
g.e.t.	ground elapsed time
G.m.t.	Greenwich mean time
IR	infrared
JPL	Jet Propulsion Laboratory
LDD	lunar dust detector
LGE	lunar geology experiment
LM	lunar module
LRL	Lunar Receiving Laboratory, NASA Manned Spacecraft Center
LRRR	laser ranging retro-reflector
LRV	lunar roving vehicle
LSM	lunar surface magnetometer
MIT	Massachusetts Institute of Technology
MSC	Manned Spacecraft Center
NASA	National Aeronautics and Space Administration
PLSS	portable life support system
PSE	passive seismic experiment
RCS	reaction control system
RTG	radioisotope thermoelectric generator
SESC	surface environment sample container
SIDE	suprathermal ion detector experiment
S–IVB	Saturn IVB (rocket stage)
SME	soil mechanics experiment
SWC	solar wind composition experiment
SWS	solar wind spectrometer experiment
TV	television
USGS	U.S. Geological Survey

Glossary

ALBEDO
al-beé-doh
Relative brightness. It is the ratio of the amount of electromagnetic radiation reflected by a body to the amount of incident radiation.

ANGSTROM UNIT
anǵ-strom
A unit of length equal to 10^{-10} meters or 10^{-4} microns. It is approximately four-billionths of an inch. In solids, such as salt, iron, aluminum, the distance between atoms is usually a few Angstroms.

APERTURE
á-per-ture
A small opening such as a camera shutter through which light rays pass to expose film when the shutter is open.

ATTENTUATION
a-teń-u-eh-shun
Decrease in intensity usually of such wave phenomena as light or sound.

BASALT
baá-salt
A type of dark gray rock formed by solidification of molten material. The rocks of Hawaii are basalts.

BISTATIC RADAR
bí-sta-tic raý-dar
The electrical properties of the Moon's surface can be measured by studying the characteristics of radio waves reflected from the Moon. If the radio transmitter and receiver are located at the same place, the term monostatic radar is used. If they are located at different places, then bistatic is used. In the study of the Moon with bistatic radar, the transmitter is aboard the CSM and the receiver is on the Earth.

BRECCIA
brećh-ya
A coarse-grained rock composed of angular fragments of pre-existing rocks.

CASSETTE
kuh-seť
Photographic film container.

CISLUNAR
sís-lune-ar
Pertaining to the space between the Earth and Moon or the Moon's orbit.

COLORIMETRIC
Pertaining to the measurement of the intensities of different colors as of lunar surface materials.

COSMIC RAYS
koś-mik
Streams of very high energy nuclear particles, commonly protons, that bombard the Earth and Moon from all directions.

COSMOLOGY
kos-mol-uh-gee
Study of the character and origin of the universe.

CRATER
craý-ter
A naturally occurring hole. On Earth, a very few craters are formed by meteorites striking the Earth; most are caused by volcanoes. On the Moon, most craters were caused by meteorites. Some lunar craters were apparently formed by volcanic processes. In the formation of lunar craters, large blocks of rock (perhaps as large as several hundred meters across) are thrown great distances from the crater. These large blocks in turn form craters also—such craters are termed secondary craters.

CROSS-SUN
A direction approximately 90 degrees to the direction to the Sun and related to lunar surface photography.

CROSSTRACK
Perpendicular to the instantaneous direction of a spacecraft's ground track.

CRYSTALLINE ROCKS
Rocks consisting wholly or chiefly of mineral crystals. Such rocks on the Moon usually formed by cooling from a liquid melt.

DIELECTRIC
dyé-ee-lek-trik
A material that is an electrical insulator. Most rocks are dielectrics.

DIURNAL
dye-eŕ-nal
Recurring daily. Diurnal processes on Earth repeat themselves every 24 hours but on the Moon repeat every 28 earth days. The length of a lunar day is 28 earth days.

DOPPLER TRACKING
dopp-lur
A system for measuring the trajectory of spacecraft from Earth using continuous radio waves and the Doppler effect. An example of the Doppler effect is the change in pitch of a train's whistle and a car's horn on passing an observer. Because of this effect, the frequency of the radio waves received on Earth is changed slightly by the velocity of the spacecraft in exactly the same way that the pitch of a train's whistle is changed by the velocity of the train.

DOWN-SUN — In the direction of the solar vector and related to lunar surface photography.

