

Bibliography

This bibliography is not intended to be extensive. It is a guide to simply written, and mostly inexpensive, books that I believe useful for additional reading. I have included a few references to more advanced material.

Allen, J. P., *American Scientist*, March 1972. "Apollo 15: Scientific Journey to Hadley-Apennine". Joe Allen was the Mission Scientist on Apollo 15 and writes with authority.

Alter, Dinsmore, editor, *Lunar Atlas*, Dover Publications, Inc., New York, 1968. Excellent and very inexpensive. Contains many photographs of various features on the Moon. Strongly recommended for the interested layman. Paperbound, \$5.

American Association for the Advancement of Science, Washington, D.C., *Apollo 11 Lunar Science Conference*, McCall Printing Company, 1970. Historic milestone in lunar science. Contains the first public release of information obtained on the Apollo 11 samples by several hundred scientists. Written for fellow scientists. Obtain from AAAS, 1515 Massachusetts Avenue, N.W., Washington, D.C. 20005, Hardback \$14. Paperback \$3.

Baldwin, Ralph B., *The Measure of the Moon*, The University of Chicago Press, 1963. Exhaustive study of the Moon. Important summary of knowledge of the Moon that existed before the lunar flights began. Although in places, the reading may be a little difficult, it is generally accessible to the layman, \$13.50.

Cortright, Edgar M., ed., *Exploring Space with a Camera*, NASA SP-168, NASA, Washington, D.C. Inexpensive. Contains many beautiful photographs obtained from space. Well worth the small investment for the layman with even mild interest in space. Government Printing Office, Washington, D.C., \$4.25.

GPO Pamphlet PL79A. *Space: Missiles, the Moon, NASA and Satellites*. Lists all space publications available through the Government Printing Office. Ask for current edition. Free.

Hasselblad Magazine. *The First Man on the Moon*. The Hasselblad Magazine. Contains many beautiful photographs taken with Hasselblad cameras. pp. 32. Hasselblad, Box 220, S-401 23, Göteborg, Sweden. Specify Swedish, English, German, or Italian. Price U.S. \$1.

Hess, Wilmot, Robert Kovach, Paul W. Gast, and Gene Simmons, *The Exploration of the Moon, Scientific American*, Vol. 221, No. 4, October 1969, pp. 54-72. General statement of plans for lunar exploration. Written before first lunar landing. Suitable for layman. The authors were all instrumental in planning the lunar surface scientific operations of the Apollo program. Reprint available from W. H. Freeman and Co., 600 Market Street, San Francisco, Calif. 94104, 25¢ postage paid.

Jastrow, Robert, *Red Giants and White Dwarfs*, Harper and Row, 1967, 176 pp. Very readable story of the evolution of stars, planets, and life. \$5.95.

Kosofsky, L. J. and Farouk El-Baz, *The Moon as Viewed by Lunar Orbiter*, NASA SP-200, NASA, Washington, D.C., 1970. Excellent reproductions of beautiful photographs of the Moon obtained from the Lunar Orbiter spacecraft. U.S. Government Printing Office, Washington, D.C., \$7.75.

Levinson, A. A., editor, *Proceedings of the Apollo 11 Lunar Science Conference*, 1970. Extensive coverage of the first public release of information obtained from Apollo 11. Advanced. Intended for fellow scientists. Pergamon Press, 3 Volumes. Proceedings of later conferences are available from the MIT Press, Cambridge, Mass. 02139.

Levinson, A. A., and S. R. Taylor, *Moon Rocks and Minerals*, 1971. Excellent introduction to the results obtained from studies of Apollo 11 lunar samples. Most of the book suitable for knowledgeable laymen. Pergamon Press, 222 pp., \$11.50.

Lunar Surface Exploration issue of *Bendix Technical Journal*, Bendix Center, Southfield, Michigan, 1971., 131 pp. Available from the Editor, *Bendix Technical Journal*, The Bendix Corp., Southfield, Mich. 48076. \$2.

Mason, Brian and W. G. Melson, *The Lunar Rocks*, 1970. Suitable for those with some familiarity with science. J. Wiley and Sons, 179 pp.

McGraw-Hill *Encyclopedia of Space*, 1967. Easy to read. Profusely illustrated. Excellent source of information written in an easy-to-read style. Covers unmanned and manned space exploration, 831 pp. \$27.50.

