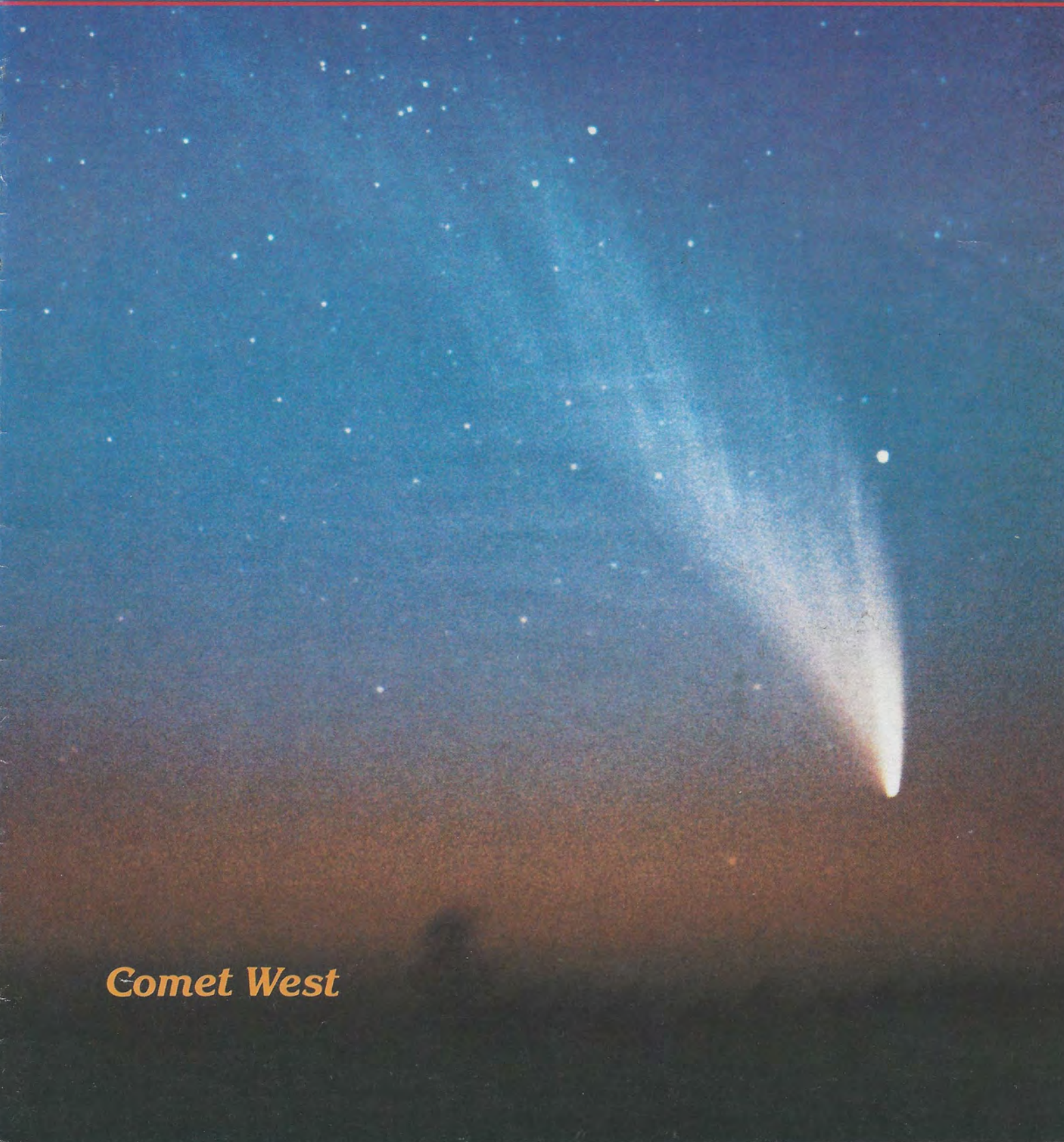
The PLANETARY REPORT

Volume I Number 3 April/May 1981



Comet West

A Publication of

THE PLANETARY SOCIETY

The Planetary Report is published six times yearly at the editorial offices of The Planetary Society, 116 S. Euclid Avenue, Pasadena, CA 91101.
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Technical Editor, James D. Burke;
Art Director, Barbara Smith.
Mail memberships, correspondence, address changes and adjustments to The Planetary Society, P.O. Box 3599, Pasadena, CA 91103.

Cover Photograph: On its return in 1986, Comet Halley will appear similar to Comet West, seen in this photograph taken in 1976. The thirty-million-mile-long dust tail of Comet West dominates this image, while its blue gas tail glows faintly. Due to its position as it moves through the inner solar system, the apparition of Comet Halley will not be as spectacular as it has been in the past, and will best be seen from the Earth's southern hemisphere.

PHOTO: Martin Grossmann

One objective of The Planetary Society is to give voice to the ideas that are driving this great human adventure of space exploration. We who work in the space program are often inarticulate about our real reasons for doing what we do. Solving problems and seeing our machines work are rewards to the engineers; drawing forth their best, and more, from our people is a reward to the managers; revealing the wonders of the solar system to our eyes, and trying to explain what we see, are rewards to the scientists; comradeship in a difficult shared devotion is a reward to all. But there is more to it than that. In the flood of new support for The Planetary Society, which now has more than 40,000 members, there come letters like the following one:

Dear Mr. Friedman,

Thank you for your invitation to become a member of The Planetary Society. I accept with pleasure. It is an honor to aid in such an endeavor, and a privilege to be associated with so distinguished a group of citizens. It is gratifying to know that there is a constituency of support for the continuing exploration of our universe, and it is challenging to envision the tasks that lie ahead for the Society.

In the quarter-century following the second World War, the popular view saw science and technology as panaceas for the ills of a devastated globe. That belief found its greatest vindication in the achievements of space exploration and the historic accomplishments of the astronauts and cosmonauts whose ventures into the unknown first brought humankind to another world. One of history's cruelest ironies must surely be the coincidence of our nation's proudest moment—on the dusty surface of our sister world—with that of our saddest, in the jungles and mountains of Indochina. In that bitter juxtaposition the best and worst in the souls of men and nations were enacted, and in the eyes of many the motive force for each was the same science, the same technology that had for so long been trusted and admired. The power of science to solve human problems in safe and reasonable ways was called into question. The role of the scientific community in determining the applications of research has become a matter of public debate. Sadly, the mistrust of technology and many of its products is well-founded, and it often seems that with each new day the light of scientific progress grows more eclipsed by the shadow of its dangerous by-products. The lives of many thousands have been detrimentally affected by the works of science. The challenge to the scientific community is clear: the public must be educated concerning the nature of science; they must be included at some level in the decisions to initiate and apply scientific research; and above all they must be motivated, by the excitement and awesome beauty of the worlds which science reveals, to support that work financially and politically.

There is now some evidence that the public view of science is shifting once again, not back toward naive faith and the expectation of miraculous solutions, but ahead toward a partnership of curiosity and mutual exploration. That partnership is exemplified in the formation of The Planetary Society and by its roster of supporters—men and women from many walks of life and varied professions unified in their love of exploration and their mutual heritage of human curiosity. The vast beauty of the planets and the stars awaits them. To share the magnificence of those distant places, to watch and listen as our robot eyes and ears bring news of them, and to bring that news to all who wish to know—these things are among the tasks of our Society. The education of its people is the richest treasure any civilization can possess, and this Society ought to concern itself primarily with that task. To huddle on the frigid desert of Mars and watch the sun in its track across that alien sky, to fly through the inky depths of space past Jupiter and Saturn, to finally know them not just as indistinct and tenuous telescopic images, but as real worlds seen in the light of the same star—these experiences place us in an age of wonder. If The Planetary Society can communicate some of that wonder to the people of our world, its work will be well done.

