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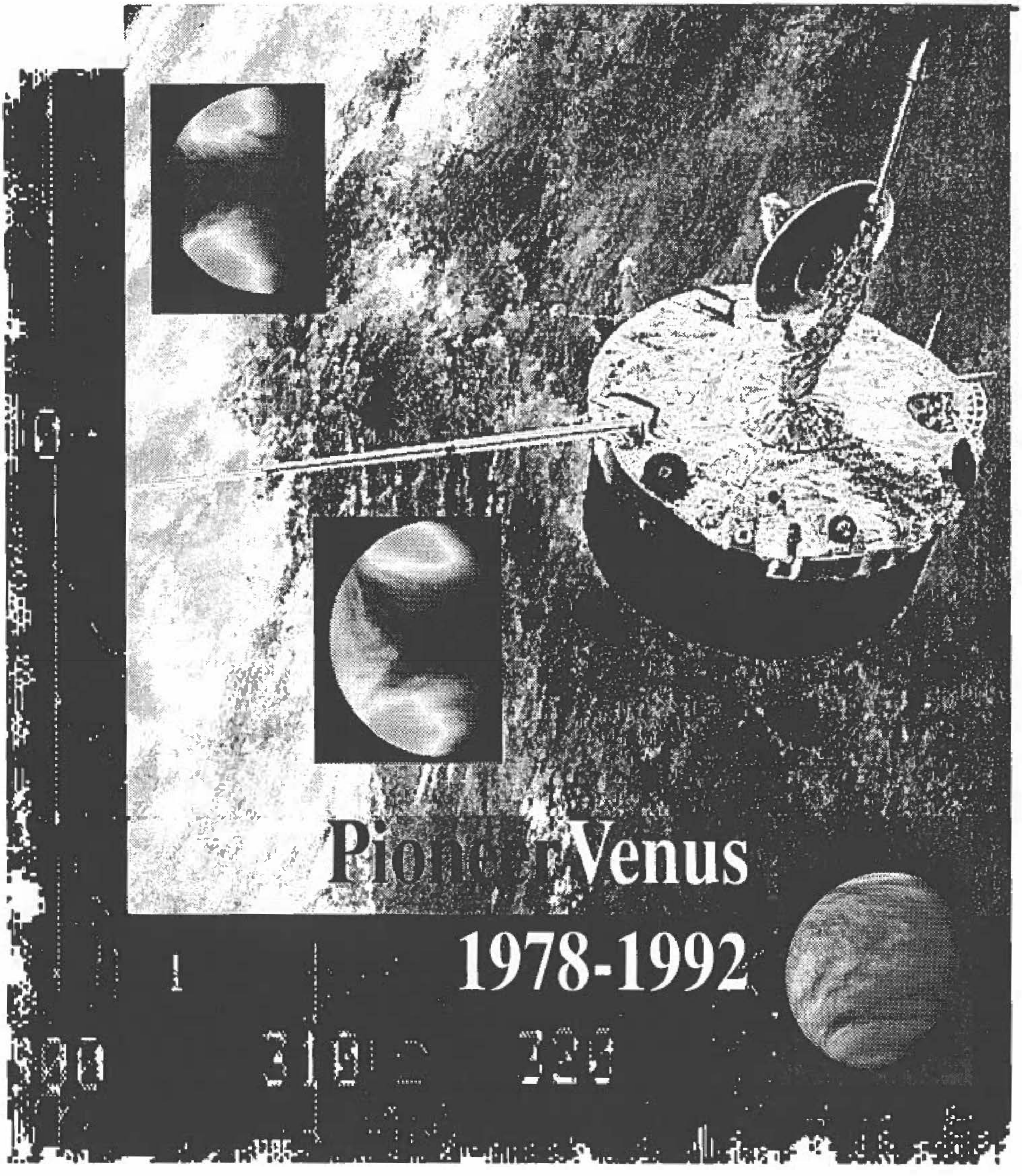

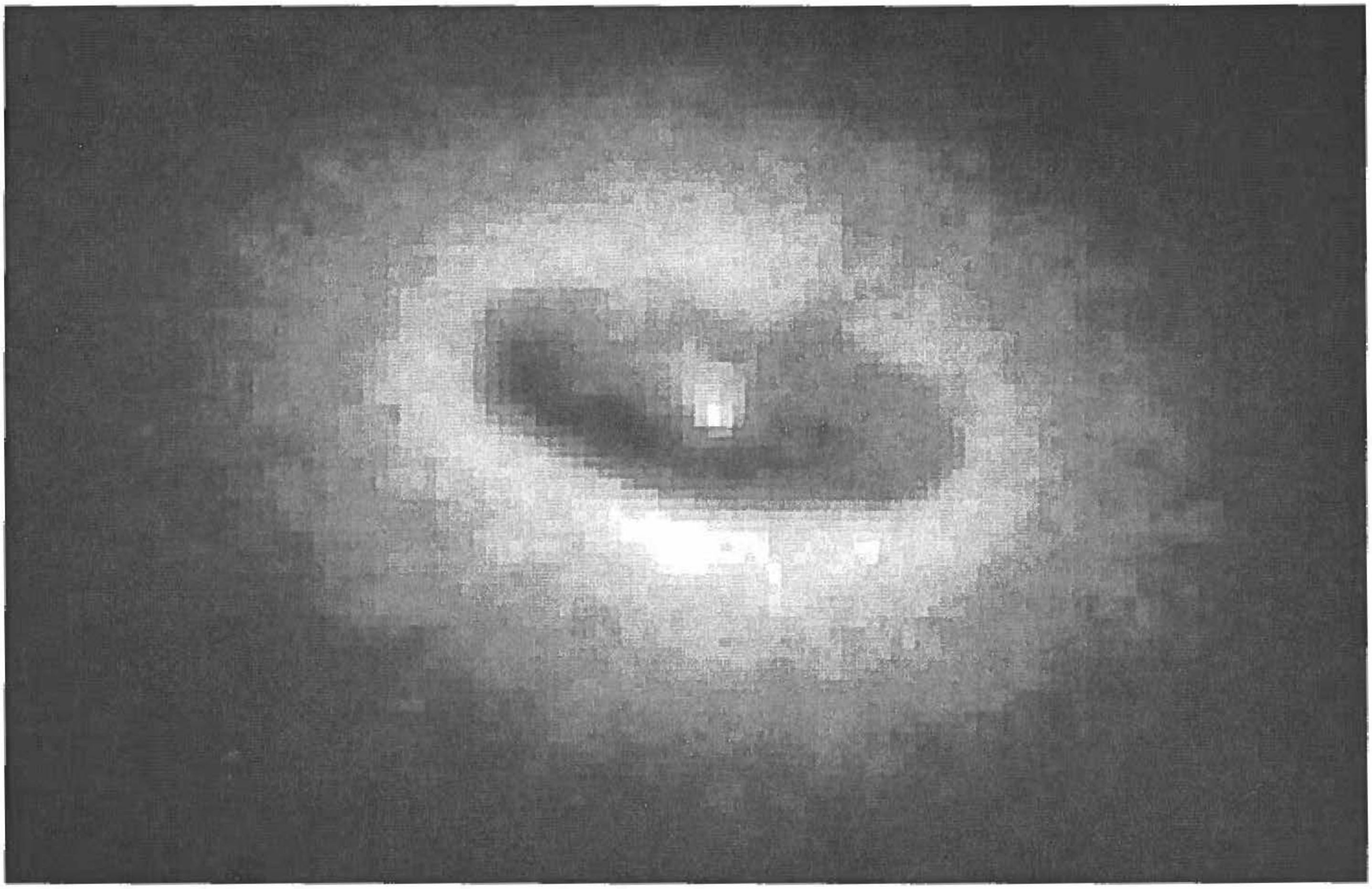

A DISK FUELING A POSSIBLE BLACK HOLE
A Hubble Space Telescope image of a giant disk of cold gas and dust fueling a suspected black hole. Estimated to be 300 light-years across, the disk is tipped enough (about 60 degrees) to provide astronomers with a clear view of its bright hub, which presumably harbors the black hole. The dark, dusty disk represents a cold outer region which extends inwards to within a few hundred million miles of the suspected black hole. The disk is at the core of galaxy NGC 4261, one of the 12 brightest galaxies in the Virgo Cluster, located 45 million light-years away. The image was taken at visible wavelengths with the Wide Field/Planetary Camera in PC mode.

SCIENTISTS MOVE CLOSER TO CONFIRMING REALITY OF BLACK HOLES

Astronomers using the Hubble Space Telescope (HST) have gotten their best look yet at a disk of material being sucked into the (suspected) black hole it surrounds. The disk is at the core of a galaxy in the Virgo Cluster 45 million light-years from Earth. Dr. Walter Jaffe of Leiden Observatory, The Netherlands, said the disk is tipped about 60 degrees — enough to provide astronomers with a clear view of the galaxy's bright hub.

"The nucleus is probably the home of a black hole with a mass 10 million times that of our Sun," Jaffe said. "This is our best view to date of the immediate surrounding of the nucleus of an active galaxy," the name given galaxies that radiate most strongly in high-energy, nonvisible portions of the spectrum. One source of such massive amounts of energy may be a black hole deep within the galaxy. "This is the first case where we can follow the disk's gas in an orderly way down to the immediate environment of the black hole," said co-investigator Dr. Holland Ford of The Johns Hopkins University in Baltimore, Maryland.

FORMED BY STELLAR COLLAPSE

The observations made with the Wide Field/Planetary Camera (WF/PC) in PC mode make a strong contribution to mounting evidence for the existence of black holes in the universe. According to theory, a black hole forms when an extremely massive star collapses, compacting the stellar material so densely that the object is virtually invisible except for the effects of its tremendous gravity. The "hole's" gravitational pull sucks in all matter that comes near it and its force is so great that light cannot escape it, rendering it invisible or "black." Scientists infer a black hole's existence by observing its gravitational influence on the motion of stars and other material near it.

NGC 4261 was selected for study because it is one of the brightest active galaxies in the Virgo Cluster.

"The galaxy is unremarkable in visible light," said Jaffe. "However, observations with radio telescopes show a pair of opposed jets emanating from the nucleus and spanning a distance of 88,000 light-years." Spectroscopic data (from the Observatory del Roque de los Muchachos in the Canary Islands) show ionized gas in the nucleus moving at speeds approaching several million miles an hour, or one percent of the speed of light.

"Most astronomers believe both phenomena, which have been seen earlier in radio galaxies and quasars (active nuclei of remote galaxies), to be caused by material being swallowed by massive black holes hiding in the nuclei of large galaxies," said Ford.

> "This is our best view to date of the immediate surrounding of the nucleus of an active galaxy."

DISK ITSELF IS PUZZLING

The dark, dusty disk, which is 300 light-years across, represents the cold outer region that extends inward to within a few hundred million miles of the suspected black hole. As matter from the disk is swallowed by the black hole, gravity compresses and heats the material to tens of millions of degrees. Some hot gas squirts out from the black hole's vicinity like twin streams of water from a lawn sprinkler. "The spin axis of the disk orients the radio jets," said Ford. "The cooler, outer regions of the washer-shaped disk confine the ionizing radiation from the hot interior into a pair of cones whose axes are parallel to the radio jets."

Because dust and cool gas (neutral hydrogen) are not normally found in elliptical galaxies, the presence of a disk at all is puzzling. Much of the dust should have been destroyed quickly by the hot gas in the galaxy. A possible explanation is that the dust is a remnant of a spiral galaxy that was swallowed by NGC 4261 in the recent past.

After the scheduled Space Shuttle servicing mission for Hubble in late 1993, the researchers hope to use spectroscopy to study the motion of the gas within a few dozen light-years of the black hole. This might allow them to prove the existence of the black hole by accurately measuring its mass. The researchers also hope to use spectroscopy to infer the thickness and shape of inner parts of the disk that are too small to be seen even with the HST. Ø

CONTINUING WORK ON CHICXULUB ESTABLISHES NEW LINKS BETWEEN IMPACT CRATER IN THE YUCATAN AND MASSIVE EXTINCTION OF LIFE

New evidence gathered by U.S. and Mexican researchers points to a single meteorite impact in the Yucatan as the trigger for massive extinctions of life on Earth 65 million years ago. The dinosaurs are the most famous victims in a moment of geologic time that saw the demise of about 70 percent of existing species. The extinctions define the boundary between the Cretaceous and Tertiary (K/T) eras in the geologic record, and they mark the emergence of mammals as the dominant form of life on the planet.

In a paper published October 29 in the journal *Nature*, scientists at the Lunar and Planetary Institute (Houston), U.S. Geological Survey (Menlo Park), and the Universidad Nacional Autonoma de Mexico present analyses of drill core samples of the 200-kilometer structure near Chicxulub, Mexico, that virtually clinch the case for its being the K/T impact crater.

The search that has now homed in on Chicxulub has been an intriguing geological detective story since the early 1980's when highly shocked mineral fragments and decidedly non-terrestrial levels of the element iridium were found in K/T-age sediments. Geologists have been searching for a crater of the right size and age ever since, and some have speculated about whether a single impact could possibly account for the worldwide distribution of shocked and iridium-enriched materials.

Several crucial new lines of evidence are presented in the study by V.L. Sharpton, G.B. Dalrymple, L.E. Marin, G. Ryder, B.C. Schuraytz, and J. Urrutia-Fucugauchi, that strengthen the case for Chicxulub as the source of the massive extinctions and suggest that this single event can explain the worldwide K/T evidence without recourse to multiple impact scenarios. In addition, isotopic age estimates agree with those determined by other workers and place the structure at the K/T boundary, about 65 million years ago.