Mutch, Thomas A., *Geology of the Moon*, A Stratigraphic view, Princeton University Press, Princeton, N.J., 1970.

Excellent introduction to lunar geology. Written before Apollo 11 landing but still quite current. Previous geological training not necessary. \$17.50.

NASA, *Ranger IX Photographs of the Moon*, NASA SP-112, NASA, Washington, D.C., 1966. Beautiful close-up photographs of the Moon, obtained on the final mission of the Ranger series, U.S. Government Printing Office, Washington, D.C., \$6.50.

NASA, *Earth Photographs from Gemini VI through XII*, NASA SP-171, NASA, Washington, D.C., 1968. Contains many beautiful photographs of the Earth from space. In color. U.S. Government Printing Office, Washington, D.C., \$8.

NASA, *Surveyor Program Results*, NASA SP-184, NASA, Washington, D.C., 1969. Final report of the results obtained in the Surveyor program. Surveyor was the first U.S. soft-landed spacecraft on the Moon and provided many important data. Because only one of the Surveyor sites has been revisited, the data given in this book are very important to our current understanding of the Moon. Part is easily readable by the layman; some is more difficult. U.S. Government Printing Office, Washington, D.C., \$4.75.

National Geographical Society. Several beautifully illustrated articles. I suggest that you see the magazine index.

Scientific American. Several articles on the scientific find-

ings of lunar research have appeared in the past two years. They are accurate, informative, and written in easy-to-read style. Copies of each article may be obtained for 25¢. I suggest you see the magazine index for articles on the Moon.

Shelton, W. R., *Man's Conquest of Space*, 1968. Beautifully illustrated overview of space exploration. National Geographic Soc., 200 pp., \$4.25.

Simmons, Gene, *On The Moon with Apollo 15: A Guidebook to the Hadley-Apennine Region.*, 1971. U.S. Government Printing Office, Washington, D.C. 20402, \$1.

Simmons, Gene, *On The Moon with Apollo 16: A Guidebook to the Descartes Region.*, 1972. U.S. Government Printing Office, Washington, D.C. 20402, \$1.

Wood, John A., *Meteorites and the Origin of Planets*, 1968. Inexpensive. Suitable for layman. Good introduction to meteorites, McGraw-Hill Book Co.

Zeiss, Carl, Inc., Space Brochure 0-142, To press, March 1973. Order from Carl Zeiss, Inc., 444 Fifth Avenue, New York, N.Y. 10018.

Zeiss, Carl, Inc., *Space Calendar 1973*, booklet 1973.

Zeiss Lenses on Earth, on the Moon, in Space—Fascination - Information - Interpretation - Exploration - Documentation, 1972. Order from Carl Zeiss, Inc., 444 Fifth Avenue, New York, N.Y. 10018, Order No. 0-135 d/e. \$3.50.

NASA EDUCATIONAL PUBLICATIONS

NASA publications in the EP (for educational publications) series have included several dealing with the Apollo program and Apollo flights. Titles listed below may be ordered from the Superintendent of Documents, Government Printing Office, Washington, D.C., 20402.

EP-70 Mission Report/Apollo 10.—The Apollo mission took two astronauts to within 50,000 feet of the lunar surface in a full dress rehearsal of the Apollo 11 lunar landing. This booklet describes that mission as the final test of all elements of the Apollo system. In full color. 12 pages. 35 cents.

EP-71 "In This Decade . . ." Mission to the Moon.—This "pre-launch" booklet outlines the complex steps leading to a manned lunar landing. The many and varied areas of research and development conducted by the National Aeronautics and Space Administration are illustrated. In color. 48 pages. \$1.25.

EP-72 Log of Apollo 11.—The greatest voyage in the history of mankind, the journey of Apollo 11, is documented in this booklet. In color. 12 pages. 35 cents.

EP-73 The First Lunar Landing/As Told by the Astronauts.—The Apollo 11 postflight press conference is recorded in the astronauts' own words. They describe the history-making mission and answer reporters' questions. 24 pages. 75 cents.

EP-74 Apollo 12/A New Vista for Lunar Science.—The mission described as ". . . a thousand, maybe even a mil-

lion times more important than Apollo 11," is shown as a significant addition to man's knowledge of the universe. 20 pages. 65 cents.

