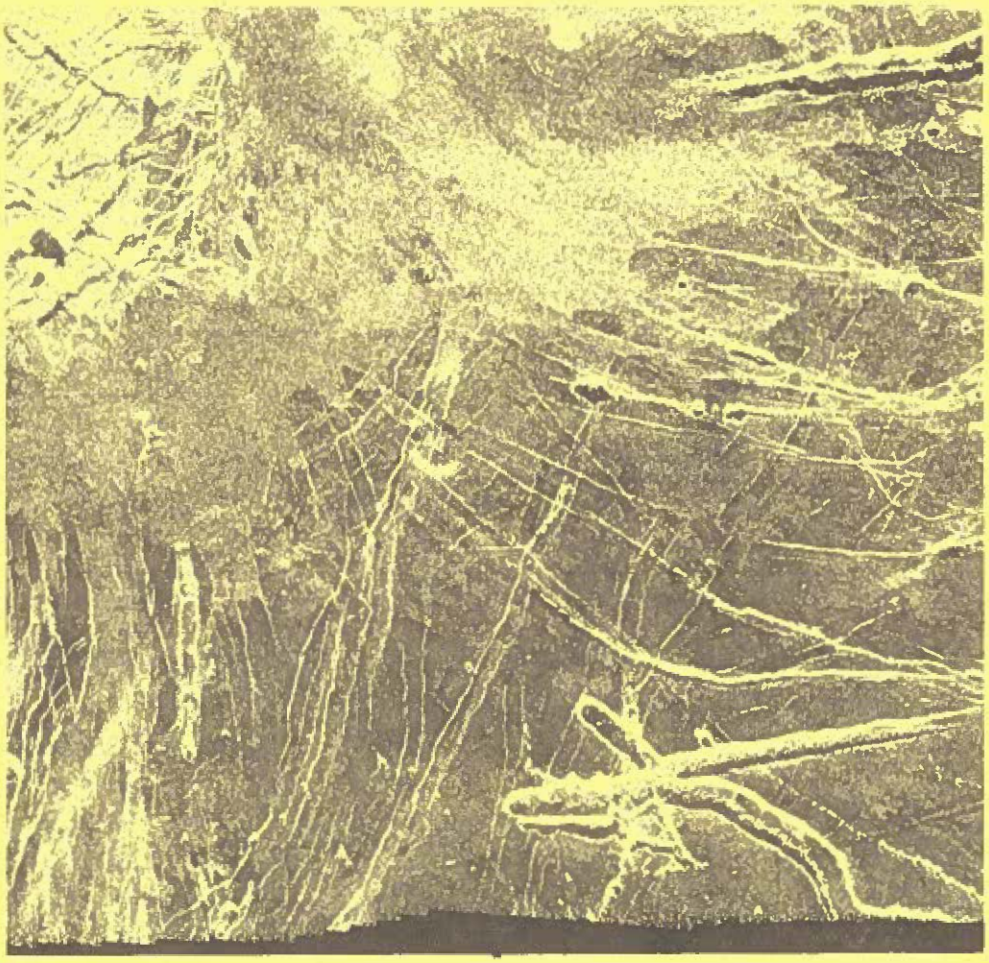
LUNAR AND PLANETARY

USRA

INFORMATION BULLETIN

DECEMBER 1990 • NUMBER 57

Magellan Mosaic Reveals Many Interesting Features



P36837

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LPSC Conference Information, Page 5

VENUS FACTS

Radius: 3630 miles
Rotational Period: 243 Earth days
Orbit Period: 225 Earth days
Distance from Sun: 64,920,000 miles
Density: 5.2 times that of water
Surface Gravity: 0.907 times that of Earth's gravity
Atmospheric Pressure at Surface: 90 times that of Earth's surface pressure
Temperature at Surface: 850°F
Atmospheric Composition: Carbon dioxide (96%), nitrogen monoxide, argon, helium, neon, hydrogen chloride, and hydrogen fluoride

CONTENTS

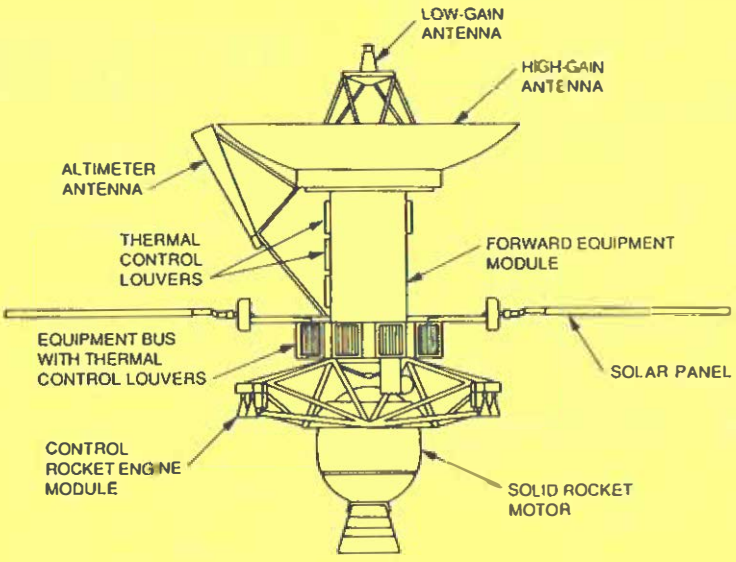
Image Reveals Venusian Geology

R. Stephen Saunders
Jet Propulsion Laboratory

The Magellan spacecraft has completed its 295th mapping orbit of the planet Venus as of this report. A total of 193 mapping orbits have been processed.

An interruption of signal was planned because of the approach of superior conjunction, with the sun nearly between the planets.

The Magellan image is a mosaic of data obtained during orbits 377-399. The image is 284 kilometers (176 miles) wide at the top and 250 kilometers (155 miles) wide at the bottom. It is approximately 575 kilometers (356 miles) long. The image is centered at 60 degrees south latitude and 349.6 degrees east longitude. The area shown is located within the Lavinia Region of Venus in northern Lada Terra. In the lower half of the image is an extensive system of fault scarps and graben trending northwest-southeast. These linear structures extend up to 300 kilometers (186 miles) in length and are 70 meters (0.04 miles) to 7 kilometers (4 miles) in width. The northern ends of the features often widen to become elongate collapse pits and calderas 2-30 kilometers (1-18 miles) in diameter. A second set of linear features trending east-west is observed in the upper left portion of the image. The exact nature of these structures is unclear, although some appear to be graben. The formation of the linear features seen in this image may be linked to subsurface magma injection along dikes and subsequent drainage and collapse. At the intersection of these two sets of linear structures is a large quasicircular feature approximately 140-215 kilometers (87-135 miles) in diameter defined by partial arcs of semiconcentric curvilinear structures including fault scarps and graben. It is interpreted to be a corona, formed by large-scale magma upwelling from the interior of Venus. Within the corona are numerous volcanic domes and pits 2-5 kilometers (1-3 miles) in diameter, volcanic flows, and a sinuous depression approximately 47 kilometers (29 miles) long. A shield volcano 19 kilometers (12 miles) in diameter with a 1 kilometer (0.6 mile) diameter summit pit is observed near the southeast boundary of the corona. The missing strip of this image is being reprocessed to remove artifacts.