EARTHSHINE — Illumination of the Moon's surface by sunlight reflected from the Earth. The intensity is many times smaller than that of the direct sunlight.

ECLIPTIC PLANE
ee-klip-tik — The plane defined by the Earth's orbit about the Sun.

EFFLUENT
eff-flu-ent — Any liquid or gas discharged from a spacecraft such as waste water, urine, fuel cell purge products, etc.; also any material discharged from volcanoes.

EGRESS
ee-gress — A verb meaning to exit or to leave. The popularization of this word has been attributed to the great showman, P. T. Barnum, who reportedly discovered that a sign marked exit had almost no effect on the large crowds that accumulated in his exhibit area but a sign marked "to egress" led the crowds outdoors. In space terminology it means simply to leave the spacecraft.

EJECTA
ee-jek-tuh — Lunar material thrown out (as resulting from meteoroid impact or volcanic action).

ELECTRON
ee-lek-tron — A small fundamental particle with a unit of negative electrical charge, a very small mass, and a very small diameter. Every atom contains one or more electrons. The *proton* is the corresponding elementary particle with a unit of positive charge and a mass of 1837 times as great as the mass of the electron.

FIELD — A region in which each point has a definite value such as a magnetic field.

FIELD OF VIEW — The region "seen" by the camera lens and recorded on the film. The same phrase is applied to such other equipment as radar and radio antennas.

FILLET
fill-it — Debris (soil) piled against a rock; several scientists have suggested that the volume of the fillet may be directly proportional to the time the rock has been in its present position and to the rock size.

FLUORESCENCE
flur-es-ence — Emission of radiation at one wavelength in response to the absorption of energy at a different wavelength. Some lunar materials fluoresce. Most do not. The process is identical to that of the familiar fluorescent lamps.

FLUX — The rate of flow per unit area of some quantity such as the flux of cosmic rays or the flux of particles in the solar wind.

FRONT — The more or less linear outer slope of a mountain range that rises above a plain or plateau. In the U.S., the Colorado Front Range is a good example.

GALACTIC
ga-lak-tik — Pertaining to a galaxy in the universe such as the Milky Way.

GAMMA — A measure of magnetic field strength; the Earth's magnetic field is about 50,000 gamma. The Moon's magnetic field is only a few gamma.

GAMMA-RAY — One of the rays emitted by radioactive substances. Gamma rays are highly penetrating and can traverse several centimeters of lead.

GEGENSCHEIN
geg-en-schine — A faint light covering a 20-degree field-of-view projected on the celestial sphere about the Sun-Earth vector (as viewed from the dark side of the Earth).

GEOCHEMICAL GROUP — A group of three experiments especially designed to study the chemical composition of the lunar surface remotely from lunar orbit.

GEODESY
gee-odd-eh-see — Originally, the science of the *exact* size and shape of the Earth; recently broadened in meaning to include the Moon and other planets.

GEOPHYSICS
gee-oh-phys-ics — Physics of planetary bodies, such as the Earth and Moon, and the surrounding environment; the many branches include gravity, magnetism, heat flow, seismology, space physics, geodesy, meteorology, and sometimes geology.

GNOMON
know-mon — A rod mounted on a tripod in such a way that it is free to swing in any direction and indicates the local vertical; it gives sun position and serves as a size scale. Color and reflectance scales are provided on the rod and a colorimetric reference is mounted on one leg.

GRADIENT
gray-dee-unt — The rate of change of something with distance. Mathematically, it is the space rate of change of a function. For example, the slope of a mountain is the gradient of the elevation.

INGRESS
in-gress — A verb meaning to enter. It is used in connection with entering the LM. See also "egress."

IN SITU
in-site-u — Literally, "in place", "in its original position". For example, taking photographs of a lunar surface rock sample "in situ" (as it lays on the surface).

LIMB — The outer edge of the apparent disk of a celestial body, as the Moon or Earth, or a portion of the edge.

MANTLE — An intermediate layer of the Moon between the outer layer and the central core.

MARE
maar — A large dark flat area on the lunar surface (Lunar Sea). May be seen with the unaided eye.

MARIA *maar-ya* — Plural of mare.

MASCONS *mass-conz* — Large mass concentrations beneath the surface of the Moon. They were discovered only three years ago by changes induced by them in the precise orbits of spacecraft about the Moon.

