Proceedings
of the
8th Planetary Congress
of the
Association of Space Explorers

To Mars Together

August 24-29, 1992
Washington DC, USA

The Association of Space Explorers-USA is a nonprofit educational organization.
Inquiries and contributions may be directed to:

ASE-USA
35 White Street
San Francisco, California, 94109
(415) 931-0585

Proceedings of the 8th Planetary Congress of the Association of Space Explorers

To Mars Together

TABLE OF CONTENTS

INTRODUCTION

On a hot Northern Virginia Saturday in early September of 1989, ASE-USA board member Charlie Walker sent an electronic message to his board colleagues reporting that he had been named Chairman of the Organizing Committee for the 1992 World Space Congress, the first joint meeting of the International Astronautical Federation (IAF) and the Committee on Space Research (COSPAR). The plan, Walker told his fellows, was to conduct the event in August/September of 1992 in Washington DC, with the American Institute of Aeronautics and Astronautics and the National Academy of Sciences serving as hosts. "Why not hold the 1992 ASE Congress in DC at the same time?" Walker queried.

This compelling question led inexorably to the largest undertaking ever attempted by the Association of Space Explorers, a fledgeling four-year old international group of astronauts and cosmonauts that had come together out of a shared commitment to beneficial space exploration, international cooperation, excellence in education, and environmental preservation. Several board members replied on line. Until now, they recalled, ASE had made it a practice to avoid holding its meetings in the United States or the Soviet Union, because the vagaries of the cold war had more than once caused the cancellation of planning meetings in ASE's prehistory. However, they agreed, times were rapidly changing, and perhaps there was now reason to hope that ASE could, in fact, hold a major meeting within the borders of a superpower. None of them could imagine that, between that warm September in 1989 and a sizzling August in 1992, the geopolitical face of the planet would change so irreversibly and unrecognizably.

When ASE-USA's leaders suggested the idea to their Soviet and international colleagues at that November's 5th ASE Congress in Riyadh, Saudi Arabia, the response was overwhelmingly favorable. ASE members unanimously endorsed ASE-USA's proposal to explore the possibility further. For a time, Walker agreed to wear the hat of chairman of the 8th Congress Organizing Committee. However, as the demands of his role as chairman of the World Space Congress Organizing Committee increased, his ASE board colleague John-David Bartoe stepped up to the job of Committee Chairman, and drove the successful effort through to its conclusion. Among other principal forces behind the drive were John Fabian, Tom Stafford, and Jon McBride. As President of the ASE-USA board, Fabian coaxed and cajoled his fellow members to play the roles of fundraisers, an unfamiliar task to most but which several grew into with a vengeance. Stafford single-handedly contributed and raised a combined total of $100,000 for the event. McBride raised funds for and managed the entire West Virginia portion of the Congress. Other principal organizers included Rick Hauck, who raised funds and orchestrated a Potomac River boatride, Don Williams, who put together a memorable evening sponsored by Purdue University, and Mary Cleave, who coordinated activities on the Congress community day.

In search of a site for the Congress, Bartoe contacted Father Leo O'Donovan, President of Georgetown University, Bartoe's alma mater. Bartoe's solar research experiments in space as a payload specialist had been the subject of his doctoral thesis at the university's physics department. O'Donovan and Physics Department chairman Ed Finn responded enthusiastically to the idea of holding the Congress at the University's new conference center, a venue which proved ideal. McBride, meanwhile, a neighbor of The Greenbrier in White Sulfur Springs, West Virginia, had sparked the interest of his community in hosting the astronauts there for a day and two nights, and so it came to pass that the Congress took place in both the city and the country, enabling the participants to experience two quintessentially American settings.

The theme for the Congress was the subject of much discussion. Several members believed that the theme should have a focus on Mars, others thought that any theme should underscore the Association's commitment to international cooperation. At the 7th ASE Congress in Berlin, informal conversations among the U.S. delegation led to the phrase "To Mars Together," which simply and elegantly integrated the two concepts. The members later discovered that The Planetary Society was sponsoring an International Space Year essay contest on the topic "Together to Mars," suggesting that the theme was both timely and broadly appealing.

The selection of Issac Asimov as the recipient for ASE's Annual Planetary Award was straightforward. While several other distinguished names were on some lists, Asimov remained at the top of everyone's list. He had made the significant creative and educational contributions to "space consciousness" that ASE felt it important to recognize in the International Space Year. Between the time that he agreed to accept the award and the convening of the Congress, Asimov passed away, and his wife Janet appeared with Carl Sagan to accept the award in his stead. ASE also elected to present a special award to Challenger Center for its unparalleled commitment to motivating and educating the next generation of space explorers.

Special mention must be made of The Planetary Society. As the single largest organizational donor to the Congress, the Society provided a needed financial boost to the effort when expectations of a successful fundraising campaign were beginning to diminish. ASE was particularly gratified at the tremendous show of moral support by the Society's Carl Sagan and Lou Friedman. At the Congress, the Society cohosted a public evening of lectures by Sagan and ASE members Joe Allen, Alexei Leonov and Igor Volk. In another successful collaboration, Challenger Center conducted a simulation of the construction of "Marsville" in Georgetown's McDonough Gymnasium, at which ASE members and junior high students worked side by side to build and supply a Mars base in severe duststorm conditions.

ASE wishes to thank all of the members of its Eighth Congress Host Committee for their contributions to the success of the conference. Without this group, the event

would not have been possible. (A list of Host Committee members appears on pages 30 and 31 of these Proceedings). Also, ASE wishes to the thank the Department of State, the U.S. Air Force, Andrews Air Force Base, and most of all NASA, for lending crucial logistical support to the Congress. In welcoming ASE members to Washington, NASA Administrator Daniel Goldin eloquently articulated a fundamental principle shared by ASE and his agency. "Exploration is not simply a pastime for the curious", he said, "it's a biological imperative - wired right into our DNA...To grow is to live; to stop is to die. Exploration is part of what we live for. It's how we grow as intelligent beings." Goldin's comments at the opening ceremony set the tone for the entire Congress proceedings, which we hope you will enjoy reading thoughout the pages which follow.

Ted Everts
Executive Director
Association of Space Explorers-USA

General Congress Statement

To Mars Together

For centuries, humanity has looked up at the heavens and seen a bright point of red light in the night sky. As we have more closely examined this shining body we now know as the planet Mars, we have learned that it is the closest and most similar planetary body to our Earth. Human curiosity, the urge to explore and discover, has since moved us to study the red planet both from afar as well as with robotic vehicles. And like explorers throughout the ages, we are drawn to this distant land because of what we can learn, how we might benefit, the challenges to be overcome, and because "it is there." Of all human endeavors, a mission to Mars promises to be the most challenging ever undertaken. These challenges will not only be scientific, technical, and economic, but intercultural, educational, and moral.