Magellan Spacecraft

MAGELLAN MISSION HIGHLIGHTS

Launch: May 4, 1989
Interplanetary Cruise: 442-468 days
Planned Trajectory Correction Maneuvers: 15 days after deployment from shuttle; 360 days after deployment from shuttle; and 17 days before Venus orbit insertion
Orbit Insertion: Aug. 10, 1990, 1700 GMT, STAR 48 solid rocket motor fires to put spacecraft in orbit around Venus
Mapping Orbit Period: 3.15 hours
Radar Mapping: 37 minutes per orbit
Mapping Orbit Inclination: 86 degrees
Superior Conjunction: Oct. 26-Nov. 9, 1990
End of Nominal Mission: April 28, 1991
Data Gap Recoverable: June 27-July 10, 1991

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Fran Waranius, *Editor*

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Ulysses: Above the Poles of the Sun

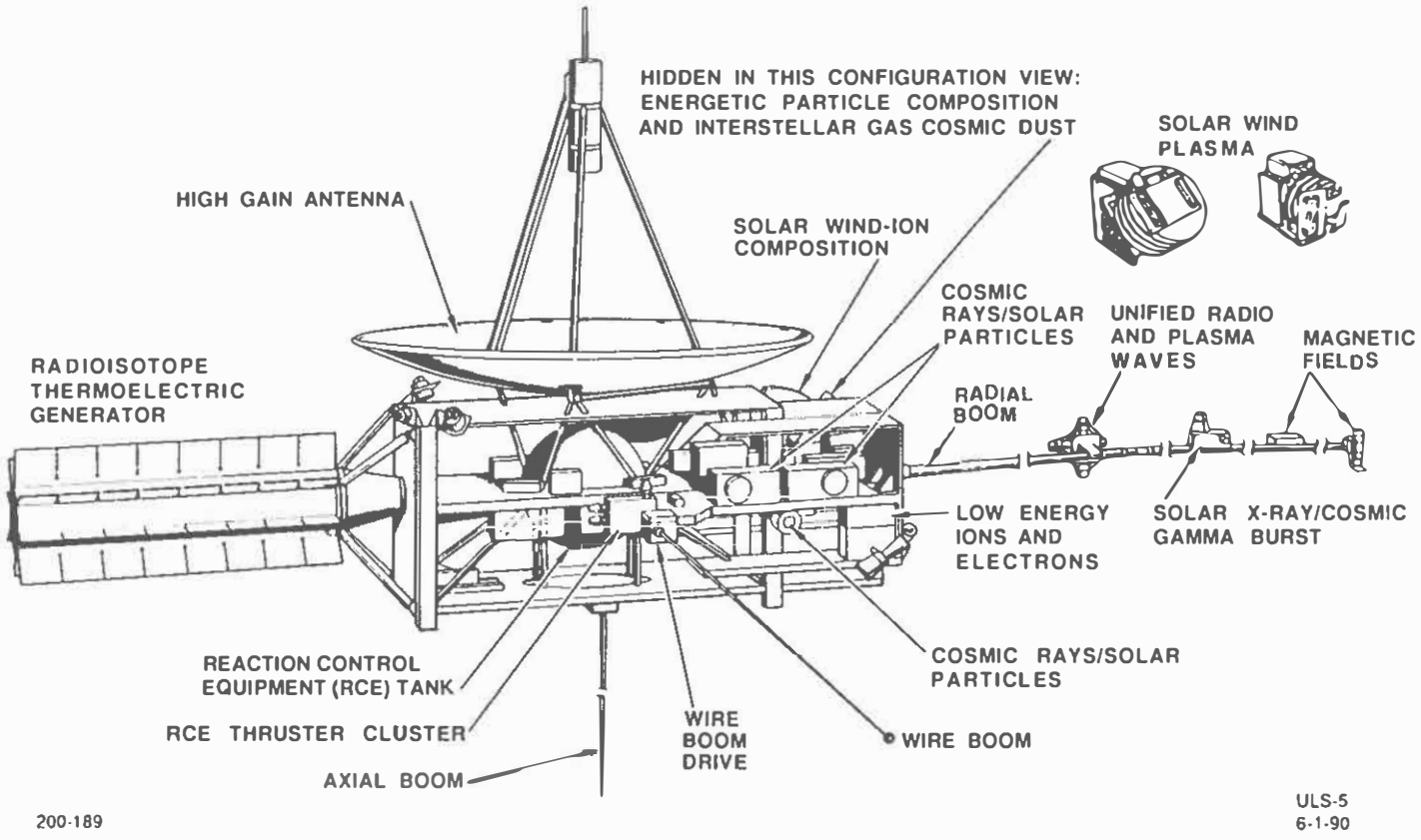
Steven H. Williams
Lunar and Planetary Institute

The Ulysses mission, a flight over both poles of the sun, is off to an extremely good start. The launch on October 6, 1990 was "letter perfect," and there have been no significant problems with any aspect of the mission since. In fact, the trajectory is so accurate that not all the planned midcourse corrections are necessary. The spacecraft is still undergoing system checkouts, but all is very well so far.

The sun is vital to all life on Earth. It has been studied extensively from both ground-based and orbital-based platforms, and we have learned a great deal about our own star. However, because the equatorial plane of the sun nearly coincides with the plane of the ecliptic, we can only get near-vertical views of the sun over its equatorial regions; the polar zones are seen obliquely, if at all. Complex theoretical models of the magnetic field of the sun's polar regions and the nature of radiation and charged particles there have never been adequately tested. The Ulysses mission will change all that.

Until now, it has not been possible to send a probe over the polar regions of the sun. It is not feasible to launch such a probe directly from Earth because of the prohibitive fuel cost needed to overcome the momentum of the Earth's orbital speed. A clever trick, similar to those employed on other space missions, will let us overcome that difficulty. The intense gravitational field of Jupiter will be used to deflect Ulysses to a trajectory roughly perpendicular to the plane of the ecliptic. It may seem odd to send a probe from the Earth to the sun via Jupiter, but that is the only way to get the job done. Ulysses will cross the sun's poles at 42 and 51 months into the mission.

Ulysses is perhaps the best example of international cooperation in space exploration. The spacecraft itself was built primarily by the European Space Agency (ESA). The United States is responsible for the launch of Ulysses to low Earth



Ulysses Spacecraft - (for description of instrument packages, see Table 1 on Page 4)

TABLE 1. **The Ulysses mission experiments.**

Instrument Package	Mission Objective	Principal Investigator (PI)
Solar X-Ray/Gamma Ray	Observe solar X-rays and cosmic gamma rays	K. Hurley, University of California-Berkeley, USA; M.Sommer, Max-Planck-Institut, Germany
Solar Wind Plasma	Observe plasma in the solar wind	S. Bame, Los Alamos Laboratory, USA
Solar Wind-Ion Composition (SWICS)	Observe heavy ions in the solar wind	G. Gloeckler, University of Maryland, USA; J. Geiss, Universitat Bern, Switzerland
HI-SCALE	Detect other low-energy particles	L. Lanzerotti, Bell Laboratories, USA
Energetic Particles	Detect particles with higher energies	E. Keppler, Max-Planck-Institut, Germany
Cosmic Rays/Solar Particles	Detect highest-energy particles	J. Simpson, University of Chicago, USA
Magnetic Fields	Measure solar magnetic fields	A. Balogh, Imperial College, UK
Interstellar Gas/Cosmic Dust	Detect interstellar dust and gas	E. Gruen, Max-Planck-Institut, Germany
Unified Radio and Plasma Waves	Measure radio waves from the sun and plasma waves near Ulysses	R. Stone, Goddard Space Flight Center, USA

orbit on the space shuttle *Discovery* and the use of an Inertial Upper Stage (IUS) for leaving Earth orbit. The Ulysses probe, using a two-stage IUS and a Payload Assist Module (PAM), now holds the record for having the highest departure speed from Earth for any spacecraft (34,130 mph). ESA is responsible for spacecraft operations. Data from Ulysses will be received on NASA's Deep Space Network. The path of international cooperation has not always been smooth for many reasons, including the *Challenger* disaster and NASA funding problems, but Ulysses is on its way and should serve as a model and incentive for future space missions.

