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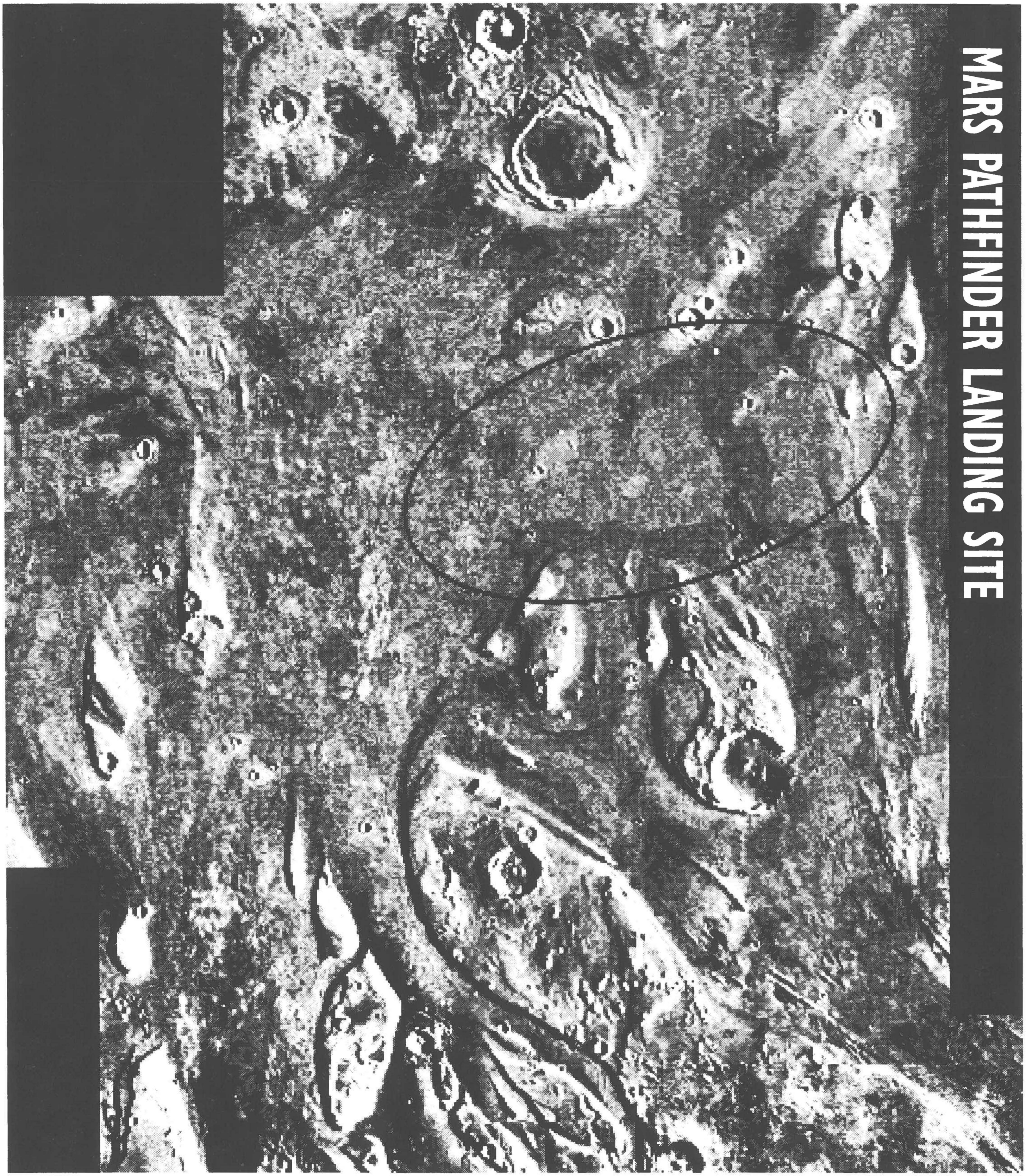


MARS PATHFINDER LANDING SITE

The 26th Annual Lunar and Planetary Science Confernce will be held March 13–17, 1995, in Houston, Texas. Sessions will be held at the NASA Johnson Space Center (JSC) and the Lunar and Planetary Institute (LPI).

The LPSC program committee will select the conference program from written abstracts, which researchers in appropriate scientific disciplines are invited to submit no later than **January 6, 1995.** Instructions for preparing abstracts are available from the Publications and Program Services Department at LPI, 713-486-2166; Internet: dotson@lpi.jsc.nasa.gov. Abstracts submitted by fax or e-mail will not be acknowledged as submissions or accepted for publication. Printed abstracts will be available at conference registration. Abstracts and conference program will be available on line around February 1. Instructions for accessing these and other meeting abstracts are given below.

ORAL PRESENTATIONS

Oral presentations will be scheduled during the four and a half days of parallel sessions Monday through Friday noon. Talks will be scheduled to allow eight minutes for speaking and seven minutes for discussion and speaker transition.

POSTER PRESENTATIONS

Poster sessions will be scheduled for Tuesday and Thursday evenings from 6:30 to 9:30 p.m. at the LPI. Authors of papers selected and scheduled for poster presentations will be asked to be available to display and discuss their results in the poster area during the assigned time period. Additionally, posters may be viewed at LPI each day of the conference. Shuttle transportation between the Gilruth Center and LPI will be available. Each poster will have a space 44" × 44" for display. Requests for tables, computers, video equipment, etc., cannot be honored due to the limited space available for poster displays.

STEPHEN E. DWORNIK STUDENT AWARDS

The Stephen E. Dwornik Planetary Geoscience Student Paper Awards are given for the best student research presentations at the Lunar and Planetary Science Conference. Two awards are given annually: one for an oral presentation and one for a poster presentation. These awards are open to U.S. citizens who are currently enrolled as students at any degree level in the field of planetary geosciences. Postdoctoral fellows are not eligible. Complete instructions for application are available from the Publications and Program Services Department at LPI, 713-486-2166 .

SPECIAL SESSIONS

Masursky Lecture

The Harold Masursky Lecture Series will continue this year at a special plenary session at 1:30 p.m., Monday, March 13, 1995. Only one lecture will be given this year to allow time for the Clementine Special Session, also to be held in plenary.

Clementine Special Session

The Defense Department's Clementine Mission mapped the entire Moon in 11 wavelengths in the visible and near-infrared, in addition to obtaining global altimetry and selected hi-res and thermal images. Data from this mission promise to revolutionize our knowledge and understanding of lunar processes and history. This session will include both invited and contributed talks from the Clementine Science and Flight teams that will give an overview of the scientific richness and potential of the Clementine data, as well as some of the exciting, initial scientific results. The Clementine Special Session will be held in plenary on Monday, March 13, 1995, following the Masursky Lecture.

Special Poster/Display Sessions on Education

Two special poster/display sessions on education will be held at LPI on the Tuesday and Thursday evenings during the regular technical poster sessions. The education special sessions will be located in and around the LPI library. Participants who need them will be provided with tables, electrical outlets, and equipment, as well as poster space to display and demonstrate the programs and products they have developed. This format allows participants to demonstrate some of the projects "hands-on" rather than simply describing them orally. Computer software, videos, handouts, etc., may be included as part of the presentations. Participants will be selected on the basis of the traditional informative abstracts by the program committee. (At the discretion of the program committee or its designates, some poster/display presentations may be invited.).

SPECIAL EVENTS

Chili Cookoff and Tex-Mex Fiesta
What would LPSC be without this traditional event? We are changing the flavor of the event this year by having a Tex-Mex dinner instead of the usual barbeque. The cookoff and dinner will be held on Wednesday from 6:30 to 9:30 p.m. at the Landolt Pavilion. Out-of-town chili cookoff teams are encouraged to enter. Because the conference staff can no longer provide cooking equipment, the "preparation on site" rule common to most cookoffs will be waived to encourage more team participation. The goal of this event is fun, not serious cooking competition.

REGISTRATION

Preregistration
A fee of $50 ($30 for students) will be charged to cover conference services. Attendees can preregister and prepay by **February 20, 1995,** to avoid a $10 late fee. Foreign participants who state on the registration form that they have a currency exchange problem may pay in cash at the meeting and avoid the $10 late fee if they return the form by February 20. Preregistration forms are available from Publications and Program Services, LPI, 713-486-2166. Requests for cancellation and a refunded fee will be accepted through **March 10.** Those who preregister but do not attend and do not notify the LPI Publications and Program Services Department by March 10 will forfeit their full fee.

