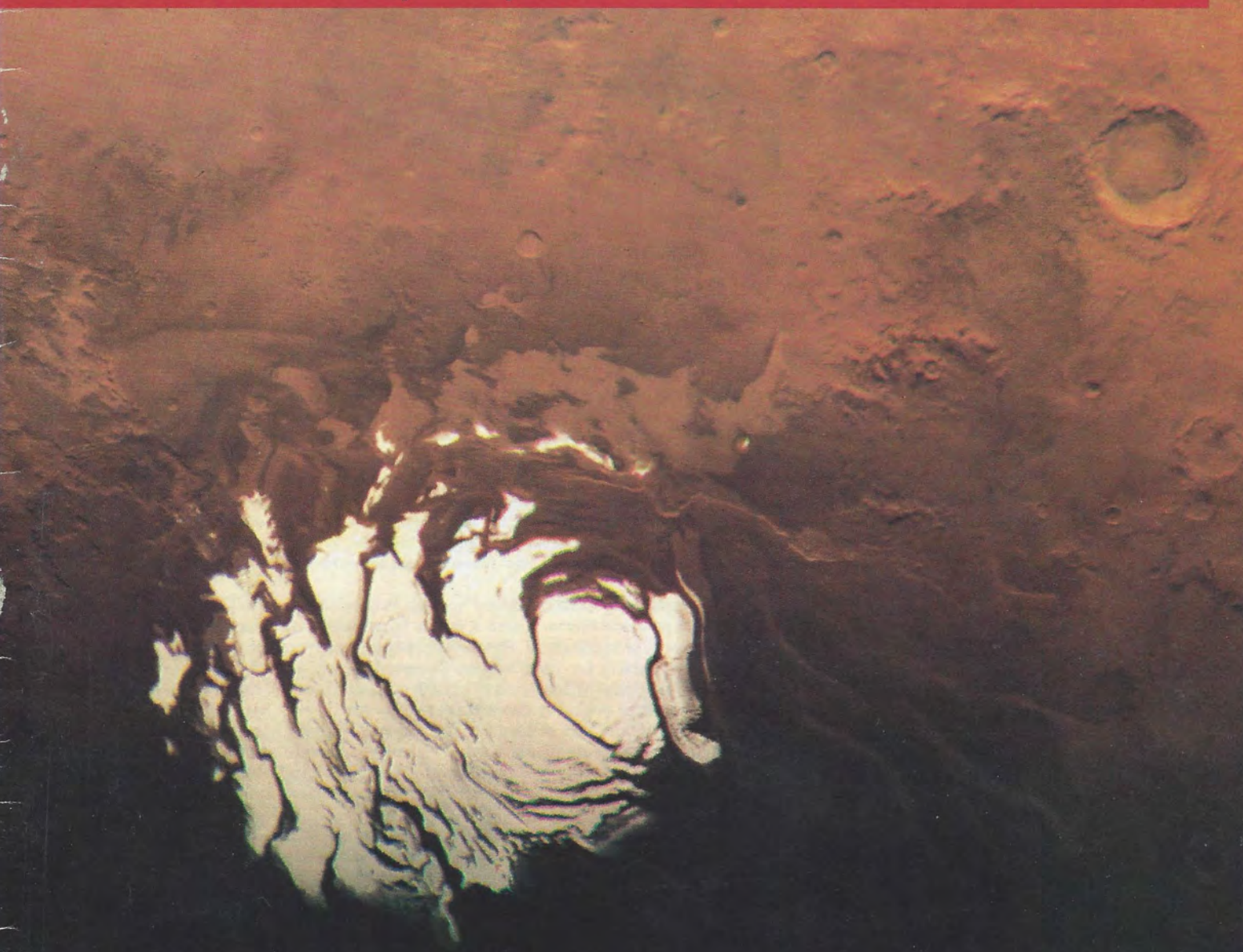
The PLANETARY REPORT

Volume VI Number 1 January/February 1986



South Pole of Mars

Fifth Anniversary Issue

A Publication of
THE PLANETARY SOCIETY

The Planetary Report (ISSN 0736-3680) is published six times yearly at the editorial offices of The Planetary Society, 65 North Catalina Ave., Pasadena, CA 91106

Editor, CHARLENE M. ANDERSON;
Technical Editor, JAMES D. BURKE;
Associate Editor, LYNDINE McAFEE;
Editorial Assistant, DONNA STEVENS;
Art Director, BARBARA SMITH

In Canada, Second Class Mail Registration Number 9597

COVER: A combination of frozen carbon dioxide, or "dry ice," and water ice covers the south pole of Mars in this image reconstructed from data returned during the* Viking *mission. The martian polar caps, and the intriguing layered terrain that may hold clues to the planet's past climate, will be prime targets of exploration when human beings reach Mars.
Image: Laurence Soderblom, United States Geological Survey

RECOLLECTION AND HOPE:
Our Fifth Anniversary Issue

IN THIS SPECIAL January/February 1986 issue of *The Planetary Report*, we look back over the first five years of The Planetary Society. We've chosen to mark this anniversary by telling the Society's story to let our members know how the organization that they so generously support came into being. As those who closely read this story will notice, the Society did exist although as a nebulous entity before January, 1981, so this issue does not mark exactly our fifth anniversary. But in that month the first issue of *The Planetary Report* appeared, and the members of the new organization had something in their hands that indicated a real, vital and growing Planetary Society. It's convenient to choose dates to mark progress in any endeavor, and this date will serve to mark the beginning of The Planetary Society.

We begin this issue with "The Planetary Society: A Short History" telling how the Society was born. To produce this we chose a writer from outside the Society, to bring an evenhanded perspective to the story. David Salisbury, who covered both planetary science and The Planetary Society for the *Christian Science Monitor*, agreed to take on the task. His readable and insightful article covers only the earliest history of the Society — a history that most members probably don't know.

Interspersed throughout this history are the recollections and hopes of Society principals, Carl Sagan, Bruce Murray and Louis Friedman — people whose dream of a Planetary Society has today become reality. Several Advisors to the Society have contributed their thoughts upon this milestone, remembering where we have been and projecting where we might go.

In this issue we also report on some of the successful events and research projects the Society has recently supported. The "Steps to Mars" conference with its commemoration of the *Apollo-Soyuz* mission attracted more media attention than any other activity in the history of the Society. The Planetary Society's support of an expedition to Mars, done cooperatively by the spacefaring nations, has brought the idea before the public. Many voices have now joined ours in calling for this mission to put human footprints on Mars near the turn of the millennium.

To give impetus to this idea, The Planetary Society formed the Mars Institute. Christopher McKay, head of the Institute, here reports to members on what we have accomplished, and still must do, to accomplish this historic beginning.

Mars has not been the only focus of The Planetary Society's attention. We have funded and put into action the most powerful equipment now operating in the Search for Extraterrestrial Intelligence (SETI). Paul Horowitz, the Harvard physicist who conceived and built both Projects Sentinel and META (Megachannel Extraterrestrial Assay), recounts the steps leading to these projects.

If we measure success in terms of discoveries, then our most successful effort must be the Asteroid Project of Eleanor Helin. This project, supported by The Planetary Society, has found half of all the near-Earth asteroids known today. In this issue, Mrs. Helin thanks the members who have so generously supported her work.

After reading through this special issue, you will know where The Planetary Society has been and where it is going. We hope you'll be with us as we work toward a bright future for planetary exploration and the search for extraterrestrial life.

— CHARLENE M. ANDERSON

THE PLANETARY SOCIETY
A Short History

Saturn and its magnificent rings graced the cover of the first* Planetary Report, *which was put together in 1980 as* Voyager 1 *approached the planet.

by David F. Salisbury

Five years ago a new star blazed up brightly in the fragmented firmament of American space interest groups. That star was The Planetary Society.

With its spectacular growth from a handful to over 70,000 members within 12 months of going public — which made it the fastest-growing membership organization in America over the previous decade — this new group rapidly outstripped the memberships of the three dozen or so older organizations of the type. In so doing, it proved decisively that public interest in space exploration was much broader than most politicians, and even many advocates, had thought. Finally, the Society easily reached a critical membership "mass" which made it self-sustaining and has allowed its members and leaders to become a significant voice in the space policy arena.

If The Planetary Society were a star, it would surely be located in the constellation Gemini. For it is the brain-child of two exceptional men: Carl Sagan and Bruce Murray. In a sense, the two are the odd couple of planetary science. Their personalities and styles are strikingly different, almost antithetical. Yet a deep mutual respect has kept them good friends even when they have disagreed strongly on matters of style and substance. Just how different the two are can be seen in how each came into his chosen profession.

For Dr. Sagan, the route into planetary science was charted by his childhood interest in astronomy. As a boy, he would frequently sit out at night, gazing up at the heavens with wonder. His interest was leavened by science fiction: Edgar Rice Burroughs, Jules Verne, H. G. Wells. As a result, his career as a planetary scientist has been unusually literate and imaginative. He has played the role of what one might call a "life chauvinist" within the scientific community. From creating, in his laboratory, organic molecules from the stuff of primordial planetary atmospheres, to statistical analyses supporting the proposition that there should be other intelligent life in the galaxy, Sagan has continually been sifting the available data in search for signs of alien life.

Thus, after sinuous channels were discovered on Mars, he argued eloquently that they were probably cut by water, that this implies Mars was once more Earthlike, and, if so, that life may have evolved there. Similarly, the reddish haze surrounding Saturn's satellite Titan immediately drew his attention because it was similar in color to the complex stew of prebiotic chemicals created in origin-of-life experiments on Earth. So, until measurements indicated surface temperatures too cold for biochemistry, he hypothesized that an atmospheric greenhouse effect might have kept Titan warm enough for life to begin.

"Certainly the possibility of life elsewhere in the solar system has focused my attention on the issue of extraterrestrial environments, but I believe I have rigorously followed the evidence where it leads," Sagan says. Thus, he was an early supporter of the view that Venus was too hot to support life and that seasonal changes on Mars were due to dust rather than biology.

Articulating Wonder

With his ability to articulate the sense of wonder and excitement involved in planetary science, Sagan naturally became a favorite of the news media. For years he walked the narrow line dividing scientist from popularizer and only rarely stumbled.

Bruce Murray's history is quite different. As a student, he wanted to go into science but he wasn't sure which field to choose. Biology appealed to him. But he found the office of the chairman of the biology department at the Massachusetts Institute of Technology depressing: It was dark and gloomy, filled with specimens preserved in formaldehyde. He couldn't picture spending an entire career in such surroundings. So he decided to go into geology instead because it would give him an opportunity to work outdoors.

Although he originally had no thoughts of becoming a planetary scientist, as a member of the geology department at the California Institute of Technology, with its ties to the Jet Propulsion Laboratory (JPL) nearby, it was natural for him to become involved in the geology of the Moon and other planets.

As he moved into this new field, Dr. Murray brought with him a natural conservatism, an insistence on hard fact and a refusal to be drawn into speculation based on incomplete evidence. In technical debates this often put him on the other side from Sagan. For instance, he resisted the interpretation of the martian channels as evidence for the past existence of liquid water until all other possibilities had been examined and rejected.

Then, in 1976, Murray was tapped to become the director of JPL, plunging him directly into the space policy arena. For the US planetary program this was a schizophrenic period. In his tenure, Murray presided over some of its most spectacular achievements: the *Viking* landers on Mars and the *Voyager* encounters with Jupiter and Saturn. At the same time, however, it proved impossible to get any new missions approved. Congress was continually paring down NASA's planetary budget. And the costs of the space shuttle cut deeply into NASA funds. As a result, planetary researchers came closer and closer to what became known as the planetary gap: a hiatus of over five years in new US exploration.

"I was very frustrated," Murray recalls. While NASA managers enjoyed the attention the planetary missions provided, they adamantly refused to modify their almost exclusive emphasis on the space shuttle and the manned program. "It was a difficult

The goals of The Planetary Society can best be carried out through international cooperation and they are far removed from any possible military application. I value The Planetary Society not only as dedicated to the increase of human knowledge, but to the increase of human peace and security as well.
— ISAAC ASIMOV

time for visionaries. The scales of plans were being reduced until they didn't meet the visions of what could be done. It was not a case of making do with a half a loaf, but with a tenth of a loaf."

Meanwhile, in another venue, Carl Sagan was experiencing similar frustrations. After writing several popular books concerning various aspects of planetary research and the search for extraterrestrial intelligence, Sagan was trying to get the television networks seriously interested in the subject. "Thousands of astonishing closeup photographs of the Moon and planets were coming back to Earth, and commercial television — an ideal medium for the portrayal of pictorial material — was not interested at all," he explains. Despite becoming a frequent guest on the Johnny Carson show, he had little success in talking the networks into something more ambitious.

After repeated disappointments with commercial TV, Sagan turned to the Public Broadcasting System. The result was the 13-part *Cosmos* television series which absorbed three years of his life. When it finally aired in 1980, the show became the most widely watched series in US public television history. To date over 250 million people from over 60 countries have seen it.

Exasperation and Conviction

What made the situation in the late 1970s so exasperating to both men was their deep conviction that the public was far more supportive of planetary exploration than politicians, bureaucrats and media pundits recognized. Following the collapse of *Apollo*, public support for the space program fell off precipitously. They were convinced that the exploration of other worlds was a topic of continuing interest to people, but that this interest had been diluted by the tedium of routine, nonexploratory manned missions.

Around 1976, polls began showing a significant rebound. People responding that the government was spending too little on space outnumbered those who felt it was spending too much. But politicians seemed unwilling to recognize this change.

Early in 1979, the filming of *Cosmos* and the *Voyager* encounters with Jupiter brought Sagan to Pasadena for an extended visit. He and Murray had an opportunity to share their feelings and frustrations. Both felt that something was deeply wrong with the political and bureaucratic process. The problem, they realized, was in large part due to the fact that planetary exploration — unlike science and technology, military uses of space, even the commercialization of space — lacked an organized constituency. It was during one such conversation that the idea of starting a public membership group came up.

"Initially, I think we had slightly different ideas about what such an organization should be. I was thinking in terms of a grass roots political organization with local chapters, organized along the lines of what I thought Common Cause was like (incorrectly, as it turned out)." Sagan envisioned an organization "through which the planetary science community could communicate with ordinary people."

Actually, John Gardner, the founder of Common Cause, may have planted the seed. He has a deep interest in space and became acquainted with Murray while serving on JPL's board of directors. Mr. Gardner recalls discussing NASA appropriations and policy with Murray. "He expressed concern that there was no constituency for deep space exploration. And I put forward the view that such an assertion should be tested, by starting either a public membership group or a journal."

ON THE PREHISTORY OF THE PLANETARY SOCIETY

by Carl Sagan

On November 13, 1971, the American spacecraft *Mariner 9* was successfully injected into orbit around Mars — the first spacecraft in human history to orbit another planet. But Mars was enveloped in a global dust storm, as the American and foreign news media dutifully reported before leaving the Jet Propulsion Laboratory for more urgent business.