– JOHN P. WELSH

HAILING FREQUENCIES OPEN!

Gene Roddenberry Looks at The Planetary Society

GENE RODDENBERRY

In the fifteen years since *Star Trek* first went on the air, I have refused to let my relationship with our fans be used for any purpose not directly related to that show. The temptations were many, including projects close to my heart (like the "Save the Whales" effort) and also some generous offers from business and other organizations who wanted our mailing list. That policy was broken last month when I signed my name to an open letter to *Star Trek* fans recommending that they join and support The Planetary Society.

Why break a rule of such long standing? It came out of a growing certainty that a revitalized space program is now a human imperative and that The Planetary Society can become one of our best ways of creating an active and respected *space constituency* able to make that message heard. This is not to say that I believed The Planetary Society to be the *only* organization for space activists. There are many other excellent groups, a respected example being the L-5 Society, which identify mainly with specific goals in space. None of these, The Planetary Society included, should be an "either-or" choice. However, it seems likely that we do need a broad-based organization which can represent *all* pathways toward space goals, and I believe that The Planetary Society fills that need.

There was a need to convince myself, of course, that The Planetary Society did indeed support a broad and representative space program. There is a distressing human tendency for the followers of any human "cause" to divide up into conflict over which is The Right Path. Space activists are as human as the next, and I had heard some who insisted that The Planetary Society is "really more interested in sending instruments into space than men." Fortunately, I have known Carl Sagan for many years and was welcome also at the office of the director of JPL, where I was able to meet with Carl Sagan and Bruce Murray, who put that rumor firmly to rest. I left our meeting fully convinced that The Planetary Society is as committed as any of us to the human exploitation (in the best sense of the word) of the many and varied potentials of space. This definitely includes human space travel, habitation and industrial applications, to name a few. The fact that they had been deeply involved recently in the *Voyager* explorations is an indication only of their eagerness to work with whatever space exploration tools are available—certainly not an indication that mechanical space robots are their sole interest. Indeed, I found them much envious of the science fiction writer's opportunities to sweep boldly past the real world's practical and budgetary limitations.

Having begun this on a personal note, let me end with an explanation of why I believe the move into space to be a human imperative. It seems to me obvious in too many ways to need listing that we cannot much longer depend upon our planet's relatively fragile ecosystem to handle the realities of the human tomorrow. Unless we turn human growth and energy toward the challenges and promises of space, our only other choice may be the awful risk, currently demonstrable, of stumbling into a cycle of fratricide and regression which could end all chances of our evolving further or of even surviving.

I believe that wisdom and responsibility will come to us in time and in ways which we cannot now foresee. Until that happens, I'm not too displeased to be a part of what seems to me a young and vigorous life form in the process of growing out from its ancestral egg and toward adulthood. Perhaps that is just the science fiction writer in me talking. However, I prefer to think that it is only human to be attracted toward an adventure of that magnitude. □

Gene Roddenberry is the creator and producer of the Star Trek *television series and film. Their enormous popularity was an early indication that planetary exploration is an activity that millions of Americans will back. We are very pleased to have the following statement of support for The Planetary Society by Mr. Roddenberry and, we hope, the millions of* Star Trek *fans.*

— CARL SAGAN

The Halley Swarm

by Jacques Blamont

Every 76 years, Halley's Comet swings through the inner solar system. As it nears the Sun, gases and dust boil off it, forming a huge coma and tail which, in the past, were regarded as evil omens. At its next return in 1985–86, Comet Halley will not be a very spectacular object, as it will blushingly hide behind the Sun. However....

In the 1680's, Isaac Newton and Edmond Halley, impressed by the splendid comet of 1680, used the new theory of gravity to compute its trajectory and found it to have a period of more than six centuries. Halley subsequently computed the trajectories of 24 comets and found that the comet of 1682 was the only one which could have been observed before—in 1607 and in 1531; he therefore predicted that it would return in 1759—which it did, exactly on time. The importance of Comet Halley is essentially due to this celebrated return; it took this well-heralded prediction and its success to convince the whole civilized world that Heaven is not an antique House of God but a modern kingdom of celestial mechanics. The influence of this event on the attitude of the ruling classes of Europe toward religion, education, scientific research and the development of technology cannot be overestimated.

This comet is therefore of worldwide interest now, not only because it is a fascinating fossil of the primitive nebula, but also because it is a symbol of the triumph of science over superstition—the banner of a vast philosophical synthesis unifying humanity in its search for progress and enlightenment.

As shown in the diagrams here, Comet Halley's orbit is inclined 162° to the ecliptic plane and is *retrograde*, meaning that the comet travels in a direction almost opposite to the movements of Earth and the other planets. Thus, the relative speeds of any observing spacecraft and the comet at encounter will be very high—of the order of 60 kilometers per second.

Three different space agencies have decided to launch probes to Comet Halley:

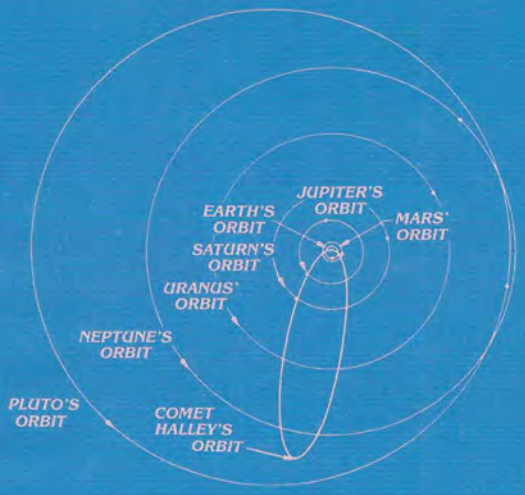
The European Space Agency (ESA) has approved *Giotto*, an *Ariane*-launched spacecraft based on the ESA satellite *Geos*, to encounter the comet near its post-perhelion crossing of the ecliptic plane on March 15, 1986. The payload consists of a camera, neutral mass, ion mass, dust impact mass spectrometers, a dust impact detector, an electron/ion plasma analyzer, a magnetometer and a photometer. The probe will carry a shield against cometary particles.

Japan has approved *Planet A*, a Japanese-launched vehicle carrying a hydrogen Lyman alpha device to observe the ultraviolet light emitted by the cloud of gases around the comet.

The Soviet Union is planning a cooperative mission to Halley with scientists from several eastern European countries, Germany and France as part of their on-going French-Soviet *Venera* 1984 mission, launched by Soviet rockets to carry buoyant stations and landers to Venus. Nine months after the Venus encounter, the two fly-by spacecraft intercept Comet Halley near its post-perihelion crossing of the ecliptic plane. The science payload will at least include two advanced technology cameras, ultraviolet and visible spectrophotometers, an infrared spectrometer, a magnetometer, a plasma-ion analyzer, plasma-wave analyzers, a dust mass spectrometer and a dust counter.

