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LUNAR AND PLANETARY SCIENCE: 30 YEARS AT A GLANCE

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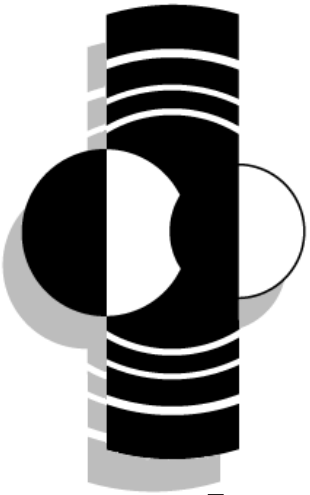
LPSC: 30 Years at a Glance

This year's Lunar and Planetary Science Conference marked the 30th anniversary of the conference that had its origins as a controlled report to NASA on the first lunar samples returned to Earth by Apollo 11. In the following pages, we present a retrospective of the conference, including photographs from the past 30 years and insights from LPI scientists and staff members David Black, Paul Spudis, Graham Ryder, LeBecca Simmons, and Pam Thompson. The quotations were taken from an informal roundtable discussion on the history and origins of the conference. The 30th LPSC, held at Johnson Space Center and the Lunar and Planetary Institute in Houston, March 15–19, 1999, again attracted a record-breaking number of abstracts and attendees. The official count tallied 1052 abstracts submitted and 1071 people attending the conference.



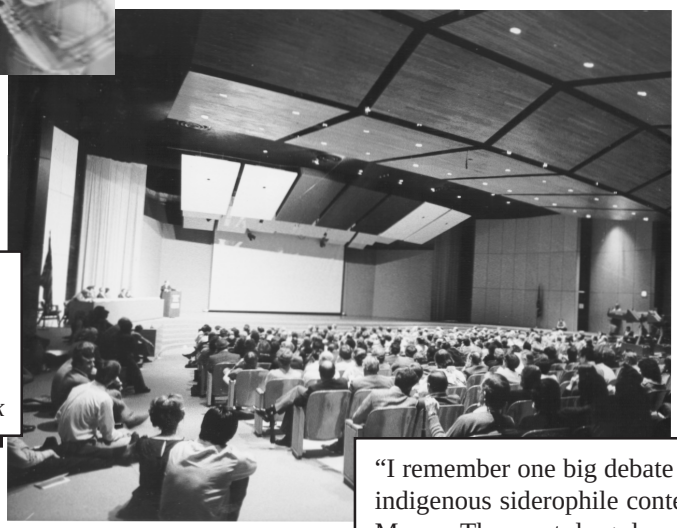
"The first meeting was at the Albert Thomas Convention Center. I stayed in the Old Rice Hotel. It was cold, a blue norther had come through. We're standing in about 30 degrees, we had the windows closed, and we had towels up against the windows. It was freezing. When I came back for the 20th, the conference had taken on this wide and diverse topical nature, with numerous sessions instead of just one. There were obviously changes in the faces — although some of the same faces were there, — but it was the structure of the meeting that changed so much."

— David Black, LPI Director, who attended the first conference as a graduate student and then did not attend again for 20 years

Participants register at the 1974 conference in the lobby of Building 1 at JSC.

"The conference started out as a way to embargo the results of lunar sample stuff — so no one would scoop anyone else. And from that it evolved into a program review meeting, where people would come and say 'OK, during the past year, here's what I did with my grant money.' And from that it evolved into the place where all the major results in our business are reported. A lot of people go to DPS, and a lot of people go to the AGU, and to GSA. This is the one meeting where I think everyone goes who's interested in planetary science and counts on what they need to know about what's new in the business."

—Paul Spudis, who first attended in 1977



A speaker attracts a large crowd in Building 2 during the 1983 conference.

"The very first one was an incredibly exciting time, because it was all about Apollo."

—David Black

"If you think about it, some of the people presenting now at the meetings weren't even born when Apollo first landed on the Moon."

—LeBecca Simmons

"I remember one big debate about the indigenous siderophile content of the Moon. The most drag-down, knock-out fights can be over the most trivial things. It was a packed Building 2 auditorium."

—Paul Spudis

The 1984 conference was marked by the release of Venera Orbital data.

"In my lifetime, the one (science presentation at LPSC) that really sticks out is when we first got the *Venera* orbital stuff of Venus. The only thing of Venus before was this very low-resolution *Pioneer* data — and you just saw bumps on a globe — it wasn't very impressive. I remember when the Russians had these first radar pictures, and that was only the northern third of the planet, and that was just an incredible high-energy conference, because it was literally like seeing a planet we had never seen before."

Paul Spudis

Robert Clayton displays his collection of LPSC badges from past conferences as Mike Duke looks on.

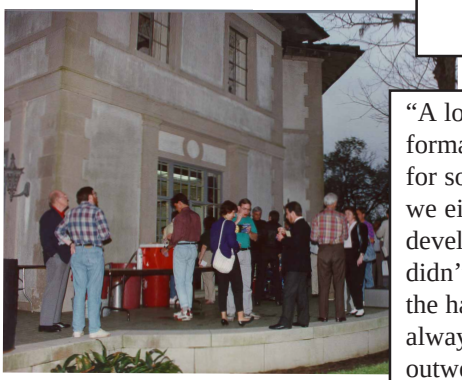
Participants celebrated the conference's 20th anniversary in 1989.

"At the 20th LPSC Anniversary Banquet, Robert Clayton of University of Chicago arrived wearing every badge he had been issued at the 20 conferences he had attended. He had each badge attached in order by year to his 20th LPSC conference badge, and the train of badges reached from his shoulder to the floor. Everyone seemed to enjoy such a distinguished member of the community making a sentimental public display of his participation in the conferences."

— LeBecca Simmons, Conference Coordinator

"When you want to look at the science highlights (of the conference), I say pick up any planetary science textbook because virtually anything in that was first reported at this conference."

— Paul Spudis



The West Mansion was last used for LPSC open house activities in 1991.

"A lot of us have used this format to publish ideas that for some reason or another we either didn't want to develop more fully or we didn't want to go through the hassle of a review. I always thought the benefits outweighed the downside."

— Paul Spudis

Attendees line up to register at the West Mansion during the 1991 conference.

"Apollo was way too hurried. Now we have time to step back and put everything into a big picture."

— Graham Ryder, who has attended every conference since 1978, save the Ninth

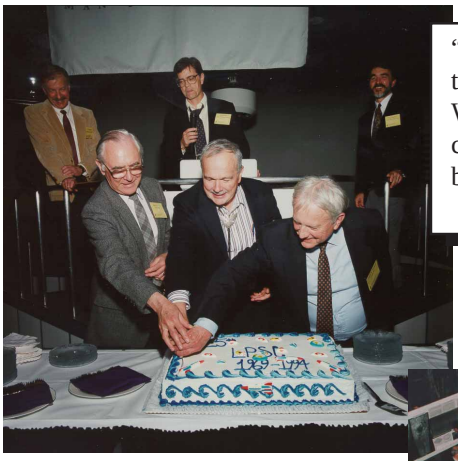
Pam (Jones) Solomon, former LPSC Conference Administrator, organizes events for the 1991 Chili Cookoff.