By January, the dust storm began to clear and extraordinary vistas of Mars were transmitted, including the largest volcanic mountains known in the solar system, ancient river valleys on a planet now bone dry, a profusion of strange albedo markings on the surface, and clear evidence of geological stratification, at least in the polar terrain.

Eventually 7,329 pictures were acquired. Those of us privileged to participate in this extraordinary mission felt that the human species was exploring a wondrous new world; we were confident that many others would share our excitement. We were also aware that since such projects are supported by the American people, it is only proper that the public see what they are paying for.

So the Offices of Public Information at JPL and at NASA Headquarters called the media back. Individual scientists did so as well. I called — or tried to call — every television and print reporter I could think of. But with only a few exceptions, the answer was the same: *Mariner 9* had achieved orbit in November 1971; this was now January of the following year. These findings weren't "news." We should have arranged for the pictures to be available when the reporters were at JPL months before. And anyway, the public — by now saturated with *Apollo* footage — just wasn't interested in exploring other worlds.

Although things were a little better in 1976 with the two *Viking* landings on Mars, many of us felt that the reportage was again grossly inadequate for the drama of the first successful landings on Mars, the first search for life on another planet, and especially for the stream of exquisite pictures — ideal for the visual medium of television. There was a widespread underestimate, it seemed to me, of the intelligence and spirit of adventure of the American people.

This was often reflected when planetary scientists would talk to members of Congress or the Executive Branch. I can remember, in the early and very shaky days of the *Galileo* project, entering the office of a key committee member of Congress and finding a picture of Jupiter on the wall. Well, at least this one ought to be easy, I thought. But I was mistaken. Yes, members of Congress or their aides might be interested in planetary exploration; they might understand its symbolic, historical, scientific and practical values. But unfortunately the American public wasn't the least interested in planetary exploration, I was told. In the congressman's entire district there were only three people who had chosen to write on *Galileo*, and two of them were below voting age. There was no industry in the district that would produce components for *Galileo*. The congressman felt he could vote against the wishes of

The Planetary Society staff recently moved to this old Pasadena house, designed by the noted architects Greene and Greene and built in 1903. Arrayed across the front is the Society staff: (back row, left to right) Evie Rourman, India Whitaker, Edwin Flores, Cosma Norton, Lou Friedman, Charlene Anderson; (seated) Debra Garcia; (front row) Donna Stevens, Iva Svitek, Cindy Grisanti, Lu Coffing, Lyn McAfee.

If that is the case, it turned out to be a subliminal suggestion. According to Murray, he and Sagan came up with the idea of founding an organization first. Then, because they realized their ignorance in the area, they went to Gardner to get his reaction. Whatever the case, he gave them both advice and encouragement. "I was pretty sure there was a constituency. There was considerable evidence of public interest in space," he says.

The more the two scientists explored the idea of forming such a group, the more appealing it became. Neither would have tried it on his own, says Murray. Sagan alone would not have been able to rally as much support from the planetary science community, many of whom would have dismissed such a group as little more than another Sagan fan club. Murray, on the other hand, didn't have the visibility required to attract a large public following. But together they had the necessary ingredients. Over the years Sagan, in particular, had met many of the rich and famous who professed an interest in supporting such a cause. So he and Murray didn't think raising the seed money to get started would be too difficult. Time, however, was another matter. Both men were extremely busy with other commitments. They needed someone to help organize such an effort.

Organizing the Activity

At this time, Louis Friedman — a mid-level engineer and mission planner at JPL — was on a year's leave of absence. He was in Washington, DC, on an American Institute of Aeronautics and Astronautics (AIAA) fellowship, serving as a staff member for the Senate Committee on Commerce, Science and Transportation. Murray thought he might be the right person for what they had in mind.

So, in May of 1979, when Dr. Friedman came to JPL to discuss what he might do at the Lab on his return, he was nonplussed when Murray interrupted him and began to talk about this new organization he and Sagan were thinking about starting. Murray concluded by asking if Friedman would be interested in helping to organize such an activity.

"The idea of working with Carl Sagan and Bruce Murray on starting a new activity was, of course, enormously appealing. All that I had to do was to think about the concept itself," Friedman recalls.

That summer Sagan and Murray began trying to raise enough money to support Friedman during a relatively short leave

---

the leadership of his party only on a few, carefully selected occasions. This was not one of them.

But this issue really crystallized for me in December 1977 when I was asked to discuss the space program — and astronomy more generally — with then President Jimmy Carter and Vice President Walter Mondale and their families, one evening at the Vice President's residence on the grounds of the US Naval Observatory.

Since such presidential briefings must be rare, I felt it was my responsibility to treat the subject of astronomy and space sciences as evenhandedly as I could, and resist the temptation to lay stress on my own particular interests. But the *Viking* mission was still ongoing, the pictures spectacular, and I was repeatedly detained on my way to the Crab Nebula and beyond by presidential interest in Mars. How definitive were the apparently negative results on life? Why had we landed in such dull places when there were such exciting places all over the planet? Hadn't we heard of "nothing ventured, nothing gained?" I found myself in the unlikely posture of pleading caution and fiscal responsibility to a President caught up in an exploratory passion — easy to come by when discussing Mars.

My hosts were knowledgeable and hospitable. After I finished — satisfactorily in the realm of galaxies — the President took me aside.

"You know, you ought to write a few more books to really get people interested in planetary exploration. Then we could do some really exciting missions."

"But Mr. President," I protested, "*you* only need write your name at the bottom of a single piece of paper and we could have a rover mission to Mars."

Mr. Carter only smiled.

The clear lesson from such experiences was that the future of planetary exploration, at least in the United States, might very well depend on the perception by politicians and the media of public interest in the subject, and this is the path that for me led to The Planetary Society. The Society's extraordinary success — as well as many other lines of evidence, including the appearance of Saturn on the covers of *Time* and *Newsweek*, the success of *Cosmos*, ABC's *Nightline* devoting whole programs to live coverage of the *Voyager* encounters, and much else — demonstrates very clearly, I think, enormous public interest in, and support for, the exploration of the planets. This is even more true of the search for extraterrestrial intelligence.

These concerns were very much on my mind when in 1979 Bruce Murray and I discussed — at first very casually — a new organization. We had been friends and colleagues for almost two decades (as well as occasional opponents on scientific issues). Then, as now, I had great respect for his integrity and dedication to planetary exploration, and very much liked the idea of working with him on this project. When Louis Friedman — with his varied background in mission design and the mysterious workings of congressional committees — and Charlene Anderson, a first-rate editor, joined us, I knew we had critical mass. I am grateful to them, Henry Tanner, Joseph Ryan, the distinguished members of our Board of Advisors, and many others who helped make The Planetary Society a reality.

After five years, The Planetary Society now plays many important roles — in public education, in scientific research, in international cooperation, and in the advocacy of great endeavors pointing toward a hopeful human future. Our next five years look very bright. □

The mortgage . . . the kids' braces. . . the broken carburetor . . . the mayoral race . . . the new boss at work. Such is the bric-a-brac that consumes our lives. Only rarely do most people have the inclination to look much beyond this. And even when they do, often they are unable to understand what they see — what it is, what it means, and why it is important.

In no area is this more true than in planetary exploration, that "irrelevant" enterprise that does not defend the nation, better the cities, or improve the economy. Yet, it does have value — scientific, technological, even spiritual. Moreover, it touches deep, basic quests: to explore and to understand worlds besides our own; and, even to wonder if we have kin beyond Earth or, if in all of space and time, we are alone. In short, it embraces some of the most profound ideas and deepest yearnings of humankind.

For the past half decade, The Planetary Society has nurtured such inquiry. It has probed, prodded, examined, cajoled and explained. It has been an advocate for exploration and understanding. In all this, clearly it has succeeded.

So, happy birthday to The Planetary Society. May it keep up its advocacy. And may it continue to inform us and challenge us and remind us about what, over time, is genuinely important. — *RICHARD BERENDZEN*

from JPL. And Friedman took advantage of Congress' August recess to discuss the idea with a number of people, including senators, congressmen, NASA and administration officials, space and other public interest group organizers.

In this round of discussion, Friedman recalls, "I received only one discouraging word: The president of the US Chamber of Commerce thought the idea of exploration and science had so little constituency that it would all be just a waste of time." But the positive responses encouraged him to commit himself to this new venture. However, as September and the end of his congressional fellowship drew near, Sagan and Murray had still had no success raising funds. So, when Friedman returned to California, he wasn't sure whether he would be going back to JPL or working on "this undefined, perhaps flaky concept."

After meeting in mid-September, the three decided that it made more sense for Friedman to take a half-time, rather than a full-time leave. That way he could be supported by a $10,000 loan which had been arranged from the CETI (Communication with Extraterrestrial Intelligence) Foundation, directed by Sagan, Barney Oliver, now with NASA, American University's Richard Berendzen, Frank Drake now of UC Santa Cruz and Philip Morrison of MIT. The Foundation's money came from some stock donated by Oliver and Sagan's royalties from the book *Murmurs of Earth: The* Voyager *Interstellar Record*. It was set up to assist CETI research which was having a difficult time attracting government support. A large public organization as envisioned "seemed an appropriate vehicle to accomplish what the CETI Foundation had started out to do," Sagan explains.

In October, then, Friedman began working half time on the new organization from a small office in his home. Besides the continuing quest for money, this period was filled with extended discussions on the name and nature of the new organization.

Naming the organization required a considerable amount of time and energy. Sagan insisted that anything with the word "cosmos" be rejected to avoid confusion with the TV series or its commercial spin-offs. Murray and Friedman came up with a list of possible titles, none of which proved satisfactory. Anxious to get on with other things, Friedman began pushing for acceptance of the name, "Space Exploration Society," although none of them were completely satisfied with it. Sagan refused to give in. "I wanted a name that would reflect not just the exploration of other worlds, but the global perspective of those who engage in such exploration. I also wanted a name that was short, easily pronounced and easily remembered," Sagan explains. He finally hit upon "The Planetary Society" and, in a mid-October conference call, Murray and Friedman agreed.

The decision was also made early on that the group would neither solicit nor accept money from aerospace corporations. This was to avoid even the appearance of acting as a front for those who might profit from the policies the organization would be advocating.

Friedman's jogging partner, Joseph Ryan, a partner in the Los Angeles law firm O'Melveny & Myers, persuaded his company to take the group on "pro bono" until the Society got on its feet. It was decided to incorporate in the state of California with Sagan as President, Murray as Vice President, and Friedman as Secretary-Treasurer.

During this time the three also began hashing out what the goals and activities of the new Planetary Society would be. In an October, 1979 document they listed three: demonstrate support for space exploration simply by being able to organize a large, broad membership around the country; educate members regarding various activities in the space program; and potentially, support a limited amount of research in particular areas of planetary exploration.

Influencing Policy

Sagan, Murray, and Friedman also agreed that they did not want the Society involved directly in political lobbying. Instead, they intended to influence public policy indirectly, through public information and education. Still, they felt that the very existence of a group such as they imagined would have a significant positive impact on government policy.

November came, and still The Planetary Society remained a paper tiger. Attempts to raise further funds continued to draw a blank. In addition to this failure, the three men were presented with a serious temptation to redirect their efforts. Jerry Grey at the AIAA contacted them. He explained that a number of space organizations were discussing a confederation. Such an umbrella group would need a popular and articulate spokesman. Would Carl Sagan and The Planetary Society be interested in playing such a role? No immediate decision was made.

In 1980, Louis Friedman and Harry Ashmore (left to right, standing) and Bruce Murray and Carl Sagan (left to right, sitting) met to discuss the formation of The Planetary Society.

"Late 1979 was a very difficult time. We had not produced any printed material. We had begun no public activity. And we did not see our way clear on financing. Our energies seemed to be dissipated," Friedman reminisces.

Still, the Society was incorporated by the end of the year. And, after a dinner with Dr. Grey in January, its three officers decided to continue on their original course rather than become an umbrella organization.

In early January 1980, they sent out personal letters to friends requesting significant donations for the fledgling organization, hoping to raise $100,000. The financial situation was getting desperate. The original $10,000 loan was running out.

A $1,000 donation from science fiction writer Larry Niven served as a valuable stop-gap. "It looked like a good cause, so I threw some money at it," Mr. Niven comments. But it was a gift of $10,000 from actor Paul Newman — who has a deep interest in the search for extraterrestrial intelligence — that marked a change in fortune.

Less than a month later Murray made one of the Society's most important connections. John Gardner engineered a meeting with Joseph Drown, a long-time Southern Cali-

fornia philanthropist. While he had no particular interest in space, Mr. Drown was interested in seeding worthwhile efforts.

"Joe was very close to Gardner and quite impressed by Murray," comments an old friend and associate, the Pulitzer prize-winning writer, Harry Ashmore. When Drown was interested in a group, he would frequently put up the money for a direct mail test campaign. In this way, Mr. Ashmore explains, for about $10,000 it was possible to determine whether or not an organization could become self-supporting.

After he had Ashmore interview the Society principals and confirm his judgement, Drown offered a $10,000 gift with two provisos: first, that the group match the amount with donations from other sources; and second, that the funds be used for a test direct mail campaign. At the time, the philanthropist was suffering from cancer. He died within a year, but lived long enough to see that his last project was a success.

While discussions with Drown were going on, Friedman was preparing a "Dear Colleague" letter to members of the planetary science community. This was an appeal to the 400 members of the Division of Planetary Sciences (which Sagan had cofounded) of the American Astronomical Society and about 1,000 scientists in related organizations such as the American Geophysical Union and the AIAA, requesting their financial support as Founding Members of the Society.

Many members of the planetary science community shared Sagan's and Murray's frustration. The two figured that many of them would be willing to contribute to an organization dedicated to improving the situation. So they drafted a letter asking fellow scientists for $45 apiece. "At the time we felt that was a daringly large sum of money," Friedman recalls. The letters were sent out in April and May. In the minds of the three men this was a Rubicon crossing. The results exceeded their expectations and set the pattern for what was to follow: Forty percent of the scientists signed up and many are still actively involved.

More than ever before we need to strengthen scientific cooperation in space. Indeed, cooperation has been there practically from the beginning of the space adventure. Soon after the first launchings of satellites, scientists from east and west joined in establishing COSPAR, the international organization for scientific cooperation in space.

I am deeply convinced that we have to continue along this avenue. Projects are getting more and more complicated and elaborate; all the intellectual forces of the world are needed to bring them to a successful end. There are research themes so fast-moving, so complicated, that they can be attacked well only when the attack is launched from several sides in close and harmonious cooperation — for example, the remote sensing of Earth to study global change, and radio interferometry of cosmic radio sources using simultaneously launched spacecraft.

The great planetary adventure will need all hands and minds together in unison when humankind takes up the challenge of human planetary missions. The Planetary Society can be very instrumental in pushing this development — a wonderful task for its next five years.