MASS SPECTROMETER *mass spek-trom-a-tur* — An instrument which distinguishes chemical species in terms of their different isotopic masses.

METEORRITE *me-te-oh-rite* — A solid body that has arrived on the Earth or Moon from outer space. It can range in size from microscopic to many tons. Its composition ranges from that of silicate rocks to metallic ion-nickel. For a thorough discussion see *Meteorites* by Brian Mason, John Wiley and Sons, 1962.

MICROSCOPIC — Of such a size as to be invisible to the unaided eye but readily visible through a microscope.

MINERALOGY — The science of minerals; deals with the study of their atomic structure and their general physical and chemical properties.

MONOPOLE *mon-oh-pole* — All known magnets have two poles, one south pole and one north pole. The existence of a single such pole, termed a monopole, has not yet been established but is believed by many physicists to exist on the basis of theoretical studies. Lunar samples have been carefully searched on Earth for the presence of monopoles.

MORPHOLOGY *mor-fol-uh-ge* — The external shape of rocks in relation to the development of erosional forms or topographic features.

NADIR — That point on the Earth (or Moon) vertically below the observer.

OCCULTATION *ah-cull-tay-shun* — The disappearance of a body behind another body of larger apparent size. For example the occultation of the Sun by the Moon as viewed by an earth observer to create a solar eclipse.

OZONE *oh-zone* — Triatomic oxygen (O_3); found in significant quantities in the Earth's atmosphere.

PANORAMA *pan-uh-ram-a* — A series of photographs taken from a point to cover 360 degrees around that point.

PENUMBRAL *pe-num-bral* — Referring to the part of a shadow in which the light (or other rays such as the solar wind) is only partially masked, in contrast to the umbra in which light is completely masked, by the intervening object.

PETROGRAPHY *pe-trog-rah-fy* — Systematic description of rocks based on observations in the field, on hand specimens, and on microscopic examination.

PLASMA *plazz-muh* — An electrically conductive gas comprised of neutral particles, ionized particles and free electrons but which, when taken as a whole, is electrically neutral.

PRIMORDIAL *pry-mor-dee-uhl* — Pertaining to the earliest, or original, lunar rocks that were created during the time between the initial and final formation stages of the Moon.

PROTON *prow-ton* — The positively charged constituent of atomic nuclei. For example, the entire nucleus of a hydrogen atom having a mass of 1.67252×10^{-27} kilograms.

RAY — Bright material that extends radially from many craters on the Moon; believed to have been formed at the same time as the associated craters were formed by impacting objects from space; usually, but not always, arcs of great circles. They may be several hundred kilometers long.

REGOLITH *reg-oh-lith* — The unconsolidated residual material that resides on the solid surface of the Moon (or Earth).

RETROGRADE — Lunar orbital motion opposite the direction of lunar rotation.

RILLE/RILL — A long, narrow valley on the Moon's surface.

RIM — Elevated region around craters and rilles.

SAMPLE — Small quantities of lunar soil or rocks that are sufficiently small to return them to Earth. On each mission several different kinds of samples are collected. Contingency sample consists of 1 to 2 pounds of rocks and soil collected very early in the surface operations so that at least some material will have been returned to Earth in the event that the surface activities are halted abruptly and the mission aborted. Documented sample is one that is collected with a full set of photographs to allow positive identification of the sample when returned to Earth with the sample in situ together with a complete verbal description by the astronaut. Comprehensive sample is a documented sample collected over an area of a few yards square.

S-BAND — A range of frequencies used in radar and communications that extends from 1.55 to 5.2 kilomegahertz.

SCARP — A line of cliffs produced by faulting or erosion.

SEISMIC
sizé-mik
Related to mechanical vibration within the Earth or Moon resulting from, for example, impact of meteoroids on the surface.

SOLAR WIND
Streams of particles (mostly hydrogen and helium) emanating from and flowing approximately radially outward from the Sun.

SPATIAL
Pertaining to the location of points in three-dimensional space; contrasted with temporal (pertaining to time) locations.

SPECTROMETER
An instrument which separates radiation into energy bands (or, in a mass spectrometer, particles into mass groups) and indicates the relative intensities in each band or group.

SPUR
A ridge of lesser elevation that extends laterally from a mountain or mountain range.

STELLAR
Of or pertaining to stars.