Humanity's thirty-five years of spaceflight experience, combined with current state-of-the-art technologies, make a program of landing humans on Mars largely achievable today. To ease the journey, however, laying a technological foundation is paramount. In addressing the reliability and safety required for a Mars mission, we will find that the transition from a maximum two week emergency return capability, typical of past space missions, to one of two years, will be a step into a new dimension. Also, we will require advanced propulsion systems and concepts such as aerobraking devices. If we are to make the mission successful, it is essential that society allocate the necessary budgetary resources to the development of these technologies.

Seen as an investment, a mission to Mars would inevitably prove to be a rewarding economic venture. Many studies have shown that the return on investment associated with space exploration is high—perhaps five to ten times the initial outlay. Much of this return can be measured directly—achievements in computers, medicine and communication, to mention a few. However, some of the greatest returns may be less measurable: the educational challenges presented to our youth, the employment of an enthusiastic and talented workforce, the thousands of lives saved by the forecasting capabilities of weather satellites. These are the outcomes which underscore the wisdom of investing time and resources into space exploration, and now, into a mission to Mars.

One benefit of a successful Mars mission will be the spin-offs in the area of safety control for technologically complex operations over long time periods at reasonable cost. However, even well controlled risk does not mean that we can and even should try to exclude risk totally. The mission to Mars is analogous to the exploration and settlement of the New World, as expressed by the oft-used phrase, "pioneering the space frontier." Risk and sacrifice are inherent features of such endeavors. Today, with all our capabilities in storing and using knowledge bases and

performing large computer calculations and simulations, there is a danger that we are becoming averse to risk. We may ask for perfection as a goal, but it cannot be a reality. If we accept only success, we will stop taking chances, and our accomplishments will diminish. In this imperfect world, astronauts have the responsibility of identifying and assessing the hazardous pathways, since we have shown our willingness to accept the high risk of spaceflight.

However, these risks, and the costs and benefits of taking them, are best shared internationally, and by both the private and public sectors. The Mars mission will require the skill of many institutions, in particular those industries which finally have to build the hardware and software. Industry will be a significant source of ideas, equipment and services, as has been the case in all Earth-orbital programs and in the Apollo program to the Moon. Industry works in association with academia, and designs and constructs for governments and for commercial users. The benefits of industry involvement extend to both the accomplishment of large scale international exploration of Mars, as well as to the smaller scale economic utilization of the skills and technologies developed.

Likewise, a mission of such scale will only be successful through close cooperation between and among nations. A journey to Mars is an opportunity for international cooperative programs greater than any previously undertaken. However, divisive and destructive global problems must be resolved. Governments must move towards an understanding of how we can to learn to live in harmony with each other and with our environment. As American President Gerald Ford said in 1974, "Docking in space and constructing a complex space structure in orbit is possible if it is preceded by docking thousands and thousands of specialists from many countries on Earth."

Indeed, a mission to Mars will not follow the old model of nations performing great feats to demonstrate national technological prowess. For the Mars endeavor, technology will not be the chief factor defining national relationships, nor will it even be our greatest challenge. Rather than a competition between nations to get there first, the mission to Mars will be an international endeavor, a program with a delegation of Earth's inhabitants on a journey to explore its nearest planetary neighbor.

A Mars program will create unprecedented international interdependence, stimulate the exchange of knowledge and technologies, and provide an opportunity for sharing the results of space activities by many nations, rather than restricting them to the few spacefaring nations. An international Mars mission will confront us with differences in how our partners work. We will need to respect these differences, and to use them synergistically rather than allow them to draw us apart. The leading space nations must actively involve smaller and developing countries and provide them with opportunities to participate in the work and share in the benefits. These countries in turn will serve as a bonding force in a network of interdependent relationships, helping keep all nations working together. When organized in a true interna-

tional manner, a mission to Mars stands to benefit all nations and peoples.

In point of fact, however, it is the next generation who will perform this mission and serve on its crew. Our generation, and in particular the Association of Space Explorers, has the responsibility of passing on its knowledge and experience in training the next generation to use the technologies we have developed. We must also prepare young prospective crew members to speak international languages and to cope with long isolation in small groups. These crew skills will allow international cooperation to flourish in an atmosphere of trust and stability, which in turn will benefit an entire new generation on Earth.

Our species' experience on our home planet over the millennia serves as both an important lesson for and inspiring model of how we interact with our environment. A Mars mission provides humankind with the opportunity to demonstrate some of those special capabilities which have made us so successful on our home planet, i.e., working with our natural world and its resources, learning from them, and channeling them to improve the quality of life. These strengths can also be successfully applied on Mars – humanity can survive, grow and find new opportunities working with the Mars environment. At the same time, we must heed the ethical and moral principals which serve as standards by which to judge our individual and collective behavior. Today we witness the terrible environmental destruction of many parts of our Earth. We also see the great damage that our species inflicts upon itself, from personal substance abuse to the radioactive altering of our very genetic code. The great achievements of science may soon turn against us and our planet unless we redirect the trends of self-destruction. A Mars mission will be most successful when we can be sure that the technical preparation for this expedition will be of benefit to ourselves and to our environment.

The challenges posed by a human mission to Mars are numerous and great. The mission challenges us as individuals, as groups and as a species. It challenges our minds, bodies and spirit. But, if we are bold enough to draw from each other's strengths and learn from our weaknesses, we will meet the challenges. For these reasons, the Association of Space Explorers recommends a global effort to send human emissaries of Earth To Mars Together.

Adopted and signed this 25th day of August, 1992

SUMMARY OF PROCEEDINGS

OPENING CEREMONY

The Eighth Planetary Congress opened on August 24, 1992 with an opening ceremony that included a welcome from Georgetown University President Leo O'Donovan, SJ, Charlene Jarvis, Member of the City Council of Washington, DC, and NASA Administrator Daniel Goldin. ASE members John Fabian and Oleg Makarov also provided remarks.

Dr. John-David Bartoe opened the Congress, announced the speakers, and introduced the members of ASE present.

Father Leo O'Donovan, SJ

Father O'Donovan welcomed the ASE members to the University and to Washington, DC, and congratulated them for their achievements. He discussed the impact of space exploration on the human imagination, inspiring us to reach out to what we do not understand. "Even now, as the twentieth century comes to a close, space still has a mythical quality to the young, inspiring young people to explore." He observed that space exploration has made an indelible mark on humanity, from accelerating the development of computers and other technology, to helping us better understand the ecology of our own planet.

Father O'Donovan also stated that he hoped these bold steps into and the exploration of space had given humankind a deeper sense of humility, and a respect for our place in the immensity of God's creation. He also acknowledged the cost of these bold steps; "We must never forget those brave men and women who have made the greatest sacrifice in the quest to expand human understanding. You who are in this hall today stand on the shoulders of those who have gone before you, such as Yuri Gagarin and Alan Shephard and those who have given their lives in the pursuit of this noble dream, like Gus Grissom, Roger Chaffee, and Edward White, and the seven crew members of the Space Shuttle Challenger, Dick Scobee, Michael Smith, Ellison Onizuka, Judith Resnik, Christa McAuliffe, Ronald McNair, and Gregory Jarvis." He concluded by encouraging the continuance of exploration despite the cost, and again welcomed ASE and wished the members success in their activities. At the conclusion of Father O'Donovan's remarks, John-David Bartoe, Chairman of the Organizing Committee for the Eighth Planetary Congress, presented him with a copy of *The Home Planet*.