EP-76 Apollo 13. "Houston, We've Got a Problem."—Failure of one of Apollo 13's oxygen tanks made it necessary to continue flight in an emergency mode to and around the Moon, and back to splashdown in the Pacific Ocean. The story of this dramatic flight is told mainly in excerpts from the conversations between the astronauts and Mission Control. 25 pages. 75 cents.

EP-91 Apollo 14: Science at Fra Mauro.—Exploration of the upland Fra Mauro area of the Moon incorporated the most extensive scientific observations in manned lunar exploration up to that time. The story is presented in text, a traverse map and spectacular color photographs. The Fra Mauro area is believed to hold debris hurled out of the Moon's interior by the massive impact of an object from space. 48 pages, \$1.25.

EP-94 Apollo 15 At Hadley Base.—The flight of Endeavour and Falcon to the Apennine Mountain area. The ability of the Apollo 15 astronauts to explore was significantly enhanced by the use of a Lunar Roving Vehicle. The story is presented in text and full color pictures. 32 pages. 75 cents.

EP-97 Apollo 16 at Descartes.—This publication covers the highlights of the mission and includes many detailed color photographs. 32 pages. 75 cents.

NASA PICTURE SETS

The picture sets described below are available, at prices quoted, from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

NASA Picture Set No. 1 Apollo—"In the Beginning . . ."—Seven 11'' x 14'' color lithographs that illustrate highlights from the Apollo 8, 9, and 10 missions. \$1.25 per set.

NASA Picture Set No. 2 Men of Apollo.—Five 11'' by 14'' color lithographs that include portraits of the crews of Apollo 7, 8, 9, 10 and 11. \$1 per set.

NASA Picture Set No. 3 Eyewitness to Space.—Twelve 16'' x 20'' color lithographs that reproduce the paintings of space program scenes by artists Mitchell Jamieson, Peter Hurd, James Wyeth, Lamar Dodd, George Weymouth, Nicholas Solovioff, Hugh Laidman, Fred Freeman, Billy Morrow Jackson, Paul Calle, and Frank McMahon. \$2.75 per set.

NASA Picture Set No. 4 First Manned Lunar Landing.—Twelve 11'' x 14'' color lithographs depict the historic journey of Apollo 11, man's first visit to another celestial body. \$1.75 per set.

NASA Picture Set No. 5 Man on the Moon.—One 16'' x 20'' color lithograph that best illustrates man's moment of success, the first step in his conquest of space. \$1 per copy.

NASA Picture Set No. 6 Apollo 12—Pinpoint Landing on the Moon.—Eight 11'' x 14'' color lithographs and two 11'' x 14'' black and white lithographs illustrating man's return to the Moon. \$1.50 per set.

NASA Picture Set No. 7 Apollo 15.—Nine 11'' x 14'' color lithographs illustrating the journey to the Moon of Endeavour and Falcon. \$1.50 per set.