STEREO
A type of photography in which photographs taken of the same area from different angles are combined to produce visible features in three-dimensional relief.

SUPPLEMENTARY SAMPLE STOP
A stop added to a traverse after the stations are numbered. Mission planning continues through launch and the supplementary sample stops are inserted between normal traverse stations.

SUPRATHERMAL
soup-rah-therm-al
Having energies greater than thermal energy.

SUBSATELLITE
A small unmanned satellite, deployed from the spacecraft while it is in orbit, designed to obtain various types of solar wind, lunar magnetic, and S-band tracking data over an extended period of time.

TALUS
tail-us
Rock debris accumulated at the base of a cliff by erosion of material from higher elevation.

TEMPORAL
Referring to the passage or measurement of time.

TERMINATOR
term-ugh-nay-tor
The line separating the illuminated and the darkened areas of a body such as the Earth or Moon which is not self-luminous.

TERRA
terr-ugh
Those portions of the lunar surface other than the maria; the lighter areas of the Moon. They are visible to the unaided eye.

TIDAL
Referring to the very small movement of the surface of the Moon or the Earth due to the gravitational attraction of other planetary bodies. Similar to the oceanic tides, the solid parts of the Earth's crust rise and fall twice daily about three feet. Lunar tides are somewhat larger. The tides of solid bodies are not felt by people but are easily observed with instruments.

TIMELINE
A detailed schedule of astronaut or mission activities indicating the activity and time at which it occurs within the mission.

TOPOGRAPHIC
Top-oh-gra-fick
Pertaining to the accurate graphical description, usually on maps or charts, of the physical features of an area on the Earth or Moon.

TRANSEARTH
During transit from the Moon to the Earth.

TRANSIENT
tran-shé-unt
A short-lived, random event; often occurring in a system when first turned-on and before reaching operating equilibrium. For example, the initial current surge that occurs when an electrical system is energized.

TRANSLUNAR
During transit from the Earth to the Moon.

TRANSPONDER
trans-pón-der
A combined receiver and transmitter whose function is to transmit signals automatically when triggered by a suitable radio signal.

UMBRA
um-bruh
The dark central portion of the shadow of a large body such as the Earth or Moon; compare penumbra.

UP-SUN
Into the direction of the Sun and related to lunar surface photography.

URANIUM
your-rain-nee-um
One of the heavy metallic elements that are radioactive.

VECTOR
A quantity that requires both magnitude and direction for its specification, as velocity, magnetic force field and gravitational acceleration vectors.

WAVELENGTH
The distance between peaks (or minima) of waves such as ocean waves or electromagnetic waves.

X-RAY
Electromagnetic radiation of non-nuclear origin within the wavelength interval of 0.1 to 100 Angstroms (between gamma-ray and ultra-violet radiation). X-rays are used in medicine to examine teeth, lungs, bones, and other parts of the human body; they also occur naturally.

ZODIACAL LIGHT
zow-dyé-uh-cal
A faint glow extending around the entire zodiac but showing most prominently in the neighborhood of the Sun. (It may be seen in the west after twilight and in the east before dawn as a diffuse glow. The glow may be sunlight reflected from a great number of particles of meteoritic size in or near the ecliptic in the planetoid belt).

Tables

TABLE 1.—*Timeline of Apollo 15 Mission Events**

Event	Time from liftoff (hr/min)	CDT/date
Launch		8:34 am July 26
Earth Orbit Insertion	00:12	8:46 am
Trans Lunar Injection	2:50	11:24 am
Lunar Orbit Insertion	78:31	3:05 pm July 29
Descent Orbit Insertion	82:40	7:14 pm
Spacecraft Separation	100:14	12:48 pm July 30
Lunar Landing	104:42	5:15 pm
Stand Up EVA	106:10	6:43 pm
EVA 1	119:50	8:24 am July 31
EVA 2	141:10	5:44 am August 1
EVA 3	161:50	2:24 am August 2
Lunar Liftoff	171:38	12:12 pm
Spacecraft Docking	173:30	2:04 pm
Trans Earth Injection	223:44	4:18 pm August 4
Trans Earth EVA	242:00	10:34 am August 5
Pacific Ocean Splash-down. (26° N. Lat./ 158° W Long.)	295:12	3:46 pm August 7

*These times are exact for launch on 26 July 71. They change somewhat for other launch dates.