Sunday Night Registration
The Sunday night reception and registration will take place at LPI at 3600 Bay Area Boulevard from 6:00 to 9:00 p.m. Shuttle buses will operate from selected hotels to LPI on Sunday night.

CONFERENCE SHUTTLE SERVICES

Conference shuttle buses will provide service between selected hotels (Nassau Bay Hilton, Days Inn, Holiday Inn, Ramada Kings Inn, Quality Inn, Motel 6, and Best Western NASA Inn), the JSC Gilruth Center, and LPI. There will be shuttle runs in the morning, during lunch, at the close of sessions, and to and from these hotels during special events. Computer displays, exhibits, poster sessions, and other conference-related events will be located at LPI; shuttle buses will make hourly stops there throughout conference week. Your conference badge will serve as your bus ticket.

Contact the LPI Publications and Program Services Department for further information about conference logistics (713-486-2166) or abstracts (713-486-2161).

CONFERENCE PROGRAM ON LINE

The program and first paragraph of abstracts for the 26th LPSC awill be available on line on or around **February 1, 1995.** Online services are accessible through either an X window interface or DEC/VT character-based terminals (VT100 and above) and ANSI terminals.

X Window Interface
To access the online services via an X window interface, perform the following steps:

From an x-term window (if you are using a Sun workstation you may use a cmdtool window) telnet to **cass.jsc.nasa.gov**. At the **login:** prompt, type **cass** (you *must* use lower-case letters for login). At the **password:** prompt, type **online**. In order for the X window interface to work on your computer, you must know your display address.

Character-based Terminal
If you are using a character-based terminal, to access the abstracts via Internet, type
telnet cass.jsc.nasa.gov or **telnet 192.101.147.17**
To access the abstracts via DECNET (if your host does not support telnet), type

set host east

You will receive the Ultrix login prompt:
ULTRIX V4.0 (Rev. 179)
east.gsfc.nasa.gov
login: **cass.jsc.nasa.gov!**
Type in the response shown above (do not forget the exclamation point!).

To access the abstracts via direct dial, call 713-244-2089 to connect to 19,200/9600/2400/1200 baud.

For all three methods of access, at the **login:** prompt type **cass** (you *must* use lower-case letters for login). At the **password:** prompt, type **online.**

Once you have successfully logged onto the system, choose "Activities" from the main menu bar. You will be given a list of resources available; choose "Meetings and Abstracts," and you will be given a choice of current meetings or past abstracts. Choose "Current Meetings" to display a list of the current (within the last six months) and upcoming CASS-sponsored meetings. Announcements, programs, and abstracts for all LPI meetings can be searched, browsed, and downloaded.

For questions concerning preparation and transmission of your abstract or as it appears on line, contact Renee Dotson (e-mail: dotson@lpi.jsc.nasa.gov; phone: 713-486-2188). If you need help accessing the LPI computer or navigating the online system, contact Eleta Malewitz (e-mail: malewitz@lpi.jsc.nasa.gov; phone: 713-486-2197). Telephone calls requesting assistance in accessing or using the online system should be placed between the hours of 9:00 a.m. and 5:00 p.m. Central Standard Time.

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

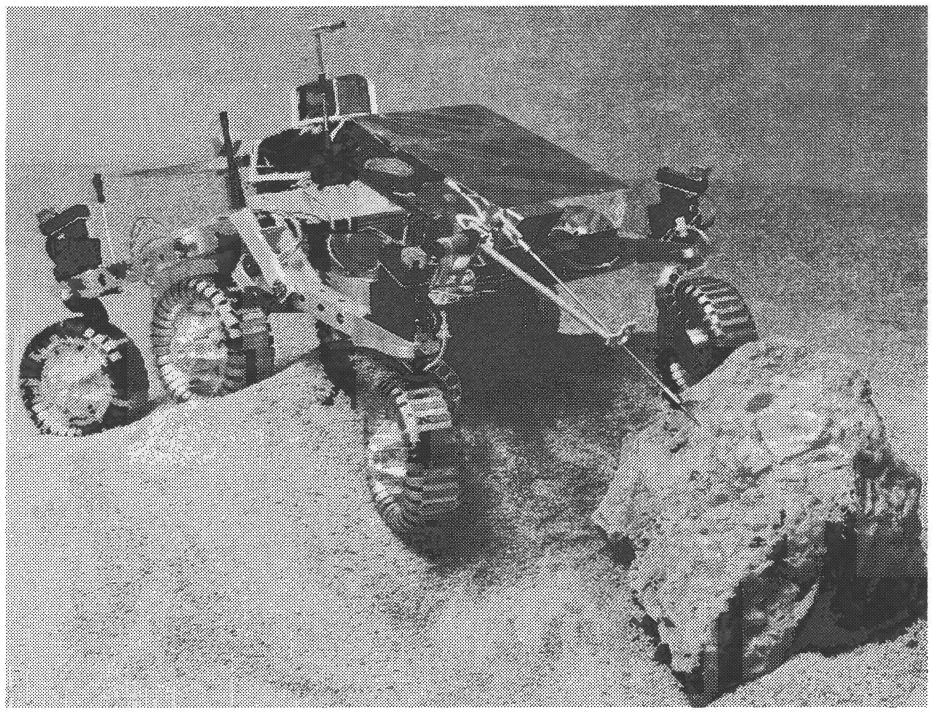
Pam Thompson, Editor

Editorial and production support are provided by the LPI Publications and Program Services Department. Copy deadline for the February issue of the LPIB is February 3, 1995.

Please send articles or announcements to:
P. Thompson, 3600 Bay Area Boulevard, Houston TX 77058-1113.

Phone: 713-486-2175, fax: 713-486-2162
E-mail: (NSI DECNET) LPI::THOMPSON
(Internet) thompson@lpi.jsc.nasa.gov

MARS PATHFINDER WILL LAND AT ARES VALLIS



An ancient flood plain on Mars* has been chosen as the landing site for NASA's December, 1996 Mars Pathfinder mission, one of the first in a new generation of small, low-cost spacecraft.

Billions of years ago, when water flowed on Mars, great floods inundated the landing site, located on a rocky plain in the area called Ares Vallis (19.5°N, 32.8°W). The site is 850 kilometers (527 miles) southeast of the spot where the first spacecraft to land on Mars, Viking Lander 1, touched down in 1976. Pathfinder will be the first to land on Mars since the twin Viking landers arrived almost 20 years ago.The spacecraft, which will arrive at Mars on July 4, 1997 after a seven-month voyage, will parachute down to Ares Vallis at the mouth of an ancient outflow channel chosen for the variety of rock and soil samples it may present.

The purpose of the new Pathfinder mission is to demonstrate an inexpensive system for cruise, entry, descent, and landing on Mars, said Project Manager Anthony Spear and Project Scientist Matthew Golombek of the Jet Propulsion Laboratory.

The lander, carrying the microrover, will aerobrake in the upper martian atmosphere using an aeroshell and a parachute. Just before impact, airbags will inflate to cushion the landing. The microrover will then roll out to examine the rocks and soil nearby.

Both lander and rover will carry scientific instruments and cameras. The lander will make atmospheric and meteorological observations during descent and function as a weather station on the surface, as well as a radio relay station for the rover.

The constraints on landing site selection had to do with engineering considerations, Spear said. Since the spacecraft are powered by nonsteerable solar arrays, the best site is one with maximum sunshine and in July, 1997, the sun will be directly over the 15°N latitude region of the planet.

The elevation must be as low as possible, Spear added, so the descent parachute has sufficient time to open and slow the lander to the correct terminal velocity. The landing will be within a 100- by 200-kilometer (60- by 120-mile) ellipse around the targeted site that will accomodate uncertainties in navigation and atmospheric entry. Ares Vallis, which meets the engineering constraints, was chosen after a workshop earlier this year attended by 60 scientists who study Mars.

The Ares Vallis site is also a "grab bag" location, according to Golombek, set at the mouth of a large outflow channel in which a wide variety of rocks washed down from highland areas by the ancient floods are potentially within reach of the rover. Even though the exact origins of the samples would not be known, he said, the chance of sampling a variety of rocks in a small area could reveal a lot about Mars. Several potential sites were considered where ancient flood channels emptied into Chryse Planitia, having cut through crustal units and ridged plains where the water would have picked up material and deposited it on the plain.