"Of all the meetings I go to, this one's the best bargain. What is it, $50? Compare that to some of these other $200 meetings."

— Paul Spudis

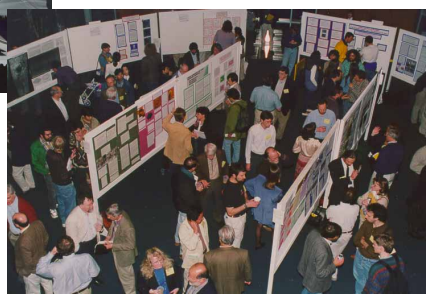
"If you look at the covers of the programs, the fourth conference had six images of the Apollo lunar landing sites; the next one had solar system objects, Mars and Mercury, and that was virtually the beginning of the transition."

— Paul Spudis



Bob Clayton, Gene Shoemaker, and George Wetherill cut the 25th anniversary cake, with David Black and Doug Blanchard looking on.

"Nobody wants to change the scope or tradition of the conference after 30 years. We even get feedback if we change the colors of the products from the traditional black and yellow colors."
— LeBecca Simmons



The new LPI facility housed the conference poster sessions for several years.

"As long as missions are flown and data comes back, this conference will be here."
—Paul Spudis

An oral session in Room 104 of the Gilruth Center attracts a large number of listeners during the 1994 conference.

"The LPSC abstracts are unique in that they're long enough to actually say something."
— Graham Ryder

LPSC THROUGH THE YEARS

• The first conference, known as the Apollo 11 Lunar Science Conference, was held January 5–8, 1970, six months after *Apollo 11* returned the first samples from the Moon.

• Approximately 240 abstracts were published in the abstract volume for the second conference, the 1971 Lunar Science Conference, held January 11–14, 1971, at the Albert Thomas Convention and Exhibit Center.

• No record of attendance for the first conference exists, although estimates for attendance hover around 1000.

• The third LPSC was held in January 1972. Approximately 375 preliminary abstracts were printed for distribution to conference participants.

• The conference was moved to the Johnson Space Center for the 4th Lunar Science Conference. The meeting attracted 300 abstracts and 700 attendees.

• The 10th conference (another celebrated anniversary year) drew 493 abstracts and 745 attendees.

• Until 1973, the conference was held in January. The fourth conference was moved to March, and it has been held in the middle of that month ever since.

• There were 643 abstracts submitted and 729 attendees for the 20th LPSC.

• There were 1052 abstracts submitted and 1071 attendees for the 30th LPSC.

• Until 1977, the conference was known as the Lunar Science Conference and was sponsored by the Lunar Science Institute and NASA Johnson Space Center. In 1978 the conference became the Lunar and Planetary Science Conference, to reflect the broadening range of topics covered at the conference, and the Institute changed its name to the Lunar and Planetary Institute.

• The logo now used by the Lunar and Planetary Institute as its trademark was originally developed by NASA artist Boyd Mounce as the LPSC conference logo. LPI later obtained permission to use the logo for the Institute.

• The *Proceedings of the Lunar and Planetary Science Conference*, the postmeeting, refereed publication associated with the conference, was last published in 1992. Through the years, the book had been published by Pergamon, Cambridge, and the American Geophysical Union. Only a *Proceedings* volume (with no abstract volume) was published for the first Apollo 11 conference.

• The LPSC abstract volume was last published in hard-copy form for mass distribution in 1997, the same year that the electronic CD-ROM abstract volume was introduced. The cumbersome abstract volume set, which had become known as the "Yellow Peril" over the years, expanded to two volumes in 1988, and had grown to three volumes by 1994.

• The James Marion West Mansion, built in 1930 and renovated in 1969, housed the Lunar and Planetary Institute through 1991 and was used for conference-related activities until the Institute relocated to its present building.

NEWS FROM SPACE

Clyde Tombaugh in 1938 at the Zeiss blink comparator, which he used to examine pairs of photographic plates from the 13-inch telescope during his search for any object that moved against the background of stars. Following the discovery of Pluto, Tombaugh continued this dedicated but ultimately fruitless work in an attempt to find planets beyond Pluto. The large glass plates Tombaugh used each measured 14 inches by 17 inches (36 by 43 centimeters).

Lowell Observatory photograph.

PLUTO: STILL A PLANET

Perhaps falling into the "Much Ado About Nothing" category, the International Astronomy Union made headlines this February when it announced that Pluto would not be assigned a minor planet number.

The decision came weeks after the Minor Planet Center, the official clearinghouse for reports of small bodies in the solar system, suggested that Pluto be included in a list of minor planets based on its similarities to a group of small bodies known as trans-Neptunian objects.

Contrary to some media reports, there was never an official move to strip Pluto of its planetary status. Rather, the International Astronomical Union, the organization that determines the official status and names of astronomical objects, rejected a proposal to classify Pluto as both a planet and as Minor Planet 10000. The proposal drew criticism from the Division for Planetary Scientists and others as a move that would be viewed as a "demotion" for Pluto.

"The Committee of the Division for Planetary Sciences of the American Astronomical Society is opposed to assigning a minor planet number to Pluto," the DPS said in an official statement. "This action would undoubtedly be viewed by the broader scientific community and general public as a 'reclassification' of Pluto from a major planet to a minor planet. We feel that there is little scientific or historical justification for such an action."

Pluto has always been considered an anomaly among the nine planets, because of its small size, highly elliptical orbit, and icy composition. The dual classification proposal was based on the continuing discovery of trans-Neptunian objects with composition and orbits similar to Pluto's. Pluto would have been the largest known of the trans-Neptunian objects.

Other scientists argue that Pluto qualifies as a planet based on its spherical shape and the presence of an atmosphere and satellite. The IAU has never drafted formal guidelines for classifying planets and minor planets.

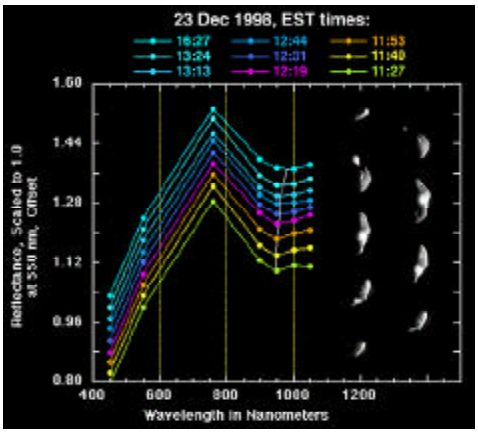
"The DPS has said that it's too confusing to give Pluto a number and there's no advantage to reclassifying it at this point," said DPS Press Officer Nadine Barlow. "In the case of Charon, it was originally classified as an asteroid but it does have some of the characteristics of a dying comet. So you do have some objects with fuzzy boundaries in the solar system."