Councilwoman Charlene Jarvis

Councilwoman Jarvis then welcomed ASE members to Washington, DC and to the

United States. She discussed her excitement about the events of world history, and stated that she had been told that it had been agreed that ASE's annual meeting would be held in the US or USSR only when tensions between the two had declined sufficiently. "This is the year we have achieved peace between our two countries, and here you are, we are proud to have you." She echoed Father O'Donovan in noting the inspirational nature of space exploration for students and adults alike. Councilwoman Jarvis then asked for a moment of silence for all fallen astronauts who gave their lives in the pursuit of space exploration. She acknowledged their contribution, and what they taught us about courage and sacrifice. Ms. Jarvis then went on to welcome the ASE members to Washington, DC, inviting them to see the city, citing its rich culture, diversity and history. She concluded by expressing her gratitude that the scientists learned how to cooperate before our governments did. Ms. Jarvis also received a copy of *The Home Planet*.

Administrator Daniel Goldin

NASA Administrator Daniel Goldin then discussed a cooperative Mars mission. He noted the importance of exploration culturally, and then listed four reasons for going to the moon and Mars. In citing the cultural reasons for exploration, he stated that "exploration is one of the hallmarks of a great nation. Turning inward is a sign of a nation in decline." He also asserted that "every generation has had its worlds to explore…Mars is within our grasp."

Mr. Goldin then went on to present four reasons why we should go to Mars. The first is economic: investment in space exploration, with associated benefits from advances in technology, spurs economic growth. Also, investment in space infra-structure will enable future use of resources elsewhere in the solar system. He compared the investment in space assets to the investment in interstate highways during the 1950's: "Thirty five years ago it was hard to see how badly America would need a gigantic interstate highway system costing tens of billions of dollars. Today we can't imagine life without it.. The moon has resources that Earth may need someday…We don't know exactly what resources on the moon or Mars will be most useful, but we know we should start looking."

Second, Mr. Goldin stated that exploration of the moon and Mars is necessary to increase our scientific knowledge. For example, studies of changes in the Martian atmosphere might tell us something about how our own planet may be changing. And because of its lack of an atmosphere, the moon might be an excellent place for astronomical observatories. Mr. Goldin mentioned ongoing programs to explore Mars using robots, such as the US Mars Observer, to be launched in September 1992, the Russian Mars-94 probe, and the MESUR (Mars Environmental Survey). Mr. Goldin argued that robots and humans together could most effectively explore Mars.

Third, Mr. Goldin stated that exploration of the moon and Mars will help us search

for extraterrestrial life. Exploration of Mars would enable us to search firsthand for fossils or other signs that life once existed on Mars. Observatories on the moon might enhance our ability to search for planets outside the solar system with characteristics similar to Earth.

Fourth, Mr. Goldin said, "The most important reason for missions to the moon and Mars, I believe, is the political evolution of humankind." With the end of the Cold War, the investment in defense can now be channeled into the peaceful exploration of space. International cooperation in exploration could, Mr. Goldin maintained, foster peace among former enemies.

Mr. Goldin concluded his remarks with a quote from T. S. Elliot, "We shall not cease from exploration\ and the end of all our exploring will be to arrive where we started\ and know the place for the first time."

Following his presentation, John-David Bartoe presented Mr. Goldin with a poster from the Congress, signed by all the ASE members present. Dr. Bartoe then introduced Ruby Chang, music student at Georgetown University, who played *Gnomenriegen* and *Consolation in D-Flat* by Franz Liszt.

Following the musical interlude, Dr. Bartoe introduced Oleg Makarov and John Fabian, members of the Executive Committee of the Association of Space Explorers, and leaders of the delegations from the Commonwealth of Independent States and the United States.

Dr. Oleg Makarov

Dr. Makarov opened by reminding his audience that ASE began with a policy of omitting politics from its activities. He noted that as the world has changed, "at least the politicians are no longer afraid of us." He discussed ASE as a symbol of what humanity is capable of when it tries. He referred to ASE as a celebration of the common impression of astronauts when they first see Earth from space: the sudden beauty and fragility of our Earth. This common experience is part of what bonds ASE members to act together to treat the Earth with the respect it deserves. Dr. Makarov ended by thanking his US colleagues and the Georgetown University for hosting the Congress.

Dr. John Fabian

Dr. Fabian followed with a welcome to the Eighth Congress, particularly to those members attending for the first time. Dr. Fabian noted that over 200 members from 25 nations now make up ASE, and that the space programs of the world are drawing closer together than ever before. He observed that since its founding in 1985, ASE has made enormous progress in furthering education, environmental stewardship, space exploration and the encouragement of international cooperation. This Con-

gress is the largest ever held, he said. Dr. Fabian thanked the sponsors of the Congress, particularly the Planetary Society, and the largest individual contributor, General Thomas Stafford. He also thanked NASA, the Air Force, the Department of State and the Air and Space Museum for their contributions to the success of the Congress. These contributions point to the strong government support for, and hence the maturity of ASE, he said. He also thanked the organizing committee and their spouses who supported the Congress.

Dr. Fabian went on to discuss the climate of international cooperation in space. He mentioned Mars Observer, and expressed his hope that it is truly a precursor to manned exploration of Mars. ASE has blazed the trail in international cooperation, with seven Congresses, exchanges of visits, and sponsorship of lecture series all over the world. He cited the recent visit of Russian astronauts to US space facilities as an indication of a new era. For the first time since Apollo-Soyuz, Russian astronauts have examined and sat in a US space vehicle, the Shuttle. Dr. Fabian quoted a recent edition of *Washington Technology*, which stated in an article on the Eighth Congress that "ASE has led, and their governments have followed, sometimes reluctantly. But they followed nonetheless." Dr. Fabian said,"Earlier meetings occurred in a bipolar space world, but those tendencies of the past are ending." He pointed to close cooperation on several missions, including upcoming plans to fly a Russian on the Shuttle in 1993, an American on Mir in 1994, and to dock the Shuttle at Mir in 1994 or 1995. These plans go beyond what anyone expected even a year ago. Dr. Fabian ended his remarks by underscoring the importance of extensive international cooperation in any future Mars mission to marshall the necessary political support, and expressed his hope that the members would come up with a unified view of how to develop such a program by the end of the Eighth Congress.

John-David Bartoe then closed the opening session.

