Planetary Exploration Through Year 2000 Outlined

On the basis of a two-year study, the NASA Solar System Exploration Committee (SSEC) has published its recommendations for a core program of low- and moderate-cost planetary missions to be flown through the remainder of this century.

The program was discussed by Drs. David Morrison, Geoffrey Briggs, and William Kaula at the special session of the 14th Lunar and Planetary Science Conference, chaired by Louis Friedman of the Planetary Society. A summary of the committee's report has been published in a 29-page booklet distributed by the Government Printing Office. (See New Publications this BULLETIN for information.)

In addition to fundamental solar system exploration, the committee has added a new goal for the program, the preliminary assay of near-earth resources on the moon and earth-crossing asteroids.

To accomplish these goals, the committee proposes a number of innovative strategies and management techniques to maintain high quality science while simultaneously reducing costs. This new approach to the program includes using derivatives of commercial, earth-orbital spacecraft for inner planet missions (Planetary Observers) and a new modular spacecraft named the Mariner Mark II, which can be reconfigured for a variety of missions to the outer planets, comets and asteroids.

The first four proposed missions are:

**Venus Radar Mapper** To be launched in 1988, this mission will provide a radar map of the cloud-enveloped surface, with a resolution of approximately one kilometer, equivalent to that carried out by television cameras aboard the first Mars orbiter, Mariner 9. The spacecraft, which has been derived from the more complicated and expensive Venus Orbiting Imaging Radar Mission (VOIR), also will carry a radar altimeter to provide topographic information, and a gravity sensor. Venus Radar Mapper (VRM) has been presented to the Congress as a new start in FY 1984.

**Mars Geoscience/Climatology Orbiter** This mission, recommended for launch in 1990, would be
the first to use the new Planetary Observer spacecraft. Its purpose is to orbit Mars for one Martian year (approximately two earth years) with a variety of sensors, gathering information on the planet's surface composition, magnetic field (if any), and seasonal cycles of carbon dioxide, water and dust that interact between the surface and atmosphere.

Comet Rendezvous/Asteroid Flyby  The new spacecraft, Mariner Mark II, is recommended to rendezvous with a short period comet as it approaches the sun then recedes into deep space. The spacecraft would carry cameras and remote sensing instruments to study the gas and dust boiling off the comet's nucleus, plus sensors to directly measure the gas and dust composition. Three suitable targets have been identified—comets Enke, Tempel 2 and Honda-Mrkos-Pajudusakova (HMP)—which could be encountered in the mid-1990s after first flying by a Mainbelt asteroid.

Titan Probe/Radar Mapper  Proposed for launch somewhere between 1988 and 1992, this mission would examine the unique, orange-colored atmosphere that shrouds Saturn's largest moon and its mysterious surface—which is cold enough for methane to form pools or possibly oceans. It would parachute a package of instruments through the atmosphere and use the probe carrier to send back radar images of the surface. The mission, if upgraded, would also employ a full-scale Saturn orbiter to study the planet's atmosphere, magnetosphere, satellites and rings. The combined probe/orbiter is considered an excellent candidate for international cooperation.

Other missions such as the return of samples from Mars and comets, rovers exploring the Martian surface, and a buoyant station floating in Titan's atmosphere are excluded from the core program because of their high cost and technological complexity.

**MARINER MARK II CLASS SPACECRAFT**
Such advanced missions, which might be mounted in an expanded budgetary climate, currently are under study. The committee’s recommendations for this augmented program are scheduled to be released at the end of this year.

Current chairman of the committee is Dr. David Morrison, professor of astronomy at the University of Hawaii; its Immediate past chairman is Dr. Noel W. Hinners, director of Goddard Space Flight Center, Greenbelt, Maryland. Dr. Geoffrey Briggs, the new director of the Solar System Exploration Division, NASA Headquarters, is executive director of the committee.

Several articles describing the work of the Committee can be found in the literature. Aviation Week and Space Technology, April 18, 1983, pages 121-131; Science News volume 123, 1250-1251, April 1, 1983; and Discover, May, 1983, pages 28-33, are among those carrying information on this new plan for continuing research in solar system exploration.

NASA News 83-50, April 8, 1983

XIVth Conference Hailed a Success


The Conference sessions were attended by 525 scientists representing 11 different countries.

Abstracts submitted for the Conference were considered by the Program Committee for inclusion in
Lunar and Planetary Science XIV and/or for oral presentation at the Conference. Of the total abstracts submitted, 470 were printed, 308 were selected for oral presentation, and 26 were selected for poster presentation.

Twenty-two of the abstracts submitted were printed in a special supplement, Return to the Moon. These papers were presented in a plenary session the afternoon of March 16 and during a special evening session March 17.

Abstracts for the sessions on the Antarctic Meteorites thought to be from the Moon and Mars were brought to the conference. These were compiled into another special supplement and distributed to those who participated in the sessions. Copies of these supplements are now available from the LPI. The Return to the Moon supplement was distributed with all requests for Lunar and Planetary Science XIV. The Meteorite special supplement can be obtained by requesting LPI Contribution No. 501 from the Lunar and Planetary Institute Library ($1.00 for mailing in the United States, Canada and surface mailing to all foreign requestors; air mailing to foreign countries will be $3.00). Please include check, money, or postal notes to cover costs.

Special sessions held during the Conference included: a meeting of European Planetary Scientists convened March 14 by K. Runcorn; a discussion session on Cosmic Dust March 14 organized by J. Gooding and R. Walker; a plenary session "Return to the Moon" March 16 chaired by Gerald D. Griffin, Director of Johnson Space Center; a joint session with the Planetary Society, "Prospects for Planetary Exploration" March 16 organized by L. Friedman; and the March 17 evening session "Future Lunar Programs" chaired by M. Duke.

Wednesday evening, March 16 the Third Annual LPSC Chili Cook-off was held on the LPI grounds and was attended by over 425 conference participants and their guests. Seventeen chili teams competed in the contest and the chili tasting was especially welcome due to the cool damp weather. A barbecue dinner was served and guests were entertained by a Dixieland band. The first prize for best chili was won by the Peripatetic Parksley Palace Personnel with their Parksley Palace Potable Potion. Members of the team were Ian Mackinnon, Chuck Lawson, Melissa Strait, Darrell Henry, and Dave Mogk.