Thirteen separate scientific experiments will be performed by the nine scientific instruments carried aboard the Ulysses spacecraft: one on each instrument, two utilizing the results of more than one device, and two using the radio transmitter. The primary objective is to observe magnetic fields, radiation, and especially charged particles in the regions over the poles of the sun. The experiments are given in Table 1; the listing of experiment principal investigators (PIs) reflects the international effort behind the Ulysses mission. In addition, data from several of the instruments will be used to determine (1) the details of variations in the solar wind plasma and magnetic field (experiments under the direction of J. Lemaire of the Institut d'Aeronomie Spatiale de Belgique, Belgium) and (2) the rate at which the sun is losing mass and angular momentum (experiments under the direction of G. Noci of the Instituto di Astronomia, Italy). The attenuation of radio signals from Ulysses will be used to determine (1) the abundance and motion of electrons in the solar corona (PI: H. Volland, Universitat Bonn, Germany) and (2) the presence of gravitational waves in the interplanetary medium as predicted by Einstein (PI: B. Bertotti, Universita di Pavia, Italy).

LPSC 22 - MARCH 1991 - ANNOUNCEMENT

The 22nd Annual Lunar and Planetary Science Conference will be held on March 18-22, 1991 in Houston, Texas. This conference brings together international specialists in petrology, geochemistry, geophysics, geology, and astronomy to present the newest results in planetary science.

During the five-day meeting, selected research papers in both topical symposia and problem-oriented sessions will be presented. Two special sessions are already slated.

Joint Session for the Division for Planetary Sciences of the American Astronomical Society and the Meteoritical Society: To promote closer contacts between meteoriticists and planetary scientists, these two societies will sponsor a joint session at the LPSC. Authors are encouraged to submit abstracts for this session for final selection by the Program Committee. The prime criteria are (1) the subject must be broad or important enough to interest members of both societies, and (2) it must be presented so as to be understandable to intelligent but uninformed outsiders.

A Session on Recent Results from Magellan: This session will feature both invited and contributed talks based on data from the Magellan spacecraft. By conference time much of the Aphrodite Terra, the great equatorial highlands of Venus, will have been mapped. It is hoped that there will be an initial assessment of the various hypotheses on the formation of the highland regions on Venus.

There will again be poster presentations. Authors will be asked to be available at designated times to display and discuss their results with interested parties in the poster area. As with oral presentations, posters must be supported by informative abstracts. The program committee will employ the same criteria to govern allocation of space and time in poster sessions as for other modes of presentation.

Abstracts for the conference are to be prepared as short papers. Abstract forms will be sent only to those who complete and return the "Indication of Interest Form." In case you did not receive the Second Announcement mailing, an Indication of Interest Form is included in this Bulletin (*see next page*). The absolute deadline for receipt of abstracts in the Publications Services Department at the LPI is **JANUARY 11, 1991.**

Due to the rousing success of last year's reinstated Chili Cook-off, we will try it again this year. Get your teams and your best recipes together and watch for further information and entry forms in the final circular, which you will get only if you return the Indication of Interest Form.

A fee of $50 ($30 for students) will be assessed each participant to cover various conference services. Preregistration and prepayment must be completed by March 1 to avoid a $10 late fee. Because of the difficulties caused by currency exchange problems, participants residing in a foreign country who preregister may request a waiver from the late charge and pay in cash upon arrival. This information should be indicated on the preregistration form.

This year, the first announcement for the LPSC was mailed only to those people who have attended previous meetings. If you have not received the first and/or second announcement, please send in the "Indication of Interest Form" found on the following page or call the Program Services Department at 713-486-2166.

Conference Program On-line

Because it is very difficult to ensure that the printed preconference program, which is contained in the February issue of the Bulletin, will reach everyone prior to conference, the program is scheduled to be available on-line on or around February 6, 1991. The NASA SPAN network or direct dial may be used to access the program.

INSTRUCTIONS

1. Using SPAN from your computer
   $Set Host LPI:: <cr>
   USERNAME: Program<cr>
   PASSWORD: LPI<cr>

or

   USERNAME: LPI <cr>
   No password is necessary. An options menu is provided for selecting the program.

2. To dial direct, call 713-486-9782, 486-8214, or 488-6967. The lines will connect to 2400/1200/300 baud modems. When the connection is made, respond with
   USERNAME: Program <cr>
   PASSWORD: LPI<cr>.

You will then be in the system and a menu of options for reading the program will be displayed.

If you have any difficulty accessing the LPI computer, contact Kin Leung at 713-486-2165 (LPI::LEUNG on SPAN) or Lorraine Fisher at 713-486-2194 (LLFISHER on NASAMAIL).

REMEMBER:
The program will be on-line by February 6, 1991.

Indication of Interest Form

22nd Lunar and Planetary Science Conference

March 18-22, 1991
NASA/Johnson Space Center, Houston, Texas

To receive abstract forms and future LPSC 22 mailings, please complete and return this Indication of Interest Form to the LPI.

Name: _____

Mailing Address: _____

_____

_____

Phone: ( ) _____

FAX Number: ( ) _____

Electronic Mail Address: _____

_____

Use this form or reproduce one and mail to:

22nd LPSC
Lunar and Planetary Institute
3303 NASA Road 1
Houston TX 77058-4399 USA
Phone: (713) 486-2166

Publications

These publications are available from the publisher listed or may be ordered through local bookstores

Planetary Mapping

Ronald Greeley and
Raymond Batson, eds.,
Cambridge University Press,
Cambridge and New York, 296 pp.,
1990. $70.00

Reviewed by Paul Spudis,
LPI Staff Scientist

Maps are often taken for granted, but they are among the most important tools used in planetary exploration. This large-format book, the latest in the Cambridge University Press' Planetary Science Series, details the principles and techniques of planetary cartography and geologic mapping. The book consists of seven chapters, each written by experts in the selected fields, outlining the methodology and principles of various subtopics of the field of planetary cartography.

After a brief introduction outlining what maps are and how they are produced, Ray Batson, Ewen Whitaker, and Don Wilhelms review the history of planetary cartography, starting with naked-eye drawings of the Moon as early as 1600 (by English astronomer W. Gilbert, done more than 10 years before the famous drawings by Galileo!) and ending with the modern techniques of computerized, digital cartography.