THEME SESSION: "TO MARS TOGETHER"

In the afternoon, Dr. Wubbo Ockels opened the theme session, *To Mars Together*, by explaining that the ASE members were preparing a statement on the theme for publication at the conclusion of the conference. He sketched out topic areas being discussed: 1) the role of international cooperation; 2) the role of industry and academia; 3) necessary technologies such as aerobraking; 4) risk management; and 5) the impact of an international Mars program on future space programs. Dr Ockels then introduced the first speaker of the session, Dr. Michael Griffin, Associate Administrator for Space Exploration at NASA.

"NASA/SEI" - Dr. Michael Griffin

Dr. Griffin outlined current NASA plans for the Space Exploration Initiative (SEI).

Dr. Griffin explained that recent NASA studies concluded that SEI must be comprised of two parts: first, a return to the moon, and second, a manned trip to Mars. He outlined the technologies necessary for the return to the moon, namely, a heavy lift launch vehicle, and a redesign of the Apollo crew module and lunar lander using microelectronics and other advanced technologies to provide more capability and enable longer initial stays. Dr. Griffin pointed out that the current approach is to make use of existing hardware today in order to control costs and to shorten development times as compared to the costs and development times of recent space programs. He also stated that the US was prepared to use technologies developed by other countries, where necessary, to achieve this goal. Dr. Griffin described the SEI architecture as modular and flexible so as to be able to incorporate international contributions. The program will be designed to be able to land a crew of four anywhere on the moon for 45 days. The hardware for the lunar step will be designed to achieve the maximum amount of commonality with Mars equipment.

"Why Explore Space" - Dr. Konstantin Feoktistov

Dr. Konstantin Feoktistov followed Dr. Griffin with a short discussion of why we should go to Mars. Reminding his audience that the purpose of such a voyage must be well-defined, Dr. Feoktistov offered two rationales: 1) A trip to Mars would yield new information and opportunities to learn about the universe, the solar system, and our place in them; and 2) new technologies developed could improve life here on Earth, as well as enable people to live in space. Dr. Feoktistov then discussed some of the areas to be addressed in our effort to reach Mars: astrophysics, orbital mechanics, and the search for life on Mars and elsewhere in the universe. He stressed the importance of learning more about how to live in space, from the supplies needed for a Mars voyage and the need for a system to provide artificial gravity to a more complete understanding of the psychological impacts of extended stays beyond Earth.

"Together to Mars: Does It Make Sense?" - Dr. Carl Sagan

Dr. Carl Sagan followed Dr. Feoktistov with his thoughts on "Together to Mars: Does It Make Sense?" Dr. Sagan's talk examined the rationales for going to Mars to see if, in whole or in part, they justified the expense of such an undertaking. He noted that his belief that going to Mars is the right thing to do is akin to a religious belief; "but it is not enough merely to state the assertions of a religion, one has to explain why going to Mars is important, what justification is there to spend trillions of dollars?"

Before beginning his discussion of the rationales, Dr. Sagan discussed the budget realities associated with such a project. A Mars project would compete with pressing national problems such as the disposal of radioactive materials, global change research, infrastructure maintenance, health care improvements, education and so

on. He indicated that clearly the US Congress has not yet been convinced, because the total budget for SEI in 1992 was $3 million, and anything else in the NASA budget which appeared related to SEI was reduced. So, Dr. Sagan argued, a more realistic near-term goal is to generate a serious national debate as to whether going to Mars is a long-term goal worthy of funding. With this introduction, Dr. Sagan then examined the standard arguments for a Mars mission.

First, Dr. Sagan listed science as a reason, asking "Is there a unique scientific question that only human presence can answer?" He concluded that while human presence would certainly enhance what we learned scientifically, most questions about Mars could be answered with robotic studies alone.

Second, there is the "spinoff" argument—that investment in space technology provides advanced technology for other sectors. Dr. Sagan dismissed this argument by stating that if spinoffs are the goal, we can invest in the desired technology directly at lower cost.

Third, there is the idea that space exploration boosts education by encouraging young people to pursue technical and scientific degrees, as occurred during the Apollo program. But, Dr. Sagan concluded, given the choice, most educators would rather the Government invested $100 billion directly in education rather than in space programs, if the goal is to improve education.

Fourth, there is the argument that a Mars program could ease the transition from military to civil production for the military-industrial complex in the post-Cold War era. It would be a means of maintaining the defense production capabilities for future military contingencies. While this is a relatively strong justification, Dr. Sagan argued, going to the moon and Mars will not completely make up for loss of military production, and conversion of military production may not be the cheapest way to develop the necessary hardware in any case.

Fifth, Dr. Sagan stated that one could argue that we should go to the moon and Mars in order to mine resources such as Helium-3 for future thermonuclear reactors, thus solving our energy problems. He countered this reason by pointing out that fusion reactor technology may be 50 or 100 years away, even if we could figure out how to bring these resources back to Earth in a cost-effective way.

Sixth, Dr. Sagan mentioned the population growth argument; creating habitable places on the moon and Mars could alleviate population pressures here on Earth. This argument is easily countered because the rate of growth—250,000 more people are born than die every day—is the problem, not the overall number. No amount of colonizing could keep up, even if we had the necessary transportation capabilities to do so.

Dr. Sagan then discussed the less tangible reasons for going to Mars, ones which, he

stated, are less appealing to voters but may still be worth something. First, a cooperative effort on a Mars program might create an "emerging cosmic perspective" which might enhance our ability to act globally on other issues such as the protection of Earth's fragile environment. Second, a Mars program would provide young people with an exciting opportunity to explore in the future. Third, it could be a force to bond together all the nations of the Earth as one people with a common goal.

Dr. Sagan concluded his remarks with the question, "Can the sum of a set of individually inadequate justifications together justify the cost of a Mars mission?" He stated that he believed that they could. The political difficulty is that such a program cannot be justified in "sound bites," and that the cost would be the biggest hurdle to overcome. He concluded that the cost could be managed with an international program, with the funding burden shared by the United States, the Commonwealth of Independent States, Europe, and Japan, and that the program should use existing technology such as the Russian Energia launch vehicle and Mir space station. Dr. Sagan ended by saying "We go to Mars together or not at all. I am delighted that the ASE is fostering this cooperation."

"The Human Experience" - Dr. Valentina Tereshkova

Dr. Tereshkova, rather than repeating the points on the human experience that NASA Administrator Daniel Goldin had made in his address at the opening ceremony, turned her attention instead to the planetary program of the Commonwealth of Independent States (CIS). She discussed the scientific questions the program seeks to address and the types of technology under evaluation for use in a Mars mission. Dr. Tereshkova opened with the observation that Mars is a chronicle of the early history of our Earth which can be read only if we leave our planet and go there. Study of a planet with many similarities to Earth could help us answer questions such as whether terrestrial life is a unique formation in the universe or whether it is a stage in the evolution of matter (rather than mere chance that will not be repeated). Dr. Tereshkova mused on the possibility that if life does exist elsewhere, it might have very different biochemical properties than does terrestrial life, and it might evolve differently. These are questions that can only be answered if we actually find traces of life elsewhere.