In addition to these three approved efforts, there is a possibility that the United States may send a mission to Comet Halley. For several years there has been a great deal of interest for this in the United States, but the outcome is still in doubt. In any event, it must be decided soon; work must begin this year if there is to be a launch in 1985. It is also proposed to coordinate both space and ground observations in an International Halley Watch, making this century's apparition of the comet the

The orbit of Comet Halley is inclined 162° to the ecliptic, the plane that runs through the orbit of the earth and sun.



The path of Comet Halley through the solar system.

This computer-enhanced, false color image of Comet Halley was made by the Kitt Peak National Observatory from a photograph taken May 19, 1910 at Lowell Observatory. The image was constructed by Michael Belton of Kitt Peak and reproduced with permission.

basis for the first truly international deep-space mission. The Committee on Space Research (COSPAR), of the International Council of Scientific Unions, at its 1980 meeting in Budapest created a group to coordinate the various missions to the comet. [*Ed. note: Dr. Blamont has been asked by COSPAR to lead this group.*]

Since the ESA probe carries a shield to protect it against particle impact, it is a good candidate for measurements in the comet's coma and tail. But its limited fuel budget restricts its flight strategy to a nonoptimal trajectory. Because the comet's large losses of mass modify its orbit, especially after perihelion, the precise encounter cannot be computed from a great distance. The miss distance of the *Giotto* spacecraft can be much reduced if the Soviets' high-quality camera, now being planned, can provide positions of the comet against a stellar background: the nearest approach of 500 kilometers for *Giotto* becomes 35 kilometers if the comet's ephemeris (position) is updated by the other spacecraft one or two days before encounter. This opens the possibility of catching evaporating molecules before they are photodissociated or ionized, and would vastly improve the scientific return of the ESA mission.

The Soviet probes are not designed for a close intercept and are good candidates for remote sensing; the improvement in ephemeris would not directly help them. But they can also be helped by international cooperation. First, the southerly path of the comet in the heavens makes it difficult for a northern tracking network to retrieve the data, and the use of a southern site such as NASA's Déep-Space Station in Australia would be advantageous. Second, more precise positioning of the Soviet probes might be possible, which would in turn aid the navigation of *Giotto*.

Much remains to be done in order to move from a committee to a real world mission in solar system exploration.

The unique character of the Halley international mission would call for a complete sharing of data. During the last encounter of the Earth with Comet Halley in 1910, enthusiasm among both the public and the astronomy community generated large amounts of data which were never published. A lack of planning made much of the effort worthless. The purpose of the Halley Watch program is to make sure that does not happen this time.

We hope the missions—no, *the mission*—to Halley will be a first step toward the organization of an international exploration program of the solar system. □

Jacques Blamont is Professor of Physics at the University of Paris and Chief Scientist, Centre National d'Études Spatiales. He is a leading authority on phenomena in the upper layers of the Earth's atmosphere. Professor Blamont discovered the interstellar wind in 1970 and has made many contributions in the fields of solar physics, comets, planetary atmospheres and atomic physics. He has been a Principal Investigator or Co-Investigator on a number of space missions, including Pioneer *Venus and* Voyager, *and is now Chairman of the Science Study Group for the joint French-Soviet* Venera '84 *mission to Venus. As a Distinguished Visiting Scientist at JPL, appointed in 1980, Professor Blamont has been actively involved in efforts to broaden international planetary programs. He recently joined the Advisory Board of The Planetary Society.*

SATURN

BY DIANE ACKERMAN

My sugardaddy bribes me
with a yellow-white brooch
(striped-enamel, diamond,
and ten glittery baguettes)
dangling in a black velvet box.
I stretch up for the honey-pale token, to pin it
on my blouse, over a heart lit like a jack-o-lantern.
But Saturn lumbers off
with its curio cloudbank,
sky-tethers the icy shoal
elsewhere, padding round
an orbit, just out of reach.

An elliptical blur creeps
into my field of vision, bellowing
light, as I wind the scope down
to such razory focus that Saturn
lies stunned in a hall of mirrors,
hog-tied by the cross-hairs, a little green at the pole.
Today lawnmowers studdered, Pekingeses yapped, trucks grumbled
through downshift arpeggios; but tonight,
risen in the botherless black,
Saturn's ball of lemon ice
looks so cool and reviving,
I track it like the Golden Fleece.

Millions of vest-pocket moons
hang together as rings
that loop round the planet
like a highway skirting the golden city.
Dusky bright, and godawful sheer,
they dog the equator (like Uranus's moons), never more than
two miles thick: a sprawling coral reef of tailless comets,
grinding one another
finer and finer, lolloping boulder
to dusty mote as, eddying
down through the crêpiest ring,
they pour into a gassy draw.

A tiny moon's constant nagging
shoos the odd guest
from Cassini's Division,
an open airway between the rings.
Phobos-sized snowballs tidy it up:
sentinel, roughshod, and devout as gestapos. Wide-open,
the rings hustle tons of light (more even
than the planetmain), coming on
so strong in the winter sky
that Dione and Tethys
pale away, like streetwise cats
ambling into the night.

In a seaquarium big enough
Saturn would float! lighter
than rock, or water. I marvel
it even holds together:
hydrogen-clotted ice, frozen
methane and ammonia, all lathered to a gaudy slush,
like Jupiter a bit, only colder, which may be why
the weatherworks and the lazy
cloud-roll idle as they do,
and ammonia freezes out
as a yellow blizzard, snowing
deep into the planetball.

Saturn nods, an out-size natural
sponge, adrift in the galactic shallows;
but far beneath the haze, in a rocky core,
20 Earths could be bedded: stowaway
planets tucked neatly inside,
like sharks napping in an underwater cave. I see the heart
of an artichoke, I remember Goya's *Saturn Devouring a Son.*
We couldn't live here, I'm afraid,
will have to stud the moons
with our kiosks and rotundas, eyeing
from below that striped hammock
bellied across thin air.

A yearlong carnival, known as
Saturnalia, begins with ritual
carving of the rings when mythic
figures hewn from snowballs—
thousands of Minotaurs, Gorgons,
and Dilemmas, Atlases and Leviathans—all swirl round
the Lord of Halcyon Days, making breezy sacrifice.
For, like Japanese sand-drawings
in an earlier epoch, moon-
carvings are meant to erode, be
dislimbed by the hobnob and bump
of the rings, till not a rack remains.

Saturnalia's a sport time, too,
when Jovian moon-surfers take to Saturn
(another leg of their endless cavort),
flying wildly round the rings' undulating
carpet, or croquet-thwacking debris
in Cassini's Division (always in danger of being thwacked themselves,
and hauled away by a moonlet-tugboat). Anytime, you'll see the usual
hawkers and parades, craftspeople, con-men,
homely souvenirs; but only early season,
before the crowds descend, can you watch
the ice-masons hard at work, or hear
the joyous *hoopla*'s of the ring-riders.

Entry, *Fodor's Guide to Saturn:*
"Best camera shots
from Iapetus or Phoebe...
Avoid Titan (too cloudy).
The other sherbety moons,
all smackdab in the ringplane, make Saturn appear
utterly ringless:
an agate bulb, with a tally line
summing mid-planet.
But, viewed from Iapetus,
Saturn swivels like a gyroscope,
its hatrim turned

up and down,
while the planetcore stands still.
Daytime, you see back
and darkside of the rings;
nighttime, the sunlit maw.
Only be sure to book a yurt on Planetview (the side facing
Saturn); on the other, glued always to deep space,
you could live out
a lifetime, never knowing
behind you lay
a lighthearted planet,
maizey in a halo of ice."