Nature of Basement Rock

One of the most important new contributions is the characterization of the crystalline basement rock beneath the structure, which formed the impact "target" that was heavily shocked and melted by the collision. This predominantly medium- to coarse-grained granitic gneiss and its accessory minerals supply the missing chemical and mineralogic link with impact debris found in the K/T boundary sediments. The analyses tie the mineralogy, structural fabric, and texture

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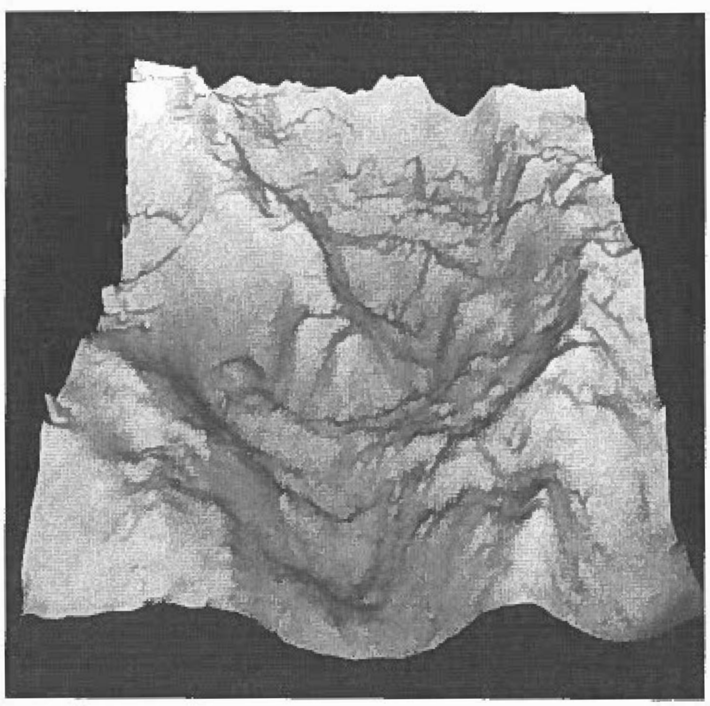
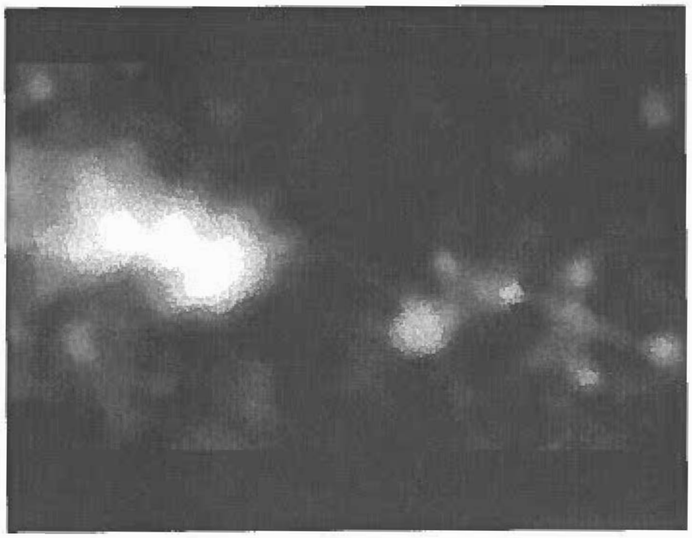


A gravity map of an area roughly 21,000 square miles in the northwest corner of the Yucatan peninsula extending offshore into the Gulf of Mexico: The gravity data were obtained from NOAA and the Defense Mapping Agency and rendered on a Kubota Pacific Titan 3000 using AVS (Application Visualization System) software. The data were first gridded using a bivariate interpolation routine and then converted to AVS image format. The resulting two-dimensional image was then transformed into a 3-D mesh surface with the height of the mesh above each point proportional to the DN value of the image at that point.

IMAGE: COMPUTING CENTER FOR PLANETARY DATA ANALYSIS, LPI

NEWS FROM SPACE



A picture of 4C41.17, the most distant galaxy known, taken with the Hubble Space Telescope's Wide Field and Planetary Camera. The clumpy structure shown closely resembles the structure seen at radio wavelengths. If the emission is produced by stars, each clump could contain about ten billion stars in a region about 1500 light-years across. The light which produced this picture has been traveling through space for more than ten billion years. The galaxy is being seen when the universe is only about ten percent of its present age.

PHOTO: GEORGE MILEY (LEIDEN UNIV.), KENNETH CHAMBERS (UNIV. OF HAWAII), WIL VAN BREUGEL (LAWRENCE LIVERMORE NATIONAL LABORATORIES, UNIV. OF CALIFORNIA), AND DUCCIO MACCHETTO (STScI)

HUBBLE TELESCOPE OBSERVES MOST DISTANT GALAXY

Using NASA's Hubble Space Telescope an international team of astronomers is uncovering intriguing new details about the most distant galaxy known, located more than ten billion light-years away. Hubble reveals a surprising chain of luminous knots at the galaxy's core. "These knots could be giant star clusters forming. If that is so then each would contain about ten billion stars and be 1,500 light-years across," said Prof. George Miley of Leiden University, The Netherlands. An alternative theory is that the knots are gas or dust clouds caught in a "searchlight" beam of energy from a massive black hole hidden at the galaxy's core.

The primordial galaxy, called 4C41.17, existed during the infancy of the universe. The galaxy's great distance from Earth means that it formed less than two billion years after the Big Bang, which marked the beginning of the observable universe. Most galaxies might have formed during this early epoch. The new picture of 4C41.17 taken with the Wide Field and Planetary Camera on the Hubble Telescope resolves details ten times better than previous photographs taken with ground-based telescopes. This allows astronomers to study the center of the galaxy with unprecedented clarity.

"A surprising result is the extreme clumpiness of the visible emission, suggesting that the inner region of this primeval galaxy is highly disturbed," said Miley. The observations were carried out by Miley and co-investigators Kenneth Chambers of the University of Hawaii, Wil van Breugel of Lawrence Livermore National Laboratories of the University of California, and Duccio Macchetto of the Space Telescope Science Institute, Baltimore and the European Space Agency. The results will be published in the December 20th issue of *Astrophysical Journal Letters*.

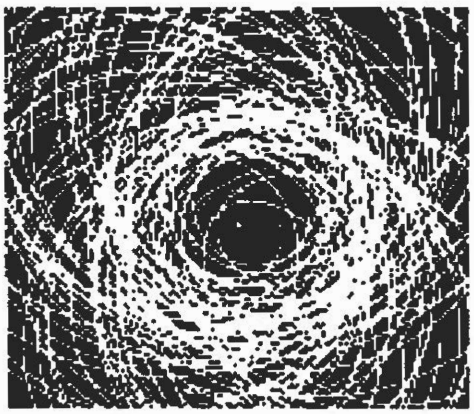
4C41.17 is one of several distant radio-emitting galaxies discovered by members of the team during the past few years. The team's search and detection strategy is based on the enormous power and special character of the radio emission from such distant galaxies. In 4C41.17 a massive black hole rotating at the galaxy's core is commonly thought to be the "engine" that produces twin jets of high-speed particles. The energy from the jets would be the source of the radio emissions.

"The Hubble pictures appear remarkably similar to radio images produced by the Very Large Array of the National Radio Astronomy Observatory in New Mexico," said Miley. "It has been known for some years that radio jets interact vigorously with the outer regions of distant radio galaxies. However, the new results show for the first time a close alignment between the optical and radio features in the central regions of such galaxies."

One possible explanation for this alignment between the optical and radio emission is that the high velocity jets of particles that produce the radio emission also compress gas and dust along their paths, triggering new star formation. The new stars would then preferentially be born along the jets' paths creating the elongated optical appearance seen in 4C41.17.

Another possibility is that the optical emission is not from stars but is produced by light scattering off clouds of gas or dust. The clumps would be illuminated by light from the accretion disk around an active black hole embedded deep in the galaxy's core. This active galactic nucleus, or quasar, would be hidden from our view by a thick dust shroud that allows light to escape only along the radio axis.

Hubble can help discriminate between these possibilities by studying further the colors and other properties of these and similar objects. After the scheduled Space Shuttle servicing mission for Hubble in late 1993, astronomers will be able to take much deeper pictures in a shorter time. Space Telescope can then be used to carry out detailed studies of many galaxies at distances comparable to 4C41.17. "More than 50 are now known," said Miley. "Observing them with the renewed Hubble would provide us with an important new window through which we can glimpse the early history of our universe."



TOUTATIS CROSSES PATHS WITH EARTH

One of the largest near-Earth objects, the asteroid Toutatis, made a close Earth approach on Dec. 8, 1992, passing by at about 2.2 million miles (3.6 million kilometers) distance. Dr. Donald Yeomans, Head of the Near Earth Object Center at NASA's Jet Propulsion Laboratory, Pasadena, Calif., said the object, formally known as Asteroid 4179 Toutatis, passes Earth less than one degree above Earth's orbital plane every 4 years, making it an excellent object for study. The asteroid, at 2 miles (3.5 kilometers) diameter, is one of the largest to cross the Earth's orbit on a regular basis.

Yeomans said the ground-based viewing conditions will be excellent for infrared optical and radar observations just before, during, and well after the close Earth passage, and he notes that astronomers in many areas of the world can simultaneously study the body using several different techniques. Toutatis will also make close Earth approaches in 1996 and 2000. In 2004, it will come as close as about four Earth-Moon distances or about a million miles (about 1.6 million kilometers). Its orbit takes it almost to the distance of Jupiter's orbit before the Sun's gravitational attraction pulls it back. The approach of Toutatis this year and the one in 2004 represent the two closest Earth passages of any known asteroid for the next 30 years, said Yeomans. Toutatis was discovered Jan. 4, 1989, by Astronomer Christian Pollas at Caussols, France, and was named after a Gallic deity called "protector of the tribe."

STARS IN DISTANT GALAXY MUCH YOUNGER THAN EARLIER ESTIMATE

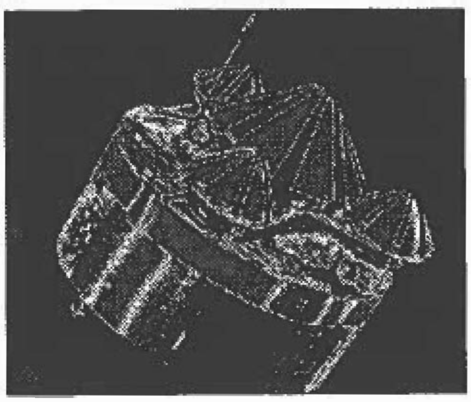
A distant radio galaxy once thought to contain old stars — older than some estimates of the age of the universe — may instead be a very young system caught in the act of formation, astronomers report. The finding, by Dr. Peter Eisenhardt of NASA's Jet Propulsion Laboratory, Pasadena, Calif., and graduate student Mark Dickinson of the University of California at Berkeley, was reported in the Nov. 1 issue of the *Astrophysical Journal Letters.*

Radio galaxy B2 0902+34 in the constellation Lynx had puzzled astronomers because its stars seemed to be much older than the universe itself., which is believed to be about 13 billion years old. The universe was about 1 billion years old when the light seen today left the galaxy, the astronomers say. Light from stars within the galaxy, however, suggested the stars were much older than 1 billion years at the time.

"Our new finding resolves the problem of how these stars possibly could be older than the universe," said Eisenhardt. "In fact it now appears that this object may be a protogalaxy — one of the holy grails of astronomy." Since the 1960s, astronomers have been searching for examples of galaxies in the process of forming.

At more than 10 billion light-years, B2 0902+34 is among the most distant known galaxies today. Because astronomers were looking back across nearly 90 percent of the age of the universe in observing the light from the galaxy, B2 0902+34 should have been a very young galaxy. Yet 1988 observations by Dr. Simon Lilly, then an astronomer at the University of Hawaii, showed that the galaxy had a very red color, a sign of old age.

In their new observations at Kitt Peak National Observatory, Eisenhardt and Dickinson measured a color 10 times bluer for the galaxy, indicating its age is much younger than previously thought. "The galaxy's color is so blue, as a matter of fact, that it is a good candidate for a protogalaxy still in the process of forming the bulk of its stars," said Eisenhardt. He said that the discrepancy between the new observations and Lilly's measurements is due in part to a problem with the infrared camera used by Lilly in 1988. In addition, Eisenhardt says the starlight is contaminated by emission from hot oxygen gas, which Lilly's report on the galaxy did not take into account.



O PIONEER!

Radio contact with the Pioneer Venus satellite was lost on October 8, signaling the end of a 14-year, first-of-a-kind mission that lasted nearly 12 years longer than researchers had anticipated. The Venus Orbiter and its companion Pioneer multi-probe spacecraft reached Venus orbit in December, 1978. From its 24-hour elliptical orbit, Pioneer Venus made thousands of the highest-resolution images to date of the cloud cover and atmospheric circulation of the shrouded planet. It also mapped 90% of the density distribution of the planet's surface for the first time, identifying new geologic features and providing our first synoptic sense of what Venus looks like beneath the clouds. The Pioneer probes described the circulation patterns of chemical reactions in the atmosphere and measured the current rate of hydrogen loss. In addition the craft recorded the first ultraviolet image of the 12-million-mile-diameter coma of Halley's Comet. When the 810-pound, drum-shaped craft descended into the upper atmosphere of Venus in September, controllers believed enough control fuel was left to boost the craft's orbit several times to study atmospheric regions never reached before, completing its survey of Venus' environment. Unfortunately, the fuel gauge gave too optimistic a reading: just before loss-of-contact, the orbiter was recording ultraviolet activity that may have signaled its fiery end in the dense venusian atmosphere.

HIGH RESOLUTION MICROWAVE SURVEY LOOKS FOR INTELLIGENT LIFE

On Oct. 12, NASA began the most comprehensive search ever conducted for evidence of intelligent life elsewhere in the universe. The search will use telescopes and antennas to detect radio transmissions from other planetary systems and will commence 500 years after Columbus landed in North America. "In the first few minutes, more searching will be accomplished than in all previous searches combined," according to Dr. John Billingham of NASA's Ames Research Center, Mountain View, Calif.

"Over the past few decades, " Billingham added, "scientific opinion has increasingly supported the theory that complex life may have evolved on planets orbiting other stars in the galaxy and the universe. In some cases, further evolution may have led to the emergence of intelligence, culture, and technology." Billingham, the program chief at Ames, said the High Resolution Microwave Survey (HRMS) consists of two parts — a Targeted Search and a Sky Survey.

The Targeted Search will use the largest available radio telescopes around the world to search the frequency range from 1,000 to 3,000 megahertz, seeking a variety of patterns that may indicate the presence of an artificially generated signal. The Targeted Search will perform the most sensitive search ever conducted of solar-type stars less than 100 light-years away. The Targeted Search begins from the world's largest radio telescope at the National Astronomy and Ionosphere Center's Arecibo Observatory in Puerto Rico.

The Sky Survey will use the 34-meter antennas at NASA's Deep Space Network sites in the northern and southern hemispheres to scan the entire sky over the frequency range from 1,000 to 10,000 megahertz. The Sky Survey begins at the Goldstone, California, site. "Because of the large increase in the area of sky and frequencies covered, a signal will have to be stronger to be detected by the Sky Survey," Billingham said. "But it could detect signals emitted in distant regions from directions that would be overlooked if the search were limited to nearby solar-type stars," he added.

Both elements of the HRMS are using specially developed digital signal processing systems capable of simultaneously analyzing tens of millions of radio frequency channels. The HRMS is part of NASA's Toward Other Planetary Systems program in the Solar System Exploration Division, Office of Space Science and Applications at NASA Headquarters, Washington, D.C. The TOPS program will employ a variety of astronomical techniques, including microwave surveys, to search for planets around other stars. The Earth is the only location known to harbor life. But as knowledge of the nature of life has grown, so too have estimates of the likelihood of life beyond Earth. Some locations can be searched directly for signs of life, as Mars was by the Viking Project of the mid-1970's. There are billions of other locations outside of this solar system that cannot be searched directly because of the enormous distances involved.