The Proceedings of the Fourteenth Lunar and Planetary Science Conference will be published by
the American Geophysical Union as a supplement to the Journal of Geophysical Research (Red). The first supplement will appear in November; the second in February. The Fourteenth Proceedings will include sample indexes for both the Thirteenth and Fourteenth Proceedings and an author index for each of the supplements. Although the Proceedings will not be distributed to individual subscribers to JGR-Red as part of their subscriptions, they will be sent to the Library subscribers this year as part of the subscription. Next year, the cost of the Proceedings will be added to the institutional subscriptions. AGU Members may order the set for $20.00 softbound, $35.00 hardbound. For all others the price will be $70.00 softbound, $100.00 hardbound. Orders should be sent directly to the American Geophysical Union, 2000 Florida Avenue NW, Washington DC 20009. Call toll free to reserve your personal copy: 800-424-2488.

1983 LPI Summer Interns Selected

The following students have been selected from this year’s applicants to participate in the Summer Intern Program at the Lunar and Planetary Institute. The program, now in its seventh year, is designed to acquaint undergraduates or recent graduates to the world of research. Each intern will have a project directed by a scientist-advisor from the LPI or the Johnson Space Center. As the ten-week program progresses, each intern will present a seminar outlining the project and detailing the results. At the end of the summer, each intern will submit a written report of the research.

This year’s interns, their advisors, and projects are:

Mariellen L. Anthony, Carleton College, Northfield, Minnesota
ADVISOR: Dr. Peter H. Schultz, Lunar and Planetary Institute
PROJECT: Development of numerical and analytical models to examine the dynamic response of the atmosphere to an impact event. These models will be compared with results from laboratory experiments in order to test their validity and to define additional experiments.

Thebeyame Ronald Chaoka, University of Manitoba, Canada
ADVISOR: Dr. William C. Phinney, NASA Johnson Space Center
PROJECT: To study petrologic-geochemical anorthosite dikes in the Shawmere Complex, Ontario to determine the origin of these dikes tentatively thought to result from partial melting of an anorthositic gabbro during high grade granulite metamorphism.

Julia Hatfield, Utah State University, Logan
ADVISOR: Dr. Everett K. Gibson, NASA Johnson Space Center
PROJECT: To study petrologic-geochemical anorthosite dikes in the Shawmere Complex, Ontario to determine the origin of these dikes tentatively thought to result from partial melting of an anorthositic gabbro during high grade granulite metamorphism.

David Allen Kring, Indiana University, Bloomington
ADVISOR: Dr. Gordon A. McKay, NASA Johnson Space Center
PROJECT: Microprobe and experimental study of concentration gradients in quenched experimental glasses.

William Ward Leslie, University of California, Los Angeles
ADVISORS: Dr. Paul Morgan, Lunar and Planetary Institute
Dr. Lewis Ashwal, Lunar and Planetary Institute
PROJECT: To investigate through thermal modeling the conditions required to produce supracrustal granulites. The investigation process will include computer modeling, literature research, and possibly some laboratory measurements.

Debbie Lynne Moberger, University of Rhode Island, Kingston
ADVISOR: Dr. Charles A. Wood, NASA Johnson Space Center
PROJECT: Photogeologic interpretation of volcanic/tectonic structures of the Kamchatka Peninsula. Seismic and petrologic data will be used to investigate 3-dimensional structures of the region.

Dennis Rashka, University of Wisconsin-River Falls
ADVISOR: Dr. Peter Francis, Lunar and Planetary Institute
PROJECT: To use LANDSAT multispectral data and the Institute's Image Processing Facility to develop techniques to aid geologic mapping in Archean and volcanic terrains.

William John Russell, University of Manitoba, Canada
ADVISOR: Dr. Gary E. Lofgren, NASA Johnson Space Center

PROJECT: Experimental and petrographic study of two lava flows from the Taas Plateau. Results will be compared to a more detailed study of a similar flow and attempts will be made to duplicate the textures of these flows.

Alain Florian Trial, University of Dayton, Ohio
ADVISORS: Dr. Lewis Ashwal, Lunar and Planetary Institute
Ms. Roberta Rudnick, Lunar and Planetary Institute

PROJECT: To study fluid inclusions in upper mantle xenoliths (spinel lherzolites and garnet lherzolites) and lower crustal rocks (amphibolites, hornblende gabbros and pyroxene gabbros) derived from a subarc environment using petrographic, microthermometric and laser Raman techniques. Such studies may yield first-hand knowledge of the types of fluids present and fo2 conditions of subarc crust and mantle.

Kevin Paul Vang, Thiel College, Greenville, Pennsylvania
ADVISORS: Dr. Friedrich Horz, NASA Johnson Space Center
Dr. Mark J. Cintala, NASA Johnson Space Center

PROJECT: To measure the apex angle of lunar herringbone patterns characteristic of secondary cratering.

Carl Varteresian, Rutgers University, New Brunswick, New Jersey
ADVISOR: Dr. David S. McKay, NASA Johnson Space Center

PROJECT: To use the scanning electron microscope, the attached energy dispersive analyzer and the new computer program to acquire and reduce data on some small (micrometer) particles collected in the stratosphere by high-flying NASA aircraft.

Deanna Gerard Wheeler, Marquette University, Milwaukee, Wisconsin
ADVISOR: Dr. Wendell W. Mendell, NASA Johnson Space Center

PROJECT: To analyze Apollo Command Module Earthshine photography of the lunar surface for evidence of luminescent phenomena using the Image Processing Facility at the LPI.

Rebecca Anne Williams, University of Connecticut, Storrs
ADVISORS: Dr. Joseph Wooden, Lunar and Planetary Institute
Dr. Darrell J. Henry, Lunar and Planetary Institute

PROJECT: To evaluate the geochemical evolution of the upper mantle associated with Archean cratons and the interaction of mafic melts with the crust using isotopic analysis. The geographic focus will be the Beartooth Mountains of Montana-Wyoming and the Minnesota River Valley of southern Minnesota.

LPI Workshop in Mainz Looks at Solar Radiation

An LPI Workshop on Past and Present Solar Radiation: the Record in Meteoritic and Lunar Regolith Material will be held September 3-4, 1983, in Mainz, Germany, prior to the 46th Annual Meeting of the Meteoritical Society (scheduled for September 5-9, 1983.)

Informal discussions and presentations will address the following topics:

1. Trapped solar gases, tracks and micrometeorite pits in regolith mineral grains
2. How and to what extent have records of incident radiation been altered in various types of grains
3. Implications of the data for the flux and compositional history of solar particle emission
4. The special role of regolith breccias and the challenge of dating their times of compaction
5. Direction and organization of future research

Co-convenors of the workshop are Dr. David McKay, NASA-Johnson Space Center, and Dr. Robert O. Pepin, University of Minnesota.

Those interested in participating in the workshop should contact Pamela Jones, Lunar and Planetary Institute, 3303 NASA Road 1, Houston, TX 77058. (Telephone: 713-486-2150).
President Orders National Space Station Study

NASA has announced that President Reagan has requested the Senior Interagency Group for Space to conduct a study to establish the basis for an Administration decision on whether to proceed with NASA development of a permanently-based, manned space station.