Other sites that were considered included Oxia Palus, a highlands region that contains highland crust and dark wind-blown deposits; Maja Valles Fan, a delta fan which drained an outflow channel; and the Maja Highlands, just south of Maja Valles. All sites were studied using Viking orbiter data.

Both the Pathfinder lander and rover have stereo imaging systems. The rover also carries an alpha proton x-ray spectrometer to examine the composition of rocks. The imaging system will reveal the mineralogy of surface materials as well as the geologic processes and atmosphere interactions that created and modified the surface. The instrument package will also enable scientists to determine dust particle size and water vapor abundance in the atmosphere.

**Cover: The proposed landing ellipse of Mars Pathfinder in Ares Vallis, where the surrounding landforms show abundant evidence of flowing water early in martian history.*

NEW IN PRINT

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

REVIEW

METEORITE CRATERS AND IMPACT STRUCTURES OF THE EARTH

by Paul Hodge (University of Washington)
Cambridge University Press, Cambridge, 1994, 124 pp.
Black and white photographs and illustrations. Hardcover. $49.95

We have created a nation of Chicken Littles.

With all the attention Chicxulub, Shoemaker-Levy 9, and the South Pole-Aitken Basin have received lately, planetary impact cratering is riding the crest of a popularity tsunami right now. But the growing awareness of impacts is producing some strange encounters at Space City. Even the woefully inadequate monosyllabic grunts of post-grunge Texabilly have been replaced by crater-speak around these parts. Just last week, I overheard a rather harried check-out clerk at the corner Stop and Go exclaim, "This job exceeds my Hugoniot-elastic limit, man; I am going irreversible!" Unfortunately, he pulled out a rather hefty Muong Nong tektite and tried to bludgeon the old patron who was buying 25 Lottos with a sack full of pennies. The geezer shifted deftly away from the strike and rapped the youngster's knuckles sharply with the pointy end of a shatter cone he had concealed in his pocket. "Decompress, sonny, the pressure just means you're near ground zero. Lower your Z and go with the flow; you'll rebound soon enough." Sonny licked his bruised hand and tried his best to fit 2500 pennies into the cash drawer.

I read Paul Hodge's book, *Meteorite Craters and Impact Structures of the Earth,* last week; I note this because I have the task of reviewing the book, and if there is one thing that I have learned from my many years at the knee of the master it is this: You should probably read a book before you review it. This simple truth is not universally adhered to, however. For instance, another book on cratering was reviewed recently by two people (who shall go unnamed) who, judging from their mistakes, could not possibly have read the book first. These tag-team reviewers clearly thought of themselves as true scientists because they, the great analytical thinkers that they are, wrote papers with lots of integral signs and inverted triangles and numbers with lots of decimal places and stuff. And the author? Well he was a poor misguided geologist, practicing the antiquated and totally unnecessary act of gathering empirical constraints. The problem arose because the author's observations didn't support the reviewers' theories. And any fool (well, two fools in this case) knows that when observations don't support model predictions, you discredit the observations. I suspect that these two wizened scientists would go irreversible if they tried to read Paul Hodge's book. It doesn't contain a single equation.

What Hodge's book does have a lot of is craters and suspected craters on Earth: 139 to be exact. It's sort of like a catalog of crater localities with some photographs and some text. The craters are organized geographicalphabetically. [Sorry, a geologist feels a strong need to invent a word now and again, and this one seems to fit here: The major divisions are geographical (Canada, Asia, Latin America, etc.) but within each major group, the individual craters are listed alphabetically.] The book's listing of craters is uncritical in the sense that a lot of controversy surrounds many of the listed features. But the author is upfront about this wherever possible, and, in my opinion (which is the only one that counts here), the major importance of the book might be that it motivates geologists to go to these places and look for themselves (except of course, for the ones that are really far away and hard to get to, like Rio Cuarto, or are in really primitive localities like suburban Chicago).

On average Hodge dedicates less than a page to each crater. But the kinds of information and how much space an individual site receives in the book vary greatly. In some cases this is scholastic; for instance, there is a lot of space given to the Barringer Crater and the Ries Crater; after all, these are well-studied and very important features. (Actually, those of us in the cratering business have long recognized that there is little need to study any other craters, but we don't want the funding to dry up.) In other cases, it seems like the author depended upon contributions from established researchers. Those that responded most generously were justly rewarded; consequently, we are treated to pages of photomicrographs from the Canadian Geological Survey in sections on Slate Islands and Saint Martin, even though there is no explanation or discussion of the microscopic features shown. Judging from the section on the Marquez Dome, I was out of town.

There is also a lot of information on Australian craters, mainly because Hodge attended the now-famous Australian Crater Expedition in 1990. That was where about 50 crazed curiosity seekers followed Gene Shoemaker across about a kajillion miles of dirt tracks, sucking dust and ogling the marvelous outback scenery that all too infrequently held, in near field, an impact crater. Hours or days of cramped travel in a crowded bus were momentarily rewarded by a brief stop at a crater, on occasion arriving just as the Sun was departing. So we visited over a dozen craters—some of the best examples on Earth—in less than three weeks. The trials of such an ambitious trip brought out extremes in personalities and brought home an important lesson to me: Some of the strongest men on that trip were the women, unflinching, always pitching in, never complaining through it all. Some of the men, however, griped and whined incessantly. Okay, we made camp a couple of nights after midnight, and maybe (just once) we had to drink water that dead birds floated in. So what if we didn't get a hot meal each and every night or that mechanical breakdowns were a daily occurrence. It was the bush a thousand miles from nowhere where feral camels, endless acres of termite mounds, and spinifex punctuated a landscape red as rust. It was roller coaster rides over 30-meter-tall sand dunes, and a night sky so bright it is forever burned on my retinas. It was an experience I will never forget and neither, apparently, will Paul Hodge.

This book is clearly not intended to be a heavyweight treatise on impact, but rather a light, short, entry-level catalog of terrestrial craters. Hodge has faithfully summarized current views on most craters from existing publications and provides a brief list of references at the end of each discussion. In all cases, Hodge's book gives enough information so that a curious outsider could go to the university library and dive into virtually any crater's literature head first (caution: literature may be dangerously shallow in some areas). In that regard it is a very useful resource.

But this prince is not without a few blemishes, and the big nose-wart, as it were, sits prominently in the book's introduction. Hodge attempts to summarize in less than a page the key aspects of the cratering process; for the most part, this suffices and is appropriate for the lay person for which it is intended. But what was he thinking when he was composing the tektite section (bottom, p. 3)? ". . . The frontal layer of compressed gas is capable of melting and ejecting blobs of rock before the solid object touches the Earth's surface. These blobs are the tektites and . . ." I don't think so. Also, on page 4 Hodge discusses "shock lamellae and linear features in quartz" and states