— CORNELIS DE JAGER

Direct Mail Campaign

By that time, Ashmore had introduced them to Peter Tagger, a direct mail technician. At Drown's request, the two had worked up a proposal for a direct mail program to determine "the nature and extent of the Society's mass donor potential." This consisted of sending out one million new pieces of mail annually for three years. Tagger, quite conservatively it turned out, estimated that such a campaign might build up the Society's membership to →

LOOKING BACK *by Bruce C. Murray*

The Planetary Society was formed when our visions of the possibilities of space — catalyzed by *Apollo* on the Moon, by *Viking* on Mars and by *Voyager* to the outer planets — so outstripped the foreshortened and modest succeeding efforts. The logical successors to the brilliant explorations of the 1970's, such as roving vehicles on Mars, never made it off the drawing boards. Even the *Galileo* mission to expand on *Voyager's* reconnaissance of Jupiter was nearly killed. The noblest scientific exploration of all — the search for extraterrestrial intelligence — was ridiculed in Congress. The painful disparity between the popular support and technical possibilities for space exploration and the systematic reduction of new American efforts in pursuit of that goal was the source of the energy and commitment that gave birth to the new Society.

Carl Sagan and I intended The Planetary Society to provide a brilliant focus for people enthusiastic for space exploration, who wished to carry the vision into the future, over the interval of diminishing expectations. The torch had to be carried by thousands — even hundreds of thousands — if the exploration of our solar system was to remain a popular theme. Over 100,000 people who shared our vision flocked to The Planetary Society, demonstrating that the energy and enthusiasm that sent *Apollo*, *Viking* and *Voyager* on their way still burned.

Looking back now, five years later, I am so glad we formed The Planetary Society. The search for extraterrestrial intelligence (SETI) has become a respectable and broadly supported endeavor. Paul Horowitz' Suitcase SETI, Project Sentinel, and now Project META — all supported by The Planetary Society — have led the way, and this program has established the direction and goals that other SETI programs must exceed. The Asteroid Project continues to lead in the discovery of near-Earth asteroids. The Mars Institute, through its conferences and courses, keeps alive the dream of sending humans to Mars.

Our country is, I believe, once again beginning to relish the prospect of space exploration. That endeavor still offers the most sublime way for a great nation to achieve international prestige and high self-esteem with virtually no negative side effects. We can now begin to discern the shape of the future. The upcoming encounters with Halley's Comet, *Voyager 2* at Uranus, *Galileo's* launch and encounter with the asteroid Amphitrite, the prospects of other missions to the terrestrial planets, will once again stimulate the imaginations of our young people, raising their expectations of themselves and their societies.

Looking ahead five years, there are no fundamental reasons that require us to limit our hopes and visions. There can be a less belligerent and more cooperative world in which the first human flights to Mars have been planned and scheduled, in which the SETI endeavor is expanded to Earth-orbital observing sites, and in which the exploration of our planetary neighbors is once again quickening.

The Planetary Society — all of us around the world — is dedicated to transforming that hopeful vision into reality. □

around 22,000. The front-end costs were approximately $20,000.

Although the decision to proceed with the test was made in April, it took until September to hammer out all the details. Despite their caution and the considerable amount of discussion, debate and reworking which went on during this period, the Planetary Society officers "were no more difficult to work with than [leaders of] any other organization," comments Mr. Tagger. "They are very intelligent people, but they

THANKS FOR THE MAGAZINE

On this fifth anniversary, we would like to thank the people who are responsible for *The Planetary Report*. Charlene Anderson has been our editor since The Planetary Society's beginning. She has consistently done an outstanding job in producing a magazine we can be proud of. Not only do we feel it is the finest product to come out of the space interest movement, but *The Planetary Report* is one of the finest membership communication media anywhere. Ms. Anderson has been the chief architect of that quality.

The team that produces *The Planetary Report* has, for the most part, been with us all five years. Jim Burke of the Jet Propulsion Laboratory has served as technical editor in a voluntary capacity. His only reward is what we can do to satisfy his deep and abiding love of space exploration. Barbara Smith, our designer, has given *The Planetary Report* its beautiful and distinctive look. Bud Vance and the staff at Welsh Graphics in Pasadena have repeatedly demonstrated their commitment to the magazine with their high quality printing. Bob Walters and Color Service have provided excellent color separations that contribute to that quality.

A few new faces have joined the team in the last two years. Donna Stevens and Lyn McAfee have helped with the editorial chores. Lorna Lyons of Bear Face Type has brought *The Planetary Report* "on-line," saving us both time and money.

We would also like to thank the many writers and artists who have contributed articles and pictures to *The Planetary Report* over the years. Without the support of the professional community, we could not do our job of bringing the latest information about planetary exploration to our members.

Finally, I would like to acknowledge the President of The Planetary Society, Dr. Carl Sagan, who has given so much of his personal time and energy to *The Planetary Report*.

— Louis D. Friedman

were not always comfortable with the jargon of advertising. However, they were prepared to do the necessary things to catch the attention of the readers."

Meanwhile, the three officers decided it was finally time to go public, using a May 30th appearance by Sagan on the Johnny Carson show as a vehicle. They prepared a press release describing the Society and released it at the same time. The Society's first official member was Jim French of JPL who saw a pre-release copy of the announcement. Membership applications began trickling in. By July 12th, they had 25 members.

Shortly thereafter, Friedman left JPL to work full time on The Planetary Society and quickly brought in Charlene Anderson, from the Cousteau Society, to work on the magazine they were starting. Ashmore convinced the new Society's officers that they needed to give their members more than a short, simple, black-and-white newsletter. So the glossy, colorful *Planetary Report* was born and things began to roll.

That fall, as the first 60,000 Planetary Society brochures flooded into the mails, everything "just seemed to click," says Mr. Tagger. Both the approach and the message were right. The five to six percent return — nearly unprecedented in direct mail campaigns — clearly indicated that the Society had substantial public support, presaging its rapid growth to over 100,000 members, making it by far the largest space interest group in the country.

Who are the people attracted to the Society? "I've really been struck by the spectrum of people joining," says Sagan. They include "the very young and the very old; blue-collar workers and the well-to-do; those with only a little education and those with a great deal."

The group has tallied responses to one questionnaire but hasn't tried to profile its membership in great detail. However, Tagger has some general impressions. The average age is close to 40 years old, a lot younger than that of members in most organizations which grow by direct mail. Economically, members appear to be quite mixed, ranging from the affluent to students who have to scrape together the annual dues. Members are extremely forthcoming in answer to requests for funds for special projects. Contributions above the basic membership fee are numerous. However, few of the gifts are large, he says.

One of the people to receive the Society's first mailing was Houstonian David Brown, president of an energy conservation company called Time Energy Systems. "I sent in the fee. Somewhat later I made a small contribution. Then I met Carl and Louis and one thing led to another," he recounts. Today, with donations of over $100,000 he is the Society's largest individual donor.

"There was a meshing of the minds," he explains. Mr. Brown worked in the *Apollo* program and says his business is built heavily on space-program spin-offs. Also, he went through school on scholarships so likes to support scholarship programs.

"A lot of zip is going out of the space program. It is necessary to have somebody lobbying for it, somebody to stand up for programs like SETI [the Search for Extraterrestrial Intelligence], for instance," he says.

Attracting Attention

The Society also attracted the attention of Hollywood producer Gene Roddenberry of *Star Trek* fame. "I was very impressed with the approach Murray and Sagan were taking. The thing I liked most was that The Planetary Society was a professional-level society recruiting laymen. For a long time I have been trying to encourage scientists and lay people to work together at the same level," Mr. Roddenberry explains. As a result, he decided to take an unprecedented step, signing an open letter to *Star Trek* fans recommending that they join and support The Planetary Society.

While the Society went from success to success on the membership front, political events were going from bad to worse. Murray, in particular, was convinced that an American mission to Halley's Comet was of pivotal importance to the planetary program. NASA Headquarters, however, had rejected the mission in favor of a technological project — development of an ion drive, the Solar Electric Propulsion System. This program failed to generate any enthusiasm in Congress and so was axed from the budget. Murray threw all his energies at JPL, at NASA and at The Planetary Society into last-gasp efforts to revive the Halley mission.

Thus, the first political position The Planetary Society took was that of advocacy for a comet mission. Despite their efforts, however, the NASA bureaucracy remained impervious and no such program was adopted. "The decision was a lot closer than most people realize," Murray maintains. Despite the failure of this first effort it was beneficial, Friedman maintains: It showed that the Society "cared" and that its membership was quite responsive — some 10,000 letters were sent to President Reagan in support of the mission.

On the SETI front, the Society was more successful. About this time, Senator William Proxmire (D-Wisconsin) had given SETI his Golden Fleece Award and, more seriously, had managed to pass legislation which prohibited NASA from spending any more money on SETI.

So the Planetary Society mounted a campaign on behalf of SETI. Sagan arranged a personal meeting with the Senator and convinced him that it wasn't the boondoggle he thought. However, it wasn't politic to immediately overturn the legislation. Instead, the situation was fixed a year later by passage of a corrective bill with Proxmire voicing no objection.

As the next millennium turns, the relative levels of national commitments to space will determine the course of human history. If America's commitment is relatively small, then other economies and other cultures will lead humankind into the future. If America's commitment is relatively large, then our economy and our culture of freedom will lead humankind into that future.

The extension of our civilization of freedom to the planetary shores of the new ocean of space should be our basic goal. With the successful establishment of a permanent Mars base by 2010, we should see the first firm steps toward permanent human settlements away from Earth.

Steadily increasing philosophical and psychological momentum for this adventure is building among young people of Earth. If you have talked with them, you will find that many have their eyes on Mars. They are the ones who will go to Mars. They are the ones, like most of our ancestors before them, who will never be satisfied with either the comforts or the restrictions of home and Earth. These are the parents of the first Martians.

Mars will be for the children of the free world what space stations were to their parents and what *Apollo* was to their grandparents — the total embodiment of the best in the human spirit. Perhaps most important, if our own determination is unequivocal, astronauts and cosmonauts may be able to join hands in this great adventure.

In this context, on its fifth anniversary, The Planetary Society can take pride in its leading efforts to keep space, particularly space science, alive in the minds of a small but important sector of the American public. The growing support of the leadership of the Society for large-scale international cooperation in the human exploration of space, particularly for a project that takes humankind to Mars, is an additional positive trend. However, we must recognize that there can be little such cooperation without unilateral and unequivocal commitment at home. We must work for that commitment as hard as we woo potential international partners.

— HARRISON H. SCHMITT

Since then the Society's board has picked its positions carefully. They haven't taken a stand on the space shuttle or the space station. When the Strategic Defense Initiative came along, however, the board decided that it required debate and discussion because the initiative may have a powerful influence on planetary exploration. They saw the Society's role as providing information to help people deal with the SDI issue and how it might affect planetary exploration. In cooperation with the American Academy of Arts and Sciences, the Society sponsored a symposium, "Weapons in Space: Implications for the Civil Uses of Space," which was held in Washington, DC. →

In the space of a few years, The Planetary Society has captured the imagination of the community throughout the world by sharing with them the amazing and rapidly advancing discoveries of our solar system. Suddenly these tiny point sources of light in the night sky have been transformed to worlds in their own right through the pictures displayed in *The Planetary Report*. But, still, only a small number of us are sharing these wondrous achievements and we must continue to strive to tell the entire population of the wonders of planetary exploration.

While the Society will also strive in this basic aspect of communication, I believe that our major objective for the next fifty years must be to encourage, support and participate in the formation of a genuine planetary society, namely through a multinational mission to set up a colony on another planet in our solar system. The obvious candidate must be Mars. In addition to the technological achievements, this colony will demonstrate the natural harmony in which people from differing backgrounds can live, when the political barriers that unnecessarily constrain the movements of so many people are removed. — *GARRY HUNT*

Advocating Mars

Wanting to provide a constructive alternative to SDI, they quickly followed the space weapons symposium with advocacy of a manned Mars mission. At a second Washington symposium, "Steps to Mars," cosponsored with the AIAA, Sagan set forth the basic rationale: "Because of their cost, [human missions to Mars] are very hard to justify solely on the grounds of science. But I can imagine circumstances in which it might be done for other reasons. Suppose the people of Earth are one day fortunate enough to discover new leaders in Washington and Moscow dedicated to a new beginning; and to seal that new beginning they embark on a dramatic joint enterprise — something like the *Apollo* program but with cooperation, not competition, the goal."

This advocacy of human exploration of Mars has clearly had an impact. At the AIAA/Planetary Society meeting last fall, NASA Administrator James Beggs personally endorsed the concept, echoing Sagan's arguments. And NASA has commissioned a new study of just such a mission. Murray and Friedman also report that of late the attitude of Soviet scientists toward a joint Mars mission has turned more favorable.

While applauding the Society's public education work and their support for programs such as SETI, some members of the planetary science community question whether the group has had as much political effect as they think. After all, they didn't get the Halley's Comet mission. And, the skeptics point out, they haven't had any discernible effect on the formulation of NASA's core planetary program. On the other hand, John Gardner, an acute observer of the political winds, feels the group's existence has had a definite impact. "Of course, it is a terrible time to try to measure that impact in dollar terms. But there is no doubt that Congress takes a different view if they know someone is out there," he says. And, since 1980, congressional support for planetary exploration has increased significantly, say Society officials.

The Planetary Society board prides itself on its ability to move quickly and decisively. The triumvirate of Sagan, Murray and Friedman is rounded out by the lawyer Joseph Ryan and Henry Tanner, Corporate Secretary of the California Institute of Technology. According to Murray and Friedman, decisions are made by consensus. "No important decisions are made

FIVE YEARS: SUCCESSES AND FAILURES

by Louis D. Friedman

Five years! As I look back on all the things we've tried and done, I realize that the range of these many projects is what has made The Planetary Society so exciting — for our members as well as for me. For this anniversary issue, I'd like to review, and to reflect a bit, on the Society's achievements and failures.

There are many successes we are proud of:

— We have involved many more people in the excitement of space exploration. We've allowed the general public to see the magnificent images taken by spacecraft, we've brought them direct contact with planetary scientists, and shared with them the knowledge gained by space exploration. With our organization we've proved there is a constituency for planetary exploration and the search for extraterrestrial intelligence equal in size to that of other politically potent public interest groups.

— We have reinvigorated interest in Mars exploration and in the goal of sending humans to Mars. We've developed this goal as a focus for worldwide cooperation and brought together American and Soviet scientists to discuss joint missions to the Red Planet.

— We have doubled the discovery rate of asteroids whose orbits bring them close to Earth.

— We have made possible the most advanced and powerful Search for Extraterrestrial Intelligence (SETI) operating in the world today.

— We have become credible advocates of new planetary missions and successfully collaborated with the planetary science community to promote these missions.

And we have had some failures:

— We were unable to convince the United States to send a mission to Halley's Comet, despite the enormous effort of our members, who sent some 10,000 letters supporting the mission to President Reagan. This effort failed, but it did help make the Society known in Washington. We also believe it helped awaken the government to the public interest in planetary exploration so that subsequent programs were approved.

— We've not yet received a SETI signal. Calling this a failure is a bit tongue-in-cheek; but in our hearts a few of us did hope we'd receive a signal shortly after we turned on our equipment. But SETI, like The Planetary Society, is a long-term activity. We're lucky to be such an important part of its beginning.