The actual process of producing a planetary map is next described by Batson, including the techniques of mosaicking of individual photos, airbrush drawing, and computer map compilation.

The next chapter, by Mimi Strobell and the late Hal Masursky, describes

planetary features, including small maps showing illustrative examples of the nomenclatural process.

The book then describes the two quantitative aspects of cartography, with chapters on geodesy by Mert Davies and topographic mapping by Sherman Wu and Fred Doyle. The geodesy chapter explains both the significance of control networks and the difficulties of obtaining such data from spacecraft. The topographic chapter describes the various techniques used to obtain planetary topography, including photogrammetry and altimetry.

In the final chapter, Don Wilhelms describes geologic mapping and discusses both the philosophy behind this widely misunderstood technique and the practical techniques of planetary geologic mapping.

Three appendixes deal with map formats, halftone reproduction of map images, and the current plans for producing digital cartographic datasets.

The book is well written and provides an excellent reference source for those who use planetary maps. The book is illustrated by well-reproduced black and white figures; there are no color illustrations. Each chapter has its own bibliography. *Planetary Mapping* is an important reference book that fills a long-neglected gap in the literature and should be widely consulted by planetary investigators and other interested parties.

The New Solar System

3rd edition, J. Kelly Beatty
and Andrew Chaikin, eds.,
Sky Publishing Corp., 326 pp.,
1990. $39.95

Reviewed by Steve Clifford,
LPI Staff Scientist

Over the past 30 years a fleet of small robotic spacecraft has traversed our solar system, revealing in spectacular detail worlds that Earth-based observers had previously seen only as tiny points of light. The resulting dramatic and rapid increase in our knowledge of these bodies has outpaced virtually all attempts to summarize the latest discoveries. Of these efforts, perhaps the most successful has been the book *The New Solar System*, which was originally published in 1981 and is

now being reissued following its second major revision.

The New Solar System is a comprehensive overview of our current understanding of the sun, planets, satellites, and other small bodies of the solar system. Each topical chapter has been authored by a noted scientist and is written at a level comparable to that of articles found in *Sky & Telescope* and *Scientific American*. The book is profusely illustrated with colored charts and diagrams that complement the hundreds of dramatic images taken by Earth-based telescopes and planetary spacecraft. This latest edition has over a third more pages than its predecessor, covering such recent events as the Comet Halley encounter and the Voyager 2 flybys of Uranus and Neptune. There is also a new chapter on the Earth, written by Don Anderson, that helps place the discussion of planetary origin, composition, internal structure, and surface evolution in much better perspective. Although most of the 23 chapter titles are holdovers from the second edition, the chapters themselves have been substantially rewritten. Indeed, four of the chapters have new authors, providing different perspectives on the sun, Moon, Mars, and Titan than presented in the previous edition.

Although the radar images now being returned by the Magellan spacecraft have already dated some of the discussion concerning Venus, the editors of *The New Solar System* have put together an entertaining and highly informative popular work on the diverse nature of our solar system. It will likely only be surpassed when they release the fourth edition.

Origin of the Earth

Horton E. Newsom and John H. Jones, eds., Oxford University Press, 384 pp., 1990. $50.00.

This book is an outgrowth of the LPI Conference on the Origin of the Earth, which was held in Berkeley, California in December 1988.

While the book is not representative of the total knowledge about the early Earth, it does contain a spectrum of opinion on the implications for the origin and earliest history of the Earth.

A strong theme of both the conference and many of this book's papers is the Giant Impact Hypothesis. The Giant Impact Hypothesis has been presented by some as a revolution and a panacea, similar to the advent of plate tectonics, that can explain the long-standing problems of the angular momentum of the Earth-Moon system, the depletion of iron metal in the Moon, and quite possibly the difference in chemical composition between the Earth and Moon. As illustrated by the papers in the volume, however, the implications of this theory for the Earth have not led to the unanimous agreement that giant impacts (connected with the origin of the Moon or not) are consistent with all geophysical and geochemical observations. What is needed now is for all the pieces of the puzzle to fit without serious whittling, carving, or shoving. As of now, they do not. It is hoped that this book will help set the stage for the next generation of investigation and for fitting some pieces of the puzzle together.

The book is divided into six sections. The first three sections deal with accretion and giant impact, and the next three discuss the establishment of chemical and physical reservoirs.

The book is available from Oxford University Press, 200 Madison Avenue, New York NY 10016, or consult your local bookstore.

Astrophysics from the Moon

American Institute of Physics Conf. Proceedings #207
Michael J. Mumma and Harlan J. Smith, eds.
xxxviii + 658 pp., 1990. $75.00

Dr. Phillip Anz-Meador
Sr. Scientist, Orbital Debris Project, Solar System Exploration Dept., Lockheed Engineering & Sciences Co., Houston, TX

This new volume in the AIP proceedings series chronicles the activities of attendees at the "Astrophysics from the Moon" symposium held in Annapolis, Maryland, February 5-7, 1990. The charge of the meeting was threefold: to estimate the frontiers of astrophysical knowledge in the early 21st century and to establish minimum scientific goals to be met to expand these frontiers; to determine which areas of specialization require, or would be augmented by, a manned or telerobotic astrophysical lunar facility or facilities; and to determine the instrumental characteristics necessary to achieve these scientific goals in the next century.

These three charges thus outline the book's contents, following an executive summary of workshop themes. Within each major section, chapters by individual authors and investigators summarize the current understanding of a topic, as well as presenting concepts for realizing that section's goal. While such a task as "determining the frontiers of knowledge" 30 years hence may seem an imposing goal, the authors do an admirable job of addressing the concerns of the major astrophysical subdisciplines. For example, section 1, entitled "Astronomical Frontiers in the Twenty-First Century," discusses in detail planetary astronomy (both solar system and external systems), solar physics, stars and stellar evolution, galactic and extragalactic astronomy, and cosmology. Summaries of panel discussions, followed by

chapters addressing current critical topics and/or technologies, constitute each subsection, and this structure is carried throughout the remainder of the book. The remaining sections consist of an introduction to lunar-based astronomy and lunar instrument development concepts. Particularly interesting among the latter is the concept of using arrays of small telescopic instruments (1-meter class) in lieu of the much larger, and hence more expensive and difficulty-prone, instruments discussed in other subsections.

Being a proceedings volume intended for quick publication, the papers as a whole are dissimilar in format, graphical presentation quality, etc. Also, as is to be expected in a book attempting to address faithfully so many topics, there is at times a certain awkwardness in leaping from (scientific) crag to ledge and back again. However, the conferees present cogent arguments in favor of utilizing the Moon's resources and physical characteristics for observations; these arguments are, and will remain, fundamental to the establishment of any lunar observatory program under the Space Exploration Initiative. The editors have also done very well in making the book readable. This volume should serve as a primer and reference for years to come for those individuals interested in assaying the current state of knowledge and expanding the vistas of astronomy and astrophysics through innovative observational means.