On Titan, warmed by a hydrogen blanket,
ice-ribbed volcanos jet ammonia
dredged out of a glacial heart. Liquid
and frozen assets uphold an empire
bigger than Mercury, and even a little
like primitive Earth; asphalt plains and hot mineral ponds. But
how I'd like to take the waters of Titan, under that fume-ridden sky,
where the land's blurred by cherry mist
and high above, like floating wombs,
clouds
tower and swarm, raining down primeval
bisque, while life waits in the wings.

Often I dwell on the Big Bang,
find my heart levied high, and the vision electric,
am wowed by that arch creativity.
When I tell people, they flinch
with terror, want no part of the ur-inferno,
will not truck with apocalypse. But Paul at the scope, one finger
on the clockdrive, tunes in the Universe with the affectionate
curiosity of a naturalist.
And I know, if I trigger the mental
clockdrive, his mind will gingerly
backtrack and zoom, run rings round
the spectral notion of Saturn.

I say, *"After the never-ending*
gas cloud coalesced, the Universe
was all in one place,
and solid: a hard, local object
in an endless ether." He smiles,
says, "Wonderful plot!" *"In the beginning was the Word,*
and the Word was a tough, silky ball of hydrogen."
He splits the double star, Albireo,
then pulls back a moment,
says, "Just imagine the commotion
of the Big Bang!" We huddle
in the breath-taking dark, and imagine.

Tonight, what with the moon
keeping so low a profile, the stars
are bright as campfires. Waltzed
around by how many planets? Drenched
in how many groundswells of life?
My saturnine ring-leader, pallid-footed, strolls along
with ten swanky moons in tow. And though I'm smitten now
with this giant manticore,
heartwise I know it's only
a panaching fancy: somewhere else
in the odds-on of space, evolution
may be minting a pipefish.

Diane Ackerman is the author of two collections of poems, The Planets: A Cosmic Pastoral *(William Morrow & Co. N.Y., 1976), from which this is reprinted;* Wife of Light; *and the prose memoir,* Twilight of the Tenderfoot. *She is currently a professor of English at the University of Pittsburgh.*

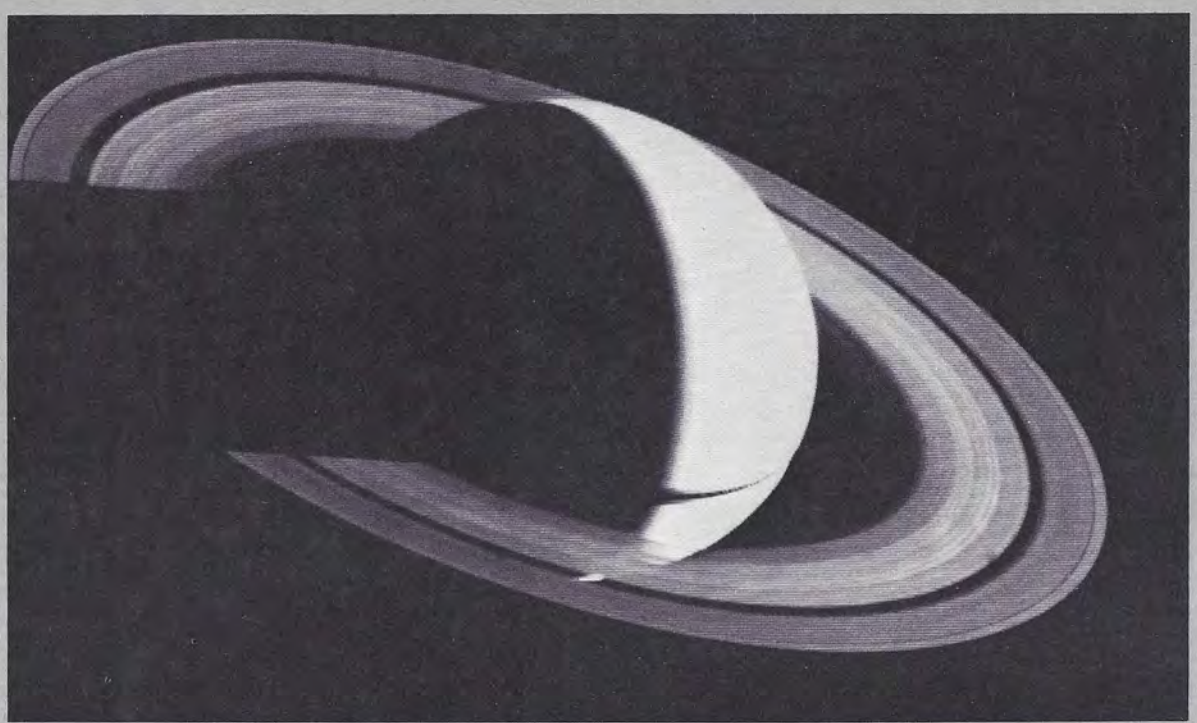


PHOTO: JPL/NASA

Extraterrestrial Life, Intelligence, and The Planetary Society

THE IDEA THAT OTHER BEINGS EXIST IN THE COSMOS has at times been a strong stimulus to experiment and discovery, and at other times it has been a target of sophists. Ancient opinions ranged from a settled belief that we are alone to a firm conviction that many heavenly bodies are inhabited. Today, despite the power of modern science, rational arguments can still be made for both of these views. However, we now possess tools that can narrow the possibilities.

Since planets are the only currently-known, possible sites of origin for the natural information-building entities that we call life, intelligence, and civilizations, planetary exploration is central to the quest for knowledge of these entities. *The Planetary Report* will, therefore, occasionally carry items on the subject. Components are SETI (the search for extraterrestrial intelligence), astrophysical studies of the formation of stars and planets, biological and geochemical studies of life's origin on Earth, and other researches bearing on evolution. In the one known example, our local hoard of information has now burst out of its evanescent biological pellicle. Memories, wisdom and dreams can outlive their creators, need no longer be stored only on their home planet, and can in principle live as long as the galaxy. Are there further states of intelligence? Are there civilizations that have mastered their fate and are in contact, while others bloom and die in isolation, never living long enough to find each other among the stars? Truly, with present knowledge we find ourselves as described in Isaac Newton's words, "I do not know what I may appear to the world; but to myself I seem to have been only like a boy playing on the seashore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me."

Thus, as *The Planetary Report* covers the outward surge of exploration and present-day discovery in the solar system, we shall occasionally look also at progress farther out in space, as in the search for radio signals from planets of other stars, and farther back in time, as in the search for the earliest organic molecular patterns on Earth.

Signals and artifacts have now left our star system forever. The book, *Murmurs of Earth*, by Carl Sagan and others (available in a Ballantine paperback for $6.98 at your local bookstore), describes the records being borne by the *Voyagers* into interstellar space. Not only are we sending messages, we are slowly preparing to receive them, using large antennas such as the one illustrated here. The NASA Ames Research Center, with assistance from JPL, is planning a search project which will at first employ smaller, Deep Space Network antennas for an all-sky survey, developing fast computer-aided signal detection. At the same time, this survey will give new scientific data on natural radio background radiation from the sky.