The interagency group, which is chaired by the Assistant to the President for National Security Affairs, William P. Clark, will consider four example scenarios of possible approaches for the continuation of this nation's manned space program, following completed development of the Space Shuttle. These scenarios are:
- Space Shuttle and Unmanned Satellites
- Space Shuttle and Unmanned Platforms
- Space Shuttle and an Evolutionary Space Station
- Space Shuttle and a Fully Functional Space Station.

The issues addressed by the study will include how a manned space station would contribute to the maintenance of U.S. space leadership and how a station would best fulfill national and international requirements versus other possible means of satisfying them. Foreign policy and national security implications and overall economic and social impacts will also be considered.

A working group, chaired by NASA and including State and Defense Department and other representatives of the Senior Interagency Group for Space, has been established to conduct this study. Results of the study will be presented to the Senior Interagency Group this fall prior to their presentation to the President.

NASA News 83-51, April 11, 1983

AGU Special Session—Meteorites: Moon and Mars?

At the Spring American Geophysical Union meeting which will be held in Baltimore, Maryland, May 30 to June 3, a special session will be convened to address the topic of Achondritic Meteorites from the Moon and Mars?. The topic will occupy both a morning and afternoon session on May 30. The chairperson for the sessions will be Dr. Ursula B. Marvin, Smithsonian Astrophysical Observatory, Cambridge, Massachusetts.

NASA Establishes Computer Science Institute at Ames

NASA has established a Research Institute for Advanced Computer Science at the Ames Research Center, Mountain View, California. It will begin operations in June 1983.

The institute will serve as a center for the academic community for activities in computer science, applied mathematics and the application of the computer to the solution of scientific and engineering problems. It will be funded by NASA through the Universities Space Research Association.

A similar Institute for Computer Applications in Science and Engineering (ICASE) has operated successfully at Langley Research Center, Hampton, Virginia for several years. The new institute extends this mechanism to the Ames Research Center.

Dr. Peter J. Denning, chairman of the Dept. of Computer Sciences at Purdue University has been named director of the Institute. He will be responsible for directing the institute's research in computer science and engineering with potential application to NASA programs.

Denning's primary fields of research include modeling and analysis of computer systems and subsystems, operating system theory, computer system architecture, concurrent systems and parallel computation, and computer system security and reliability.

Denning has been Associate Professor and then Professor of Computer Sciences at Purdue since 1972. He was Assistant Professor of Electrical Engineering at Princeton University from 1968 to 1972. He received his master's degree and doctorate in electrical engineering from Massachusetts Institute of Technology in 1965 and 1968, respectively. He earned a bachelor's degree in electrical engineering at Manhattan College in 1964. He is a past president of the Association for Computing Machinery (ACM).

Denning has received numerous honors and awards, holds membership in ten professional societies, and has published extensively. In 1983 he will also serve as editor-in-chief of "Communications of the ACM".

NASA News 83-38, March 22, 1983
**Space Shuttle Program Conference**

The Space Shuttle Program: From Challenge to Achievement will be the theme of a conference to be convened at the Johnson Space Center, Houston, Texas, on June 28-30, 1983. The purpose of the conference is to provide a vehicle for presentation and documentation of fundamental scientific and engineering data derived from the Space Shuttle development program.

The conference will address ten technical topic areas:
- Integrated Avionics
- Guidance, Navigation, and Control
- Aerodynamics
- Structures
- Life Support, Environmental Control, and Crew Station
- Ground Operations
- Propulsion and Power
- Communications and Tracking
- Mechanisms and Mechanical Systems
- Thermal, Contamination Environments, and Protection Systems

The conference is open to all NASA employees and contractors, members of the military, the university community, NASA advisory bodies, national technical bodies, other government officials (national, state, local), and the press.

The organizing committee of the conference includes: Aaron Cohen, Johnson Space Center, chairman; E. W. Land, Jr., NASA Headquarters; James E. Kingsbury, Marshall Space Flight Center, and Peter A. Minderman, Kennedy Space Center. Norman H. Chaffee at the Johnson Space Center is in charge of arrangements for the conference at JSC.

In addition to the technical sessions, a conference banquet will be held at the Gilruth Center on Tuesday evening. Dr. Glynn Lunney, Manager, National Space Transportation Systems Program, will be the featured speaker.

For more information about this conference contact Mr. Chaffee at Mail Code: EP, Johnson Space Center, Houston TX 77058 (phone: 713-483-3995).

**Conference on Glass—August 14-18, 1983**

The occurrence of natural glasses in such phenomena as volcanism, meteoric impact, electrical atmospheric discharge and others, has long been recognized. A more recent development is the association of natural glasses (or their disintegration products) with the Cretaceous/Tertiary and terminal Eocene extinctions. In addition, a need has arisen to understand more fully the corrosion and leaching of man-made glasses in geological environments—prompted in part by the potential use of borosilicate glass for the fixation and immobilization of nuclear wastes now stored throughout the world. Accordingly, to review these and other developments and to provide focus for present understanding, an international Conference on Glass in Planetary and Geological Phenomena will be convened at Alfred University, New York State College of Ceramics, August 14-18, 1983. A major goal of this conference is to join the disciplines of glass science, geology, geochemistry and others in a concerted effort to understand the origin, occurrence, distribution and alteration of natural glasses.

Following a plenary lecture on Natural Glasses by Dr. John O'Keefe, NASA Goddard Space Flight Center, other sessions are planned on Glass Science in Geology, Volcanic Glasses, Libyan Desert Glasses, Impact Glasses, Tektites, Lunar Glasses and the Corrosion and Leaching of Natural and Man-made Glasses in Geological Environments. An evening exhibition session, chaired by Dr. Kurt Fredriksson, Smithsonian Institution, will feature a display of natural glasses gathered from all over the world. Speakers and other conference attendees are encouraged to bring natural glasses for inclusion in this session. A poster session will be organized if needed. To the extent possible parallel sessions will be avoided. The conference will conclude with a panel discussion.