Dr. Tereshkova then described the CIS program to study Mars. The CIS is planning to launch one spacecraft in 1994 which would rendezvous with Mars 11 months later. The spacecraft is to carry a Mars lander and a probe that would be sent down to the surface of the planet for one year or more. The goal of the program is to study the equatorial regions of the planet. The probe would contain ten instruments to study the geology, atmospheric chemistry and temperature, and the magnetosphere of Mars. Dr. Tereshkova also highlighted aspects of the engineering challenges faced in designing the probe: it must be lightweight, yet strong enough to survive the landing, and it must have very reliable communications. Dr. Tereshkova con-

cluded her remarks by commenting that in the current economic climate, financing the Mars mission will continue to be a problem. For this reason, and because of the scientific benefits, close international cooperation is critical to mission success.

"Realities" - Lt. Gen. Thomas Stafford

Gen. Stafford discussed the results of the work of the "Synthesis Group", a panel he headed at NASA in 1991-1992 that pulled together ideas about how to approach future exploration. The panel's report attempted to "cover the waterfront," assessing all ideas without providing detail on any one. The group concluded that the most sensible approach to future exploration was to use existing capabilities where possible, including cooperation with the CIS. This approach would save development funds for critical, and as yet unavailable, technologies, such as advanced life support, transfer vehicles, and heavy lift launch capabilities.

Gen. Stafford went on to discuss the political realities of funding a program like a mission to Mars. Exploration is not doing well in Congress, he said; NASA requested $33 million for SEI in FY 1992, and received only $3 million. He briefly described the difficulties of engendering sufficient Congressional support, and pointed out that even when a President is committed to an enterprise, as President Bush is with SEI, getting it funded will still take an enormous amount of effort. Gen. Stafford then took some questions.

Walt Cunningham asked General Stafford why it was necessary to go to the moon first, and was this step being considered primarily for political reasons. Gen. Stafford replied that going to the moon first would enable us to develop and test new hardware, such as new 1-g spacesuits and life support systems. Dr. Sagan stated that he believed going to the moon first would scuttle the mission altogether because it is not exciting to repeat history. A better intermediate step, he believed, would be to go to a near-Earth asteroid.

Don Lind asked Gen. Stafford if nuclear propulsion is really needed, given the immense difficulties of obtaining public support for its development. Stafford replied that without nuclear propulsion, there would be no way to be launch the necessary mass into space. He expressed optimism that its development could be accomplished.

"International Cooperation and Mars Exploration" - Nandasiri Jasentuliyana, Esq.

Mr. Jasentuliyana began his presentation by stating his belief that, because of the challenge and benefits, a journey to Mars is inevitable. He stated, "It is humanity's nature to rise to such challenges, just as Columbus did when warned of the perils and folly of his great expedition."

The main theme of Mr. Jasentuliyana's speech was that international cooperation is imperative for a successful Mars program. Apollo, Mr. Jasentuliyana observed, was born of political competition, and it fizzled once the immediate political goal had been reached. Any opportunity for moving beyond a preliminary exploration of the moon was lost. Thus, a future Mars program must be built on cooperation rather than competition, and we must plan the program's long-term goals in advance. Science is one justification for the journey, but other tangible benefits must also be realized—new materials, energy development, and other spinoffs. Because much of space science can be done from Earth, science cannot be the only rationale for going to Mars.

Mr. Jasentuliyana stated his belief that international cooperation on a Mars program was virtually inevitable for financial reasons, and that such cooperation had both tangible and intangible benefits. Among the tangible benefits is faster, cheaper technology development. Intangible benefits include the fostering of cooperation in other areas, and the help it could give to non-spacefaring countries who wish to become involved. Mr. Jasentuliyana pointed out that the 18 nations represented in the membership of the ASE are the nucleus of international space projects, and he underlined the importance of allowing any country who wished to participate the opportunity to contribute. He then briefly discussed the organizations currently acting as vehicles for cooperation: the International Telecommunications Union (ITU), the World Meteorological Organization (WMO), the Committee on Space research (COSPAR) the International Astronautic Federation (IAF) and the Space Agency Forum for International Space Year (SAFISY).

Mr. Jasentuliyana concluded by asserting that international cooperation must be a primary goal of any Mars program. Such a goal would vividly demonstrate the participants' commitment to space endeavors for exclusively peaceful means. He also warned that while a mission to Mars is inevitable, its timetable must be balanced with competing priorities and needs here on Earth and should be conducted to maximize benefits to all people. He closed with a quotation by Arthur C. Clarke; "Where there is no vision, people perish. Men need the mystery and romance of new horizons almost as badly as they need food and shelter. In the difficult years ahead, we should remember that the Snows of Olympus lie silent beneath the stars, waiting for our grandchildren."

General Session

The General Session, held August 25-28, was closed to the public. During the session, ASE members gave space program updates, discussed new ideas and initiatives, and addressed the futures of the space agencies. The Congress participants spent Thursday, August 27 in West Virginia.

Space Program Updates

At the space program update session, members involved in recent missions reported on the results of their work. Sergei Krikalyov and Igor Volk described Russia's activities, showing video footage from Krikalyov's space walks during his recent ten-month Mir mission and giving an update on the Buran program. Astronaut chief Dan Brandenstein, Dick Richards, Bonnie Dunbar and John-David Bartoe reported on US program activities. Their presentations included a review of the past year of shuttle flights, a report on the results of the STS 50 US Microgravity Laboratory mission, and plans for international participation on Space Station Freedom. Presenting for Europe, Wubbo Ockels outlined the European Space Agency's (ESA) plans for the Columbus space station. Concluding the session, a diverse set of international flyers reported on their recent guest missions aboard a US shuttle or Russia's Mir station. The group included Dirk Frimout of Belgium, Franco Malerba of Italy, Claude Nicollier of Switzerland, Toyohiro Akiyama of Japan, Franz Viehböck of Austria and Michel Tognini of France.

Technical Sessions

At the first of the two Congress technical sessions, members discussed several ideas and initiatives now under consideration and development by various sectors of the international space community. Bryan O'Connor and Valery Ryumin shared some of the results of their joint work on the possible adaptation of Russia's Soyuz spacecraft as a crew rescue vehicle for space station Freedom. Pete Conrad followed with a report on McDonnell Douglas's continuing development of single stage-to-orbit-technology. Europeans Ernst Messerschmid and Wubbo Ockels concluded with a comparison of the advantages of winged vs. unwinged spacecraft. The second technical session focused on the futures of the space agencies. In discussing the US program, Senator Jake Garn made an impassioned plea for a reinvigorated national political and financial commitment to space exploration. Alexei Leonov and Igor Volk outlined the challenges and opportunities facing the newly created Russian Space Agency. For the European side, Wubbo Ockels and Reinhard Furrer previewed a range of ESA programs planned for the next decade.