Frank Drake, one of the founders of the SETI program, and one of the senders of the first message from Arecibo to the stars, writes here on the subject of communications. If "others" do exist, will we and they be able to exchange information? In Drake's opinion, we will: "There have been countless episodes of humans being thrust through shipwreck, kidnapping, slavery, etc., into cultures where they did not know the language, nor was their language known. True, communication was slow at first (but even crude communication is possible at first contact), but eventually completely fluent. More relevant, hundreds of thousands of humans now converse routinely with intelligent devices very different from biological beings, and probably more different from us than extraterrestrial aliens—computers.

"There are many routes to a common language between civilizations in space. We can teach each other laboriously as babies are taught. But it is really easier than that. All technical civilizations do have a lot in common, even if we are one type and they are a band of 14-legged spiders. This commonality can be the basis for the quick establishment of a sophisticated common language. The things in common are mathematics, the basic physics and chemistry of the universe, and the arrangement of the cosmos. This is a rich resource of shared facts and experiences which can be utilized to establish a 'code,' which we call language, expressing relationships deriving from this basic library of shared facts and experiences.

"When you really work at the nitty-gritty of this problem, seeking quick and clearcut ways to establish cosmic languages, you find that the use of pictures with the facts of the universal library is very helpful, although not necessary. We have constructed (on the *Voyager* records) pictures which work as anti-codes, a way of communicating with a wide variety of other intelligences without prior contact. There are 116 pictures borne on the *Voyager* spacecraft, and they impart a wealth of information about this planet, surely without any language problem."

Other scientists are not so sure, though most of them agree that, because physical laws are the same everywhere, two advanced societies would have some knowledge in common. But what if one society were immensely older and more highly-developed than the other? In a future issue we shall report to you some present opinions on that.—JAMES D. BURKE

RIGHT: The 64-meter deep space tracking antenna at Goldstone, California. This, with similar antennas in Spain and Australia, comprises the Deep Space Network. Any of them could exchange messages with equivalent stations near other stars in our neighborhood of the galaxy. However, other such stations must first be found. For the search, smaller antennas with less sensitivity but wider beam width can be used.
PHOTO: JPL/ NASA

BACKGROUND: Star field in the constellation Sagittarius, looking toward the center of our galaxy. The telescope receives light from gas and dust clouds and from millions of stars. Do any of these stars have planets inhabited by an advanced civilization? No one yet knows.
PHOTO COURTESY OF HALE OBSERVATORIES.

WASHINGTON WATCH

by Louis Friedman

The Reagan Administration has submitted its Fiscal Year 1982 budget to Congress, indicating initial plans for NASA and the future of the United States' space program. No new starts were proposed. The Carter budget had proposed a new start for the Venus Orbiting Imaging Radar (VOIR). The Reagan plan is to defer the mission for a later start and launch date. This is the third straight nineteen-month deferral for VOIR.

One deep space mission was not funded—the U.S. portion of the International Solar Polar Mission (ISPM). Launch and science support for the European half of the mission was maintained, but due to the scaled down value of the mission, European continuation is in doubt. Ambassadors from many western European countries protested what they considered unilateral abrogation of an international agreement. Congress may consider restoring the U.S. portion of the mission with a one-year delay of the launch.

The only approved future planetary mission, the *Galileo* orbiter and probe to Jupiter, was continued, although apparently barely so. Newspapers reported its cancellation and an Office of Management and Budget plan showing this was published. This provoked a strong negative public reaction, which may have helped save the mission. The *Galileo* launch for 1985 is dependent on a NASA plan for development of a *Centaur* upper stage propulsion system for the space shuttle, which was included in the Reagan budget. This plan replaces the Interim Upper Stage (IUS), which has run into cost and performance problems. The IUS will still be developed in its smaller Air Force version.

The budget is now going through the Congressional approval process—authorization and appropriation. It is possible that Congress could restore cuts (such as to ISPM or general research and technology) or start new missions (such as VOIR or the Halley Comet mission). It is also possible that it could attack the program further, perhaps demanding deferral or cancellation of *Galileo*. Planetary Society members can keep up to date between issues of *The Planetary Report* by consulting newspapers and periodicals or by requests for information from their members of Congress. The Society will follow the budget process closely and keep members informed and involved. The large popular constituency we are building should help convince government decision makers that space science and exploration is a truly popular, as well as important, endeavor.

Many individuals have written to us asking how they can help, or to whom they should write. The most effective action is to write individual letters of opinion to members of Congress (if you don't know their names, consult your local library or newspaper) at the House of Representatives, Washington, D.C. 20515 and at the U.S. Senate, Washington, D.C. 20510. Because very few constituents write, the importance of such letters cannot be overestimated.

Louis Friedman, Planetary Society Executive Director, spent one year as a Congressional Fellow with the Senate Committee on Commerce, Science and Transportation.

CALENDAR OF EVENTS

April 27

"CRADLES OF ASTRONOMY," a series of archeoastronomy lectures by Dr. Edwin Krupp, director of the Griffith Park Observatory, Los Angeles, California. The programs will be: April 27, Ancient Eygpt; May 4, Babylon; May 18, Ancient China. Lectures begin at 8:00 in the planetarium theater and admission is $1.75.

April 29–May 1

EIGHTEENTH SPACE CONGRESS in Cocoa Beach, Florida. A series of talks and panel discussions focusing on the Space Transportation System or space shuttle. Highlights will include a speech by John Glenn and a "Meet the Astronauts" panel. The entire Congress is open to the public. For information, contact Chuck Morley (305) 867-7731 or Melodie de Guibert (305) 867-3160.

April 29–May 2

"THE CASE FOR MARS," University of Colorado, Boulder, Colorado; co-sponsored by The Planetary Society. A workshop on the development of a manned mission to Mars. On Saturday, May 2, there will be a public session with a panel and forum organized by The Planetary Society. For information, contact Chris McKay, Department of Astro-Geophysics, University of Colorado, Boulder, Colorado 80309.

May 9

ASTRONOMY DAY. "*Voyager* on Tour" lectures, part of the series sponsored by The Planetary Society, will be given at:

- The Schenectady Museum of Science, Schenectady, New York. Stewart Nozette, of the Massachusetts Institute of Technology, will speak. For more information, contact Don Knapp (518) 382-7890.
- The Pacific Science Center, Seattle, Washington. Speaker to be announced. For more information, contact Diane Carlson (206) 382-2888.

May 18–21

FIFTH PRINCETON CONFERENCE ON SPACE MANUFACTURING, Princeton University, Princeton, New Jersey. A multidisciplinary conference, chaired by Dr. Gerard K. O'Neill of the Space Studies Institute. The conference is open to the public, registration fee is $125.00. A summary session, May 21 at 9:00 a.m., is free and open on a first come, first served basis.

June 23–July 31

"THE PHOTOGRAPHY OF SPACE EXPLORATION," a collection of 185 photographs from 19th century France to *Voyager* at Saturn. At the Grey Art Gallery and Study Center, New York University. For photographs and information, contact Michael Boodro (212) 598-7603.

July 18–19

ASTRONOMY WORKSHOP FOR TEACHERS, sponsored by the Astronomical Society of the Pacific. "The Universe in the Classroom" is the theme of the first day; "The Universe Unfolding," on the second day, will feature non-technical lectures by noted space scientists Dr. David Morrison, Dr. William Kaufman and Dr. John Brandt. For information, write to Educator's Workshop, A.S.P., 1290 24th Avenue, San Francisco, California 94122.