continued on page 17

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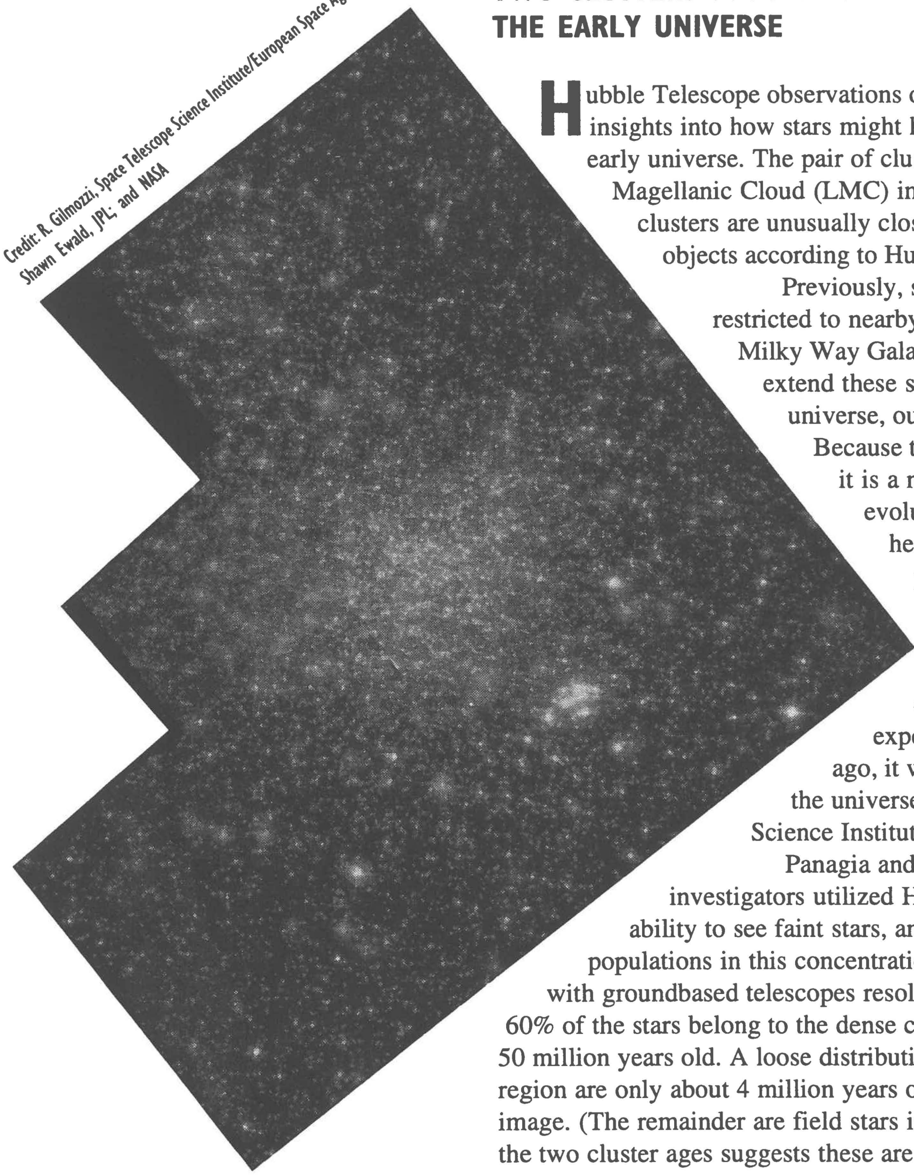
NEWS FROM SPACE

TWO CLUSTERS SUGGEST STAR BIRTH SCENARIO IN THE EARLY UNIVERSE



Credit: R. Gilmozzi, Space Telescope Science Institute/European Space Agency; Shawn Ewald, JPL; and NASA

This composite image is assembled from exposures taken in ultraviolet, visible, and near-infrared light. Yellow stars correspond to Main Sequence stars (like our Sun) with average surface temperatures of 6000 Kelvin; red stars are cool giants and supergiants (3500 K); white stars are hot young stars (25,000 K or more) that are bright in ultraviolet.

Hubble Telescope observations of a pair of star clusters have provided new insights into how stars might have formed many billions of years ago in the early universe. The pair of clusters are 166,000 light-years away in the Large Magellanic Cloud (LMC) in the southern constellation Doradus. The clusters are unusually close together for being distinct and separate objects according to Hubble astronomers.

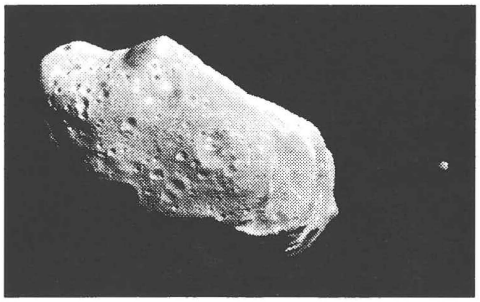
Previously, such detailed stellar population studies were restricted to nearby star-forming regions within the plane of our Milky Way Galaxy. However, Hubble's high-quality images extend these stellar studies one hundred times farther into the universe, out to the distance of a neighboring galaxy.

Because the LMC lies outside of our Milky Way Galaxy, it is a natural laboratory for studying the birth and evolution of stars. The stars in the LMC have few heavy elements, thus their composition is more primordial—like the stars that first formed in the early universe.

A preliminary assessment of the HST observations indicates that these compact clusters contained many more massive stars than expected. "If this were also the case billions of years ago, it would have altered drastically the early history of the universe," says Dr. Nino Panagia of the Space Telescope Science Institute and the European Space Agency.

Panagia and R. Gilmozzi (also of STScI/ESA) and co-investigators utilized HST's unique capabilities—ultraviolet sensitivity, ability to see faint stars, and high resolution—to identify three separate populations in this concentration of nearly 10,000 stars. Previous observations with groundbased telescopes resolved less than 1000 stars in this region. About 60% of the stars belong to the dense cluster called NGC 1850, which is estimated to be 50 million years old. A loose distribution of extremely hot massive stars in the same region are only about 4 million years old and represent about 20% of the stars in the image. (The remainder are field stars in the LMC.) The significant difference between the two cluster ages suggests these are two separate star groups that lie along the same line of sight. The younger, more open cluster probably lies 200 light-years beyond the older cluster, says Panagia. He emphasizes that if it were in the foreground, then dust in the younger cluster would obscure stars in the older cluster.

Because having two well-defined star populations separated by such a small gap of space is unusual, this juxtaposition suggests that they might be linked in an evolutionary sense. A possible scenario is that an expanding "bubble" of hot gas, from more than 1000 supernova explosions in the older cluster, might have triggered the birth of the younger cluster. This would have happened when the bubble expanded across space for 45 million years before plowing into a wall of cool gas and dust. The shock front then caused the gas to contract, precipitating a new episode of star formation. The massive, hot stars are destined to explode in a few million years, and thus create yet a new expanding bubble of gas.



IDA'S MOON NAMED DACTYL

The International Astronomical Union (IAU) has approved the name Dactyl for the tiny moon discovered this year in orbit around the asteroid Ida by the Galileo spacecraft. The IAU also approved names for surface features on the asteroid Gaspra, which became the first asteroid ever visited by a spacecraft when Galileo flew by it on October 29, 1991.

Dactyl is the first natural satellite of an asteroid ever discovered and photographed. The tiny moon, about one mile (1.5 kilometers) across, was discovered in images returned by Galileo after its flyby of the asteroid on August 28, 1993. The discovery was confirmed in March 1994 by members of Galileo's imaging and infrared science teams who recommended the new name to the IAU, which is responsible for the formal naming of solar system bodies.

The name is derived from the Dactyli, a group of mythological beings who lived on Mount Ida, where the infant Zeus was hidden—and raised, in some accounts—by the nymph Ida and protected by the Dactyli. Other mythological accounts say that the Dactyli were Ida's children by Zeus.

Three regions on Gaspra were named for scientists associated with the asteroid. Neujmin Regio was named for G. Neujmin, the Ukrainian astronomer who discovered the asteroid in 1916. Yeates Regio honors the late Dr. Clayne M. Yeates, who was Galileo Science Manager and Science and Mission Design Manager until his death in 1991. Dunne Regio was named in honor of the late Dr. James A. Dunne, who served as Galileo Science and Mission Design Manager until late 1992.

Galileo continues on its way to Jupiter where it will send a probe into the atmosphere on December 7, 1995, and then go into orbit for a two-year scientific tour of the planet, its satellites, and its magnetosphere.

FULLERENES FOUND IN SAMPLES FROM SUDBURY IMPACT STRUCTURE

Fullerenes thought to be of extraterrestrial origin have been found in shock-produced impact breccias at the Sudbury impact structure in Ontario, Canada, by researchers at Scripps Institution of Oceanography, Argonne National Laboratories, and NASA Ames Research Center.

The huge crater, formed almost two billion years ago by an asteroid or comet and strongly deformed by subsequent geological activity, contains the largest deposit of natural fullerenes found on Earth to date. "For the first time, we can point to carbon in an impact crater and say that it is probably extraterrestrial," Theodore Bunch, a NASA Ames Research Center scientist said. Fullerenes, usually made of 60 carbon atoms (sometimes 70) arranged like a soccer ball-shaped cage, are the rarest form of elemental carbon that occurs naturally on Earth. Diamond and graphite are other, more common, forms.

Bunch collected rock samples from three sites in the crater, which is 110 miles (164 kilometers) in diameter. Laser analysis was performed by Luann Becker at the Argonne National Laboratories. Bunch said the molecules, also known as buckyballs, probably formed during the impact event by cannibalizing other carbon forms or organic compounds contained in the comet.