General Business Session

At its organizational business session conducted on the morning of August 28 in West Virginia, members elected Ulf Merbold of Germany and re-elected Bertalan Farkas of Hungary to ASE's international executive committee. Members also approved a charter amendment enabling international astronauts to join ASE between Congresses. Finally, the delegates passed a resolution authorizing ASE-USA to explore possible observer status for ASE with the United Nations Committee on the Peaceful Uses of Outer Space.

PLANETARY SOCIETY LECTURE

On the evening of August 28, ASE and the Planetary Society jointly conducted a series of presentations designed to expand on the Congress theme "To Mars Together." The program featured remarks by Dr. Carl Sagan, Dr. Joseph P. Allen, Dr. Alexei Leonov, and Mr. Igor Volk.

Alexei Leonov introduced the speakers, first introducing Carl Sagan. He made a special point to thank Dr. Sagan for publishing his theory of nuclear winter which helped the US and Soviet governments move toward serious discussions of nuclear arms control.

Dr. Carl Sagan

Dr. Carl Sagan thanked Dr. Leonov for his kind introduction, and complimented Dr. Leonov's contribution to US-Soviet relations during the Apollo-Soyuz mission. Dr. Sagan then began his presentation.

Dr. Sagan discussed reasons why it makes sense, despite the enormous practical problems, for the US, the CIS and others to work together on a long term project such as a mission to Mars. He noted that Mars is the only world other than Earth on which a relatively unprotected human being could live and work. "Referring to Mars as "the world next door," Dr. Sagan discussed the popular and scientific interest in Mars as a place to explore since canals on the Martian surface were thought to have been discovered in 1877.

Dr. Sagan then talked about what we had learned about Mars from the Mariner 9 and Viking programs, and the questions this new information had raised, questions which could certainly be seen as reasons to explore Mars. The first robotic spacecraft to orbit another planet, Mariner 9 discovered a world vastly different than what had been imagined, a landscape with immense volcanoes and deep canyons. There were, Dr.Sagan said, no canals after all. But there were channels—ancient valleys that almost certainly indicate that liquid water once flowed abundantly across the Martian surface. Today, because of the low density of the Martian atmosphere, no liquid water exists there. This evidence that water—perhaps even oceans and lakes, as well as rivers—had once existed on Mars raises the question, "How could a planet once like Earth have changed so?" Dr. Sagan pointed out that this question has a practical significance for Earth: "Would it not be valuable to know what caused the change for us humans who are so rapidly changing the environment of our own planet?"

When Viking landed in 1976, Dr. Sagan stated, there was no sign of microbial life, or even organic molecules. This was surprising, given that such molecules are falling on Mars from nearby asteroids. Dr. Sagan explained that the lack of ozone in the

Martian atmosphere meant that ultraviolet light from the sun reaches the surface of Mars unimpeded, converting water molecules at the surface into highly oxidized substances such as hydrogen peroxide. Hydrogen peroxide would destroy any organic molecules, creating an "antiseptic world." Dr. Sagan asked, "Isn't this of some interest to us, who are so busy destroying our ozone layer with chlorofluorocarbons (CFCs) and other products?" Thus, he concluded, "Mars provides cautionary tales about what dumb things not to do on our own planet."

More important yet, Dr. Sagan argued, is the search for life. While Viking saw no signs of life on the surface, it is possible that there may be fossils or other evidence at deeper soil depths. Water probably existed on Mars its first few 100 million years—the same time in which life first formed on Earth. "Could it have happened on Mars?" he asked. Finding life, even simple life, on another planet would be a revolutionary event, he argued.

Dr. Sagan then discussed the more metaphysical reasons for a trip to Mars. He pointed out that Mars is a world next door that we can just get to with existing technology, at exactly the moment in time when we have explored virtually all the land surface of our own planet. Mars is "the natural continuance of the human exploratory condition…Mars holds stunning surprises for us." But can this promise justify the cost? Such a voyage could not be justified on science alone, because most of the science can be accomplished with robots, which are much cheaper to send. Dr. Sagan noted other proposed justifications, such as the development of advanced technology, conversion of industry from the arms race, and the educational value, which some find compelling and others not. But for him, "the intangibles are the most compelling, the longer term reasons." He talked of the perspective gained from astronauts on Mars seeing the rising in the morning of a morning star, a blue dot that is Earth in the sky of Mars just before sunrise. This perspective would drive home to all people that "we humans share a common danger, have a common responsibility for the planet, [and would provide] an improved understanding of our place in the universe." An international effort to go to Mars would inspire young people who would "grow up knowing that it is the intention of the nations of the Earth that humans one day will live and work on Mars."

Dr. Sagan went on to place such a voyage in historical context. A trip to Mars, he said, would be an historic event, not just in terms of the last few thousand years, but in the last few million years, because it is the emergence of the human species into a new unlimitable environment. Such a step would be comparable to the moment when the first amphibian left the sea and began to live on land, or when, some 5000 years ago, "our arboreal ancestors came down from the trees and started inhabiting the savannas." Dr. Sagan then posed the question such an argument begs, "Yes, but what's the hurry?" He answered it by arguing that we should do it to provide something positive for our children—the proof that countries can work together on behalf of the entire human species.

Dr. Sagan then moved to a discussion of international cooperation on a Mars mission. Arguing that we "go together or not at all," Dr. Sagan pointed to US polls showing that support for an international mission to Mars is much higher than a US-only program. Such a program could use existing resources such as the CIS's Energia booster, the Mir space station, and Soviet data on long duration spaceflight. If we do not cooperate, it may be too expensive to do it at all. Dr. Sagan called for a commitment by the US, the CIS, Japan and the members of the European Space Agency to agree on a cooperative program to go to Mars.

Dr. Sagan concluded his remarks by recognizing the winners of the Planetary Society's worldwide essay contest on the importance of going to Mars together. The winners, from twenty countries, were present to receive their prizes. He told the recipients that he hoped that if they could not go to Mars themselves, that they would "witness the stirring exploration of the newest Earth-like world by representatives of the human species."

Dr. Leonov then introduced Mr. Igor Volk, describing him as a cosmonaut and test pilot who could fly anything that could fly, and perhaps some things which could not.

Mr. Igor Volk

Mr. Volk discussed his thoughts on why we should go to Mars. He began by saying that everything invented on Earth began with a thought or idea. "Thought is the essential first step of an enterprise because it eventually leads to a concrete result." Mr. Volk illustrated his point by stating, "When I first met John Fabian, I was surprised to see his license plate, which said *Go 2 Mars*. I don't know if he lives with this thought, but he certainly travels with it!"

Among Mr. Volk's main reasons why a Mars trip is necessary is its contribution to world peace. He referred to a meeting at Oxford University in April 1987 at which Dr. Sagan said that a trip to Mars was a reasonable substitute for a US-Soviet confrontation. Mr. Volk pointed to the progress made in nuclear arms control to date, but pointed out that the new challenge would be to productively employ those who once worked in the US and Soviet defense industries.