Three New Titles in the LPI Technical Report Series

The abstracts and summary of the Workshop on Antarctic Meteorite Stranding Surfaces, held at the University of Pittsburgh in July 1988, are contained in LPI Technical Report 90-03, edited by W. A. Cassidy and I. M. Whillans. Meteorite stranding surfaces are places where there are concentrations of meteorites on the ice surface. The emphasis of the discussions at the workshop was directed toward understanding the potential in Antarctic meteorite stranding surfaces for supplying data on earlier climates and ice sheet size. A need had been perceived for such a workshop because, while the potential value of the recovered meteorites had been recognized early and rich dividends have been realized from their study, their importance to glaciology was being underemphasized.

On January 15-17, 1990, the Workshop on the Evolution of Magma Bodies on Mars was held in San Diego, California. This workshop focused on many of the diverse approaches related to the evolution of magma bodies on Mars that have been pursued during the course of the Mars: Evolution of Volcanism, Tectonics, and Volatiles (MEVTV) Program. Approximately 35 scientists from the Mars volcanology, petrology, geochemistry, and modeling communities attended. LPI Technical Report 90-04 is edited by P. Mouginis-Mark and J. Holloway.

LPI Technical Report 90-05 documents the Workshop on Cosmogenic Nuclide Production Rates held at the Institute of Geochemistry, University of Vienna, on July 25-26, 1989. An earlier workshop held in 1984 demonstrated that the study of the effects of cosmic-ray bombardment of small and large bodies of the solar system is still very active. Recent improvements in experimental techniques and theoretical understanding, together with new materials being investigated and new scientific applications of cosmogenic nuclides, have caused a revival of this field of science. However, the large variety of applications makes it impossible to deal with all the different aspects of the interactions of cosmic rays with matter within a two-day workshop. Therefore, this workshop was restricted to work involving extraterrestrial materials. Editors of this report are P. A. J. Englert, R. C. Reedy, and R. Michel.

These technical reports can be ordered from the Lunar and Planetary Institute by using the Order Form included in this Bulletin.

New From the Astronomical Society of the Pacific

Quasars

A new information packet describing the distant cosmic "powerhouses" astronomers call quasars is now available. The 24-page packet on quasars explains—in nontechnical language—what astronomers think quasars are, how quasars were discovered, and what we can learn about the universe by observing them. Also included are a guide to measuring cosmic distances and a reading list of books and articles about quasars. Send a $4.00 donation to cover postage and handling; for airmail outside the U.S., add $2.00 and remit in U.S. funds.

New Astronomy Catalog

A new expanded catalog of interesting educational materials on astronomy has just been published. The 32-page catalog includes video and audio tapes, software, slides, posters, video disks and CD-ROMs, books, and observing aids to help everyone learn, enjoy, or teach astronomy. Among the new items in the catalog are software to show the planets and satellites in our solar system with unprecedented detail, a videotape of the PBS special "Creation of the Universe," slides from and of the Hubble Space Telescope, and even an astronomical calculator/watch. To receive the catalog, send two first-class stamps with your name and address to Catalog Request Desk, ASP.

July 1991 Total Eclipse of the Sun

A new book giving full weather, astronomical, and travel information for the total eclipse of the sun visible from Hawaii and Mexico on July 11, 1991, is being made available by the ASP. Written by meteorologist and veteran "eclipse chaser" Joe Rao, the 140-page book, entitled *Your Guide to the Great Solar Eclipse of 1991* (published by Sky Publishing), tells you what you need to know to select a location, prepare for viewing, and understand what is happening during the eclipse. For those who can't travel to the narrow line where the eclipse is total, the book also has a guide and maps for what the partial eclipse will look like throughout North and South America. $17.95 includes shipping and handling; California residents, please add sales tax. Outside the U.S., add $4.00 for postage.

New in Video

A new videotape showing images, animations, and computer simulations from the Voyager 2 flyby of Neptune in August 1989 is now available. The 33-minute color VHS tape includes 21 short films produced at the Jet Propulsion Laboratory. Some of the films are narrated; others are accompanied by baroque music in excellent stereo sound. Among the dramatic clips shown in the tape are the rotation of Neptune, the motion of the circulating weather patterns around its Great Dark Spot (including the mysterious feature nicknamed "the Scooter"), and close-ups of the geysers and other bizarre terrain on the surface of the large moon Triton. The tape is available for $33.95, which includes postage and handling; outside the U.S., add $3.00 and remit in U.S. funds.

The Astronomical Society of the Pacific is an international scientific and educational organization that works to increase the public understanding of astronomy. Founded in 1889, the Society has members throughout the U.S. and in over 75 other countries.

The Astronomical Society of the Pacific
390 Ashton Avenue,
San Francisco CA 94112
415-337-1100

Space Science CD-ROMs from LASP

The Laboratory for Atmospheric and Space Physics at the University of Colorado is pleased to make available to the general public NASA Space Science CD-ROMs. There are currently two disk sets available.

Space Science Samplers

This set consists of two CD-ROM volumes. The first volume has 800 of the best images of Uranus from Voyager 2, including all the images of Uranus' rings and moons. The second volume contains 1400 files of space and earth science data, including a sampling of Voyager and Viking images, data on the Earth's oceans, and data on comets.

Voyagers to the Outer Planets

This set consists of eight CD-ROM volumes containing Voyager images of Jupiter, Saturn, and Uranus. Each image is recorded twice: once at the full 800 pixel by 800 scan line by 8 bit/pixel resolution but in a compressed format, and the second time at reduced resolution (200 x 200 x 8) to facilitate rapid browsing of images.

About the Space Science CD-ROMs

All the CD-ROM volumes described above conform to the ISO 9660 standard for volume, directory, and file formats, except for the Space Science Sampler, Volume I, which conforms to the somewhat older High Sierra CD-ROM standard. All these disks can be played on any CD-ROM disk player and they can be read on computers that can access disks in the High Sierra/ISO 9660 format. Microsoft CD-ROM extensions, available from many computer dealers for less than $100, can be used to read these disks on MS-DOS machines. Apple Computer sells High Sierra/CD-ROM extensions for Macintosh computers through Apple Computer dealers.

With each CD-ROM disk order, LASP supplies software to display images from the disks on your choice of IBM PC (EGA or VGA monitor) or Macintosh II computers (with 256-level display).

Pricing

The two-volume Space Science Sampler disk set is $25.00. The eight-volume Voyagers to the Outer Planets disk set is $75.00. Both sets can be ordered together (10 volumes) for $90.00.

All prices are in U.S. dollars. For orders delivered in the U.S., there are no additional shipping and handling charges. For orders delivered outside the U.S., add $10.00 per disk set for shipping and handling.

Each disk set comes with documentation and your choice (please specify with order) of image display software for either IBM PC or Macintosh II computer.

Ordering

Order by check, money order, or bank draft made payable in U.S. funds to the University of Colorado.

Send orders to:

Space Science CD-ROMs
LASP - Campus Box 392
University of Colorado
Boulder CO 80309
USA
Phone: 303-492-7666
FAX: 303-492-6946

MMI Corporation Announces New Catalogs

MMI Corporation has released its 18th annual educational materials catalogs: *Astronomy, Space Science and Planetarium Guide:* Catalog 91-A and *Geology and Earth Science:* Catalog 91-G.

Featuring a completely renovated format, the 48-page astronomy catalog includes a wide selection of portable planetariums, a variety of astronomy laserdiscs, four recently released planetarium effects laserdiscs, a wide variety of new astronomy slide sets, the Carl Sagan Cosmos Video Series, celestial globes and astronomical models, computer software, wall murals, and information on Goto permanent planetarium installations.