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GOLDIN ANNOUNCES CHANGES IN NASA ORGANIZATION TO FOCUS AND STRENGTHEN PROGRAMS AND MANAGEMENT

On October 15, Administrator Daniel S. Goldin announced structural changes at NASA to improve management and bring focus to programs that are essential to America's future.

"Of all the agencies in government, NASA has a unique responsibility to invest in the future to ensure there is hope and opportunity for future generations and to keep America on the cutting edge of technology," Goldin said, "Today, I am announcing a series of structural changes to better focus NASA's programs, to streamline how we do business so we can meet the challenges ahead," Goldin said.

In preparation for the announcement, Goldin said that over the past 6 months he has traveled to NASA centers, visiting with hundreds of employees, worked with the red & blue teams, met with CEOs of America's top companies, met with small and disadvantaged companies and small entrepreneurial companies, and reached out into minority and women-owned companies.

He has traveled abroad to meet with leaders on space policy, met personally with nearly 200 members of Congress and analyzed major reports such as the Augustine Report, the Paine Commission Report, and the Rogers Commission Report. He also has reached out to academia and the science community.

"The past 6 months, I've reached deep into NASA to listen to the hopes and dreams of employees. I've listened to concerns expressed by America's leaders outside the agency," Goldin said. "If there is universal agreement on one point it's that NASA cannot afford to fail, that it must be the preeminent technological leader of the world," Goldin said. "NASA must reach for the stars and bring back to America dual-use technology to improve life on Earth." To achieve its goals, Goldin announced the following structural and managerial changes at NASA.

SPACE STATION FREEDOM

Strengthening the focus of management of Space Station Freedom (SSF) is of the highest priority for NASA. In a September 17, 1992 speech, Goldin said he was "taking steps to ensure NASA's top talent is working on this program."

Marty Kress will become Deputy Program Manager for Policy and Management, responsible for strengthening cooperation with the space station user community, international partners, and the private sector. His previous position was Assistant Administrator for Legislative Affairs. "Marty Kress is one of NASA's best and brightest rising young stars, who has successfully helped me steer the agency through difficult budget deliberations on Capitol Hill," Goldin said. "His talent is now needed for even greater challenges, to pull together, coordinate, and integrate the scientific and commercial communities so they take full advantage of the opportunities aboard Space Station Freedom." The appointment will allow Dick Kohrs, Space Station Associate Administrator, to focus his skills on the day-to-day development and construction of SSF.

"NASA must reach for the stars and bring back to America dual-use technology to improve life on Earth."

Mary Kerwin, Director, Liaison Division, will become Acting Assistant Administrator for Legislative Affairs. Tom Campbell, formerly NASA Comptroller, will become the Chief Financial Officer for SSF to help ensure SSF keeps within its budget estimates. Gary Allison, who was Deputy Comptroller, will become Acting Comptroller.

SCIENCE & TECHNOLOGY

NASA, which is recognized for its great scientific achievements, must strengthen its outreach to the science community to improve the integration and coordination of research.

Len Fisk will be promoted to the new position of Chief Scientist for NASA. Len's previous position was Associate Administrator for Space Science and Applications. "Len is one of NASA's most brilliant and outstanding scientists," Goldin said. "His formidable challenge will be to aggressively work with the scientific and engineering community, particularly academia, to fully involve them in our research goals. He will be responsible for forging a strong bond with the directors of research and development in corporate America to ensure NASA is getting the very best technology in all our science missions," Goldin said.

"Len, because of his outstanding communication abilities, will also be instrumental in explaining to the public the importance of NASA's research to improve life on Earth and to inspire humanity with wonderful scientific achievements," Goldin said.

EARTH AND PLANETARY SCIENCE

The Office of Science and Space Applications will be divided into two parts to bring focus to the programs.

Shelby Tilford will become Acting Associate Administrator of Mission to Planet Earth. He was previously Director of Earth Sciences. "Mission to Planet Earth is more than a duty, it's a moral commitment to future generations," Goldin said. "We must understand our environment — separating natural from human causes and effects — so policy makers can make decisions on hard data, not suppositions."

Wes Huntress, previously Director of Solar System Exploration, will become Acting Associate Administrator of Planetary Science and Astrophysics. "We must build and launch many more spacecraft that are smaller, faster, and cheaper," Goldin said. "By studying our solar system and the universe, we will be able to better understand Earth's environment and its future and see if life has developed on other planets and understand how the planets formed."

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HUBBLE SPACE TELESCOPE

GALAXY CLUSTER PROVIDES A GRAVITATIONAL LENS FOR HUBBLE TELESCOPE

NASA's Hubble Space Telescope (HST) has photographed a striking mirror image of a very distant galaxy. The observations might unlock the secrets of the dark matter mystery, which has puzzled astronomers for decades.

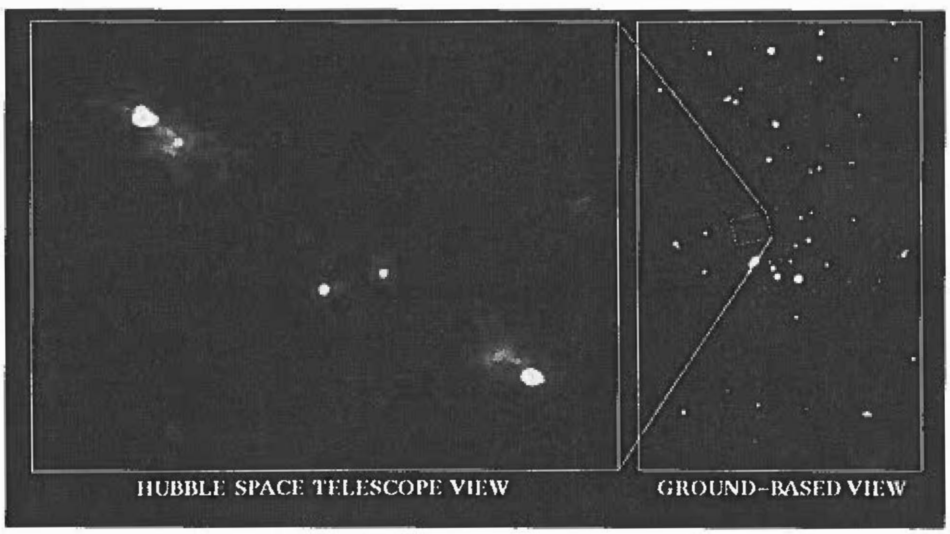


PHOTO: RICHARD ELLIS (DURHAM UNIVERSITY)/NASA

GRAVITATIONAL LENS IN GALAXY CLUSTER AC114

The NASA Hubble Space Telescope photograph (above left) shows a pair of L-shaped images with striking mirror symmetry. These are thought to arise from a very distant galaxy seen through a cluster of foreground galaxies (above right). The gravity of the galaxy cluster acts as a natural magnifying glass, bending and focusing the light of the more distant source into several images, each of which is apparently larger and brighter than would otherwise be the case. This rare combination of Hubble's powerful telescope mirrors and the natural "telephoto lens" gives astronomers unprecedented information on the nature of very distant galaxies, and on the distribution and nature of matter in the foreground cluster. The two compact objects in the center of the HST image are thought to be unrelated galaxies in the foreground cluster. The observations were made with Hubble's Wide Field Camera in one of the first long exposures (six hours) with the orbiting observatory.

The image is seen through a huge cluster of foreground galaxies located four billion light-years away. The gravity of the galaxy cluster acts as a natural "magnifying glass," bending and focusing the light of the distant galaxy into several images, each of which is enlarged and made brighter than would otherwise be the case. This rare combination of Hubble's powerful telescope mirrors and the natural "telephoto lens" gives astronomers new information on the nature of distant galaxies.

By studying how the lens bends the light, investigators can also deduce the amount and location of mysterious "dark matter," thought to make up most of the cluster's mass. Astronomers estimate that at least 90 percent of the universe consists of material that does not emit any radiation that can be detected by current instrumentation. Although dark matter cannot be seen directly, the phenomenon of gravitational lensing provides a powerful probe in the search for dark matter.

"We already knew that this cluster of galaxies could act as a gravitational lens from groundbased images," says Richard Ellis of Durham University, England. "The remarkable feature of the new data is the detail with which we can study background galaxies by combining the lensing phenomenon with the excellent image quality possible with HST. The unique combination has allowed us to measure the bending power of the lens very precisely, enabling us to determine the distribution of matter in the cluster regardless of whether it emits light."

Ellis and co-researchers Dr. Warrick Couch (University of New South Wales, Australia), and Dr. Ray Sharples and Ian Smail (Durham University) made the discovery when observing the cluster called AC 114 in one of the first long exposures with the spacecraft's Wide Field camera. Two six-hour exposures revealed a striking pair of faint objects close to the center of the cluster. Each image has a faint structure attached to it. These structures show perfect mirror symmetry, as expected if both are lensed images of the same source. The images are unusually far apart for a lensed system, implying AC114 has a dense massive core.

"Despite their wide separation, the high degree of symmetry and identical colors of the objects are a strong indication that they are images of the same source, supporting the hypothesis that AC114 is acting as a very powerful and massive lens," Ellis explained. "We believe that we are looking at a very faint distant galaxy whose blue color may indicate energetic star formation. At first we thought we were privileged to see such a dramatic feature in the first long exposure with Hubble, but we now believe that similar highly magnified multiple images may be observed when the spacecraft looks through the centers of other massive clusters."

"We believe that we are looking at a very distant galaxy whose blue color may indicate energetic star formation."

A ZOOM LENS IN SPACE

Albert Einstein was the first to point out that gravitational fields deflect light as well as matter. The gravitational field of a massive object, such as a cluster of galaxies, will deflect light rays from more distant sources seen close to the cluster center. This has the effect of shifting their apparent positions and magnifying and distorting their shapes and brightnesses. The greater the cluster's mass, the greater the effect. If the cluster is dense enough it can create several images of a single distant object.

Multiple-lensed systems provide astronomers with a powerful probe to investigate the form of the gravitation field of the lens. Ellis and fellow researchers have developed numerical models based on Einstein's theory. Starting from the location and shapes of the first two images, they predict the existence and location of further images. The remarkably blue color and unusual morphology of the source has enabled them to identify a third, fainter candidate image.

This, and any further images similarly located, will enable the group to refine their lens model. The goal is to make it precise enough to find the distances and properties of hundreds of very faint galaxies viewed through the cluster. These objects are far too faint for more traditional distance-measuring techniques and promise to reveal the nature of the very early universe. "Just as in elementary optics, once you know the basic properties of a lens, you can examine the images it produces and figure out how far away the sources are," Ellis explained.

THE SEARCH FOR DARK MATTER

Clusters like AC 114 are not only very useful probes for the galaxies at the limits of the universe, but their lensing properties also show how much dark matter they contain. Astronomers estimate that 90 percent of the universe may consist of material that does not emit any radiation detectable by current instrumentation. Although such dark matter cannot be seen, its existence has been inferred from its gravitational influence on the motions of galaxies in clusters.

More importantly, the amount can be measured directly via gravitational lensing. The team's model for AC1 14 provides an important new measurement of the amount of dark matter in AC114 that agrees with previous estimates based on the motions of its galaxies. It also suggests that the dark matter may be more concentrated toward the center of the cluster than the individual galaxies. The group now plans to extend this work to other clusters. "We intend to use HST's superlative image quality to search for similar lensed systems in other rich clusters," said Ellis. "Using these we hope to directly probe the changes in the structure of clusters as they evolve and grow in the universe."

NEW IN PRINT

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

A REVIEW

A LUNAR-BASED CHEMICAL ANALYSIS LABORATORY

Proceedings of the Ninth College Park Colloquium on Chemical Evolution
Edited by Cyril Ponnamperuma and Charles W. Gehrke
A. Deerpak Publishing, Hampton, Virginia, 1992, 281 pp.
Black and white illustrations. Hardcover. $45.00

The Ninth College Park Colloquium on Chemical Evolution was held in October 1989 at the University of Maryland. Its subject matter was the concept of a lunar-based chemical analysis laboratory, with presentations and discussion on policy, research opportunities, and specific operational and instrumentation requirements. This book is the Proceedings of that conference, but I found it somewhat confusing in presentation; in particular, the introductory material is inadequate to explain the book. The varied formats show that the papers were author-produced but without common guidelines; some have extensive references, others none. Some appear to be pre-meeting abstracts, some to be close to typed copies of spoken presentations, and others to have been thoughtfully revised after the conference. All papers presented at the conference appear as papers in this volume, and have the same sequence as the program, with one exception; for some reason (which as a one-time editor I can guess at!) this one has been tacked onto the end. But while the program is divided into sections with informative headings, the papers are not. Most of the paper titles are at least slightly different from the program titles, and in several cases the authors, including the first authors, are different. Thus it appears that at least some of the papers have been revised, rewritten, and perhaps reviewed between the conference and publication; at least one summarizes work presented in others. But the introductory material does not help understand what is what in this book. There is an executive summary, but from my reading of it, it could have been written before the conference.

A basic given of the conference appears to have been that there will and should be a lunar base as part of NASA's future, and that successful scientific research depends on the presence of sophisticated analytical research tools and technology. The papers address both life sciences and physical sciences, where the latter includes both planetary science and exobiology. However, the Colloquium and the Proceedings are heavily biased towards life sciences: the needs of chemical laboratories for the health care and study of the human body under low gravity, including psychological stress. Even exobiology is hardly represented. Planetary scientists will find little here to keep them occupied, although my impression on seeing the book title was that this WAS mostly about the study of the Moon itself. The lunar papers (of which there are three) are good reviews, but are probably more to inform others at the Colloquium than to inform planetary scientists. The bias may not be surprising in view of the backgrounds of all on the organizing committee, but with no information about how the conference was organized, and who was invited, it is difficult to assess significance of the balance of presentations.

The bottom line of the Proceedings, an apparent major consensus of the Colloquium, is that a multipurpose, miniaturized, automated chemical analysis laboratory and its requirements should be boosted by funded work over the next decade and more, with strong support for a consortium of academic, government, and industry researchers to develop the requirements, design, and implementation of such a laboratory. But I think I would have guessed before the conference that that would be a conclusion of the conference; it is hardly likely that naysayers were at the Colloquium!

—Graham Ryder

(Dr. Ryder is a staff scientist at Lunar and Planetary Institute.)

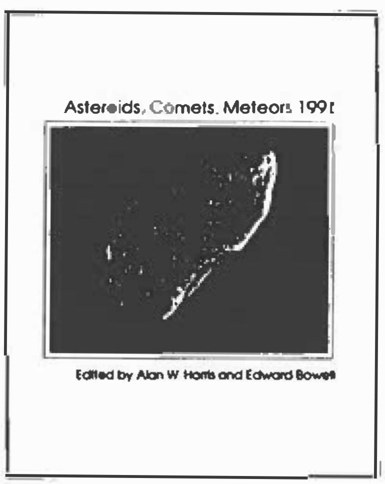
LUNAR BASES II

A limited number of copies of *The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volumes I and II,* is available by written request from LPI. When this supply is exhausted, requestors should contact the National Technical Information Service, 5285 Port Royal Road, Springfield VA 22161; phone: 703-487-4650. The publication is NASA CP 3166.