According to Bunch, heat from the impact may also have stripped carbon from the abundant carbon dioxide scientists think saturated Earth's early atmosphere. The object was a comet rather than an asteroid, Bunch suggests, because of the large amounts of carbon found in the impact deposits. He estimates that the comet was 10 miles (15 kilometers) in diameter and contained 20–30% carbon.

The fullerenes in rock samples from the Sudbury impact site range between 1 and 10 parts per million. The abundance of sedimentary carbon in the Sudbury impact target rocks is less than 1%, an insignificant carbon source for the fullerenes. "The startling thing is that not only were the fullerenes there, but they were there in an amount that is really extraordinary," said Jeff Bada, a professor at Scripps Institution of Oceanography.

Bunch, with another research team, recently found fullerenes in a tiny crater on the Long Duration Exposure Facility (LDEF) spacecraft that had orbited Earth for almost six years. It is unclear whether the fullerenes came from a carboneaceous micrometeorite or were formed by the high-speed collision creating the crater.

The large ball-shaped carbon molecules are thought to form in red giant or carbon stars that are nearing the end of their stellar lives. They were discovered in 1985 on Earth by accident when scientists heated carbon vapor to temperatures exceeding 14,000 degrees Farenheit.

The first naturally occurring fullerenes on Earth were found in July, 1992, in carbon-rich rock in ancient sediments in Russia. They have also been found in Colorado, formed in melted rock where vegetation (carbon) was present when lightning struck the ground. But the amounts previously detected on Earth are much smaller than those discovered at the Sudbury site.

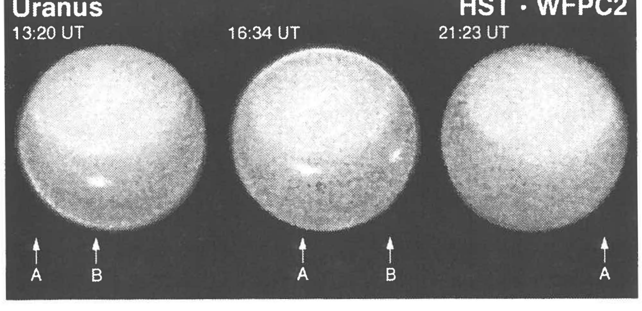
The Sudbury structure is the second largest impact crater on Earth. Only the Chicxulub crater, formed by the 65-million-year-old impact that led to mass extinctions including the dinosaurs, is larger. Fullerenes associated with Chicxulub could have come from the impactor itself or have been formed in the intense global forest fires ignited by the explosion.

A similar process, Bunch said, may have happened during Comet Shoemaker-Levy's fiery plunge into Jupiter's stratosphere, burning carbon compounds in the jovian atmosphere. Carbon freed from the jovian atmosphere (and the comet) could have combined into soot and possibly some fullerenes, he said, forming the mysterious dark spots visible after the impacts.

HUBBLE TRACKS ROTATION OF URANUS

New Hubble Space Telescope images of Uranus reveal the motion of a pair of bright clouds in the planet's southern hemisphere and a high altitude haze that forms a cap above the planet's south pole.

Credit: Kenneth Seidelmann, U.S. Naval Observatory, and NASA



The images were obtained on August 14, 1994, when Uranus was 1.7 billion miles (2.8 billion kilometers) from Earth. Atmospheric details have been seen before only by the Voyager 2 flyby in 1986. Since then, detailed observations of Uranus's atmospheric features have not been possible because the planet is at the resolution limit of groundbased telescopes.

Hubble's Wide Field Planetary Camera 2 observed Uranus through a filter that is sensitive to light reflected by high altitude clouds. This allows us to see a high-altitude haze over Uranus' south polar region, along with the pair of high-altitude clouds or plume-type features, 2500 and 1800 miles (4300 and 3100 kilometers) across, respectively. The sequence of images shows how the clouds (labeled A and B) rotate with the planet during the three hours that elapsed between the first two observations (left and center) and the five hours that elapsed between the second pair (center and right). Some cloud motion might be due to high-altitude winds on the planet.

By tracking the motion of high-altitude clouds, astronomers can make new measurements of Uranus' rotation period. Based on Voyager observations, Uranus is thought to complete one rotation every 7 hours, 14 minutes. One of the four gas giant planets of our solar system, Uranus appears largely featureless. Unlike other planets, its south pole points toward the Sun during part of the planet's 84-year orbit.

TWO KINDS OF COMETARY ICE?

Slight temperature differences in the two comet-forming regions of the solar system cause the water ice that largely makes up comets to form in different ways, researchers from NASA's Ames Research Center say. "We predict that comets from the Kuiper belt and Oort cloud.contain structurally different forms of water ice," Peter Jenniskens said. Jenniskens, with David Blake, published their results in the August 5 issue of *Science.*

Comets are thought to be pristine chunks of debris left over from the solar system's formation about 5 billion years ago. They are made of more than 40% water ice and come from exceedingly cold regions of the solar system. According to Jenniskens, two populations of comets exist, based on their present location in the solar system and where scientists think they originated.

Some comets formed in the Kuiper belt, which is in the outer region of the solar system beyond Pluto's orbit. These comets, known as short-period comets, probably formed at temperatures colder than –370° F, he said. Oort cloud comets probably formed in the Neptune-Uranus region and were then expelled to much greater distances from the Sun. Oort cloud comets, known as long-period comets, were probably formed at temperatures warmer than –320° F, Jenniskens said.

Most Oort cloud comets come from a solar "sphere" around 30,000 astronomical units (AU) away, but scientists think the cloud itself extends almost halfway to the nearest star, Alpha Centauri, which is four light-years from the Sun. One AU equals the distance from the Earth to the Sun. There are about 60,000 AU in a light year.

Water vapor frozen onto the rocky grains which coalesced to form comets is frozen like a glassy film rather than a crystalline solid, Jenniskens said. This glassy ice has the same basic structure as liquid water. In this form, the water molecules are connected to each other by four strong hydrogen bonds in an open cage-like structure. At the very low temperatures of comet formation in the Kuiper belt—colder than –380° F—some water molecules are trapped in the cages of this structure during freezing. But comets formed at slightly higher temperatures in the Oort cloud expelled the water from the cages. Kuiper belt comets, therefore, consist of a different form of water ice than Oort cloud comets.

Comet Shoemaker-Levy, which recently crashed into Jupiter, was most likely a lower-temperature, short-period comet formed in the Kuiper belt, Jenniskens said. Because short-period comets orbit the solar system faster and more often, Jupiter's gravity is more likely to capture them, he said.

These predictions are based on laboratory simulations of cometary ice formation under conditions thought to exist when the objects formed. The researchers discovered the water-trapping process of the lower temperature comets by simulating the freezing process in an Ames laboratory and observing with a transmission electron microscope.

MAGELLAN'S LEGACY: REVEALING THE FACE OF VENUS

The Magellan mission to Venus ended on October 12 as Earth-based tracking stations lost the spacecraft's radio signal at 10:02 Universal Time (3:02 a.m. PDT). The loss of signal, which had been expected, was caused by low power on the spacecraft exacerbated by Magellan's orientation as it performed a final experiment in the upper atmosphere. Magellan was expected to burn up in the planet's upper atmosphere within two days.

The spacecraft's thrusters were fired in four sequences on October 11 to lower its orbit into the thin upper atmosphere and set up the final experiment. Magellan gathered scientific data on the upper atmosphere and spacecraft aerodynamics during the final descent by orienting its solar panels in opposite directions like a windmill. The termination experiment was an extension of the windmill experiment performed in early September. It was carried out as the spacecraft was within weeks to days of the end of its life because of degradation of solar power output by the thermal stress of more than 15,000 orbits of Venus.

Launched in May 1989, Magellan entered Venus orbit in August 1990 and gathered data for over four years. It used radar to see through clouds enshrouding the planet to map 98% percent of the surface with an average resolution of better than 300 meters and compiled a high-resolution gravity field map for 95% of the planet. The gravity data will allow scientists to develop models for the planet's interior and evaluate them in light of surface features revealed by Magellan's radar imaging.

Magellan also performed the first aerobraking maneuver by dipping into the atmosphere to reshape its orbit. This technique is being used in designing the Mars Global Surveyor mission, enabling the spacecraft to enter Mars orbit in 1997 using less fuel, thus saving weight and cost.

"The Magellan mission to Venus has been successful beyond all expectations," said JPL Director Edward Stone. "It not only fulfilled its science and mission objectives, it also demonstrated innovative technologies for future missions."