Much of the criticism of the proposal to reclassify Pluto undoubtedly grew from public sentiment. Because of its distance and small size, the planet has remained largely shrouded in mystery since its discovery in 1930. This aura of mystery, along with Pluto's association with the Walt Disney cartoon character (who made his film debut in 1930), have added to its public appeal even while relatively few scientists are able to study the planet.

"There is not much data available on Pluto and until we actually get a spacecraft out there, it's going to remain pretty mysterious," said Barlow.

NEAR SPACECRAFT REVEALS MAJOR FEATURES OF EROS

Asteroid 433 Eros is slightly smaller than predicted, with at least two medium-sized craters, a long surface ridge, and a density comparable to the Earth's crust,



These spectral measurements of the asteroid Eros were taken on December 23, 1998, from the Near Earth Asteroid Rendezvous (NEAR) spacecraft as it flew by the asteroid. The measurements were compiled from data taken by the multispectral imager over 5 hours surrounding the closest approach at 2375 miles (3830 kilometers) from the asteroid at 1:43 PM EST. Each spectrum is a measure of the fraction of sunlight of different wavelengths that is reflected by the asteroid. The images at right show the asteroid's appearance at the times of the measurements. Different minerals reflect sunlight with a different spectrum, providing a "fingerprint" of composition of the asteroid's surface. The progressive shift in the depth and position of the trough in Eros's spectrum (traced by the thin gray line) results from subtle changes in the mixture of minerals exposed on different parts of the asteroid.

according to measurements from NASA's Near Earth Asteroid Rendezvous (NEAR) spacecraft.

NEAR's science instruments observed about two-thirds of Eros on December 23, 1998, as the spacecraft flew by the asteroid following an unsuccessful firing of its main engine a few days earlier. A subsequent successful firing of the engine put NEAR on course to rendezvous with Eros to begin its planned yearlong orbital mission starting in mid-February 2000.

Scientists and engineers at the Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland, which manages the mission, and science team members from affiliated institutions quickly planned the valuable flyby observations in the wake of the unsuccessful engine burn on December, 20.

During the flyby, 222 photos and supporting spectral observations of Eros were taken from as close as 2375 miles (3830 kilometers) from the asteroid by the spacecraft's multispectral imager, infrared spectrometer, and radio science experiment.

"The flyby of Eros has given us fundamental information that will help us plan a better orbital mission at Eros," said Dr. Andrew F. Cheng, NEAR project scientist at APL. "It has taken some of the risk out of our orbit insertion maneuver and early operations."

First observed from the Earth more than 100 years ago, Eros was known to be an S-type asteroid with high concentrations of silicate minerals and metal. However, few details about its structure or composition are observable from the ground. The NEAR flyby produced evidence of variations in surface color and reflected light (or albedo) that suggest the asteroid has a diverse surface makeup. Closer observations during the comprehensive yearlong orbital study of Eros will be needed to determine its precise composition.

The science team has determined that Eros is slightly smaller than originally estimated from groundbased radar observations, with a size of $21 \times 8 \times 8$ miles ($33 \times 13 \times 13$ kilometers), versus an estimate of $25.3 \times 9 \times 8$ miles ($40.5 \times 14.5 \times 14$ kilometers). The asteroid rotates once every 5.27 hours and has no discernible moons.

The asteroid's density is approximately 1.55 ounces per cubic inch (2.7 grams per cubic centimeter), close to the average density of Earth's crust. This makes Eros about twice as dense as asteroid 253 Mathilde, a C-type, carbon-rich asteroid that NEAR flew past in June 1997, and about the same density as S-type asteroid 243 Ida, which NASA's Galileo spacecraft flew past in 1993. Eros and Ida are the only S-type asteroids for which mass and density have been determined.

Flyby imaging of the asteroid's surface revealed a prominent elongated ridge that extends along its length for as much as 12 miles (20 kilometers).

"This ridge-like feature, combined with the measurements of high density, suggests that Eros is a homogeneous body rather than a collection of rubble" such as Mathilde appears to be, said Dr. Joseph Veverka of Cornell University, Ithaca, New York, who heads the mission's imaging team. "It might even be a remnant of a larger body that was shattered by an impact."

The surface of Eros is pocked with craters. The two largest craters are four miles and 5.3 miles (6.5 and 8.5 kilometers) in diameter, less than half the size of asteroid Mathilde's largest craters. The existence of fewer, smaller craters could be an indication that Eros has a relatively young surface when compared to Ida.

NEAR and Eros will cross paths again in February 2000. The spacecraft will then be inserted into orbit around the asteroid and begin its yearlong study. Images taken during orbit are expected to have more than 200 times better resolution than those obtained during the flyby and will be taken from as close as 9 miles (15 kilometers) from the asteroid's surface.

Flyby images of Eros, a related movie, an asteroid-shaped model, and a chart of spectral observations are available on the NEAR mission Web site at http://near.jhuapl.edu.

RESEACHER DISCOVERS 18th MOON ORBITING URANUS

An Arizona scientist using 13-year-old data has discovered an 18th moon orbiting the planet Uranus, the International Astronomical Union announced in late May. Until this discovery, Saturn was the only planet in the solar system known to have as many as 18 satellites.

The moon was discovered by Erich Karkoschka, a researcher at the Lunar and Planetary Laboratory of the University of Arizona in Tucson. The newly found moon is the first satellite of Uranus discovered in 1999 but will still be designated as Satellite 1986 U 10 (short S/1986 U 10).

"This discovery is very unusual," Karkoschka said. "Typically, satellites are found within days after the discovery image has been taken. In this case, the discovery image is more than 13 years old."

The interplanetary spacecraft *Voyager 2* took seven images of the new satellite when it flew by Uranus in late January 1986. These images have been publicly available in digital format. However, nobody recognized the satellite until Karkoschka investigated the images recently. He found the new satellite when he compared Hubble Space Telescope data with images taken by *Voyager 2*.

Belinda and S/1986 U 10, imaged near the upper right hand corner in the discovery image, circle Uranus in almost identical orbits. They pass each other once a month. This is the first example of two satellites in nearby orbits passing each other so slowly.

The new satellite is about 25 miles (40 kilometers) in diameter, similar in size to Comet Hale-Bopp, and it may also have similar composition as the comet, Karkoschka said.

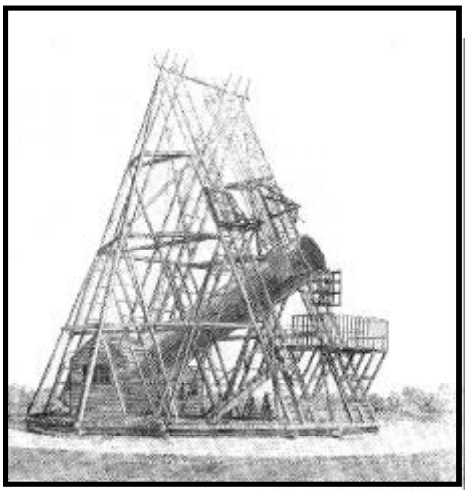
"Hale-Bopp was a spectacular sight when it crossed the inner part of the solar system two years ago," he said. "On the other hand, the new satellite will never get spectacular since it will remain in the dark, frigid parts of the solar system. It will remain a tiny speck of light."