NEW FROM THE ASTRONOMICAL SOCIETY OF THE PACIFIC

SLIDE SET ON WOMEN IN ASTRONOMY

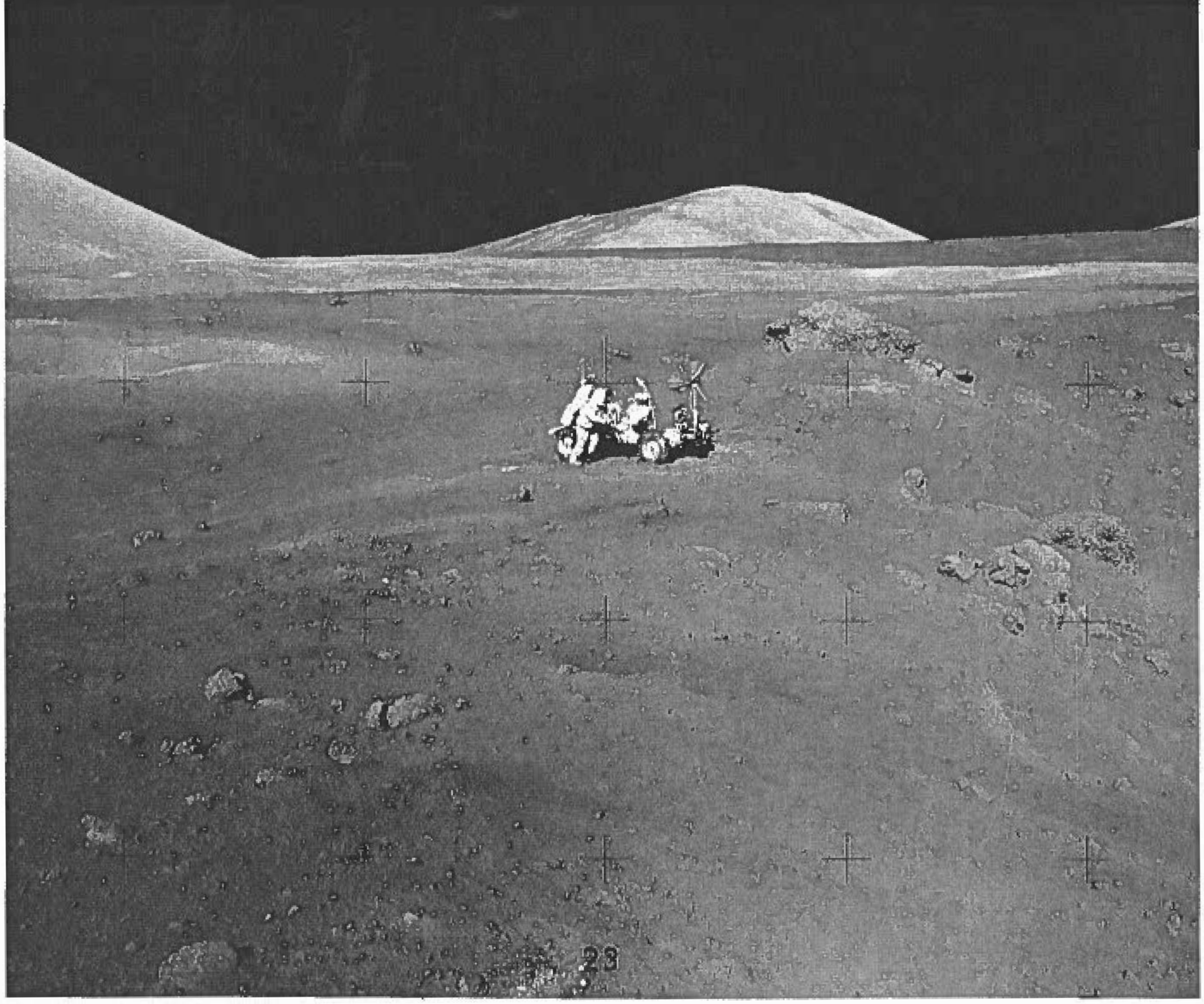
A set of 26 slides and a 36-page booklet depicting the important role women play in astronomy are available from the non-profit Astronomical Society of the Pacific. Included are photographs from historical archives and recent images of women at work in astronomy around the world. The booklet includes detailed captions and a biography of the women profiled, opinions and advice from the astronomers gleaned from their experience in the field, and a thorough reading list. The women pictured in the set include Caroline Herschel, Maria Mitchell, Annie Cannon, Henrietta Leavitt, Jocelyn Bell Burnell, Margaret Burbidge, Sally Ride, Vera Rubin, Jill Tarter, and Eleanor Helin. $39.45 from A.S.P., Women's Slide Orders, 390 Ashton Avenue, San Francisco CA 94112.



ACM PROCEEDINGS AVAILABLE FROM LPI

Asteroids, Comets, Meteors 1991, edited by A. W. Harris and E. Bowell, is now available from the Lunar and Planetary Institute. This 694-page softcover volume is the result of the international conference held in Flagstaff, Arizona, June 24–28, 1991, and contains 159 articles on numerous aspects of studies of asteroids, comets, meteors, and their interrelations, including discovery, astrometry, orbital dynamics, origin and evolution, physical observations, laboratory studies, and space missions. The book also contains author and subject indexes. To order a copy, please see the Order Form contained in this issue of the Bulletin.

APOLLO 17 - TWENTY YEARS LATER



Station 4 at Taurus-Littrow, Apollo 17 landing site. The rover is on the rim of Shorty Crater, an impact crater 110 m in diameter, which has excavated dark material (volcanic pryoclastic glasses) from beneath the light mantle (highlands debris). LM Pilot Jack Schmitt prepares to study, sample, and characterize the dark ejecta depostis of this crater.

By Graham Ryder

Workshop on Geology of the Apollo 17 Landing Site. Dec 2–4, 1992, at the Lunar and Planetary Institute, Houston. Convenors G. Ryder, P.D. Spudis, and H.H. Schmitt.

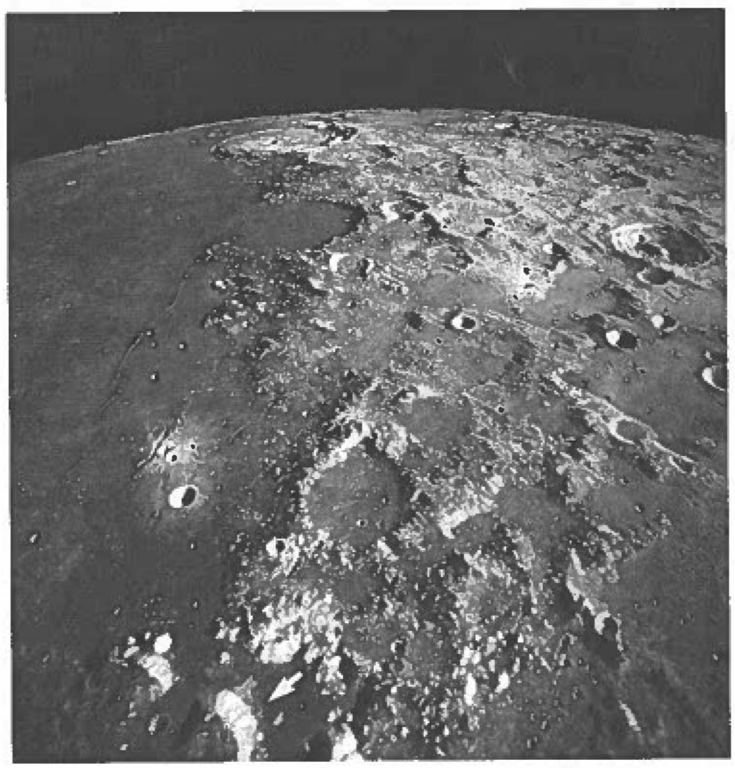
Held to nearly coincide with the 20th Anniversary of the launch of the Apollo 17 mission (11.30 pm c.s.t., December 6, 1972), the Workshop on the Geology of the Apollo 17 Landing site was a mixture of nostalgia and review on the one hand, and reports of recent, ongoing, and suggested future work on the other. The 2 1/2 day meeting had 78 registered attendees who discussed the wide range of topics engendered by the diversity of both the landing site and its regional context. The Taurus-Littrow valley floor was chosen as the final Apollo site for the mountains that circle the Serenitatis basin, the young-appearing dark mantle that might provide volatiles and xenoliths, and the dark volcanic valley floor. Both samples and remote sensing data (from lunar orbit and ongoing from earth) provide continued new information on the geology and petrology of the landing site; for scientific purposes the Apollo 17 mission continues. The Workshop brought together a diverse crowd, including geologists, remote sensors, sample analysts, and resource experts, some of whom were involved in the landing and many of whom were too young to have had more than a passing interest in it at the time.

The surface crew, Gene Cernan and Jack Schmitt (one of the convenors, and the only fully-fledged geologist to study the Moon close-up), participated in the Workshop. They contributed considerable substance and flavor to discussions of surface observations such as the study of orange materials at Shorty crater and color boundaries distally in the highlands massifs and proximally in the boulders, as well as to orbital observations and the problems of working and living on the Moon. The Workshop started with overviews of the landing site, the samples collected, and crew observations. It then considered sequentially the ancient crust sampled in the massifs; the Serenitatis basin as a structural, geological, and petrological entity; mare volcanism including pyroclastic glasses and the mantle sources; post-mare tectonic and regolith processes; and our potential future in scientific research and resource use at the Apollo 17 or a similar site. The abstracts for the presentations are available as LPI Technical Report Number 92-09, Part 1. A summary of the discussions at the Workshop will be made available in 1993 as Part 2.

Few topics addressed or created by the Apollo 17 mission can be said to be completely closed, even if the broad outlines of geology were established (with some realignment of pre-mission concepts) soon after the mission. The open issues were a main target of the Workshop. Participants found themselves addressing a series of questions, few as yet with definitive answers (why not?). The ingredients of the massifs remain somewhat uncertain; most of the samples are a single impact melt composition (Serenitatis, presumably), that cannot represent most of the massifs (e.g. the soil chemistry doesn't allow it). Work is progressing on understanding what the smaller sampled pieces are, and varied feldspathic impactites and even troctolitic anorthosites are the most conspicuous. But how do they fit into the massifs, and in turn into early crustal genesis? Plutonic norites and troctolites are obvious in the melt sheet, but do they occur out of it? Why are ferroan anorthosites so rare at the Apollo 17 site (this shows in the remotely sensed data as well as samples)? Are the Sculptured Hills different from the main massifs? And is the valley even a graben as normally accepted; there are certainly alternatives to that interpretation that have implications for the provenance of the collected samples. Even until late in the 70's, the age of Serenitatis was variedly taken as between 3.9 and 4.2 Ga; few now deny an age of 3.87 Ga give or take a little bit. But what do any other ages mean? Just how to tackle these questions is a goal of future and ongoing research on the massifs and the Serenitatis basin. An improved understanding of smaller regolith particles, clasts in breccias, and the geochronology of components are essential parts of the study. Improvement of concepts of the regional context from remote spectral study of mineralogy need to be made and assimilated.

Recent work on the mare basalts has provided a more complete chemical and isotopic picture of the types of basalt at the site and the melted mantle beneath them, but the picture is certainly not complete, and puzzling or at least contentious features remain. Particularly significant is the presence of volatiles in the pyroclastic samples: where they come from and their implications for lunar genesis and evolution, and how they behave during eruption. At least some participants in the Workshop probably arrived believing that many of these questions were satisfactorily closed, but left feeling that as yet they are not. A thickness of 1400 meters of basalt in the valley has been generally accepted since the Apollo 17 mission, but so great a thickness was questioned at the Workshop. Does the geophysical data require it, and if so, how did the 15% highlands material in the central valley soils get there when horizontal transport is otherwise concluded to be inefficient?

One obvious conclusion is that we will not entirely answer these questions until we have improved orbital data and even actually return to the site. Thus the Workshop addressed the question of a return specifically. Such a return would be not only for science (e.g. check out the massifs, the basin fill thickness, and the real nature of the Sculptured Hills), but also for more practical purposes. The ilmenite-rich soil is a particularly attractive target for the lunar production of hydrogen and oxygen, and thus for the supply of humans living for long periods on the Moon. Perhaps in another 20 years we will have practical experience with some of the production techniques discussed — practical experience obtained on the Moon itself. ⌀



The Apollo 17 landing site at Taurus-Littrow.

continued from page 11

AERONAUTICS

Goldin announced in a recent speech that NASA needs a better balance of programs between subsonics, National Aerospace Plane hypersonics, and high speed civil transport. In addition, NASA needs to develop a strategic plan to ensure we have the proper facilities to keep America's aerospace industry the world's leader. The Office of Aerospace and Space Technology will be divided to provide focus as specified below.

Pete Petersen will become Special Assistant to the Administrator to develop a comprehensive and integrated long-term plan that identifies the critical facilities for aeronautics and space. He was Associate Administrator for Aeronautics And Space Technology. "As the Augustine Report points out, NASA's infrastructure is critical to meeting its mission goals," Goldin said. "NASA must develop an integrated facilities plan, in coordination with other government agencies and private industry, to construct world class facilities for aeronautics and space. We must avoid duplication in government and industry to achieve maximum results and stretch taxpayer's dollars."

Cecil Rosen, who was Director for Aeronautics, will become Acting Associate Administrator for the Office of Aeronautics. Gregory Reck will become Acting Associate Administrator for the new office of Advanced Concepts And Technology. Courtney Stadd will become Acting Deputy Associate Administrator for the new office of Advanced Concepts And Technology.

"NASA needs to attract and work with America's greatest researchers and entrepreneurs in academia and industry," Goldin said. "This office will push America's technological frontiers. It will be the catalyst for innovation and commercialization of technology and for transferring technology to create jobs, opportunity and creatively commercialize space."

As part of the restructuring, the Office of Commercial Programs will become part of this new division. Jack Mannix, who was Assistant Administrator for the Office of Commercial Programs, will become Associate General Counsel for Intellectual Property.

RUSSIAN PROGRAMS

Sam Keller, Associate Administrator for Russian Programs will be on Special Assignment. "Because of Sam Keller's talent and hard work, NASA has been able to sign far-reaching contracts with Russia in record speed," Goldin said. "He now will be moving on to new and exciting challenges." ⌀

Chicxulub continued

of the crater target materials to the mineral fragments, shocked clasts, and glasses dispersed around the world at the K/T boundary layer.

Previous work apparently sampled only the shattered carbonate-evaporite platform atop the crater and could not account for the chemistry and mineralogy of clasts found in the boundary deposits.

"These results leave no room to doubt that Chicxulub is the K/T source crater," said Dr. Sharpton of the findings.