Mr. Volk also noted the importance of a Mars trip for future generations, saying, "Adults have their own adult games. These games are not ones that children understand, yet they want to play them with us. I think that a trip to Mars is one of those games which children will want to play. And we see competitions occurring in various countries to collect ideas for the best way to go to Mars. [Competitions] are like advertisements store owners design to attract children to their stores, because they know the children will bring their parents along." This observation was met with enthusiastic applause from Planetary Society members.

Mr. Volk ended by thanking the Planetary Society and Dr. Sagan, whose support made the Eighth Congress possible. He then concluded, "We are meeting together to bring to the thoughts and minds of people around the world the need for this common effort of ours. And today we have passed beyond the theoretical idea of going to Mars, and have moved to discussion of how to build the political support necessary for such a trip. I find that our common task is to convince those in power of the need for a trip to Mars, and I urge all of you to participate in that task."

Dr. Joseph P. Allen

Dr. Leonov then introduced Dr. Allen. Dr. Allen began by noting that Washington, DC in 1992 was a particularly fitting time and place to be reflecting on the meaning of the space age and its future. 1992 is the International Space Year, and the 35th Anniversary of International Geophysical Year and Sputnik. It's just past the 30th anniversary of Yuri Gagarin's epic voyage, and President Kennedy's commitment to land an American on the moon. 1992 is just past the twentieth anniversary of our last landing on the moon, the tenth anniversary of the Space Shuttle's first operational flight, and the 500th anniversary of Columbus' discovery of the new world. And Washington is an appropriate place to be discussing cooperative journeys to Mars because the choice of this city for the site of an ASE meeting was dependent on the end of the Cold War between the US and USSR. Also, Washington is the site of the first World Space Congress, jointly sponsored by the Committee on Space Research (COSPAR) and the International Astronautical Federation (IAF), beginning August 29, 1992.

Dr. Allen then discussed whether or not it was possible to cooperate on a complicated technical undertaking such as a trip to Mars. He highlighted Apollo-Soyuz as an example of such active cooperation, and suggested the US and the Soviet Union successfully went to the moon together, although competitively. The Soviet Union provided the US with a set of "existence proofs" that President Kennedy's goal of reaching the moon within eight years was possible, having demonstrated that artificial satellites were possible, human spaceflight was possible, spacewalks were possible, and lunar transfer orbits were possible. These accomplishments, combined with the competition of the Cold War, put "pressure on the piston of competition," driving the US program to success. Dr. Allen contrasted this with the challenge issued by President Reagan to build a space station in eight years, a goal which the US has failed to meet. He blamed this failure on a reduction of the "pressure on the piston of competition." Without such pressure, he said, politicians engage in "short-term thinking which destroys long-term planning." Dr. Allen hoped that in a literal, rather than a figurative, sense the US and CIS will go to Mars together.

Dr. Allen concluded with three specific words of political advice: 1) we must go together if we are to go at all; 2) the projects to develop the ability to go to Mars

must be packaged in quantum units of time consistent with the rhythms of politics, business and our school systems—building the infrastructure in time blocks of four years or less; and 3) space enthusiasts must be patient and persistent, and lay the groundwork for a Mars journey by offering compelling arguments as to why the world should support such a mission. Dr. Allen ended expressing the hope that, in the year 2024, some of those present would still be alive to attend the 40th ASE Congress, and that they would witness the television announcement that the first international crew had landed on Mars.

Dr. Alexei Leonov

Dr. Leonov opened by commenting that while, as Igor Volk had said, no one knows who first thought of going to Mars, the 19th century Russian writer, Konstantin Tsiolkovsky, had predicted that one day man would fly to Mars with an international crew, including Russians and Americans. Up until now, all of Tsiolkovsky's predictions have come true. Thus the history of our flight to Mars has already begun.

Dr. Leonov then discussed recent events indicating that cooperation between Russia and the United States on a Mars mission is possible. In October 1975, a group of US Senators, headed by Gaylord Nelson came to the Soviet Union. They met with then Foreign Minister Gromyko, and persuaded him to sign a joint statement urging a joint trip to Mars.

Ten years later in 1985, Dr. Leonov said, the crew of the Apollo-Soyuz met in Washington for a celebration of the tenth anniversary of the program, and were received at the White House. There, Senator Matsunaga proposed a detailed concept of a joint trip to Mars which was to take place in 1992. "He wanted to go to Mars very much, but did not understand how difficult it was going to be; we understood the difficulties, but we weren't able to convince him. Mr. Gromyko, our President at that time, told the United States that we would be able to discuss a trip to Mars provided you remove your missiles from Europe, and also rethink the Strategic Defense Initiative. Well, Senator Matsunaga said that if we just got started on the joint Mars trip, these other issues would start to resolve themselves. And there were a number of people at the meeting who were for the Mars trip. After the meeting, I went to talk with our Foreign Minister, Shevardnadze; I told him the whole story. He supported our position. Our military-industrial complex was also very much in support. The common view developed in our country that it was necessary to develop a joint Mars program. This view was expressed by Gromyko to President Reagan at one of their meetings. And Reagan was the one who said, "Well, we will have to think it over."

Dr. Leonov noted that since 1985, the political situation has changed significantly for the good. Both scientists and the Russian people support the concept of a joint

mission to Mars. He expressed optimism that the changes in the former Soviet political system were permanent, as was the change in US-Soviet competition.

Dr. Leonov then briefly discussed areas of cooperation. He noted that the CIS has assets such as the Soyuz vehicle, the Mir space station, the Energia booster, as well as advanced life support systems that can support cosmonauts in near Earth orbit for one year. These assets could be made available under a cooperative program which would save both countries money. He stated, "As long as there are people in the world who understand the importance of spaceflight, we can count on success. And I would urge all of those in the audience, including those who are leaders in this country, we need your support to guarantee the success of the program." He also noted the change in how budgets were approved in the CIS, with much closer scrutiny of every ruble spent, and the continuing economic problems of the Commonwealth.

Dr. Leonov concluded by discussing the need for education and training of future cosmonauts and astronauts in preparation for a trip to Mars. The CIS space research team is working on development of a program, which would include the establishment of international space academies, to address this need. This proposal would amount to establishing academies for future astronauts and cosmonauts around the world. Dr. Leonov urged ASE to discuss this issue, and concluded with the hope that as future generations of people were trained for spaceflight…space programs would "take the place of the military programs we are putting behind us."

Reception and Awards Banquet

The Planetary Society Lecture was followed by a reception and the ASE Award Banquet. Dr. Isaac Asimov was posthumously awarded ASE's Annual Planetary Award, the Crystal Helmet, and the Challenger Center received a special award for its educational work with young people.