Acronyms and Abbreviations

ALSD	Apollo Lunar Surface Drill	LBW	Low Speed Black and White
ALHT	Apollo Lunar Hand Tools	LCRU	Lunar Communications Relay Unit
ALHTC	Apollo Lunar Hand Tool Carrier	LDAC	Lunar Surface 16-mm Data Acquisition Camera
ALSE	Apollo Lunar Sounder Experiment	LDD	Lunar Dust Detector
ALSEP	Apollo Lunar Surface Experiments Package	LEAM	Lunar Ejecta and Meteorite Experiment
ALSRC	Apollo Lunar Sample Return Container (Rock Box)	LESC	Lunar Environment Sample Container
AMU	Atomic Mass Unit	LGE	Lunar Geology Experiment
ASE	Active Seismic Experiment	LM	Lunar Module
BLSS	Buddy Secondary Life Support System	LMP	Lunar Module Pilot
BW	Black and White	LMS	Lunar Mass Spectrometer
CAPCOM	Capsule Communicator, the single individual on Earth who talks directly with the crew	LNP	Lunar Neutron Probe Experiment
CCIG	Cold Cathode Ion Gauge	LOI	Lunar Orbit Insertion
CM	Command Module	LP	Long Period
CSM	Command and Service Module	LPM	Lunar Portable Magnetometer
CDR	Commander	LRL	Lunar Receiving Laboratory
CRD	Cosmic Ray Detector	LRRR	Laser Ranging RetroReflector (Pronounced LR-cubed.)
C/S	ALSEP Central Station	LRV	Lunar Roving Vehicle (ROVER)
CSVC	Core Sample Vacuum Container	LSAPT	Lunar Samples Analysis and Planning Team
DAC	Data Acquisition Camera	LSG	Lunar Surface Gravimeter
DPS	Descent Propulsion System	LSM	Lunar Surface Magnetometer
DOI	Descent Orbit Insertion	LSPE	Lunar Surface Profiling Experiment
DSEA	Data Storage Electronics Assembly	LSPET	Lunar Sample Preliminary Examination Team
ETB	Equipment Transfer Bag	LSUV	Lunar Surface UV Camera
EVA	Extravehicular Activity	LTG	Lunar Traverse Gravimeter Experiment
FMC	Forward Motion Compensation	MC	Mapping Camera
FOV	Field of View	MCC	Mission Control Center
FUS	Far Ultraviolet Spectrometer	MESA	Modularized Equipment Stowage Assembly (A storage area in the LM that contains science equipment.)
FWD	Forward	MIT	Massachusetts Institute of Technology
GASC	Gas Analysis Sample Container	MPA	Mortar Package Assembly
GCTA	Ground-Commanded Television Assembly	MSC	Manned Spacecraft Center
GET	Ground Elapsed Time	MSFN	Manned Space Flight Network
GMT	Greenwich Mean Time	NASA	National Aeronautics and Space Administration
GLA	Grenade Launch Tube Assembly	NM	Nautical Mile
GN ₂	Gaseous Nitrogen	OPS	Oxygen Purge System
HBW	High-Speed Black and White	PC	Panoramic Camera
HCEX	High-Speed Color Exterior	PET	Preliminary Examination Team
HEC	Hasselblad Electric Camera	PI	Principal Investigator
HEDC	Hasselblad Electric Data Camera	PLSS	Portable Life Support System
HFE	Heat Flow Experiment	PM	Portable Magnetometer (also LPM)
IMC	Image Motion Compensation	ppm	Parts per Million
IR	Infrared	PSCB	Padded Sample Collection Bag
ISR	Infrared Scanning Radiometer	PSE	Passive Seismic Experiment
JPL	Jet Propulsion Laboratory	PTE	Photographic Tasks and Equipment
KSC	Kennedy Space Center		
LA	Laser Altimeter		
LACE	Lunar Atmospheric Composition Experiment		

RCS	Reaction Control System	SP	Short Period
REV	Revolution	SPS	Service Propulsion System
RTG	Radioisotope Thermoelectric Generator	SRC	Sample Return Container (=ALSRC)
SC	Stellar Camera	SSC	Surface Sampler Device
S/C	Spacecraft	SWC	Solar Wind Composition Experiment
SCB	Sample Collection Bag	SWP	Science Working Panel
SEP	Surface Electrical Properties	TEC	Transearch Coast
SEQ	Scientific Equipment Bay	TEI	Transearch Injection
SESC	Surface Environment Sample Container	TV	Television
SEVA	Standup Extravehicular Activity (An Apollo 15 term, not planned for 17.)	UHT	Universal Hand Tool
SIDE	Suprathermal Ion Detector Experiment	USGS	U.S. Geological Survey
SIM	Scientific Instrument Module	V/h	Velocity-to-Height
S-IVB	Saturn IVB (rocket stage)	VHBW	Very High Speed Black and White
SM	Service Module	VHF	Very High Frequency (The same term ap- plies to VHF television.)
SME	Soil Mechanics Experiment	VSA	Vibrating String Accelerometer