IN RESPONSE TO A COMMITTEE REQUEST, DR. SAGAN SUBMITTED A LETTER TO THE HOUSE SUBCOMMITTEE IN CHARGE OF NASA AUTHORIZATION FOR THE PLANETARY PROGRAM. FOLLOWING IS AN EXCERPT FROM THAT LETTER:

Subcommittee on Space Science and Applications
Committee on Science and Technology
U.S. House of Representatives
Washington, D.C. 20515

Dear Mr. Chairman and Members of the Subcommittee:

...I am pleased to note we now see proof of the enormous popularity of planetary exploration in the phenomenal response and growth in The Planetary Society, a non-profit public membership organization that my scientific and non-scientific colleagues and I began organizing this year. In five months of membership solicitation we have grown to more than 30,000 members, making us already one of the fastest growing membership organizations in the world. The growth rate is still increasing. We have recently begun a mail solicitation to 2.2 million Americans. The breadth of membership is as noteworthy as our numbers, and I hope our existence now provides effective testimony to the popular interest space exploration serves.

As we look to the next decade, we see three planetary missions immediately confronting us: *Galileo*, the Venus Orbital Imaging Radar (VOIR) and a Halley Comet intercept mission. Beyond that we must plant seeds for the next decade of exploration. This Committee deserves great credit for its support of the *Galileo* mission. This mission, not unlike its namesake, continues to be buffeted by political winds (as well as continued delays in the availability of new launch configurations to replace the *Titan/Centaur* which launched the *Voyagers* and the *Vikings*). It has been twice delayed. Indeed, even cancellation (despite an investment of now two hundred million dollars) has been several times threatened. Yet it is the only new effort in deep space exploration which has been approved. The *Galileo* work underway at two NASA Centers, in industry and in Europe is at the cutting edge of technology. Your continued support for *Galileo*, with the earliest possible launch date, 1985, is, in my opinion, the most important immediate action you can take in support of planetary exploration.

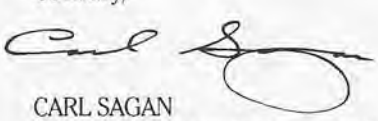
VOIR continues to slip its planned launch date at the awkward rate of 19 months per year (a launch to Venus is possible only once every 19 months). First planned for 1983, it now appears destined for 1988 at the earliest. Venus, in several respects, is a planet like the Earth, which somehow took a wrong turn. There may be important environmental lessons for us there. The importance of a first global look at the Venus surface cannot be over-emphasized. History is replete with important surprises from such first looks. The VOIR synthetic aperture radar technology has significance far beyond the mission itself. The deferral of VOIR, in light of budget pressures, is perhaps unavoidable; but this Committee, and its counterpart in the Senate, can ensure that further delays do not occur.

Finally, I must address the subject of a mission to Halley's Comet: no mission decision before you has more poignancy or immediacy. This is the most famous comet in history. When it last approached the Earth, in 1910, it mesmerized people all over the world. After its 1986 apparition, it will not return until 2062. No comet has ever before been examined close-up by spacecraft. An understanding of comets promises new insights into the early history of the solar system and the origin of life. Who in the 1970s would have predicted that the United States would ignore the coming of Halley's Comet, especially when all the other spacefaring nations (the Soviet Union, France, Japan and the European Space Agency) flew to it? The proposed American mission developed at JPL for NASA has an observatory phase. Unlike the missions of other nations, it is capable of extended observations of the comet's development as it flies around the sun. Its precise navigation system provides a unique capability for obtaining results close-up even if the comet is significantly different from our expectations. Such an American mission to Halley's Comet would provide a plethora of otherwise unobtainable data, and would also greatly improve the data to be obtained by the other spacefaring nations.

...

I urge you to take action which, at the least, will permit the Halley option to be exercised later; or, better yet, to initiate a new start for a Halley Intercept Mission. It is an activity with excellent scientific justification, major popular support, important technological benefits, and a cost of 30¢ per American per year.

Cordially,



CARL SAGAN
Director, Laboratory for Planetary Studies and President, The Planetary Society

News & Reviews

by Clark R. Chapman

Planetary science is now an enterprise concerned primarily with the exploration of our neighboring worlds in the solar system. Yet, this is but a passing phase in humanity's quest to find Earth-analogs or other habitable places in the universe. Research is just beginning on the larger topic of planetary systems about other stars. Nurtured by hopes, our theoretical expectations are that extrasolar planetary systems may be fairly common, but there is no proof as yet. According to David C. Black, writing in the September–October, 1980 issue of *Mercury* (published by the Astronomical Society of the Pacific, 1290 24th Avenue, San Francisco), "there is currently no unequivocal observational evidence for the existence of other planetary systems."

Dr. Black believes we can learn about the formation of our solar system by studying the frequency of occurrence of planetary systems elsewhere in our galaxy. His article is a primer on the methods astronomers use to try to detect distant planetary systems. *Direct* methods would detect planets by observing radiation from the planetary companions themselves; such schemes may be developed in the next decade. *Indirect* methods in use today are being refined; we may be optimistic that any Jupiter-like planets around nearby stars may soon be detected. An astrometric wobble in the position of a star, caused by the gravity of a massive orbiting planet, may yield reliable results for nearby stars, especially if planets are greater than five Astronomical Units from their sun (one A.U. = distance between Earth and the Sun). Earlier reports of positive detections of such wobbles are now regarded as premature. A spectroscopic Doppler shift approach is also promising, which may soon measure stellar motions of only ten meters per second. Dr. Black expects such planet-caused motions to be several tens of meters per second, which cannot be detected by the present accuracy of a few hundred meters per second.

Mount St. Helens and Mars

Planetary science is also directly concerned with our own planet. The Earth let us know it is alive and kicking last year when Mount St. Helens erupted. Indeed, several geologists with the Astrogeology Branch of the Geological Survey found their scientific attention temporarily distracted from Mars and the Galilean satellites. For some penetrating human perspectives on that awesome eruption, replete with striking pictures and maps, see the three-part series of articles in the January, 1981 issue of *National Geographic*.

Mudflows associated with the Mount St. Helens eruption have already been studied as an analog for processes that may occur on Mars. Indeed, our whole perspective concerning flow-like processes on the red planet is evolving, judging from several talks presented at the January meeting of NASA-funded planetary geologists, held at Louisiana State University. No longer is it certain that the giant river valleys on Mars were carved by flooding rivers. And few geologists, if any, still prefer the once prevalent notion that the smaller networks of apparent stream-channels are due to runoff from rainfall during some past climatic epoch on Mars. Much attention was given in Baton Rouge to the role of underground water and ice in sapping and undermining the terrain. Even the large-scale flow features in some channels are now thought to reflect mudflows or movement of glaciers. For example, Geological Survey scientist Baerbel Lucchitta has concluded that "sculpturing of Martian outflow channels by ice may well have been a dominant mechanism" for forming the apparent glacial grooves on their floors.

Publications Available

Dr. Lucchitta's report is one of over 150 brief reports published in NASA Technical Memorandum 82385 (*Reports of Planetary Geology Program—1980*), available from the National Technical Information Service, Springfield, VA 22161. These reports are short and up-to-date, but like most scientific research "hot off the press," they are quite technical and undigested. Most readers of *The Planetary Report* will do better to acquire (from the Superintendent of Documents) some of the excellent, inexpensive books and booklets published in the NASA Special Publication series. For example, NASA SP-441 (*Viking Orbiter Views of Mars*) is a 182-page, hardbound book of Mars pictures, some in color and others in stereo (a fold-up stereo viewer comes with the book). A recent, smaller collection of 31 exquisite *Viking* Mars-scapes is available as NASA SP-444.