More Supporting Evidence

The team also measured iridium contents hundreds of times higher than normal in the melt rocks they studied—the first time anomalously high iridium levels observed at the K/T boundary have been measured at the Chicxulub structure itself, another clear link between the crater and the boundary debris.

Magnetic data presented in the paper show that the rocks melted by the tremendous impact cooled during a time when the Earth's magnetic poles were reversed. By looking back through the geologic record of periodic polarization "flips," the authors single out the 29R chron as the only reversal episode consistent with isotopic ages obtained: this episode includes the K/T boundary.

Radiometric ages for the structure obtained by the team are in agreement with those found by other researchers using the same dating technique. The confirmation is important because impact features are notoriously difficult to date even given excellent analytical precision.

The enormous shock pressure caused by massive impact resets the atomic clock of some elements, which are then used to measure the time since the event. But the resetting is often not uniform throughout a structure and may be affected by post-impact events; thus dating of many samples builds confidence in the result.

Prior to the analyses of the basement rock at the crater, other workers suggested that several simultaneous impacts might be needed to explain the material at the boundary layer that was not tied to the Chicxulub structure. While the new results do not rule out multiple impacts, Dr. Sharpton concludes, "There is no compelling need for multiple simultaneous impacts or comet showers to account for the shocked material distributed at the K/T boundary. Chicxulub seems able to account for it all—singlehandedly." ⌀

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Pam Thompson, Editor

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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 (NASAMAIL)PBTHOMPSON

CALENDAR 1992–1993

1992 is International Space Year

A host of activities, events, and meetings around the world will focus on space science and exploration with a special emphasis on education. The year-long celebration is coordinated by the national space agencies of 29 countries, the United Nations, 9 international organizations, and many other groups, large and small. Some of the highlights are included in the *LPIB* Calendar. For a more complete list, refer to the special ISY insert in the January/February issues of *Ad Astra* or *Final Frontier* or contact the US-ISY Association, 600 Maryland Avenue NW, Suite 600, Washington DC 20024; phone: 202-863-1734; FAX: 202-863-5240.

DECEMBER

1-3

Technology 2002, Baltimore, Maryland. Contact: NASA and Technology Utilization Foundation. Phone: 800-944-NASA.

2-4

LAPST Workshop on the Apollo 17 Landing Site, Houston, Texas. Contact: Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2150; FAX: 713-486-2160.

7-11

American Geophysical Union, Fall Meeting, San Francisco, California. Contact: AGU Meetings, 2000 Florida Avenue NW, Washington DC 20009. Phone: 202-462-6903.

8-10

Planetary Systems: Formation, Evolution, and Detection—First International Conference, Pasadena, California. Contact: Neil Nickle, Jet Propulsion Laboratory, 180-704, 4800 Oak Grove Drive, Pasadena CA 91109-8099. Phone: 818-354-8244.
NASAMAIL: NNICKLE

JANUARY 1993

4-9

Hazards Due to Comets and Asteroids, Tucson, Arizona. Contact: Tom Gehrels, Lunar and Planetary Lab, University of Arizona, Tucson AZ 85721. Phone: 602-621-6970.

10-13

32nd Aerospace Sciences Meeting and Exhibits, Reno, Nevada. Contact: David Owens, AIAA. Phone: 202-646-7447.

10-14

10th Symposium on Space Nuclear Power and Propulsion, Albuquerque, New Mexico. Contact: Mohamed El-Genk, Institute for Space Nuclear Power Studies at University of New Mexico, CHNE Department-ISNPS, FEC 239, Albuquerque NM 87131-1341.

FEBRUARY

8-11

Ninth Thematic Conference on Geologic Remote Sensing: Exploration, Environment, and Engineering, Pasadena, California. Contact: Nancy Wallman, ERIM, Box 134001, Ann Arbor MI 48113-4001. Phone: 313-994-1200 ext. 3234; FAX: 313-994-5123.

11-16

American Association for the Advancement of Science, annual meeting, Boston, Massachusetts. Contact: AAAS, 1333 H Street NW, Washington DC 20005. Phone: 202-326-6400.

18-19

Smaller, Cheaper, Faster Missions to the Moon and Mars—4th Annual Symposium of the UA/NASA Space Engineering Research Center, Tucson, Arizona. Contact: Dr. T. Triffet, University of Arizona, 4717 E. Ft. Lowell Road, Tucson AZ 85712. Phone: 602-322-2304; FAX: 602-326-0938.

22-24

AAS/AIAA Space Flight Mechanics Meeting, Pasadena, California. Contact: AAS Business Office. Phone: 703-866-0020.

28-Mar 5

Digital Image Processing, Kona, Hawaii. Contact: C. V. Freiman, Engineering Foundation, 345 E. 47th Street, New York NY 10017. Phone: 212-705-7835.

MARCH

9-10

31st AAS Goddard Memorial Symposium, Arlington, Virginia. Contact: AAS Business Office. Phone: 703-866-0020.

15-19

24th Lunar and Planetary Science Conference, Houston, Texas. Contact: Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2150; FAX: 713-486-2160.

CALENDAR

APRIL

1-3
Fractals and Dynamic Systems In Geosciences international meeting, Franfurt/Main, Germany. Contact: Jorn H. Kruhl, Geology-Paleontology Institute, JW Goethe-University, Senckenberganlage 32, D-6000 Frankfurt/Main, Germany. Phone: 0049-69-7982695; FAX: 0049-69-7988383.

1-4
National Science Teachers Association Annual Meeting, Kansas City, Missouri. Contact: NSTA, 1742 Connecticut Avenue NW, Washington DC 20009-1171. Phone: 202-328-5800; FAX: 202-328-0974.

4-8
25th International Symposium on Remote Sensing and Global Environmental Change, Graz, Austria. Contact: Nancy Wallman, ERIM Symposium, P.O. Box 134001, Ann Arbor MI 48113-4001. Phone: 313-994-1200, ext. 3234; FAX: 313-994-5123.

5-8
Global Warming International Meeting, Chicago, Illinois. Contact: Sinyan Shen, Natural Resource Management Division, SUPCON International. One Heritage Plaza, Woodridge IL 60517-0275. Phone: 708-910-1551; FAX: 708-910-1561.

15-16
Science and Technology Policy Meeting, Washington, DC. Contact: American Association for the Advancement of Science, 1333 H Street NW, Washington DC 20005. Phone: 202-326-6400.

21-25
Geoscience Education and Training, Southampton, UK. Contact: Mrs. Esther Johnson, GEOED Conference Secretariat, University of Southampton, Southampton S09 5NH, UK. Phone: (0703) 593049; FAX: (0703) 593052; telex: 47662 SOTONU G.

23-26
Robotic Observatories: The First Decade, Tucson, Arizona. Contact: B. Rafert, Florida Institute of Technology, Physics and Space Sciences, 150 West University Boulevard, Melbourne FL 32901. Phone 407-768-8000, ext. 7324; FAX: 407-984-8461.

MAY

15-17
Workshop on the Analysis of Interplanetary Dust, Houston, Texas. Contact: Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2150; FAX: 713-486-2160.

MAY (CONTINUED)

17-19
Annual Meeting of the Geological Association of Canada and Mineralogical Association of Canada, Edmonton, Alberta, Canada. Contact: J. W. Kramers, Alberta Geological Survey, P.O. Box 8330, Station F, Edmondton, Alberta T6H 5X2, Canada. Phone: 403-438-7644; FAX: 403-438-3644.

JUNE

6-9
5th International Space Conference of Pacific-Basin Societies, ISCOPS, Shanghai, China. Contact: AAS Business Office. Phone: 703-866-0020.

14-18
Asteroids, Comets, Meteors 1993, Belgirate (Novara), Italy. Contact: Dr. Vincenzo Zappala, Astronomical Observatory, Strada Observatorio 20, 10025 Pino Torinese (70), Italy. or Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2150; FAX: 713-486-2160.

21-23
Catastrophic Disruptions of Small Solar System Bodies, Gubbio (Umbria), Italy. Contact: Paolo Paolicchi, Departimento di Fisica, Universita di Pisa, Piazza Torricelli 2, I-56126, Pisa, Italy.
STARGAS@ICNUCEVM.BITNET

28-30
MSATT Workshop on Atmospheric Transport on Mars, Corvallis, Oregon. Contact: Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2150; FAX: 713-486-2160.

JULY

5-9
Gordon Research Conference on Origins of Solar Systems, New London, New Hampshire. Contact: John A. Wood, Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge MA 02138. Phone: 617-495-7278; FAX: 617-495-7001.
SPAN: CFA::WOOD
Bitnet: WOOD@CFA
Internet: WOOD@CFA.HARVARD.EDU

10-16
105th Annual Meeting of the Astronomical Society of the Pacific, San Diego, California. Contact: ASP, 390 Ashton Avenue, San Francisco CA 94112. Phone: 415-337-1100.

JULY (CONTINUED)

10-11

Universe '93—A Weekend Astronomy Exposition and Fair, San Diego, California. Contact: Meeting Information, Astronomical Society of the Pacific, 390 Ashton Avenue, San Francisco CA 94112. Phone: 415-337-1100.

13-14

The Universe in the Classroom: A Workshop on Teaching Astronomy in Grades 3-12, San Diego, California.Contact: Meeting Information, Astronomical Society of the Pacific, 390 Ashton Avenue, San Francisco CA 94112. Phone: 415-337-1100.

15

Teaching About the Universe, a one-day program on astronomy education in the U.S., San Diego, California. Contact: Meeting Information, Astronomical Society of the Pacific, 390 Ashton Avenue, San Francisco CA 94112. Phone: 415-337-1100.

Environmental Context of Human Evolution (International Scientific Congress and Exhibition), The Netherlands and Indonesia. Contact: Dr. Hans Beijer, Geological Survey of the Netherlands, P.O. Box 157, NL-2000 AD Haarlem, The Netherlands. FAX: 31 23 351614.

19-23

56th Meteoritical Society Meeting, Vail, Colorado. Contact: Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2150; FAX: 713-486-2160.

26-28

MSATT Workshop on Early Mars: How Warm and How Wet, Colorado. Contact: Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2150; FAX: 713-486-2160.

AUGUST

8-14

MSATT Workshop/Field Trips on The Martian Northern Plains: Sedimentologic, Periglacial, and Paleoclimatic Evolution, Fairbanks, Alaska. Contact: Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2150; FAX: 713-486-2160.

16-19

AAS/AIAA Astrodynamics Conference, Victoria, British Columbia, Canada. Contact: AAS Business Office. Phone: 703-866-0020.

SEPTEMBER

25-Oct 1

International Association of Volcanology and Chemistry of the Earth's Interior General Assembly, Canberra, Australia. Contact: IAVCEI ACTS, GPO Box 2200, Canberra ACT 2601, Australia. Phone: 61-6-257-3299; FAX: 61-6-257-3256.

OCTOBER

25-28

Geological Society of America Annual Meeting, Boston, Massachusetts. Contact: Vanessa George, GSA, Box 9140, Boulder CO 80301. Phone: 303-447-2020.

24th LPSC

March 15–19, 1993, marks the dates of the 24th Lunar and Planetary Science Conference in Houston, Texas. Sessions wil be held at the NASA Johnson Space Center and the Lunar and Planetary Institute .

The Magellan spacecraft is providing a global view of Venus and significant new data on volcanism, tectonism, impact cratering, and surface modification processes. A special session on Magellan will focus on the most recent results in analyses of Magellan and related data and comparisons to Earth and other planets.

Planning for missions to be carried out by NASA's Office of Exploration has progressed substantially in recent months. This special session will feature results from the December 1992 Galileo lunar flyby as well as discussions of instrument planning for two lunar orbital missions, lander science, and other activities for human outposts on the Moon.

The Mars Surface and Atmosphere Through Time Program will sponsor a session to highlight research into the evolution of physical and chemical features of the martian surface and atmosphere and their interactions.

A session on "Successful Education Programs at the Secondary and College Levels" is being planned. Suggestions may be made to Doug Blanchard or Joe Boyce.

Please contact the LPI Program Services Department (713-486-2166) for further information about the Conference. Contact the LPI Publications Services Department (713-486-2143) for information about abstract submission. ∅

SPECIAL SECTION

Help For Users Of Online Services

During 1992 the Lunar and Planetary Institute has introduced some new online services to facilitate the announcement of LPI-sponsored meetings, to convey pertinent meeting-related information, and to provide pre-conference access to abstracts and programs. Included in these services is e-mail submission of abstracts. Because technology is bringing about rapid change in scholarly research and communication, we thought it might be helpful to reprint a guide recently published by the American Astronomical Society (AAS).

The following "User's Guide to Electronic Mail and Network Services" was published in the *1993 Membership Directory* of the American Astronomical Society and is being reprinted with the permission of the AAS. Our purpose in reprinting this guide is the same as the stated purpose of the authors of the Guide: "to give new or aspiring users of electronic mail some knowledge of how the process works." Likewise, "we hope to give the new user enough information to get started . . . and we hope that experienced e-mailers may pick up some hints which will make their life easier."

USER'S GUIDE TO ELECTRONIC MAIL & NETWORK SERVICES

Prepared by: *Peter B. Boyce,* American Astronomical Society; *Donald C. Wells,* National Radio Astronomy Observatory; *Robert J. Hanisch,* Space Telescope Science Institute; *Joanie Thompson,* Sterling Software, NASA Science Internet

1. Introduction

Computer networks now span the world, and the gateways between them allow millions of users to send electronic mail messages to one another, permitting easy collaboration between researchers in different countries. However, the syntax required to send a message from one machine to another may be complicated. . . .

. . . This guide is designed to give new or aspiring users of electronic mail some knowledge of how the process works. We attempt to give enough background to help anyone understand enough of the various networks and procedures to be able to communicate effectively with their scientific colleagues. We have made every effort to make this guide complete and accurate.

Up to now, the main use of networks has been rapid and convenient communication (the main subject of this Guide). However, with a direct network connection, a whole range of services and capabilities becomes possible, which will soon prove to exceed in usefulness the current communications capabilities.

. . . To take advantage of many of these services it is necessary to have a direct Internet connection. Connections through BITNet and dial-up modems do not have sufficient capabilities to provide more than e-mail services and simple file transfers.

This overview of electronic mail communications was drawn originally from a document by Chris Benn and Ralph Martin of the Royal Greenwich Observatory and updated (to accommodate a North American point of view) by Peter Shames and the authors. We are greatly indebted to everyone who has helped in the preparation of this and all previous versions. The present (1993) version is significantly revised and reflects the changes in philosophy and operation which have taken place as the networks have grown.

This Guide assumes that the user has access to a computer at his or her institution which has a connection to a campus or institutional network and is, in turn, connected to one of the major networks used by scientists. As an alternative, electronic networks may be accessed by modem through such services as the AIP's PINET. Each user on a network is identified by a name of some kind, the username. A person's username is often composed of the first initial and last name. It is issued by the system administrator of the local campus or department network.