The 40-page geology catalog includes John Shelton's *Earth Science* slide set (500 slides), *Earth from Space Landsat* and *Plate Tectonics* slide sets, filmstrips and videos, Earth history 3-D models, rock and mineral sets, and a variety of geology manuals.

Catalogs are free for educators and researchers who request them on school or company letterhead. When requesting, state areas of special interest and provide a summary of your programs.

A variety of ancillary catalogs is offered and can be obtained by returning a form enclosed in each catalog.

Contact: MMI Corporation
P.O. Box 19907
Baltimore MD 21211
Phone: 301-366-1222
FAX: 366-6311
Telex: 6849070 MMI UW

Sky & Telescope Mars Globe

Sky Publishing Corporation, in cooperation with NASA, the U.S. Geological Survey, and Replogle Globes, has produced a new Mars globe in time for the Mars opposition on November 27. Observing conditions for the red planet will be at their best in the next few months, and Mars will not be seen this well again until the year 2001.

The globe has been produced from the best available data from Viking and Mariner spacecraft. It is 12 inches in diameter (approximate scale 1:22,000,000) and has bright and dark markings like those visible through a telescope. Longitude is marked every 30 degrees, latitude every 15 degrees. More than 100 feature names are given (all using IAU-approved nomenclature), including the planet's principal volcanos, impact basins, canyons, river valleys, and craters. Topographic features, based on Viking's stereoscopic imagery, are accurately depicted with shadows, giving a unique, raised-relief effect. Colors used approximate the martian surface.

The globe comes with a stand that allows it to be positioned freely and an informative booklet containing Viking surface photographs and data table.

As a special introductory offer, if the globe is ordered before December 31, 1990, a free Mars map will be included. Printed in color, this 39 x 40" sheet has a Mercator projection of Mars to latitude 65 degrees north and south, along with two circular maps of the polar regions. Map scale is 1:25,000,000 with topographic contours every 1000 meters.

To obtain globe and map, order number 39214 Mars Globe and Map from Sky Publishing Corporation, P.O. Box 9111, Belmont MA 02178-9111. Phone: 617-864-7360; FAX: 617-864-6117. $79.95.

In Memoriam

Harold Masursky
1923-1990

Harold Masursky, for over 20 years a world-renowned pioneer in space exploration, died on August 24. His contributions to planetary geology, to the design of spacecraft instruments, and to international scientific cooperation will be long remembered.

During Hal's scientific career, he successively applied his many talents to the fields of economic, structural, and planetary geology. In the 1960s he played a major role in the choice of Apollo landing sites. In the 1970s he headed the scientific team that first mapped the planet Mars and he was actively involved in selection of the Viking landing sites. Throughout the 1980s he was a key figure in the Voyager Project.

His work has resulted in over 200 publications. He was an officer or member of many scientific societies and innumerable committees involved in planetary research. One of his major contributions was as President of the Working Group for Planetary System Nomenclature of the International Astronomical Union.

He was the recipient of many honors from NASA, USGS, and other scientific bodies.

"So long as we live, they too shall live, for they are now a part of us . . . As we remember them."
(Kaddish Prayer)

News From Space

Exploration Initiative News

As the Space Exploration Initiative develops over the next few years, the NASA Johnson Space Center will have the lead role in developing plans for a Lunar Outpost. In cooperation with JSC and other NASA centers, LPI will play an increasingly important role in defining lunar-based science, especially geology and astronomy, as well as related aspects of the Exploration Initiative. Plans for lunar-based astronomy were significantly advanced due to a large GFSC-sponsored workshop held at Annapolis, Maryland, in February 1990, co-organized by Michael Mumma (GFSC) and Harlan Smith (LPI Visiting Scientist). The proceedings appeared in August as a 656-page book, *Astrophysics from the Moon*, AIP Conference Proceedings 207, published by the American Institute of Physics, New York.

Beginning in 1963 with the discovery of quasars, scientists in Texas began holding a series of symposia on relativistic astrophysics. The meetings soon became biennial, with worldwide organizing committees and returning only occasionally to the original venues of Dallas and Austin. The 15th Texas Symposium on Relativistic Astrophysics, this time called the Texas/ESO-CERN Symposium, was held in Brighton, England, December 16-21, 1990. This meeting included two "mini-symposia" treating the prospects for the future of space astrophysics, respectively from Earth orbit (Hubble Space Telescope and Space Stations) and from the Moon (Lunar-Based Astrophysics), organized by LPI Visiting Scientist Harlan Smith.

As planning for lunar base(s) continues to accelerate, selection of one or at most a very few candidates for the initial site becomes increasingly urgent. Astronomical observatories will clearly be among the most important users. Accordingly it is timely for astronomers to consider in careful detail the pros and cons of latitude, terrain, and other variables that will affect their work during the many years in which most if not all of their instruments will almost certainly need to be located near the initial lunar outpost. Toward this end a small invitational workshop on Astronomical Factors Bearing on Lunar Outpost Site Selection is tentatively planned for early 1991.

Contributed by Harlan Smith

New Initiative Newsletter

The Lunar and Mars Exploration Program Office at the NASA Johnson Space Center conducts mission analysis and systems engineering studies for the Space Exploration Initiative. They have begun publishing a monthly newsletter, *The Explorer*, which contains brief articles on current studies and issues in the SEI, biographical sketches of SEI participants, and a variety of contributed items. Requests for copies of *The Explorer* or inclusion on its distribution list should be directed to Mike Duke at 713-283-5553, or MDUKE on NASAMAIL or SN::DUKE on SPAN.

Contributed by M. Duke, NASA Johnson Space Center

Lunar Mining Could Provide Future Energy Source

Researchers at the University of Wisconsin's Center for Space Automation and Robotics, one of 16 NASA Centers for the Commercial Development of Space, have recently finished a study that determined that lunar helium-3, which originated from the sun and was deposited on the Moon by the solar wind, could be mined and transported to Earth. Some early estimates place the value of helium-3 equivalent to buying oil at $7 a barrel.

A major stumbling block to the use of helium-3 as an energy source has been the unavailability of a large source of helium-3 on Earth, said Gerald Kulcinski, a nuclear engineering professor and technical director of the center's Astrofuel* project. Kulcinski estimates that there is enough helium-3 on Earth to demonstrate the first powerplant. By the year 2010 or 2015, however, a larger source will have to be tapped. The question isn't whether the supply is available, he said, but whether the Department of Energy can develop a fusion reactor in time.

*Astrofuel is a registered trademark of the University of Wisconsin-Madison.

NASA Press Release 90-139

Baldwin Observatory at Aquinas College

A new modern observatory will be constructed on the campus of Aquinas College, Grand Rapids, Michigan. The Baldwin Foundation, under the leadership of Dr. Ralph B. Baldwin, has contributed half the monies needed to construct the observatory. "The installation of a 16-inch telescope will allow our students, as well as members of the community at large, a closer look at the skies," commented Charles R. Frydrych Jr., assistant professor of physics.

Dr. Baldwin is well known in the lunar and planetary science community for his many books and articles on the Moon.