Glossary

ALBEDO <i>al-beé-doh</i>	Relative brightness. It is the ratio of the amount of electromagnetic radiation reflected by a body to the amount of incident radiation.
ALPHA PARTICLE	A positive particle consisting of 2 protons and 2 neutrons. It is the nucleus of a helium atom.
ANGSTROM UNIT <i>ang'-strom</i>	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 <i>á-per-ture</i>	A small opening such as a camera shutter through which light rays pass to expose film when the shutter is open.
ATTENUATION <i>a-teñ-u-eh-shun</i>	Decrease in intensity usually of such wave phenomena as light or sound.
BASALT <i>baá-salt</i>	A type of dark gray rock formed by solidification of molten material. The rocks of Hawaii are basalts.
BISTATIC RADAR <i>bi-sta-tic ray-dar</i>	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. A coarse-grained rock composed of angular fragments of pre-existing rocks.
BRECCIA <i>brech'-ya</i>	The interaction layer between the solar wind bow shock and the magnetopause.
BOUNDARY LAYER	The shock wave produced by the interaction of the solar wind with the Earth's magnetosphere.
BOW SHOCK	The production and science of accurately scaled maps.
CARTOGRAPHY	Photographic film container. Also magnetic tape container.
CASSETTE <i>kuh-set'</i>	Pertaining to the space between the Earth and Moon or the Moon's orbit.
CISLUNAR <i>sis-lune-ar</i>	A device for producing beams of parallel rays of light or other electromagnetic radiation.
COLLIMATOR <i>kol'-i-má-ter</i>	Pertaining to the measurement of the intensities of different colors as of lunar surface materials.
COLORIMETRIC	Streams of very high energy nuclear particles, commonly protons, that bombard the Earth and Moon from all directions.
COSMIC RAYS <i>kos-mik</i>	Study of the character and origin of the universe.
COSMOLOGY <i>kos-mol'-uh-gee</i>	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 from craters also—such craters are termed secondary craters.
CRATER <i>cray-ter</i>	A direction approximately 90 degrees to the direction to the Sun and related to lunar surface photography.
CROSS-SUN	Perpendicular to the instantaneous direction of a spacecraft's ground track.
CROSSTRACK	Rocks consisting wholly or chiefly of mineral crystals. Such rocks on the Moon are usually formed by cooling from a liquid melt.
CRYSTALLINE ROCKS	

DIELECTRIC <i>dyé-ee-lek-trik</i>	A material that is an electrical insulator. Most rocks are dielectrics.
DIURNAL <i>dye-er'-nal</i>	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 <i>dopp'-tur</i>	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 that is directly away from the Sun 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 <i>ee-klip'-tik</i>	The plane defined by the Earth's orbit about the Sun.
EFFLUENT <i>eff-flu-ent</i>	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 <i>ee-gress</i>	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 <i>ee-jek'-tuh</i>	Lunar material thrown out (as resulting from meteoroid impact or volcanic action).
ELECTRON <i>ee-lek'-tron</i>	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 <i>proton</i> is the corresponding elementary particle with a unit of positive charge and a mass of 1,837 times as great as the mass of the electron.
EXOSPHERE	The outermost portion of the Earth's or Moon's atmosphere from which gases can escape into outer space.
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 <i>fill'-it</i>	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 <i>flur-es-ence</i>	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 United States, the Colorado Front Range is a good example.
GALACTIC <i>ga-lak'-tik</i>	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.
GARDENING	The overturning, reworking, and changing of the lunar surface due to such processes as meteoroid impact, volcanic action, aging and such.
GEGENSCHNITT <i>geg'-en-schine</i>	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 <i>gee-odd'-eh-see</i>	Originally, the science of the <i>exact</i> size and shape of the Earth; recently broadened in meaning to include the Moon and other planets.
GEOPHONE	A small device implanted in the lunar surface during the deployment of the ASE to detect vibrations of the Moon from artificial and natural sources.