A must for *Voyager* enthusiasts is *Voyage to Jupiter* (NASA SP-439), beautifully illustrated and with a most informative text by David Morrison and Jane Samz. The book places *Voyager* in its human and historical contexts and also provides a fine summary of the scientific results of the first year of analysis of data from the two 1979 *Voyager* encounters with Jupiter and its satellites.

Only now are articles on detailed analyses of *Voyager* data beginning to appear in technical journals. Among the first is a series of reports about the geology of Europa in the January 1–8, 1981 issue of the British weekly science journal, *Nature*. Europa is placed in the larger context of Jupiter's system in a non-technical article by John Guest. Then, JPL scientists A. Finnerty, G. Ransford, and D. Pieri, in collaboration with K. Collerson of Canberra, lay out a new view of the interior composition and structure of Jupiter's second satellite. If they are correct, some of the cracks on the surface of Europa may have been created in a bizarre process of aquaeous vulcanism. As the interior of Europa warmed and was dehydrated, overlying layers became saturated with upward-percolating water. The resulting expansion of embrittled mantle rocks and of Europa's thin overlying ice crust eventually cracked the surface. The water erupted as a crack rapidly propagated around the moon-sized body, in a manner analogous to the kimberlite eruptions on Earth that are responsible for diamonds.

In closing, let me note that the lead articles by Richard Berry in the January and February, 1981 issues of *Astronomy* are among the most comprehensive popular reports yet published on the spectacular November, 1980 *Voyager* encounter with Saturn.

Clark Chapman, of the Planetary Science Institute in Tucson, Arizona, is a member of the Galileo *Project Imaging Team. His primary research interests are asteroids and small bodies.*

WEATHER ON JUPITER

For centuries astronomers have observed Jupiter and noted the apparently permanently-banded appearance of the clouds of varying colors, interspersed with a wide range of spots of differing shapes, colors and sizes. As their observations continued, many of these small-scale features disappeared and were replaced by new features. Within this massive and dynamic atmosphere, the huge Red Spot seemed to move slowly across the disk of the planet, interacting with neighboring systems, while cloud colors continually changed. But the banded structure remained.

At first sight, the weather systems on Jupiter appear to be very different from those found on the Earth and other terrestrial planets. However, the studies conducted with *Voyager* observations have now provided a new perspective for our investigations of planetary meteorology.

The Jovian jets (narrow, fast-moving windstreams) seem to be remarkably stable. The jet speed maxima have remained in approximately the same positions for about a century, while the appearance of the Jovian clouds has constantly changed. It would therefore seem that the jets are driven and constrained by processes deep in the atmosphere, below the levels which influence the visible cloud properties.

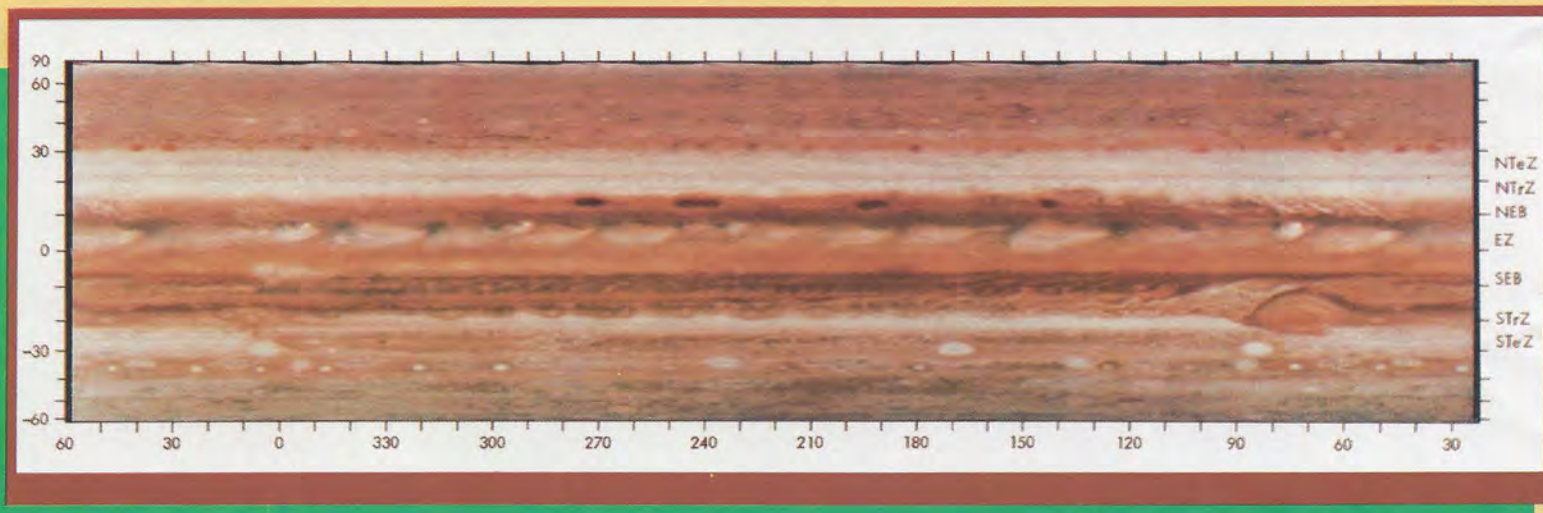
The major surprise of Jovian meteorology is that it seems to be driven in a manner similar to terrestrial weather systems. On Jupiter, the jets are fed energy from the turbulent eddies, swirls and streaks seen in the pictures. Indeed, out of the apparent chaos in the Jovian pictures has come order and some understanding. A major difference between the two planets is that the energy transfer appears to be one hundred times more efficient on Jupiter than on Earth. It appears that Jupiter's weather, with its large internal heat source, is star-like on the inside and Earth-like on the outside.

Some insight has also been gained into the large-scale cloud systems. The Great Red Spot (GRS), white ovals and other compact cloud systems are all members of the same meteorological family; the GRS is simply the largest member. The color of the GRS is a major puzzle. However, the suggestion that material flows slowly out of this famous feature is consistent with the idea that red phosphorus is produced at its top from phosphine (PH_3) brought to that level from the deeper layers.

Even the equatorial plumes seem to have a terrestrial connection. They appear to be giant storm systems, rather like huge thunderstorms, causing major perturbations in the equatorial weather. Their characteristics seem very similar to systems observed in the tropical regions of the Earth.

The *Voyager* studies have added a major dimension to our knowledge of the Jovian weather system and have shown that there is a close relationship to phenomena observed in the more familiar terrestrial surroundings. This further supports the need for more comparative studies of the Earth and planets.

Garry E. Hunt, of the Laboratory for Planetary Atmospheres, Dept. of Physics and Astronomy, University College, London, England, is a member of the Voyager *Imaging Science Team.*



This cylindrical projection of Jupiter was created by computer from ten color pictures taken by Voyager 1 during a single ten-hour rotation of the planet. Four dark brown oblong areas lie in the north equatorial belt (NEB). Some scientists believe them to be openings in the upper cloud layers, allowing darker clouds beneath to be seen. Giant white plumes dominate the broad equatorial zone (EZ). They appear to be giant storm systems, somewhat like thunderstorms on Earth.