Members of the convening committee include L. D. Pye, V. D. Frechette Co-chairmen, Alfred University; J. A. O'Keefe, Honorary Co-chairman, NASA Goddard Space Flight Center; K. Fredriksson, Smithsonian Institution; B. Glass, U. Delaware; N. J. Kreidt, U. New Mexico; C. Moore, Arizona State U.; H. Schaeffer, Universität Erlangen-Nurnberg; and R. Weeks, Oak Ridge National Laboratory.
Further information can be obtained from any of the above committee members or by contacting Prof. L. D. Pye, New York State College of Ceramics, Alfred University, Alfred, New York 14802 (phone: 607/871-2432)

Archean Geochemistry Field Workshop


The workshop will examine lithologies, structures, and inter-relationships of Archean supracrustals, plutonics, and high-grade gneisses in the Abitibi, Kapuskasing, and Wawa terranes of the Superior Province in northeastern Ontario. Researchers in the area are currently testing the hypothesis that the section from Wawa, Ontario (greenschist facies) to the eastern boundary of the Kapuskasing structural zone at Foleyet, Ontario (granulite facies) represents an oblique cross-section through about 25 km of Archean crust.

Activities will include an initial day of research presentations and discussions and a 4-day field trip led by J.A. Percival, K.D. Card (Geological Survey of Canada), R. Sage (Ontario Geological Survey), and L. Luhta (Ministry of Natural Resources, Timmins). A Post-field-trip meeting is planned for those participants contemplating or currently involved in research projects in the field trip area.

The 40 attendees were selected to insure a balanced coverage of disciplines. Student participation has been encouraged. An abstract volume and field trip guide published by the Institute will be available after the Field Workshop. Its availability will be announced in a subsequent issue of the LPiB. For further information, contact one of the co-conveners listed below.

Lewis D. Ashwal
Lunar and Planetary Institute
3303 NASA Road One
Houston TX 77058
USA
Telephone: 713-486-2147

Kenneth D. Card
Geological Survey of Canada
588 Booth Street
Ottawa, Ontario, K1A 0E4
Canada
613-995-4935

Southern European RPIF Has Formal Opening

The Consiglio Nazionale delle Ricerche (CNR) and National Aeronautics and Space Administration announce the formal opening for the Southern European Regional Planetary Imagery Facility in Rome, Italy, on May 10-11, 1983. This RPIF is one in a network of regional centers established by NASA which now includes eight in the United States and two in Europe.

These Space Image Centers contain nearly half-a-million images of the planets and their satellites taken both from Earth and in space, as well as topographic and geologic maps produced from this imagery. The Centers, located at several different institutions, are intended for use by individuals and groups who use photographic and cartographic materials of the Moon and planets in their research programs. These programs include geologic, photogrammetric, and atmospheric dynamical studies. In addition to the local scientists and their associates who use these data on a daily basis, NASA principal investigators and others elsewhere throughout the country are encouraged to use the Space Image Centers. There are many researchers who use this type of material but have access to only limited collections in their own institutions. These individuals can significantly enhance their research programs by using one of the Centers.

The Centers are not facilities for the production of photographs for users. Such materials can be obtained from the National Space Science Data Center or World Data Center A, both at the NASA Goddard Space Flight Center in Greenbelt, Maryland 20771. The Centers are used to study and/or select lunar and planetary images for research in the study of planetary surfaces.

At the present time the following Centers are in operation:
1. Jet Propulsion Laboratory, Pasadena CA 91109
2. University of Arizona, Tucson, AZ 85721
4. Washington University, St. Louis, MO 63130
5. Cornell University, Ithaca, NY 14853
6. Brown University, Providence, RI 02912
7. Lunar and Planetary Institute, Houston, TX 77058
8. Smithsonian National Air and Space Museum, Washington DC 20560
10. Dell’ Universita DegLI Studi, Piazzale Delle Scienze 00100, Rome, Italy

Persons who are interested in making use of these Centers should address inquiries to the Director, Planetary Image Center, at the Center closest to their home institution. The Director of the new Center in Rome is Dr. Marcello Fulchignoni; the librarian at the Center is Antonella Picchiotti.

**Pioneer 10 Beyond the Known Planets**

On June 13th of this year, the U.S. unmanned spacecraft, Pioneer 10, will cross the orbit of Neptune. With that crossing, Pioneer will be farther out from the Sun than any known planet, and will, in effect, have left the solar system. Though Pluto is normally the outermost planet, its orbit is so elliptical that for the next 17 years it will be inside Neptune’s orbit, and Pluto will never again catch up with Pioneer.

Since launch in 1972, Pioneer 10, the first spacecraft to Jupiter, has traversed the asteroid belt, survived Jupiter’s punishing radiation belts, and operated almost without flaw. By June 13, 1983, Pioneer 10 will have traveled 3.59 billion miles on its flight path, will have received 98,900 commands from Earth, and transmitted more than 126 billion bits of scientific data.

Over the next 850,000 years, Pioneer’s closest approach to any star system probably will be to the star, Ross 248. This will take place 32,610 years from now, with passage at 3.27 light years from the star. Star trajectories are not well-known, and beyond 850,000 years, closer approaches may well occur. At typical star-separation distances, Pioneer might expect a relatively close approach to a star system on an average of once every million years.

Pioneer 10 will be farther out than Pluto at 2 p.m. PDT on April 25, 1983, 2,779,209,908 miles from the Sun. At Pluto distance, Pioneer’s speed of travel will be 30,613 mph.

At 5 a.m. PDT, on June 13, 1983, the spacecraft will cross the orbit of Neptune at 2,813,685,909 miles from the Sun. It will then be outside all of the known planets in the solar system.

At Pioneer’s Neptune distance of 2.81 billion miles, it will take four hours and 20 minutes for spacecraft data, traveling at the speed of light to reach the Pioneer Operations Center at NASA’s Ames Research Center. This is a round-trip communication time of 8 hours and 40 minutes. At Pluto distance, one-way light time will be four hours and 16 minutes. At Neptune distance, communication time will be increasing at an average of about one minute every four days. Experts at NASA’s Deep Space Network expect to be able to track Pioneer out to somewhere beyond five billion miles.

Despite damage from intense Jovian radiation, and hits by tiny micrometeoroids, plus 11 years of continuous operation, almost all systems are performing well. Pioneer’s magnetometer ceased to function in 1975 but experimenters can calculate the interplanetary field from charged particle trajectories, magnetic data already gathered, and several correlations from five other Pioneer scientific instruments.

With this one exception, the far-traveling U.S. spacecraft continues to function well, and is currently engaged in a new enterprise, defining the extent and behavior of the Sun’s atmosphere, the magnetic bubble which contains the Sun and the planets. This “bubble” in the interstellar medium is called the heliosphere.
Scientists await current spacecraft findings “with intense excitement,” says Dr. James A. Van Allen, University of Iowa, Pioneer 10 experimenter, “because we think the Sun is typical of a majority of the stars in the universe. It’s the only star we can measure from ‘close up’. Finding the extent and exact mechanisms of the Sun’s atmosphere will tell us a great deal about the Sun itself, about the interstellar gas surrounding the solar system, and hence about stars in general.”