HUBBLE OBSERVATIONS DEEPEN THE MYSTERY OF DARK MATTER

Two teams of astronomers, working independently with the Hubble Space Telescope (HST), have ruled out the possibility that red dwarf stars constitute the so-called dark matter, believed to account for more than 90% of the mass of the universe. Until now, the dim, small stars were considered ideal candidates for dark matter by some astronomers.

Whatever dark matter is, its gravitational pull ultimately will determine whether the universe will expand forever or will someday collapse. "Our results increase the mystery of the missing mass. They rule out a popular but conservative interpretation of dark matter," said Dr. John Bahcall, of the Institute of Advanced Study, Princeton, a leader of one of the teams. The group led by Bahcall and Andrew Gould of the Ohio State University, showed that faint red dwarf stars, which were thought to be abundant, actually are sparse in the Milky Way, and, by inference, in the universe.

The team led by Dr. Francesco Paresce of the Space Telescope Science Institute and the European Space Agency determined that the faint red stars rarely form and that there is a cutoff point below which nature does not make this type of dim, low-mass star.

The pair of HST observations involved accurately counting stars and gauging their brightness. The observations overturn several decades of conjecture, theory, and observation about the typical mass and abundance of the smallest stars in the universe.

GROUNDBASED RESULTS INCONCLUSIVE

In our own stellar neighborhood, there are almost as many red dwarfs as there are all other types of stars put together. The general trend throughout our galaxy is that small stars are more plentiful than larger stars, just as there are more pebbles on the beach than rocks. This led many astronomers to believe that they were only seeing the tip of the iceberg and that many more extremely faint red dwarf stars were at the limits of detection with groundbased instruments.

According to stellar evolution theory, stars as small as 8% of the mass of our Sun are still capable of shining by nuclear fusion processes. Over the past two decades, theoreticians have suggested that the lowest mass stars also should be the most prevalent and so might provide a solution for dark matter. This seemed to be supported by previous observations with groundbased telescopes that hinted at an unexpected abundance of what appeared to be red stars at the faintest detection levels achievable from the ground. However, these observations were uncertain because the light from these faint objects is blurred slightly by Earth's turbulent atmosphere. This makes the red stars indistinguishable from the far more distant, diffuse-looking galaxies.

PINNING DOWN THE HALO POPULATION

The spacebased Hubble made it possible for astronomers to observe red stars that are 100 times dimmer than those detectable from the ground—a level where stars can be distinguished easily from galaxies. Hubble's high resolution also can separate faint stars from the much more numerous galaxies by resolving the stars as distinct points of light, as opposed to the fuzzy extended signature of a remote galaxy.

The HST observations show that dim red stars make up no more than 6% of the mass in the halo of the Galaxy and no more than 15% of the mass of the Milky Way's disk. The Galactic halo is a vast spherical region that envelopes the Milky Way's spiral disk of stars.

FAINT RED STARS MISSING FROM A GLOBULAR CLUSTER

By coincidence, Paresce pursued the search for faint red dwarfs after his curiosity was piqued by an HST image taken near the core of the globular cluster NGC 6397. He was surprised to see that the inner region was so devoid of stars that he could see right through the cluster to far more distant background galaxies. Computer simulations based on models of stellar population predicted the field should be saturated with dim stars—but it wasn't.

Paresce, and co-investigators Guido De Marchi (STScI and the University of Firenze), and Martino Romaniello (University of Pisa) used HST to conduct the most complete study to date of the population of the cluster (globular clusters are ancient, pristine laboratories for studying stellar evolution). To his surprise, he found that stars 1/5 the mass of our Sun are very abundant (there are about 100 stars this size for every single star of solar mass) but that stars below that range are rare. "The very small stars simply don't exist," he said.

A star is born as a result of the gravitational collapse of a cloud of interstellar gas and dust. This contraction stops when the infalling gas is hot and dense enough to trigger nuclear fusion, causing the star to glow and radiate energy. "There must be a mass limit below which the material is unstable and cannot make stars," Paresce emphasizes. "Apparently, nature breaks things off below this threshold." Paresce has considered the possibility that very low-mass stars formed long ago but were thrown out of the cluster as a result of interactions with more massive stars within the cluster or during passage through the plane of our Galaxy. This process would presumably be common among the approximately 150 globular clusters that orbit the Milky Way. However the cast-off stars would be expected to be found in the Milky Way's halo, and Bahcall's HST results don't support this explanation.

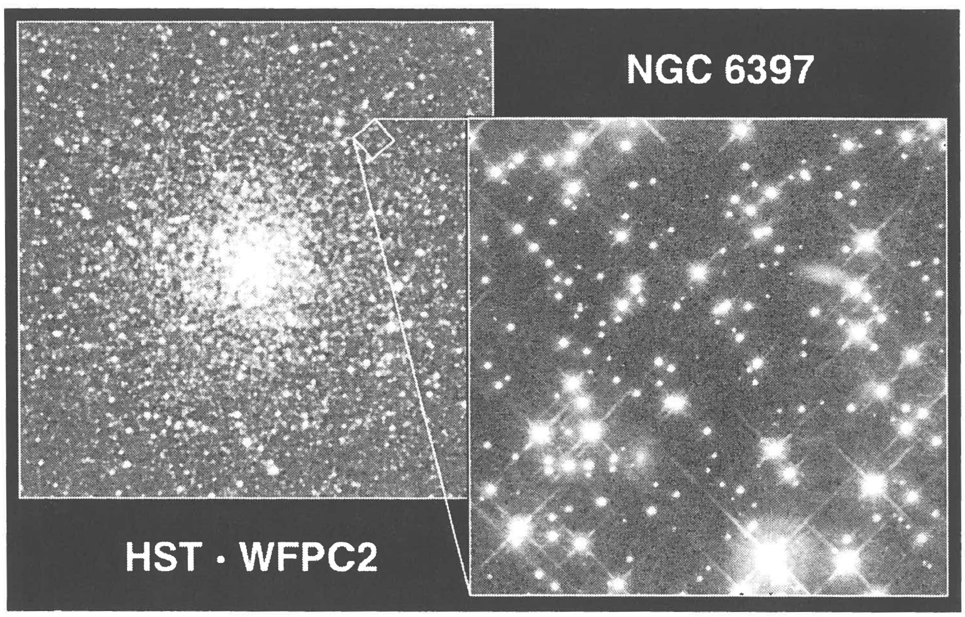
THE SEARCH FOR DARK MATTER

The findings are the latest in the astronomical quest to understand the puzzle of the universe's missing mass. Models of the origin of helium and other light elements during the Big Bang predict that less than 5% of the universe is made up of "normal stuff," such as neutrons and protons. This means more than 90% of the universe must be some unknown material that does not emit radiation that can be detected by current instruments. Candidates for dark matter include black holes, neutron stars, and a variety of exotic elementary particles.

Within the past year, astronomers have uncovered indirect evidence for a dark matter candidate called a MACHO (Massive Compact Halo Objects). These observations detected several instances of an invisible object that happens to lie along the line of sight to an extragalactic star. When the intervening object is briefly aligned between Earth and a distant star, it amplifies, or gravitationally lenses, the light from the distant star. The new HST finding shows that faint red stars are not abundant enough to explain the gravitational lensing events attributed to MACHOs. Bahcall cautions, however, that his results do not rule out other halo objects that could be smaller than the red stars such as brown dwarfs—objects not massive enough to burn hydrogen and shine in visible light.

Additional circumstantial evidence for dark matter in the halo of our galaxy has been inferred from its gravitational influence on the motions of stars within the Milky Way's disk. Recently, this notion was further supported by groundbased observations, made by Penny Sackett of the Institute for Advanced Study, that show a faint glow of light around a neighboring spiral galaxy that is the shape expected for a halo composed of dark matter. This could either be light from the dark matter itself or stars that trace the presence of the galaxy's dark matter.