TABLE 2.—*LRV Exploration Traverse*

[The entries in this table are brief. They are explained in the text and in the glossary. The table should be considered a general guide only; not every item is mandatory at each stop. The times are especially likely to change during the mission. The reader may wish to mark the actual times for himself on the table]

Station/activity	Elapsed time at start (hr:min)	Segment time (hr:min)	Geological features	Observations and activities
				EVA I
LM		1:25	Smooth mare	Observe LM, prepare for departure from moon, contingency sample, deploy LRV
Travel	1:25	0:17	Across typical smooth mare material toward rim of Hadley Rille	Observe and describe traverse over smooth mare material Describe surface features and distribution of large boulders Note any difference between mare and rille rim material
Check Point	1:42	0:02		
Travel	1:44	0:07	Around Elbow Crater	Observe low ridge around Elbow Crater Observe any differences between rille rim material and mare material

TABLE 2.—*LRV Exploration Traverse*—Continued

Station/activity	Elapsed time at start (hr:min)	Segment time (hr:min)	Geological features	Observations and activities
				EVA I—Continued
				Observe distribution of ejecta around Elbow Crater
1	1:51	0:15	Southern part of Elbow Crater ejecta blanket	Radial sampling of rocks at Elbow Crater Panoramic photography
Travel	2:06	0:08	To Apennine Front slope north of St. George Crater	Look for changes in rocks or ground that indicate the base of the mountain Compare the material of the Front with mare and rille rim material Observe character and distribution of St. George ejecta blanket
2	2:14	0:45	Near base of Apennine Front north of St. George Crater	Radial sampling of rocks at St. George Crater Comprehensive sample in area at Front Double drive core tube 500mm lens camera photography of blocks on rim of St. George and of rille Stereo pan from high point Fill SESC at Apennine Front Penetrometer
Travel	2:59	0:09	Across base of Apennine Front to edge of possible debris flow	Observe Apennine material and its relation to mare surface
Area Stop 3	3:08	0:14	At base of Apennine Front adjacent to possible debris flow	Examine flow and compare with mare and Front Documented samples of Apennine Front and flow material Observe and describe vertical and lateral changes in Apennine Front: compare with previous stop Panoramic photography Observe characteristics of EVA II route
Travel	3:22	0:28	From base of Apennine Front across mare to LM	Observe characteristics and extent of possible debris flow Observe area to be traversed on EVA II Compare mare material with Apennine Front and rille rim Observe possible ray material
LM	3:50	3:10	Smooth mare	ALSEP deployment—see Table 3 for details Store samples and records Ingress LM
				EVA II
LM		0:49	Smooth mare	Egress LM, prepare for traverse
Travel	0:49	0:11	South along smooth mare SW of secondary crater cluster to base of Apennine Front	Observe smooth mare characteristics Observe secondary crater cluster characteristics Traverse along Apennine Front; determine position of base of Front and search for optimum sampling areas for stops on return leg of traverse Photography as appropriate
Check Point	1:00	0:02		
Travel	1:02	0:15	East along Apennine Front	Same as above
4	1:17	0:20	Secondary crater cluster south of 400m crater	Soil/rake sample Documented samples Panoramic photography 500mm photography of Apennine Front Exploratory trench Possibly drive core tube through secondary ejecta Observe crater interior and ejecta Sample both typical and exotic rock types Compare secondary crater material with other geologic units at the site