Based on the detection in seven images, Karkoschka concluded that the satellite orbits Uranus once every 15 hours and 18 minutes. This is similar to the rotation period of Uranus. The satellite hovers 32,000 miles (51,000 kilometers) above the clouds of Uranus, or the same distance as the diameter of Uranus.

When *Voyager 2* took the discovery image on January 23, 1986, it was 650,000 miles (1,000,000 kilometers) from Uranus. This is 2500 times closer than the Earth ever gets to Uranus. Nineteen hours later, *Voyager 2* flew by Uranus.

Astronomers began discovering moons around other planets in the 17th century. Throughout the approximately 60 satellite discoveries made over the four centuries since, either Jupiter or Saturn has had the most known satellites. Saturn is known to have 18 moons. Jupiter has 16 known satellites, not counting the *Galileo* spacecraft, an artificial satellite around that planet. Many scientists had thought that these two largest

This view of Uranus was recorded by Voyager 2 on Jan 25, l986, as the spacecraft left the planet behind and set forth on the cruise to Neptune. Voyager was 1 million kilometers (about 600,000 miles) from Uranus when it acquired this wide-angle view.



Herschel's 40-ft-long, 48-in-aperture reflecting telescope near Windsor, England. Uranus was called "Herschel's Planet" for a time after its discovery.

planets in our solar system would have more moons than smaller planets. The new discovery around Uranus puts that belief into question.

The other known satellites orbit Neptune (8 satellites); Mars (2 satellites); Earth; Pluto; and asteroids Ida and Eugenia (1 each).

Soon after England's William Herschel discovered Uranus in 1781, he found its two largest satellites, which are about half the size of Earth's Moon. In 1851, English astronomer William Lassell detected two more uranian satellites. In 1951, Gerard Kuiper of the University of Chicago — later founder of the UA Lunar and Planetary Lab — discovered Uranus' fifth satellite. The Voyager team found 10 more uranian satellites in 1985–1986.

Two years ago, Brett Gladman of the Canadian Institute for Theoretical Astrophysics and Philip Nicholson of Cornell University discovered the 16th and 17th satellites. These two satellites are some 100 times farther away from Uranus than are the satellites discovered by the Voyager team.

Gladman, Nicholson, and Karkoschka have been the only scientists to find new moons around a major planet in the 1990s. However, during this decade, the first two satellites of minor planets (Ida and Eugenia) were imaged.

Uranus may well have more than 18 satellites, Karkoschka noted: Jupiter and Saturn have satellites of about half the size of the new uranian satellite. No such small satellite has yet been discovered around Uranus since the dim sunlight at Uranus makes the detection of such small satellites difficult.

The 10 satellites shown in the new discovery picture have been in continuous sunlight during the last 25 years. Starting next year, Cordelia, the satellite inside the ring system, will enter the shadow of Uranus during every orbit. The other satellites will follow. By 2002, all 10 innermost moons will enter the shadow of Uranus every orbit. These eclipses occur during two intervals within the 84-Earth-year-long Uranus year. Similarly, lunar eclipses on Earth occur twice within each Earth-year, currently in January and July.

The new discovery image is a mosaic of 10 exposures, Karkoschka said. The exposures of Uranus had shorter exposure times than the exposures of the surrounding area containing the rings and satellites. Since Uranus is a million times brighter than its satellites, Karkoschka retained the darker planet image so the satellites would be visible.

"To an astronaut onboard the Voyager spacecraft, the satellites would have appeared as faint stars while Uranus in the center would have been blazingly bright, as bright as the full moon on Earth," Karkoschka said. "In visible light, Uranus seems to be a bland, quiet place. Only two faint little cloud features can be found upon close examination of the image. The true activity in the atmosphere of Uranus is only revealed in infrared light."

The colors in the image are close to realistic, he added.

The newly discovered moon won't be stuck with the name "S/1986U10" forever, Karkoschka noted. The International Astronomical Union names satellites and asteroids a year or more after discovery. In the past, the IAU has often adopted a name suggested by the discoverer if that name fits in the context of the system's previously named satellites. However, anyone can suggest what the new moon might be named, Karkoschka added.

Fourteen of Uranus' other moons are named after female and fairy-like characters from the plays of William Shakespeare, including Cordelia, Ophelia, Bianca, Juliet, Desdemona, Rosalind, Portia, Cressida, Belinda, Puck, Miranda, Ariel, Titania, and Oberon. The other moon, Umbriel, takes its name from a character in Alexander Pope's *The Rape of the Lock.*

Portions of these news briefs have been drawn from NASA and International Astronomical Union press releases.

Invasion of the Flying Disks

Like any publication with a scholarly bent, the *Lunar and Planetary Information Bulletin* regularly receives copies of books from publishers hoping for a review or release notice. In recent years, however, many of these books have begun to be replaced by shiny metallic disks, packed with data, text, pictures, and movies. Often, these CD-ROMs are elegantly produced; just as often, they are haphazardly organized, giving ammunition to those who criticize electronic publishing as an easy way to reuse old images and data.

The advantages of CD-ROM publication are readily apparent. A compact disk allows a text to be supplemented with high-quality digital images, movies, sounds, and Internet hot links. Disks are highly portable and take less shelf space, although the disks in and of themselves are useless without a capable computer. Compact disks have long been the standard in music and computers for "prerecorded" music and software, and experts are already predicting the demise of the popular home video tape as the new DVD technology takes hold.

With any relatively new medium, there is always the danger of premature obsolescence, and many have expressed fear that CDs are nothing more than a transitory medium like the much-maligned 8-track tape. Indeed, DVDs, while similar in appearance to CDs, far surpass the medium in terms of data storage capacity and the ability to reproduce quality video.

While CDs are slowly making inroads into more traditional publishing — including the publication of single-volume CDs encompassing entire libraries of literary classics — the scientific world has embraced the medium with more enthusiasm. Electronic publication seems particular well suited to scientific publishing in that it allows for more images and data files as well as search mechanisms that negate the need for cumbersome indexing.

The Lunar and Planetary Science Conference has been touched by the swing toward electronic publishing. The conference has gradually phased out its "Yellow Peril" three-volume abstract sets published each year in conjunction with the conference in favor of a single CD-ROM. Although abstracts from the conference must be viewed using Adobe© Acrobat© software (included on the CD-ROM), the switch has allowed for faster processing of the abstracts and a drastic reduction in printing costs. In addition, the new format allows authors to include color figures with their abstracts and to create their own small hard-copy volumes composed only of those abstracts of interest to their discipline.

While authors and bibliophiles may deride the rise of the CD-ROM as an unsuitable substitute for the traditional book — which can be taken on a bus and read without the aid of a laptop computer — it is obvious that the digital medium (whether in the form of CDs or some higher-capacity storage device) is here to stay. With that in mind, we have here gathered reviews and descriptive summaries of several NASA-related data and educational CD-ROMs. As a whole, the reviews (all written by LPI staff scientists) give a good overview of where this trend is going, and where it may yet go.

Imagine the Universe!