— We haven't made deep inroads into the educational community. Our education program has gone more slowly than we had hoped, despite our successes with the Mars Institute, scholarships, new materials for schools, and our national high-school essay contest. Curriculum development, and more significant, curriculum influence, are slow processes because of the enormous institutional inertia of our educational community.

These have been our principal projects, but there are many other highlights worth recalling. Scores of Planetary Society lectures have been given to thousands of members around the United States and in several other countries. Coincidentally, Professor Tobias Owen of New York State University at Stony Brook gave the first lecture in New York (at the Explorers' Club) and gave the most recent lecture,

contrary to the strong feelings of any member of the board. If Carl or I are unalterably opposed to something, it won't happen. That is one reason why the board has proven to be so conservative," Murray comments.

Mr. Ryan agrees. While with Carl and Bruce there is a definite "star" system at work, "I feel I'm an equal participant. On almost any issue, if I had strident objections and reasonable grounds for them, they wouldn't go ahead with it," he says.

Members of the board are in touch, usually by telephone every few days. In this fashion "we can make decisions to commit resources in a hurry," says Murray. For instance, the "Steps to Mars" symposium was thrown together rapidly. And the Society's funding of the Suitcase SETI project of Dr. Paul Horowitz at Harvard came only 30 days after they first heard about it.

Hope for the Future

An important principle underlies and helps explain decisions the board has made: They see themselves, in Murray's words, as "in the business of providing hope for the future." Thus, despite considerable pressure from some of their planetary science colleagues, they have stayed aloof from issues like the space shuttle and space station, because they involve decisions already made or issues which tend to be divisive rather than unifying. Instead, the Society has channeled its resources into long-term efforts such as SETI and the exploration of Mars.

What does the future hold?

The leaders of the Society would like to continue to build their membership. With a view to becoming a truly global organization, they have already begun to concentrate on recruiting members in several other countries. They have realized that methods which work well in the US may not be effective in other cultures. So they are trying to come up with new recruitment techniques. Under David Brown they have formed a New Millennium Committee to organize events which will make them more attractive to large donors in order to deepen their pockets. They are also moving into television, joint venturing a Halley's Comet TV show with the M&M/Mars Company and the Asahi Broadcasting Company.

The end of the long planetary science drought may be in sight. Next January the *Voyager* spacecraft will reach Uranus. And then there will be the flurry of international activity surrounding the intercept of Halley's Comet in March. In May, *Ulysses* (the International Solar Polar Mission) and *Galileo* will both be launched. The Society is now seeing the best returns on its mailings in several years. So whatever the future holds, one thing is almost certain: In the years ahead, it will be anything but dull in the picturesque old Pasadena house that serves as headquarters of The Planetary Society.

In an ideal world, we would be deft caretakers of our planet and solar system, unflagging celebrants of life's variety, and bold inquirers into the startling universe we both navigate and find ourselves at sea in. I'm sure The Planetary Society doesn't believe it can single-handedly achieve that alchemy of mind, from the baseness depicted in the news everyday to the gold of a renewed sense of wonder, awareness and responsibility. But it offers the right attitude for us to keep in mind and try to measure up to, and reminds us with its many projects that we are beings whose hallmark is the ability to marvel. I'm delighted to be associated with that sense of celebration and inquiry.

— *DIANE ACKERMAN*

David Salisbury has been writing about planetary science for ten years. A veteran of the Christian Science Monitor, *he is now working in the public information office at the University of California at Santa Barbara and doing freelance writing.*

also in New York (at a preview of "Comet Halley," our PBS television special). Both lectures were sold out.

This lecture program would not have been possible without the participation of the planetary science community. We appreciate their cooperation and recognize that it is motivated by their devotion to the cause of planetary exploration.

Planetfest '81 was the largest event we've yet produced, attracting some 10,000 people to Pasadena during the August 1981 *Voyager* encounter with Saturn. They heard a special concert by John Williams and the Pasadena Symphony Orchestra, watched images returned from Saturn, walked through two buildings of exhibits, saw films, listened to lectures and enjoyed an art show. Planetfest '81 set a standard that we hope to achieve again.

We've sponsored many science and policy conferences and invited our members to participate. These have included: two Case for Mars conferences; Washington, DC meetings on the implications of space weapons for the civil uses of space, the *Apollo-Soyuz* commemoration and "Steps to Mars." Symposia have been offered on the missions to Halley's Comet, comparative planetology and SETI. We've sponsored special public sessions at several meetings of professional scientific organizations, including the American Association for the Advancement of Science and the Division for Planetary Sciences of the American Astronomical Society.

In Graz, Austria we brought together leading scientists from the Soviet Union and the United States to discuss missions the two countries could do together. This meeting was such a success we're now planning "Graz II."

We have been gratified by our members' willingness to become involved in our projects, particularly their advocacy of space missions and SETI. When the *Galileo* mission to Jupiter and the Venus Radar Mapper project were threatened, you helped us fight to save them. You supported the option to add an encounter with the asteroid Amphitrite to *Galileo's* itinerary. You wrote letters to the Senate committee considering funds for basic research in planetary science and urged them to provide the necessary support.

Your involvement in a lighter vein includes naming our SETI project, an asteroid and the Venus Radar Mapper mission (still being studied by a NASA committee). You suggested new nomenclature for human spaceflight. NASA is now very aware of Society members and their innovative suggestions.

1986 will, I hope, be more exciting than all of the five years we've had so far. Halley's Comet will be encountered, *Galileo*, *Ulysses* (the International Solar Polar Mission) and the Hubble Space Telescope will be launched. *Galileo* will fly by Amphitrite. We will host a cruise for Earth-based viewers to see Halley's Comet.

We hope to see approval of several new missions by NASA, the European Space Agency (ESA) and the Soviet Union. These include the Comet Rendezvous Asteroid Flyby (NASA), the *Vesta* mission to Venus and several asteroids (Soviet Union and France), a Lunar Polar Orbiter (NASA, ESA or the Soviet Union), and a Saturn Orbiter-Titan Probe (NASA and ESA).

In 1986, we will make a mighty effort to get a commitment to Mars exploration by the United States and the Soviet Union. We hope to expand our SETI program in the southern hemisphere. We will try to expand The Planetary Society in many countries, especially in Japan and Europe, who will be witnessing their first space missions with *Suisei* and *Giotto's* encounters with Halley's Comet.

To each and every member, and the hundreds of people who have helped make our first five years so eventful, we thank you, and congratulate you for being part of it. □

Steps T

A Look to the Past

On July 16, 1985, in cooperation with the American Institute of Aeronautics and Astronautics (AIAA), The Planetary Society sponsored "Steps to Mars," a conference on future human exploration of the Red Planet held at the National Academy of Sciences auditorium in Washington, DC. The date for the conference was chosen for its symbolic value — in July, 1975 *Apollo* and *Soyuz* spacecraft docked in Earth orbit, and astronauts and cosmonauts shook hands in space. That milestone showed that Soviets and Americans can work together to each others' benefit.

When a spacecraft carrying human explorers reaches Mars, it may well be with an international crew, made up of people from several countries, including the US and USSR. And so, while the "Steps to Mars" conference looked forward to the day humans set foot on Mars, it also looked back to the *Apollo-Soyuz* mission, an achievement of the past that may make a Mars mission possible.

The conference was divided into a morning session, led by the AIAA, emphasizing the technical challenges of sending humans to Mars, and an afternoon session, led by The Planetary Society, addressing the question: Why go to Mars? Frank Press, President of the National Academy of Sciences, John McLucas, past President of the American Institute of Aeronautics and Astronautics, and Senator Spark Matsunaga (D-HI) all spoke in the morning. Selections from their speeches are reprinted here. The technical problems were discussed by a panel of distinguished engineers and scientists, including James French of the Jet Propulsion Laboratory, John Niehoff of Science Applications International, Louis Friedman of The Planetary Society, Joseph Loftus of Johnson Spaceflight Center, John Billingham of Ames Research Center and Harold Masursky of the United States Geological Survey.

The assembled *Apollo-Soyuz* cosmonauts and astronauts narrated a film recounting their adventures in space. Alexei Leonov, Valeriy Kubasov, Donald "Deke" Slayton, Vance Brand and Thomas Stafford shared some of their memories of the mission with the audience of over 500.

The afternoon panel was moderated by Bruce Murray, Vice President of The Planetary Society, and included Carl Sagan, President of The Planetary Society, former US Senator and *Apollo* astronaut Harrison H. Schmitt, Space Shuttle astronaut Sally Ride, Roger Bonnet of the European Space Agency and James Beggs, Administrator of NASA. Thomas Paine, Chairman of the US National Commission on Space, closed the conference.

MORNING SESSION

Frank Press: We are honoring an important event that took place ten years ago — the *Apollo-Soyuz* link-up. With more than 28 cooperative experiments, ranging from x-ray astronomy to geophysical exploration, the mission was a symbol of how cooperation between nations can lead to global peace and stability. But we are not simply looking back; we are also looking ahead to a new, great technological and scientific adventure — the human exploration of Mars.

John McLucas: *Apollo-Soyuz* marked the beginning of international space cooperation on a large scale. This is not without its problems, especially between countries who are adversaries in many important fields. But because of our differences, it is even more important to find areas for cooperation. Fortunately, through good times and bad, we've been able to maintain some cooperation, especially in the space sciences. Individual scientists, universities and academies have all helped to keep this spirit alive.

For ten years, from 1972 to 1982, we operated under an agreement with the Soviets. Senator Spark Matsunaga (D-HI) introduced a resolution calling for further initiatives and last October President Reagan signed it into law. Let us hope that this will lead to more cooperation with the Soviets.

But let us not forget, in our preoccupation with improved relations with the Soviets, that already we cooperate in space with many other countries. An outstanding example is the European Spacelab. With the space station coming along, more international ventures are around the corner. The manned exploration of Mars meets our desire for cooperation in a very appropriate way. Flights to Mars are far enough away that we have plenty of time to plan properly, and yet not so far away that it is fruitless to make plans today.

Spark Matsunaga: A meaningfully successful Mars exploration program will require unprecedented levels of public support, consistent long term funding, and an international framework. To obtain those prerequisites, I would like to offer a proposal that takes advantage of an unusual convergence occurring in 1992. 1992 is the 500th anniversary of the discovery of America by Christopher Columbus and it is the 35th anniversary of the International Geophysical Year, or IGY, which launched the space age. I propose that the United States take the lead in promoting a sequel to the IGY in 1992 — an ISY, or International Space Year — featuring international space missions and related activities. To start the ball rolling, I will offer a Congressional resolution calling for an ISY in 1992. The role of the AIAA and The Planetary Society will be crucial in building support for an ISY and writing its agenda.

AFTERNOON SESSION

Bruce Murray: This morning we reviewed the technical feasibility and scientifc desirablity of sending humans to explore Mars. This afternoon we have assembled a panel of distinguished individuals to consider why humans should go to Mars. Why should we undertake such an expensive and challenging endeavor? I'd like each panelist to make a brief statement and then I will read written questions from the audience. Let us begin with Carl Sagan.

Carl Sagan: When the astronauts and cosmonauts were receiving the awards and plaudits from the AIAA and The Planetary Society, there was something remarkable happening in the audience. You could hear it and see it. There was a longing, a hunger, a hope for the future, a wish that the major technological nations would do something together on behalf of the human species. That hunger is a central justification for a human mission to Mars.

Mars is a world of wonders. It has soaring volcanic mountains two or three times higher than the largest such structures on Earth. It has ancient river valleys where liquid water once flowed under a regime quite different from the climate on Mars today. In the polar regions it has a set of stacked plates which indicate some periodic climate processes. It is a world of raging sandstorms and stolid calm. Two small moons, apparently made of organic matter, orbit it.

Mars, at least as far as the *Viking* landers could tell, is without a trace of life. Maybe there's a kind of life that we were too dumb to recognize, or life where the two *Vikings* didn't land. Here are two quite similar planets — Mars has the environment closest to

To Mars

and to the Future

Earth's in all of the solar system — and life is on one and, apparently, not on the other. How come? It's the classic situation: the experiment and the control.

There are enormously good scientific reasons for going to Mars, although by themselves they do not justify the cost of a mission with humans rather than robots.

The Planetary Society has established the Mars Institute to help plan for future Mars exploration. We have taken the lead in discussions among American, Soviet and European scientists on cooperation in future Mars missions. We have commissioned an important study by Science Applications International about the design and cost of future Mars missions.

I can imagine circumstances in which the people of Earth are lucky enough to find national leaders dedicated to a new beginning and, to seal that new beginning, they embark on a dramatic joint enterprise on behalf of the human species — something like the *Apollo* program, but with cooperation, not competition, at its base.

Harrison Schmitt: The *Apollo-Soyuz* mission stands as an historic example of how two very different societies, indeed two very different cultures, can find it in their mutual interest to work together. The key ingredient is the perception that there are things to be gained by each, however different those things might be. For Americans, the *Apollo-Soyuz* mission gave us new friends and understanding of a society about which we know far too little. The Soviets gained a clear technological window on the west and political parity with the nation that had been to the Moon.

Thus, in addition to the questions of why, how and when we should go to Mars, there will be the question of whether the nations of the world can find it in their interests to work together on this truly magnificent endeavor. The answer to this last question should be "Yes" for both the United States and the Soviet Union, I hope in cooperation with as many other nations as wish to and can participate. However, that answer *will* be "yes" only if the United States makes an unequivocal commitment to go to Mars under any circumstances.

Sally Ride: Why shouldn't we send people to Mars? We can't justify it with planetary science alone; we'd get a better return on our scientific dollar by sending unwomanned probes. Unfortunately, that philosophy puts me out of a job. We also can't justify it with assured economic benefits.

We should evaluate any policy on its own merits. Soviet policies and actions may be relevant factors, but they shouldn't be the sole impetus. So why should we go to Mars? The desire to explore is a basic human trait. History books are full of explorers, the Vikings, the Venetians, Columbus, Magellan. Many of our greatest heroes are explorers: Jacques Cousteau, Sir Edmund Hillary, Neil Armstrong, Jack Schmitt. Our culture certainly recognizes the adventurousness of the human spirit. The US expeditions to the Moon rank as humankind's greatest adventure, and those voyages inspired an entire generation of scientists, engineers, writers and artists. It's this inspiration and fuel for the imagination that drives people to greatness.

We will be going to Mars; the questions are, "When and with whom?" There are obviously pros and cons to joint US-Soviet expeditions, but astronauts and cosmonauts do share a common ground. Anything that cultivates that common ground can only improve the world situation.

I'd like to leave you with a little bit of *Apollo 17* history. When Jack Schmitt stepped out on the lunar surface, he offered a challenge to the next generation — to leave their footprints on other, more distant worlds. I think we should take him up on that challenge.

Roger Bonnet: I strongly believe that manned exploration of Mars should be conducted on a broad international basis, for two reasons. First, the project could cost $40 billion, a prohibitive cost for a single country or organization. The second reason is, of course, political. The two superpowers, the US and USSR, should collaborate. As long as they have to peacefully cohabit on this planet, why not do it constructively? A team of astro-cosmonauts in space for several years would offer a means of political stability.