In order to send electronic mail, it is typically necessary to know the username of the addressee, the name of the machine on which he or she is working (the host), and the name of the network to which the machine is connected (the domain). This information may be obtained from the sender (Section 3 gives some hints on deciphering electronic mail addresses.) Because there are several different networks in wide use, a lot of electronic mail has to cross from one network to another via gateway machines or relays. These are computers that are connected to two or more different networks and which accept mail from one network and forward it onto another network. Many of the mysteries of electronic mail have to do with determining the syntax needed to send mail through such relays. In the past three years, the Internet has emerged as the major network, and mailing among component networks of the Internet has been greatly simplified. General advice on the syntax required to send electronic mail is given in Section 2. Information relating to specific networks may be found in Section 4.

We hope to give the new user enough information to get started. Likewise, we hope that experienced e-mailers may pick up some hints which will make their life easier. Because the interface between the e-mail system and the user differs among sites, we encourage the reader to ask for help from the e-mail experts at their own institution. Finally, users are warned that the situation is constantly changing and that information given in this guide may become outdated with little or no notice.

2. Network Descriptions

The computer network in most common use by astronomers in North America is now the Internet, which is an interconnected collection of networks which all use the same addressing scheme and transfer protocols. Other networks are the various DECnets (the NASA supported one was formerly known as SPAN — for NASA's Space Physics Analysis Network), BITnet and UUCP. In addition, astronomers in other countries have access to their own national networks, such as JANET and Starlink in Britain. The situation is evolving from a complicated melange of networks, which was the situation circa 1987, to the elegant simplicity of Internet universal service and the use of a series of distributed address lists known as Domain Name

Service (DNS). The Internet and some of its component networks will be described below. A number of other networks that may be encountered are described as well.

Mail delivery times will vary from network to network. On the Internet, which uses a store and forward technique, the time for delivery will vary from seconds to hours. DECnet (which used to be known as SPAN) mail delivery is essentially instantaneous (indeed, if the mail cannot be sent the user is informed of this immediately, and queuing of messages is not supported). On UUCP it may take several days for a message to reach its destination. Most networks provide mail delivery in times between a few minutes and a few hours, and if the mail does not go through immediately they will try again several times before returning the mail to the sender. Some networks (such as BITnet) only provide electronic mail services, while others (such as SPAN and Internet) allow users to log in on other computers and copy files.

Although e-mail communication has recently become much simpler, the state of computer networks has, until now, been somewhat akin to telephone systems around the turn of the century. There are numerous systems, some incompatible, and some interconnected through gateways that provide mail forwarding services. Moreover, different networks use different protocols, or data encoding schemes, for the transmission of information. Some of these protocols are open standards, such as TCP/IP (Transmission Control Protocol/Internet Protocol), and some are proprietary to certain manufacturers (such as DEC's DECnet).

As a result of the historical legacy of complexity, there is still often no one simple way to specify a mail address. But, some sense of clarity is emerging from this jumble of addresses and networks. Although there is no equivalent to the standard telephone number, the scheme used on the Internet is becoming the virtual standard. This guide is intended to function like the front pages in your telephone book, which provide telephone dialing instructions, that most of us never read because it's all so simple and standardized. In the case of electronic mail, however, it has not been quite so simple and standardized. Nevertheless, it is getting much better very rapidly as the Internet protocol and forms of address have been adopted by the scientific users in nearly every country.

As far as the user is concerned, electronic mail/data communications lines are essentially error free; complex error checking and error correcting procedures are defined in the standards, and are carried out by a combination of hardware and software. As an alternative to data communications lines, one may use direct dial-up with normal telephone lines and error correcting modems. However, the costs compared with data communications networks are high over long distances, and the passband and signalling standards used on audio networks can vary from country to country, which may result in incompatibility between modems (e.g., between the USA and the UK). Generally, the costs of commercial data communications lines are related to the quantity of data transmitted, while direct dial-up costs are related to the length of time that a call takes. Different methods are used to encode the data on data communications lines and telephone lines. On telephone lines between modems, the data are encoded as a frequency modulated audio tone, and the transmission rate is limited by the bandwidth of the line, usually to 2400 baud (although baud rates up to 9600 can be obtained by using special modems). On data communications links, although the physical media may be similar, phase encoding is used which allows a much higher transmission rate, typically 56K baud. Standards for data communications links are defined by the International Standards Organization (ISO). ISO has attempted to identify a seven layer model describing the interconnection of computers of different types via any kind of network. The lower levels are concerned with hardware matters, such as defining the pin for the "transmit" line, while the upper layers are concerned with more esoteric problems, such as the means by which one might transmit an encrypted picture to a telex machine. However, there is still much confusion, because there exist competing standards from different organizations, such as TCP/IP from the Internet, DECnet from DEC, SNA from IBM and the "Coloured Book" protocols in the UK, some of which incorporate a mixture of ISO and proprietary protocols.

The user marketplace has effectively chosen the TCP/IP standard. Seamless connections which use the Internet addressing schemes are now in place to most countries and other networks. In other words, many of the problems are diminishing. There also seems to be a trend toward establishing a standard form for the name of an e-mail user. Many institutions are using the first initial and the first seven letters of a person's last name as a standard form for the username.

Note on case sensitivity: Most electronic mail addresses are not case sensitive. Thus, you can usually equate an address such as user@site.domain with USER@SITE.DOMAIN or User@Site.Domain. As a matter of convention the networks that are composed primarily of computers running the UNIX operating system tend to use lower case addresses (UUCP, Internet). In the past, networks composed primarily of VMS machines used upper case addresses (SPAN). The present tendency is to use all lower case except where case matters. One should be careful with UUCP addresses in particular where the addresses are case sensitive; the address host1!host2!user is not the same as host1!host2!User.

2.1 Internet

The Internet is now the dominant organization of networks for scientific communication. As of January, 1992, there were more than 727,000 host machines connected to the network. Over 400,000 machines were added to the Internet last year. The Internet is supported by the National Science Foundation, NASA, the Department of Energy, and the United States Geological Survey. The Internet is the network formed by the set of all TCP/IP networks which are interconnected. There are two major cross-country networks of interest to astronomers and other users, one supported by the NSF (NSFNET) and one by NASA (NSI). The two TCP/IP backbones are interconnected, and the namespace of each network is known to the other. Both agencies support major, long-distance, high-speed connections known as backbones. Both of these networks have excellent user help facilities but, unfortunately, neither of them refer to the services supported by the other. Details are covered in separate sections below. The Internet developed out of the Defense Advanced Research Project Agency (D)ARPA network, which was initially set up by the U.S. Department of Defense in 1969. It now includes hundreds of networks in approximately 17,000 domains, which are arranged in a hierarchical scheme. Within the U.S. the major high order domains are:

.com commercial organizations
.edu educational/research organizations
.gov civilian government organizations
.mil Department of Defense
.org other organizations
.net network facilities

Most Internet network sites that astronomers communicate with will be in the .edu domain (universities, national observatories) which has over 240,000 host machines in the U.S.. There are important exceptions: NASA and NSF machines are in the .gov domain, AAS and the European Southern Observatory live in the .org domain and NRL and the U.S. Naval Observatory machines inhabit the .mil domain. There are additional domains for countries outside the USA, e.g., de (Germany - 31,000 machines), uk (United Kingdom - 19,000 machines) and au (Australia - 32,000 machines). Internet machines in these countries are addressed as easily as machines in the U.S. While not originally adopted in other countries, the Internet addressing protocols are now in fairly widespread use in nearly every country. User pressure and the need for compatibility has broken down resistance to the use of Internet addresses, and foreign usage is growing rapidly. In the United Kingdom our colleagues use an inverted order for their machine and domain names, one would hope that they will eventually switch over to become compatible with the rest of the world. Internet connections to the eastern European countries is now fairly reliable, although the recipients are charged for messages received. Please do not send long files to a foreign colleague without first checking that they want them. Typical mail delivery times on Internet are a few minutes. It is sometimes helpful to know that on the Internet individual computers are assigned numerical addresses within a hierarchical system, separated by periods. The first number (or first two numbers) in the address being the number of the individual network on Internet. For example [4.0.0.0] is SATNET, [128.112.0.0] is the Princeton network, and [128.112.24.2] is an individual machine at Princeton. These addresses are mapped against alphanumeric addresses via host tables. Thus, the machine [128.112.24.2] corresponds to pupgg.princeton.edu. In practice, each numbered machine is also given an alphabetic name. The Domain Name System serves as a distributed directory so that users will generally only have to specify the alphanumeric name of the host, rather than its numerical address, when sending mail or doing a remote login. Other examples of Internet host names are stsci.edu, scivax.stsci.edu, noao.arizona.edu, and astro.umd.edu. These names all have at least two components, (site.domain), and may have several fields separated by periods preceding the domain, e.g.,

astro.as.utexas.edu.

These fields can generally be interpreted as a hierarchy — machine, (subnet,) campus, domain. The Network Information Center (NIC) coordinates site and host numbers for all of the systems connected to Internet.

Additional information about the Internet, including more detailed user's guides, can be obtained by following the instructions at the end of the NSFNET and NSI sections below. At the time of writing, both the Senate and House have passed bills funding the development of a National Research and Education Network (NREN) which will be a high-capacity, high-speed version of the present networks based on fiber optic technology.

2.1.1 NSF ScienceNet (NSFNET)

NSF has the mandate to support national networking for the scientific research community. The NSF communications backbone is continually being upgraded with more gateways and faster high-speed lines. This backbone connects supercomputer sites in Princeton, Ithaca, Pittsburgh, Urbana, Boulder, and San Diego. In addition there are backbone nodes in Ann Arbor, College Park, Houston, Lincoln, Palo Alto, Salt Lake City, and Seattle. NSF backbone links provide at least 1.5 Mbits/s and some links have recently been upgraded to 45 Mbits/s.

The NSF backbone services the main node sites and a hierarchically structured set of mid-level networks which include regional networks such as NYSERNET and NorthWestNet, consortia such as SDSC and JVNC, and affiliates such as BITnet. Formal agreements between NSF and other agencies (DARPA, NASA, DOE) further facilitate communications. All of the mid-level networks support communications with at least 56 kbits/sec links and many have 1.5 Mbits/s service.

The NSF supports network connections and the regional and consortia networks connect university campuses. Each campus is expected to provide local network connections and assistance to any department that needs network access. This policy provides a level of local control yet supports connections at high speed. All of the campus links have 56 kbits/sec lines at minimum, and most campuses have one or more 10 Mbits/sec Ethernet Local Area Networks (LANs) on campus, making access quite simple.

NSF does not support a central help facility. This function, for NSF supported services and institutions, is provided by the regional networks which serve the individual institutions around the country. Sites or facilities wishing to connect should send their postal address to the Program Office (dncri@note.nsf.gov).

The online information about NSF sponsored network services and facilities which was referenced in previous versions of this guide is apparently not working at this time. NSF will be changing the way general information is made available, but as of September, 1992, no online help seems to be available.

2.1.2 NASA Science Internet (NSI)

NASA's Office of Space Science and Applications established the NASA Science Internet (NSI) project in 1987 to provide communications to the entire NASA science community. NSI began by putting into place a TCP/IP-based network known as the "NSN" which interconnected the NASA Centers. In 1989, the Space Physics Analysis Network (SPAN) was brought under the umbrella of the NSI organization. SPAN was built on the DECnet protocol suite, but because of national and international trends in networking, NASA could no longer afford the costs associated with separate networks. The two networks (NSN and SPAN) were merged into one. The result has been the emergence of a high-speed, dual-protocol, international network called "NSI" which is serving a broader community of users.

NSI has in place an "interoperability gateway" which allows e-mail, file transfer and remote logon operations between computers which use different (TCP/IP and DECnet) communication protocols. Use of the gateway is described in a following section.

The NSI backbone currently connects the NASA centers at fractional T1 speeds with full T1 (1.544Mbits/sec) service on the way. Most of the tail circuits to individual institutions are 56Kbits/sec. There are a number of foreign connections, including a line to the Cerro Tololo Inter-American Observatory in Chile and to the U.S. South Pole station.

NSI currently provides its users with transparent access to the larger Internet community through direct connections to other U.S. Government agency networks such as the National Science Foundation's NSFNET, Department of Energy ESNET and to Mid-Level networks (such as SURANET) in the U.S. NSI also has connections to foreign networks such as the Australian Academic Research Network (AARNET). Overall NSI project management, requirements management, network engineering and network operations are centrally managed from the NASA Science Internet office at NASA/Ames Research Center, Mail Stop 233-8, Moffett Field, CA 94035-1000.

Requests for network connections or upgrades to existing NSI connections should be directed to the Discipline Requirements Manager for Astrophysics, Joanie Thompson, Tel: (415) 604-4550, or joanie@nsipo.nasa.gov

The Network Operations Center (NOC) is staffed 24 hours a day, seven days a week, to monitor the functions of the network. The NOC phone number is (800) 424-9920 or (415) 604-3655.

The NSI Network Information Center (NIC) is staffed at the NASA/Goddard Space Flight Center. The NSINIC supports a Help Desk to handle user requests/questions/problems related to NASA and/or computer networking, an online menu-driven information system (NONA), anonymous FTP archives (The NSI File Cabinet), e-mail services, NSI Pass-Thru Account, dial-in information and much more. To learn more, or ask a question novice and experienced users. The phone at GSFC is:

Voice: (301) 286-7251
FAX: (301) 286-5152.

Online help is available at help@nic.nsi.nasa.gov or FTP to nic.nsi.nasa.gov with the username nsinic to download various help documents. Help can also be obtained by mailing to:

nsinic@nsipo.nasa.gov

2.2 BITnet/EARN

BITnet (the name is derived from the phrase "Because It's Time") is a worldwide network originally connecting individual hosts by means of leased 9600 baud telephone lines. Funding used to be provided by the IBM Corporation, but user sites must now foot the bill for their BITnet network traffic. IBM's RSCS (Remote Spooling and Communications Subsystem) protocols are used, which provides a real-time scrolled listing as your message is passed along from computer to computer. New e-mail users find this detailed listing of the progress very comforting, but experienced users sometimes find it to be an annoyance since there is not much you can do if the message gets hung up. BITnet is now affiliated with the Internet, and uses Internet lines for much of its traffic. BITnet has recently merged with CSNET. BITnet does not provide direct connections between computers, making it impossible to log on to another machine remotely. It is generally used for sending mail messages, but file transfer capability is also available by means of file transfer software.

The network has different names in different countries: BITnet in the USA, NETNORTH in Canada, EARN (European Academic Research Network) in Europe, etc., but these distinctions are invisible to the user. The network has a tree-like structure with the trunk at host CUNYVM in New York, and there is just one route between any two hosts. Host names are non-hierarchical and are limited to 8 characters.

Although Internet addresses provide the easiest way to communicate with most European sites, it may still be necessary to use EARN in which case the following information may be helpful.