Produced by the High Energy Astrophysics Science Archive Research Center (HEASARC) at the NASA Goddard Space Flight Center.

Imagine the Universe! is an educational compact disk that describes the large-scale structure of the universe and how it is studied via high-energy astronomy and astrophysics. The CD was written by astronomers and programmers at HEASARC, and it targets a general audience as well as teachers and students at intermediate and high-school levels. This CD is in fact a copy of HEASARC's *Imagine!* Web site as it existed in January 1998 and it can be viewed on a Mac or PC using any browser. The content is delivered via descriptive text that is amply illustrated with figures, movies, and audio clips. Although a young user might find the use of scientific jargon rather challenging, definitions of all scientific terms are just a click away. The CD contains discussions of most of the topics that one might expect of an encyclopedia on high-energy

astrophysics: galaxies, black holes, neutron stars, etc., as well as descriptions of X-ray, gamma-ray, and cosmic-ray astronomy.

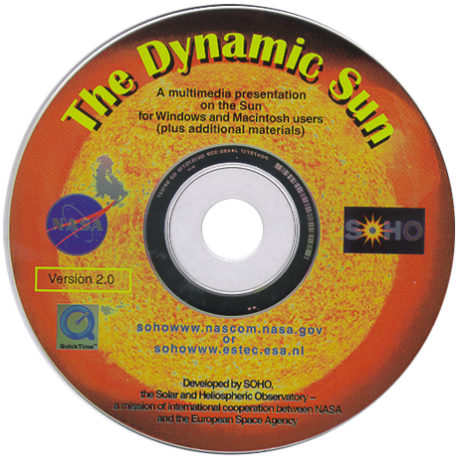
Although generally informative, the coverage of individual topics is somewhat uneven. For instance, the CD provides a very compelling and up-to-date description of the latest findings on gamma-ray bursts, yet its treatment of all of cosmology (i.e., the Big Bang, origins of the elements, and expansion of the universe) is rather terse and uninteresting. While this CD does not provide a "grand view" of the universe, it does a good job of informing the user about the universe's varied members (e.g., galaxies, stars, and their endstates) and how they are observed using X-ray and gamma-ray satellites.

Also included on the CD are snapshots of several other astrophysics and spacecraft-related educational Web sites, though these are of smaller scope than the *Imagine!* site. There are also several astronomy-related lesson plans that teachers of grades 6–12 might find useful. Also included is a modest amount of content aimed at children 4+ years old; although this reviewer found the astronomical sing-a-longs rather amusing, they did drive the spouse from the room. As far as "edutainment" goes, the *Imagine the Universe!* CD probably has a low likelihood of repeat usage since it is not as visually stimulating as other educational software and astronomy Web sites. This, perhaps, is the curse of gamma and X-ray astronomy, which can sometimes seem to be little more than the study of fuzzy blobs of light. Nonetheless, HEASARC has produced a quality CD on high-energy astronomy and astrophysics that students and teachers will no doubt find to be a useful and informative reference.

— Joe Hahn

The Dynamic Sun

Produced by SOHO, the Solar and Heliospheric Observatory.
Suitable for middle-and high-school students.
Available through NASA CORE.



This CD consists of PDF files that contain multimedia presentations about the Sun. There are two primary presentations on the CD: one geared toward middle-school students and one geared toward high-school students. Each presentation consists of about 50 viewgraph-style pages that describe various aspects of the Sun and its relationship with Earth. In addition to a number of spectacular individual images, many of the pages can be clicked on to play videos of a number of time-lapse images. An Acrobat file that is a teacher's guide for each presentation is also on the CD, and it gives supplementary information and tells the teacher what the key points are that the students should take away from the presentation.

The primary topics covered in the presentation are the structure of the Sun, the Sun's appearance over time and at different wavelengths, solar flares and their effect on Earth, and interaction of the solar wind with Earth and comets.

Going through the entire presentation would take a couple of class periods and would probably best be accomplished using a computer-screen projection device. The middle-school presentation is mainly a sequence of bulleted slides while the high-school presentation is more of a narrative style, and I personally preferred the latter. Most of the images are unique and of high quality, and with the inclusion of the video clips the overall presentation should generally be interesting enough to hold the students' attention. While it seems unlikely that there are very many science classes that wish to discuss the Sun in as much detail as this CD does, there are some great images and video clips of eclipses, solar flares, a comet going into the Sun, and other topics that could be excerpted and used in a wide variety of science classes. The teacher's guide and directions on how to use the CD are well written and easily comprehensible. The CD also contains some classroom exercises (not particularly good), and Acrobat versions of a SOHO poster and two SOHO lithograph sets. The CD will work on both PCs and Macs. I would recommend this CD to anyone teaching a class that covers the Sun in some detail, and some of the images and video clips would be great for general class units on the solar system.

— Robert Herrick

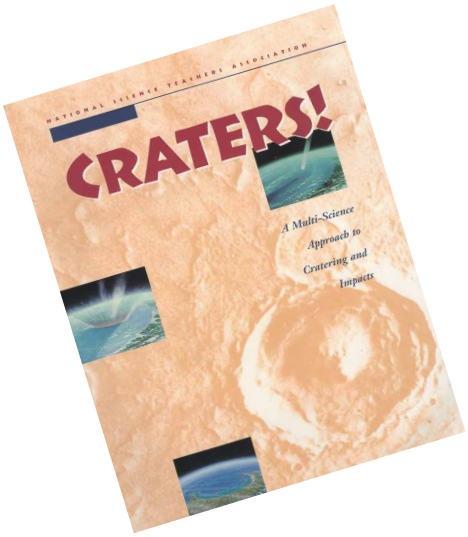
Mars VE, The Virtual Exploration Mission

Produced at NASA Ames Research Center.
Targeted for grades 5–8.
Available through NASA CORE or at
http://exploringspace.arc.nasa.gov/vecd.htm.

This CD contains as a printable Acrobat file a series of exercises culminating in planning and reporting on a mission to the planet Mars. There are both student's and teacher's versions of the activities guide. A third of the exercises utilize a stand-alone interactive program on the CD. The program has a sophisticated graphical interface where the user navigates through four domes in a futuristic-appearing space base. The four domes provide information on four topics: basic facts about Mars, different techniques for exploring the planets, an overview of the different fields of study in planetary exploration, and a survey of potential landing sites. The program runs on both PCs and Macs, and sound capability is necessary.

Craters! A Multi-Science Approach to Cratering and Impacts

By William K. Hartmann with Joe Cain
Published by the National Science Teachers Association.
Suitable for advanced high-school students.



This is a 20-exercise book with accompanying CD that introduces students to impact cratering as a scientific discipline. There are both student sections and teacher sections for each activity, and I estimate that each exercise would take one or two class sessions.

Most of the exercises are reasonably well designed and fairly interesting. They cover most aspects of impact cratering as a science, such as using craters for age dating a surface, cratering mechanics, and impacts and extinctions. Some of the exercises involve concepts that are sophisticated even for high school, such as trigonometric relations, probabilities, kinetic energy, and trace-element abundances. It seems like it would take a pretty smart class and a very knowledgeable teacher to be able to successfully accomplish and understand all the activities in the book. Some of the exercises would be well-suited for lab experiments or homework assignments in college-level introductory geology courses.