Pioneer 10 data also is currently being used to seek a possible dark star companion to the Sun, for which there is significant scientific evidence (unexplained deviations in the orbits of Uranus and Neptune). Less likely, these deviations could be due to a relatively close-in tenth planet. Because of its great distance away, Pioneer also will provide a unique instrument for attempting the first detection of gravity waves employing enormously long wavelengths never before observable.

Pioneer 10 has an array of achievements and discoveries. Some are:
1. First trip to Jupiter.
2. First crossing of the Asteroid Belt and finding that it presents little hazard to spacecraft.
3. Discovery that Jupiter is a liquid planet.
4. First model of Jupiter’s huge, pulsating magnetosphere and tremendously powerful radiation belts.
5. First accurate measurements of mass and densities of Jupiter’s planet-sized moons, key to the planet’s formation history.
6. First closeup pictures of Jupiter’s Great Red Spot and belts and zones showing details of atmospheric circulation.
7. Proof of origin of the gegenschein and zodiacal light (Interplanetary dust).

The Pioneer 10 project is managed by NASA’s Ames Research Center, Mountain View, CA. Pioneer 10 was built by TRW’s Space & Technology Group, Redondo Beach, CA. The spacecraft had an original design life of 21 months and has performed almost perfectly for more than 11 years. NASA and other groups plan to mark the historic flight of Pioneer, the first man-made object to leave the solar system, with ceremonies involving Pioneer participants, investigators, and other interested people.

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**Final Efforts to Regain Contact with Viking**

Engineers have concluded that communications cannot be re-established with NASA’s Viking Lander 1 (the Thomas A. Mutch Memorial Station) on Mars, after several months of unsuccessful efforts to regain contact at NASA’s Jet Propulsion Laboratory, Pasadena, California.

Communications with Viking Lander 1, which touched down on Mars on July 20, 1976, were lost in late November 1982, and engineers at JPL have been trying since then to contact the station, without success.

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*Viking, Phone Home*

Engineers have repeatedly commanded the spacecraft in attempts to reestablish contact. The command sequences were based on detailed studies of possible failure modes. The lack of success has led to the conclusion that communications with the lander probably cannot be achieved. However, the lander does have an internal program that will initiate transmissions to earth without commands from earth. In the event that the lander is still operating, engineers at JPL will listen on May 5, the first time such automatic transmission would occur. One week later, in case the lander is operating but could not initiate communications on its own, engineers will command the lander to switch to different components of its transmitter, in the event some of those components have failed.
Mars will reach superior conjunction—where the red planet will be directly opposite the Sun from earth—in late May and early June. During superior conjunction earth-based antennas will be unable to communicate with the lander.

Viking Lander 1 was launched to Mars in August 1975. It landed on the Martian surface at Chryse Planitia, on July 20, 1976, and was joined by Lander 2 on September 3, 1976. Both landers conducted the most thorough examination of another planet ever undertaken.

Viking Lander 1 was renamed the Mutch Memorial Station in memory of Dr. Thomas A. Mutch, former Viking Lander Imaging Team leader, and former Associate Administrator of NASA’s Space Science Division. Dr. Mutch disappeared during an attempt to climb Nun Kun, a peak in the Himalayas, in September 1980.


Spaceweek '83
Space: The Next 25 Years

Spaceweek National Headquarters has announced that Spaceweek '83 activities will occur in at least 82 U.S. cities this July 16-24. Spaceweek is an annual pro-space campaign, when space supporters sponsor educational and entertaining events for the American public.

Spaceweek is an event, not a society. Thus, there are no "members". Rather, a Spaceweek organizer may be someone active in a society, a science or engineering student, employed in a technical profession, an educator, or just an individual concerned about the country's participation in space-related activities. As varied as the people coordinating them, pro-space sentiments are expressed in many ways during Spaceweek. This is why there is no formal structure; rather, there is a loose network of hard-working space supporters, sharing ideas and information.

In each Spaceweek city, one person usually acts as the central point of contact and coordination, the Director. This person encourages, coordinates, and publicizes the events, and builds a team of volunteers to help.

In addition, a group of seasoned space supporters in Houston, Texas, anxious to help fellow space activists organize this annual campaign, supports and advises most Spaceweek Directors. Spaceweek National Headquarters, as this group is called, provides Directors with promotional materials and acts as an intermediary to national organizations and media. The National Headquarters distributes a free newsletter which allows the Directors to exchange ideas and report on the progress of their plans. Headquarters also helps interested people in the same city to get in touch with one another so they can work together on Spaceweek.

The 1983 Spaceweek theme is Space: the Next 25 Years, in honor of NASA's 25th anniversary. The Spaceweek philosophy is that, by getting space supporters together and building a national event, we can make things happen. But, to do so we must all pull together and invest our time and energies. Participation in Spaceweek has nearly doubled in size each year. This increased participation reflects the growth of the overall space movement. We call on all planetary scientists to help keep it growing with their support.

Further information on Spaceweek can be obtained from local Directors or from Spaceweek National Headquarters at P.O. Box 58172, Houston TX 77258, or call Dennis Stone at 713/483-2337. A handbook and a registration kit are available to those wishing to start a Spaceweek effort.

Dennis Stone and Anne Lutz-Garihan

Unique Object in the Milky Way Galaxy

A team of physicists from the Jet Propulsion Laboratory have reported that they have identified an object in the Milky Way galaxy that is emitting high-energy gamma radiation 50,000 times as great as the total power output of the Sun.

Dr. Allan S. Jacobson told the American Physical Society's annual meeting in Baltimore that radiation from the object, called SS 433, appears to come from the isotope magnesium 24. Observations at lower energies by other scientists have indicated SS 433's behavior is unlike any other object in our galaxy. "The new observations make a unique object even more bizarre," Jacobson said.
Jacobson says data gathered by the High-Energy Astronomy Observatory (HEAO-3) shows that the radiations occur at two different energies—one at 1.5 million electron volts and a second at 1.2 million electron volts.

Two jets of material appear to stream from SS 433, the scientists say, one toward Earth and the other away. Because of their different velocities relative to Earth, radiation from the receding jet shifts toward the lower energies and the radiation from the approaching jet shifts toward higher energies. In this scenario, the higher-energy radiation is from the jet coming toward us, the lower-energy radiation from the jet moving away.

According to Dr. Richard Lamb, who led the analysis, the precise energies associated with each radiation shift by a few percent over several weeks as the jets change their orientation in space relative to Earth.

The physicists say the material appears to be moving at 26 percent of the speed of light (Light moves at 186,200 miles a second), and—if it is indeed magnesium 24—it must have been heavily nuclear processed. (Nuclear processing takes place in the interior of stars, and synthesizes elements from the original hydrogen and helium.)