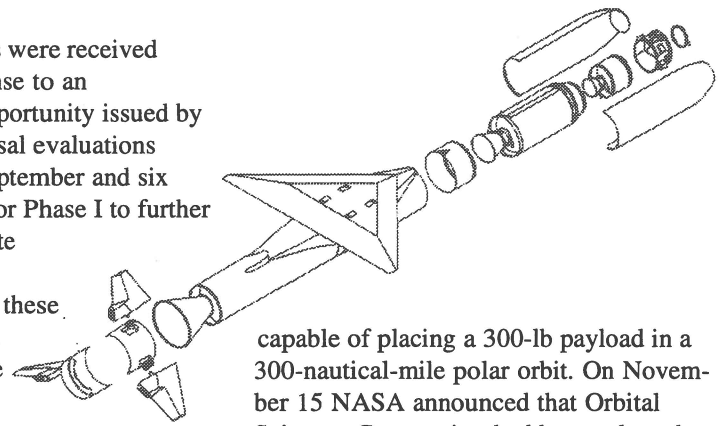
The ultimate fate of the universe will be determined by the amount of dark matter present. Astronomers have calculated that the amount of matter—planets, stars, and galaxies—observed in the universe cannot exert enough gravitational pull to stop the expansion that began with the Big Bang. Therefore, if the universe contains less than a critical density of matter it will continue expanding forever, but if enough of the mysterious dark matter exists, the combined gravitational pull someday will cause the universe to stop expanding and eventually collapse.



CREDIT: F. PARESCE, STSCI & ESA AND NASA.

A NASA Hubble Space Telescope image of a small region (1.4 light-years across) in the globular star cluster NGC 6397 shows far fewer stars than would be expected if faint red dwarf stars were abundant. HST resolves about 200 stars. The stellar density is so low that HST can literally see right through the cluster and resolve far more distant background galaxies. This observation shows the surprising cutoff point below which nature apparently doesn't make many stars smaller than 1/5 the mass of the Sun. If there were lower mass stars in the cluster, then the image would contain an estimated 500 stars.

STEDI Moves Ahead: Six Teams Selected for Phase I



The Student Explorer Demonstration Initiative (STEDI) is a pilot program designed to assess the efficacy of smaller, low-cost space-flight missions and to test the proposition that a complement of missions in this class can be ideally matched to the traditional processes of research and development at the nation's universities. The expected cost of a STEDI mission, excluding the costs of the launch vehicle and associated launch services, is less than $4.4 million.

STEDI is funded by NASA and managed by the Universities Space Research Association under its Division of Educational Programs. The program has three phases: Phase I, mission definition (4 months); Phase II, mission implementation (2 years); and Phase III, mission operations and data analysis (up to 1 year).

Sixty-six proposals were received last summer in response to an Announcement of Opportunity issued by USRA in May. Proposal evaluations were completed in September and six teams were selected for Phase I to further develop their candidate missions.

In February two of these teams will be selected to continue into Phase II. These will be funded at no more than $4.15 million for spacecraft and instrument development and mission operations.

In parallel with the selection of the USRA mission teams, NASA held a competition for its Ultralite Expendable Launch Vehicle (UELV). The RFP was released in July and called for a vehicle capable of placing a 300-lb payload in a 300-nautical-mile polar orbit. On November 15 NASA announced that Orbital Sciences Corporation had been selected for contract negotiations and that their Pegasus XL vehicle will be the UELV. The Pegasus XL is a three-stage rocket approximately 50 feet in length and is air-launched after dropping from an L-1011 at 38,000 feet.

The first STEDI launch will be in early 1997.

STEDI Teams Selected for Phase I Mission Definition

Principal Investigator and Institution	Proposal Objective	Major Partners
Richard C. Henry The Johns Hopkins University	Ultraviolet search for dark matter between the galaxies.	Morgan State University Maryland Space Grant Consortium
Brian E. Gilchrist The University of Michigan	Demonstrate tether technology making lower thermosphere and ionosphere measurements. Marshall Space Flight Center	Martin Marietta Astronautics University of Alabama, Huntsville University of Texas, Dallas Goddard Space Flight Center
David J. Forrest University of New Hampshire	Measure distance and polarization of gamma-ray bursts.	Weber State University University of Leicester
Daniel Cotton Boston University	Tomographic measurements of properties of ionosphere and thermosphere.	Naval Research Laboratories MIT University of Illinois AeroAstro, Inc.
Charles A. Barth University of Colorado	Measure nitric oxide density in terrestrial lower thermosphere.	NCAR Ball Aerospace Corporation
Elaine R. Hansen Colorado Space Grant College	Measure global ozone and ozone-affecting constituents.	Ball Aerospace Corporation

CASS ONLINE ACCESS

CASS ONLINE is the remote access point for the databases and information available from the Lunar and Planetary Institute, Division of Space Life Sciences, and Division of Educational Programs, the three components of the Center for Advanced Space Studies (CASS). All are part of Universitities Space Research Association (USRA). CASS is a major research and conference facility located adjacent to the Clear Lake campus of the University of Houston and near NASA's Johnson Space Center.

INFORMATION & DATABASES AVAILABLE VIA CASS ONLINE

Newsletters
The Lunar and Planetary Information Bulletin is now available on World Wide Web. See URL under WWW Access.

Meetings and Abstracts
This database contains announcements and other meeting information for all CASS-sponsored meetings as well as abstracts that have been contributed to the meetings.

CASS Library Catalog
The library catalogs contain information on the Center for Information and Research Services' collection. These include the book catalogs, journal holdings, special indexes, new arrivals, and more.

Lunar and Planetary Bibliography
(Legacy System) This database contains references to the scientific literature in the planetary sciences field.

Image Retrieval and Processing System (IRPS)
(Legacy System) This system provides the ability to search a database of images from various planetary missions using a variety of parameters.

HOW TO GET THERE

World Wide Web (WWW) Access
If you are using an Internet information browser like NCSA Mosaic, the URL for CASS is:
http://cass.jsc.nasa.gov/CASS_home.html

Internet Access
When you log on for the first time, please read the Information for New Users screen before continuing.

At your system's prompt, type:

telnet cass.jsc.nasa.gov
or
telnet 192.101.147.17

The username prompt should be displayed. Use only lower case characters for logging onto this account.

USERNAME: cass
PASSWORD: online

NSI/DECNET (formerly SPAN) Access
At your system's prompt type:

set host east::
or
set host 6913::

You should receive the ULTRIX 4.0 (Rev.179) (east.gsfc.nasa.gov) login prompt.

At the ULTRIX login prompt, type:
cass.jsc.nasa.gov!
(be sure to include the exclamation point)

The username prompt should be displayed. Use only lower case characters for logging onto this account.

USERNAME: cass
PASSWORD: online

Modem Access
For modem access(at 14.4K/9600 bps), DEC VT series terminal emulation (100 and above) is required.

(713)244-2089
(713)244-2090

Press <ENTER> until you receive the username prompt. Use only lower case characters for logging onto this account.

USERNAME: cass
PASSWORD: online

GETTING HELP

For more information or assistance with connecting to CASS ONLINE, please contact:
Eleta Malewitz
(malewitz@lpi.jsc.nasa.gov)
Phone: (713) 486-2183
Fax: (713) 486-2155

NEW IN PRINT, *continued from page 6*

that "these kinds of features are common in lunar rocks. . . ." This is, at best, misleading to the uninitiated student for which this book would otherwise be most useful.

Other than these deficiencies, the errors are minor and the annoyances are few. In the next edition I would like to see more use made of the photographs; some are so small they are useless, some are not described, most need scale bars, and virtually all seem simply to be expedient ways to fill the pages of, even so, a very short book. And speaking of artwork, who thought up the bright idea of putting midnight blue print on a black cover? This virtually ensures that the book will go unnoticed on library shelves.

While this book will be of limited use to impact specialists, it could be a valuable resource for students or anyone else interested in learning more about impact features. This in itself is a laudable purpose given that so many of the major contributions in terrestrial cratering come from outside the professional community. So, if you have a repressed desire to learn about terrestrial craters but don't know where to start, this book is for you. Who knows, maybe you'll discover something that the theorists will attempt to discredit. At that point, congratulations would be in order.

—Buck Sharpton

(Dr. Sharpton is a staff scientist at LPI.)

CALENDAR 1994

DECEMBER

5–9
Flares and Flashes (IAU Colloquium 151), Sonneberg (Thuringia), Germany. Contacts: H. W. Dürbeck, Astronomisches Institut, Wilhelm-Klemm-Strasse 10, 48149 Münster, Germany. Phone: 49-251-83-3561; fax: 49-251-83-3669. J. Greiner, Max-Planck-Institut für Extraterrestrische Physik, 85740 Garching, Germany. Phone: 49-89-3299-3577; fax: 49-89-3299-3569.
Internet: iauc151@cynus.uni-muenster.de

5-16
The Structure of the Sun, Tenerife, Canary Islands. Contact: Lourdes Gonzales.
Internet: lgp@iac.es

6–10
American Geophysical Union, Fall Meeting, San Francisco, California. Contact: AGU Meetings Department, 2000 Florida Avenue NW, Washington DC 20009. Phone: 202-939-3203; fax: 202-328-0566.