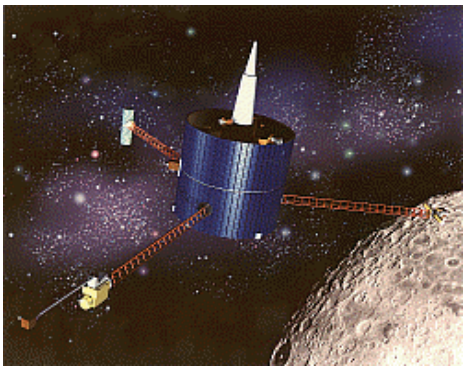
The CD is not mandatory for most of the book's activities and is designed to provide supplementary material. The CD consists mostly of a collection of images of craters throughout the solar system, with an emphasis on the Moon. The images are of high quality and each has an accompanying caption. Overall I would recommend this product to a high-school geology or physics teacher that wants to spend a few weeks on impacts, and it could prove useful to university professors of introductory geology courses.

— Robert Herrick

Lunar Prospector Mission

Produced by NASA Ames Research Center.
Suitable for a general audience.

NASA Ames Research Center and ACES Entertainment Inc. teamed up for this CD, a smoothly produced trove of information on the *Lunar Prospector* mission, its science, and the people behind it. The review version of the CD was produced in spring 1998, and we are promised updates as the mission and its science evaluation continue. After a brief introductory movie, the viewer can chose what area to explore: People, Interviews, Art, the Mission, Lunar Prospector in Depth, Photos, History, and Mission Clips. Each area is subdivided then into additional levels, most of which then read as Hypercard-like stacks. For instance, LP in Depth includes stacks on the Discovery program, LP's science objectives, spacecraft design, scientific instruments, frequently asked questions,



Lunar Prospector

and a timeline. Hidden in all this is most of what the general reader might want to know about LP, at a range of presentation levels from the simplest to some steeped in engineering jargon.

Hidden is an appropriate word, for the CD isn't arranged according to likely audience; for instance, instruments and their measurements are described in a number of places (including interviews) at varying levels of technical and scientific knowledge. The education component of the *Lunar Prospector* program is available at their Web site (http://www.lunarprospector.ames.nasa.gov), not on this CD.

This CD sets a high standard for artistic presentation of NASA mission outreach materials. I enjoyed reviewing the CD, and recommend it as an introduction to the LP mission. However, there is always room for improvement. The material could be organized better according to audience level. The history section is not of lunar exploration and science, but of scattered "image bites" of NASA history, with a prominent place for Ames' advances in aviation. I had trouble navigating the CD, as arrows and buttons were not in consistent places and were commonly unmarked. And, on exiting the CD, I needed to reboot my PC (Dell Pentium II, Win 98).

— Allan Treiman

Techno-Agent

Produced by NASA Goddard Space Flight Center's Technology Transfer/Commercialization Office

This CD is an advertisement for NASA Goddard's Technology Transfer Program, which aims to take NASA's technological innovations and apply them in practical, commercial products. The CD is cast as a game; the user is Techno-Agent, who chooses which Goddard-developed technologies are useful in a range of applications. To play the game, the user reads screens (or listens to them being read) about some of Goddard's successful technologies, and then either answers questions or chooses an application from a list of choices. The idea of a game is good, but the static presentation doesn't generate much enthusiasm, and the transferred technologies lack zip. It could have been so much more.

— Allan Treiman

CLARIFICATION

In the "The Greenhouse Effect," the cover story for the Lunar and Planetary Information Bulletin, Number 85, it was incorrectly stated that the NASA-developed artificial soil is composed of zeolite, a naturally occurring volcanic clay. The zeoponic plant growth media is actually a mix of zeolite and apatite.

BIOMARKER TASK FORCE TO BE ESTABLISHED

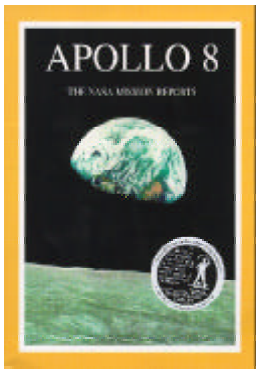
A task force is being formed to produce a document outlining a strategy for the development of biomarkers for use in Mars exploration. These biomarkers will be used to evaluate samples returned from Mars for possible evidence of past biological activity.

Preliminary task-force activities got under way with the symposium on chemical and isotopic biomarkers at the annual meeting of the American Chemical Society in March 1999. However, interested scientists who were unable to attend the ACS meeting are invited to participate in an upcoming symposium focusing on morphological and mineralogical biomarkers at the annual meeting of the GSA in October 1999.

Subsequent to the GSA symposium, the task force will meet at a date and location to be determined, and a report will be prepared for publication as a NASA Special Publication. For more information, contact John F. Kerridge, Department of Chemistry 0317, University of California, San Diego, La Jolla CA, 92093, (619) 534-0443 (jkerridg@ucsd.edu.)

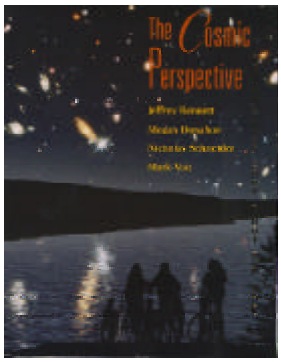
NEW IN PRINT

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



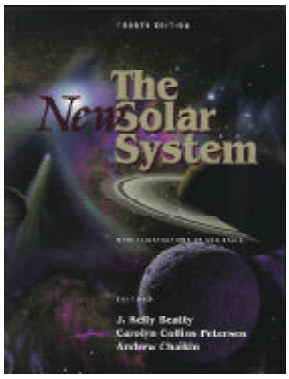
RECENTLY PUBLISHED

Apollo 8: The NASA Mission Reports, Compiled by Robert Godwin, Apogee Books, 1998, $13.95. Culled from NASA archives, this compilation of mission reports (the first in a planned series of eight through Apollo 15) includes the Apollo 8 press kit, the premission report and objectives, the supplemental technical report, and the postflight summary. In addition to the repackaged original reports, the publisher has included a CD-ROM with 8 minutes of documentary footage from the mission. The book was unveiled recently at the Apollo 8 30th anniversary dinner.



The Cosmic Perspective, edited by Jeffrey Bennett et al., Addison Wesley Longman, 1999. College-level introductory astronomy textbook.

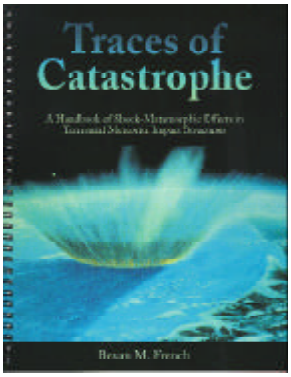
The Hubble Library of Electronic PictureBooks, Space Telescope Science Institute, 1996, CD-ROM. Multimedia compilation CD of STSI's *Electronic PictureBooks*, with a focus on contemporary astronomical images. The compilation includes such *PictureBook* titles as *Gems of Hubble, The Impact Catastrophe that Ended the Mesozoic Era, The Red Planet: A Survey of Mars*, and *Clementine Explores the Moon.* For more information, or to download individual *PictureBook* titles, visit the STSI's Web site at http://www.stsci.edu/exined/exined-home.html.