Europe wants to participate in this venture. In recent years we have established a long-term program for the European Space Agency. This program includes two strong elements of planetary exploration. The first is a comet or asteroid sample return mission. The second is developing a Mars rover. Europe could offer several

(continued on page 14)

The linked *Apollo* and *Soyuz* spacecraft drift over a sunset Earth.
Painting: Pamela Lee

At the invitation of The Planetary Society and the American Institute of Aeronautics and Astronautics (AIAA), *Soyuz* cosmonauts Alexei Leonov and Valeriy Kubasov and *Apollo* astronauts Thomas Stafford, Vance Brand and Donald "Deke" Slayton came together in Washington, DC to commemorate their historic joint mission of July 1975. During the "Steps to Mars" conference, they relived their adventure by narrating a film of their activities in space. To symbolize hopes for the future of space exploration, The Planetary Society presented each astronaut and cosmonaut with a plaque of Kasei Valles on Mars. The AIAA gave them certificates commemorating their 1975 flight.

On behalf of Valeriy Kubasov and himself, Alexei Leonov thanked the conference participants for the celebration of *Apollo-Soyuz*.

The astronauts and cosmonauts also visited the US Senate where they were recognized by that legislative body; and the House Committee on Science and Technology hosted a reception for them. The *Apollo-Soyuz* mission was remembered at a ceremony at the Smithsonian Institution, where replicas of the linked spacecraft hang in the National Air and Space Museum.

Ladies and gentlemen, dear colleagues and friends, let me first of all express our gratitude for the invitation and for your congratulations on this anniversary. Many things have happened during the ten years since our flight. We have become more mature — very mature, indeed — and we have acquired more experience. Some of us have become grandfathers. But our feelings have not become rusty. We continue to value greatly our friendship and we will continue to work to make it firmer.

Ten years after the flight I would like to say "Thank you" to everybody and to express the hope that our work does have a future. I'd like to wish you all justice, happiness and a peaceful life. Thank you very much. — ALEXEI LEONOV

The men who met in space reunite in Washington, DC, left to right, Donald "Deke" Slayton, Valeriy Kubasov, Thomas Stafford, Alexei Leonov and Vance Brand.

Mars Conference Receives National Press Coverage

The "Steps to Mars" conference and commemoration of the Apollo-Soyuz linkup received attention from the press across the United States. Here we reprint some selections from that coverage.

Washington Post July 17, 1985

U.S.- Soviet Mars Mission Urged

"Two Soviet cosmonauts and three American astronauts who met up in space 10 years ago met again on Earth yesterday and called on their countries to undertake a joint manned mission to Mars.

. . . . . .

"As the men urged their countries to explore Mars together, the Soviet Union released details of its next unmanned mission to Mars — the landing of a spacecraft on Phobos, the larger of Mars' two moons. The Soviets said the landing will take place in 1989 on their May Day holiday.

" 'The Soviets have told us they plan to launch their Phobos spacecraft in July 1988, arrive in orbit around Mars in late January 1989, and then do a series of maneuvers to rendezvous with Phobos,' Louis D. Friedman, executive director of The Planetary Society, told a conference entitled 'Steps to Mars' that was held simultaneously with the Apollo-Soyuz celebration.

. . . . . .

"The conference heard repeated calls for the United States and Soviet Union to begin planning a joint manned mission to Mars, whose distance from Earth varies between 35 million and 248 million miles."

The Christian Science Monitor

July 18, 1985

A Serious Look At a Trip to Mars

"Around the world, long-range manned spaceflight planners are seriously considering an expedition to Mars.

"No one has yet established a permanently manned space station, nor have astronauts returned to the moon. Many experts say these feats should precede a visit to the Red Planet.

"A Mars expedition, however, appears to be technically feasible as an early 21st-century project. More important, it is beginning to be perceived as a politically feasible way for the United States and the Soviet Union to work together, because a Mars expedition would almost certainly be a global project."

Atlanta Journal and Constitution

July 20, 1985

U.S.-Soviet Mars Mission: If Only

"Consider the possibilities: An unprecedented level of scientific cooperation and information sharing. An imagination-riveting and dangerous quest pitting humankind, both the American and Soviet variety, against harsher elements for a longer duration than ever before. A three-year journey, and years more in the making, during which the peoples of each country might justifiably cheer the other side's contributions — and, conversely, mourn their setbacks.

"Staking a joint claim on Mars in the name of the United States and Soviet Union would give an ironic twist to Neil Armstrong's words as he first set foot on the Moon.

"It would constitute one small step into the cosmos and a giant leap here on Earth."

Planetary Society Vice President Bruce Murray shakes hands with Apollo-Soyuz astronaut Thomas Stafford. Cosmonaut Valeriy Kubasov is to Stafford's right, astronaut Vance Brand is to his left, and Donald "Deke" Slayton is at far right.

(continued from page 13)

ways to help a Mars mission. For example, we could play an important diplomatic role between the East and the West.

James Beggs: The time will come within the lifetimes of most of the people in this audience when human beings will go to Mars. They will be the precursors of a permanent establishment on Mars and, perhaps, will allow us to look forward to even more interesting and ambitious ventures in space.

This epochal step should be a cooperative international effort. Nevertheless, if any one country wanted enough to do it, nothing would preclude the technologically advanced and dedicated nation from going it alone. I hope that does not happen.

The program must be viewed as a long-term commitment. A Mars landing must include planning for subsequent sustained operations. The first Mars explorers probably will not become permanent residents, but they will be precursors. They will start the building, the learning to inhabit Mars.

Mars has a special meaning for those of us who look out on the universe to plan the next steps in the post-space-station era. The adventure is attainable. There are mysteries to be solved. Exploration of the planet has revealed it's a "halfway" world — in part like Earth and in part like Mercury and the Moon. What caused the climatic changes on the planet? How did its great rift valleys and huge volcanos form? Why is the planet lifeless? Or is it lifeless? If it is, why?

Consider George Bernard Shaw's line from *Methuselah:* "Some men see things as they are and say, why? I dream things that never were and say, why not?" Why not go to Mars to advance the human presence in space? Why not go to Mars and build a gateway to the asteroid belt and the outer planets? Why not go to Mars to use human judgment, abilities and intelligence to explore an exciting new world? Why not go to Mars to recognize, to describe, to organize, to correlate, and to solve problems as only human beings can solve them? Why not go to Mars to better understand ourselves, Earth, its ice ages, atmospheric changes and climate? In T.S. Eliot's words, "The end of all our exploring will be to arrive at where we started, and to know the place for the first time."

Finally, why not go to Mars to build on the framework of international cooperation that the space station will have begun, and perhaps a lunar base will have continued? The immensely challenging program could be a strong force for peace. It could redirect creative human efforts from dealing with armed conflict to planning and carrying out a peaceful, stimulating and ultimately more valuable program of unprecedented scope and imagination. Ironically, perhaps Mars, the "war god," could become a powerful instrument for peace.

Humans to Mars? Indeed, why not?

AUDIENCE QUESTIONS

Bruce Murray: Sally, if a human mission to Mars were possible today, do you think your training would enable you to deal psychologically with a three-year mission?

Sally Ride: I'm not sure that any training can prepare you psychologically for a three-year mission. Weightlessness is very benign; your body likes weightlessness and being weightless for a year would be a joy and a pleasure. It would probably help you deal psychologically with the fact that you were up there.

The year spent getting to Mars wouldn't be difficult — you'd have something to look forward to and the time would pass quickly. But the year and a half or two years coming back would drain you. We will have to be careful in choosing people to go for three years at a time.

Bruce Murray: Jim, what is the next step in long-range planning, an operational lunar base or manned exploration of Mars?

James Beggs: That choice will probably be made by someone other than me, but I would opt for building a base on the Moon before I went to Mars.

If you could put together a group of nations, including the Soviets, the Europeans and the Japanese, then you would have a powerful base from which you could do almost anything. But to do that, you're going to have to set your objectives so that mutual interests are served. We haven't done that as well in the past as perhaps we could, and should, do it in the future.

Bruce Murray: Carl, in *The Cosmic Connection,* published in 1973, you said that

Space Shuttle astronaut Sally Ride and Apollo 17 astronaut Harrison "Jack" Schmitt shared the podium at the "Steps to Mars" conference. These veterans of space travel discussed sending humans on a three-year trek to Mars.

a human mission to Mars was too costly, and that the money was needed to solve problems on Earth. What has changed?

Carl Sagan: What I was talking about then was a human mission for scientific purposes. I said then, and I say now, it cannot be justified on science alone — it's too expensive. But since 1973 there has been a very worrisome decline in relations between the United States and the Soviet Union and an increasing sense of hopelessness because of it.

There is a remarkable branchpoint here: Precisely the same rocket and nuclear technology that can destroy our global civilization can also put a self-sustaining base for human beings on Mars. It's as if humans were given this gift and now we have to show how wise we are. Since 1973 it has become apparent to many people that a joint expedition to Mars could have a powerful effect in raising hope on Earth and providing an aperture to a benign future.

Bruce Murray: This question is to the panel. The realist's response to a joint Soviet-US mission to Mars is that, on a large mission representing a large fraction of each country's discretionary resources, neither country would permit itself to be held hostage to the other. How can we deal with that possibility?

Sally Ride: You have to assume, going into a joint venture, there's always the possibility that your partners may pull out. But there are many ways you can ameliorate the situation by initial negotiations. For example, instead of a group splitting the launcher equally, one country provides the launcher, another the habitat module, another something else, so that you're not left with a system that is defunct if one group pulls out. You will have the option of building your own orbital transfer vehicle or aerobraking technique or whatever without the missing partner.

Harrison Schmitt: There are proven models for international cooperation in technical ventures: Intelsat (International Telecommunications Satellite) and Inmarsat (International Maritime Satellite). We should see if their successful methods can be modified and applied to very large international endeavors. That would give you a mechanism for implementing what Sally has described and also would decrease the probability that a country would pull out.

The Soviet Union is unequivocally committed to these types of endeavors in the indefinite future. As soon as the Western World has made a similar unequivocal commitment, we will be able to proceed.

CLOSING REMARKS

Carl Sagan: Let us imagine Americans and Soviets on their way to Mars. The American lives depend on the Soviets doing well. The Soviet lives depend on the Americans doing well. It is a microcosm of the situation here on Earth, where the life of every American depends on what the Soviets decide, and the life of every Soviet depends on what the Americans decide.

Such a mission could capture the global imagination as nothing else can. Clearly it would be a major first step toward a human presence on many worlds. It would be, in the long historic perspective, a key event, when we first really stepped off Earth — an event as important as the colonization of the land by the first amphibians some 500 million years ago.

Bruce Murray: Dr. Thomas Paine was the Administrator of NASA during the planning of *Apollo-Soyuz*. He is now the Chairman of the US National Commission on Space, which is looking at a broad range of possible futures in the civil space program. I'd like to ask him now to wind up our meeting.

Thomas Paine: The views we've heard today are consistent with the direction of the National Commission on Space, which is looking toward man's expansion outward from the planet of our birth, not just in expeditions, but in human settlement. Mars will not be settled as a national enterprise; indeed, that would be grossly unfair to mankind as a whole. Everyone will want to participate in this mighty endeavor; we must arrange for this with America providing sustained leadership. Everyone can contribute to, and enjoy, this great adventure.

The resulting banding together of the world's people to conquer the inner solar system can bring our home planet many benefits, not only in new technology, but also, as has been so eloquently stated here today, in a more cooperative, more forward-looking and more human planet Earth. □

TIME July 29, 1985

"Humans to Mars? Why Not?"

"Despite the vivid images relayed by the Viking landers in the mid-1970s, Mars to most people remains a planet of the imagination, as unlikely a home for humans as it is for diminutive green men. To a surprising number of prominent scientists and politicians, however, it is the next frontier, a new world to be tamed and colonized.

. . . . . .

"The hope shared by the spacemen [cosmonauts Alexei Leonov and Valeriy Kubasov, and astronauts Tom Stafford, Deke Slayton and Vance Brand] is that by working together toward a common goal, the two nations might somehow put aside their differences. 'It's hard to imagine a more dramatic and fitting symbol on behalf of the human species,' said [Carl] Sagan. 'We should embrace not the god of war, but the planet named after him.' "

. . . . . .

"Even without the rationale of superpower cooperation or scientific benefit, the delegates agreed, human beings will eventually land on Mars, driven by nothing less than good old-fashioned nosiness. 'We will never be satisfied with data streams from some distant planet,' said [Harrison] Schmitt. 'We want to be there.' Concluded James Beggs: 'Humans to Mars? Why not?' "

Aviation Week & Space Technology
July 29, 1985

Commission Considers Joint Mars Exploration, Lunar Base Options

"Recent comments by the chairman of the National Commission on Space, Thomas O. Paine, indicate the panel may recommend development of a technology base during the next 20 years that can support either human exploration of Mars or a permanent lunar base.

"Paine, a former administrator of the National Aeronautics and Space Administration, offered his views here at a symposium on human exploration of Mars, sponsored by the American Institute of Aeronautics and Astronautics and The Planetary Society.

. . . . . .

"Commenting on the views offered by earlier speakers, who described the scientific exploration potential of Mars, the technological and physiological challenges involved and the need for a cooperative international effort, Paine said, 'The things we've heard today are very consistent with the views that the National Commission on Space is taking in its initial deliberations.'

Aerospace America September, 1985

Mars or Bust!

" 'A manned Mars mission could be a strong force for peace in the world,' asserted NASA Administrator James Beggs, 'by redirecting human creativity from a preoccupation with armed conflict to planning and carrying out a peaceful, stimulating, and ultimately more valuable program of unprecedented scope and magnitude.' "

. . . . . .

"Although Beggs said that commitment is more important than cooperation, the mood of the more than 500 Mars buffs who attended the symposium was mostly international in orientation, especially toward a joint U.S.-Soviet effort. Planetary Society President Carl Sagan was direct and unequivocal. To him, the only rationale for a manned Mars mission — which the Society supports enthusiastically — would be as a symbol of cooperation because, he said, exploration of Mars could be carried out 10 to 100 times more cheaply using robot spacecraft."

By Jerry Grey

THE MARS INSTITUTE

Building Momentum for Human Exploration of Mars

by Christopher McKay

An early morning fog covers canyon floors on Mars. Such fogs can occur daily, suggesting that water vapor condenses nightly as ice on the ground, then evaporates with the morning Sun. Ground ice, atmospheric vapor and the frozen poles of Mars — plus the ancient river beds — all indicate that water is readily available on Mars. One of the first tasks of Mars mission planners is to discover a means to make this water usable by future explorers.
Image: JPL/NASA

Soon after its formation, The Planetary Society recognized that it could play an important role in advancing the human exploration of Mars. The Mars Institute was going to bring national attention to Mars mission concepts and to support student research and discussion of humans on Mars.