The source of the radiation, they say, could be a neutron star buried within SS 433. A neutron star is a star with about the same mass as the Sun that has collapsed to a diameter of only a few miles. Another, more exotic, possibility is that SS 433 contains a black hole. The scientists believe the neutron star or black hole in SS 433, which is 15,000 light years from Earth, must have formed within the last 1,000 to 10,000 years, and that the jets pouring from it are punching holes in the interstellar medium around it.

SS 433, while in the Milky Way galaxy, appears to be undergoing processes on a relatively small scale that occur on a larger scale in quasars and active galaxies, scientists say.

Dr. Lamb is at JPL on a leave from Iowa State University. Other members of the team, in addition to Lamb and Jacobson, are James Ling, Guenter Riegler, William Wheaton and William Mahoney, all of JPL.

The HEAO-3 satellite was launched by NASA in 1979 to observe the sky in high-energy-radiation ranges.

JPL Press Release #1018, April 14, 1983.

Managing NASA in the Apollo Era
A new entry in the NASA History Series, this volume written by Arnold S. Levine describes and analyzes the organization of the National Aeronautics and Space Administration during the 1960's. It presents a detailed historical account on the development of NASA during the 1960's. Topics covered include: key administration decisions in the early history of NASA, a narrative account of NASA from its origins through 1969, contracting, manpower, the budgetary processes, headquarters organization, relations with the Department of Defense, and long range planning. This 364-page book is available from
the Superintendent of Documents for $10.00. It is NASA SP-4102; SOD S/N 033-000-00844-9.

Ten Years of Planetary Exploration
This new poster (49x39") depicts in full color the planets which have been explored by the various manned and unmanned probes. The poster includes, in a most attractive way, pictures of the actual spacecraft and detailed pictures showing some of the most important discoveries on each of the planets which have been explored. Short paragraphs explain each of the pictures. The poster is available from the Superintendent of Documents for $4.50. The S/N is 033-000-00861-9.

Planetary Exploration through Year 2000: a Core Program
This 29-page booklet, richly illustrated with color pictures, is the first part of a report of the Solar System Exploration Committee of the NASA Advisory Council. A report of the recommendations of this Committee are published elsewhere in this Bulletin. Available from the Superintendent of Documents. Price not yet set.

Other Publications
Two new posters have been published recently. Solar System Chart published by Hansen Planetarium is a full-color chart depicting the essential features of the Solar System, including the relative sizes of the planets and their distances from the Sun, interesting and important statistics are furnished for each of the planets, the Sun and the Moon. The Solar System chart was revised in 1982 to feature the latest information, and includes both metric and English values for planet mass, distance, and speed. This 39×25" chart is mailed rolled for $3.50. Send $2.00 for a complete set of the Planetarium's astronomical catalogs and receive a $2 credit toward your next purchase. Add $5 each for foreign airmail orders. Order from: Hansen Planetarium, Dept. SSM, 1098 South 200 West, Salt Lake City UT 84101. Charges to Mastercard or Visa accepted.

The second chart celebrates 25 years in space. 25 Years of American Space Exploration has been published by Astromedia. From Project Mercury to the Space Shuttle, this colorful 21 x 30" poster is filled with photos and facts, highlighting all of NASA's major achievements of the last quarter-century. This poster presents the steps leading to the first lunar landing, the first close-up views of Venus, Mars, Jupiter... and beyond. Plus, a look at the mighty machines which opened the space frontier. To order send $4.95 to Astromedia Order Dept., P.O. Box 92788, Milwaukee, WI 53202.

Volcanoes in Our Solar System, by G. Jeffrey Taylor. Published by Dodd Mead, 1983, $10.95.

Our children's teachers probably never had an opportunity to study planetary geology, and hence aren't prepared to respond to current questions from inquisitive young minds. Jeff Taylor has provided two exemplary texts to explain planetary geology to children (and to their teachers). His earlier work, "A Close Look at the Moon" is an award winning account of our post-Apollo understanding of the Moon. Now this Ross Taylor of the kiddie set has condensed the ideas of the "Basaltic Volcanism" compendium into a light and attractive 95-page introduction to volcanism on the Earth, other planets, moons, and asteroids. Illustrated with numerous interesting photographs—not just familiar scenes from Hawaii—the book describes volcano and magma types on Earth and evaluates their occurrence on other worlds in the solar system, including the eucrite parent body. Recent ideas such as the meteorites-from-Mars story are included. The book is not without faults, however, Aconcagua is not, as claimed on page 28, the tallest volcano on Earth because it is not a volcano at all (it is uplifted Cretaceous conglomerates, etc.). In order to present a simple story—although uncertainties are often pointed out—explanations are sometimes incomplete: it is not just the lack of air that produces low angle pyroclastic cones on the Moon, reduced gravity is also a major factor. Similarly, the discussion of calderas (page 38) uses the Hawaiian collapse model but doesn't mention the more common style of caldera formation due to eruption of massive quantities of ignimbrite which pile up around the rim. Despite these and a few other criticisms "Volcanoes in our Solar System" is highly recommended. It teaches children the comparative approach to nature and lets them know that if we continue to explore, the mysteries of volcanism in the solar system will be gradually understood. Perhaps the excitement of planetary geology may be remembered 10-15 years from now, when decisions about going to the Moon and Mars are
being debated and our children will be of voting age.

Review by Dr. Charles A. Wood,
Johnson Space Center


This publication contains the papers from the conference on Large Body Impacts and Terrestrial Evolution: Geological, Climatological, and Biological Implications, held at Snowbird, Utah, October 19-22, 1981. The Conference was sponsored by the National Academy of Sciences and the Lunar and Planetary Institute. The conference drew together specialists in a wide range of scientific disciplines from planetary astronomy and geology to explosion physics and aspects of paleontology and zoology to consider the following questions:

What has been the history of the impacts of large asteroids and comets on the earth during the last three and a half-billion years?

What have been the physical, chemical, and biological consequences of these impacts?

Have they produced major perturbations of the important indigenous physical and biological trends of terrestrial evolution?

This publication contains the papers written by the scientists attending this conference to answer these questions and more.

Available from the Geological Society of America, 3300 Penrose Place, Boulder CO 80301.


Many of our readers will be well acquainted with Dr. Hartmann's first edition of this book published in 1972. This very useful text is an attempt to make the solar system discoveries understandable to freshman in an astronomy course or geology course, and also useful to the first-year graduate student. The basic text material is a virtually nonmathematical presentation, starting with background on basic facts and planetary motions, and moving into topical areas such as planetary origins, interiors, surfaces, and atmospheres. Using the book while ignoring the math notes should give a good descriptive overview. Using the book with the math notes should allow a moderate level of physical sophistication. The author states, "I hope that general readers as well as advanced students coming into planetary science from a background specialty such as astronomy or geology will find the book to be a thought-provoking review and overview of this intriguing field."