The New Solar System, Fourth Edition, edited by J. Kelly Beatty, Carolyn Collins Petersen, and Andrew Chaikin, Sky Publishing, 1999, $39.95. Copublished with Cambridge University Press and illustrated by Don Davis, this updated version of the popular 1990 reference book includes 11 new chapters as well as information and images from recent missions.

Sky Atlas 2000.0: Deluxe Edition, by Wil Tirion and Roger W. Sinnott, Sky Publishing, 1998, $49.95. This large, spiral-bound atlas features 26 star charts, covering both hemispheres, and seven detailed charts of selected regions.

Traces of Catastrophe, by Bevan M. French, Lunar and Planetary Institute, 1998. Designed as a sourcebook, laboratory manual, and reference for working geologists, this book provides a detailed introduction and overview of impact processes, crater formation, and shock metamorphism. According to the author, the book is intended for "students who want to learn about the importance of meteorite impact; professors who want to add impact information to their geoscience courses; and professional geologists who may unexpectedly encounter an impact structure in the next field area or in the next drill core." This book is available from LPI for the cost of shipping and handling.



When the Earth Explodes: Volcanoes and the Environment, by Buck Dawson, Kroshka Books, 1998, $23.95. Author Buck Dawson gives historical accounts of six volcanic eruptions, including Vesuvius, Laki, Tambora, Krakatoa, Pelee, and Katmai. Dawson also argues that phenomena ranging from El Niño to the Bermuda Triangle can be at least partly attributed to the effects of volcanos. The book includes a chapter on atolls by the late Texas writer James Michener.

CALENDAR 1999–2000

JULY

1–7

111th Annual Meeting of the Astronomical Society of the Pacific, co-presented with the American Association of Variable Star Observers and the Royal Astronomical Society of Canada, University of Toronto. Contact: Laurie Keechler, ASP Meeting Planner, 390 Ashton Avenue, San Francisco CA 94112.
http://www.aspsky.org

6–8

Workshop on Extraterrestrial Materials from Hot and Cold Deserts, Kwa-Maritane, Pilanesburg Game Reserve, South Africa. Contact: Ludolf Schultz
Phone: 49-6131-305279; fax: 49-6131-305483
E-mail: schultz@mpch-mainz.mpg.de
http://www.mpch-mainz.mpg.de/~kosmo/workshop/circular.htm

11–16

62nd Annual Meteoritical Society Meeting, Johannesburg, South Africa. Contact: Wolf Uwe Reimold, Department of Geology, Wits University, Private Bag 3, P.O. Wits 2050, Johannesburg, South Africa.
Phone: +27-11-716-2946; fax: +27-11-339-1697
E-mail: 065msoc@cosmos.wits.ac.za
http://www.wits.ac.za/metsoc99/

12–16

The 11th Annual Planetary Science Summer School, California Institute of Technology. Contact: Neil L. Nickle, Mail Stop 264-788, Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena CA, 91109.
Phone: 818-354-8244; fax: 818-354-7586
E-mail: neil.l.nickle@jpl.nasa.gov

15–16

Lunar Base Development Symposium, South Shore Harbour Resort, League City, Texas.
http://www.space-frontier.org/EVENTS/Lunarbase/

18–23

The Fifth International Conference on Mars, Pasadena, California. Contact: Arden Albee, Graduate Office, Mail Stop 02-31, California Institute of Technology, Pasadena CA 91125.
Phone: 626-395-6367; fax: 626-577-9246
E-mail: 5thMars99@caltech.edu
http://cass.jsc.nasa.gov/meetings/5thMars99/

18–30

The 22nd General Assembly of the International Union of Geodesy and Geophysics International Union of Geodesy and Geophysics University of Birmingham, United Kingdom. Contact: IUGG99

JULY (CONTINUED)

School of Earth Sciences, University of Birmingham, Edgbaston Birmingham B15 2TT, UK
Phone: +44-121-414-6165; fax: +44-121-414-4942
http://www.bham.ac.uk/IUGG99

26–30

Asteroids, Comets, & Meteors Conference, Ithaca, New York. Contact: Beth E. Clark, ACM Conference, Space Sciences Building, Cornell University, Ithaca NY 14853-6801.
Phone: 607-254-8895; fax: 607-255-9002
E-mail: acm@scorpio.tn.cornell.edu
http://scorpio.tn.cornell.edu/ACM

AUGUST

2–6

Sixth Bioastronomy Meeting: Bioastronomy 99: A New Era in Bioastronomy, Kohala Coast, Hawai'i. Contact: Karen Meech, Institute for Astronomy, 2680 Woodlawn Drive, Honolulu HI 96822.
Phone: 808 956-6828; fax: 808 956-6828
E-mail: meech@ifa.hawaii.edu
http://www.ifa.hawaii.edu/~meech/bioast/

22–27

Ninth Annual V. M. Goldschmidt Conference, Cambridge, Massachusetts. Contact: Stein B. Jacobsen, Department of Earth and Planetary Sciences, Harvard University, Cambridge MA 02138.
Phone: 617-495-5233; fax: 617-496-4387
E-mail: goldschmidt@eps.harvard.edu
http://cass.jsc.nasa.gov/meetings/gold99/

SEPTEMBER

22–24

New Views of the Moon II: Understanding the Moon Through the Integration of Diverse Datasets, Museum of Northern Arizona, Flagstaff, Arizona. Contact: Publications and Program Services Department, Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston TX 77058-1113.
Phone: 281-486-2158; fax: 281-486-2160
E-mail: simmons@lpi.jsc.nasa.gov

23–24

Workshop on Pluto and Triton: Comparisons and Evolution Over Time, Lowell Observatory, Flagstaff, Arizona. Contact: Will Grundy, Lowell Observatory, 1400 W. Mars Hill Road, Flagstaff AZ 86001.
Phone: 520-774-2096 (ext. 231)
E-mail: grundy@lowell.edu
http://www.lowell.edu/workshop/

CALENDAR 1999–2000

Calendar listings may be submitted via e-mail to anderson@lpi.jsc.nasa.gov

SEPTEMBER (CONTINUED)

27–30

International Symposium of Planetary Impact Events and Their Consequences to the Planet Earth, Yamaguchi, Japan.
Contact: Yasunori Miura, Faculty of Science, Yamaguchi University, Yoshida 1677-1, Yamaguchi, 753-8512, Japan.
Phone: 81-839-33-5746; fax: 81-839-33-5786
E-mail: yasmiura@po.cc.yamaguchi-u.ac.jp
http://www.sci.yamaguchi-u.ac.jp/geo/PIECE1.html