Sending humans to explore Mars was the original goal of Wernher von Braun and other early space engineers. The *Apollo* missions to the Moon were just a step along the way. *Das Marsproject* was written in 1952, but by the time *Apollo* was nearing completion in the early 1970's, the political climate was no longer favorable to Mars missions. In fact, the response to mission scenarios at the time was so negative that NASA stopped all activity related to human Mars missions, cancelling studies underway and never releasing some that had just been completed.

Meanwhile, the robotic *Viking* missions to Mars, beginning in July 1976, allowed us to remotely explore this fascinating planet and begin to understand its surface conditions. We learned that Mars is apparently devoid of life and, compared to Earth, is a cold, dry place. However, all the elements required to support life were identified in some accessible form. Water was detected in the atmosphere, soil and polar caps. Carbon dioxide comprises 95 percent of the atmosphere, which also contains nitrogen. Mars began to look like a place where a little human ingenuity could go a long way.

Time to Look Again

After a few years of studying the *Viking* data, it became clear that it was time to look again, in a different way, at the prospects of sending humans to Mars. In the spring of 1981, students at the University of Colorado at Boulder organized a conference called "The Case for Mars." The Planetary Society and other space interest groups sponsored it. The conference papers and workshops demonstrated that human missions to Mars warranted further study.

After the Case for Mars conference, Louis Friedman, Executive Director of The Planetary Society, suggested forming the Mars Institute within the Society to initiate and support activities related to human Mars missions. The goals of the Mars Institute were twofold: first, to initiate research and hold conferences to persuade NASA and other government agencies to seriously consider and study a human Mars mission; second, to involve college and university students in the Mars mission studies and to encourage them to contribute their energies and ideas to the conferences. The Institute's educational goals were seen as doubly important, for these students could one day be the scientists and engineers who would participate in a human Mars mission.

The first major undertaking of the Mars Institute was the Case for Mars II conference. This conference brought together the work that had been begun as a result of Case I. An important contribution to the success of Case II was the human mission study conducted for The Planetary Society by Science Applications International Corp. (See the March/April 1985 *Planetary Report*). This study, supported by Society funds, developed a conceptually new approach to orbital transfer problems in a round trip to Mars.

Goals Achieved

Since the Case for Mars II, the Mars Institute has achieved its first goal: NASA resumed its own studies of human Mars missions at three field centers: Ames Research Center, Marshall Spaceflight Center and Johnson Spaceflight Center. NASA headquarters has again made Mars missions an integral part of advanced planning. There is serious discussion in Washington about an international mission, as demonstrated by the Society's recent Steps to Mars conference. (See pages 12-15.)

The Mars Institute has also succeeded in its educational efforts. The Mars Student Essay Contest is now in its third year. The topic for this year's contest is: Design a system of transportation for a Mars base.

The major educational thrust of the Mars Institute has been to support university courses on human Mars missions. Courses have been held at several institutions, including the University of California at San Diego, the University of Colorado at Boulder, Pikes Peak Community College, California State Polytechnic College at Pomona and Northwestern University.

The Mars Institute is now concentrating on expanding its educational services. We are preparing course curricula to help educators interested in a Mars Institute course but unsure of how to get started. We are also assembling a slide set as an introduction to Mars mission concepts. In the next few months our biggest efforts will be to bring the Mars Institute "on-line." With the help of Thomas Meyer, a telecommunications expert, we are developing a computer-based communications system that will allow students and researchers to exchange information and ideas. The system is already in place and is being tested.

Not long ago I was a university student trying to start a course on Mars exploration. From that first-hand experience, I can attest to the profound effect that interest and support from the "established" community can have on student motivation and performance. The Mars Institute has an important job to do if humans are ever to explore the planet Mars.

Christopher McKay, a planetary scientist at NASA's Ames Research Center, serves as coordinator for The Planetary Society's Mars Institute.

SETI and The Planetary Society

by Paul Horowitz

My involvement with The Planetary Society began in 1981, when I was visiting the Ames Research Center at Moffett Field, California on a National Research Council fellowship, a program that encourages academic scientists to spend some time at NASA centers. Ames and the Jet Propulsion Laboratory are the two centers involved with the Search for Extraterrestrial Intelligence (SETI), and Jill Tarter of Ames had encouraged me to come and work with the hardware being built at nearby Stanford University. As it turned out, I arrived before the hardware, so Ivan Linscott and I designed a nifty little SETI-in-a-suitcase machine that we thought could be built in less than a year.

Well, design is one thing, a finished piece of hardware another. We had the design, we had a name (Suitcase SETI), we just didn't have the cash. At a scientific review meeting for the SETI project, I gave a brief talk about what we could do with $20,000. Tom McDonough, Planetary Society SETI coordinator, was there representing the Society, and he was impressed with the plan for Suitcase SETI. He and John Billingham of Ames quickly worked out a joint funding arrangement, with a little catalysis by Barney Oliver. The Planetary Society grant was quickly approved by its Board of Directors.

Working in Allen Peterson's lab at Stanford, with the help of Kok Chen, Cal Teague and Peter Backus, we finished Suitcase SETI in six months. Ivan, Cal, Peter and I celebrated with a week's observations at the 1000-foot dish at Arecibo, where we examined 200 stars like the Sun at the 1420 megahertz frequency of hydrogen and its second harmonic, 2840 megahertz. 1420 megahertz, or the 21-centimeter line of hydrogen, is the celebrated choice of Cocconi and Morrison in their classic 1959 paper in *Nature* pointing out the possibility of interstellar communication via microwaves. We didn't find anything, but we proved the concept of continuous, automated ultra-narrowband SETI.

Project Sentinel is Born

While we were at Arecibo, I talked to Mike Davis about a plan I had for looking at a million stars with the 84-foot radio dish at Harvard, Massachusetts. My idea was to put the coordinates of a million stars in a computer, then go from one to the next with automated telescope motions. Mike shrewdly pointed out that the most efficient way to look at a million stars is to survey the whole sky impartially, since at these wavelengths an 84-foot telescope's beam has fewer than a million resolvable directions in the sky. Mike was right (as usual) and thus was born Project Sentinel.

The basic idea behind Sentinel is that communicative life won't be found around every star, or every hundredth star, but more likely one star or less in a million. So, although searches like the one at Arecibo (which used 75 hours of telescope time) are useful for testing equipment and for confirming that the sky isn't sparkling with alien signals, a better strategy consists of continuous observation at a telescope that is not in demand for other purposes. I therefore proposed Sentinel as an efficient use of Suitcase SETI, a way to put a year's worth of hardware effort to work on a schedule of searching 24 hours a day.

Once again The Planetary Society came through, this time with the $30,000 needed to restore the radio telescope to full operation, with an additional $20,000 per year for operation and maintenance. We inaugurated Project Sentinel on March 7, 1983, complete with fanfare and champagne, under the interested eye of the press and the local scientific community. In the first week it accomplished as much searching as all previous searches in all nations combined.

Sentinel was a major step forward in SETI, and it demonstrated convincingly that inexpensive and trouble-free searches are possible. One reason for the low cost, however, is a severe restriction in the kinds of signals it can detect. In particular, Sentinel requires a continuous transmission of a narrow carrier, at a guessable "magic" frequency (like 1420 megahertz) transmitted so that it arrives in the target star's system at exactly the magic frequency. Sentinel is only sensitive to transmissions directed at our star, and would miss an omnidirectional galactic beacon transmission.

The solution is a *mega*channel spectrum analyzer, a receiver that can receive millions of channels simultaneously. John Forster, a clever engineer who was working on Sentinel at the time, suggested parallel replication of the Sentinel architecture to expand the system to 8 million channels. In the summer of 1983, only three months after starting Sentinel, we sent a proposal to The Planetary Society and received that fall approval for this major expansion. The new system would be called META, for Megachannel Extraterrestrial Assay. "Meta" also means "beyond." META would cost $95,000.

Sentinel Becomes META

We began work immediately, designing a custom processor with the latest computer-aided design tools — loaned to us by a company involved in oceanography, Sea Data Corporation. We built 150 processors, each comparable in power to a fast microcomputer such as a VAX, and knitted them together into a parallel processor with the speed (for this computation) of a Cray supercomputer. The system has a half million solder joints (done by hand), 25,000 chips, and 20,000 backplane connections. Ivan Linscott of Stanford built a digital bandpass filter, a component of NASA's SETI, as the "front end" for our signal processor. Brian Matthews, a Harvard student, wrote a monumental 7,000 lines of beautiful computer code, while Mal Jones and Mike Williams renovated the radio telescope itself to comparable beauty.

By September, 1985, the world's largest spectrum analyzer was complete and ready to install. Steven Spielberg, whose gift to The Planetary Society helped finance the megachannel instrument, was on his way to Harvard, Massachusetts to throw the ceremonial switch. Hurricane Gloria was on her way, too. She got there first, cleared away some extraneous trees and power lines, then headed toward Europe.

At 11:30 am, on September 29, 1985, Spielberg turned on the power to META. It is now the most powerful search on Earth, and it can detect a microwave beacon transmitted omnidirectionally at a guessable frequency by an advanced civilization in our galaxy. Faithfully pointed to a fresh portion of the sky by Skip Schwarz each day at 1:30 pm, the antenna will cover the sky visible from Massachusetts every seven months, looking on successive special wavelengths for a galactic beacon from one of the 100 billion suitable stars in the Milky Way.

If there are technological civilizations elsewhere in our galaxy that wish to communicate via microwave beacon, The Planetary Society's Project META could well be the instrument that liberates Earth from 4 billion years of cultural isolation.

Harvard University physicist Paul Horowitz is the originator and leader of Project META (Megachannel Extraterrestrial Assay).

The ASTEROID PROJECT Shows Results

by Eleanor Helin

I am Eleanor Helin, Principal Investigator for the Asteroid Project supported by The Planetary Society. Since 1982, Society members have generously provided funds to assist me in this research. The continuing grant has provided very necessary discretionary funds for a Jet Propulsion Laboratory project which is primarily conducted at Palomar Observatory — on an ever-decreasing budget. The Planetary Society has covered the costs for many necessities, including student assistants, photographic supplies, observatory accommodation costs, associated travel, and a portable measuring device.

Even though we were funded by NASA and enjoyed the support of the World Space Foundation, a private space group, our Asteroid Project sorely needed financial assistance to progress more effectively in view of the needs of the space program. Not only did the Planetary Society give us financial help, but perhaps even more important, it reported on our work and gave visibility to our asteroid search activities. The Society focused attention on the importance of our work, which had been an overlooked area of planetary science. In *The Planetary Report*, we were able to explain near-Earth asteroids, their role in the solar system, their transient nature, their long history of impact with the terrestrial planets, their probably generic relationship with comets and meteorites, their potential for striking Earth, their accessibility for spacecraft missions, and their possible use as resources.

Members Help Out

Planetary Society members became our listeners, thinkers and lookers. You volunteered your services and your telescopes to become members of the backup observing team in the discovery of brighter asteroids. You entered the contest to name an asteroid we discovered (we will announce the name soon). You became the compelling motivation to push a little harder, to search a little longer, to show by our discoveries and successes our gratitude for the confidence and support you have given this work.

Now let me tell you about some of our discoveries and results during the last three years.

The first year of your support was a banner year for discovery: The two most accessible near-Earth asteroids — 1982 DB and 1982 XB — were discovered from Palomar. They head the list of best candidates for spacecraft missions because their orbits make them the easiest to reach, in terms of energy, for rendezvous. (See the July/August 1982 *Planetary Report*.)

In 1983 we had another fruitful year, with the help of Steve Swanson, an undergraduate at the California Institute of Technology, and Amara Graps from the University of California at Irvine. We found an Apollo asteroid (with an orbit crossing Earth's), 1983 LC, an Amor asteroid (with an orbit inside Earth's), 1983 LB, and an unusual, deep Mars-crosser, 1983 PA. Finding 1983 LB and 1983 LC on the same photographic plate was unprecedented. We also gained greater access to the 48-inch Palomar Schmidt telescope, making it possible to extend our Planet-Crossing Asteroid Search (PCAS) program to fainter magnitudes. The support and recognition gained by Planetary Society sponsorship assisted in our effort to obtain more observing time with the large Palomar Schmidt.

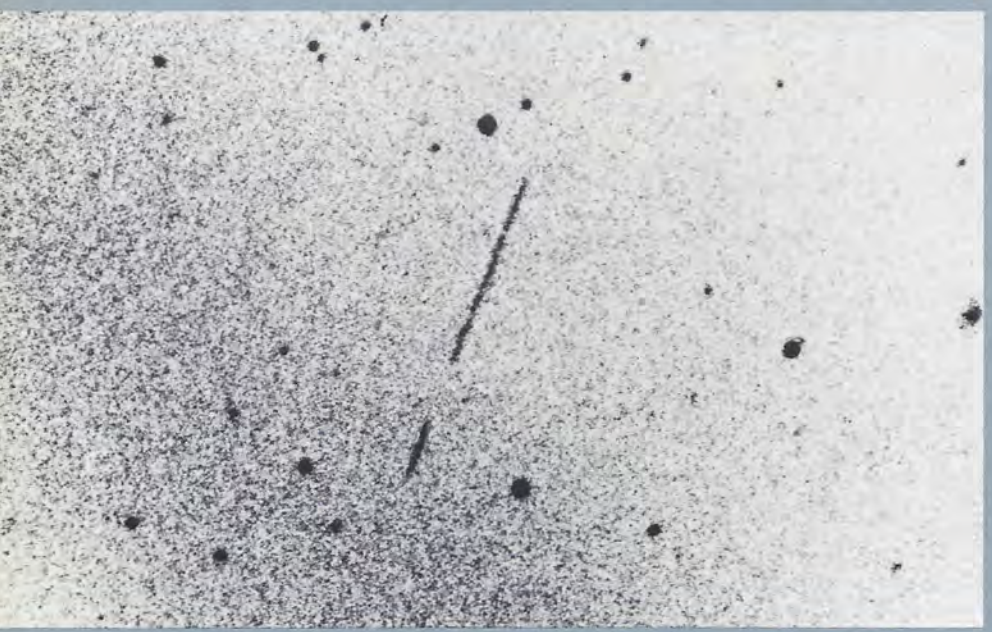
Parades and Asteroids

I started the new year of 1984 by riding in the Rose Parade on the Jim Henson's Muppets float, which depicted "Miss Piggy in Space." Immediately after the novel ride I left for Mount Palomar for an observing run with my colleague R.S. Dunbar. We hit the jackpot, finding an unusual object, 1984 AB, the second discovery made in the new year. We soon recognized it as a unique object with an orbit closer to Mars' orbit than any object previously known. Later that month we found another rare object, 1984 BC, a Mars-crossing Jupiter crosser. 1984 BC's orbit and physical characteristics suggest a cometary origin.