This book is organized not planet by planet, but by topical areas such as planetary surfaces, in order to show how basic physical principles in each area apply to different worlds. Therefore, discussions of a single planet may appear in various chapters, and it is wise to use the index as a guide when seeking information on a specific planetary body.

The book is very readable and made most attractive by the many fine illustrations and photographs incorporated into the text. The up-dated Planetary Data Table in the appendix is almost worth the entire cost of the book.

The book should be available from Wadsworth or through your local book store.

The LUNAR AND PLANETARY INFORMATION BULLETIN is published by the Lunar and Planetary Institute. There are usually three issues per year. It is distributed free on request to lunar and planetary scientists, educators, students, and their institutions.

The next issue will be in November. Copy deadline is October 10, 1983. If you have any announcements which you would like to have printed in the BULLETIN, please send them to the Editor. We reserve the right to select and edit copy.

Editor. Frances B. Waranius,
Lunar and Planetary Institute
3303 NASA Road One,
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Phone: 713/486-2135
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If you want to be sure that you get all of your mailings from the Institute promptly, be sure to send a change of address to: Mailist, Lunar & Planetary Institute, 3303 NASA Road One, Houston, TX 77058. It often takes the postal service 60-90 days to return an item to us with the address correction. Do yourself and us a service. Remember the LPI Mailing List when you move. Thanks. (ye editor)

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CALENDAR

May 30-June 3
American Geophysical Union. Spring Meeting
Baltimore, Maryland
Contact: American Geophysical Union
2000 Florida Avenue NW
Washington DC 20009

May 30
Achondritic Meteorites from the Moon and Mars
Special Session at AGU Spring Meeting
Contact: Ursula B. Marvin
Smithsonian Astrophysical Observatory
Cambridge MA 02138

June 14-16
94th Annual Scientific Meeting of the Astronomical Society of the Pacific
Contact: Hawaii Meeting
ASP
1290 24th Avenue
San Francisco CA 94122
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### June 19-22

162nd Meeting of the American Astronomical Society, Radisson Hotel, St. Paul, Minnesota  
Contact: Executive Office, AAS  
1816 Jefferson Place NW  
Washington DC 20036  
Phone: 202-659-0134  
or  
Dr. Tom Jones  
University of Minnesota  
Dept. of Astronomy  
116 Church St. S.E.  
Minneapolis MN 55455  
Phone: 612-373-3307  

### June 21-24

Physics of the Jovian and Saturnian Magnetospheres, Massachusetts Inst. of Technology, Cambridge, Massachusetts  
Contact: Professor H. S. Bridge  
MIT: 37-241  
Cambridge MA 02139  
Phone: 617-253-7501  

### June 28-30

Space Shuttle Program Technical Conference  
Johnson Space Center, Houston, Texas  
Contact: Norman H. Chaffee  
Johnson Space Center  
Mail Code: EP  
Houston TX 77058  
Phone: 713-483-3995  
(continued)
July 5-9
International Conference on Natural Satellites,
Cornell University, Ithaca, NY
Contact: Myrna Talman
Space Sciences Bldg.,
Cornell University
Ithaca NY 14853
Phone: 607-256-4875

July 10-15
7th International Conference on the Origins of Life
and 4th Meeting of International Society for the
Study of the Origin of Life (ISSOL),
Mainz, F.R.G.
Contact: ISSOL
7th ICOL 1983 Secretariat
Institut fur Biochemie
Gutenberg Universitat
Postfach 3980
D-6500 Mainz FRG

August 1
Title DEADLINE for DPS/AAS Meeting

August 8-13
9th International Association of Planetology
International Symposium, 2d IAP General Assembly
and 2nd IAP International Planetological Conference,
Brussels, Belgium
Contact: Rene J. DeJaiffe
Royal Observatory of Belgium
Avenue Circulaire 3
B1180 Brussels Belgium
Phone: 2-375-2484

August 10-16
1983 Field Workshop “A Cross Section of Archean
Crust” Northeastern Ontario, Canada
Contact: Pam Jones
Lunar and Planetary Institute
3303 NASA Road One
Houston TX 77058
Phone: 713-486-2150

August 14-18
Conference on Glass in Planetary and
Geological Phenomena,
Alfred, New York
Contact: Prof. L. D. Pye
New York State College of Ceramics
Alfred University
Alfred NY 14802
Phone: 607-871-2432

August 15
DEADLINE for DPS/AAS Abstracts
August 15-27

International Union of Geodesy and Geophysics,
XVII General Assembly, Hamburg, FRG
Contact: IUGG
Hamburg Messe und Congress GmbH
P. O. Box 30 23 60
D-2000 Hamburg 36
FRG
Phone: 040/3592-381

September 3-4

Workshop on Past and Present Solar Radiation:
The Record in Meteoritic and Lunar Regolith
Mainz, Germany
Contact: Pamela Jones
Lunar and Planetary Institute
3303 NASA Road One
Houston TX 77058
Phone: 713-486-2150

September 5-9

46th Annual Meteoritical Society Meeting,
Mainz FRG
Contact: Dr. Friedrich Begemann
MPI fur Chemie
Postfach 30 60
D-6500 Mainz FRG

October 9-12

Association of Earth Science Editors
Houston, Texas
Contact: Pamela Jones
Lunar and Planetary Institute
3303 NASA Road One
Houston TX 77058
Phone: 713-486-2150

October 17-20

DPS/AAS 15th Annual Meeting
Sheraton Conference Center, Ithaca NY
Contact: Steven J. Ostro (program)
Joseph A. Burns (arrangements)
Space Sciences Building
Cornell University
Ithaca NY 14853

October 31-November 3

Geological Society of America, Annual Meeting,
Indianapolis, Indiana, with associated societies
Contact: Arthur Mirsky
Dept. of Geology
Indiana University/Purdue University
925 W. Michigan Street
Indianapolis IN 46202
Phone: 317-264-7484

(continued)
Future solar system exploration will help fit the pieces into the puzzles in our knowledge!
ANNOUNCING A NEW LPI PUBLICATION

The LPI is publishing a book entitled Chondrules and Their Origins. It is a collection of papers, most of which were given at the LPI Topical Conference of the same title in November, 1982. The publication date is set for October, 1983.