Aquinas Magazine, v. 27, no. 3

Mars Balloon Tests in Mojave Desert

French balloons, destined to explore Mars, drifted across the California desert in September when the Planetary Society organized international Mars Balloon tests in the Mojave Desert. Soviet and French team members of the USSR's Mars '94 mission, during which the Mars Balloon will be launched, participated in the tests.

A high-tech update of a centuries-old concept, the Mars Balloon combines the consistent buoyancy of a gas balloon with the ascent and descent capability of a hot-air balloon heated by the sun during the martian day.

This deceptively simple design allows the craft to fly large distances in the martian winds, to make multiple landings, to photograph objects as small as four inches on the planet's surface, and to survey possible landing sites for future robotic and human explorers to the red planet.

An instrumented guide rope called the SNAKE will be dragged along the surface of Mars at night when the balloon descends closer to the ground. The Planetary Society's contribution to the Mars Balloon project is to design the SNAKE.

Harris M. "Bud" Schurmeier, project manager, heads the Planetary Society Mars Balloon team, which includes a group from Utah State University, the California Institute of Technology, the NASA Jet Propulsion Laboratory, Titan Systems, Inc., and volunteers working with The Planetary Society. Mr. Schurmeier, a former associate director of JPL, reports that the tests went very well.

The SNAKE was able to traverse crevasses and rocks and did well on both the lava and sand dune terrain. The wind speeds were lower than anticipated so no data were obtained for a high-speed wind. With the exception of an entanglement with a few plants, which the team does not expect to encounter on the martian surface, the test was deemed very successful.

The quantitative data collected in the gondola is being analyzed by the Centre National d'Etudes Spatiale (CNES). The Planetary Society is working on the development of the Mars Balloon under the direction of CNES, the Space Research Institute (IKI) of the USSR Academy of Sciences, and the USSR's Babakin Center of the Lavotchkin Industry Association.

Although NASA has no role in the development of the Mars Balloon, the U.S. space agency is cooperating with the Soviets and French in an official government Mars Balloon Relay utilizing the Mars Observer, which should be launched in 1992. The Mars Observer will help relay scientific data to Earth from the balloon and other vehicles on the Mars '94 mission.
Planetary Society Press Release and communication with Mr. Schurmeier.

COBE Spacecraft Takes First Image Of Interstellar Dust

NASA's Cosmic Background Explorer (COBE) has taken its first image of the entire Milky Way Galaxy in a wavelength that reveals the dust from which planets and galaxies are formed. The image of the Milky Way, taken in far-infrared wavelength by the Diffuse Infrared Background Experiment, shows radiation from cold interstellar dust. An image taken last April by the same instrument in the near-infrared wavelength revealed millions of stars in this galaxy. A comparison of these images shows the difference in the spatial distribution of the galaxy's stellar and interstellar components.

Scientists will continue to study these data in determining the content, energetics, and large-scale structure of the Milky Way, as well as the nature and distribution of the dust within the solar system.

Dr. Michael G. Hauser, NASA Goddard Space Flight Center, is the COBE investigator on the Diffuse Infrared Background Experiment.
NASA Press Release 90-140

International Space Groups Endorse Solar Sail Race

At the Annual Congress of the International Astronautical Federation recently held in Dresden, Germany, international endorsements of a unique space race were received by the American, European, and Japanese competitors. The race, which is to commemorate the 500th anniversary of Christopher Columbus' first voyage to America, will involve three spacecraft launched into Earth orbit and propelled to their destinations only by the faint pressure of sunlight acting on their large gossamer-thin sails.

Prior to the international meeting, the winner of a competition to select the American entry was announced by U.S. Senator John Glenn. The World Space Foundation has been selected as the designated entry of the Columbus 500 Space Sail Cup.

The Foundation proposal was prepared by a team led by World Space Foundation Solar Sail Project director Emerson LaBombard and proposal manager John Garvey, with key contributions from partners around the country: McDonnell Douglas Space Systems Co., the Radio Amateur Satellite Corp., the Jet Propulsion Laboratory,

the Planetary Society, Utah State University, Weber State College, and Aura Systems Inc. of Los Angeles.

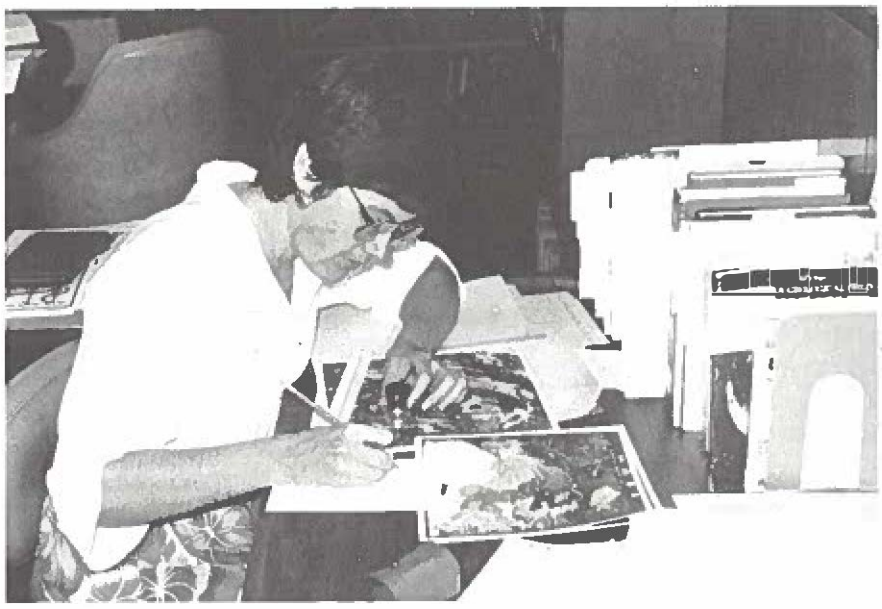
The races to the Moon and Mars were endorsed by the International Astronautical Federation's International Space Year (ISY) and Education Committees.

Contributions or inquiries may be sent to:

Solar Sail Project
World Space Foundation
P.O. Box Y
South Pasadena, CA 91031-1000
World Space Foundation

Contact:
Emerson LaBombard
213-476-5437

Diane Sayre
818-505-6474



The Summer Intern Program at the Lunar and Planetary Institute is in its 15th year. The program offers selected undergraduate students an opportunity to participate actively in lunar and planetary science research with scientists at the LPI and the NASA Johnson Space Center.

The purpose of this program is to help undergraduate students in planetary and terrestrial studies examine and focus their career goals by exposing them to an actual research environment and encouraging their development as planetary scientists.

The ten-week 1991 Summer Intern Program will begin on June 10 and end on August 16. Deadline for applications is February 12, 1991, with selection to be made by March 8.

If you are interested in participating in the 1991 program and would like information on requirements, send your name and address to:

LeBecca Simmons
Summer Intern Program
Lunar and Planetary Institute
3303 NASA Road 1
Houston TX 77058-4399
Phone: 713-486-2166

SUMMER INTERN PROGRAM

PUBLICATIONS AVAILABLE FROM LPI

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	B-Plans	PLANETARY SCIENCE: A LUNAR PERSPECTIVE	$30.00	
		SLIDE SETS		
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Calendar

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January

7-10 **Resources of Near-Earth Space, 2nd Annual Symposium of the UA/NASA Space Engineering Research Center**, Tucson, Arizona. Contact: Prof. John S. Lewis, LPL, University of Arizona, Tucson AZ 85721. Phone: 602-621-4972; FAX: 602-621-4933.