The summer of 1984 saw a phase of our International Near-Earth Asteroid Search (INAS) implemented in a three-month visit by M. A. Barucci of Italy. This introduction to our observing program, its techniques and strategy, led to the discovery of an Aten asteroid, 1984 QA. (Aten asteroids circle the Sun inside Earth's orbit.) This is a rare object, only the fourth Aten found to date (all were found in the course of PCAS from Palomar). 1984 QA was the highlight of our collaboration, but was only one of many discoveries made during Barucci's visit to JPL and Palomar.

During the summer of 1985 we continued this joint search program, this time from the CERGA (Centre d'Etudes et de Recherches Geodynamiques et Astronomiques) Schmidt telescope in France. With Barucci and J.L. Heudier of France, I made a spectacular Apollo discovery, 1985 PA. This international aspect of the PCAS program was coordinated with our JPL asteroid team members simultaneously observing from Palomar. This team included Steve Singer-Brewster, who has been helping us for the past six months with the support of The Planetary Society.

Thank you, Planetary Society members for your support of this research. We shall continue to do our best to discover more asteroids and advance knowledge about these intriguing mavericks of the solar system.



As a result of an international effort organized by the JPL Asteroid Project, 1985 PA was discovered on August 15, 1985. Eleanor Helin of JPL and M. A. Barucci of the European Space Agency found the asteroid using the CERGA telescope in Caussols, France. Observers in California, Massachusetts, Arizona and Hawaii followed up the discovery, confirming and refining measurements of the near-Earth asteroid.
Photograph: Eleanor Helin/JPL and M. A. Barucci/ESA

Planetary scientist Eleanor Helin is the principal investigator for the JPL Asteroid Project supported by The Planetary Society.

SOCIETY NOTES

SPIELBERG TURNS ON META

On September 29, 1985, film director and producer Steven Spielberg flipped a switch and turned on Project META (Megachannel Extraterrestrial Assay), the new 8.4 million channel receiver at Harvard University's Oak Ridge Radio Observatory. Project META is the latest advance in The Planetary Society's Search for Extraterrestrial Intelligence (SETI) project. (See the January/February 1984 *Planetary Report.*)

Society President Carl Sagan and META Project Scientist Paul Horowitz joined Mr. Spielberg for the ceremony. With a donation of $100,000, Mr. Spielberg had provided the funds to build the new receiver. And with his donation, he became the newest member of The Planetary Society's New Millennium Committee.

In response to a letter announcing Mr. Spielberg's gift, Planetary Society members provided more than $50,000, which insures that META will run for at least two years, searching the sky continuously for radio signals with the most capable and advanced electronics involved in SETI. The initiation of this project is one of the most exciting events in the Society's history.

WHAT TO CALL IT?

While discussing possible cover pictures for our special issue of *The Planetary Report* on humans in space (March/April 1985), Louis Friedman, our Executive Director, had a whimsical idea — the result is pictured here. Our Advisor, Sally Ride, is one of many women who have shown that it is no longer accurate to speak of "manned" spaceflight. But what should we call it? In that special issue, Dr. Sagan invited our members to help us decide on an alternative.

We might have predicted the range of responses — many applauded our effort to be sensitive to this subject, and many told us it was too trivial to bother with. Humor, trivia, scorn and many constructive suggestions typified the responses. But while we might have predicted the range of responses, we never would have predicted their number: 236! Some, of course, are not serious, but most had a logic that deserved some consideration. The most popular choice was *staffed*, chosen 29 times, with *live* right behind with 28. *Astronaut, inhabited, piloted, occupied* and *personned* were all suggested more than 10 times each.

We must point out that 29 people said: Leave it alone, "manned" is perfectly acceptable.

Of course, we are not going to select a new, correct term. Popular use will have to determine that. We will, however, try out some of these expressions by using them in our writings and encouraging our members to do the same. Maybe by the time humans go to Mars *live, staffed, humanned, personned* or some other term to modify spaceflight will have passed into popular use.

We would like to share some of the responses: An Iowa City policeman said his force had solved the problem by changing "manned vehicles" to "occupied vehicles." Several people noted that they had put in days of work on the subject, and cited their research. Some members reminded us that we should not forget the imbalance of men to women in our membership — 85 percent male to 15 percent female. One person said, "Forget writing about it and get some women into the Society."

One comment we especially like was: "From an extraterrestrial point of view, the difference between Sally Ride and Neil Armstrong doesn't seem worth worrying about." Another person quoted Shakespeare, "What's in a name? That which we call a rose/By any other name would smell as sweet," and then added, "As to the future we reap with our technology, may it be as sweet as the Bard's proverbial rose."

VOICES OF THE CHILDREN

At a meeting with the leaders of the American, Japanese, European and Soviet space agencies, Roger Bonnet, Director of Space Sciences for the European Space Agency, made a suggestion to The Planetary Society: With so much attention being paid to those who saw Halley's Comet in 1910, shouldn't we give some attention to those who we hope will see it in 2061?

Part of the importance and attraction of Halley's Comet is that, as a once-in-a-lifetime event, stories of its appearances have been passed from parent to child for generations. We should recognize that what we see and learn at this apparition will be a legacy for those who will observe it next.

And so, The Planetary Society wants to hear from children under 10 years of age who will have a chance to see Halley's Comet in 2061. We invite these children to send us a communication — an essay, picture or cassette recording — about what they expect to see this year, and what they hope to see 76 years from now. Submissions should be limited to one page, or if a cassette, one minute. We will see that the submissions are saved as part of an archive for the return of Halley's Comet. The International Halley Watch — the official Halley archive — has agreed to cooperate with us on this project.

All children who make submissions — and whose parents are Society members — will receive a print of a spacecraft image taken during the spacecraft encounters with Halley's Comet in March, 1986.

What to Call It

These are a few of the suggestions we received about what to call "manned" space flight.

accompanied
ambisextrous
animated
anthropic
attended
beset
bionic
corporeal
creatured
droogied
(from Russian for "friend")
hominized
hybrid
missionary
organic
peopled
personned
piloted
prosopal
(Greek for "personned")
starred
tended
wamo
(woman or man operated)

News & Reviews

by Clark R. Chapman

During late October, planetary astronomers from around the United States congregated in Baltimore to share their research results. The annual meeting of the Division of Planetary Sciences (DPS) of the American Astronomical Society is one of the two main professional planetary events. Between Halloween parties and committee meetings, the scientists shuffled from poster displays to coffee dispensers. Each day there were two or three simultaneous paper sessions where speakers gave five-minute synopses of their progress and discoveries, illustrated with slides and viewgraphs.

Several speakers described new results on the mysterious objects orbiting Neptune, revealed by unexpected dimmings or blink-outs of stars in the sky near Neptune, most recently on August 20th. Astronomers don't know what to make of these objects, but the term "ring-arc" was frequently heard in the halls of the Baltimore Plaza.

Nick Schneider, a planetary science graduate student, exhibited a poster about his novel approach to studying the tenuous sodium-enriched atmosphere of Jupiter's weird moon Io. He waited until Io was about to eclipse Europa, when all sunlight falling on Europa had passed through Io's atmosphere. Schneider's well-timed spectra of Europa show absorption bands at wavelengths where Io's sodium has scattered the sunlight away. This clever technique enabled Schneider to probe Io's lower atmosphere, which had never been done before.

Speaking of sodium, there were four talks about the sodium atmosphere of Mercury, just discovered in early 1985. The inner planet's atmosphere might have been observed years ago had astronomers thought to look for it.

Comets, Comets, Comets

At the last DPS meeting in Maryland, there were just two talks about comets. What a difference a decade makes! This time in Baltimore there were about 45 comet talks. Preliminary results of the International Cometary Explorer (ICE) encounter with Comet Giacobini-Zinner were described. This little spacecraft, launched years ago for other purposes, had been propelled by an intricate maneuver of celestial pinball-wizardry past the Moon to intercept Comet G-Z in early September. In Baltimore, the spacecraft experimenters — many from the nearby Goddard Spaceflight Center — compared notes with ground-based astronomers who had been taking simultaneous data on G-Z.

Naturally, the impending arrival of Halley's Comet was on everyone's mind in Baltimore. Though Halley was still too faint to be seen with even a good pair of binoculars (especially through the murky skies of Baltimore), astronomers had been monitoring the comet intensively for the previous year. In the winter of 1984-5, they had observed when Halley "turned on;" that is, when it stopped looking like an icy asteroid and began to grow the coma, or head, that is characteristic of comets warmed by the Sun.

All the excitement about Halley's Comet was tempered by NASA's confirmation two weeks earlier that it would not even try to get Office of Management and Budget approval for starting the long-planned Comet Rendezvous Asteroid Flyby (CRAF) mission (see *Science*, 1 November, 1985). This mission will initiate the Solar System Exploration Committee's program of outer solar system missions using the generic *Mariner Mark II* spacecraft. A one-year delay would postpone CRAF's arrival at a comet for two years; it would be monitoring peak activity on its target — Comet Tempel 2 — just a few months before the end of the century.

Subsequent *Mariner Mark II* missions are also threatened, including the Saturn/Titan mission called *Cassini*. At the DPS meeting, scientists hoped to have a dialog with NASA Administrator James Beggs about their concerns. But Beggs' stand-in on an evening panel discussion — Associate Administrator Burt Edelson — himself sent Dr. Jeff Rosendhal to read a positive, but ambiguously worded, message about starting CRAF a year from now.

Cometscopes and Bright Skies

Flying home from Baltimore, I struck up a conversation with a fellow passenger and learned that he was an astronomy buff who had recently invested in an eight-inch backyard telescope. I was chagrined to hear that he was disappointed in his new purchase. Galaxies and globular clusters just didn't look like the pictures he had seen. The Moon and brighter planets were fun to look at, he reported, but the famous Andromeda galaxy looked about like it does through binoculars.

Unfortunately, the same is true of all distended objects in the sky, including Halley's Comet. Recent advertising hype has misled many space buffs into thinking that they can overcome the comet's long-predicted faintness near the southern horizon by buying a fancy telescope. If you haven't yet bought a telescope, you would do well to first read *Consumer Reports* for November. A conventional telescope can give good views of the Moon, or of small, bright objects like planets and double stars. For galaxies and comets, you can't do better than a good pair of binoculars or a rich-field telescope, unless you can catch a glimpse through a very large observatory telescope during a public night.

If you heed *Consumer Reports'* ratings for telescopes in the $200 to $2000 price range, you can derive pleasure by using them under ideal atmospheric conditions. As civilization has spread throughout the world, we have lost touch with our celestial heritage. Turbulent heat convection from our rooftops and subdivisions disrupts the still air, often making Saturn's rings blurry in a telescopic eyepiece. Worst of all for galaxies and comet-watching is light pollution. I once saw the Andromeda galaxy from a mountain-top in northern Mexico a hundred miles from the nearest town. It was an awesome spindle of light, so large it would have barely fit in the Big Dipper's bowl. But for tens of millions of Americans, Andromeda is invisible even on the clearest winter nights. For the would-be Halley-watcher this spring, the best advice is to drive *far* away from any big city and hope for cirrus-free skies.

Light pollution is an ever-increasing problem for amateur and professional astronomers alike. The answers are political ones, as explained by Stephanie and John Mood in the November *Astronomy*. We can't get human beings to Mars, or even a simple *Mariner* spacecraft into orbit around a comet, without getting political: writing to, and talking with, NASA officials and our congressional representatives. Light pollution is addressed by the political process, too, but generally on the local level. It is local city councils and county supervisors that control the destinies of some of the world's greatest telescopes. Sitting, as I do, on the Planning and Zoning Commission of the county containing Kitt Peak and other major observatories, I can attest to the truth of the Moods' approach to political activism on the local level. What convinced the San Diego City Council to save Palomar's skies can be tried in your community, too. And this spring's great hunt for Halley provides an opportunity to start.

Clark R. Chapman, a planetary scientist, is also a Planning and Zoning Commissioner in Pima County, Arizona.

World Watch

by Louis D. Friedman

GREENBELT, MD — On September 11, 1985, at approximately 7:00 am, the International Cometary Explorer (ICE) passed through the tail of Comet Giacobini-Zinner. The press coverage given to this encounter proved once again that exploration of other worlds still commands the attention of people around the world.

Launched in 1978 as the International Sun-Earth Explorer-3, the renamed ICE spacecraft had studied the solar wind and Earth's magnetosphere from a point between Earth and the Sun. A clever technique of celestial mechanics, devised by Robert Farquhar of NASA's Goddard Space Flight Center, used "gravity assist" from the Moon to boot the craft on toward the comet. (See the May/June 1985 *Planetary Report*.)

At Giacobini-Zinner ICE took the first measurements from inside a comet. As with every space mission so far, scientists were surprised with the results. The tail region and magnetosphere were much more active than expected. We will report on the scientific findings in a future issue of *The Planetary Report*.

WASHINGTON, DC — The Comet Rendezvous Asteroid Flyby (CRAF) mission, once planned for a 1991 launch, will not be proposed as a new start for fiscal year 1987. The mission would have sent a spacecraft to examine briefly asteroid Hestia and to fly alongside Comet Wild 2. NASA officials in the Office of Space Science decided against proposing this mission to either the President or Congress in favor of other space programs, even though this mission had been scheduled for a new start in 1987 by the Solar System Exploration Committee, a NASA advisory group.

Thus, once again, the United States will not attempt a comet mission, despite enormous public interest and expected scientific results from missions to Giacobini-Zinner and Halley's Comet.

Although there will now be no comet mission in 1991, plans are being examined to permit a launch to Comet Tempel 2 one year later. The spacecraft would travel alongside the comet as it moves around the Sun, observing it in the outer solar system, where the comet would be relatively inert, and as it approaches the Sun and its ices and dust begin to boil off. If cometary material could be brought back to Earth, we could determine the nature and composition of particles making up the comet. Since comets are probably primitive remnants of our solar system's formation, this analysis would be extremely important.

To understand the organic chemistry of our solar system, we will have to study comets and bodies like Titan, the large moon of Saturn. Titan's atmosphere is rich in hydrocarbons, and other organic molecules, the building blocks of life. Planetary scientists would like to send a probe into that atmosphere. The *Mariner Mark II* spacecraft being developed for the CRAF mission is almost identical to that proposed for a mission to probe Titan and orbit Saturn. Both *Mariner* class spacecraft could be built with the 1988 new start. So, onward to Comet Tempel 2 and to Titan!

It's not too late for a 1988 new start for CRAF. Members who want to advance the cause of cometary exploration should write to the Office of Space Science, NASA, Washington, DC, 20546. Tell them it's time to rendezvous with a comet.

PARIS — A sailing race to the Moon! Jules Verne fantasy? No, a solar sailing race to the Moon is being organized by the Midi-Pyrenees Regional Council in France. The region is known for its aeronautical and space industries. The regional council sees the race as "introducing the notions of 'sport' and 'game' into space activities." According to Alex Raymond, President of the Midi-Pyrenees Council, "What better synergy between space and 'joie de vivre' could be hoped for than this race, whose finishing line will be the Moon?"

The winning sailcraft will be the one that travels the fastest from geosynchronous orbit about Earth to behind the Moon. Any organization — amateur, professional, governmental, industrial, university — can enter. The only rule is that solar sailing must be the only form of propulsion used beyond Earth orbit.