Within EARN there are some conventions about how these names are constructed. For Austria, Germany, Sweden and Switzerland, the first character of the host name is the international country abbreviation (i.e., 'D' for Germany), the second and third letters are an abbreviation for the location, the fourth to sixth letters are the initials of the organization, the seventh letter is the number of the software version, and the eighth letter is a system number (1-9, A-Z). Other European countries follow related conventions.

Consequently, most EARN names are unpronounceable and unmemorizeable, and there is often confusion between the letter 'O' and the digit '0'. For example, dgaeso51 is the host name for the European Southern Observatory, Garching, West Germany, hlerul51 is the Sterrewacht Leiden in The Netherlands, and ukacrl is the Rutherford Appleton Laboratory in England. Note that the Netherlands is denoted not by nl but by hl (Holland).

Correspondents may refer to their host machine in a number of non-standard ways. For example, an EARN host at the Institut d'Astrophysique in Paris (friap51) might be referred to as friap51, or as earn.friap51, or asfriap51.earn, or as iap51 on the FREARN network). Likewise, hlerul51 might be referred to as lerul51 on the HEARN network, and secthf51 as ecthf51 on SEARN. When sending BITnet mail, you should use the standard site address, i.e., hlerul51 for Leiden.

The single EARN host in the United Kingdom, ukacrl, serves as a gateway to the JANET network. It relays mail only between JANET and proper BITnet hosts; it will not forward mail sent through another relay to BITnet. On BITnet in the United States the names tend to have more obvious meanings. For example, alaska is the University of Alaska, nrao is the National Radio Astronomy Observatory, and uwaphast is the University of Washington Physics Department. Sometimes BITnet hosts are referred to as host.bitnet. From those machines on the Internet with sufficiently smart mailers, it is sufficient to use the address form username@host.bitnet. The final .bitnet may usually be omitted in electronic mail addresses totally within the BITnet network. Because BITnet/EARN is IBM-based, characters sent from other types of machines may be translated from ASCII to EBCDIC, and "exotic" characters such as { _ # may be corrupted.

To get information about using BITnet, send a message (or mail) to netserv@bitnic.bitnet with the words GET BITnet USERHELP. You may also use the addresses: listserv@marist.bitnet or listserv@cmuccvma. bitnet

2.3 CSNET

After merging with BITnet in 1989 the Computer Science Network has just terminated service to its subscribers. In the early days of the Internet, CSNET provided an alternative means of connecting to the network for those institutions which could not qualify for one of the limited set of connections available on the old ARPA network, or who did not want to wait the two years required to get a connection. The CSNET was part of the Corporation for Research and Educational Networking (CREN) which was formed by the merger of the CSNET and BITnet networks.

2.4 UUCP/USENET

The UNIX to UNIX CoPy network (UUCP) includes of order 7000 hosts, most running the UNIX operating system. The network mostly uses simple dial-up modem connections, with TCP/IP network connections where possible. The first links were made in 1978 at Bell Laboratories. Each host pays for its own links, which are generally low-speed (1200 and 2400 baud) and low-cost. Administration is minimal. Typical delivery times are on the order of 12-36 hours. With the widespread availability of the Internet, the need to use the UUCP network has greatly diminished and we see fewer AAS members providing UUCP addresses for the Directory.

UUCP host-names are non-hierarchical. Some examples are aardvark, edison, groucho, kludge, tukey, yoyo, and zyx. The UUCP network is unusual in using explicit source-routing, in which addresses of the form hosta!hostb!host!user are interpreted as a route along which the message must be sent in order to reach user at host. A few central hosts are known, reasonably reliable forwarding machines; use of these hosts in UUCP addresses makes the routing information shorter. Some example addresses are

...mcvax!enea!astol!user (Lund Obs., Sweden),
...mcvax!ukc!qmc-ms!user (Queen Mary College),
{cfa,ihnp4,seismo}!noao!sunspot!user (National Solar Observatory, New Mexico).

The curly brackets indicate that any of the specified backbone sites may precede !noao!sunspot. The ellipses should be replaced by whatever routing information is needed (if any) to get the message as far the host name which follows them. The trick in making successful use of UUCP is to be able to determine a routing path from your machine to another machine (as if you had to tell Ma Bell or MCI how to route your phone calls!). Some sites have software that can provide routing information; if you cannot provide the full route the program will try to determine a route for you automatically.

There are a number of UUCP-related networks: EUNET in Europe (900 hosts), JUNET in Japan (160 hosts) and ACSNET in Australia (see Section 2.7). In Europe, there is one backbone site in each country, e.g., TUT in Finland, INRIA in France, ARIADNE in Greece, MCVAX in the Netherlands, ENEA in Sweden, and UKC in the United Kingdom. All the European backbone sites are connected to MCVAX in Amsterdam, which also connects to uunet, the main routing node in the USA. The Australian backbone site is MUNNARI. From the Internet mail can be relayed through uunet.uu.net.

For more information about UUCP, send a message to the following address:

info-server@sh. cs.net

with the text:

request: info
topic: usenet map
topic: ml-3

2.5 PINET

The American Institute of Physics is upgrading an electronic network service it has established called PINET. PINET includes the KOSMOS electronic mail service of the American Geophysical Union. In addition to listings of jobs, physics abstracts in advance of publication, meeting notices and other data, PINET provides an electronic mail service with direct connections to BITnet and the Internet. There is a charge for the use of PINET. PINET can be accessed either through the Internet at pinet.aip.org or via the commercial Sprintnet which only requires a computer and a modem. AIP pays the Sprintnet costs. PINET can provide satisfactory access to the Internet for individuals whose institutions do not have network access. PINET is particularly useful for people who travel, since all you need is a laptop computer with a modem to be able to get Internet access. With Internet access, you can sign on to your home computer, read your e-mail and run most programs as if you were there.

PINET subscribers can mail to both BITnet and Internet networks without having to use gateways. AIP will charge only for the communications costs. Note that AIP will not serve as a gateway between networks, but will allow their subscribers who come in the free Sprintnet connection to communicate directly and easily with the other two networks. To get more information on PINET contact the Electronic Publishing Division, 500 Sunnyside Blvd., Woodbury, NY 11797-2999 (tel. (516) 576-2262) or send a message to elepub@pinet.aip.org. To get information on local Sprintnet phone numbers in your area, call 1-800-336-0437.

2.6 PSI/DTE—International Data Communications

Most countries have public data communications networks that allow national and international calls to be made in support of electronic mail, file transfers, and remote logins. In most countries, these networks are operated by the government, and for many years, the intrusion of the Internet (or TCP/IP) protocols for addressing machines and transferring messages was forbidden or strongly discouraged. As stated above, this situation has changed remarkably in the last two years, and the Internet reaches nearly everywhere. However, some countries are still in the throes of transition and you may have to go use the PSI addressing scheme to reach your destination.

In these increasingly rare cases, to make a call to a remote computer, it is necessary only to know the machine's DTE (Data Terminal Equipment) number, often quoted as a PSI (Packetnet System Interface) number, DNIC number, or X.25 number. The X.25 protocols (X.3, X.25, X.28,..., sometimes known as "Triple-X") may be used directly to establish connections with remote host computers. International gateways (using the X.75 protocol) ensure that links can be made between countries. The Triple-X protocols are used by a number of other networks to provide connections between sites. Most of these X.25 links are not visible to network users, but they do provide many gateway-gateway links in Internet, CSNET, and UUNET. Also, these protocols are the underpinnings for the Telenet networks, the new international X.400 standards, and for DEC's PSI. PSI supports mail, remote logins, and remote file transfers, and there are several relays between PSI mail and other networks.

Each DTE number is unique to a given machine and is internationally recognized. The first 3 digits are a country code, the 4th digit distinguishes individual networks within the country, and the next 8 (or so) digits are used to distinguish physical lines on the network. As well as this total of approximately 12 digits, 3 more digits may be added to specify local sub-addresses (individual computers) sharing the given line. Some countries allow only one digit for the subaddress, others allow two, and a few allow three. DTE numbers are often quoted with a zero preceding the country code. The DTE number functions much more like the standard telephone numbers we are accustomed to; the DTE address is the same regardless of your particular host.

Since DTE numbers are generally long, difficult to remember, and easy to mistype, some sites will set up alias tables for commonly addressed sites. These allow users to refer to the site by a simple name rather than by the DTE number.

On DEC systems you may see addresses of the form PSI%HOST or PSI%311030100140l2, the latter being the DTE number. The names of the data communications networks in different countries and their international DTE codes are listed in Table 2.

2.7 Other Networks

Earlier versions of this guide listed a number of other networks which are no longer of interest, having been absorbed into the Internet name space. For instance in Australia, the Australian Academic Research Network (AARNET) uses TCP/IP protocols and is simply one of the component parts of the Internet with the domain name .au.

NASAMAIL. Some NASA sites continue to use an internal NASA network where only the username is given as an address. Anyone on NASAMAIL can be reached by using the address: username@nasamail.nasa.gov

JANET. The UK Joint Academic Network is a network which connects the academic community in Great Britain. All UK universities and most polytechnics are connected. The network originated with SERCNET (the Science and Engineering Council Network) in 1977, and was renamed JANET in 1984. Electronic mail and other services on JANET are implemented using "Coloured Book" protocols which are only used in the UK. For e-mail to the UK from the Internet the JANET names can be regarded as being Internet names with the order reversed. Host names conform to a National Registration Scheme (NRS), managed by Salford University, and are hierarchical like those of hosts on the Internet, but with the most significant element first. For example, uk.ac.cam.phy-ravx is the Radio Astronomy VAX in Cambridge. Note that uk. is the UK domain name and .ac. stands for Academic Community, i.e., it corresponds to the edu part of the Internet. There is also a .co. domain catering to commercial clients.

SolarMail. SolarMail is an electronic mail distribution system run by Rick Bogart of Stanford University for solar astronomers. With mailboxes on DECnet, Internet, and BITnet, this can be a convenient way to contact solar astronomers or receive notices of interest to the solar community. For further information contact rick@solar or solar::rick.

3. Hints on Deciphering Electronic Mail Addresses

To the novice, many electronic mail addresses appear to be incomprehensible jungles of acronyms and punctuation marks. Below are a few hints on deciphering them, followed by some real-life examples.

- All the alphabetic and numeric characters, including @ % ! - " :., may appear in electronic mail addresses. % signs (! signs for UUCP) usually separate the names of hosts through which the message is to be routed. For example, a message to user%host%host1 %host2@host3 will be sent to host3, which will in turn forward the message to user%host%host1 at host2, and so on. Note that the @ character is only used once in any address, to separate the highest level host, the one which the network sees. With the Domain Name Service now functioning well, the number of multiple hosts in addresses should decline rapidly. Exclamation marks, curly brackets, and ellipses are used in specifying UUCP addresses.
- To determine the network of origin, look at the form of the sender's address in the 'from' field in the header. An address of the form user@host or user@host.domain has probably originated on Internet or BITnet/EARN. UUCP addresses will be punctuated by exclamation marks (host1 !host2!host3!user). Addresses on

DECnet based networks have a host name and user name separated by two colons (host::user).

• Host names on the Internet are hierarchical, of the form domain1 .domain2.domain3. Except in Great Britain, networks with hierarchical naming place the least significant domain (i.e., the final destination machine) first (host.site.domain). In JANET addresses the most significant domain comes first, e.g., uk.ac.cam.phx, and JANET names must often be reversed when communicating from networks outside the UK. Hence, for example, Dave Green from Cambridge quotes his UK address as dag9@uk.ac.cam.phx but gives dag9@phx.cam.ac.uk for non-UK colleagues. All UK scientists may not be so considerate, but the rule is easy; if the hostname starts with uk.ac., reverse the order of all the dot-separated components. If one of the dot-separated components contains a hyphen, (e.g. .jodrell-bank.), the whole set of characters between the dots remains unchanged. The hyphen is treated as an alphabetic character, part of the domain name.

• Internet names frequently end in .edu, e.g., noao.edu, but addresses from the domains .com, .gov, .mil, and .org are all used by astronomers and are valid names.

• DECnet hosts are sometimes referred to by area and number or by number alone. These should be equivalent representations. The conversion depends upon name tables which are centrally maintained and distributed to each institution. If the name table in your machine has not been upgraded recently, you may have to resort to using the numeric form.

The most general form of an address where the message must pass from one network to another, or through some intermediate host, has the form

user%host.domain@relay.my_domain.

The message is sent first to the computer called relay which is in a network my_domain that your local system can reach. The computer relay then passes the message on to the remote machine called host in the network domain. The computer relay may actually modify the address you specify in order to perform the message forwarding. In cases where the remote address is of some peculiar form, or where the relay host does not know how to modify it, the remote part of the address will generally get written inside quotation marks. For example, an address of the form

"astrts::adoc"@east.nasa.gov

will relay a message from Internet (note the .gov domain) to the user adoc at the ASTRONET site astrts by way of the gateway machine named east. However, the explicit use of relay machines is becoming a thing of the past for Internet users.

4. Sending Electronic Mail Across Networks

Mail crosses network boundaries through forwarding systems known as gateways or relays. This is becoming extremely simple for Internet users as the mailing software (mailers) at most sites become more intelligent. Many mailers can now handle cross-network addresses without any effort on the part of the user. A prime example is sending to BITnet from the Internet. An address of the form username@host.bitnet will often work. Some mailers will also recognize addresses of the form username@host.span for DECnet addresses. As this type of sophistication becomes more widespread, all users will find communication becoming simpler.

4.1 Internet to DECnet; the NASA Science Internet Interoperability Gateway

One of the recent improvements is the availability of a very sophisticated, yet easy-to-use gateway linking Internet machines with DECnet machines. The NASA Science Internet Project Office (NSIPO) has funded an Interoperability Gateway to facilitate the exchange of e-mail, file transfer and remote logon capability between the Internet networks (TCP/IP protocol based) and DECnet networks. The gateway is attached to both the TCP/IP Internet and DECnet. No account or special access is needed on the gateway machine to make use of these capabilities. Interoperability functions, e-mail and file transfer are translated from one protocol to the other "on-the-fly" in a one step operation and are not "staged" onto the gateway, translated, and then sent off to their end destination. The Interoperability Gateway at GSFC is known as:

DECnet name/address: east or 6913
Internet name/address: east.gsfc.nasa.gov or 128.183.104.4

1. Sending E-mail From the Internet to DECnet

First, note that DECnet names have the form host::username which is the reverse order from the Internet format. Be sure to take this into account and put the username first when sending from the Internet. From an Internet machine mail can be sent to a user on a VMS/DECnet machine by mailing to:

username@host.dnet.nasa.gov

where host is the name of the VMS/DECnet host you wish to send mail to, and username is the login name of the person you wish to send to there. *NOTE:* If your TCP/IP mail software does not use the Domain Name Service to get information about hosts, you may have to use the following syntax. Most mailers support the use of MX (mail exchange) records in which case this is unnecessary.

username%host.dnet@east.gsfc.nasa.gov

2. Sending E-mail from DECnet to the Internet

To send mail to an Internet site from a VMS/DECnet host, mail to the address:

east::"username@host.domain"

where once again host.domain is the full name of the Internet host you wish to send mail to, and username is the login name of the person you wish to send to. (You must also type the quotes as shown). *NOTE:* If node east is not defined on your system, see your local system manager or substitute "6913" for "east".