11 **LPSC 22 Abstract Deadline.** Publication Services Department, LPI, 3303 NASA Road 1, Houston TX 77058-4399. Phone: 713-486-2143.

March

13-15 **Humans and Machines in Space: 29th AAS Goddard Memorial Symposium**, Washington DC. Contact: American Astronautical Society, 6352 Rolling Mill Place, Suite 102, Springfield VA 22152. Phone: 703-866-0020; FAX: 703-866-3526.

18-22 **22nd Lunar and Planetary Science Conference**, Houston, Texas. Contact: Program Services Department, LPI, 3303 NASA Road 1, Houston TX 77058-4399. Phone: 713-486-2166; FAX: 713-486-2162.

24-28 **EUG VI, Biennial Meeting of the European Union of Geosciences**, Strasbourg. Contact: EUG VI Organizing Committee Secretariat, via S. Nicolo 14, 34121 Trieste Italy. Phone: (39) 40-368752; FAX: (39) 40-368808.

April

20 **Astronomy Day.** Contact: Gary Tomlinson, Astronomy Day Headquarters, Astronomical League, Chaffee Planetarium, 54 Jefferson S.E., Grand Rapids MI 49053. Phone: 616-456-3987.

29-May 2 **Eighth Thematic Conference Geologic Remote Sensing, Exploration, Engineering, and Environment**, Denver, Colorado. Contact: ERIM/Thematic Conference, P.O. Box 8618, Ann Arbor MI 48107-8618. Phone: 313-994-1200, Ext. 3234; FAX: 313-994-5123.

May

22-27 **Space: A Call for Action; 10th Annual International Space Development Conference**, San Antonio, Texas. Contact: Carol Luckhardt Redfield, Southwest Research Institute, 6220 Culebra Road, San Antonio TX 78228-0510. Phone: 512-522-3823 or 679-7625.

28-June 1 **American Geophysical Union, Spring Meeting**, Baltimore, Maryland. Contact: AGU, 2000 Florida Avenue N.W., Washington DC 20009. Phone: 202-462-6900.

June

10-August 16 **LPI Summer Intern Program.** Contact: LeBecca Simmons, Summer Intern Program, LPI, 3303 NASA Road 1, Houston TX 77058-4399. Phone: 713-486-2166.

21-27 **103rd Annual Astronomical Society of the Pacific Meeting**, University of Wyoming, Laramie, Wyoming. Contact: Wyoming Meeting Info, ASP, 390 Ashton Avenue, San Francisco CA 94112. Phone: 415-337-1100.

24-28 **Asteroids, Comets, Meteors 1991**, Flagstaff, Arizona. Contact: Pam Jones, ACM '91, Program Services Department, LPI, 3303 NASA Road 1, Houston TX 77058-4399. Phone: 713-486-2150; FAX: 713-486-2162.

30-July 3 **International Conference on Near-Earth Asteroids**, San Juan Capistrano, California. Contact: Dr. Clark R. Chapman, Chairman, NEA Conference, Planetary Science Institute, 2421 E. 6th Street, Tucson AZ 85719. Phone: 602-881-0332.

July

11 **Total eclipse of the sun visible from Hawaii and Mexico.**

21-26 **54th Meteoritical Society Meeting**, Monterey, California. Contact: Dr. Peter Englert, San Jose State University, School of Science, Nuclear Science Facility, One Washington Square, San Jose CA 95192-0163. Phone: 408-924-4820.

Calendar

1 9 9 1

23-August 1 **International Astronomical Union XXI General Assembly,** Buenos Aires, Argentina. Contact: IAU Secretariat 98bis, bd Arago, 75014, Paris, France.

August

5-6 **Stellar Populations of Galaxies, IAU Symposium No. 149,** Angra dos Reis, Brazil. Contact: Dr. B. Barbuy, Dept. de Astronomia, Instituto Astronomico e Geofisico/USP, Caixa Postal 30627, Sao Paulo 01051 Brazil.

October

5-10 **Twenty-eighth Annual Meeting of Clay Minerals Society,** Houston, Texas. Contact: D. R. Pevear, Exxon Production Res., P. O. Box 2189, Houston TX 77001. Phone: 713-529-8909.

November

4-8 **23rd Annual Meeting of the Division for Planetary Sciences of the American Astronomical Society,** Palo Alto, California. Contact: Christopher P. McKay, Space Sciences Division, NASA Ames Research Center, Moffett Field CA 94035. Phone: 415-694-5499.

The NASA/IPAC Extragalactic Database

The June 1990 release of the NASA/IPAC Extragalactic Database (NED) is available to the astronomical community worldwide for use on an experimental basis. NED is a computer-based central archive intended to accumulate a broad range of published extragalactic data and to organize them for fast and flexible retrieval via electronic networks.

The current version of NED provides positions, names, and basic data for extragalactic objects, as well as related bibliographic references and notes from catalogs and other publications. This version also offers for browsing the abstracts of recent articles of extragalactic interest from the major journals (A&A, AJ, ApJ, MNRAS, PASP, and the associated Letters and Supplements). Future releases will provide data from the current literature and from catalogs and tools for obtaining file versions of the data retrieved.

NED is an object-oriented database, meaning that all information is organized around individual objects (e.g., galaxies, groups of galaxies, quasars, radio sources) rather than stored in catalogs. It is built around a master list of astronomical objects obtained by establishing detailed cross-identifications among twenty major extragalactic catalogs, with additional catalogs being folded in constantly. Except for this aspect of the architecture, the user does not need to understand the internal structure of NED to make efficient use of it. Objects can be selected by name (a high-level name interpreter is built into the interface), or by vicinity, either to a name object or to a position on the sky (in any of four coordinate systems).

The NED service may be accessed using either one of two electronic computer networks: (i) From a computer that is part of "internet," a connection to IPAC is set up by typing at the system prompt: "telnet ipac.caltech.edu". (ii) From S node on the SPAN network, a connection to IPAC can be established by typing at the system prompt: "set host IPAC". Either way, you need to have a VT100 terminal or a software emulation of such a terminal to use the NED interface. Once you are connected to IPAC (this is a SUN workstation) and prompted for a "login," please respond with "NED"; no password is needed. From this point on, the system is self-documenting, especially through the "HELP" utilities and the "control-H" key. It will be useful for the novice to invoke the "TUTORIAL" option in the first screen presented by the interface.

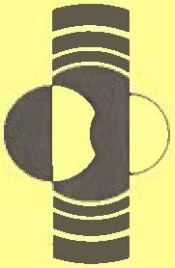
You may invoke the "COMMENTS" option in the NED interface to leave messages or suggestions. In case of problems that require special attention, you may contact one of the following:

George Helou (818) 584-2928
helou@ipac.caltech.edu

Barry Madore (818) 584-2912
bfm@ipac.caltech.edu

Marion Schmitz (818) 584-2994
zb4ms@ipac.caltech.edu

This work is carried out by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.



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