OCTOBER

2–4

Workshop on Mars 2001: Integrated Science in Preparation for Sample Return and Human Exploration, Houston, Texas.
Contact: LeBecca Simmons, Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston TX 77058-1113.
Phone: 281-486-2158; fax: 281-486-2160
E-mail: simmons@lpi.jsc.nasa.gov
http://cass.jsc.nasa.gov/meetings/marsmiss99/

10–15

31st Annual Meeting of the Division for Planetary Sciences, AAS, University of Padova, Italy.
Contact: Gianandrea Bianchini, Dept. of Mechanical Engineering, Padova University, Via Venezia 1, 35131, Padova.
Phone: +39-049-8276808; fax: +39-049-8276785
E-mail: bianchini@warp.dim.unipd.it
http://www.aas.org/dps99/

22–24

2nd International Meteorite Fair, Gifhorn Lower Saxony, Germany.
http://www.stadt-gifhorn.de

27–29

Space Resources Utilization Roundtable, Colorado School of Mines, Golden, Colorado. Contact: Publications and Program Services Department, Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston TX 77058-1113.
Phone: 281-486-2158; fax: 281-486-2160
E-mail: simmons@lpi.jsc.nasa.gov
http://cass.jsc.nasa.gov/meetings/resources99/

DECEMBER

13–17

1999 Fall Meeting of the American Geophysical Union, San Francisco, California. Contact: AGU Meetings Department, 1999 Fall Meeting, 2000 Florida Avenue, NW, Washington DC 20009.
Phone: 202-462-6900 or 800-966-2481; fax: 202-328-0566
E-mail: meetinginfo@agu.org
http://www.agu.org/meetings/fm99top.html

DECEMBER (CONTINUED)

2000

JANUARY

January 30–February 3

Space Technology and Applications Forum, Albuquerque, New Mexico. Contact: Mary J. Bragg, University of New Mexico, Institute for Space and Nuclear Power Studies, Farris Engineering Center, Room 239, Albuquerque NM 87131.
Phone: 505-277-4950; fax: 505-277-2814
http://www-chne.unm.edu/isnps

FEBRUARY

February 28–March 2

Space 2000 and Robotics 2000, Albuquerque, New Mexico.
http://www.spaceandrobotics.org

JULY

9–12

Catastrophic Events and Mass Extinctions: Impacts and Beyond, Institute of Geochemistry, University of Vienna, Vienna, Austria.
Contact: Christian Koeberl, Institute of Geochemistry, University of Vienna, Althanstrasse 14, A-1090 Vienna, Austria.
Phone: +43-1-31336-1714; fax: +43-1-31336-781
E-mail: christian.koeberl@univie.ac.at

AUGUST

27–Sept. 1

25th European Congress on Molecualr Spectroscopy, School for Sciences and Technology, University of Coimbra, Coimbra, Portugal.
Contact: Rui Fausto, Department of Chemistry, University of Coimbra, P-3049 Coimbra, Portugal.
Phone: +351-39-852080 / +351-39-857037; fax: +351-39-827703
E-mail: rfausto@gemini.ci.uc.pt
http://qui.uc.pt/~rfausto/eucmos_xxv/principal.html

NEW FROM LPI

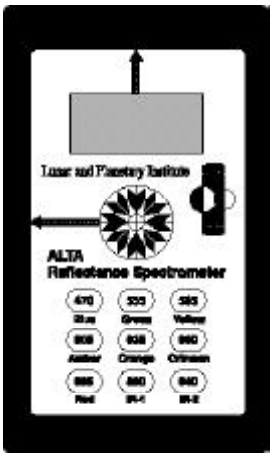
The ALTA© Reflectance Spectrometer

Comes with complete classroom lesson package.

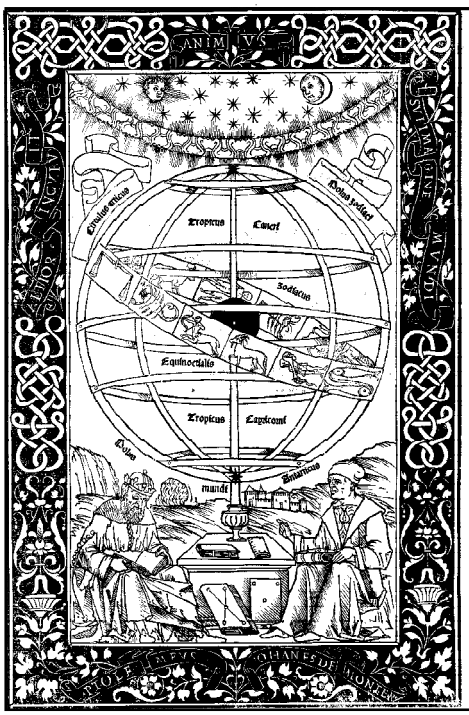
The ALTA© Reflectance Spectrometer is a rugged, hands-on classroom instrument designed to help students learn about light, color, and spectroscopy. It has push buttons, colored lamps, and a numeric display with immediate response time.

Using ALTA, students can collect real scientific data: the proportions of colored light (including infrared) that reflect off real-world objects. Data collection is simple and rapid. The students' data can be calibrated against standards and mathematically manipulated into graphs of reflectances versus light wavelength that are nearly identical to those in text and reference books. ALTA uses light in visible colors (blue through red in seven wavelengths) and in two invisible "colors" of infrared light.

ALTA's results are good models of spectra from NASA probes like Mars Pathfinder and environmental satellites like LANDSAT. The ALTA Reflectance Spectrometer can be used in any course that deals with light, color, or spectroscopy. Accompanying curriculum materials include basic operation instructions and exercises in biology, environmental science and remote sensing, geology and planetary science, and physics. Extensions are suggested for astronomy, physiology (color vision and illusion), and art. ALTA is designed for grades 8 through college, and has tested well in fifth-grade gifted and talented classes. ALTA is ideal for open-ended research and has been adopted for science-fair projects in geology and biology. The spectrometer comes with a classroom lesson package and is priced at $129.95. See order page for more information.



The ALTA hand-held spectrometer is 3.75" × 6.25" and weighs 9 ounces.



When I Heard the Learn'd Astronomer

When I heard the learn'd astronomer;
When the proofs, the figures, were ranged in columns before me;
When I was shown the charts and the diagrams, to add, divide, and measure them;
When I, sitting, heard the astronomer, where he lectured with much applause in the lecture-room,
How soon, unaccountable, I became tired and sick;
Till rising and gliding out, I wander'd off by myself,
In the mystical moist night-air, and from time to time,
Look'd up in perfect silence at the stars.

— Walt Whitman, 1900

The *Lunar and Planetary Information Bulletin* is published quarterly by the Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston TX 77058-1113.

Brian Anderson, Editor

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The Bulletin welcomes the submission of articles and essays dealing with issues related to planetary science and exploration. Please send articles or announcements to:
B. Anderson, 3600 Bay Area Boulevard, Houston TX 77058-1113.

Phone: 281-486-2164, fax: 281-486-2125
E-mail: lpibed@lpi.jsc.nasa.gov