3. File Transfers Invoked From A VMS/DECnet Machine.

To copy a file from an Internet machine with FTP capability to your local VMS/

DECnet machine, you type the command at the $ prompt:

copy east"host.domain!username password"::"remote-file" VMS-file

where host.domain is the full name of the Internet host you want to get the file from user is the login name on the Internet machine, password is the login password for the designated user account on the Internet machine, and remote-file is the name of the file to fetch from the Internet machine (the syntax of remote-file is dependent on the operating system on the remote Internet machine). VMS-file is the name of the local file to create on your VMS/DECnet machine (and is in normal VMS syntax). Again, if node east is not defined on your system, see your local system manager or substitute "6913" for "EAST". In the above COPY command, you must type the quotes exactly as shown.

To transfer a file from your VMS/ DECnet machine to an Internet machine, simply reverse the order of the arguments to the VMS COPY command, i.e., put the local VMS-file name first and then east and following parts of the remote file specification last, so that you get:

copy vms-file east"host domain!username password"::"remote-file"

If the Internet machine happens to be set up for anonymous FTP and the file you want has been placed in the anonymous FTP directories there, you can use a username of anonymous and put anything in as the password (although a password must still be present; by convention the last name of the invoking user is often used as the password).

4. File Transfers Invoked From An Internet Machine
To transfer a file from an FTP-capable Internet machine to a remote DECnet machine, type the command:

ftp east gsfc.nasa.gov

NOTE: If you get an "unknown host" error, you can use the numeric IP address to make the FTP connection:
ftp 128.183.104.4

Once you have connected and received the login prompt, respond with:

host::username

where host is the name of the VMS/ DECnet host you wish to send a file to, and username is the login account you wish to place the file in. When prompted for the password, give the password for this account. You may then use normal FTP commands such as get and put to transfer files. It is not possible to invoke a gatewayed transfer from the Internet side without a password for a VMS/DECnet account because VMS/DECnet networking does not provide any kind of password-less access like anonymous FTP.

5. Transferring Binary Files
A word of warning: UNIX systems do not have a record structure format like VMS files do. Therefore, if a binary file is sent from a VMS/DECnet node through the gateway to an Internet machine using the techniques described above, the record structure information is necessarily lost, even if the destination Internet machine is also running VMS. Files sent through the gateway from the Internet side to a VMS/ DECnet machine in binary mode will create files on the destination VMS machine that have fixed length 512-byte records. It is also likely that if the Internet machine is not a DEC machine or other machine that uses DEC byte ordering, you may run into byte ordering problems when the data in the destination file is interpreted.

6. Logging Into Internet Hosts From VMS/DECnet Hosts
To log onto an Internet host with telnet capability from a VMS/DECnet host, execute the command at the $ prompt:

SET HOST east

Again, if node east is not defined on your system, see your local system manager or substitute "6913" for "east". You will receive the Ultrix login prompt:

Ultrix-32 V4.1 (Rev.9)
(east.gsfc.nasa.gov)

Give the response:

host.domain!

where host.domain is the full name of the Internet host you wish to connect to. You should receive a login prompt from the designated Internet machine.

7. Logging Into VMS/DECnet Hosts From Internet Hosts
To log onto a VMS/DECnet host from an Internet host, issue the command:

telnet east.gsfc.nasa.gov

As with FTP above, if the gateway machine is not known to your local machine, you may telnet to the IP address128.183.104.4. You will receive the login prompt from the gateway machine as shown:

east.gsfc.nasa.gov login:

respond with:

host::

where host is the name of the VMS/ DECnet host you wish to log on to (followed by the double colon as shown). If the VMS/DECnet host is not known to the gateway, you may use its DECnet node number if you happen to know it (followed by the double colon) and the gateway will connect you. After entering this line, you should see the usual Username: prompt from the DECnet machine.

8. If You Experience Any Problems, Please Contact:
Jeffrey Burgan NASA Ames (NSIPO)
Internet: jeff@nsipo.nasa.gov
DECnet: EAST::"jeff@nsipo.nasa.gov"
Tel: (415) 604-5705

4.2 Internet to BITnet

Most BITnet hosts now have mailers which simplify the task of sending mail from BITnet to other networks. They supply an "envelope" with the correct Internet address format and send the mail to the correct gateway.

BITnet users can just use the full Internet address, and the mailer will usually do the rest.

Internet users mailing to BITnet addresses should just add the .bitnet to the address.

4.3 Foreign Addresses

As explained above, most foreign networks have adopted (or are adopting) the

Internet TCP/IP protocols. Internet users communicating with foreign users on the Internet will see no difference from U.S. communication and vice versa. For help in interpreting foreign addresses, the popular domains on the Internet are given as follows (listed in general order of popularity):

.de	Germany	.no	Norway
.ca	Canada	.jp	Japan
.uk	United Kingdom	.at	Austria
.se	Sweden	.it	Italy
.fr	France	.dk	Denmark
.nl	Netherlands	.nz	New Zealand
.ch	Switzerland	.es	Spain
.fi	Finland	.za	South Africa

Table 1. Network Gateways

From	To	Syntax
BITnet	BITnet	user@host
	Internet	user@host.domain
	JANET	user%host.uk
	NASAMAIL	user@nasamail.nasa.gov
	DECnet	user@host.dnet.nasa.gov
	UUCP	host1!host2!host!user@PSUVAX1
Internet		
	BITnet	user%host.bitnet@cunyvm.cuny.edu
	BITnet	user@host.bitnet
	DECnet	user@host.dnet.nasa.gov
	DECnet	user%dnet@east.gsfc.nasa.gov
	GSFCMAIL	user@gsfcmail.nasa.gov
	Internet	user@host.domain
	JANET	user@host.domain (for Internet)
	JANET	user%host.domain@ns&et-relay.ac.uk
	NASAMAIL	user@nasamail.nasa.gov
	UUCP	user%host.UUCP@UUNET.UU.NET
JANET	BITnet	user%host@uk.ac.earn-relay
	DECnet	"host::user"@uk.ac.span-relay (Mar 1990)
	Internet	user%domain.host@uk.ac.earn-relay
	Internet	user%domain.host@uk.ac.nsfnet-relay
	JANET	user@uk.host
	UUCP	host1!host2!host!user@uk.ac.ukc

Note: The situation in the UK is changing rapidly as the number of Internet machines grows.

From	To	Syntax
DECnet	BITnet	east::"user@host.bitnet"
	DECnet	host::user
	GSFCMAIL	east::"user@gsfcmail.nasa.gov"
	Internet	east::"user@host.domain"
	Internet	6913::"user@host.domain"
	JANET	east::"user@host.domain"
	JANET	east::"user%host.domain@nsfnet-relay.ac.uk"
	NASAMAIL	east::"user@nasamail.nasa.gov"
UUCP	BITnet	PSUVAX1!host.bitnet!user
	DECnet	user%host@east.nasa.gov
	Internet	UUNET!host.domain!user
	JANET	relay!NSS.CS.UCL.AC.UK!host.UK!user
	UUCP	host1!host2!host!user

Where the word ".domain" appears in the above table, one of the Internet top-level domains, e.g., .com, .edu, .au should be substituted.

Table 2: International DTE Communications Access Codes

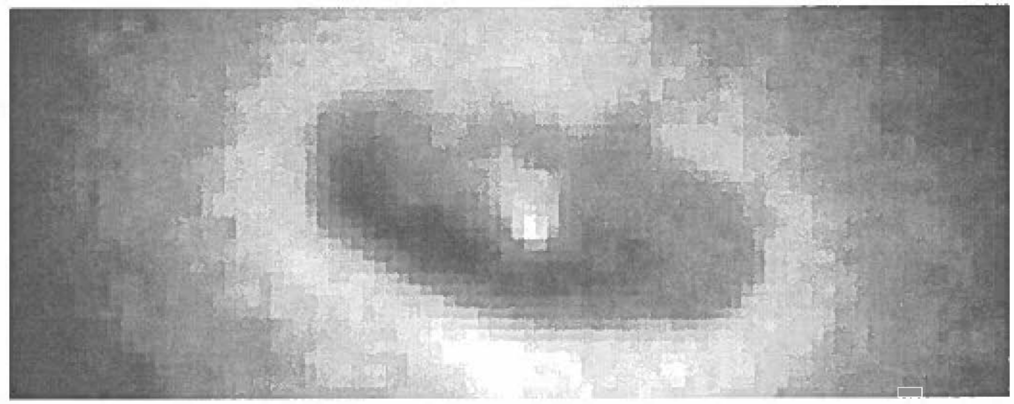
Country	DTE Code	Data Communications Networks
Austria	2322	DATEX-P
Australia	5052	AUSTPAC, MIDAS
Belgium	2062	DCS
Brazil	7241	RENPAC, INTERDATA
Canada	3020	DATAPAC, GLOBEDAT, INFOSWITCH
Denmark	2382	DATAPAK
Finland	2442	DATAPAC
France	2080	TRANSPAC
Germany (West)	2624	DATEX P
Greece	2022	HELPAC
Ireland	2724	EIRPAC
Israel	4251	ISRANET
Italy	2222	ITAPAC
Japan	4401	DDX P, VENUS P
Netherlands	2041	DATANET1, DABAS
New Zealand	5301	PACNET
Norway	2422	DATAPAK
Portugal	2680	(incoming only)
South Africa	6550	SAPONET
Spain	2145	IBERPAC, TIDA
Sweden	2405	DATAPAK
Switzerland	2284	TELEPAC
United Kingdom	2342	PSS
United States	3126	AUTONET
	3132	COMPUSERVE (outgoing only)
	3103	ITT-UDTS
	3113	RCA-LSDS
	3110	TELENET
	3119	TRT-DATAPAC
	3140	SNET
	3106	TYMENET
	3125	UNINET
		WUI-DBS
	3101	WUTCO

Glossary

AARNET	Australian Academic Research Network NASA/ARC, Sunnyvale, California
ARPA	Advanced Research Project Agency network
ASCII	American Standard Code for Information Interchange (character set)
baud	maximum number of changes of state per second; usually = bits/second
BARRNET	Bay Area Regional Research Network
BITnet	"Because It's Time" Network
block	area of space on disk, typically hundreds of bytes (vendor dependent)
bps	bits per second
byte	8 bits (a character usually occupies one byte)
CCITT	International Consultation Committee on Telegraphy and Telephony
CDNNET	Canadian network
Coloured Book	a sel of standards that attempts to conform to the ISO ideal; used in the United Kingdom
com	Internet domain for commercial clients
CREN	Corporation for Research and Educational Networking
CSNET	Computer Science Network, now defunct
DDN	Defense Data Network = ARPANET + MILNET + MINET + DISNET
DEC	Digital Equipment Corporation
DECnet	proprietary networking protocols developed by DEC
DISNET	part of DDN
DRENET	ARPANET-like Canadian military network
DTE	Data Terminal Equipment number
EAN	X.400 networks in Australia, Canada, Europe
EARN	European Academic Research Network, connected to BITnet
EBCDIC	Extended Binary Coded Decimal Interchange Character set (IBM)
edu	Internet domain for academic/research clients
ESANET	European Space Agency Network
Ethernet	local area network defined by ISO 802.3
EUNET	European affiliate of UUCP
Fax	facsimile transmission
FIDONET	cooperative network in United States (≈ 1000 hosts)
FNET	French UUCP network—part of EUNET
FTP	File Transfer Protocol (part of Internet file transfer protocols)
gateway	computer providing message transfer service between networks
GSFC	Goddard Space Flight Center, Greenbelt, Maryland
GSFCMAIL	Telenet-based mail network for GSFC
HEPNET	High Energy Physics Network
host	computer which is connected to a network
INFNET	Italian DECnet
IP	Internet Protocol, basis of Internet communication and addressing schemes
IPSS	International PSS
ISO	International Standards Organization
JANET	Joint Academic Network (UK)
JVNCNET	JvNC Northeast Research Regional Network
line speed	data transmission rate
MILNET	USA defense network (part of Internet)
MINET	European hosts on MILNET
NASAMAIL	internal network for NASA employees, contractors, and scientists
MERIT/MichNet	MERIT computer Network/Michigan Network
MIDNET	Midwestern States Network
NCAR	National Center for Atmospheric Research
NCP	Network Control Protocol (DECnet)
NEARNET	New England Academic and Research Network
NETILLINOIS	Illinois state network

NETNORTH	Canadian equivalent of BITnet
NORDUNET	Nordic network
NORTHWESTNET	Northwestern States Network
NREN	U.S. National Research and Educational Network
NRS	Name Registration Scheme (for JANET)
NSFNET	part of Internet supported by NSF
NSSDC	National Space Science Data Center at GSFC
NYSERNET	New York State Education and Research Network
packet	typically between 1 and 255 bytes
packet switching	use of a communications channel by multiple users whose data are split into individually identified packets
PAD	Packet Assembler/Disassembler, interfaces host with X.25 network
PSCNET	Pittsburgh Supercomputing Center Network
PSI	Packetnet System Interface (VAX/VMS)
PSN	Packet Switch Node
PSS	Packet Switched Service
relay	computer providing message transfer and translation services between dissimilar networks
RSCS	Remote Spooling and Connection Subsystem—protocol used by BITnet
SATNET	Internet satellite links
SDSCNET	San Diego Supercomputer Center Network
SESQUINET	Texas Sesquicentennial Network
SMTP	Simple Mail Transfer Protocol (Used by the Internet)
SPAN	Space Physics Analysis Network
Sprintnet	commercial network in the United States
Starlink	UK astronomy DECnet
SURANET	Southeast Universities Research Association Network
T1	a line speed of 1.45 Mbits/s
TCP	Transmission Control Protocol, used by Internet
Telemail	Telenet mail services
Telenet	commercial network in United States
TP0 - TP4	Transmission Protocols in the ISO suite
TYMENET	commercial network in the United States
UNIX	operating system (pun on *MULTICS)* used by many scientific computers
USAN	NCAR's University Satellite Network
USENET	alternative name for UUCP network
UUCP	Unix to Unix CoPy network
VMS	proprietary operating system used on DEC computers
WESTNET	Southwestern States Network
X.25	international standard for operation of a packet switched network
X.29	international standard for terminal calls over X.25 network
X.400	new international standard for electronic mail
X.500	new international standard for name and directory services

INSIDE



HUBBLE SPACE TELESCOPE ASSISTS SCIENTISTS IN CONFIRMING REALITY OF BLACK HOLES

SEE PAGE 2

Universities Space Research Association USRA

Center for Advanced Space Studies
3600 Bay Area Boulevard
Houston TX 77058-1113

ADDRESS CORRECTION REQUESTED