Joint Session with the World Space Congress

On Saturday, August 29, ASE held a joint session with the World Space Congress on "Human Space Flight - Past and Future of International Cooperation." Speakers and topics included Alexei Leonov, "ASTP/CIS Activities," Oleg Makarov, "The Intercosmos Program," Bertalan Farkas, "Earth Observation and Astrophysics," Miroslaw Hermaszewski, "Materials Science and Life Sciences," Richard Truly and Charles Bolden, "USA Activities," Ulf Merbold and Wubbo Ockels, "Spacelab," Jean-Loup Chretien, "Bilateral Flights," and Ernst Messerschmid, "Technology Projects." A panel discussion followed these presentations.

COMMUNITY DAY PRESENTATIONS

Also on Saturday August 29, ASE members addressed several community audiences, including three groups of incoming freshmen at Georgetown University. John-David Bartoe, Michel Tognini and Don Williams welcomed Georgetown's new arts and sciences, language and business students. Other members spoke to public audiences on topics ranging from space medicine, space stations and astronomy to space sciences and exploration, spacecraft design and space commerce. Throughout the day, ASE members joined junior high school students in Georgetown's McDonough Gymnasium to help construct a simulated Martian colony, a project organized by the Challenger Center for Space Science Education.

Host Committee of the 8th Planetary Congress

Honorary

NASA
National Air and Space Museum

Benefactors

CSX Corporation
The Greenbrier
Mr. & Mrs. Lawson W. Hamilton Jr. and Family
The Planetary Society
Tom and Linda Stafford
Wheelabrator Technologies Inc.

Sponsors

A-B Emblems, Caps, & Custom Wearables
Sultan bin Salman bin Abdulaziz Al-Saud
Challenger Center
Computer Sciences Corporation
Consolidated Airborne Systems, Inc.
The Equitable
John and Donna Fabian
Flying Eagle Corporation
Mr. and Mrs. Wade S. McClure and Family
Mylan Pharmaceuticals
Purdue University
Rockwell International
SMH (US) Inc.

Patrons

Addison-Wesley Publishing Company
Allied Signal
Boeing Defense and Space Group
James H. "Buck" Harless
Hilton Hotels Corporation
INTEC
Key Centurion Banc Shares
Lockheed Corporation
Lockheed Missiles and Space Company
Martin Marietta Astronautics Group
A.T. Massey Coal Company, Inc.
Merck & Co., Inc.
Oracle Corporation
David Sugar and Carol Iselin
Preston Energy Corporation
James C. Taylor
West Virginia School of Osteopathic Medicine
West Virginia University College of Engineering
West Virginia University Medical School

Friends

Loren and Evelyn Acton
Ashland Coal, Inc.
Aviation Week and Space Technology
Donna and John-David Bartoe
Bassett Printing
Bechtel
Booz, Allen and Hamilton, Inc.
Bowden, Bennett & Barnes, Inc.
C & P Telephone Co. of West Virginia
CAE-Link Corporation
Charleston National Bank
Commerce Bank
Coors Brewing Company
DeSmet Sound
Monte Diehl
Eastern Associated Coal Corporation
Marshall and Kay Ellison
Estes Industries
Gene Frazee
Owen and Eve Garriott

Georgetown University
GraphTec Printing
Greenbrier Technical Services
Greenbrier Valley National Bank
John Hardesty
Jim Justice
Lamplighter Industries
Gordon and Susan Lane
Byron Lichtenberg
Alan Lively and Family
McDonnell Douglas Corporation
McJunkin Corporation
Mobil Corporation
The Nature Company
Don and Bonnie Peterson
PM Enterprises
Pro-Motion Technologies, Inc.
C.F. Shewey and Family
The Space & Rocket Center,
U.S. Space Camp
Space News
Technical & Administrative Services
Corporation (TADCORPS)
Touchstone Research Lab
United Bankshares, Inc.
Scott Vangen
West Virginia Chamber of Commerce

ASSOCIATES

Charles Butcher
Center for Space and Advanced
Technology, Inc. (CSAT)
Chinchar Visual Communicaton Inc.
Michael Collins
Lou Dunn Diekemper
Charles M. Duke, Jr.
Charlie Earehart
Ferreri Concrete Structures, Inc.
Jack and Gratia Lousma
Jim Lovell
Missouri Technical School
National Space Society
Vernon J. Roden, MD
Sandoz Pharmaceuticals Corporation
Mr. and Mrs. Richard B. Sayford
Stiefel Foundation for
Dermatological Research
Charlie Walker and Susan Flowers
Chris Walkup
Don and Linda Williams
Tom Zimmerman

ASE Members Attending the 8th Planetary Congress

USA
Loren Acton
Joseph Allen
John-David Bartoe
John Blaha
Karol Bobko
Charles Bolden
Daniel Brandenstein
Scott Carpenter
Gerald Carr
Robert Cenker
Mary Cleave
Charles Conrad
Walter Cunningham
Charles Duke
Bonnie Dunbar
Samuel Durrance
John Fabian
Drew Gaffney
Jake Garn
Owen Garriott
Edward Gibson
Frederick Gregory
Frederick Hauck
Karl Henize
Jeffrey Hoffman
Millie Hughes-Fulford
Byron Lichtenberg
Don Lind
John Michael Lounge
James Lovell
Jon McBride
James McDivitt
Bill Nelson
Bryan O'Connor
Ronald Parise
Gary Payton
William Pogue
Richard Richards
Stuart Roosa
Jerry Ross
Russell Schweickart
Paul Scully-Power
Loren Shriver
Donald Slayton
Robert Springer
Thomas Stafford
Kathryn Sullivan
Richard Truly
Lodewijk van den Berg
Charlie Walker
Taylor Wang
Donald Williams

CIS
Alexander Alexandrov
Anatoly Artsebarsky
Yuri Artyukhin
Toktar Aubakirov
Konstantin Feoktistov
Yuri Glazkov
Georgi Grechko
Pyotr Klimuk
Vladimir Kovalyonok
Sergei Krikalyov
Valery Kubasov
Alexei Leonov
Oleg Makarov
Andrian Nikolayev
Leonid Popov
Yuri Romanenko
Nikolai Rukavishnikov
Valery Ryumin
Viktor Savinykh
Svetlana Savitskaya
Vladimir Solovyov
Valentina Tereshkova
Igor Volk
Alexander Volkov
Boris Yegorov
Vyacheslav Zudov

Austria
Franz Viehböck

Belgium
Dirk Frimout

Bulgaria
Alexander Alexandrov
Georgi Ivanov

Czechoslovakia
Vladimir Remek

England
Helen Sharman

France
Patrick Baudry
Jean-Loup Chretien
Michel Tognini

Germany
Reinhard Furrer
Sigmund Jähn
Ulf Merbold
Ernst Messerschmid

Hungary
Bertalan Farkas

Italy
Franco Malerba

Japan
Toyohiro Akiyama

The Netherlands
Wubbo Ockels

Poland
Miroslaw Hermaszewski

Romania
Dumitru-Dorin Prunariu

Saudi Arabia
Sultan Al-Saud

Switzerland
Claude Nicollier