The technique of solar sailing uses the force of photons streaming from the Sun to "push" a craft through space. Because the acceleration of the photon-driven craft would be small, the contestants will find it easier to start from geosynchronous orbit — about 22,300 miles up — to escape from Earth's gravity. The craft will then travel a spiral path to the Moon, arriving in about one year.

Groups in France, Japan, England and the United States are all working on solar sailing projects, although no group yet has assured professional backing, financial support or launch vehicles. The race has been promoted by the Union pour la Propulsion Photonique (U3P) in France. They are designing a solar sail for the race. The World Space Foundation in the US is also designing a sail, which they hope to fly from a space shuttle in the next two years as a proof of concept.

STOCKHOLM — At the annual meeting of the International Astronautical Federation, Soviet scientists reported on their recent *Venera* and *Vega* missions to Venus. They interpret their results to indicate that Venus may once have had an ocean of liquid water — perhaps holding two-thirds of the volume of Earth's ocean. They also said radar images show clear evidence of a great deal of tectonic activity, possibly caused by active volcanos or maybe even by the movement of continental plates across that planet's surface.

Louis Friedman is Executive Director of The Planetary Society.

Planetary Society/ABC News Comet Coverage

The Planetary Society has made a special arrangement with ABC-News to provide live coverage of television transmissions from spacecraft flying by Halley's Comet. As images from the Soviet *Vega* and European *Giotto* are received, Society President Carl Sagan will be at mission control to describe the new data for ABC-News.

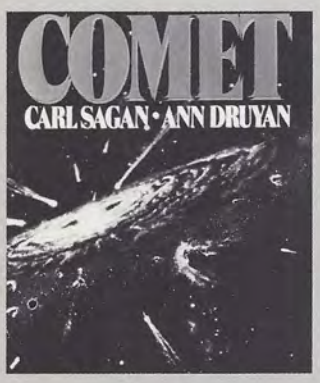
The encounter dates for the spacecraft are:

Vega 1, March 6 at 2:19 am; *Suisei*, March 8 at 7:56 pm; *Vega 2*, March 9 at 2:22 am; and *Giotto*, March 13 at 6:59 am (all times are Eastern Standard Time).

Over the next few months, The Planetary Society and ABC-News will also provide information on Halley's Comet with a special telephone line, 900/410-STAR. The recording of viewing information and scientific developments will be updated every few days. The cost of a one-minute call is $0.50.

Last Chance for Halley's Comet!

Don't let the comet catch you unprepared!

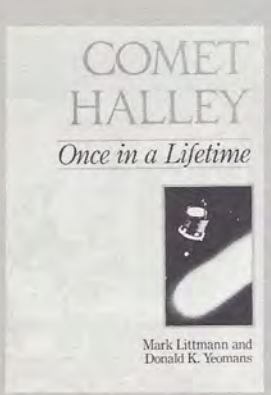


COMET
(#140)

Written by Carl Sagan and Ann Druyan, *Comet* is an enthralling encounter in words and pictures with the myth and science of comets, with special emphasis on Comet Halley. Lavishly illustrated with photographs and dozens of specially commissioned paintings by distinguished astronomical artists, this book is a unique blend of science, poetry and imagination.

COMET!
THE STORY BEHIND HALLEY'S COMET
by Greg Walz-Chojnacki
(#104)

An exciting, fast-paced book written for older children, *Comet!* supplies information and activities with a refreshing enthusiasm which is sure to foster a life-long interest in astronomy.



COMET HALLEY — ONCE IN A LIFETIME
by Mark Littman and Donald K. Yeomans
(#143)

Historical anecdotes highlight this fact-filled book about comets. Numerous pictures and illustrations plus very readable language make this an enjoyable *and* educational reading experience.

HALLEY'S COMET PIN
(#217)

This tasteful five-color pin in cloisonné enamel marks the return of Halley's Comet in 1985-86. Collect this pin commemorating a once in a lifetime event.

THE RETURN OF THE COMET
by Dennis Schatz (#139)

Designed primarily for the 9-14 age group, this well-designed book contains an exciting variety of information and activities, both entertaining and scientific. An adult guide containing lesson plans and teaching strategies is included, making it suitable for home or classroom use.

THE COMET BOOK
by John Brandt and Robert Chapman (#141)

A well-illustrated guide to observing and photographing the 1985/86 appearance of Halley's Comet, this eminently readable book also contains historical facts and details on comets in general. The text is suitable for both the general public and the amateur astronomer.

THE COMET AND YOU
by E.C. Krupp, illustrated by Robin Rector Krupp
(#138)

This humorous and informative book deals with all aspects of Halley's Comet in a format designed to capture the imagination. The stimulating text and bold illustrations will particularly appeal to children in the 5-9 age range.

MR. HALLEY'S COMET
by the Editors of Sky & Telescope (#221)

A basic 30-page pamphlet which contains charts and time-tables for viewing and photographing the comet. Straightforward text makes this publication ideal for the lay reader.

HALLEY'S COMET IN COLOR!
(16″ x 20″ Laser Print, #152)

See the comet as it appeared from Lowell Observatory in May, 1910. This striking print has been computer processed to give more detail than the original.

"COMET HALLEY"
The Planetary Society's Television Special
(VHS #231, BETA #241)

James Earl Jones narrates this exciting 60-minute videotape on Comet Halley's science and history. This beautiful and fact-filled visual presentation is a fitting commemoration of the 1985/86 apparition.

THE HALLEY ARMADA (# 300)

This NASA special publication provides vital information on the spacecraft investigating Halley's Comet. It's available to Planetary Society members for only $1.00 to cover postage and handling.

COMET OBSERVING INFORMATION

For more information about how to observe Halley's Comet, contact:

The Astronomical Society of the Pacific
1290 24th Avenue, San Francisco, CA 94122;

The Astronomical League
7117 Misty Meadow Drive South, Fort Worth, TX 76133;

The International Halley Watch
Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109.

Sky & Telescope and *Astronomy* magazines also provide excellent information on how to make the best of this visit by Halley's Comet.

The Solar System in Pictures and Books

Books

ORDER NUMBER			PRICE (IN US DOLLARS)
101	**Voyage to Jupiter** by David Morrison and Jane Samz. 199 pages.		$11.00
103	**Journey to the Planets** by Patricia Lauber. 87 pages.		$11.50
104	**Comet! The Story Behind Halley's Comet** by Greg Walz-Chojnacki. 64 pages.		$ 9.50
105	**The Case for Mars** edited by Penelope J. Boston. 314 pages	Soft Cover	$18.00
106	**Mission to Mars** by James Oberg.	Soft Cover	$11.00
107	**Out of the Cradle: Exploring the Frontiers Beyond Earth** by William K. Hartmann, Ron Miller and Pamela Lee. 190 pages.	Soft Cover	$11.00
108	**The Case for Mars II** edited by Christopher P. McKay. 700 pages.	Soft Cover	$27.00
109	**The Surface of Mars** by Michael Carr. 232 pages.		$15.00
110	**Imaging Saturn** by Henry S.F. Cooper, Jr. 210 pages.		$13.00
111	**Voyages to Saturn** by David Morrison. 227 pages.		$14.00
113	**The New Solar System** edited by J. Kelly Beatty, Brian O'Leary, and Andrew Chaikin.	2nd Edition	$12.50
117	**The Grand Tour: A Traveler's Guide to the Solar System** by Ron Miller and William K. Hartmann. 192 pages.		$ 9.00
119	**Planets of Rock and Ice** by Clark R. Chapman. 222 pages.		$12.50
121	**The Planets** edited by Bruce Murray. 129 pages.	Soft Cover	$ 9.50
123	**Murmurs of Earth** by Carl Sagan, Frank Drake, Ann Druyan, Timothy Ferris, Jon Lomberg, Linda Salzman Sagan. 273 pages.		$ 7.00
127	**Out of the Darkness** by Clyde W. Tombaugh and Patrick Moore. 221 pages.		$13.00
131	**Earth Watch** by Charles Sheffield. 160 pages.		$20.00
133	**Pioneer Venus** by Richard O. Fimmel, Lawrence Colin and Eric Burgess. 253 pages.		$12.50
134	**Rings – Discoveries from Galileo to Voyager** by James Elliot and Richard Kerr. 209 pages.		$16.00
135	**Atlas of the Solar System** by Patrick Moore and Garry Hunt. 464 pages.	Soft Cover	$20.00
137	**Worlds Beyond: The Art of Chesley Bonestell** by Ron Miller and Frederick C. Durant III. 133 pages.		$13.00
138	**The Comet and You** by E.C. Krupp, Illustrated by Robin Rector Krupp. 48 pages.		$11.50
139	**The Return of the Comet** by Dennis Schatz, Design and Illustration by Yasu Osawa. 42 pages.		$11.50
140	**Comet** by Carl Sagan and Ann Druyan		$21.00
141	**The Comet Book** by Robert Chapman and John Brandt. 168 pages.		$14.00
143	**Comet Halley – Once in a Lifetime** by Mark Littmann and Donald K. Yeomans. 175 pages.		$12.00
144	**Voyager: The Story of a Space Mission** by Margaret Poynter and Arthur C. Lane. 152 pages.		$ 8.50
145	**Cosmic Quest: Searching for Intelligent Life Among the Stars** by Margaret Poynter and Michael J. Klein. 124 pages.		$ 9.00
221	**Mr. Halley's Comet** by editors of *Sky & Telescope*. 30 pages.		$ 1.00

For a written description of each item, see back issues of THE PLANETARY REPORT or write to The Planetary Society.

Other Items

ORDER NUMBER			PRICE (IN US DOLLARS)
147	**Voyager 2's Future Missions** – Don Davis paintings (set of 2 color reproduction prints)		$ 2.00
148	**Human in Space** photograph of astronaut in space (16" x 20" Laser Print)		$ 8.00
149	**Earthrise** photograph of Earth from the Moon (16" x 20" Laser Print)		$ 8.00
151	**Apollo** photograph of Earth – full disk (16" x 20" Laser Print)		$ 8.00
152	**Comet Halley** (16" x 20" Laser Print)		$ 8.00
153	**Earthprint** photograph of North America (8" x 10" Laser Print)		$ 4.00
155	**Voyager 1 at Saturn** (set of five posters)		$16.00
157	**Planetfest '81** – Saturn and the F-ring (Two 23" x 35" posters)		$ 5.00
159	**You Are Here** (23" x 29" poster)		$ 5.00
161	**Other Worlds** (23" x 35" poster)		$ 7.00
163	**Chesley Bonestell's Vision of Space** (40 slides with sound cassette)		$15.00
164	**Comets and Comet Halley** (30 slides with booklet)		$24.00
165	**Voyager 1 Saturn Encounter** (40 slides with sound cassette)		$15.00
167	**Voyager 2 Saturn Encounter** (40 slides with sound cassette)		$15.00
169	**Voyager 1 & 2 at Jupiter** (40 slides with sound cassette)		$15.00
171	**Viking 1 & 2 at Mars** (40 slides with sound cassette)		$15.00
173	**The Solar System Close-Up, Part One** (50 slides with booklet)		$36.00
175	**The Solar System Close-Up, Part Two** (50 slides with booklet)		$36.00
179 VHS 189 BETA	**Universe** (30 min. videotape)		$30.00
231 VHS 241 BETA	**Comet Halley** (60 min. videotape)		$15.00
183 VHS 193 BETA	**The Voyager Missions to Jupiter and Saturn** (28 min. videotape)		$30.00
185 VHS 195 BETA	**Mars, the Red Planet** (30 min. videotape)		$30.00
187 VHS 197 BETA	**Billion Dollar Image** (30 min. videotape)		$30.00
199	**Mars and Beyond** (CAV Laser Videodisc)		$36.00
201	**Space Shuttle Mission Reports: STS 5, 6, & 7** (CAV Laser Videodisc)		$36.00
203	**Apollo 17 Mission to Taurus Littrow** (CAV Laser Videodisc)		$36.00
205	**Calendar for 1986**		$ 7.00
207	**Men's T-Shirt** – white with blue logo. S M L XL		$ 9.00
209	**Women's T-Shirt** – navy with white logo. S M L XL (sizes run small)		$ 9.00
211	**TPS Buttons** – blue with logo (2 for $2.50)		$ 1.50
213	**Planetary Report Binders** – blue with gold lettering. (2 for $16.00)		$ 9.00
215	**Mars Model** by Don Dixon and Rick Sternbach		$65.00
217	**Halley Comet Pin**		$5.00
219	**Back issues** of THE PLANETARY REPORT – Each volume contains six issues (Vol. 1, #5 & 6 and Vol. 3, #1, & 2 have been sold out.) Specify the issues you are ordering by volume and number.	each	$ 2.00
223	**Precision Planet and Star Finder** (Latitude 30°)		$14.00
225	**Precision Planet and Star Finder** (Latitude 35°)		$14.00
227	**Precision Planet and Star Finder** (Latitude 40°)		$14.00
225	**Precision Planet and Star Finder** (Latitude 45°)		$14.00
225	**Precision Planet and Star Finder** (Latitude 50°)		$14.00
300	**The Halley Armada** (NASA special publication)		$ 1.00

IF YOU NEED MORE ROOM, JUST ATTACH ANOTHER SHEET OF PAPER

NAME

ADDRESS

CITY, STATE, ZIP

COUNTRY

☐ CHECK OR MONEY ORDER FOR $ _____ (Sorry, no C.O.D.'s)

☐ VISA ☐ MC ☐ AM/EXP EXPIRATION DATE / ___ / ___ / ___ /

COMPLETE ACCOUNT NUMBER _____

SIGNATURE _____

ITEM NUMBER	QUAN	DESCRIPTION	PRICE EACH	PRICE TOTAL

For faster service on credit card orders:
Phone: 8 A.M. – 5 P.M. (Pacific Time)
(818) 793-5100

Sales Tax:
California residents add 6%.
Los Angeles County residents add an additional ½% transit tax.

Foreign Orders add $4.00 for shipping and handling.

Total Order:

Officers of The Planetary Society do not receive any proceeds from sales of books of which they are authors and contributors.

MAIL ORDER AND PAYMENT TO: ***THE PLANETARY SOCIETY, 65 N. CATALINA AVE., PASADENA, CA 91106***

GALACTIC WAVE — Inspired by Hokusai's famous woodcut of Mount Fuji, artist Jon Lomberg depicts the density wave theory of star formation. New stars are tossed like sea spray from the breaking wave of compressing gas. In Hokusai's work, Mount Fuji appeared on the distant horizon; in this painting the galactic center is seen there.

Jon Lomberg, an artist and journalist specializing in space sciences, designed The Planetary Society's logo. His paintings appear in the new book Comet, *by Carl Sagan and Ann Druyan, and on the cover of Dr. Sagan's novel,* Contact. *He lives in Toronto, Ontario.*

THE PLANETARY SOCIETY
65 North Catalina Avenue
Pasadena CA 91106

NONPROFIT ORG.
U.S. POSTAGE
PAID
LONG BEACH, CA
PERMIT NO. 786