TABLE 2.—*LRV Exploration Traverse*—Continued

Station/activity	Elapsed time at start (hr:min)	Segment time (hr:min)	Geological features	Observations and activities
			EVA II—Continued	
Travel	1:37	0:10	South along smooth mare SW at secondary crater cluster to base of Apennine Front	Observe smooth mare characteristics Observe secondary crater cluster characteristics and crater forms Photography as appropriate
Check Point	1:47	0:04		
Travel	1:51	0:10	East along Apennine Front	Traverse along Apennine Front; determine position of base of Front and search for optimum sampling areas for stops on return leg of traverse Photography as appropriate Observe possible debris flows, downslope movement; look for source
Check Point	2:01	0:04		
Travel	2:05	0:05	East along Apennine Front	Same as above
Check Point	2:10	0:04		
Travel	2:14	0:12	Along Apennine Front to area stop 5	Same as above
Area Stop 5	2:26	0:51	At base of Apennine Front near rim of Front Crater	Documented samples from upslope side of Front Crater in Apennine Front Documented samples from northern rim of Front Crater; particularly at sharp 80-m crater on rim Stereo pan Exploratory trench upslope of Front Crater 500mm photography of any interesting targets Stereo pairs upslope of any interesting targets
Travel	3:19	0:15	Along base of Apennine Front	Observe lateral variations in material and surface textures Search for blocky areas along Apennine Front which are suitable for sampling (craters, etc.) Photography as appropriate
6	3:32	0:44	Along base of Apennine Front on slope in inter-crater areas or on crater rims; chosen at crew's discretion, based on previous observations	Include the following activities which should be modified according to the local geology: Description of Apennine Front in sampling area Comparison of Apennine Front and of the material there with other surface units Documented samples of Apennine Front material Panoramic photography Exploratory trench Possible drive core tube 500mm photography Stereo pairs of interesting features upslope
Travel	4:16	0:08	Along base of Apennine Front	Observe lateral variations in material and surface textures Search for blocky areas along Apennine Front which are suitable for sampling (craters, etc.) Photography as appropriate
7	4:24	0:44	Along base of Apennine Front on slope in inter-crater areas or on crater rims; chosen at crew's discretion, based on previous observations	Observe lateral variations in material and surface textures Search for blocky areas along Apennine Front which are suitable for sampling (craters, etc.) Photography as appropriate At the last Apennine Front stop, based on previous observations along Front, crew uses discretion to complete sampling

TABLE 2.—*LRV Exploration Traverse*—Continued

Station/activity	Elapsed time at start (hr:min)	Segment time (hr:min)	Geological features	Observations and activities
			EVA II—Continued	
Travel	5:08	0:22	From base of Apennine Front along southwestern edge of secondary crater cluster	Observe secondary crater deposits and relation to other terrain Observe eastern edge of possible debris flow from Apennine Front Photography as appropriate
8	5:30	0:37	Mare material near crater	Comprehensive sample area Double core tube Documented sampling of large mare crater Possible fillet/rock sample Possible large and small equidimensional rock samples Panoramic photography Trench Possible buried rock sample Fill SESC Penetrometer
Travel	6:07	0:13	Across smooth mare	Compare mare material with other lunar material Observe possible ray material
LM	6:20	0:40	Smooth mare	Store samples and records Ingress LM
			EVA III	
LM		0:42	Smooth mare	Egress LM, prepare for traverse
Travel	0:42	0:07	Across smooth mare between LM and rim of Hadley Rille	Compare smooth mare material with rille rim material
Supplementary Sample Stop	0:49	0:05	Smooth mare between LM and rim of Hadley Rille	Soil/rock sample Panoramic photography
Travel	0:54	0:12	Across smooth mare to rille rim turning NW at rille rim to the Terrace	Compare smooth mare material to rille rim material
9	1:06	0:50	At rim of Hadley Rille at southern end of the Terrace	Observe and describe rille and far wall 500 mm lens camera photography Comprehensive sample Single or double drive core tube Panoramic photography Documented sampling of crater at edge of rille Possible pan on edge of crater Penetrometer
Travel	1:56	0:03	Along rille rim at the Terrace	Continued description of rille and rim material Photography as appropriate
10	1:59	0:10	Along rille rim at the Terrace	500mm lens camera panoramic photography—provides stereo base for station 9; same targets should be photographed Documented sample from crater on rille rim Panoramic photography
Travel	2:09	0:06	Along rille rim to north end of the Terrace	Continued description of rille and rille rim material Photography as appropriate
11	2:15	0:10	At rim of Hadley Rille at NW end of the Terrace	Observe and describe rille and far rille wall; compare with previous observations 500mm lens camera photography Documented samples of rille rim and crater at edge of rille Panoramic photography Compare rille rim material with other terrain
Travel	2:34	0:07	From rille rim and traverse across mare toward North Complex	Observe changes in material from rille rim to mare to North Complex