JANUARY 1995

4–7
Venus II—Geology, Geophysics, Atmosphere, and Solar Wind Environment, Tucson, Arizona. Contact: Amy Schumann, Lunar and Planetary Lab, Space Science Building, University of Arizona, Tucson AZ 85721. Phone: 602-621-2902.
Internet: amys@lpl.arizona.edu

8-12
185th Meeting of the American Astronomical Society, Tucson, Arizona. Contact: American Astronomical Society.
Internet: aas@aas.org

9–12
9th Annual Microgravity Science and Space Processing Symposium, Reno, Nevada. Contact: John Hockstein, Memphis State University. Phone: 901-678-2257.

FEBRUARY

7–10
1995 Yosemite Conference on Solar System Plasma Physics, Yosemite National Park, California. Contact: Jim Burch or Hunter Waite, Southwest Research Institute, P.O. Drawer 28510, San Antonio TX 78228. Phone: 210-522-2526; fax: 210-522-3493.

FEBRUARY (CONTINUED)

27-28
1995 Conference on Quality in the Space Industry, League City, Texas. Contact: Helen Schneider, 5400 Bosque Boulevard, Suite 680, Waco TX 76710-4446. Phone:817-776-3550; fax: 817-776-3767.

MARCH

13–17
26th Lunar and Planetary Science Conference, Houston, Texas. Contact: Publications and Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2166; fax: 713-486-2160.
Internet: simmons@lpi.jsc.nasa.gov

23-26
National Science Teachers Association Annual Meeting, Philadelphia, Pennsylvania. Contact: Convention Registration Office, NSTA, 1840 Wilson Boulevard, Arlington VA 22201. Phone: 703-243-7100; fax: 703-243-7177.

27–30
Solar System Ices, Toulouse, France. Contact: Michel Festou, Observatoire Midi-Pyrenees, 14, avenue Edouard-Belin, 31400-Toulouse, France. Fax: 33-61-53-67-22.
Internet: festou@obs-mip.fr

27-30
Astrophysics in the Extreme Ultraviolet (IAU Colloquium 152), Berkeley, California. Contact: Sharon Lilly.
Internet: iau152@cea.berkeley.edu

APRIL

3-5
NASA/AIAA Life Sciences and Space Medicine Conference, Houston, Texas. Contact: Reginald M. Machell, AIAA Technical Chairman, 14923 Village Elm Street, Houston TX 77062-2914. Phone: 713-283-6000.

9-13
European Union of Geosciences (EUG 8), Strasbourg, France. Contact: EUG 8 Office, E.O.P.G., 5 Rue René Descartes, Strasbourg Cedex 67084, France. Phone: 33-88-41-63-93; fax: 33-88-41-17-66.
Internet: eug@eopg.u-strasbg.fr

MAY

8-12

The Impact of Comet Shoemaker-Levy 9 on Jupiter (IAU Colloquium 156), Baltimore, Maryland. Contact: Michael A'Hearn.
Internet: ma@astro.umd.edu

9-11

Tenth Annual Goddard Conference on Space Applications of Artificial Intelligence and Emerging Information Technologies, Greenbelt, Maryland. Contact: James Rash, NASA Goddard Space Flight Center, Code 531.1, Greenbelt MD 20771. Phone: 301-286-3595; fax: 301-286-1724.
WWW: http://ddwilson.gsfc.nasa.gov

12-13

Planetary Surface Instruments Workshop, Houston, Texas. Contact: Publications and Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2166; fax: 713-486-2160.
Internet: simmons@lpi.jsc.nasa.gov

17-19

Joint Annual Meeting of the Geological Association of Canada and Mineralogical Association of Canada, British Columbia, Canada. Contact: Chris R. Barnes, General Chair, SEOS, University of Victoria, P.O. Box 1700, Victoria BC V8W 2Y2, Canada. Phone: 604-721-6120; fax: 604-721-6200.

29-Jun 2

American Geophysical Union and Mineralogical Society of America Annual Spring Meeting, Baltimore, Maryland. Contact: AGU Meetings Department, 2000 Florida Avenue, NW, Washington DC 20009. Phone: 202-462-6900; fax: 202-328-0566.

29-Jun 2

CO: Twenty-five Years of Millimeter-wave Spectroscopy (IAU Symposium 170), Tucson, Arizona. Contact: CO Symposium, NRAO, Campus Building 65, 949 N. Cherry Avenue, Tucson AZ 85721-0655. Fax: 602-882-7955.
Internet: symp95@nrao.edu

JUNE

25-30

Cataclysmic Variables and Related Objects, Keele University, England. Contact: F. Ringwald, Department of Physics, Keele University, Staffordshire, ST5 5BG, United Kingdom. Phone: 44-782-583319; fax: 44-782-711093.
Internet: cvconf@astro.keele.ac.uk

JULY

2-14

International Union of Geodesy and Geophysics XXI General Assembly, Boulder, Colorado. Contact: IUGG XXI General Assembly, c/o AGU, 2000 Florida Avenue, NW, Washington DC 20009. Phone: 202-462-6900; fax: 202-328-0566.
Internet: iugg_@kosmos.agu.org

20-23

Ecological Consequences of Earth Collisions with Small Bodies of the Solar System, Tomsk, Russia. Contact: Gennadij Andreev, Astronomical Observatory of the Tomsk State University, Box 1106, 634010 Tomsk, Russia. Phone: 7-3822-909721; Fax: 7-3822-230450.
Internet: ok@siberia-ltd.tomsk.su *or* niipmm@urania.tomsk.su

24-31

Fifth International Tunguska Expedition, Tunguska Meteoritic Park, Evenkiya, Russia. Contact: Gennadij Andreev, Astronomical Observatory of the Tomsk State University, Box 1106, 634010 Tomsk, Russia. Phone: 7-3822-909721; Fax: 7-3822-230450.

31-Aug 3

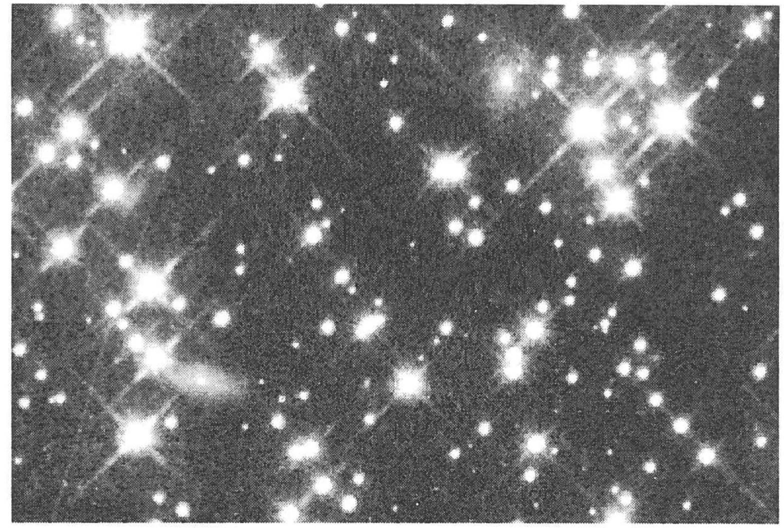
Workshop on Chaos in Gravitational *N*-Body Systems, La Plata, Argentina. Contact: J. C. Muzzio, Observatorio Astronómico, Paseo del Bosque, 1900 La Plata, Argentina. Fax: 54-21-21-1761 or 54-21-25-8985.
Internet: chaos@fcaglp.edu.ar

JANUARY 1996

22-26

New Extragalactic Perspectives in the New South Africa: Changing Perceptions of the Morphology, Dust Content, and Dust-Gas Ratios in Galaxies, Johannesburg, South Africa. Contact: David L. Block, Department of Computational & Applied Mathematics, Witwatersrand University, P.O. Box 60, WITS 2050, South Africa. Phone: 27-11-339-7965; fax: 27-11-716-3761.

INSIDE



RED DWARFS MISSING . . . See Page 14

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