GEOPHYSICS <i>gee-oh-phys-ics</i>	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 <i>know'-mon</i>	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 size scale. Color and reflectance scales are provided on the rod and a colorimetric reference is mounted on one leg.
GRADIENT <i>graj'-dee-unt</i>	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.
IMBRIAN AGE	Two methods of measuring age on the Moon are used. One provides the absolute age, in years, and is based on radioactivity. The other gives only <i>relative</i> ages. A very old event on the Moon is that which produced the Imbrium basin. The age of other geologic features can be determined with respect to the Imbrium event.
INGRESS <i>in'-gress</i>	A verb meaning to enter. It is used in connection with entering the LM. See also "egress."
IN SITU <i>in-sit'e-u</i>	Literally, "in place", "in its original position". For example, taking photographs of a lunar surface rock sample "in situ" (as it lies 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.
LITHOLOGY	The character of a rock formation.
LUNATION	One complete passage of the Moon around its orbit.
MANTLE	An intermediate layer of the Moon between the outer layer and the central core.
MARE <i>maar'-ray</i>	A large dark flat area on the lunar surface (Lunar Sea). May be seen with the unaided eye.
MARIA <i>maar'-ya</i>	Plural of mare.
MASCONS <i>mass-conz</i>	Large mass concentrations beneath the surface of the Moon. They were discovered only 3 years ago by changes induced by them in the precise orbits of spacecraft about the Moon.
MASS SPECTROMETER <i>mass spek-trom'-a-tur</i>	An instrument which distinguishes chemical species in terms of their different isotopic masses.
METEORITE <i>me-te-oh-rite</i>	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 iron-nickel. For a thorough discussion see <i>Meteorites</i> by Brian Mason, John Wiley and Sons, 1962.
METRIC PHOTOGRAPHY	Recording of surface topography by means of photography, together with an appropriate network of coordinates, to form the basis of accurate measurements and reference points for precise photographic mapping.
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 <i>mo'oh-pole</i>	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 <i>mor-fol'-uh-ge</i>	The external shape of rocks in relation to the development of erosional forms or topographic features.
MOULTON POINT	A theoretical point along the Sun-Earth line located 940,000 statute miles from the Earth at which the sum of all gravitational forces is zero.
NADIR	That point on the Earth (or Moon) vertically below the observer.
NAUTICAL MILE	It is 6,280 feet—19 percent larger than a "regular" mile.
NEUTRON	An uncharged elementary particle that has a mass nearly equal to that of a proton and is present in all known atomic nuclei except hydrogen.
OCCULTATION <i>ah'-cull-taj'-shun</i>	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 <i>oh'-zone</i>	Triatomic oxygen (O ₃); found in significant quantities in the Earth's atmosphere.
P-10	A gas mixture consisting of 90 percent argon, 9.5 percent carbon dioxide, and 0.5 percent helium used to fill the X-ray detectors of the X-Ray Fluorescence Experiment.

PANORAMA	A series of photographs taken from a point to cover 360 degrees around that point.
PENUMBRA <i>pe-num'-bra</i>	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	Systematic description of rocks based on observations in the field (e.g. on the Moon), on returned specimens, and on microscope work.
PHOTOMULTIPLIER TUBE	An electron tube that produces electrical signals in response to light. In the tube, the signal is amplified to produce a measureable output current from very small quantities of light.
PLASMA	A gas composed of ions, electrons, neutral atoms, and molecules. The interactions between particles is mainly electromagnetic. Although the individual particles are electrically positive or negative, the gas as a whole is neutral.
POSIGRADE	Lunar orbital motion in the direction of lunar rotation.
PRIMORDIAL <i>pry-mor'-dee-uhl</i>	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	The positively charged constituent of atomic nuclei.
RADON	Isotopes of a radioactive gaseous element with atomic number 86 and atomic masses of 220 and 222 formed by the radioactive decay of radium.
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 <i>reg'-oh-lith</i>	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.
SÉISMIC <i>sizé-mik</i>	Related to mechanical vibration within the Earth or Moon resulting from, for example, impact of meteoroids on the surface.
SHOCKED ROCKS	Rocks which have been formed by or subjected to the extremes of temperature and pressure from impacts.
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	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.
STOP	Having energies greater than thermal energy.
SUPRATHERMAL <i>soup'-rah-therm'-al</i>	
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 <i>tail-us</i>	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 <i>term'-ugh-nay-tor</i>	The line separating the illuminated and the darkened areas of a body such as the Earth or Moon which is not self-luminous.
TERRA <i>terr'-ugh</i>	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 <i>Top'-oh-grá-fick</i>	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	A short lived event that does not repeat at regular intervals, 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 <i>Trans-pón-der</i>	A combined receiver and transmitter whose function is to transmit signals automatically when triggered by a suitable signal. Those used in space are sensitive to radio signals.
UMBRA <i>um-bruh</i>	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 <i>your-rain'-nee-um</i>	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 <i>zo-dié-uh-cal</i>	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).