TABLE 2.—*LRV Exploration Traverse*—Continued

Station/activity	Elapsed time at start (hr:min)	Segment time (hr:min)	Geological features	Observations and activities
				EVA III—Continued
Supplementary Sample Stop	2:41	0:05	Between rille rim and North Complex	Soil/rock sample Panoramic photography
Travel	2:46	0:12	Toward Chain Crater in the North Complex	Observe changes in material from rille rim to mare to North Complex Observe characteristics of crater chain originating in Chain Crater Observe possible secondary craters
12	2:58	0:23	Southeastern rim of Chain Crater in North Complex at junction with elongate depression	Documented sample of crater ejecta Documented sample of North Complex material Panoramic photography Possible drive core tube Describe wall of crater and its relation to elongate depression Attempt to determine whether crater was caused by impact
Travel	3:21	0:08	Between large craters in North Complex	Observe area between craters in North Complex and compare ejecta with other materials at the site Continue to compare North Complex with other terrain types
13	3:29	0:53	Multiple objective stop at end of North Complex between Chain Crater and 700-m crater	The more interesting features in the North Complex are the following: 160-m crater on western rim of the 700-m crater 700-m crater Eaglecrest Crater Scarps Based on the characteristics and accessibility of each of these features, the following tasks should be completed at the discretion of the crew: Documented sampling Panoramic or stereo panoramic photography Possible drive core tube Exploratory trench Soil sample Targets for 500mm photography Penetrometer
Travel	4:22	0:19	From North Complex into the mare region with possible secondaries from ray	Observe and describe differences in material and surface textures between North Complex and mare Note amount of secondary cratering Photography as appropriate
14	4:41	0:20	180-m crater in mare south of North Complex	Compare blocks and mare material with North Complex Documented sample of mare material Possible fillet/rock sample Possible large and small equidimensional rock samples Possible radial sampling of fresh 5-10m. crater Panoramic photography Exploratory trench in ray material
Travel	5:01	0:15	Across mare between North Complex and LM	Describe differences between this area and other mare areas Note distribution of possible secondaries
LM	5:16	0:44	Smooth mare fill	Store samples and records Ingress LM

TABLE 3.—*Summary Timeline for ALSEP Deployment*

Approximate time at start of activity (minutes)	Commander's activity	LM pilot's activity
0		Both remove ALSEP from LM and stow it on ROVER
10		Both remove ALSEP from LM and stow it on ROVER
20	Drive Rover to ALSEP site	Walk to ALSEP site
30	Heat Flow Experiment Removes equipment from Rover and sets up on moon.	Make electrical connections to ALSEP
40	HFE—Continues to deploy equipment	Deploy Passive Seismic Experiment (PSE)
50	HFE—Assemble drill	Solar Wind Experiment Lunar Surface Magnetometer (LSM)
60	HFE—Drill first hole, place probes in first hole	LSM
70	HFE (drill second hole)	Install sunshield Install ALSEP antenna
80	HFE—Place probes in second hole	ALSEP antenna SIDE/CCIG
90	Drill core sampling	Activate ALSEP Central Station
100	Drill core sampling	LRRR—Photos of ALSEP
110	Drill core sampling	Photos of ALSEP

TABLE 4.—*Principal Investigators for the Apollo 15 Lunar Surface Scientific Experiments*

Experiment	Principal investigator	Institution
Passive Seismic	Dr. Gary V. Latham	Lamont-Doherty Geological Observatory Columbia University Palisades, New York 10964
Lunar Surface Magnetometer	Dr. Palmer Dyal	Space Science Division NASA Ames Research Center Moffett Field, California 94034
Solar Wind Spectrometer	Dr. Conway W. Snyder	Jet Propulsion Laboratory Pasadena, California 91103
Suprathermal Ion Detector	Dr. John W. Freeman	Department of Space Science Rice University Houston, Texas 77001
Heat Flow	Dr. Marcus E. Langseth	Lamont-Doherty Geological Observatory Columbia University Palisades, New York 10964
Cold Cathode Ion Gauge	Dr. Francis S. Johnson	University of Texas at Dallas Dallas, Texas 75230
Lunar Geology Experiment	Dr. Gordon A. Swann	Center of Astrogeology U.S. Geological Survey Flagstaff, Arizona 86001
Laser Ranging Retro-Reflector	Dr. James E. Faller	Wesleyan University, Middletown, Connecticut 06457
Solar Wind Composition	Dr. Johannes Geiss	University of Berne, Berne, Switzerland
Soil Mechanics	Dr. James K. Mitchell	Department of Civil Engineering, University of California, Berkeley, California 94726
Lunar Dust Detector	Mr. James R. Bates	Science Missions Support Division, NASA Manned Spacecraft Center, Houston, Texas 77058