Special features of this volume will include:

• an extended bibliography on chondrules
• a thorough index that lists the page(s) on which an entry may be found
• a preface written by E. A. King, volume editor

Chondrules and Their Origins will be a hardbound book of approximately 275 typeset pages. At this time, we estimate the price of the book will be about $30. If you would like to receive information on ordering this book, please use the form below to give us the address where we may reach you in July. Return the form to:

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MOON. MOTION OF THE MOON, DYNAMICS


MOON. PHYSICAL STRUCTURE


MOON. MORPHOLOGY, STRATIGRAPHY, MAPPING


MOON. CHEMICAL COMPOSITION, PETROLOGY


MOON. CHEMICAL COMPOSITION (Cont.)

NORD.G.L.JR. + WANDLESS,M.-U. ( 959 NATIONAL CENTER, U.S. GEOLOGICAL SURVEY, RESTON VA 22092 ) : PETROLOGY AND COMPARATIVE THERMAL AND MECHANICAL HISTORIES OF CLASTS IN BRECCIA 42234


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MOON. ELECTROMAGNETIC PROPERTIES

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COWLEY,S.W.H. + SHULL,P.JR. ( BLACKETT LAB., IMPERIAL COLLEGE, LONDON, SW7 2BZ, U.K. ); CURRENT SHEET ACCELERATION OF IONS IN THE GEOMAGNETIC TAIL AND THE PROPERTIES OF ION BURSTS OBSERVED AT THE LUNAR DISTANCE

PLANETARY AND SPACE SCIENCES VOL. 31, 235-245 (1983)

SUGIURA,N. + STRANGWAY,D.W. ( DEPT. OF GEOLOGY, UNIV. OF TORONTO, TORONTO, ONTARIO, M5S2A1, CANADA ); MAGNETIC PALEOMAGNETIC DETERMINATION ON LUNAR SAMPLE 62235


MOON. ENVIRONMENT, SOLAR WIND

BORG, J. + BIRGIN,J.P. + COWSIK,G. + LANGEVIN,Y. + MAURETTE,M. ( LABORATOIRE RECH. BERNAS, 91406 ORSAY, FRANCE ); A NOBEL FOR THE ACCUMULATION OF SOLAR WIND RADIATION DAMAGE EFFECTS IN LUNAR DUST GRAINS, BASED ON RECENT RESULTS CONCERNING IMPACTION AND EROSION EFFECTS


WIELER,R. + ETIQUETTE,P. + SIGNER,P. + POPEAU-G. ( SWISS FEDERAL INST. OF TECH., SONNENBRUGER STRASSE, 5 CH-8092 ZURICH, SWITZERLAND ); DECREASE OF THE SOLAR FLARE/SOLAR WIND FLUX RATIO IN THE PAST SEVERAL AEONS DEDUCED FROM SOLAR NEON AND TRACKS IN LUNAR SOIL PLAGIOCLASES


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KOLTZ,C. ( WASHINGTON, UNIV., ST. LOUIS, MO 63130 ); MINING THE MOON

SPACE WORLD VOL. T-2-230, 30-31 (1983)

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ALLEN,D.A. ( ANGLO-AUSTRALIAN OBSERVATORY ); INFRARED VIEWS OF THE GIANT PLANETS

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CORADINI,A. + FEDERICO,C. + LANCIANO,P. ( ISTITUTO DI ASTRONOMIA SPAZIALE DEL CNR, REPARTO DI PLANETOLOGIA, VIALE DELL'UNIVERSITA 11, 00153 ROMA, ITALY ); EARTH AND MARS: EARLY THERMAL PROFILES


FEGLEY,B.JR. ( HARVARD COLLEGE OBSERVATORY, CAMBRIDGE, MA 02138 ); PRIMORDIAL RETENTION OF NITROGEN BY TERRESTRIAL PLANETS AND METEORITES


GIERASCH,P.J. ( CENTRE FOR RADIOASTRONOMY AND SPACE RESEARCH, CORNELL UNIV., ITHACA, NY 14853 ); DYNAMICAL CONSEQUENCES OF OTHOHYDROGEN-PARAHYDROGEN DISEQUILIBRIUM ON JUPITER AND SATURN

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JOURNAL OF GEOPHYSICAL RESEARCH VOL. 88, 49-57 (1983)

KLEIN,L.C. + FASANO,B.V. + WU,J.M. ( RUTGERS UNIV., DEPT. OF CERAMICS, PISCATAWAY, NJ 08854 ); VISCOS FLOW BEHAVIOR OF FOUR IRON-CONTAINING SILICATES WITH ALUMINA; EFFECTS OF OXIDATION CONDITIONS

PLANE(NS (Cont.)


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LPIB No. 35


Mendis,D.A. + Hill,J.R. + Houpar,H.L.F. (Dept. of Electrical Engineering and Computer Science, Univ. of California at San Diego, La Jolla, CA 92093) CHARGED DUST IN SATURN'S MAGNETOSPHERE PROCEEDINGS OF THE THIRTEENTH LUNAR AND PLANETARY SCIENCE CONFERENCE, PART 2 JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 88, SUPPLEMENT, PAGES A929-A942 (1983)


URANUS


VENUS


OTHER OBJECTS: ASTEROIDS


OTHER OBJECTS. ASTEROIDS (Cont.)


OTHER OBJECTS. COMETS.


COOK, A. (GRIFFITH OBSERVATORY, 2800 EAGLE STREET, INDIANAPOLIS, IN 46208): COMET HALLEY UPDATE. GRIFFITH OBSERVER Vol. 47(2) 8-9 (1983)


OTHER OBJECTS. METEORITES.


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1: RADIATION HISTORY OF LUNAR MICROBRECCIAS AND LITHIC CHONDRULES FROM WESTON METEORITE BY TRACK DATA

LIPSCHUTZ,M.E. + DISWAS,S. + MCSWEEN,H.Y., JR. (DEPT. OF CHEMISTRY, PURDUE UNIV., W. LAFAYETTE, IN 47907)
1: CHEMICAL CHARACTERISTICS AND ORIGIN OF H CHONDRITE REGLITH BRECCIAS
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MARTI,K. (DEPT. OF CHEMISTRY, B-017, UNIV. OF CALIFORNIA AT SAN DIEGO, LA JOLLA, CA 92093)
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NYQUIST,L.E. (NASA/JOHNSON SPACE CENTER, HOUSTON, TX 77058)
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RUBIN,A.E. + KEIL,K. (DEPT. OF GEOLOGY AND INST. OF METEORITICS, UNIV. OF NEW MEXICO, ALBUQUERQUE, NM 87131)
1: MINERALOGY AND PETROLOGY OF THE ABE CONSORTIUM BRECCIA AND ITS DARK INCLUSIONS

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