The most famous feature of Jupiter's atmosphere, the Great Red Spot, lies at about 75 degrees longitude in the southern hemisphere. Large white ovals, of the same meteorological family as the GRS, appear at 5, 85 and 170 degrees longitude in the south temperate zone (STeZ).

The symbols at the right edge of the photograph denote major atmospheric features (dark belts and light zones): NTeZ—north temperate zone; NTrZ—north tropical zone; NEB—north equatorial belt; EZ—equatorial zone; SEB—south equatorial belt; STrZ—south tropical zone; and STeZ—south temperate zone.

PHOTO: JPL/NASA

Society Notes

by Louis Friedman

WHO IS THE PLANETARY SOCIETY? It is a most interesting question and the answer provides a fascinating and gratifying glimpse of the popularity of space exploration.

A woman in Los Angeles supported our cause, but felt she could not afford the dues, so she sent in $5 with an offer to help at night. Four weeks later she sent another $5 as an additional donation to us (now she is a member). A man in a rural Appalachian town donated to us his father's life insurance check of $2000; the father was fascinated by space exploration. Our correspondent, a blue collar worker, didn't even ask for membership, just for some hope that exploration of the solar system will continue and that young people can aspire to be a part of it.

A young man in Ohio gave a gift membership to his brother, only to have the first issue of *The Planetary Report* arrive on the day his brother was tragically killed in a fire. He donated $1000 in his brother's name.

Twenty-five volunteers showed up on a rainy Thursday night at our tiny Pasadena office to stuff envelopes for a special mailing to announce our national lecture series. Three-quarters of these volunteers have jobs unrelated to aerospace—in banking or accounting, with the post office, in child psychology and art history, as a security guard, or are students. All long for some involvement in the exploration of the planets.

An anonymous woman in southern California donated $30,000 on the day after Christmas because of her enthusiasm, first in response to Dr. Sagan's *Cosmos* television series, and then to The Planetary Society's efforts to popularize the process of discovery and the acquisition of new knowledge of other planets.

A single parent of four with a limited budget donated an additional $10 simply because "we owe it to (our children) to leave a legacy of continuing support of exploration."

In one noteworthy local membership drive in rural Michigan, a group of women not only solicited members, but generated several prominent new stories about the Society and its concern for future planetary exploration. Thus, in examining our membership lists, we find unexpected pockets of concentration in perhaps unlikely towns throughout the country.

Celebrities such as James Michener and Paul Newman have helped us in words and deeds. Dozens of scientists contribute first-hand new information to *The Planetary Report* and to our lecture series, "*Voyager* on Tour." In the two short weeks before Christmas, 14,000 new members joined the Society, temporarily saturating our (and the U.S. Government's) mail-handling capabilities.

In summary, we are the largest public interest group concerned with space exploration in the world. We'll do the usual scientific demographic analysis of our membership someday, but it's clear from our mail and membership lists that our breadth mirrors the diversity, not only of our country, but of our planet. Our 40,000 members reside in all 50 states and more than 20 countries and on all continents, except Antarctica. Members of The Planetary Society—"fellow inhabitants of the Earth"—are joined together knowing that we can insure that space exploration will continue in a vital and beneficial way for all.

Society Activities

The response to our formation and membership drive exceeded all projections—14,000 new members in two weeks in December, another 20,000 last month. We may be the fastest growing membership group in the country since the 1960's. This growth—a tremendous affirmation of the popularity of space exploration—has caused us to continually play catch-up, especially in putting mail into the sometimes complicated postal system.

Membership cards and certificates are now out, newsletter and gift picture mailings are on schedule and we are current with responses to thousands of membership inquiries. Reaction to *The Planetary Report* has been overwhelmingly positive. We have initiated the "Voyager on Tour" lecture series and five talks were given in the first three weeks. Our picture sales have started and are growing. And we are cosponsoring our first national conference, "The Case for Mars," at the end of April and beginning of May. (See the Calendar, page 10, for more information on the lecture series and conference.)

Of most excitement is the Pasadena Planetary Festival (see page 15), a concerted effort to reach out to young people who are motivated toward achievement in science and space exploration. A nationwide high school essay contest—announced in 100,000 classrooms—is being conducted; the topic is "Why Explore the Planets?" We have begun a pilot summer school program for students with new curricula in space sciences and exploration. All this is progress toward our ultimate goal of enhancing the popularity of space exploration in our culture.

The Planetary Society has been active in communicating the extraordinary public interest in space exploration to those involved in setting space policy and in NASA budget deliberations. In particular, we are stimulating efforts to keep open the possibility of a mission to Halley's Comet.

Much is planned for the future—special funds for projects and research, conferences, advanced technical studies, scholarships, national programs and symposia, distribution of books and other materials to our members. It will take a lot of doing, but I think we have made a good start. Help from our members is particularly important—next month we'll talk about volunteer work. □

Voyager on Tour

THE PLANETARY SOCIETY'S FIRST LECTURE SERIES, "Voyager on Tour," was initiated with a talk by Dr. Tobias Owen at the Explorer's Club in New York City. Prior to the talk, a special picture provided by the Society was hung in the Explorer's Club foyer which exhibits memorabilia in the history of exploration.

The lecture series is designed to be part of our public information program and will provide a focus for local Planetary Society activities. Six lectures were given in March, 1981 and many more are now being scheduled. Members will be informed in this newsletter (see the Calendar of Events, page 10) of scheduled talks and/or through special mailings. Ken Savary is director of the lecture series.

Pasadena Planetary Festival

The *Voyager 2* encounter with Saturn, on August 25, 1981, marks an important milestone in exploration: The completion of the initial reconnaissance of the solar system known to the ancients. In commemoration of this event, and in recognition that space exploration is an epitome of creativity and excellence, The Planetary Society is sponsoring the Pasadena Planetary Festival, chiefly oriented to young people. There will be many student programs, and an opportunity for the general public to view pictures of the Saturn encounter as they are returned by *Voyager 2*.

The program is still being developed, but will include several events—lectures, a concert, panel discussions, exhibits and displays of the *Voyager* pictures of Saturn—at the Pasadena Center. A national high school essay contest, "Why Explore the Planets?" has been initiated with the National Science Teachers Association and the American Association for the Advancement of Science. Interested students should consult their science teachers.

Now Available to Members—

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SET G: Posters of the Voyagers' JUPITER Encounter

Each full color poster is 23" x 35"

Set of six (6) posters–$12.00

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A FACSIMILE OF THIS FORM IS ACCEPTABLE.

THE GIANT GAS PLANET NEPTUNE is seen beyond the horizon of its nearest satellite, Triton, some 354,000 kilometers distant. In this painting by Rick Sternbach, Neptune covers nearly 10 degrees of an overall scene 35 degrees wide. Neptune is the possible future target of scrutiny by Voyager 2 *after the spacecraft passes Uranus in 1986.*

Rick Sternbach has done astronomical and space hardware art for numerous magazines, books, motion pictures and television productions. He was assistant art director for the PBS series Cosmos *and has done illustration and design work on* The Black Hole *and* Star Trek: The Motion Picture. *He lives with his wife, two cats and three parakeets in Irvine, California.*

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